Grid Comms Revised Investment Program Summary

In support of the Ergon 2025 – 30 Regulatory Proposal

November 2024

ERGON ENERGY NETWORK
Part of Energy Queensland

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1 SUMMARY

<table>
<tr><th>Title</th><th>Grid Comms Revised Investment Program</th></tr>
<tr><td>DNSP</td><td>Ergon Energy</td></tr>
<tr><td>Expenditure category</td><td>☒ Replacement ☒ Augmentation ☐ Connections ☐ Tools and Equipment
☐ ICT ☐ Property ☐ Fleet</td></tr>
<tr><td>Identified need
(select all applicable)</td><td>☒ Legislation ☐ Regulatory compliance
☒ Reliability ☐ CECV ☒ Safety ☐ Environment ☒ Financial
☐ Other
The Grid Comms network assets encompass a range of critical systems that underpin and enable business objectives for the delivery of safe, secure, affordable, and sustainable energy solutions. This program seeks to manage risks and costs associated with provision of telecommunications services through proactive program to replacement equipment ahead of likely in-service failure and to improve the reliability, performance and capacity of the network.</td></tr>
<tr><td>Summary of recommended option</td><td>The recommended option ensures a well-balanced prudent approach to maintaining system stability, increase reliability and performance.</td></tr>
<tr><td>Capital Expenditure
($m, direct 2025-30)</td><td>
<table>
<tr><th>Type</th><th>Previous period</th><th>2025-26</th><th>2026-27</th><th>2027-28</th><th>2028-29</th><th>2029-30</th><th>2025-30</th></tr>
<tr><td>Repex</td><td>55.50</td><td>7.79</td><td>9.38</td><td>12.50</td><td>15.78</td><td>18.05</td><td>63.52M</td></tr>
<tr><td>Augex</td><td>13.24</td><td>3.34</td><td>3.35</td><td>3.36</td><td>3.36</td><td>3.37</td><td>16.80M</td></tr>
<tr><td>Total</td><td>68.74</td><td>11.13</td><td>12.74</td><td>15.86</td><td>19.14</td><td>21.42</td><td>80.32M</td></tr>
</table>
</td></tr>
<tr><td>Benefits</td><td>

Avoidance of significant business disruptions in the delivery of planned and unplanned work on the network due to the failure or performance issues caused by aging communications platform and supporting technology stack.
Avoided cyber security risks associated with exposure and possible exploitation of vulnerabilities associated with aging software and hardware.
Avoids risks associated with system failure or degradation that can result in breach of National Electricity Rules legislative obligations.
Enables critical voice and data communications during natural disasters such as cyclones and floods.
Improves safety through effective person-to-person remote communication in real time.
Minimises customer impacts as result of inadequate or failure of the communications platforms.
Enables EQL to deliver on its strategic objectives

</td></tr>
</table>

2 OVERVIEW

2.1 Purpose and scope

This document has been prepared as part of the 2025-2030 Regulatory Proposal with intention of recommending the optimal capital investment necessary to support forecast Replacement and Augmentation expenditure for Grid Communications assets.

Based on the AER's Feedback provided in its Draft Determination where investments have not been accepted or expenditure modified, we have modified expenditure on 6 of the investments and provided further justification for 9 investments supporting the investment level that we proposed in the initial submission. For the remainder of the investment cases we have accepted the AER Draft Determination.

This revised investment strategy document has been developed for the purposes of seeking funding for the required investment in coordination with the Ergon Regulatory Proposal to the Australian Energy Regulator (AER) for the 2025-30 regulatory control period.

Prior to investment, further detail will be assessed in accordance with the established Energy Queensland (EQL) investment governance processes. The costs presented are in (2022/23) direct dollars.

This document should be considered in conjunction with the individual Grid Comms Replacement and Augmentation Project Justification Statements. Note for the revised submission, Project justification statements have only been provided for those cases where we are requesting an investment value different to the AER's Draft Decision.

2.2 Introduction

Ergon Energy employs the use of telecommunications networks whose primary function is to directly support the automation and operation of the power network. This includes critical voice and data services to enable monitoring and control across the distribution network, and to coordinate safe and efficient work. A number of assets in this network are reaching end of life, and action is necessary to ensure these services continue.

The telecommunications networks are comprised of assets such as routers, switches and microwave radio links, along with the site infrastructure used to power, secure and physically support these network devices. Telecommunications assets are installed all over the state of Queensland at substations, dedicated telecommunications sites, control & data centres, depots, offices and 3rd party locations.

The functionality supported by this asset class includes protection signalling, SCADA, operational telephony, corporate voice & data security, alarming and ancillary services that are present within the power network, for the following purposes: -

- Improve safety through effective person-to-person remote communication in real time.
- Improve safety through implementation of advanced power network protection schemes requiring inter site communications facilities.
- Make possible the centralised monitoring & management of the power distribution network and co- ordination of protection between sites.
- Extend the reach of corporate information systems for improved productivity across the organisation.

- Support the efficient operation and adaption of the electrical distribution network through a common infrastructure.

Energy Queensland is committed to maximising value from its assets for the benefits of its customers, stakeholders and the communities in which it operates. In line with our corporate vision and purpose, EQL will look to safely deliver secure, affordable, and sustainable energy solutions to its communities and customers by optimally managing its assets throughout life cycle.

2.3 Grid Comms Investment Summary

2.3.1 Summary

The Grid Comms Investment program comprises both Replacement and Augmentation programs to address different needs.

2.3.2 Replacement Program

The Grid Comms replacement program seeks to manage risks and costs associated with provision of comms services by replacing equipment ahead of asset obsolescence and in service failure. Not proceeding with the program will result in more expensive, reactive replacement when in-service units fail, will require more complex management arrangements to manage the older versions of equipment and will require reactive replacement arrangement (including extensive spares warehousing) once vendors no longer supply spare equipment for the reactive fail-fix processes.

Ergon Energy is aware of the need to effectively manage these assets and this program proposes 20 x individual projects with a total capital expenditure of $63.52M to ensure enhanced performance, improved stability, and increased reliability within our grid communications network infrastructure.

Note where we have proposed expenditure different to that of the AER draft determination, we have provided separate (updated) investment justification statements.

Table 1 Grid Comms Replacement Project Summary

Technology Type	"GRID COMMS" Project Title		Original Proposal	AER Draft Decision	Revised Proposal
Time Division Multiplexing (TDM)	SDH Replacement Edge and SDH Replacement Core (5.5.12A & 5.5.12B)		8.60M	5.43M	**7.64M**
	PDH Replacements		4.05M	2.56M	**2.56M**
Microwave Radio Infrastructure	Microwave Radio Core Replacements (5.5.19)		4.00M	2.52M	**4.00M**
	Microwave Radio Edge South West and Wide Bay Replacement (5.5.14)		4.83M	3.05M	**4.83M**
	Microwave Radio Edge Capricornia and Mackay Replacements (5.5.11)		2.71M	1.71M	**2.71M**
	Microwave Radio Edge North Queensland and Far North Replacements (5.5.15)		4.24M	2.68M	**4.24M**
Network Control Systems	Operational Support Systems Replacements (5.5.20)		3.99M	2.52M	**3.98M**
	Operational Voice Replacements (5.5.16)		2.03M	1.28M	**2.03M**
P25 Radio Systems	P25 Replacement Edge South	Single Justification statement provided for these. (5.5.18)	5.55M	3.50M	**2.39M**
	P25 Replacement Edge North		4.92M	3.10M	**2.12M**
IP Network	Core IP MPLS Ethernet Replacements (5.5.22)		1.36M	0.86M	**1.36M**
	Data Centre Ethernet Replacements (5.5.17)		4.37M	2.76M	**4.37M**
	Edge Router Replacements (5.5.13)		3.67M	2.32M	**3.25M**
	Fringe Network Replacements (5.5.23		0.87M	0.55M	**0.69M**
Site Supporting Infrastructure	Building Replacements		3.91M	2.47M	**2.47M**
	AC Systems Replacement (5.5.10)		4.94M	3.12M	**4.40M**
	Structures Replacements		1.59M	1.00M	**1.00M**
	DC Systems Replacements (5.5.21)		4.94M	3.12M	**4.94M**
	Auxiliary Infrastructure Replacements		2.54M	1.60M	**1.60M**
Linear Media	Linear Aged Replacements		4.68M	2.95M	**2.95M**
		Total	**77.77M**	**49.08M**	**63.52M**

2.3.3 Augmentation Program

The Grid Comms augmentation program proposes 11 x individual projects with a total capital expenditure of $16.84M to improve the availability, reliability, performance, coverage and capacity of telecommunications services. During the past AER period evaluation of the network highlighted a number of deficiencies identified in key technology areas to be addressed in individual projects as listed in the table below.

These projects seek to improve the safe, effective and efficient operation of the electrical network to support Grid modernisation and enablement of other broader business benefits including:

- Real-time monitoring of electrical infrastructure – increased primary asset lifecycle.
- Remote operation of the electrical network – efficient operation of the electrical network
- Integration and enablement of Renewable energy
- Customer Service improvement – decreased electrical network outages with improved communication network performance and reliability.

Note where we have proposed expenditure different to that of the AER draft determination, we have provided separate (updated) investment justification statements.

Table 2 Grid Comms Augmentation Project Summary

Technology Type	"GRID COMMS" Project Title	Original Proposal	AER Draft Decision	Revised Proposal
IP Network & Linear Media	Capacity Upgrade Fibre and Capacity Upgrade DO WAN	5.65M	5.65M	5.65M
	Reliability Core MPLS and Fibre (5.6.04)	4.64M	0.00M	**1.62M**
	Reliability Edge Fringenet and Backhaul (5.6.05)	2.98M	0.00M	**1.49M**
	Operational Enhancement	1.53M	1.53M	1.53M
	Reliability Isolated Systems	1.49M	1.49M	1.49M
	Digital Enablement	0.39M	0.39M	0.39M
P25 Radio Systems	P25 Coverage South West	1.31M	1.31M	1.31M
	P25 Coverage Far North	1.31M	1.31M	1.31M
	P25 Reliability Upgrade	0.69M	0.69M	0.69M
	P25 Coverage Capricornia	0.65M	0.65M	0.65M
	P25 Capacity Upgrade	0.68M	0.68M	0.68M
	Total	**21.3M**	**13.69M**	**16.84M**

2.4 Energy Queensland Strategic Alignment

The table below details how this Grid Comms Program contributes to Energy Queensland's corporate strategic plan as we evolve towards an 'electric life' and renewable targets as described in Queensland Energy and Jobs Plan (QEJP).

Table 3 Energy Queensland Strategic Alignment

Objectives	Relationship of Initiatives to Objectives
Powering tomorrow The fusion of a smart, safe and secure energy system	The programs proposed in the Grid Comms portfolio underpin EQL ability develop, operationalise and embed smart grid technologies required to deliver a reliable and secure energy system and assists EQL digital transformation objectives as the primary supporting technology that facilities the transfer of information, enabling enhanced data-driven opportunities, supporting operational excellence, and enrich the customer experience.
Experience excellence Setting new standards for customers in their energy transition	A secure and reliable Grid Comms network can significantly improve customer experience through reducing delays in restoration of both planned and unplanned outages. The enablement of remote real-time asset telemetry data collection from power network assets will enable smarter asset management and operational decisions enhancing the customer experience.

Sustainable future Leading the charge for a successful. greener tomorrow	Provision of high availability Grid Comms solutions are essential to enabling intelligent integration of Renewables and Distributed Energy Resources as it enables Demand Management and Load Control applications and systems to operate effectively assisting EQL to deliver on strategic targets to get to Net Zero. l
Anchored in strength Striving for operational excellence and creating a future-fit employee experience	The Grid Comms program assists in improving safety and wellbeing to both staff and the community through providing protection to equipment, enabling safety duress capability of which is profound during natural disaster events where conditions are typically far worse than during normal day to day operation.

3 BACKGROUND

3.1 Asset Population / Site Summary / Capability

The Grid Comms Replacement program covers the management of Ergon Energy's Grid Communications asset class, which consists of telecommunications networking devices and equipment, along with site infrastructure that provides power, security and physical support.

Telecommunications assets assist in facilitating the automation and control of the power network by operating at the Physical, Data Link, Network and Transport OSI layers to provide real-time communications, allow centralised monitoring and management of the power network as well as extend the reach of corporate information systems across a common infrastructure.

Ergon Energy owns and maintains over 690 sites that contain telecommunication assets throughout Queensland.

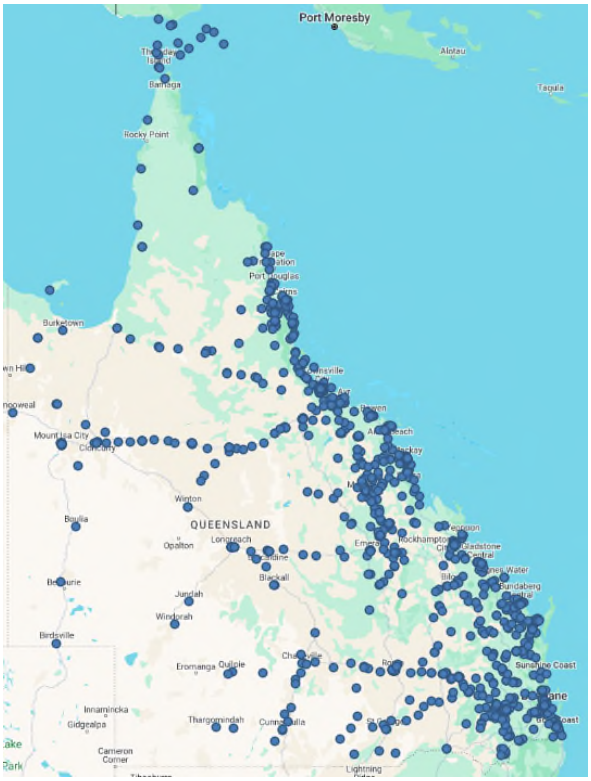


Figure 1: Ergon Energy Grid Comms Site

The asset class is faced with a number of issues, most of which relate to the challenges associated with needing to keep pace with technological advancements and the increased network capacity, reliability and security requirements of rapidly advancing intelligent devices.

Given the large scope of telecommunications assets, EQL maintains robust asset management strategies that ensure each asset is dealt with appropriately. These include performance monitoring systems, periodic condition inspections, regular scheduled maintenance, condition-based asset retirement, as well as simply taking a fail-fix approach of replacing assets should they fail in service.

3.2 Asset Summary

Ergon Energy has wide range of Grid Comms network assets across numerous technology categories, manufacturer makes and models. The table below lists the total asset population quantities for each asset type within the network, the quantity that has exceeded vendor end of life support dates, the driver for replacement and the asset criticality to the business.

Table 4 Grid Comms "Network Assets" Summary

Technology Type	Asset Class	Total Quantity	2025-30 End of Life Quantity	Replacement Driver
P25 Network	Base Station Assets	379	379	Proactive replace critical assets strategically – to use as spares for remaining fleet
	RFFS Core Sites	12	12	Proactive Replacement
	P25 Radios	1448	-	Fail in service replacement
	SATPTT - Radios	381	-	
Time Division Multiplexers (TDM)	PDH	633	545	Proactive replace critical assets strategically – to use as spares for remaining fleet
	SDH	415	415	
IP Network Equipment	IP/MPLS Network - Core	161	30	High Criticality - Proactive Replacement
	IP/MPLS Network - Distribution	367	233	Proactive replace critical assets strategically – to use as spares for remaining fleet
	IP/MPLS Network - Edge	813	547	
	Cellular Modems	2833	750	Low Criticality – Fail-Fix or proactively upon vendor service removal.
	Satellite Terminals	286	165	
	DSL Modems	35	25	
	Other	137	114	
Microwave Radio	Core Microwave Radio	98	96	Proactive replace critical assets strategically - to use as spares for remaining fleet
	Edge Microwave Radio	368	326	
Network Control Systems	Operational Support Systems	28	28	Proactive replace critical assets strategically
	VOIP Phones	352	165	Fail in service replacement
	Operational Call Control System	21	18	Proactive Replacement

The above Grid Comms Network assets are installed within and rely upon on a wide range of physical site infrastructure to ensure reliable and secure network as summarised in the table below. Replacement strategy for this asset class is a combination of age, condition based proactive replacement and reactive return to service based replacement.

Table 5 Grid Comms "Site Assets" and "Linear Comms" Summary

Technology Type	Asset Class	Total Quantity	2025-30 Age/Condition Repairs
Linear Media	Fibre Pits	1598	80
	Fibre Optic Cable	1,700km	15km
	Pilot Wire cable	35km	9km
Buildings	Small	33	4
	Large	93	0
	External Cabinets	47	22
Structures	Wooden Pole	29	0
	Concrete Pole	165	5
	Steel Pole / Tower	89	12
	Guyed Mast	14	1
Site Infrastructure	Battery Banks	269	97
	UPS	17	0
	Generators	100	33
	Solar Power Systems	54	13
	Air Conditioning	282	150
	Site Security	250	18

3.3 Asset Descriptions

3.3.1 Summary

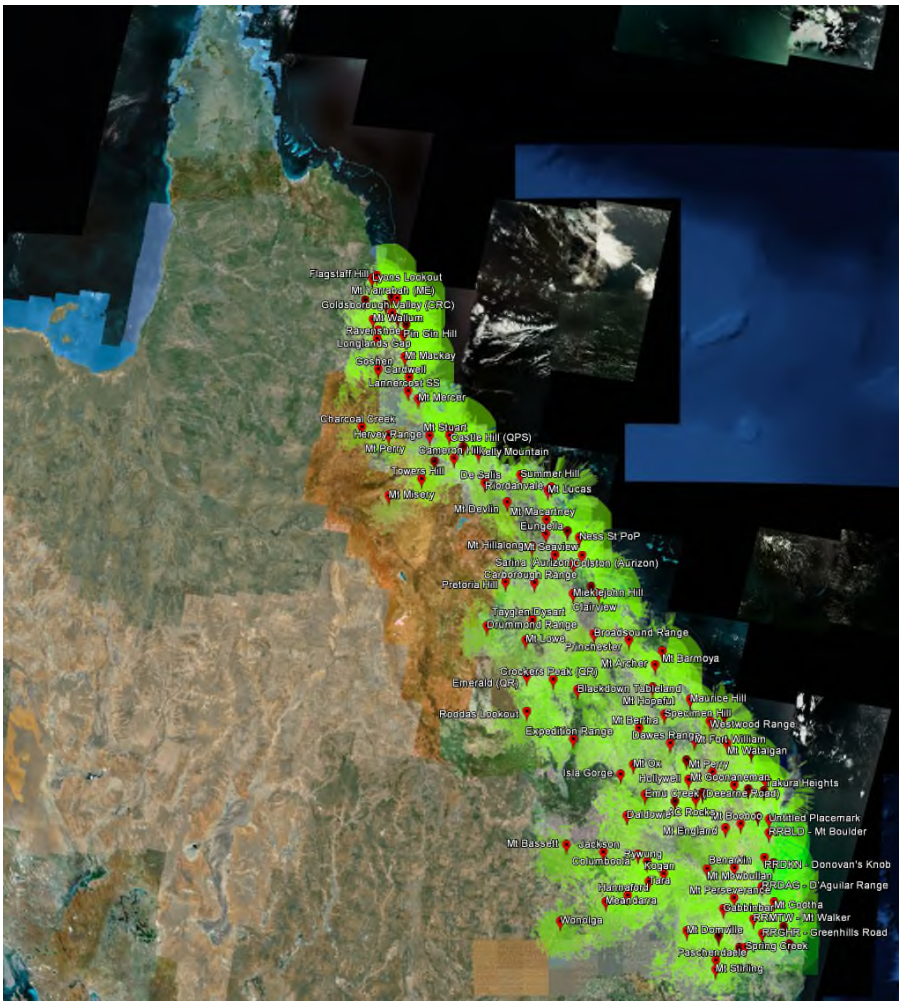
Ergon Energy maintains and operates a large number of electronic telecommunications equipment to meet requirements for operation of the electricity network. These assets are comprised of a number of different asset classes as described below.

3.3.2 P25 Network

The P25 Trunked radio network provides critical mobile voice communications for operational switching co-ordination, work force co-ordination and safety for Energy Queensland. Additionally, P25 provides GPS tracking of the vehicles and inbuilt safety distress button (with location information) which is available at the control centre and area operations managers providing safety, delivery efficiency and potentially reliability benefits.

The P25 Network has been implemented over the past 11 years at 14 Core sites and 115 Base station sites, providing voice communications to over 2000 in-vehicle/handheld radios. The P25 network provides the primary means of voice communications during disasters, operational switching and safety events for EQL.

Figure 2: P25 Network Coverage Map



3.3.3 Time Division Multiplexers (TDM)

Time Division Multiplexers (TDM) technology is comprised of SDH (Synchronous Digital Hierarchy) and PDH (Plesiochronous Digital Hierarchy) equipment which are previous generation technology that was designed to allow many different types of services to be provisioned over a single network platform. It was developed before IP (Internet Protocol) became the dominant networking solution and is now nearing obsolescence. Nodes are comprised of a variety of electronic networking devices, that collectively allow multiple services to be “multiplexed” onto digital links between sites, these are collectively called multiplexors.

Ergon’s PDH networks carry a number of different substation-based service types including business critical Tele-protection services and where serial based interface requirements exist on SCADA, AFLC and remote equipment management. As part of Ergon’s deployment of its IP/MPLS networks many services have commenced migration to IP under a well-established technology transition strategy.

3.3.4 IP Network Equipment

IP networking equipment utilises packet switched technology that employs various protocols including Ethernet, Internet Protocol (IP) and Multi-Protocol Label Switching (MPLS). This allows

data to be packaged when transmitted across the network providing an effective and efficient transmission method.

Energy Queensland IP networks are vital to support the operation of the electricity distribution and sub-transmission network. This network is utilised to support a variety of services including operational voice and data enabling safe and efficient work activities including staff communication and control of substation and distribution network infrastructure. At the completion of the 2020-25 AER period, this network will also carry Teleprotection services as part of EQL's strategic direction away from legacy TDM technologies.

3.3.5 Microwave Radio

Ergon Energy deploys microwave radio links to supply mission critical real-time voice and data communications long distances where it is not cost effective to install fibre optic cable.

Figure 3: Microwave Radio Links

3.3.6 Operational Support Systems

Telecommunications Operational Support Systems (OSS) consist of a wide range of hardware and software systems that play a crucial role in efficiently managing and maintaining a large telecommunications network. These set of systems provide the following capability such as:

- Fault Detection, Network Visibility and Monitoring
- Configuration Management
- Performance Management
- Compliance and Reporting

3.3.7 Buildings

There are multiple types and styles of building used across the network to house the communication equipment. They are either external cabinets or buildings which are constructed from, galvanised iron, fibro, brick and Colourbond.

3.3.8 Structures

Across the network a variety of communication structures are utilised which include, steel towers, steel guyed masts, concrete, steel and wooden poles.

3.3.9 Site Infrastructure

Ergon maintains and operates a large number of dedicated communication sites to meet requirements for operation of the electricity network. These sites assets support the telecommunications network assets and are comprised of several different asset classes such as:

- Battery Banks: *supporting equipment during loss of mains supply or where mains supply is not available.*
- Generators: *supporting equipment during extended periods of mains outages, where mains supply is not available or access to respond to faults is difficult.*
- Air Conditioning: *supporting equipment by ensuring operational temperatures remain within manufacturers specifications extending in-service life.*
- Site security: *systems protecting equipment from nefarious external interaction; protection from theft, tampering or damage.*

3.4 Asset management Approach

Ergon Energy employs various asset management methodologies as summarised in the table below to manage GRID COMMS Assets.

Table 6 Grid Comms Asset Mgmt approach

Asset Class	Asset Management approach	2025-30 Age/Condition Repairs
Spares Mining	Extend use of this infrastructure beyond supplier EOL via replacing sections of the network with supported infrastructure, utilise displaced infrastructure as spares for fail fix of the remainder of the fleet	Determine failure rates, estimate required number of spares required per annum, propose infrastructure removal projects that will generate suitable spares (younger units) cost effectively.
Maintain Manufacturers support	Ensure systems remain current for manufacturers support by actively replacing before support lapses.	Monitor supplier support cycles and replace infrastructure and software's before support lapses.
Hybrid – Maintain Manufacturers support for high risk and fail fix	Ensure that high risk assets remain in vendor support by replacing units proactively (before support lapses), low risk infrastructure is operated beyond supplier EOL via resulting spares.	Categorize infrastructure into low and high risk units, Monitor supplier support cycles, proactively replace high risk equipment before support lapses, utilise displaced infrastructure to support units beyond end of life as fail fix.
Fail Fix	Replace equipment with current supported equipment on asset failure	N/A
Proactive replacement ahead of Inservice failure	Failing assets proactively replaced before in-service failure	Monitor failure performance and replace equipment ahead of in-service failure
Vendor network removal	Remove equipment before supplier removes services that equipment is dependent on	Monitor supplier network retirement dates and replace equipment ahead of network removal
Inspections based replacement	Inspections to inform asset condition, replace units before in service failure based on condition	Regular inspection routine identifies condition of the assets, equipment replaced ahead of in-service failure based on condition.

The following table provides a listing of the asset management approach for each class, total asset base, nominal asset life and the proposed replacement numbers for the 2025-30 regulatory period.

Table 7 Grid Comms Asset Replacement Overview

Technology Type	Asset Class	Asset Management Approach	Total Units	2025-30 Qty EoL	Asset life	2025-30 Qty to be replaced
P25 Network	Base Stations	Spares Mining	379	379	12	22
	RFFS Core Sites	Maintain manufacturers support	12	12	12	3
	P25 Radios (in vehicle, Port, depot)	Fail Fix	1448	-	-	NA
	SATPTT - Radios	Fail Fix	381	-	-	NA
Time Division Multiplexers (TDM)	PDH	Spares Mining	633	545	20	46
	SDH	Spares Mining	415	415	20	82
IP Network Equipment	IP/MPLS Network - Core	Maintain manufacturers support	161	30	9	30
	IP/MPLS Network - Distribution	Maintain manufacturers support	367	233	9	
	IP/MPLS Network - Edge	Hybrid	813	547	9	91
	Data Centre Ethernet Equipment	Maintain manufacturers support	92	40	7	40
	Cellular Modems	Hybrid	2833	750	12	18
	Satellite Terminals	Hybrid	286	165	12	
	DSL Modems	Hybrid	35	25	12	
	Other	Hybrid	137	114	12	
Microwave Radio	Core Microwave Radio	Hybrid	98	96	12	88
	Edge Microwave Radio	Hybrid	368	326	12	
Network Control Systems	Operational Support Systems	Maintain Manufacturers support	28	28	5	28
	VOIP Phones	Fail Fix	352	165	12	NA
	Operational Voice Control System	Maintain Manufacturers support	21	18	7	18
Site supporting Infrastructure	External Cabinets	Inspection Based Replacement	47	22	25	0
	Small Buildings	Inspection Based Replacement	33	4	25	4
	Large Buildings	Inspection Based Replacement	93	0	25	0
	Solar	Proactive Replacement	54	13	20	13
	Generators	Proactive Replacement	100	33	15	33
	Concrete Poles	Inspection Based Replacement	165	5	25	3
	Guyed Masts	Inspection Based Replacement	14	1	25	1
	Steel Towers	Inspection Based Replacement	83	12	25	7
	Battery Chargers	Proactive Replacement	260	78	15	78
	Small Battery Banks	Proactive Replacement	133	42	10	42
	Medium Battery Banks	Proactive Replacement	53	23	10	23
	Large Battery Banks	Proactive Replacement	83	32	10	32
	Air Conditioners	Inspection Based Replacement	282	150	15	95
	Mechanical Site Security	Inspection Based Replacement	250	18	20	18
Linear Media	Fibre Pits	Inspection Based Replacement	1598	80	30	50
	Fibre Cable (kms)	Inspection Based Replacement	1700	15	30	9

	Pilot Cable (kms)	Proactive	35	9	50	6

4 IDENTIFIED NEED

4.1 Summary

Ergon Energy aims to minimise expenditure in order to keep pressure off customer prices, however understands that this must be balanced against critical network performance objectives. These include network risk mitigation (e.g. safety, bushfire), regulatory obligations (e.g. safety), customer reliability and security and preparing the network for the ongoing adoption of new technology by customers (e.g. solar PV). In this case safety is a strong driver, as the Grid Comms system is critical for coordinating safe and efficient work.

The Grid Comms program is required to ensure Ergon Energy can meet critical operational requirements that support our obligations in relation to safety and reliability, by ensuring ongoing and reliable carriage of operational voice and data communications services. These assets provide Telecommunications for mission critical Protection and Supervisory Control and Data Acquisition (SCADA) applications, and there is no alternate method available for provisioning this network. This proposal aligns with the CAPEX objectives and criteria from the National Electricity Rules as detailed in Appendix C.

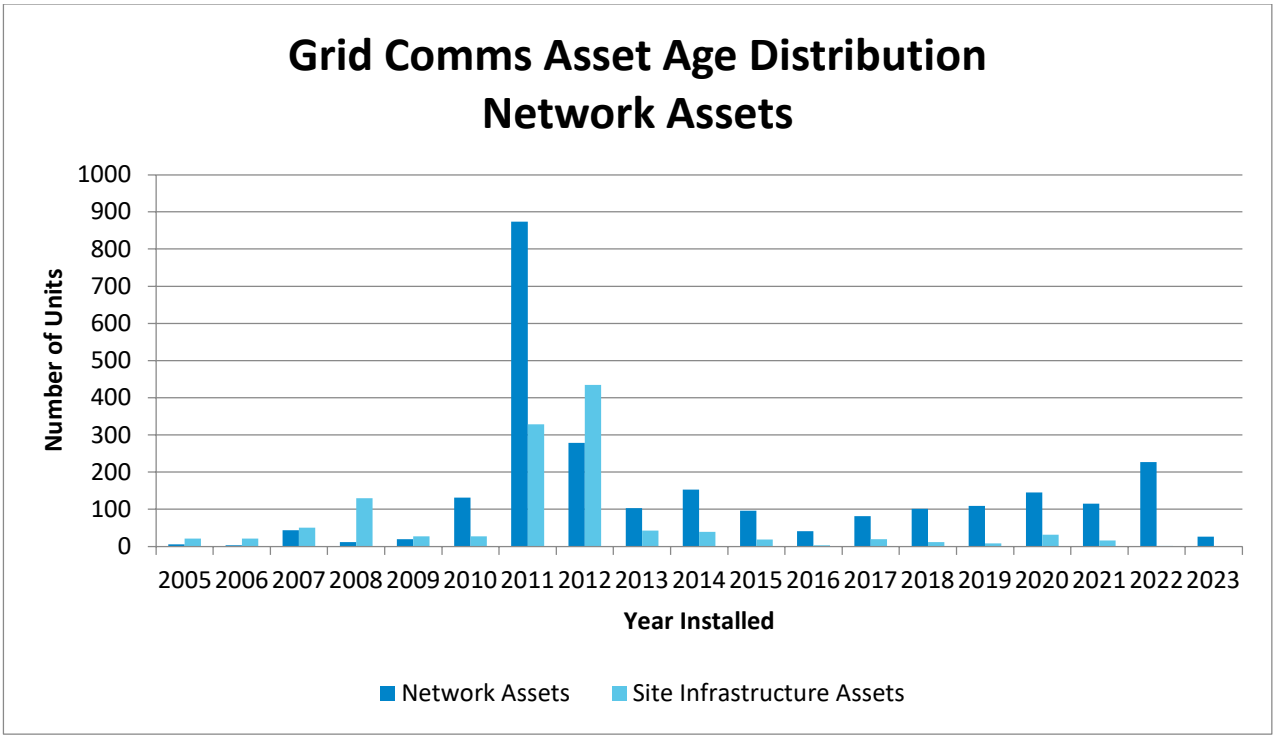
The Grid Comms replacement program seeks to manage risks and costs associated with provision of telecommunications services by replacing equipment ahead of asset obsolescence and in service failure. Not proceeding with the program will require expensive reactive replacement when in-service units fail, will require more complex management arrangements to manage the older versions of equipment and will require reactive development of replacement arrangement once vendors no longer supply spare equipment for the reactive fail fix processes.

4.2 Drivers for Investment

4.2.1 Aging asset base

The majority of Ergon's communication assets was established between 2009 and 2013 with a total capital investment of ~$140M under a project called UbiNet. Many of these assets have lives in the order of 7-12 years and have since become obsolete having exceeded vendor end of life support dates.

Figure 4: Grid Comms Asset Age Distribution



The three primary drivers for asset replacement are shown in the table below.

Table 8 Grid Comms Asset Replacement drivers

Driver	Driver Description
Equipment Condition	Aged telecommunications equipment that is experiencing high failure rates, extended outages, high ongoing maintenance costs and/or high replacement costs in a complete failure scenario. In addition, the equipment is out of production and is no longer supported by the manufacturer. It is not reinforced by high levels of safety stock (refurbished equipment), technical support or service knowledge.
Product Support Removal	Product support by vendors is critical for many types of assets to obtain device information, as well as troubleshooting and device software updates if the device malfunctions. Configuration updates for software that runs active equipment hardware are needed to improve operation, fix bugs, and maintain the device's functionality as the telecommunications network evolves. The equipment vendor is the only possible source for these updates.
Commercial Product Removal	The future disconnection of external vendors' network services is a risk to the Ergon Energy telecommunication network. Due to the high volume of reliant equipment, measures need to be undertaken to ensure the risk is reduced.

4.2.2 Increasing failure rates and performance considerations

As depicted in the subsequent sections below, many of the Grid Comms asset classes are experiencing failure rates that are trending upwards as the fleet of assets is aging. Additionally, there are other several key considerations that impact the fleet performance.

4.2.2.1 SDH Assets

Asset performance considerations for the SDH fleet is as follows:

- All existing SDH components have gone End of Life, manufacturers have ceased support and very limited options exist for equipment repairs and refurbishment.
- All existing SDH components do not have like-for-like replacements; it is required to conduct a technology migration to IP/MPLS which introduces a range of complexities.
- Vendor supplied SDH Network Management Systems; craft terminals have all gone end of life, along with the supporting software components such as Windows / Linux operating systems these systems depend on.
- Combined average failure rate during the period between 2018 and 2023 has been ~4.10% and is anticipated to increase as the electronic components age.

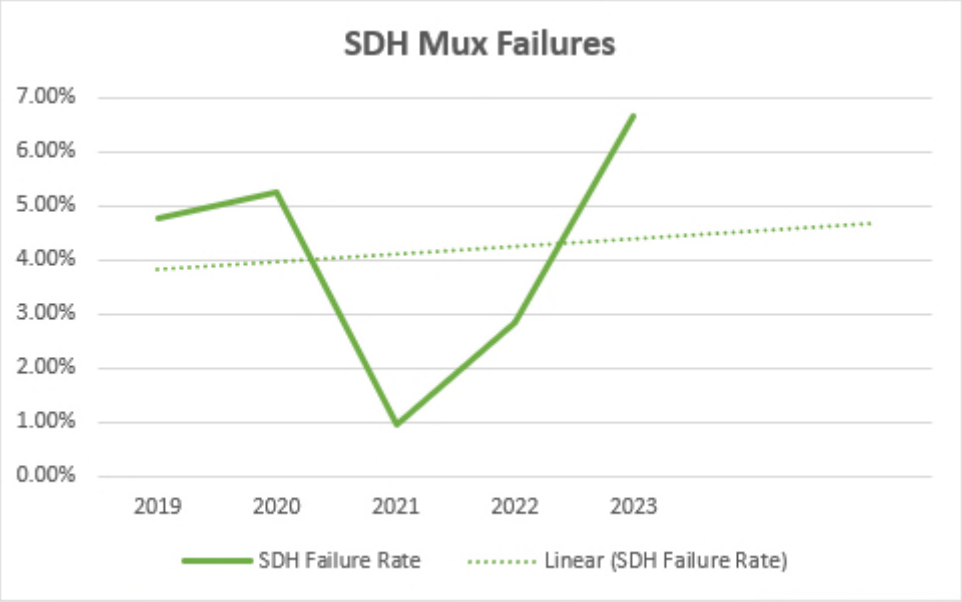


Figure 5: SDH Asset Failures

4.2.2.2 Microwave Radio Assets

Asset performance considerations for the Microwave radio fleet is as follows:

- The MW Radio components comprise of both Indoor and Outdoor electronic components installed in rugged environments that deteriorate with age.
- The MW Radio components which have gone End of Life, manufacturers have ceased support and very limited options exist for equipment repairs and refurbishment.

- Large portion of the fleet (approx. 90%) went End of Sale in 2015 with End of Support occurring in 2025-2026.
- Like for like replacements do not exist for both Indoor and Outdoor MW radio equipment resulting in increased complexities associated with upgrading to current contracted equipment from legacy equipment.
- The manufacturer has released notice that a specific radio systems have been susceptible to a software bug that leads the system to malfunction, significantly reducing the asset life. Ergon have 234 of these units and have already experienced several failures on this platform which this bug is believed to be the root cause and have implemented the manufacturers recommended action.
- Combined average failure rate during the 5 year period between 2019 and 2023 has been ~4% and is anticipated to increase as the electronic components age.

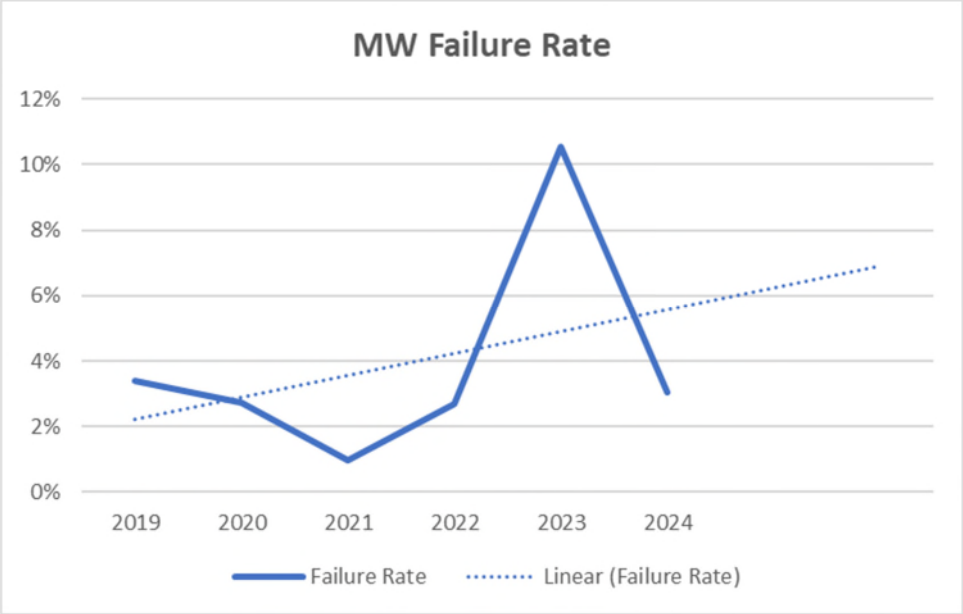


Figure 6: MW Radio Asset Failures

4.2.2.3 Data Centre Equipment

Asset performance considerations for the Data Centre Ethernet equipment is as follows:

Firmware Bugs

From the period between 2021 to 2024 the manufacturer has published 279 x software bugs that impact operation of the specific make/model of Data Centre routing and switching infrastructure deployed in the network.

The manufacturer firmware release policy generally offers in the order of 12-18 months of full updates and bug fixes after the initial release, then in the order of 24-36 months where only critical bug fixes and security patches are provided.

It is required to maintain vendor support firmware on critical data centre equipment in order to obtain vendor support and patch known issues.

Failure Rates

Current failure rate is forecasted at approx. 5.6% per annum that will experience either hardware/software defects or performance degradation issues.

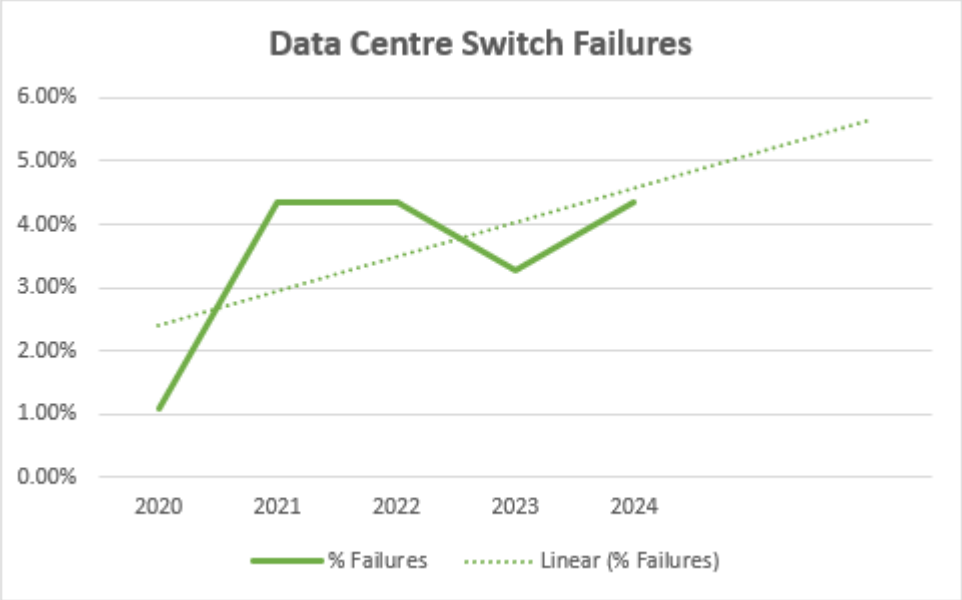


Figure 7: Data Centre Asset Failures

4.2.2.4 Edge Routers

Asset performance considerations for the Edge Router Ethernet equipment is as follows:

Cyber Security Considerations

The obsolete Edge Router comms equipment in scope of this program has in the order of 13 x Vulnerabilities and Exposures rated with High/Medium impact that have been identified and disclosed in the manufacturers products as listed below.

Ergon needs to continuously monitor these and apply the relevant software patches and remediations in line with manufacturer recommendations which requires equipment to be in support.

As the manufacturer no longer do software maintenance releases for these end-of-life assets; to resolve these vulnerabilities requires full asset replacement to occur.

Firmware Bugs

It is required to maintain vendor supported firmware revisions on these assets during their life in operation in order to obtain vendor support and patch known issues.

From the period between 2012 to 2023 the manufacturer has published 57 x software bugs that impact operation of the specific make/model of Edge Routing infrastructure deployed in the network.

Since these assets are now obsolete the manufacturer is ceasing any further software development and any new bugs identified will require hardware replacement.

Manufacturer End of Life issues

After the end-of-support date, the manufacturer will no longer provide range of essential services such as configuration support, hardware replacements, software updates (including essential bug fixes and security patches), field notices, configuration guides, technical manuals, bug tracking, vulnerability tracking etc. This introduces a range of issues that can compromise network reliability.

Failure Rate and Lack of Like for Like replacements

Current failure rate of Edge Router assets over the current RCP period is ~3.05% per annum that involve either hardware/software defects or performance degradation issues.

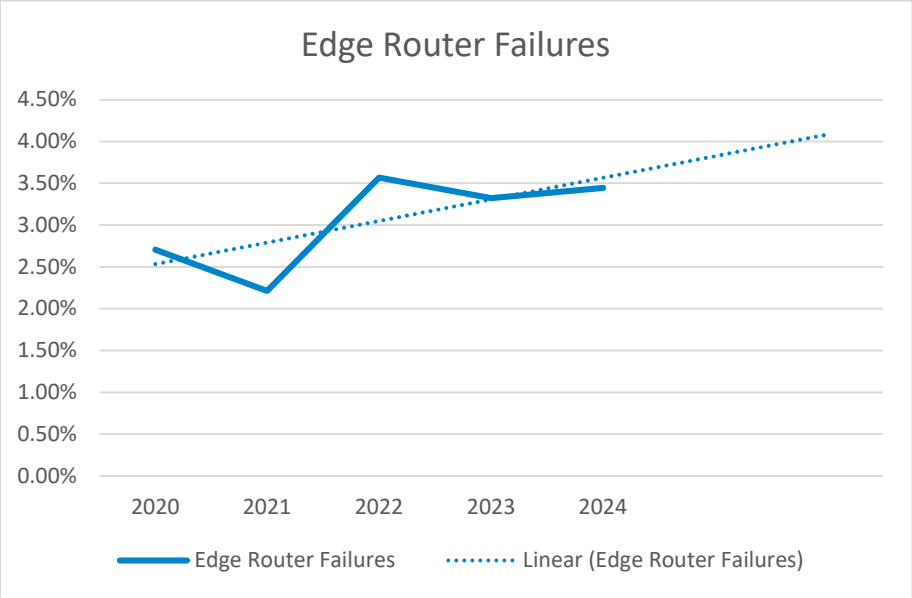


Figure 8: Edge Router Asset Failures

Current contracted standard equipment is not drop in like for like replacements and require a complete redesign for the sites communications arrangements. Any hardware failure where like for like spares do not exist could result in prolonged downtime, negatively impacting operational efficiency and causing costly delays.

4.2.2.5 Fringe Network assets

Asset failure performance associated with the terminal equipment for the Fringe Network over the 2022 to 2024 period is 6.35%, this failure rate includes a significant number of firmware issues that resulted in equipment locking up, a need to attend site, upload a new firmware and restart the device.

However, given the recent large number of replacements (50% of fringe net equipment) associated with the 3G close down, this failure rate is expected to decrease. The estimated failures would be expected to halve with a projected failure rate of ~3%.

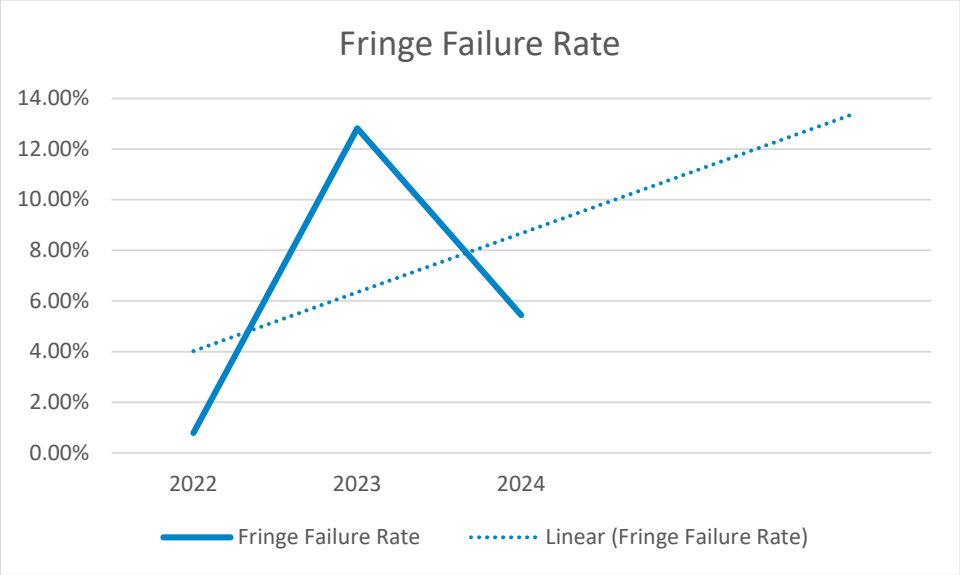


Figure 9: Fringe Equipment Failures

Below are listed the various current or future considerations for the Fringe Network fleet for removal of commercial services and reduction in performance of existing services.

- Expected cellular network closure of 4G during AER 2030-35 period with the need to commence works (standards development and testing for 5G equipment) during the 2025-30 period.
- Performance deterioration for the BGAN Satellite Service. Ergon's existing Satellite network provider for assets in this category is increasingly becoming not fit for purpose due to significant performance decline experienced in current BGAN terminal operation. The service had a significant issue which saw around 60+ of our remote pole mounted reclosures uncontactable for over 6 months due to issues that decreased satellite coverage. The service continues to have increasing latency and high data usage costs. Devices are frequently toggling on/off with unreliable communications during periods when there is no faults on the satellite system. The figure below shows the number of pole mounted devices utilising satellite that are contactable sampled over a 5 day period.

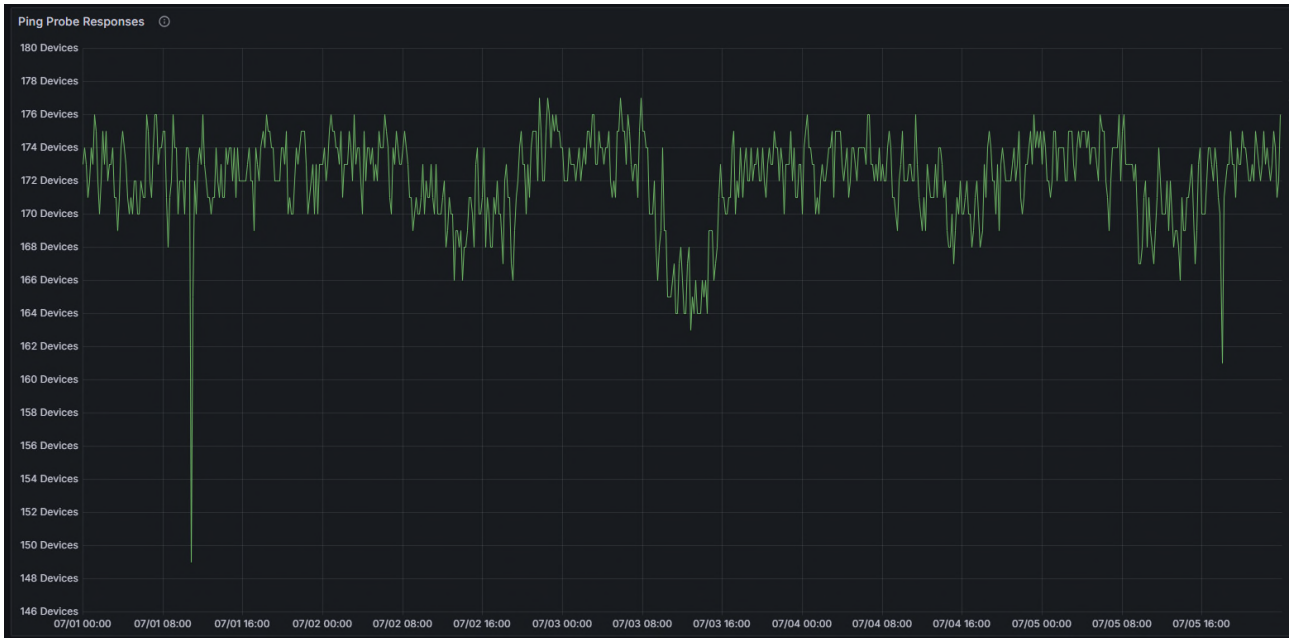


Figure 10: Responding Satellite unit counts over time

- Performance of Cellular services is degrading in remote locations. Overall performance of cellular network with daily cycle of losing connectively (longer than 10 minutes), multiple widespread outages, increasing latency and congestion issues impacting 1000+ units per day

    - As evident in the figure below, in remote areas Ergon has observed significant performance degradation on public cellular networks during the hours when the community is most active. The figure below shows the significant increase in latency for packets that for many applications can mean the services will not operate effectively or at all.

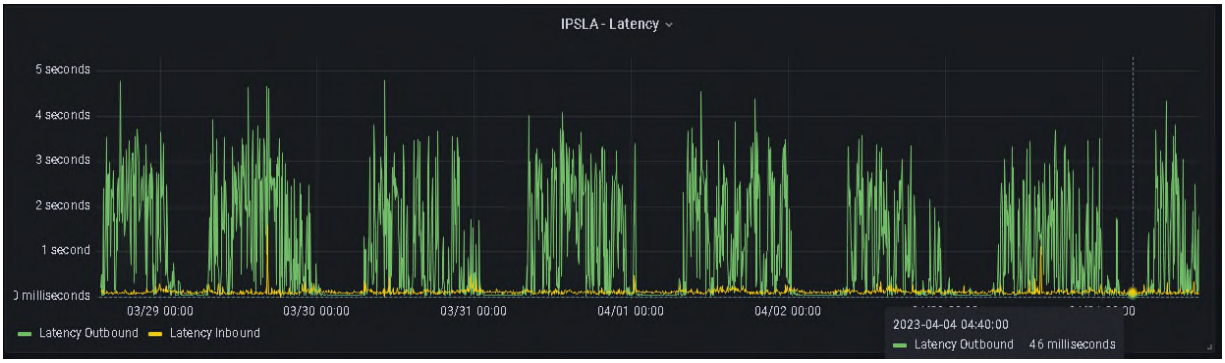


Figure 11: Latency performance of remote Cellular connected equipment over time

    - The below performance graph highlights the large number of cellular devices which are unavailable for longer than a 10 minute period in any in a 24 hour reporting period due to poor performance of the 3rd party carrier networks (single operator).

Over a third of the devices experience these issues on a daily basis. This is caused by cell coverage reduction as number of active devices per cell results in power restrictions, outages, network congestion and actual equipment failures. These cellular connected devices provide service to substations and discreet electrical assets such as reclosers, sectionalises, Line Fault Indicators etc.

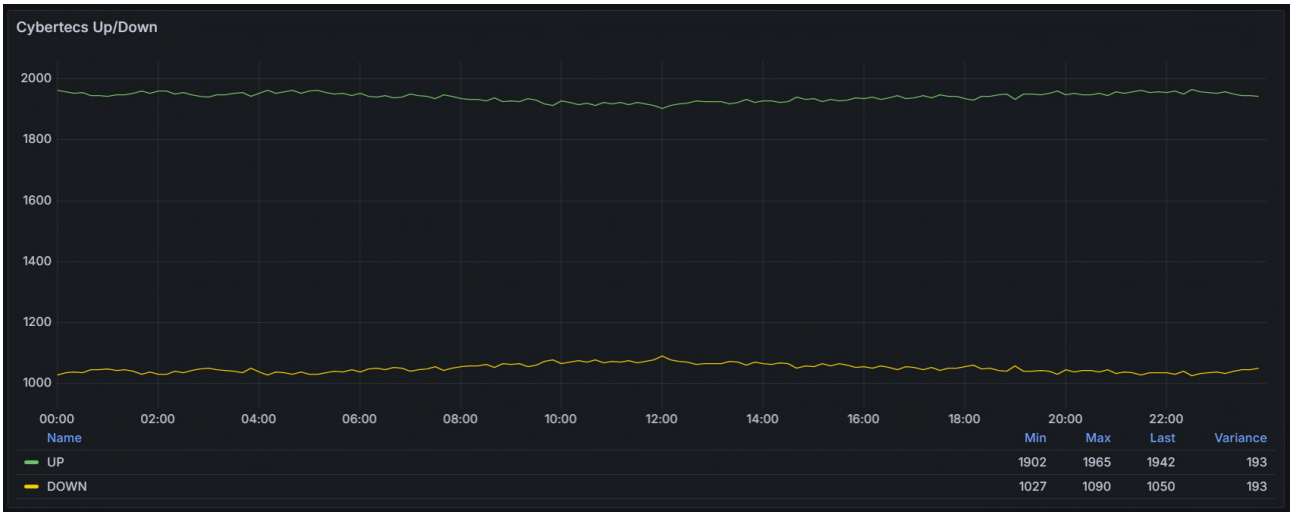


Figure 12: Cellular devices online performance

4.2.2.6 AC Systems

EQL has a current Generator replacement program from this AER 2020-25 regulatory control period which has been successful in the reduction of generator outages and improved site reliability.

The below table highlight the success of this Generator program with the final generator failure rate at 5% as of 2023.

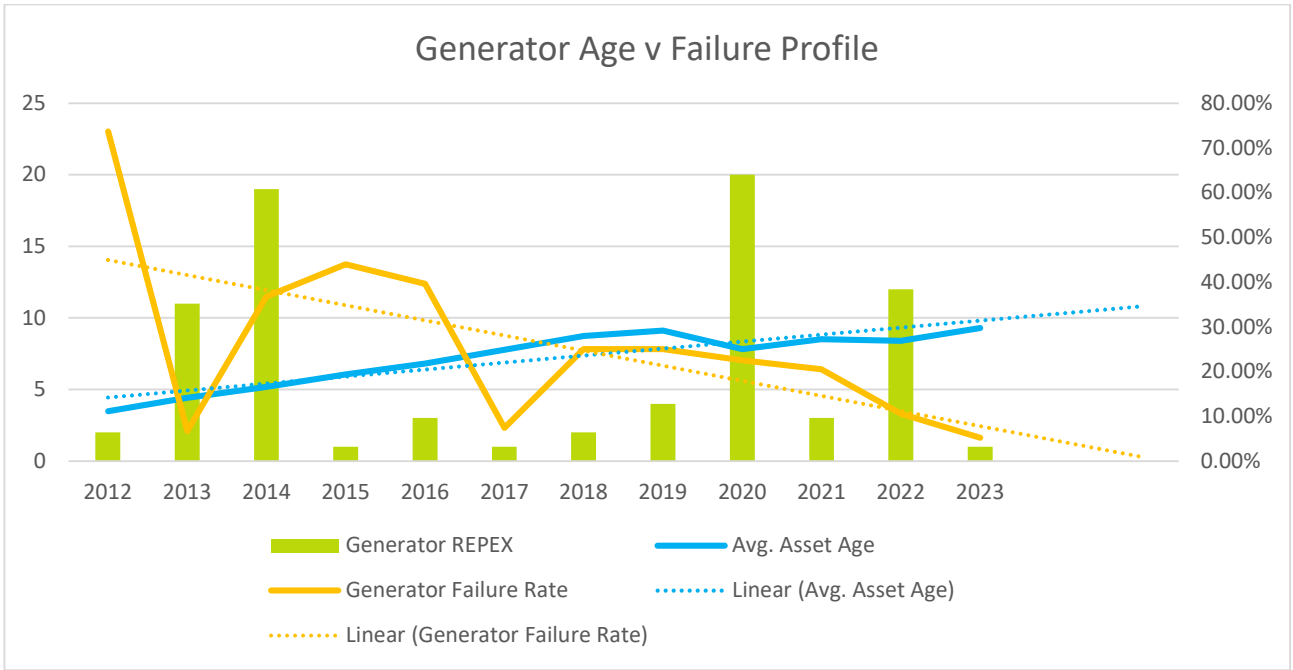


Figure 13: Generator REPEX v Failure Profile

However this downward trend will be temporary, with the average age of the assets continuing to increase (assuming no proactive program is progressed), which could moves us back to failure rates above 10% seen previously.

In contrast there has been no program to replace those known solar rectifier which are end of life asset and this is reflected in rising failure rate shown in the below failure rate table.

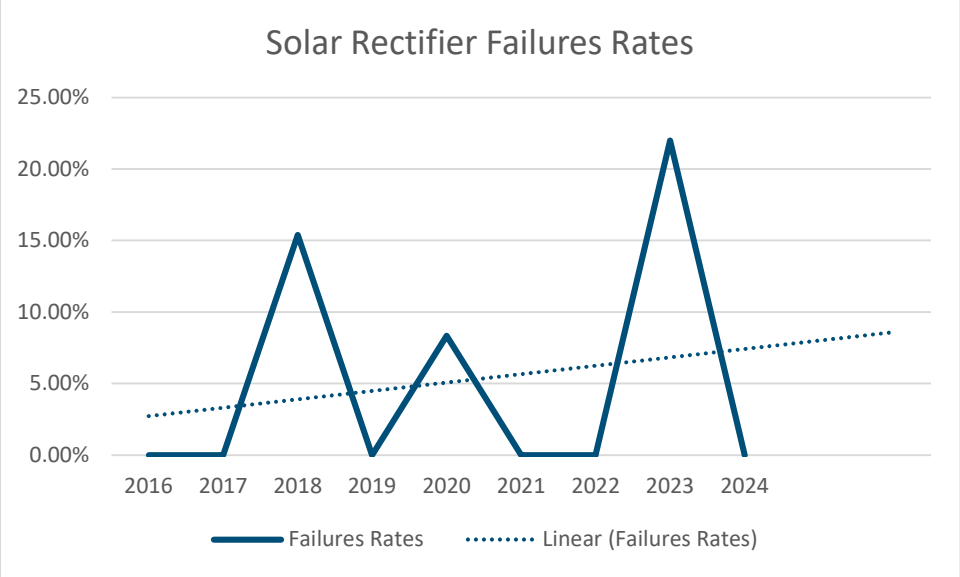


Figure 14: Solar Rectifier Failure Rate

4.2.2.7 DC Systems

The majority of the battery chargers and rectifiers were installed between 2000 and 2022. Failure rates for batteries as seen in figure 3, are increasing. To allow comparison of options a conservative failure rate is assumed at 6% for Batteries

The graph below highlights the failure rate of the rectifiers that are installed in battery chargers.

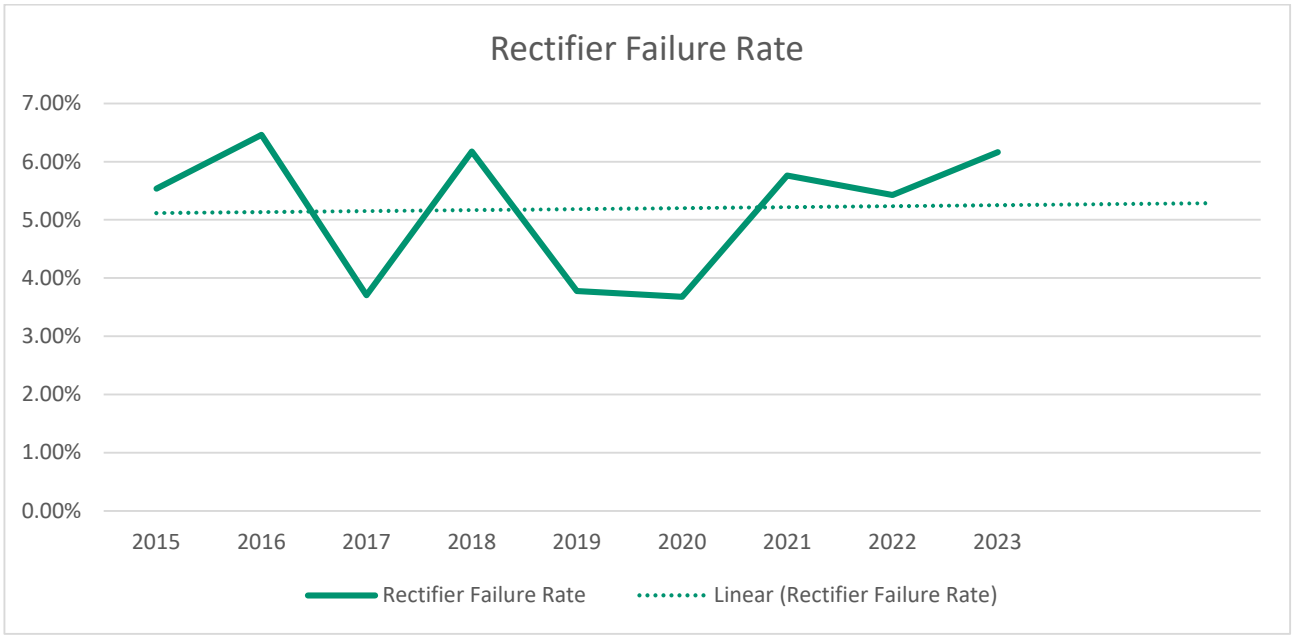


Figure 15: Rectifier Failure Rate

The graph below highlights the failure rates of Battery Cells that are installed in battery banks. The batteries are replaced under an Aged Asset program, or reactively when a failure is identified and are typically under 15 years old.

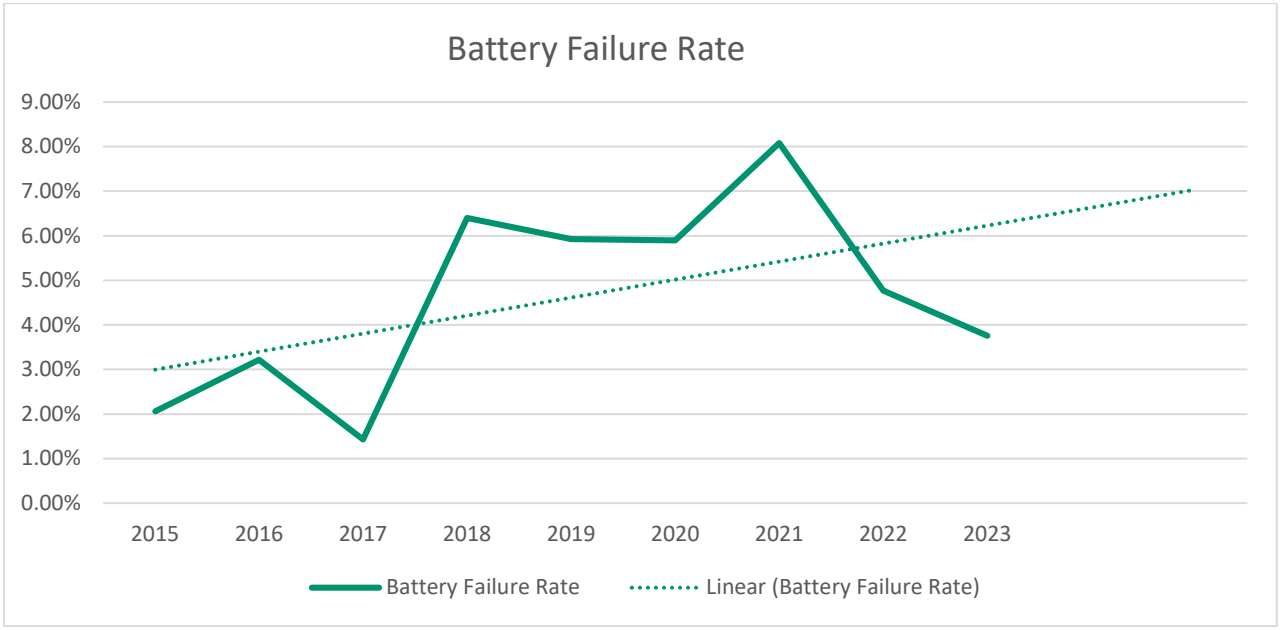


Figure 16: Battery Failure Rate

4.2.3 Increasing maintenance and defect expenditure

In the past 10 years; Ergon Energy's Grid Comms maintenance and defect costs continue to increase as assets age as represented in the subsequent graphs/tables.

The graph below highlights maintenance expenditure increasing approximately 57% over the period.

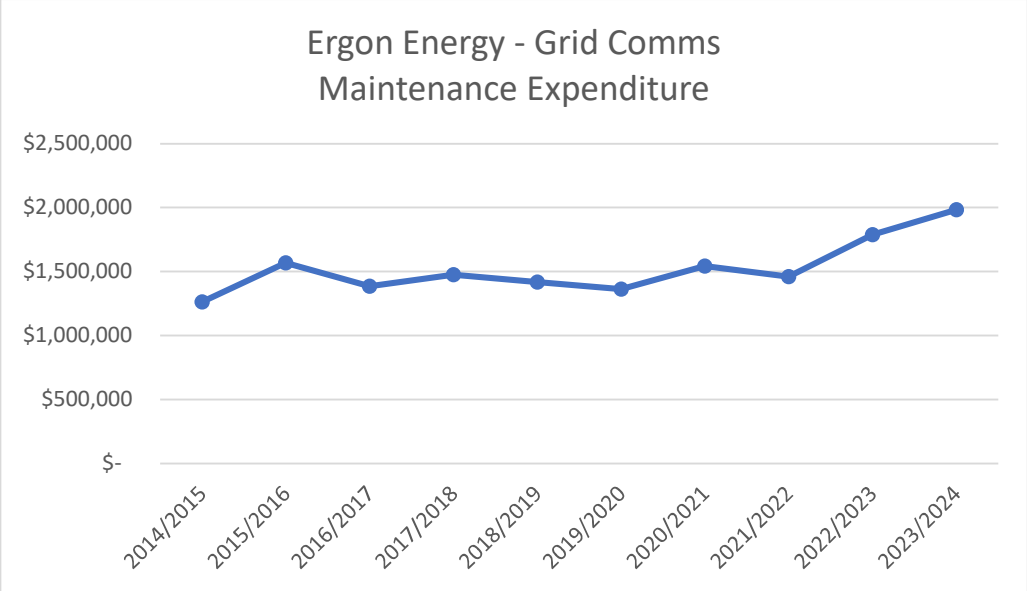


Figure 17: Grid Comms Maintenance Expenditure

The graph below highlights defect expenditure increasing approximately 164% over the period.

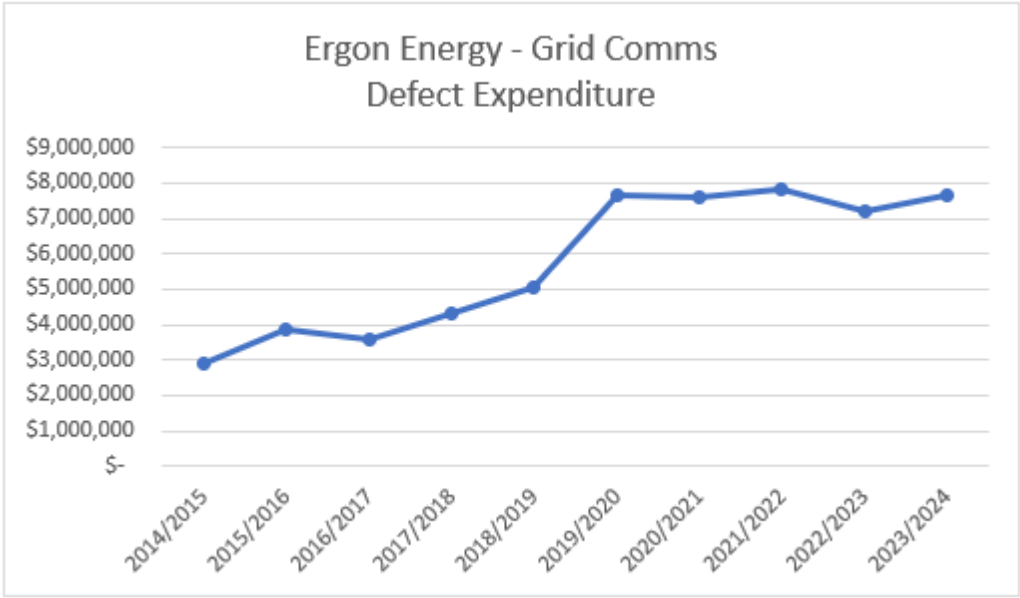


Figure 18: Grid Comms Defect Expenditure

Summary of maintenance and defect expenditure is as follows:

Financial Year	Maintenance	Defects	Total Maintenance & Defect Expenditure
2014/2015	$1,263,052	$2,893,592	$4,156,644
2015/2016	$1,566,924	$3,840,559	$5,407,483
2016/2017	$1,384,192	$3,569,372	$4,953,564
2017/2018	$1,475,893	$4,320,846	$5,796,739
2018/2019	$1,418,666	$5,053,799	$6,472,465
2019/2020	$1,362,377	$7,639,638	$9,002,015
2020/2021	$1,541,516	$7,603,105	$9,144,621
2021/2022	$1,460,060	$7,848,603	$9,308,663
2022/2023	$1,787,759	$7,175,033	$8,962,792
2023/2024	$1,983,194	$7,647,547	$9,630,741

4.2.4 High replacement costs in a complete failure scenario

The below table includes summary of each Grid Comms asset type, the issues and factors that lead to high costs associated with reactive replacement of assets in a complete failure scenario.

Technology Type	Asset Class	Replacement Approach	Rational for High replacement costs during complete failure of the infrastructure when proposed programs are not progressed
P25 Network	Base Stations	Proactive replace critical assets strategically – to use as spares for remaining fleet	Reactive replacement is estimated to cost significantly more (at least double) and take months to occur due to no spares available for like replacements, resulting in the need to replace entire base station equipment and potentially core infrastructure to maintain compatibility between the P25 Base Station and Core infrastructure.
	RFFS Core Sites	Proactive Replacement	Reactive replacement of core infrastructure is estimated to cost significantly more (at least double) and take months to occur due to incompatibility between remaining old core infrastructure and new core infrastructure and old core infrastructure and new core infrastructure, thus requiring the replacement of RFFS Core equipment.
	P25 Radios	Fail in service replacement	Not included in proactive replacement activities.
	SATPTT - Radios	Fail in service replacement	
Time Division Multiplexers (TDM)	PDH	Spares mining - Proactive replace critical assets strategically – to use as spares for remaining fleet	Reactive replacement of PDH equipment is expected to cost at least twice based on the replacement node in most cases is not a like for like drop-in replacement. It requires redesign work at multiple sites along a string and technology migration of obsolete services to IP equipment resulting in complete redesign.
	SDH	Proactive replace critical assets strategically – to use as spares for remaining fleet	Reactive replacement of SDH assets is estimated to cost at least 2.5 times to reactively restore services due to assets having gone end of sale with no like for like replacements available. Redesign is required to replace complete strings of assets at multiple sites rather than at the site of the failure. Additionally, the SDH network underpins the PDH and IP/MPLS network and is often inter-connected with either 3rd party SDH services or SDH based Microwave radio equipment. Therefore, SDH asset failure can result in many ripple effects requiring replacement of other dependant assets.
IP Network Equipment	IP/MPLS Network - Core	High Criticality - Proactive Replacement	Reactive replacement of Core/Distribution IP MPLS assets is estimated to cost twice as much to reactively restore services due to replacements not being a like for like drop-in with changes required across multiple sites, interoperability issues with vendor proprietary protocols and additionally the equipment provides carriage for large volumes of telecommunications services that when failed involves broader business disruption to large geographic areas for critical services such as SCADA, Remote Engineering, Corporate, telephony and site security for an extended period.
	IP/MPLS Network - Distribution	Proactive replace critical assets strategically – to use as spares for remaining fleet	
	IP/MPLS Network - Edge		Replacement of edge equipment results in twice the cost to replace reactively due to current contracted equipment standards not being like for like drop-in replacements, requiring redesign work to install multiple separate hardware components that have different integrations to the upstream network.
	Data Centre Ethernet Equipment	High Criticality - Proactive Replacement	Replacement of Data Centre equipment results in twice the cost to replace reactively due to equipment having vendor proprietary protocols which when a single asset fails would require replacing multiple other assets and/or installing duplicated parallel infrastructure.
	Cellular Modems	Low Criticality – Fail-Fix or proactively upon vendor service removal.	Replacement of Fringe network assets results in 40% cost to replace as these assets are generally in more remote areas where extended travel time from the main regional depots is required. Often the assets do not display complete failure symptoms; the triage process can involve multiple site visits to reset hardware; or outwork potential issues with 3rd party supplied services before decision is made to reactively replace. Significant efficiencies can be obtained by planning proactive
	Satellite Terminals		
	DSL Modems		
	Other		

			replacement in a geographic region to minimise costs associated with remobilisation and travel.
Microwave Radio	High Capacity Microwave Radio	Proactive replace critical assets strategically - to use as spares for remaining fleet	Replacement of Microwave radio assets is estimated to cost twice as much due to current contracted equipment is not a like for like replacement. It involves replacing both indoor and outdoor equipment located on tower/structures, at minimum both ends of the links and often multiple sites along the string require replacement of legacy assets due to differences in protocols used to manage equipment.
	Low Capacity Microwave Radio		
Network Control Systems	Operational Support Systems	Proactive replace critical assets strategically	Replacement of Operational Support Systems is estimated to cost 2.5 times to resolve back to normal operations and take significant time in the order of weeks and months as it requires deploying new hardware/software revisions in parallel then migration exercise. When the systems are down there is increased labour costs with fallback to manual methods resulting in number of cascading flow on effects.
	VOIP Phones	Fail in service replacement	Not included in proactive replacement activities.
	Operational Call Control System	Proactive Replacement	Replacement of Operational call control systems is estimated to cost in the order of 2.5 times as much to fix due to the replacement solution not being a drop in substitute. Replacement requires complete redesign, parallel hardware/software deployment across multiple sites.
Site Assets	Linear media (Fibre) Buildings Structures Site Infrastructure	Combination of Age/condition based repairs and reactive program for in service failures.	Failure of supporting site assets is likely to cost twice that of the proactive program as result of multiple services being offline till such time a replacement asset can be installed, likely in the order of weeks to months as often redesign is required for replacement along with temporary arrangements and other disruption when not done in a careful planned methodical manner.

In addition to the considerations raised above, other factors that lead to high replacement costs when reactively replacing failed Grid Comms assets include:

- Large reactive work disrupts the program of work, requiring other proposed works to be delayed so the reactive work to proceed. EQL allows for a certain amount by basing estimates on previous works, however a step increase in reactive works would occur if programs are not progressed.
- Often there are broader business impacts as the Grid Comms assets underpin other systems and failure can result in cascading flow effects to services such as outages to Teleprotection, SCADA, Remote Engineering, Corporate voice/data, Operational voice/data and site security services.
- Planned proactive replacement allows for better allocation of resources, including labour and materials. Coordination can occur during low-usage periods, reducing the business impact on daily operations and avoiding unexpected downtime. Additionally enables alignment with other maintenance activities or planned works, ensuring a cohesive approach that reduces remobilisation, travel, minimising costs and time to implement.
- Increased labour costs as staff are unable to communicate or use digital OT and IT systems effectly which is heavily utilised for day to day planned and unplanned work activities. Extended loss of Grid Comms services would require staff to revert back to manual paper-based practices.
- Customer impacts as result of delays to both planned and unplanned power restoration works due to the lack of ability of voice/data communications between field crews and control rooms and the loss of remote engineering access and control of the power network.
- Grid Comms network assets are highly configurable equipment also susceptiable to software/firmware issues which makes it difficult to determine if it's a complete asset failure without conducting wasted sunk time/cost to triage and fault find root cause of incidents before decision is made on approach to restore services.

- In a reactive replacement scenario, generally involves sub-optimal investment in aging technology, the decision to resolve is in the best immediate short term interest which involves wasted temporary work to restore services which is generally not in alignment with longer term intentions that would be taken under a planned proactive approach ultimatly increasing costs when compared to planned proactive replacement.
- Replacing Grid Comms network assets in planned proactive approach replacements can take advantage of bulk purchasing and service cost savings when compared to that of reactive procurement.

4.2.5 Technology Obsolescence

Many telecommunications devices are procured with vendor supply and support contracts that define the time period that further purchases and operational support of these devices will persist. As these factors significantly impact EQL's asset management strategies, assets will often be considered obsolescent at the expiration of these contracts. Maintaining a fleet of obsolescent assets on the network carries significantly increased risks - especially when strategic spares holdings dwindle – so these assets are typically targeted for replacement prior to reaching obsolescence. The removal of obsolescent devices from the network is generally complex given the quantities and service integration, so the process is often staggered into consecutive stages. The first devices pulled from service can also be held as strategic spares to minimise in-service failure risks until the further removals are completed.

4.2.6 Decommissioning of Third-Party Services

Ergon Energy relies heavily on third-party public networks for provision of telecommunications solutions in regional QLD. The public networks go through a rapid change and historically removed previous generations of technology from service to enable later generation of network equipment to be deployed. Due to the current reliance on public telecommunications networks, changes in the market by external vendors is a risk to Ergon's operational telecommunication networks. Some recent examples of this issue include:

- The decommissioning of the 3G cellular network. In this instance all equipment that was only compatible with the 3G network had to be replaced prior to the public telecommunications carrier service disconnection dates.
- 3rd Party retirement of SDH based services impacting large portions of Ergon's core IP/MPLS transmission network from Brisbane to Roma, through to Marathon.
- The decommissioning of ISDN and PSTN telephony lines. Public carriers' removal of ISDN services required Ergon to migrate to SIP equivalents.
- The decommission of ADSL, Frame-relay and other copper-based services required migration to VDSL and NBN Ethernet Bitstream services.
- 3rd Party service use-policy changes requiring Ergon to utilise other Business Satellite services.

4.2.7 Cybersecurity Pressures

Threats to the availability power systems and telecommunications services will increase due to the increased interconnectivity of systems, greater extent, and higher exposure. The extent will increase in physical (e.g. geographical) and logical (e.g. number of subsystems) dimensions. The exposure will increase through connectivity with external (potentially hostile) systems and through the use of commercial telecommunications components having well publicised vulnerabilities.

During the 2020-25 AER period, EQL has significantly improved its Cyber capability with a range of new processes, systems, standards, policies and procedures introduced. Many of EQL telecommunications systems fail to meet these new strategic directions including:

- Alignment to the “Security Legislation Amendment (Critical Infrastructure Protection) Act 2022 (SLACIP Act)”
- Meet the target state maturity level of Security Profile SP2 as defined in the Australian Energy Sector Cyber Security Framework (AESCSF)
- Progressively uplift operational systems to align with the zero-trust framework.

4.2.8 Accommodation of Ongoing Changes to Business Needs

As EQL responds to changes in customer needs, economic conditions and developments in the products available for improved network performance, it can impact planned works. The consequential changes to telecommunications service requirements can require re-allocation of resources to enable cost-effective, architecturally compliant solutions.

The significant recent growth in Distributed Energy Resources (DER) is one such challenge; that requires highly available telecommunications solutions with IP interfaces to various 3rd Parties whilst maintaining the security and integrity of EQL’s networks.

EQL has shaped the strategic planning approach to consider what we need to do to deliver financial sustainability whilst balancing our ability to transform in an environment of significant market disruption and increased competition as we evolve towards an ‘electric life’ and renewable targets as described in Queensland Energy and Jobs Plan (QEJP).

4.2.9 Compliance

Ergon is required to meet regulatory and compliance obligations in relation to operational technologies as set out below.

Table 9: Ergon's Regulatory and Compliance Obligations related to Grid Comms

Obligation	Description of Requirement
Security Legislation Amendment (Critical Infrastructure Protection) Act 2022 (SLACIP Act)	The Security Legislation Amendment (Critical Infrastructure Protection) Act 2022 (SLACIP Act) applies in managing national security risks relating to critical infrastructure. Grid Comms network assets is considered by Ergon to be a critical system. The Security Legislation Amendment (Critical Infrastructure) Bill introduces new requirements: • additional positive security obligations for critical infrastructure assets, including a risk management program, to be delivered through sector-specific requirements, and mandatory cyber incident reporting; • enhanced cyber security obligations for those assets most important to the nation, described as assets of national significance; and • government assistance to relevant entities for critical infrastructure sector assets in response to significant cyber-attacks that impact on Australia's critical infrastructure assets.
Privacy Act 1988, Information Privacy Act 2014	As specified in the Privacy Act 1988, Ergon is required to maintain strong controls and security on the accessibility of employee and customer data as well as ensuring appropriate availability of data. Keeping Ergon's critical systems up to date, supported and secured is a key enabler of maintaining these controls.
National Electricity Law (NEL) and National Electricity Rules (NER)	The NEL requires Ergon to promote efficient investment in, and efficient operation and use of electricity services for the long-term interests of consumers of electricity with respect to price, quality, safety, reliability, and security of supply of electricity as per the National Electricity Objective. The operating and capital expenditure objectives set out in the NER require Ergon to maintain both the quality, reliability, and security of supply of standard control services and the reliability and security of the distribution network.
The Australian Energy Cyber Security Framework (AESCSF)	Ergon must ensure its OT infrastructure is up to date, supported and secure to meet the AESCSF maturity targets. There is potential that this will become a licensing requirement in the future and therefore the assets must be maintained to enable licenses to be up to date.

4.2.10 Improve network reliability.

Various of the proposed programs seek to resolve known Single Points of Failure and capacity constraints within the network. Removal of these issues results in improved availability / reliability and capacity of the network, ultimately improving the effectiveness of the work force, improving automated functionality (like protection signalling) improving safety and in many cases lowering costs.

4.2.11 Lack of connectivity at field sites

Field workers are increasingly reliant on the use of digital devices such as corporate laptops, iPhones, tablets etc. to perform their work activities efficiently. Field workers utilise these various digital tools and data management techniques to make faster and better decisions that enable and optimize a process or set of processes that they participate in.

Existing network standards in most cases has two physical ethernet ports enabled for Field Worker's laptops and do not have any existing capability for WiFi device connectivity. Smart devices such as iPhones, Tablets etc. will often have no or unreliable connectivity due to insufficient or obstructed cellular coverage when working within substation buildings. This severely limits productivity to field staff when working in these environments as they cannot access the information and systems when they require it.

4.2.12 Increased labour costs for operational maintenance

The telecommunications network assets are increasingly becoming more intelligent with greater ability to perform real time streaming telemetry of health/performance data and remote diagnostic information. The telecommunications fault, configuration and performance management tools are capable to collect a large volume of this data. The telecommunications Network Operations Centres (NOCs) receive thousands of alarms daily, yet less than 1% lead to true actionable incidents or problems. Existing standard alarm classifications and correlations result in too many events to handle through manual processes.

The telecommunications NOCs are expected to continue to receive higher volumes of alarms as the network continues to grow and older equipment is swapped with newer smart equipment with significantly improved remote telemetry and health reporting capabilities.

4.2.13 P25 Capacity Constraints

There is an ongoing need to review and where prudent upgrade the P25 network capacity where base stations are congested due to high call volumes. A recent review of the P25 network performance has identified several highly congested P25 base stations that consistently exceed the channel occupancy limits preventing field workers from being able to communicate effectively with their P25 radios.

4.2.14 P25 Coverage Black Spots

Evaluation of the P25 network coverage in comparison with the electrical power network has identified several black spot locations where staff are working in areas that have problematic voice communications due to poor or no P25 and mobile cellular coverage.

Satellite radio communications are not available in all vehicles as this is predominantly a "far western" technology where there is minimal electrical network and no P25 coverage.

Some of the potential consequences which can occur as a result of no P25 network coverage, in no cellular coverage areas include:

- Inability of field crews to report on emergency situations,
- No ability of locational services to report on vehicle incidents, vehicle rollover / impacts,
- Ineffective operational switching, group call function is heavily utilised for switching activities.

4.2.15 IP/MPLS Reliability Improvements

There have been several single points of failure identified in the Core IP/MPLS network that impact the underlying communications services for protection, SCADA, Corporate data, substation voice

communications and a range of other services. Several reliability improvements can be made including:

- Implement alternate MPLS transmission paths for existing portions of the Core network which are in “spur” configuration utilising legacy SDH backhaul;
- Implement diverse transmission paths via newly introduced 3rd party alternate transmission capacity, (eg. Powerlink, Queensland Rail, NBN, Telstra etc);
- Implement diverse transmission path on multi-hop spur microwave links to improve reliability and availability;
- Deploy standard IP/MPLS nodes to improve reliability of microwave and fibre connected networks in ring topology;

4.2.16 Fibre Cable capacity and reliability issues

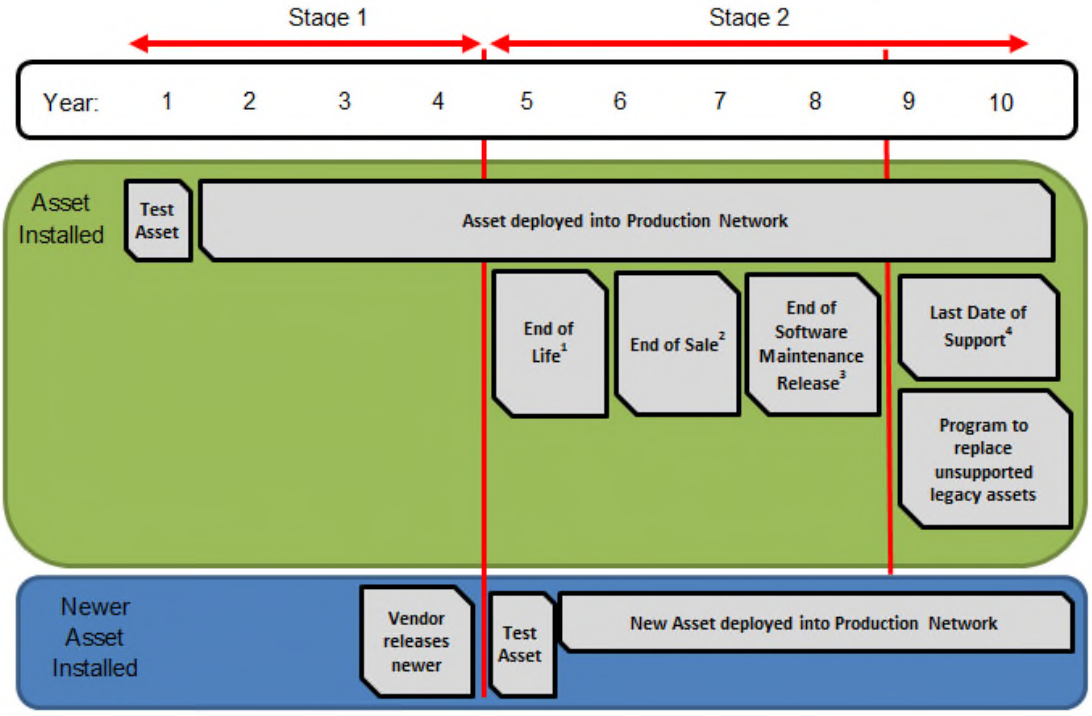
There are single points of failure and capacity issues identified in the fibre network that impact the underlying communications services for protection, SCADA, Corporate data, substation voice communications and a range of other services. Several improvements are proposed including:

- Implement alternative technology deployment options at targeted location to recover fibre cores for operational use.
- Implement new fibre build to reduce fibre core congestion at key locations on the network, to allow migration of operational services in emergency situations
- Implement small fibre builds (<1km) to remedy common pit / pole SPOF location in the transmission network.
- Implement Medium fibre builds (<10km) to remedy common pit / pole SPOF location in the transmission network.

4.3 Optimal Timing

The following diagram depicts the optimal asset lifecycle timeframes associated with replacement of Grid Comms network assets. The optimal asset life is typically 10 years for telecommunications active equipment. This assumes Ergon adopted the product early in the vendor’s product lifecycle. Typically on average Ergon Energy are not always early adopters to the vendor’s latest products, hence the Stage 1 timeframe typically vary between 1 to 4 years depending on when the product was acquired after the vendor released the product. Therefore actual asset life on average is more likely to be 6 to 7 years.

Figure 19: Grid Comms Optimal Asset Replacement Timing



1. EoL - This is just a notification that the vendor will eventually stop supporting a particular product. Feature freeze goes into effect on the platform and no new features or expansion modules will be added to the product line.
2. EoS - Typically one year after EoL is announced, the product can no longer be ordered through normal channels. The asset however, is still eligible for vendor support and is still receiving maintenance updates and bug fixes.
3. EoSMR – The vendor stops issuing any additional updates for the asset.
4. LDoS –The vendor stops all support for the product, thus making it obsolete.

4.4 Retirement decision

Retiring the parts of the Grid Comms assets as they become obsolete would reduce the ability of Ergon Energy to monitor and control the network and would leave workers without critical voice communications in the field. This is an unacceptable risk both to the safety of the workers and to the ability to provide an adequate service. This replacement work needs to be considered in the wider context of the Energy Queensland business plan as we evolve towards an ‘electric life’ and renewable targets as described in Queensland Energy and Jobs Plan (QEJP), as well as the other planned project that address these goals. As such, no retirement option is available.

4.5 Risks

With the continued use of aging Grid Comms equipment with an observed susceptance to failure, reliability, capacity or coverage constraints will result in broad range of risks as detailed in the table below. Note refer to each individual Grid Comms Project Justification Statement for detailed risk assessments based on each technology/asset class basis.

Table 10 Risks Associated with the Counterfactual (no proactive program in place)

Risk Type	Description of Risk
Business Impact	• Generally resolving hardware/software defects back to normal operations in a reactive unplanned manner will result in at least 2.5 times the costs to when compared to undertaking as part of planned proactive work. This is due to the additional complexity, integration problems and cascading flow on effects to dependant assets and services that results in significant increase in time/cost. • Increased cost of labour to manually manage, monitor and configure the network during the extended period of the system being down. • Additional cascading flow on broader business impacts as result of voice and data communications to depots, substations, comms sites etc. which results in extended outages to business-critical services such as Teleprotection, SCADA, Remote Engineering, Corporate voice/data, Operational voice/data and site security for an extended period. • Sub-optimal investment in aging technology resulting in extra reactive works increasing costs. • Inability for Ergon staff to communicate effectively due to loss of voice communications which is heavily utilised for day to day planned and unplanned work activities. • Inability for EQL to efficiently deliver on strategic objectives due to aging Grid Communications infrastructure. • Asset obsolescence results in inability to obtain vendor support patches which is vital for these assets because it offers technical expertise, bug fixes, compatibility updates, resolve known cyber security and performance problems.
Legislated	• National Electricity Rules should failures occur Ergon would be unable to restore duplicate communication paths for protection services in a timely manner resulting in lack of NER compliance, extended exposure of power system assets (e.g. power transformers and circuit breakers) to fault currents and ultimately extended customer power outages due to a lack of appropriate power system protection. • Security of Critical Infrastructure Act applies to managing national security risks relating to critical infrastructure. Grid Comms systems is considered by Ergon to be of critical significance and with continued use of obsolete end of life assets introduces risks of Ergon being increasingly vulnerable to cyber threats and inability to meet new obligations.
Safety	• Delay in protection tripping time as result of Grid Comms asset failure can result in a fatality or a serious injury noting however is very low likelihood. • In locations of poor or no mobile cellular coverage will significantly hinder ability for field crews to communicate effectively and utilise safety distress button capability on radios and also the ability to report vehicle GPS location services on safety incidents such as vehicle rollover / impacts. Estimated very low probability of occurring however should a staff member be involved in an accident; significant delays will occur in responding that may result in a fatality or serious injury.
Customer	• Issues with Grid Comms equipment can result in extensive customer impacts as result of delays to both planned and unplanned power restoration works due to the lack of ability to voice/data communications between field crews and control rooms and the loss of remote engineering access and control of the power network.

The above risks are more profound during natural disaster events (cyclones, floods etc.) where operational activities and staff concentrations increase in impact areas resulting in substantial increase and reliance on the Ergon's Grid Communications network. During natural disasters, the likelihood of significant public carrier telecommunications service disruption is highly likely as carrier's mobile networks are not designed for

extended power outages, call congestion (that occurs at these times) and damage to mobile infrastructure. This has been experienced during most natural disasters. Additionally, the underlying environmental conditions where restoration activities take place are during natural disasters are typically worse than during normal day to day operations which impacts a number of these risks.

5 PROGRAM ANALYSIS

5.1 Replacement Program

5.1.1 Options Analysed

Ergon Energy performed a detailed analysis of each Grid Comms technology/asset class and for each project evaluated other options. The options below were candidate options for each of the cases noting that not all options were analysed for each case as some of the options amounted to approximately the same proposed change.

Where appropriate additional options to those listed below were evaluated in the detailed individual cases where appropriate – eg. where replacements where not necessarily like for like and different technology replacement options existed.

Table 11 Grid Comms Replacement Options Summary

Option	Description
Accelerated program with minimal risk	Under this option, assets are replaced as soon as they reach end of product support. This minimises the risk associated with the asset which represents higher costs with minimal risks. The cost and time associated with this option would be unacceptable given that most of the assets are still operating. This option was rejected on the basis that it would not represent a balanced decision in term of weighing risk and asset performance against commercial goals. Performing wholesale proactive replacement of all obsolete Grid Comms assets based on age, condition and vendor support removal as an alternate to the proposed approach that replaces a smaller subset however the program was grossly ($274M) more expensive than the proposed program and was rejected.
(Previous) Targeted risk-based replacement	Under this option, assets are not replaced immediately after the end of product support as per Option 1. Instead, this option seeks to manage risks and costs associated with provision of Grid Comms services by permitting obsolete equipment to remain in service after the end of support if they are still in good condition and replace with a modern equivalent ahead of in-service failure in more critical locations as a priority. In most cases recovered assets can then be repurposed as spares to extend the life of the remaining fleet.
(Revised) Multi-faceted proactive approach	This is the revised proposed option which allows for reduction of cost through proactive replacement of assets based on allowing for a failure rate of equipment to not increase from the current observed trends. This option allows the obsolete Grid Comms assets to continue to remain in service without significant change to ultimately extend the life of the existing infrastructure. Additionally, this option includes the necessary standards development work to validate compatibility and integrate the latest revisions of manufacturers equipment into the network to reduce costs associated with reactive replacements for failed in service deployments and to maintain software currency on equipment to resolve bugs, improve stability, patch security vulnerabilities, maintain vendor support and ultimately extend the life of the asset.
AER Proposed Program	This option is accepting the AERs 37% reduction in the program and reducing the quantity of proactive asset replacements. In many cases this resulted in proactive replacements beingless than forecasted failure rates and requiring additional reactive replacement expenditure to cover the fail-fix where spares would not be available.

Counterfactual – Reactive Only	The counterfactual considers the continued use of the current infrastructure platform beyond its useful asset life. This means that only remedial/restoration of services will be funded through operating costs, with no capital investment in minor and major upgrade and/or replacement of the infrastructure.

5.1.2 Cost Summary

The asset lifecycle and replacement strategy are evaluated on a per technology/asset class basis, considering the specific circumstances and objectives of each system that is divided into multiple projects to address differing needs, priorities and completion timings.

The following table lists the cost summary for each option analysed for the replacement program. Further detail and supporting information can be found in each individual case.

"GRID COMMS" Project Title	Wholesale Replace	Original Proposal	AER Draft Decision	Revised Proposal
SDH Replacement Edge and SDH Replacement Core	42.0M	8.60M	5.43M	**7.64M**
PDH Replacements	26.0M	4.05M	2.56M	**2.56M**
Microwave Radio Core Replacements	17.0M	4.00M	2.52M	**4.00M**
Microwave Radio Edge South West and Wide Bay	24.7M	4.83M	3.05M	**4.83M**
Microwave Radio Edge Capricornia and Mackay Replacements	12.6M	2.71M	1.71M	**2.71M**
Microwave Radio Edge North Queensland and Far North Replacements	19.2M	4.24M	2.68M	**4.24M**
Operational Support Systems Replacements	3.98M	3.99M	2.52M	**3.99M**
Operational Voice Replacements	2.0M	2.03M	1.28M	**2.02M**
P25 Replacement Edge South	16.6M	5.55M	3.50M	**2.39M**
P25 Replacement Edge North	17.7M	4.92M	3.10M	**2.12M**
Core IP MPLS Ethernet Replacements	2.3M	1.36M	0.86M	**1.36M**
Data Centre Ethernet Replacements	10.0M	4.37M	2.76M	**4.37M**
Edge Router Replacements	22.0M	3.67M	2.32M	**3.25M**
Fringe Network Replacements	15.0M	0.87M	0.55M	**0.69M**
Building Replacements	4.87M	3.91M	2.47M	**2.47M**
AC Systems Replacement	7.55M	4.94M	3.12M	**4.40M**
Structures Replacements	2.09M	1.59M	1.00M	**1.00M**
DC Systems Replacements	12.3M	4.94M	3.12M	**4.94M**
Auxiliary Infrastructure Replacements	2.90M	2.54M	1.60M	**1.60M**
Linear Aged Replacements	9.0M	4.68M	2.95M	**2.95M**
Totals	274M	77.77M	49.08M	**63.52M**

5.2 Augmentation Program

5.2.1 Options Analysed

Below is high level summary of options considered with further information and details found in the individual revised project cases.

Table 12 Grid Comms Augmentation Options Summary

Option	Option Description
Change program size or alternate solution	Various options were considered in each of the separate investments. Predominately the options involved either using a different technology to solve the issues or changing the threshold of issues to be address and looking at the impact to risk and costs. For cases where different technologies were proposed to resolve issues, the costs to implement the alternative solutions varies from equivalent costs to many times the cost of the proposed option. For cases where there were equivalent costs, other risk factors drove the decision to use the proposed solution. For cases where the use of other solutions was not feasible then the level of issues to be addressed was considered and varied (beyond what has already been done to achieve a suitable NPV or the best possible outcome for cases that only came out negative for NPV) and in most cases were rejected as the expenditure was excessive.
(Original) Targeted program	In this option of a strategic targeted program to address known issues with reliability, capacity and coverage in key locations that represents the most benefit and leverages existing deployed technologies and standard solutions to ensure prudent expenditure.
AER Proposed Program	The AER Proposed program accepted 9 of the 11 projects with the two projects not accepted being: • Reliability Core MPLS and Fibre • Reliability Edge Fringenet and Backhaul
(Revised) Targeted program	Following AER feedback Ergon has since revised the two Reliability cases not accepted to include changes such as: • Further options analysis to evaluate multi technology options. • Reduction of scope including removal of Reliability FringeNet and Fibre projects completely. • Targeted those sites of higher priority which have had previous known poor performance and or are in higher risk due to service impacts.
Counterfactual – Reactive Only	The counterfactual for AUGEX programs considers simply allowing the issues that currently exist and that are emerging or are increasing to continue without programs to mitigate. The counterfactual option is considered as unacceptable for the cases presented, as existing limitations / arrangements are impacting the organisation's efficiency and exposure to risk that could be mitigated via the programs proposed.

5.2.2 Cost Summary

The original Grid Comms augmentation program proposed an expenditure of 21.31M. The AER draft decision accepted all the Grid Comms augmentation projects with exception of two projects highlighted in blue below.

Ergon has since revised these two cases and submitted a revised augmentation program totalling $16.84M. The two cases have been updated to include further supporting information.

Technology Type	"GRID COMMS" Project Title	Original Proposal	AER Draft Decision	Revised Proposal
IP Network & Linear Media	Reliability Core MPLS and Fibre	**4.64M**	**0.00M**	**1.62M**
	Reliability Edge Fringenet and Backhaul	**2.98M**	**0.00M**	**1.49M**
	Capacity Upgrade Fibre and Capacity Upgrade DO WAN	5.65M	5.65M	5.65M
	Operational Enhancement	1.53M	1.53M	1.53M
	Reliability Isolated Systems	1.49M	1.49M	1.49M
	Digital Enablement	0.39M	0.39M	0.39M
P25 Radio Systems	P25 Coverage South West	1.31M	1.31M	1.31M
	P25 Coverage Far North	1.31M	1.31M	1.31M
	P25 Reliability Upgrade	0.69M	0.69M	0.69M
	P25 Coverage Capricornia	0.65M	0.65M	0.65M
	P25 Capacity Upgrade	0.68M	0.68M	0.68M
	Total	**21.3M**	**13.69M**	**16.84M**

6 NPV ANALYSIS

The NPV analysis of various different options has been modelled under each individual project with benefits realised through proactive project delivery calculated.

Below is summary of the NPV analysis for the preferred option for each revised case that's requesting an investment value different to the AER's Draft Decision with the resulting NPV calculated being $5.29M.

Table 13 REPEX NPV analysis

"GRID COMMS" Project Title	NPV	Discount rate		Benefits	
		2.5%	4.5%	75%	125%
AC Systems Replacement	$860,541	$1,202,698	$573,910	-$277,945	$2,000,489
P25 Replacements	$179,261	$380,633	$10,408	-$817,879	$1,199,962
SDH Replacement Edge	$85,118	$173,905	$7,807	-$655,107	$825,343
SDH Replacement Core	$46,569	$152,002	-$45,041	-$855,872	$949,009
Data Centre Ethernet Replacements	$14,349	$102,861	-$61,304	-$1,008,135	$1,186,974
Operational Support Systems Replacements	$413,789	$550,755	$291,500	-$570,546	$1,398,125
Fringe Network Replacements	$52,150	$88,354	$21,315	-$107,251	$211,551
MW Radio Core	$684,131	$933,441	$471,404	-$329,930	$1,698,193
Microwave Radio Edge Capricornia and Mackay Replacements	$459,208	$627,627	$315,517	-$226,512	$1,144,928
Microwave Radio Edge South West and Wide Bay	$1,034,369	$1,356,670	$758,615	-$241,947	$2,310,684
Microwave Radio Edge North Queensland and Far North Replacements	$779,228	$1,049,027	$548,825	-$309,189	$1,867,646

Edge Router Replacements	$423,586	$580,235	$287,764	-$456,493	$1,303,666
DC Systems Replacements	$82,489	$283,533	-$88,817	-$1,018,238	$1,228,283
Core IP MPLS Ethernet Replacements	$95,933	$141,095	$57,534	-$200,545	$392,411
Operational Voice Replacements	$81,505	$134,482	$36,392	-$346,186	$509,195
Totals	**$5,292,227**	**$7,757,317**	**$3,185,828**	**-$7,421,775**	**$18,226,458**

The resulting NPV value calculated for the entire GRID COMMS augmentation program was $0.19M.

Table 14 AUGEX NPV analysis

"GRID COMMS" Project Title	NPV	Discount rate		Benefits	
		2.5%	4.5%	75%	125%
Reliability Core MPLS	$70,923	$117,564	$30,213	-$377,436	$620,530
Reliability Edge Backhaul	$123,961	$174,551	$79,631	-$442,306	$943,349
Totals	**$194,884**	**$292,115**	**$109,844**	**-$819,742**	**$1,563,879**