Grid Comms Reliability Edge Fringenet and Backhaul AUGEX Ergon

Justification Statement

18/ 10/ 2024

ERGON ENERGY NETWORK
Part of Energy Queensland

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DOCUMENT VERSION

Version Number	Change Detail	Date	Updated by
1.0	Approved Version	15/11/2024	General Manager Grid Technology

1 SUMMARY

Title	Grid Comms Reliability Edge Fringenet and Backhaul
DNSP	Ergon Energy
Expenditure category	☐ Replacement ☒ Augmentation ☐ Connections ☐ Non-network
Identified need *(select all applicable)*	☐ Legislation ☒ Regulatory compliance ☒ Reliability ☐ CECV ☒ Safety ☐ Environment ☐ Financial ☒ Other This program will target reliability improvements of Edge network transmission components, specifically leveraging extension of the MLPS diversity capability, diverse paths from new 3rd party carrier extensions and migration of poorly performing 3rd party services to more reliable carriers.
Expenditure	**Year** | **2025-26** | **2026-27** | **2027-28** | **2028-29** | **2029-30** | **2025-30** $m, direct 2022-23 | $0.297M | $0.297M | $0.297M | $0.297M | $0.297M | $1.49M
Benefits	Improved reliability and network control as a modern Distribution Network Service Provider (DNSP) with a more dynamic and resilient network.

2 PURPOSE AND SCOPE

This document recommends the optimal capital investment necessary to provide suitable network reliability upgrades to the Edge of the Ergon Energy network to enable the increased reliability in Edge network transmission.

This is a preliminary business case document and has been developed for the purposes of seeking funding for the required investment in coordination with the Ergon Energy 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 investment governance processes. The costs presented ($1.49M) are in (2022/23) direct dollars.

3 BACKGROUND

3.1 Asset Population / Site Summary / Capability

Ergon Energy's Telecommunications Network Assets enable mission critical real-time voice and data communications to allow automation, remote monitoring and control of the power network,

enable ability to co-ordinate safe and efficient work activities as well as extend the reach of corporate information systems across a common infrastructure.

These network assets largely operate at the Data Link, Network and Transport OSI layers and comprises assets including Internet Protocol (IP) network routers and switches, microwave radio links, Time Division Multiplexing (TDM) equipment, Cellular Modems, Operational Support Systems (OSS), and Mobile P25 Digital Radio and Fixed IP Telephony systems.

There is an ongoing need for assessment and evaluation of current and future needs of the telecommunication network to meet the growth of the network reliability, capacity and coverage requirements.

Ergon Energy is aware of the need to efficiently and effectively plan, operate and maintain the telecommunications network to ensure delivery of services to the business.

The comms network asset types are separated into three levels of importance as categorised below based on the criticality to the business should they fail:

- *High* – Multiple services on Critical or Core infrastructure. These assets typically provide carriage for very large volumes of telecommunications services. Examples include assets that form part of the network core that should it fail will cause significant widespread business disruption or loss of control or functional capability of business systems.
- Medium – Multiple services on a Core or Distribution network device that should it fail will cause moderate regionalised business disruption.
- Minor – Typically only single service on an Access or Edge network device that should it fail will have minor low level localised business impacts affecting a single site or service.

This specific program will target reliability improvements of Edge network transmission components at a *Medium to Low* level of importance, specifically leveraging extension of the MLPS diversity capability, diverse paths from new 3rd party carrier extensions and migration of poorly performing 3rd party services to more reliable carriers.

The program aligns with EQL strategic plan and underpins “Powering Tomorrow” initiative by enabling a more reliable smart grid network to support operational excellence and improve customer experience.

3.2 Asset Failure / Performance Issues

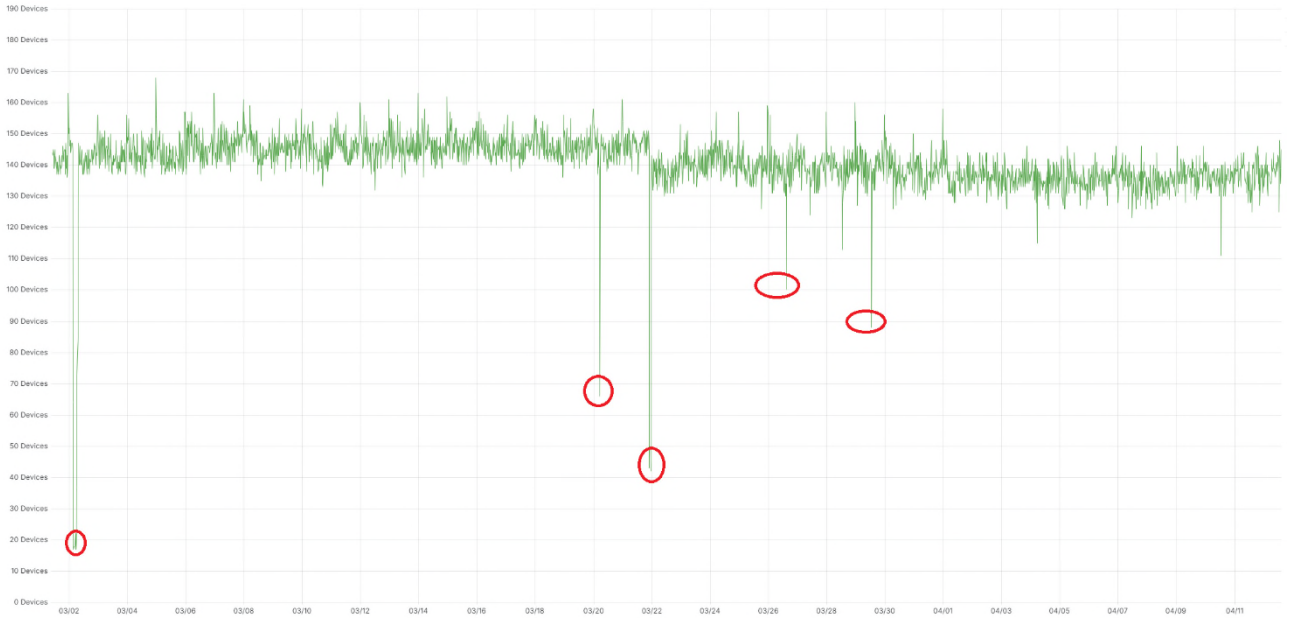
This program is targeting reliability issues in relation to edge components in the network with no current alternate/redundant paths for underlying protection, SCADA, OT and Corporate data services.

These edge sites leverage a number of technology types to provide connectivity to the larger Ergon Energy network, including fibre, microwave, narrowband radio’s, cellular & satellite. The majority of these edge sites only have a single backhaul connection configured with no or minimal redundancy and in a “Spur” topology which makes them susceptible outages and some for extended periods due to the remoteness of these sites. In addition to this many sites utilise 3rd party carriers services which do not have any Service Level Agreements for performance and restoration.

The below provides performance details of some of the deployed technologies.

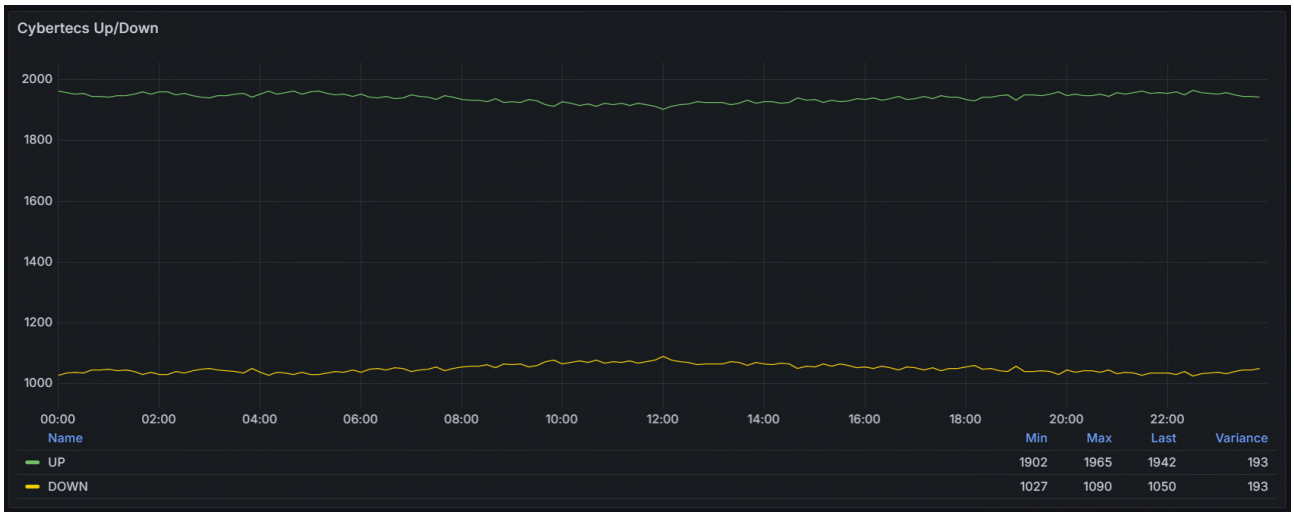
Satellite Connected Sites

The performance graph below highlights the ongoing performance issues experienced by our sites with Satellite communications whereby frequent large outages are experienced to the entire fleet; It shows the availability performance of sites over a 60 days and specifically shows 5 significant outages (worst case to the left of the graph shows only 20 of the approx. 165 sites remained contactable during the outage) in that period. It also shows that approximately 10.1% of the fleet experience daily communications interruptions.



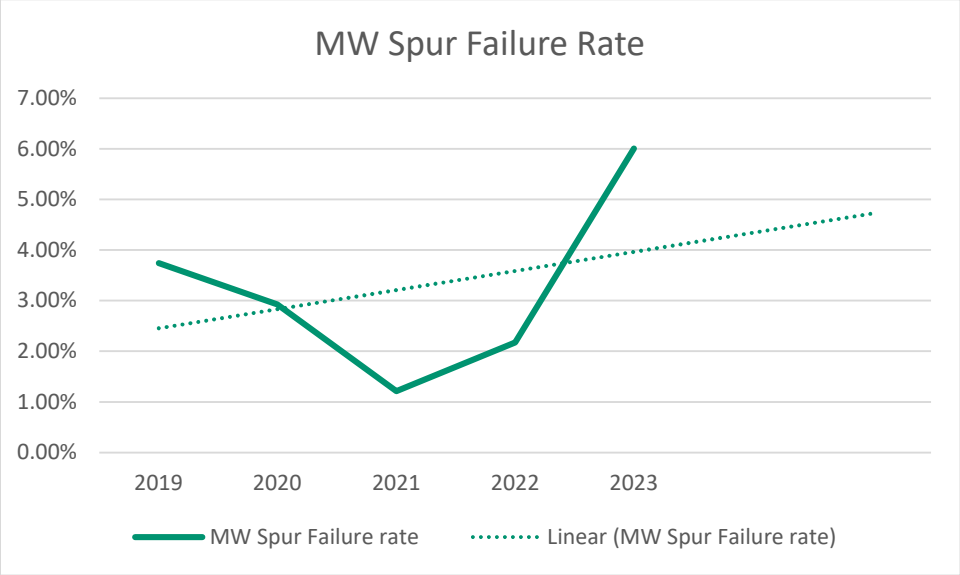
Cellular Connected Sites

The performance graph below 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 outages, network congestion and actual equipment failures. These cellular connected devices include substations, discreet electrical assets such as reclosers, sectionalises, Line Fault Indicators etc.



Spur Microwave Links

Below is a graph of failure rates experienced on “Spur” microwave links. These services are susceptible to a number of failure events including severe weather events (cyclones etc) and equipment failures, with an observed average service restoration time of 39hrs per event.

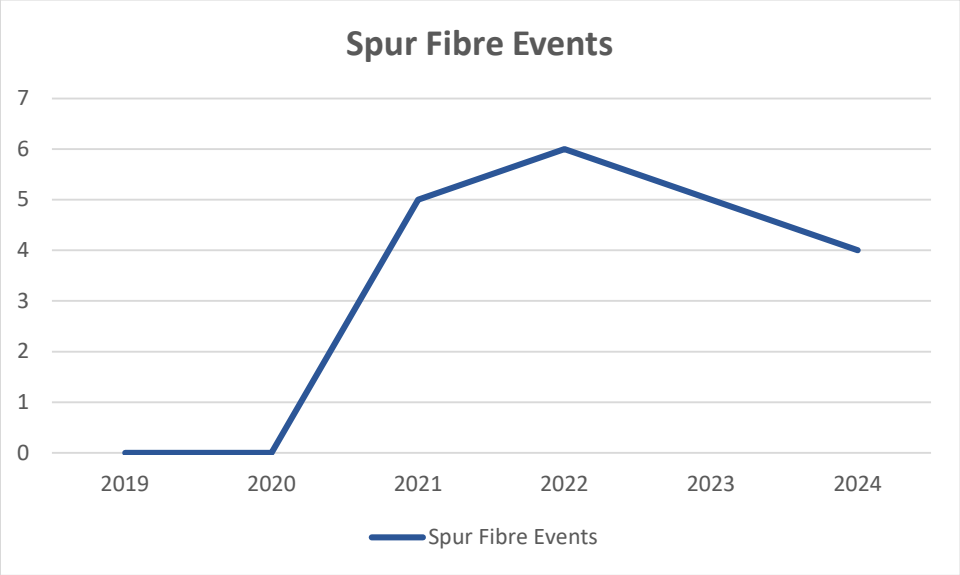


Spur Microwave Failure Rate

The majority of the Edge microwave assets are utilising EoL assets with a current asset failure rate of 3.2% per annum. This rate is expected to increase over time and will impact these Edge spur backhaul links.

Spur Fibre Links

Below is a graph of failure rate experienced on “Spur” fibre links. These links are susceptible to a number of failure events including failed individual cores, Fibre Creep, Joint failure, severe weather events (cyclones etc) damaging cable / fittings and line driver / multiplex and routing / switching equipment failures, with an observed average service restoration time of 93.8hrs .



Spur Fibre Outage Events

Example Fibre Spur Outage – Memooloo SS to Blackwater SS

The spur fibre link was impacted in February 2024 with fibre cable damage repair works impacting all services for 5 days. During this period there was a complete outage on SCADA for the connected substations.

This single fibre spur failure impacted the below services during this period:

- 2 substation SCADA services (~44MW Load)
- OT & Corporate data services

4 IDENTIFIED NEED

4.1 Summary

This program seeks to improve the reliability of the comms network by implementing enhanced communications equipment that can take advantage of existing redundancy and by adding redundant comms links removing single points of failure. The program will also change off poorly performing third party services onto newly available service offerings in the market. This will improve the performance of the underlying comms services for protection, SCADA, Corporate Depot data, substation voice communications, pole mounted recloser comms performance and a range of other services. Cost savings will be achieved in avoided lost productivity, loss of control of substations when SCADA links are down and reduction in risk associated with protection services not operating.

This program enables the safe, effective and efficient operation of the electrical network enabling reliability improvements for remote operation and monitoring of electrical assets and depot communications with alternate backhaul.

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 business case safety, reliability and program of work efficiencies are strong drivers, based on the continuing focus of reliability improvements on Edge network infrastructure.

- Deploy standard IP/MPLS nodes to improve reliability for the Edge network in locations with SDH/MST rings or microwave ring topology:
    - The Core network has been extending MPLS to the edge of the network which has enabled the ability to leverage the improved diversity with the reduction of Layer 2 spanning tree protocols for diversity and redundancy options.
    - There are numerous microwave ring topology networks which current utilise STP for diversity switching, implementing MPLS to the edge of these network areas will provide a more robust and reliable diversity ring topology which shall improve reliability in these areas of the network.
- Implement diverse distribution paths via newly introduced 3rd party alternate transmission capacity, (eg. PLQ, QR, NBN, Telstra etc) including some additional standard IP/MPLS deployments:
    - With the continued expansion of 3rd party carrier networks additional redundancy is able to be leveraged to enable improved capacity and reliability with minimal infrastructure increase from Ergon Energy. The carrier expansions provide the ability to provide logical ring topology for current spur routes in the network.
    - Deployment of standard IP/MPLS deployments leverages the improved reliability / redundancy options available.
- Migration of poorly performing Cellular / Satellite connected field devices (ACR's, Sectionaliser / LBS) to alternate cellular carriers and trial dual carrier integration.
    - In addition to the distribution network, edge services are delivered by low capacity 3rd party services such as cellular and satellite which can have significant network reliability fluctuations due to the nature of these network types. With alternate carrier coverage continually changing, alternate solutions can be leverage to increase reliability to existing electrical network infrastructure.

Reliability Improvement Summary

Description of Work	Site / Link Upgrades	Reliability Improvement Site Qty
Deploy standard IP/MPLS nodes to improve reliability for the Edge network for SDH / MST ring topology.	3 sites	6 sites (Multiple Regions)
Implement new transmission capacity from 3rd party at Biloela SS and evaluate potential fibre build to Biloela Depot to facilitate additional diversity Mt Murchison and subsequent sites.	2 sites	5 sites (CA region)

Implement new transmission capacity from existing 3rd party carriers to provide alternate path for end of spur / single point of failure / poor performing sites to improve reliability, some locations also requiring standard IP/MPLS node deployment	7 sites	48 sites (Multiple Regions)
Implement new transmission capacity from existing 3rd party carriers to provide alternate path for end of spur & poor performing sites to improve reliability, additional fibre build components required at Kidston.	1 sites	2 sites (FN Region)
Implement alternate cellular / satellite services for poor performing critical fringe ACR / LBS / REG site and trial dual SIM connected devise to improve reliability.	12 sites	12 sites (Multiple Regions)

Do Nothing' counterfactual approach, if this program does not implement the recommended reliability improvements in the network infrastructure we will see no reduction in the number of emergency restoration activities with associated extended outages impacting Protection, SCADA, OT & Corporate data services that we currently experience. These outages are more significant in the remote locations often well over 24 hours before services are restored. Improvements in reliability at these remote locations will reduce the impact to planned works programs and associated resourcing issues.

This has various observed impacts:

- **Reliability:** Extended outage on impacting multiple services and locations whilst emergency repairs are undertaken.
- **Protection:** Loss of ability for communication protection schemes to operate during the extended outage period whilst repairs are being undertaken.
- **SCADA:** Loss of ability for control of substation during the extended outage period whilst repairs are being undertaken.
- **Business:** Extended outage on OT, Voice and corporate data services during the extended outage period whilst repairs are being undertaken.

4.2 Options Considered

Ergon Energy has evaluated a number of options to determine the most suitable solution to for reliability improvements at the Edge of the network. These options are summarised in the table below with more details in the subsequent section.

Option	Site Technology Distribution			Total Cost	OPEX /annum	NPV
	Fibre / PLQ / Other Backhaul	Satellite & Cellular	Total Sites			

Option 1A (Original) – Multi Technology *Utilises all available standard technology solutions*	13	22	35	$1.82M	$118k	$0.076M
Option 1B (Preferred) – Multi Technology (reduced scope) *Utilises all available standard technology solutions*	13	12	25	$1.49M	$76k	$0.123M
Option 1C – Multi Technology (Expanded scope) *Utilises all available standard technology solutions*	35	22	57	$4.0M	$152k	-$1.3M
Option 2 – Sat & Cellular *Utilises only Satellite & Cellular standard technology solutions*		25	25	$0.587M	$112k	$2.2k
Option 3 – Do Nothing *Reactive works only @ failure rate of 4% of edge assets year (Edge MW are 40% of MW assets)*			30	$11.475M	$0	-$9.673M

4.2.1 Option 1A – Multi Technology (Original Option)

This option is to implement standard solutions for diverse backhaul in Edge portions of the network for those spur links which have multiple sites / services which could be impacted by a single backhaul failure.

Priorities will be allocated to potential risk of failure due to service criticality and transport medium.

These solutions will be implemented with standard multi-technology approach to provide the most cost-effective solution for the applicable links and mitigating the risk of a single backhaul failure impacting all services to a specific site.

4.2.2 Option 1B – Reduced Program (Preferred Option)

This option will implement the same strategy as Option 1A however the scope of sites will be reduced due to other recently developed standards (COTE WAN solution) and product developments which has impacted the site selections from the original proposal.

The site priorities will target those links which have had previously known poor performance and or are at a higher risk due to service impact's, an example would be links with protection services, multiple substation SCADA or strategic electrical asset.

4.2.3 Option 1C – Multi Technology (Expanded scope)

Ergon Energy considered implementing the same solution at all Edge sections in the network suffering reliability issues however as this cost would have been in excess of $4M this option was rejected.

4.2.4 Option 2 – Satellite / Cellular Technology Solution

Ergon considered a single technology solution approach to manage the reliability issues however this was not practical with application to the variation of services being supported, eg. Protection cannot be supported over a Cellular / satellite network which is the most cost-effective solution. Alternatively, fibre implementation is cost prohibitive at the majority of these edge sites with microwave being the most suitable technology to implement due to cost.
Similarly, requirements for duplicate and diverse communications paths would rule out a duplicate microwave link due to adverse weather impacts at common ends of microwave links.

A revised solution with Satellite / cellular backhaul has been assessed with reduction of alternate services to support protection removal of other 3rd party carrier options such as Powerlink.

4.2.5 Option 3 – Counterfactual (Do nothing)

This program would be intended to be purely reactive with no mitigation of risk for failure of equipment and subsequent services due to single backhaul connection to the Ergon Energy network. This means that only restoration of services will be funded through operating costs, with no capital investment in minor or major upgrades of the network infrastructure.
The current failure rates of microwave equipment 3.2% & are expected to increase over the next AER period as over 89% of this backhaul equipment is EoL & EoS.
These failure of spur components of the Edge network make up approximately 50% of the microwave network Edge assets. With projected failures of 52 failures projected over 5 years from total edge assets it would be expected 30 of these would be from the spur area's of the network. The restoration of these would be expected to cost at least 2.5 times to restore due to end of sale of asset.

Whilst the counterfactual option will cost nothing initially, the required effort and associated cost to restore the services at location with significant travel time will significantly increase the outage durations and impact to services:

- Customer impacts – extended outages for corporate OT, voice and data services potentially impacting deports and offices, which would equate into reduce efficiency of impacted depot / office staff.
- Loss of control of substations for extended period (duration asset replacement at remote location with significant travel time could be in excess of 10 to 24 hours)

- Loss of protection scheme / schemes for extended periods (duration asset replacement at remote location with significant travel time could be in excess of 10 to 24 hours)
- Service restoration costs - additional costs associated with minimising the service impacts by replacing suspected faulty devices or implementing interim solutions to maintain or improve network connectivity.

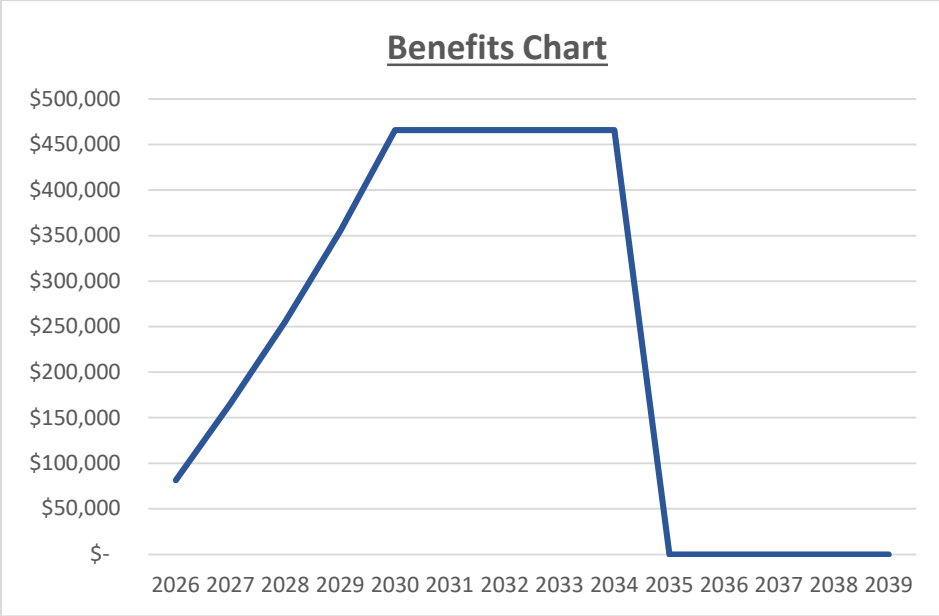
4.3 Risks

The risks addressed under this business case primarily address the reliability of Ergon Energy Edge backhaul connections.

Table below outlines the risk assessment for the counterfactual scenario with no proactive program in place to address reliability issues.

Risk Scenario	Description of Risk
Multi hop microwave link spur has a catastrophic failure of a structure / asset impacting all downstream sites and services, no end of spur alternate route available	Emergency construction required to restore services. Extended outage for duration of works, significant delays in construct due to effort required and availability of materials and people resources. Potential to impact multiple substation controls / OT data / corporate IT services during the outage period. Reactive works to implement planned program would require twice the effort and resources.
Poor 3rd party carrier coverage impacting critical control and monitoring of electrical asset with multiple cellular failure across the state impacting multiple assets.	Inability to effectively control electrical asset, potential impacting customer service restorations / safety. 10 event per year requiring staff to manually operate network assets – 80hrs/annum
Vehicle impact an electrical network pole during network outage. Protection and SCADA impacted by delays in restoration of network outage, resulting in a fatality or a serious injury.	A vehicle impacts a pole during network outage, with no SCADA to substations due to inability to reroute network services, results in a fatality or a serios injury, very low likelihood.
Failure of single backhaul link for small regional depot impacts productivity of all depot staff.	Impacting efficiency of 4 staff for 8 hours with a yearly 50% probability
No alternate network route available, major carrier outage / muti hop microwave link outages to multiple substation / network sites, all services cannot be returned to service till cellular returns / microwave links are repaired. Extended outage, Power Network fault and issue delays restoration to customers.	Emergency design and construction required to restore services causing an extended outage. Delays in service restoration totalling 20 hours of half an average 22kV feeder (1000kW) with an assumed VCR of $52 per kwh with a likelihood of 15% p.a.

The table below outlines the cost benefits which have only been modelled over the estimated asset life of 9 years of the equipment with the shortest asset life.



5 ECONOMIC ANALYSIS

5.1 Cost summary 2025-30

Table 1 Cost summary 2025-30

Options	2025-26	2026-27	2027-28	2028-29	2029-30	Total 2025-30
Option 1A	$363,621	$363,621	$363,621	$363,621	$363,621	$1,818,104
Option 1B	$297,800	$297,800	$297,800	$297,800	$297,800	$1,489,000
Option 1C	$801,200	$801,200	$801,200	$801,200	$801,200	$4,006,000
Option 2	$117,500	$117,500	$117,500	$117,500	$117,500	$587,500
Option 3	$2,295,000	$2,295,000	$2,295,000	$2,295,000	$2,295,000	$11,475,000

We have modelled the costs and benefits in our NPV in the way we would deliver the program absent of any deliverability constraints. The investments have been phased for deliverability in the capex model, and so there will be some differences in the capital cost phasing. This phasing does not change the preferred option for this investment.

5.2 NPV analysis

The resulting NPV value calculated for the proposed program was $123,961

Table 2 NPV analysis

	Discount rate		Benefits		
Options	**2.5%**	**4.5%**	**125%**	**75%**	**NPV**
Option 1A	$131,004	$28,385	$953,002	-$547,485	$76,198
Option 1B	$174,551	$79,631	$943,349	-$442,306	$123,961
Option 1C	-$1,319,962	-$1,313,492	-$329,962	-$2,054,995	-$1,319,039
Option 2	$21,665	-$14,607	$601,223	-$343,607	$2,248
Option 3	-$10,148,413	-$9,225,976	-$9,673,080	-$9,673,080	-$9,673,080

APPENDICES

5.3 Appendix 1: Alignment with the National Electricity Rules

Table 3 Recommended Option's Alignment with the National Electricity Rules

NER capital expenditure objectives	Rationale
A building block proposal must include the total forecast capital expenditure which the DNSP considers is required in order to achieve each of the following (the capital expenditure objectives):	
6.5.7 (a) (1) meet or manage the expected demand for standard control services over that period	
6.5.7 (a) (2) comply with all applicable regulatory obligations or requirements associated with the provision of standard control services;	As indicated in section 4, this proposal supports achieving safety obligations, reliability obligations and protection requirements by providing an appropriate, economically efficient program of works to improve communications services.
6.5.7 (a) (3) to the extent that there is no applicable regulatory obligation or requirement in relation to: (i) the quality, reliability or security of supply of standard control services; or (ii) the reliability or security of the distribution system through the supply of standard control services, to the relevant extent: (iii) maintain the quality, reliability and security of supply of standard control services; and (iv) maintain the reliability and security of the distribution system through the supply of standard control services	This program of work improves the integrity of communications functions that support SCADA, protection, voice and data communications systems. They are critical in the provision of network reliability in support of MSS and safety net security and reliability targets.
6.5.7 (a) (4) maintain the safety of the distribution system through the supply of standard control services.	This program of work improves the integrity of communications functions that support SCADA, protection, voice, and data communications systems. They are critical in ensuring safety through correct protection operation, and through the availability of voice and data communications.
NER capital expenditure criteria	**Rationale**
The AER must be satisfied that the forecast capital expenditure reflects each of the following:	
6.5.7 (c) (1) (i) the efficient costs of achieving the capital expenditure objectives	The options considered in this proposal take into account the need for efficiency in delivery. The preferred option has utilised a delivery approach that provides for bundling of work in terms of both timing and geography to enable a lower cost delivery compared to other options. It generally avoids emergency replacements that incur higher costs by enabling efficient use of labour resources in the delivery of the work programs. Specialised contractors are utilised as appropriate to ensure that costs are efficiently managed through market testing. Cost performance of the program will be monitored to ensure that cost efficiency is maintained.

NER capital expenditure objectives	Rationale
	The unit costs that underpin our forecast have also been independently reviewed to ensure that they are efficient (Attachments 7.004 and 7.005 of our initial Regulatory Proposal).
6.5.7 (c) (1) (ii) the costs that a prudent operator would require to achieve the capital expenditure objectives	The prudency of this proposal is demonstrated through the options analysis conducted. The prudency of our CAPEX forecast is demonstrated through the application of our common frameworks put in place to effectively manage investment, risk, optimisation and governance of the Network Program of Work. An overview of these frameworks is set out in our Asset Management Overview, Risk and Optimisation Strategy (Attachment 7.026 of our initial Regulatory Proposal).
6.5.7 (c) (1) (iii) a realistic expectation of the demand forecast and cost inputs required to achieve the capital expenditure objectives	NA

5.4 Appendix 2: Reconciliation Table

Table 4 Reconciliation

Expenditure	DNSP	2025-26	2026-27	2027-28	2028-29	2029-30	2025-30
GRID COMMS Reliability Edge Backhaul	Ergon	$0.297M	$0.297M	$0.297M	$0.297M	$0.297M	$1.49M

5.5 Appendix 3: Example Networks