



Maintaining Reliability of Supply to Kamerunga, Cairns and Northern Beaches area

Project Assessment Conclusions Report



Preface

Powerlink Queensland is a Transmission Network Service Provider (TNSP) that owns, develops, operates and maintains Queensland's high-voltage electricity transmission network. The network transfers bulk power from Queensland generators to electricity distributors Energex and Ergon Energy Corporation Limited (Ergon Energy), part of the Energy Queensland Group, and to a range of large industrial customers.

Ergon Energy is a Distribution Network Service Provider (DNSP) and manages an electricity distribution network which supplies electricity to more than 765,000 customers, spanning one million square kilometres, which accounts for 97% of the state of Queensland. Ergon Energy's electricity network consists of approximately 160,000 kilometres of powerlines and one million power poles, along with associated infrastructure such as bulk supply and zone substations. Ergon Energy also own and operate 33 stand-alone power stations that provide supply to isolated communities across Queensland which are not connected to the main electricity grid.

This Project Assessment Conclusions Report has been prepared in accordance with version 254 of the National Electricity Rules (NER), and the Regulatory Investment Test for Transmission (RIT-T) [Instrument](#) (November 2024) and RIT-T [Application Guidelines](#) (November 2024). The RIT-T Instrument and Application Guidelines are published and administered by the Australian Energy Regulator (AER).

The NER requires Powerlink to carry out forward planning to identify future reliability of supply requirements, which may include replacement of network assets or augmentation of the transmission network. Powerlink must then identify, evaluate and compare network and non-network options (including, but not limited to, generation and demand side management) to identify the preferred option which can address future network requirements at the lowest net cost to electricity customers.

Powerlink also has obligations under the NER to address power system security requirements identified by the Australian Energy Market Operator in its annual [Transition Plan for System Security](#).

Under the NER, TNSPs and DNSPs must conduct joint planning to determine the needs of the networks and potential efficient solutions to these and allow for the undertaking of a RIT-T or Regulatory Investment Test for Distribution (RIT-D) for proposed projects. As the lead party for this engagement is Powerlink, the RIT-T would be the more suitable instrument. Ergon Energy's responsibility and obligations to undertake a RIT-D can be satisfied via the RIT-T for the joint planning project.

This document provides details of the identified risks and need associated with this project. It also provides information on credible options, categories of market benefits likely to impact the ranking of credible options and recommends the preferred option for implementation.

More information on how Powerlink applies the RIT-T process is available on Powerlink's [website](#).

A copy of this report will be made available to any person within three business days of a request being made. Requests should be directed to the Manager Network and Alternate Solutions by phone ((07) 3860 2111) or email (networkassessments@powerlink.com.au).

Disclaimer

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Powerlink acknowledges the Traditional Owners and their custodianship of the lands and waters of Queensland and in particular, the lands on which we operate. We pay our respect to their Ancestors, Elders and knowledge holders and recognise their deep history and ongoing connection to Country.

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Executive Summary

Powerlink has identified the need to maintain reliability of supply to Kamerunga, Cairns and the northern beaches area due to the deteriorating condition and obsolescence of key transmission network assets currently providing electricity services to these areas.

Key transmission network assets located in the Kamerunga, Cairns and northern beaches area

Kamerunga 132 kilovolt (kV) Substation

Located approximately 10 kilometres (km) north-west of Cairns and established in 1976, Kamerunga Substation is a major injection point into the Ergon Energy (part of the Energy Queensland Group) distribution network. Joint planning studies confirm there is an enduring need at Kamerunga to maintain the supply of electricity in the Cairns area and meet legislative requirements.

The primary plant, transformers and secondary systems at Kamerunga Substation are nearing the end of their technical service lives with identified condition and obsolescence issues. The substation is also susceptible to major flooding events which could result in damage to equipment leading to loss of supply. Much of the substation's primary plant and transformers – the equipment through which the electrical power passes – have reached the end of their technical service lives, resulting in performance degradation and increasing the risk to supply in the Cairns area. In addition, the site has inherent design issues, including insufficient electrical clearances (currently managed through temporary measures), a single 125V Direct Current (DC) supply system and poor drainage.

Secondary systems are the control, protection and communications equipment that are necessary to operate the transmission network and prevent damage to primary systems when adverse events occur. Many of the secondary systems at Kamerunga Substation are nearing the end of their technical service lives and have become or are becoming obsolete, where they are no longer supported by the manufacturer and have only limited, or no, spares available. Under the National Electricity Rules (NER), Powerlink is required to provide sufficient secondary systems with levels of reliability to ensure the transmission system is adequately protected.

In the case of extreme flooding events (cyclones), studies have shown the substation would be inundated with 1.25 metres of water during a 1 in 100-year flood event, and 1.6 metres for a 1 in 200-year event, resulting in extensive damage to its protection and control systems. This would result in a significant risk to supply in the Cairns area.

In August 2019, Powerlink published a Project Assessment Conclusions Report (PACR) to address the emerging condition risks at Kamerunga Substation. Subsequent to the conclusion of the consultation process, Powerlink identified a material change in circumstances due to the identification of an additional credible option not included in that Regulatory Investment Test for Transmission (RIT-T), and significant cost increases across all credible options assessed. This material change in circumstance requires the reapplication of the RIT-T. The identified need considered in the earlier RIT-T has been captured within this RIT-T. In addition, this RIT-T addresses reliability and safety risks associated with the Woree to Kamerunga 132kV transmission line.

Woree to Kamerunga 132kV transmission line

The Woree to Kamerunga 132kV transmission line was first established in 1963. It is a double circuit 132kV steel tower transmission line operating in an aggressive tropical environment. The line is nearing the end of its technical service life with the majority of structures showing signs of degradation.

Joint planning studies confirm there is an enduring need to maintain the supply of electricity currently provided by these assets to Kamerunga, Cairns and northern beaches area, as well as connecting the Barron Gorge Hydro Power Station to the transmission network.

Maintaining reliability of supply to Kamerunga, Cairns and northern beaches area

The condition and obsolescence of key transmission network assets currently providing electricity services to Kamerunga, Cairns and northern beaches area present Powerlink with a range of reliability of supply, safety and compliance risks.

Powerlink must therefore take action to maintain existing electricity services, ensuring an ongoing safe, reliable and cost-effective supply to customers in the Kamerunga, Cairns and northern beaches area.

Powerlink and Ergon Energy are required to apply the relevant Regulatory Investment Tests given the credible options under consideration

The estimated capital cost of the most expensive credible option to maintain reliability of supply to Kamerunga, Cairns and the northern beaches area meet the minimum cost threshold (currently \$8 million) to apply the RIT-T process. In addition, given the credible options identified include potential works by Ergon Energy over the minimum cost threshold (currently \$7 million) for the Regulatory Investment Test for Distribution (RIT-D), this RIT-T discharges Ergon Energy from its obligation to undertake a RIT-D. The costs associated with the investments in the transmission and distribution network are included in the options considered in this RIT-T.

As the identified need for the proposed investment is to meet reliability and service standards specified within Powerlink's Transmission Authority, guidelines and standards published by the Australian Energy Market Operator (AEMO), and Powerlink's ongoing compliance with Schedule 5.1 of the NER, it is classified as a reliability corrective action under the NER. Similarly, Ergon Energy has obligations to comply with reliability performance standards specified in its Distribution Authority issued under the *Electricity Act 1994* (Qld).

This PACR is the final step in the RIT-T process to address the network, financial, safety and environmental risks associated with maintaining Powerlink's existing assets in the Kamerunga, Cairns and northern beaches area. The PACR contains the results of the planning investigation and the cost-benefit analysis of the credible option compared to a non-credible base case where the asset condition issues are managed via operational maintenance or operational measures only. The base case is used as a reference point to compare the credible option against and reflects a situation which would result in an increase in overall risk levels due to continuing deterioration of asset condition.

Powerlink has developed two credible network options to address the identified need

The table below details the credible network options and shows that Option 1 has the highest NPV relative to the base case.

Summary of Credible Options

Option	Description	Breakdown of costs (\$m, 2026)	NPV relative to base case (\$m)	Ranking
1	Rebuild of transmission line with Overhead/Underground Alignment by 2030 (Powerlink works).	163.9	4,117.4	1
	Greenfield 132kV Air Insulated Switchgear (AIS) at a new site (to be called Barron River Substation) by 2030.			
	Powerlink works include replacement of primary and secondary assets with AIS and land purchase.	96.3		
	Ergon Energy works include 22kV switchgear, building and cut-in works.	32.2		
2	Rebuild of transmission line with Underground Alignment by 2030 (Powerlink works)	178.7	4,105.4	2
	Greenfield 132kV AIS at a new site (to be called Barron River Substation) by 2030.			
	Powerlink works include replacement of primary and secondary assets with AIS, and land purchase.	96.3		
	Ergon Energy works include 22kV switchgear, building and cut-in works.	32.2		

Evaluation and conclusion

The major differences between the credible options relates to the difference in capital expenditure associated with an overhead transmission line compared to an underground cable.

- Option 1 involves the construction of an overhead/underground alignment from Woree to Kamerunga substation by 2030, and the construction of a Greenfield Air Insulated Switchgear (AIS) substation at a new Kamerunga substation site with a 2030 completion. Under Option 1, work will commence in 2027, with greenfield site establishment, overhead/underground line construction and associated commissioning works. The indicative capital cost of this option is \$292.4 million in 2025/26 prices.
- Option 2 seeks to minimise visual impacts in the project vicinity. Under Option 2, work will commence in 2027, with greenfield site establishment, underground line construction and associated commissioning works completed by 2030.

The cost-benefit analysis for this RIT-T demonstrates that Option 1 provides the highest net economic benefit in NPV terms and is therefore the preferred option.

Powerlink has undertaken a range of activities to support community engagement

Over the past five years, Powerlink has undertaken a range of activities to investigate the development of substation and transmission line replacement options. In early 2019, Powerlink commenced discussions with

relevant landholders to inform the planning of a new corridor for the overhead transmission line from Kamerunga to Redlynch.

In October 2024, Powerlink ran several community information drop-in sessions to seek feedback on the project's Draft Corridor and Site Selection Report from landholders, Traditional Owner groups, the community and other stakeholders. Since publishing the report in September 2024, further detailed studies have been underway to support finalisation of the corridor and to meet Powerlink's statutory requirements.

More information on Powerlink's community engagement, including newsletters and other resources, is available on Powerlink's [website](#).

Dispute Resolution

In accordance with clause 5.16B(a) of the NER, energy industry participants, the Australian Energy Market Commission, electricity consumers (including their representatives) may, by notice to the Australian Energy Regulator (AER), dispute conclusions made by Powerlink in this PACR in relation to:

- the application of the RIT-T;
- the basis on which Powerlink has classified the preferred option as a reliability corrective action; or
- Powerlink's assessment of whether the preferred option will have a material inter-network impact.

Notice of a dispute must be given to the AER within 30 days of the publication date of this report. Any parties raising a dispute are also required to simultaneously provide a copy of the dispute notice to Powerlink. Powerlink requests a copy of any dispute notice be sent by email (NetworkAssessments@powerlink.com.au) and marked for the attention of the Head of Legal Services.

1. Introduction

1.1. Powerlink asset management and obligations

Powerlink's approach to asset management delivers value to customers and stakeholders by optimising whole of life cycle costs, benefits and risks, while ensuring compliance with relevant legislation, regulations and standards. This is underpinned by Powerlink's corporate risk management framework, risk assessment guidelines and methodologies.

1.2. Powerlink and Ergon Energy joint planning

The objective of joint planning is to collaboratively identify network and non-network solutions to limitations which best serve the long-term interests of customers, irrespective of the asset boundaries (including those between jurisdictions).

Powerlink's joint planning framework with the Australian Energy Market Operator (AEMO) and other Network Service Providers (NSP) is in accordance with the requirements of the [National Electricity Rules](#) (NER).¹ The joint planning process results in integrated area and inter-regional strategies which optimise asset investment needs and decisions, consistent with whole of life asset planning considering Powerlink and Ergon Energy (part of the Energy Queensland Group) electricity transmission and distribution needs in the area. This process is where the load reliability need for Kamerunga, Cairns and its northern beaches was assessed, options developed and the proposed solution recommended.

In general, joint planning seeks to:

- understand the issues faced by the different network owners and operators;
- understand existing and forecast network limitations between neighbouring NSPs;
- help identify the most efficient options to address these issues, irrespective of the asset boundaries (including those between jurisdictions); and
- influence how networks are operated and managed, and what network changes are required.

Powerlink's [Transmission Annual Planning Reports](#) (TAPRs) from 2023 onwards have identified the key assets under consideration in this Regulatory Investment Test for Transmission (RIT-T) were being addressed as a joint planning project.

1.3. Overview of the Regulatory Investment Test for Transmission

The purpose of a RIT-T is to identify the preferred investment option that meets the identified network need. The preferred option maximises the present value of economic benefit. If the identified need is for a reliability corrective action, the preferred option may have a net economic cost.²

Powerlink applies the RIT-T to potential prescribed (regulated) investments in the transmission network where the estimated capital cost of the most expensive option exceeds \$8 million.³

Powerlink commenced this RIT-T with publication of a Project Specification Consultation Report ([PSCR](#)) on 18 December 2024. Powerlink did not receive any submissions on the PSCR and, in March 2026, issued a Project

¹ National Electricity Rules (NER), clauses 5.10.2, 5.14.1, 5.14.3 and 5.14.4.

² NER, clause 5.15A.1(c) and chapter 10, glossary ('net economic benefit').

³ NER, clauses 5.15.3(a) and (b)(2) set the threshold at \$5 million. The Australian Energy Regulator's (AER) latest [cost threshold review](#) increased the value to \$8 million for three years from 1 January 2025. At the time Powerlink issued the PSCR for this RIT-T, the threshold was \$7 million.

Assessment Draft Report ([PADR](#)). The PSCR and PADR identified Option 1, involving the construction of an overhead/underground alignment from Woree to Kamerunga substation by 2030, and the construction of a Greenfield Air Insulated Switchgear (AIS) substation at a new substation site (to be called Barron River Substation) with a 2030 completion, as the preferred option. Submissions on the PADR were due to Powerlink by 8 May 2026; as no submissions were received, no additional credible options that could deliver a material market benefit have been identified via the RIT-T consultation process.

This Project Assessment Conclusions Report (PACR) is the final step in the RIT-T process to maintain reliability of supply to Kamerunga, Cairns and the northern beaches area. The PACR includes:

- a description of each credible option assessed;
- a quantification of the costs, including a breakdown of operating and capital expenditure, and classes of material market benefit for each credible option;
- reasons why Powerlink has determined that a class or classes of market benefit are not material;
- the results of Net Present Value (NPV) analysis for each credible option assessed, together with accompanying explanatory statements;
- the identification of the proposed preferred option, including details of the technical characteristics and the estimated construction timetable and commissioning date; and
- triggers to reopen this RIT-T.⁴

More information on the RIT-T process is provided in Appendix 1.

Powerlink is undertaking this RIT-T with Ergon Energy. The credible options identified include potential works by Ergon Energy that are over the minimum cost threshold (currently \$7 million) for the Regulatory Investment Test for Distribution (RIT-D). This RIT-T therefore includes consideration of investment in the distribution network and discharges Ergon Energy from its obligation to undertake a RIT-D as allowed for in the NER.⁵

1.4. Material change in circumstances

In August 2019, Powerlink published a PACR to address the emerging condition risks at Kamerunga Substation. Based on information received subsequent to the conclusion of the 2019 consultation process, Powerlink identified a material change in circumstances has occurred for that RIT-T due to:

- the identification of an additional credible option not assessed under the RIT-T; and
- significant cost increases across all credible options assessed under the cost-benefit analysis.

The material change in circumstances requires reapplication of the RIT-T.⁶ Given this and:

- emerging transmission line structural corrosion risks between Woree and Kamerunga substations;
- the expected project delivery timing of the proposed options to address the condition risks of the primary plant and secondary systems at Kamerunga Substation; and
- based on network connectivity, the common identified need to maintain reliability of supply and provide electricity services to the area

there is an opportunity to identify and assess new credible options. This also enables identification of a proposed preferred option under the RIT-T, as part of an integrated solution to maintain reliability of supply to the Cairns northern beaches area.

⁴ NER, clause 5.16.4(v).

⁵ NER, clause 5.14.1.

⁶ NER, clause 5.16.4.

Powerlink is managing the network risk associated with the condition of the existing Kamerunga Substation site through established asset management practices, including regular planned maintenance checks, replacement of high-risk components if required (e.g. circuit breakers) and minor civil works, until the preferred option identified under this RIT-T is implemented.

1.5. Consumer and non-network engagement

Powerlink undertakes a considered and consistent approach to ensure an appropriate level of stakeholder engagement is undertaken for each individual RIT-T consultation. The scope of engagement activities is dependent upon various considerations, such as the characteristics and complexity of the identified need and potential credible options.

For all RIT-Ts, members of Powerlink's Non-network Engagement Stakeholder Register receive email notifications of publication of RIT-T reports. For projects where Powerlink identifies material or significant market benefits, additional activities such as webinars or dedicated engagement forums may be appropriate. For more information, see Powerlink's [RIT-T stakeholder engagement matrix](#).

Additionally, Powerlink takes a proactive approach to engagement generally. This includes:

- the Transmission Network Forum – Powerlink's annual customer engagement event.
- collaboratively working with Powerlink's customers, including regular consultation on RIT-Ts with our Customer Panel ([Powerlink Customer Panel | Powerlink](#))
- transparency on future network requirements, such as our TAPR.

Appendix 2 provides more detail on Powerlink's engagement approach, as well as the project specific activities that have taken place in the Kamerunga, Cairns and northern beaches region.

2. Identified Need

The primary driver for reinvestment at Kamerunga Substation is deteriorating plant reliability leading to loss of power supply to the Kamerunga, Cairns and northern beaches area, as well as the safety risks associated with in-service failure of transmission line equipment due to the condition of the transmission line and primary and secondary system assets. Generation from Barron Gorge Power Station may also be affected.

2.1. Geographical and network need

Kamerunga Substation is located approximately 10 kilometres north-west of Cairns with a switchyard operating at 132 kilovolts (kV). It provides the only injection point to the 22kV network in the Cairns and northern beaches area, including Cairns Airport and connects the Barron Gorge Power Station to the transmission network. The substation is supplied by the Woree to Kamerunga 132kV double circuit transmission line, providing the connection to the broader Powerlink network. Figure 2.1 provides an overview of Powerlink's Far North zone.

Figure 2.1: Far North zone transmission network



2.2. Description of identified need

Powerlink's Transmission Authority requires it to plan and develop the transmission network in accordance with good electricity industry practice, having regard to the value that end users of electricity place on the quality and reliability of electricity services. It allows load to be interrupted during a critical single network contingency, provided the maximum load and energy will not exceed 50 megawatts (MW) at any one time, or will not be more than 600 megawatt hours (MWh) in aggregate.⁷ The Transmission Authority is also subject to a broader obligation under the *Electricity Act 1994* (Qld) (the Electricity Act) that Powerlink operate, maintain (including repair and replace if necessary) and protect its transmission grid to ensure the adequate, economic, reliable and safe transmission of electricity.⁸

Planning studies confirm there is an enduring need for the services currently provided by Kamerunga Substation to meet ongoing customer requirements and the reliability standard in Powerlink's Transmission Authority. The transmission lines supplying Kamerunga Substation and the primary and secondary systems equipment at Kamerunga Substation have all been identified as being at the end of their serviceable lives and have a higher likelihood of in-service failure resulting in loss of supply to customers supplied by the substation. Additionally, in-service failure of these assets can pose a safety risk to the community.

Secondary systems are used to control, monitor, protect and secure communication to facilitate safe and reliable network operation.⁹ Schedule 5.1 of the NER sets minimum standards for network service providers on the availability and operation of protection systems. Schedule 5.1.9(c) specifically requires Powerlink provide

⁷ Transmission Authority No. T01/98, section 6.2(c).

⁸ *Electricity Act 1994* (Qld), section 34(1)(a).

⁹ NER, Schedule 5.1.

sufficient primary and back-up protection systems (including breaker fail protection systems) to ensure that a fault anywhere on the transmission system is automatically disconnected.¹⁰

Protection systems are also important for maintaining power transfer following a credible contingency event, such as the disconnection of a generating unit or transmission line. Powerlink is required to ensure that all protection systems for lines at voltages above 66kV, including associated inter-tripping, are well maintained to always be available other than for periods not greater than eight hours while maintenance of a protection system is being carried out.¹¹

AEMO's [Power System Security Guidelines](#) and [Power System Data Communication Standard](#) require Powerlink to be able to safely resolve all protection, remote control and monitoring system problems and defects within 24 hours.

Powerlink must therefore take action to avoid the increasing likelihood of loss of power supply arising from failure of the aging transmission line and substation equipment to ensure customers are provided with a reliable and safe supply of electricity.

As the proposed investment is to meet reliability and service standards arising from Powerlink's Transmission Authority and to ensure Powerlink's ongoing compliance with Schedule 5.1 of the NER, it is a reliability corrective action under the NER.¹² A reliability corrective action differs from that of an increase in producer and consumer surplus (market benefit) driven need in that the preferred option may have a negative net economic outcome because it is required to meet an externally imposed obligation on the network business.¹³

2.3. Description of asset condition and risks

The risks being addressed as part of this RIT-T are associated with condition and obsolescence of key transmission network assets currently providing electricity services to Kamerunga, Cairns and northern beaches area, namely:

- the end of technical life and obsolescence of the primary plant, transformers and secondary systems at Kamerunga Substation, as well as the existing flood risk (refer to section 2.3.1); and
- the deteriorating condition of the steel lattice towers between the Woree and Kamerunga substations (refer to section 2.3.2).

These two key assets present Powerlink with a range of reliability of supply, safety and compliance risks which put at risk Powerlink's ongoing compliance with the reliability and service standards set out in the NER, Powerlink's Transmission Authority and applicable regulatory instruments.

2.3.1 Kamerunga 132kV Substation

Kamerunga Substation, established in 1976, is a major injection point into the Ergon Energy distribution network. The operation of a 22kV distribution network around Kamerunga, Cairns and northern beaches area is necessary for the continued supply of electricity into this area. The identified needs outlined below on the Powerlink network have flow-on implications for Ergon Energy's obligation to comply with reliability performance standards specified in its Distribution Authority.

The primary plant at Kamerunga Substation is nearing the end of their technical service lives with identified condition and obsolescence issues. These issues will result in performance degradation, increasing the risk to power supply in the Cairns area. In addition, the site has inherent design issues including insufficient electrical

¹⁰ NER, Schedule 5.1.9(c).

¹¹ NER, Schedule 5.1.2.1(d).

¹² NER, clause 5.10.2 (definition of 'reliability corrective action').

¹³ NER, clause 5.15A.1(c).

clearances (currently managed through temporary measures), poor drainage and a single 125V Direct Current (DC) supply system. The substation is also susceptible to major flooding events which could result in damage to equipment leading to loss of supply.

The secondary systems equipment at Kamerunga Substation is nearing the end of its technical service lives and have become or are becoming obsolete. The obsolescence issue is due to equipment being no longer supported by the manufacturer and limited, or no spares being available. Under the NER, Powerlink is required to provide sufficient secondary systems, including redundancies, to ensure the transmission system is adequately protected.

In the case of extreme flooding events, such as cyclones, studies have shown the substation would be inundated with 1.25 metres of water during a 1 in 100-year flood event and 1.6 metres for a 1 in 200-year event, resulting in extensive damage to its protection and control systems and loss of supply. This would result in a significant risk to supply in the area.

2.3.2 Woree to Kamerunga 132kV transmission line

The Woree to Kamerunga transmission line was established in 1963. It is a double circuit 132kV steel tower transmission line operating in an aggressive tropical environment, nearing the end of its technical service life with the majority of structures exhibiting signs of degradation.

2.4. Consequences of failure of primary plant and transmission line assets

Poor asset condition increases the risk and frequency of faults, while site constraints and location increase the time needed for Powerlink to undertake any necessary repairs, prolonging the return to service time. The potential in-service failure of ageing primary plant at Kamerunga Substation and the transmission line assets supplying Kamerunga Substation present Powerlink with a range of unacceptable safety, network and financial risks, and the inability to meet legislative obligations and customer service standards.

2.5. Consequences of failure in obsolete secondary systems

The duration of a fault is not only dependent on the nature and location of the fault, but also on the availability of a like-for-like replacement of the failed component. If a like-for-like replacement is available (i.e. same hardware and firmware as the failed device), then the replacement is often not complex and can generally be rectified within 24 hours, the timeframe specified by AEMO for resolution. If a like-for-like replacement is not available, then replacement is operationally and technically more complex due to:

- physical differences with the mounting and installation;
- development and testing of new configurations and settings;
- cabling, connectivity and protocol differences;
- interoperability between other devices on site, and with remote ends (if applicable);
- non-standard settings / configuration requirements; and
- legislative requirements for professional engineering certification.

All the above complexities add time to fault resolution, typically resulting in a fault duration well in excess of 24 hours.

Given the specific nature of the NER obligations and the AEMO requirements relating to protection, control and monitoring systems, accepted good industry practice is to replace the ageing and obsolete secondary systems when they reach the end of their technical service lives, rather than letting them run to failure.

Due to the condition and obsolescence issues with the secondary systems at Kamerunga Substation, there is a significant risk of breaching these mandated obligations and requirements if the secondary systems are left in service beyond 2030.

3. Potential Credible Network Options to Address the Identified Need

3.1. Credible options

Powerlink has developed two credible network options to address the Kamerunga Substation and Woree to Kamerunga transmission line condition risks and compliance obligations between the Woree and Kamerunga substations:

- Option 1 – Rebuild of transmission line with Overhead/Underground Alignment by 2030; and Greenfield 132kV AIS at a new site (to be called Barron River Substation) by 2030.
- Option 2 – Rebuild of transmission line with Underground Alignment by 2030; and Greenfield 132kV AIS at a new site (to be called Barron River Substation) by 2030.

Option 1 seeks easier access (compared to the existing easement) to build the replacement infrastructure. Under Option 1, work will commence in 2027, with Greenfield site establishment, overhead/underground line construction and associated commissioning works completed by 2030. Option 2 seeks to minimise visual impacts in the project vicinity. Under Option 2, work will commence in 2027, with Greenfield site establishment, underground line construction and associated commissioning works completed by 2030.

A summary of these options is shown in Table 3.1.

Table 3.1: Summary of credible options

Option	Description	Breakdown of costs (\$m, 2026)	Total Cost of option (\$m, 2026)	Indicative annual O&M costs (\$m, 2026)
1	Rebuild of transmission line with Overhead/Underground Alignment by 2030 (Powerlink works).	163.9		
	Greenfield 132kV AIS at a new site (to be called Barron River Substation) by 2030.			
	Powerlink works include replacement of primary and secondary assets with AIS and land purchase.	96.3		
	Ergon Energy works include 22kV switchgear, building and cut-in works.	32.2	292.4	0.2
2	Rebuild of transmission line with Underground Alignment by 2030 (Powerlink works)	178.7		
	Greenfield 132kV AIS at a new site (to be called Barron River Substation) by 2030.			
	Powerlink works include replacement of primary and secondary assets with AIS, and land purchase.	96.3		
	Ergon Energy works include 22kV switchgear, building and cut-in works.	32.2	307.2	0.2

Note: O&M denotes operations and maintenance.

Each credible option addresses the major risks resulting from the end of life of primary plant and secondary systems at Kamerunga Substation, and the deteriorated condition of transmission line between the Woree and Kamerunga substations. The credible options allow Powerlink to meet its reliability of supply and safety obligations under its Transmission Authority, the Electricity Act and Schedule 5.1 of the NER, by the replacement of primary plant, secondary systems and deteriorated transmission line. The credible options also allow Ergon Energy to meet its obligations under its Distribution Authority.

Powerlink also note the challenges associated with replacement of the existing overhead line in the current easement. There is insufficient space on the existing 20-metre wide alignment for additional overhead construction, and the land adjacent to the easement is residential. Widening the easement would require obtaining easements over a significant number of residential lots as well as requiring easements over a number of existing dwellings.

An outline of options considered but not progressed is in section 4.3 of the PADR for this RIT-T.

3.2. Cost increases from PSCR

The estimated cost for this work has increased from that published in Powerlink PSCR in December 2024. The estimate for the rebuild of the transmission line has increased by \$60.7 million, the substation work has increased by \$18.3 million, and Ergon Energy's estimated costs have increased by \$12.2 million.

Given the complex nature of the project, and significant potential impact on customers in the region, Powerlink sought to engage early. To achieve this, Powerlink used a Class 5 estimate in the PSCR, which has an accuracy band of -50% to +100%. The change in forecast cost was within these bands. The PADR utilised a Class 3 estimate for Option 1, which has an accuracy band of -20% to +30%. Option 2 remained a Class 5 estimate but leveraged the Class 3 estimates from Option 1 for common scope items.

4. Economic Analysis of the Base Case

Powerlink has developed a risk modelling framework consistent with the RIT-T Application Guidelines. An overview of the framework is available on Powerlink's [website](#) and the principles of the framework have been used to calculate the monetised risk, termed risk costs, in the National Electricity Market (NEM) context for the base case. The framework includes the modelling methodology and general assumptions underpinning the analysis.

4.1. Modelling a base case under the RIT-T

The base case is the situation in which the RIT-T proponent does not implement a credible option to meet the identified need and continues with business-as-usual (BAU) activities.¹⁴

The assessment undertaken in this RIT-T compares the costs and benefits of credible options to address the risks arising from an identified need with a base case. As characterised in the RIT-T Application Guidelines, the base case reflects a situation in which the condition and obsolescence issues arising from the ageing assets are only addressed through standard operational activities, with resultant safety, financial, environmental and network risks.¹⁵

To develop the base case, the existing condition and obsolescence issues are managed by undertaking operational maintenance or operational measures only. This results in higher overall risk levels as the condition and availability of the asset deteriorates over time. These risk levels are assigned a monetary value that is used to evaluate the credible options designed to offset or mitigate these risk costs.

The base case therefore includes the costs of work associated with operational maintenance and the risk costs associated with the failure of the assets. The costs associated with equipment failures are modelled in the risk cost analysis and are not included in the operational maintenance costs. The base case acts as a benchmark and provides a reference point in the cost-benefit analysis to compare and rank the credible options against each other over the same timeframe.

4.2. Quantifiable Risk Costs for the Base Case

The NER requires RIT-T proponents to quantify a number of classes of market benefits for each credible option, unless the proponent can demonstrate that a specific category(ies) is/are unlikely to materially affect the outcome of the assessment of credible options.¹⁶ In line with Powerlink's [framework](#), five key risk costs have been quantified in the cost benefit analysis in response to the identified need:

¹⁴ AER, *Regulatory Investment Test for Transmission*, November 2024, glossary ('base case').

¹⁵ AER, *Application Guidelines, Regulatory Investment Test for Transmission*, November 2024, page 21. See AER, *Regulatory Investment Test for Transmission*, November 2024, paragraph 24 and AER, *Application Guidelines, Regulatory Investment Test for Transmission*, November 2024, pages 32-35 for a definition and discussion of states of the world in a RIT-T.

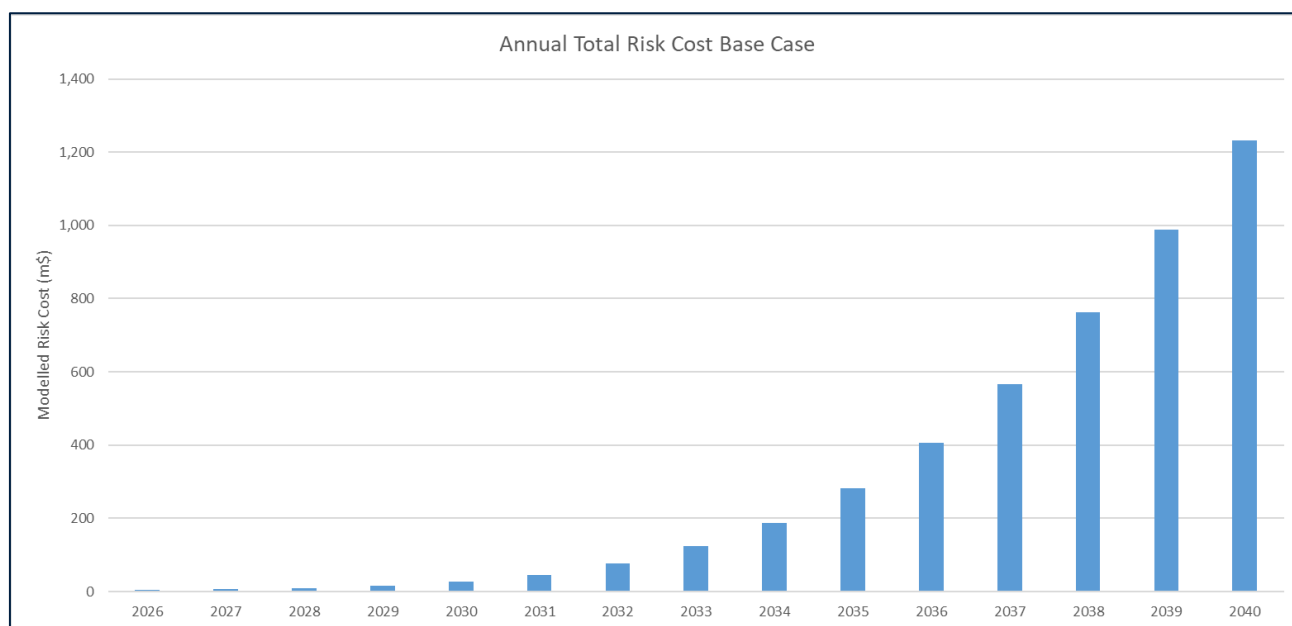
¹⁶ NER, clauses 5.15A.2(b)(4), (5) and (6). See also AER, *Regulatory Investment Test for Transmission*, November 2024, paragraphs 10 to 13.

- **Network risk cost** – this is the cost of loss of supply that results from an in-service failure of the identified equipment and is typically known as unserved energy. This generally accrues under concurrent failure events; however the primary network risk cost is associated with a failure of a single transmission structure, which would cause an outage to the entire electrical supply at Kamerunga Substation. In addition, Powerlink has also included the risk cost that is associated with Ergon Energy's 22kV circuit breakers. Kamerunga Substation supplies a mixture of residential, industrial and agricultural load types. Historical load data has been analysed to approximate the ratio of the load types, resulting in a Value of Customer Reliability (VCR) of \$35,841/MWh, published within the 'Value of customer reliability – Final report on VCR values' by the AER (updated in December 2024).
- **Financial risk cost** – this is the cost associated with rectifying an in-service failure of the identified equipment. Spares for secondary system equipment items are assumed available prior to the point of expected spares depletion (at around 2032), and after this point the cost and time to return the secondary system back to service increases significantly.
- **Safety risk cost** – this is the assessed safety impact that may result from the unlikely event of a catastrophic in-service failure of the identified equipment. Powerlink utilises guidance from the Department of Prime Minister and Cabinet to assess and quantify this risk.
- **Environmental risk cost** – this is the assessed impact of flood risk at the site. Kamerunga Substation is currently below the 1 in 100-year flood level. Where a flood occurs, Powerlink have estimated the loss of supply to the surrounding area, and a restoration cost of \$1 million following the event.
- **Changes in patterns of generation dispatch:** replacement of the ageing assets under the credible options does not affect transmission network constraints or affect transmission flows that would change patterns of generation dispatch. Reduction in reliability if not replaced may influence generation dispatch patterns. While these changes do not have a significant impact on the outcome of the analysis, they have been included given there are impacts for customers from the change in generation dispatch that would result. This is discussed more in Appendix 3.

Appendix 4 outlines the market benefits that Powerlink has assessed as not having a material impact on the options analysis.

The 15-year forecast of risk costs for the base case is shown in Figure 4.1.

Figure 4.1: Modelled base case risk costs



Based upon the assessed condition of the ageing secondary systems and primary plant at Kamerunga, the total value of monetised risk is projected to increase from approximately \$4.9 million in 2026 to approximately \$1.2 billion in 2040. This substantial increase is based on the significantly escalating probability of failure of the transmission line structures and substation assets, as well as flood risks, which would result in network, financial, safety and environmental risk costs, based on a total loss of supply and the proximity to the community of these assets.

5. Cost-benefit Analysis and Identification of Preferred Option

5.1. Cost estimation

Basis of Estimation

The basis for the estimation for the credible options presented in this PACR are outlined in the methodologies and processes used to derive cost estimates as described in Powerlink's Cost Estimation Methodology. The estimates are informed by the level of specific project information available at the time of PACR preparation. Powerlink's Cost Estimation Methodology also provides context to the classes of estimate discussed in this section.¹⁷

Key inputs and assumptions

Option 1: Rebuild of transmission line with Overhead/Underground Alignment by 2030; and Greenfield 132kV AIS at a new site (to be called Barron River Substation) by 2030. Project start by 2027.

A Class 3 Estimate under the Association for the Advancement of Cost Engineering (AACE) system has been produced for Option 1 line works with an accuracy range of -20% to +30%.

Powerlink has made the following scope assumptions in producing this estimate:

- Complete replacement of secondary and telecommunication systems at a new site (to be called Barron River);

¹⁷ The methodology is available on the [RIT-T Consultations](#) page of Powerlink's website.

- Complete replacement of primary plant at new Kamerunga site;
- Overhead transmission line from new Kamerunga site to Redlynch Substation and underground cables from Redlynch to Woree Substation;
- Overhead transmission line from existing Kamerunga site and new Kamerunga Substation;
- Associated 22kV Ergon Works;
- Remote end works at Barron Gorge Power Station and Woree Substation; and
- Social licence costs associated with landholder payments and community engagement are included in the estimate

Option 2: Rebuild of transmission line with Underground Alignment by 2030; and Greenfield 132kV AIS at a new site (to be called Barron River Substation) by 2030. Project start by 2027.

A Class 5 Estimate has been produced for Option 2 line works with an accuracy range of -50% to +100%. This estimate has also utilised the information gained as part of the Class 3 estimate for Option 1.

Powerlink has made the following scope assumptions in producing this estimate:

- Complete replacement of secondary and telecommunication systems at a new site (to be called Barron River);
- Complete replacement of primary plant at new Kamerunga site;
- Underground cables from new Kamerunga site to Woree Substation;
- Overhead transmission line from existing Kamerunga site and new Kamerunga Substation;
- Associated 22kV Ergon Works;
- Remote end works at Barron Gorge Power Station and Woree Substation; and
- Social licence costs associated with landholder payments and community engagement are included in the estimate.

Main components of capital cost estimate of credible options

The capital costs for this project are shown in Table 5.1.

Table 5.1: Summary of capital costs of credible options

Cost Estimate Components	Option 1 (\$m)	Option 2 (\$m)
Design	31.8	33.4
Materials	33.5	35.2
Construction	151.3	159.0
Commissioning	50.3	52.8
Other ¹⁸	25.6	26.9
Total	292.4	307.2

¹⁸ Generally, comprises project management, design and commissioning coordination, project governance, administrative support, cost estimation and RIT-T consultation costs.

Contingency allowance

For proposed transmission investments subject to the RIT-T, known and unknown delivery risk costs are excluded from the cost of the option. This approach aligns with that of the RIT-T Instrument which requires that the cost of the options considered include only direct costs, apart from any other costs the AER has agreed to in writing.¹⁹

5.2. Modelling assumptions

Each option is scoped to manage the major risks arising in the base case and to maintain compliance with all statutory requirements, the NER and AEMO standards. The residual risk is calculated for each option based upon the individual implementation strategy of the option. This is included with the capital and operational maintenance cost to develop the NPV inputs.

Powerlink has undertaken the RIT-T analysis over a 20-year period, from 2025 to 2044. A 20-year period considers the size and complexity of the line, cable and substation replacement options. There will be remaining asset life by 2044, at which point a terminal value is calculated to account for capital costs under each credible option.

Powerlink has adopted a real, pre-tax commercial discount rate of 7.0% as the central assumption for the NPV analysis.²⁰ Powerlink has tested the sensitivity of the results to changes in this discount rate assumption, and specifically to the adoption of a lower bound discount rate of 3% and an upper bound discount rate of 10%.²¹

5.3. Scenario Analysis

Powerlink has considered capital cost, discount rate and risk cost sensitivities individually, and in combination, and found that none of the parameters has an impact on the ranking of the results (see Appendix 5). Table 5.2 outlines the key parameters of the reasonable scenario presented.

Table 5.2: Reasonable scenario parameters

Key parameter	Central Scenario
Capital cost	100% of base capital cost estimate
Maintenance cost	100% of base maintenance cost estimate
Discount rate	7.0%
Risk cost	100% of base risk cost forecast

¹⁹ AER, *Regulatory Investment Test for Transmission*, November 2024, paragraph 5.

²⁰ This indicative commercial discount rate of 7% is based on AEMO, *2025 Inputs, Assumptions and Scenarios Report*, August 2025, page 158.

²¹ A discount rate of 3% lower bound discount rate is based on AEMO, *2025 Inputs, Assumptions and Scenarios Report*, August 2025, page 158.

5.4. NPV analysis

Table 5.3 outlines the NPV and the corresponding ranking of each credible option relative to the base case.

Table 5.3: NPV of credible option relative to the base case

Option	Description	Central scenario NPV relative to Base Case (\$m)	Ranking
1	Overhead/Underground Alignment by 2030. Greenfield AIS (new 22kV switchboard) by 2030.	4,117.4	1
2	Underground Alignment by 2030. Greenfield AIS (new 22kV switchboard) by 2030.	4,105.4	2

Figure 5.1 sets out the NPV results, determined using a breakdown of capital cost, operational maintenance cost and monetised risk for base case and Option 1 under the central scenario. Note that the non-credible base case consists of operational maintenance and total risk costs and does not include any capital expenditure.

Figure 5.1: NPV of credible option (NPV \$m)

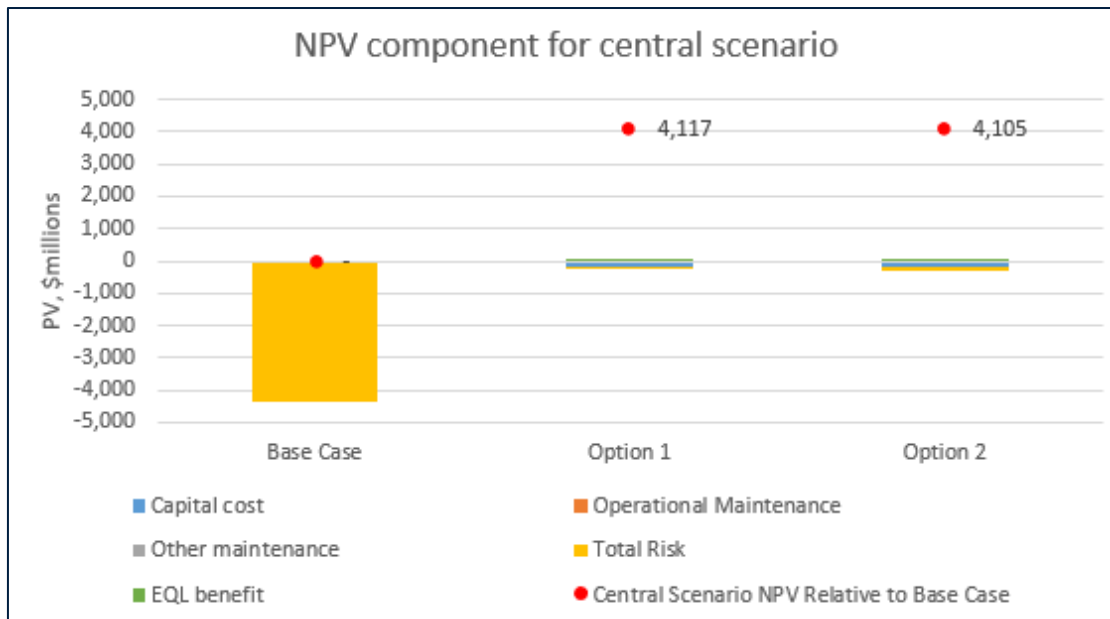


Figure 5.1 illustrates that the two options are not materially different, which is as a result of the significant economic benefits for both options. Option 1 is the lower cost of the two options and is the preferred option.

5.5. Conclusion

The result of the cost-benefit analysis indicates that Option 1 provides the highest net economic benefit over the 20-year analysis period. Sensitivity testing shows the analysis is robust to variations in the capital cost, risk cost, maintenance cost and discount rate assumptions (see Appendix 5). Powerlink therefore considers Option 1 satisfies the requirements of the RIT-T and is the proposed preferred option.

6. Final Recommendation

Based on the conclusions drawn from the NPV and sensitivity analysis and regulatory requirements relating to the proposed replacement of transmission network assets, Option 1 satisfies the RIT-T and is recommended to be implemented to address the reliability of supply to Kamerunga, Cairns and the northern beaches area. Implementing this option will also ensure ongoing compliance with relevant standards, applicable regulatory instruments and the NER.

Option 1 involves the construction of overhead/underground alignment from Woree to Kamerunga substation by 2030, and the construction of a Greenfield AIS new Kamerunga substation by 2030. The indicative capital cost of this option is \$292.4 million in 2025/26 prices to allow comparison with the costs published in the PSCR.

Powerlink and Ergon Energy will now proceed with the necessary processes to implement the preferred option.

7. Reopening Triggers

The sensitivity analysis in Appendix 5 demonstrates that the proposed preferred option is robust to changes in costs (including assumed risk costs) and the discount rate. Powerlink therefore considers it to be unlikely that the preferred option would change.

Powerlink is required to include reopening triggers at the PADR stage of a RIT-T, if the estimated capital expenditure is greater than \$103 million and AEMO is not the sole RIT-T proponent.²² In the PADR, Powerlink offered the following potential reopening trigger events that may require an altered response and possibly a new RIT-T.

- Identification of circumstances in construction of the underground cable that significantly impacts cost by more than \$90 million and/or time by more than two years. Situations that may cause this are:
 - unmarked and other underground services that do not show up in searches but only materialise in on site 'potholing' type of testing;
 - corners and angles that, in the final design in the proposed alignment, prove too severe for cables of this type prompting the need for realignment and associated approvals;
 - as yet unknown competing interests for congested space under roads for cables and pipes;
 - final geotechnical results along the alignment which prove unsuitable for cable in conduit without significant substructure modifications.
- Delays and changes to planned approved access to site for this project may impact the timeframe in which this project can be constructed (greater than 2 years) and therefore, in association, cost increases of more than \$80 million.

Powerlink did not receive any submissions in response to the PADR, and confirms the triggers proposed at the PADR stage as the final reopening triggers at the PACR stage. If any of the above reopening triggers are activated following completion of the RIT-T, Powerlink would notify the AER of the material change in circumstances, and outline (for the AER's approval) the actions Powerlink proposes to undertake.²³

Further, as noted in the PADR, Powerlink will also advise the AER of, and propose actions to respond to, a change in the key assumptions used to identify the identified need described in the PACR, or a change in circumstances

²² NER, clause 5.16.4(k)(10). NER, clause 5.15.3(b)(7) set the threshold at \$100 million. The AER's latest [cost threshold review](#) increased the value to \$103 million for three years from 1 January 2025.

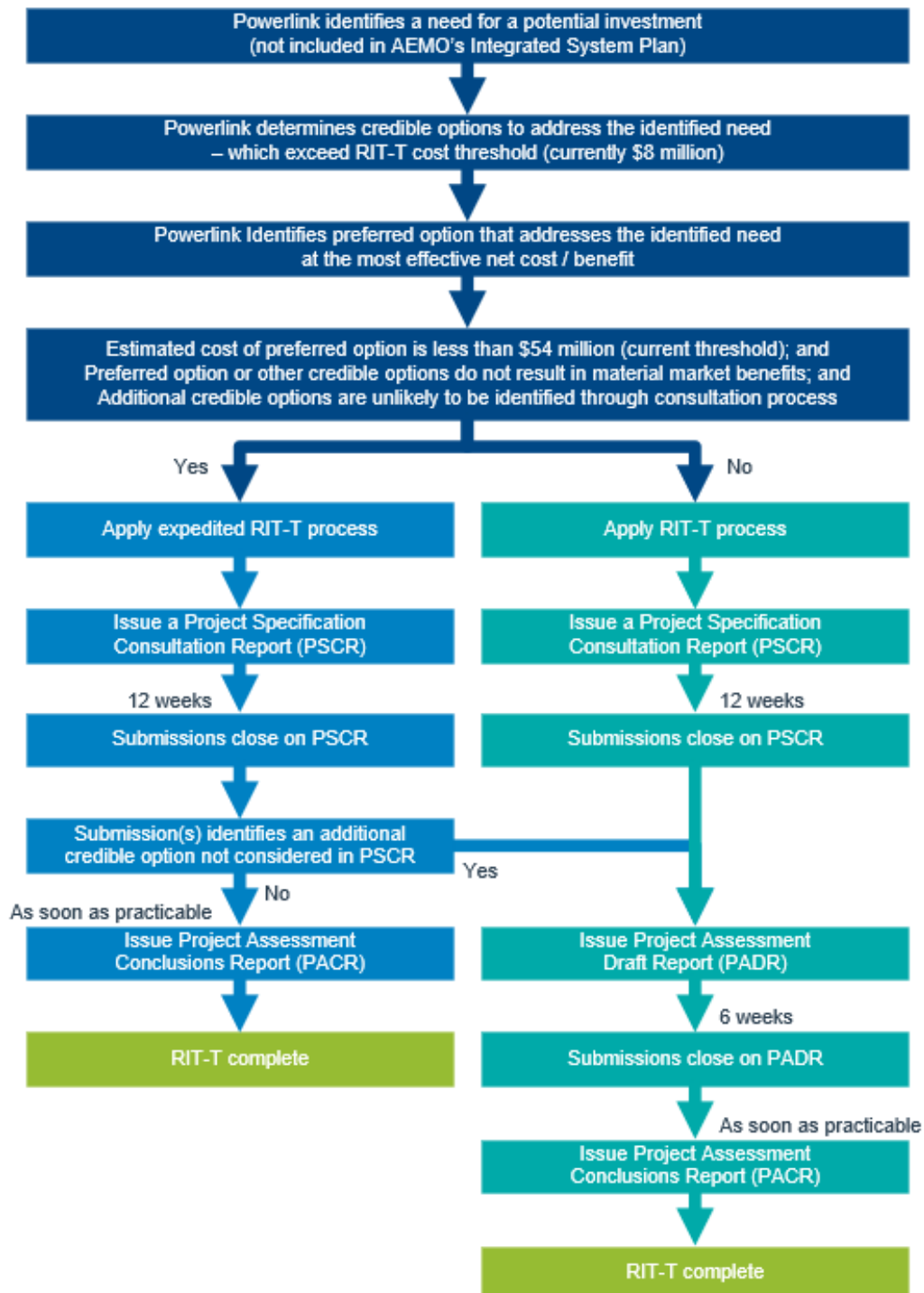
²³ NER, clause 5.16.4(z3)(4).

which, in Powerlink's reasonable opinion, means that the preferred option identified in the PACR may no longer be the preferred option.²⁴

²⁴ NER, clause 5.16.4(z4).

Appendix 1: RIT-T Process

The flow chart below illustrates the RIT-T process where the need is not an actionable project in AEMO's ISP.



Appendix 2: Powerlink's Approach to Engagement and Social Licence

More than five million Queenslanders and 241,000 Queensland businesses depend on Powerlink's performance. Powerlink recognises the importance of engaging with a diverse range of customers and stakeholders who have the potential to affect, or be affected by, Powerlink activities and/or investments.

Together with our industry counterparts from across the electricity and gas supply chain, Powerlink has committed to the [Energy Charter](#). The charter is a national CEO-led collaboration that supports the energy sector towards a customer-centric future. Powerlink joins other signatories in committing to progress the culture and solutions needed to deliver more affordable, reliable and sustainable energy systems. Powerlink's [Energy Charter Disclosure Statement for 2024/25](#) shows Powerlink's achievements against the principles of the Energy Charter.

Powerlink takes a proactive approach to engagement

Powerlink regularly hosts a range of activities to provide timely and transparent information to customers and stakeholders within the broader community to maintain social licence obligations.

Powerlink's annual Transmission Network Forum (TNF) is a primary vehicle used to engage with the community, understand broader customer and industry views and obtain feedback on key topics. It also provides Powerlink with an opportunity to further inform its business network and non-network planning objectives. TNF participants include customers, landholders, environmental groups, Traditional Owners, government agencies, and industry bodies.

Engagement activities such as the TNF help inform the future development of the transmission network and assist Powerlink in providing services that align with the long-term interests of customers. Powerlink also incorporates feedback from these activities into a number of [publicly available reports](#).

Working collaboratively with Powerlink's Customer Panel

Powerlink's [Customer Panel](#) provides a face-to-face opportunity for customers and consumer representatives to give their input and feedback about Powerlink's decision-making, processes and methodologies. The panel also provides Powerlink with a valuable avenue to keep customers and stakeholders better informed, and to receive feedback about topics of relevance, including RIT-Ts.

The Customer Panel is regularly advised on the publication of Powerlink's RIT-T documents and is briefed quarterly on the status of current RIT-T consultations as well as upcoming RIT-Ts. This provides an ongoing opportunity for the Customer Panel to ask questions and provide feedback to further inform RIT-Ts, and for Powerlink to better understand the views of customers when undertaking the RIT-T consultation process.

Powerlink will continue to provide updates to and request input from the Customer Panel throughout the RIT-T consultation process.

Transparency on future network requirements

Powerlink's annual planning review findings are published in the [Transmission Annual Planning Report](#) (TAPR) and TAPR templates (available via the [TAPR portal](#)). It provides early information and technical data to customers and stakeholders on potential transmission network needs over a 10-year outlook period. The TAPR plays an important part in planning Queensland's transmission network and helping to ensure it continues to meet the needs of Queensland electricity customers and participants in the NEM.

Community engagement

Powerlink recognises the importance of engaging with stakeholders who may reasonably be expected to be affected by the works required to meet the identified need described in this PACR.

The engagement frameworks and strategies that underpin Powerlink's engagement approach include:

- The International Association for Public Participation (IAP2) spectrum²⁵, noting each stakeholder group has unique needs and requires an individual assessment on the spectrum;
- Powerlink's [Community Engagement Approach](#) and [Reflect Reconciliation Action Plan](#); and
- the Energy Charter [Landholder and Community Better Practice Engagement Guide](#) and [Better Practice Social Licence Guideline](#).

Assessment and basis of assessment on the need for community engagement

Powerlink has assessed that community engagement would be required given the scope of works under consideration for any proposed network options to meet the identified need. This is due to:

- the least cost option to install AIS at the existing Kamerunga Substation site is not technically feasible; and
- a substantial proportion of the transmission line requiring replacement traverses built-up residential, encroached development and a number of major and minor road crossings, potentially impacting local communities as well as causing access and construction work challenges.

Description of community stakeholder engagement and associated activities

Over the past five years, Powerlink has undertaken a range of activities to investigate the development of substation and transmission line replacement options. In early 2019, Powerlink commenced discussions with relevant landholders to inform the planning of a new corridor for the overhead transmission line from Kamerunga to Redlynch. Planning for the Kamerunga to Redlynch overhead line replacement project was paused in early 2020, to allow for additional investigations into options for the Redlynch to Woree line replacement and identification of requirements for a new substation.

In October 2024, Powerlink ran several community information drop-in sessions to seek feedback on the project's Draft Corridor and Site Selection Report from landholders, Traditional Owner groups, the community and other stakeholders. Since releasing the Draft Corridor and Site Selection Report in September 2024, further detailed studies have been underway to support finalisation of the corridor and to meet Powerlink's statutory requirements.

Powerlink has identified two credible options to maintain reliability of supply to Kamerunga, Cairns and the northern beaches area which take into consideration potential community impacts. These options include the establishment of a proposed new substation in Barron River, approximately 600 metres from the existing Kamerunga Substation, and a proposed new line corridor between Kamerunga and Woree substations (refer to Section 5.1). Powerlink considers that the construction of a new overhead transmission line for the Redlynch to Woree section of the line is not feasible as it would pose significant impacts to the communities in residential areas. As a result, the credible options identified in the PSCR included only the construction of an underground cable between Redlynch and Woree, where no residential land or easements on private property will be required for construction.

In terms of community feedback, the majority of interest has been expressed by those who will be impacted by the delivery aspects of the proposed project works, rather than the options under consideration in this RIT-T. The

²⁵ Refer to IAP2's [website](#).

matters raised include the removal of the overhead transmission line between Redlynch to Woree, when and how this may occur and whether the associated easement will be relinquished. These matters fall outside the scope of the credible options assessed under this RIT-T and will be taken into consideration as part of the construction Project Engagement Plan, utilising the frameworks and strategies discussed in this appendix subsequent to the conclusion of this RIT-T and identification of the proposed preferred option.

A range of additional engagement activities will be held as consultation on the works associated with proposed project progress and which is outside of the current RIT-T process. Detailed information on next steps, in particular status of the planning and environmental approvals process for the proposed project, is available on Powerlink's [website](#). Where appropriate, feedback received through community and stakeholder engagement activities will be used to inform changes and guide next steps including future activities.

Appendix 3: Methodology used to quantify material benefit for change in dispatch

Market modelling was used to assess the operational market impact of constraining off units at the Barron Gorge Hydro Power Station as a result from outages of primary and/or secondary system equipment at the Kamerunga Substation and of constraining off the entire Barron Gorge Hydro Power Station due to an outage of the double circuit line between Woree and Kamerunga substations

The market modelling approach is consistent with the RIT-T requirements that a market benefit must be a benefit to those who consume, produce and/or transport electricity in the market; that is, the change in producer plus consumer surplus. Critically, a market benefit must not include the transfer of surplus between consumers and producers of electricity.²⁶

As such, the market impact is assessed by comparing the changes in costs for market participants due to the differences in the operational and maintenance costs (including fuel costs), changes in involuntary load shedding (at the value of customer reliability [VCR]²⁷), and changes in greenhouse gas emissions (at the value of emissions reduction [VER]²⁸)

The market modelling simulations considered committed and anticipated generators were commissioned on time, coal units closed according to their announced dates (as of December 2025), and modelled generation and storage projects consistent with the Queensland Energy Roadmap 2025.²⁹ The profiles of demand and energy available for variable energy resources followed the 2015 weather reference year as published by AEMO, as being a year found to result in 'median' outcomes.

A schedule of generator planned outages was modelled. However, generator forced outages were not considered. Instead, a reserve requirement is maintained via a reserve constraint equation, and therefore unserved energy may be underestimated in some circumstances.

Appropriate network detail (in the form of network constraints or sub-regional transfer limits) was added to adequately represent the network capability across major grid sections.

The outages (e.g. Barron Gorge Hydro Power Station units as a result of the failure of primary or secondary system equipment at Kamerunga Substation or the entire Barron Gorge Hydro Power Station as a result of the failure of the Woree to Kamerunga double circuit line) were modelled as occurring in perpetuity to approximately capture the effect of this occurring at any time.

The market impact was then quantified in both scenarios as the differential total system cost (as above) for each hour between a base case with Barron Gorge Hydro Power Station available against the state of the world with an outage of unit/s of or the entire hydro power station. Both the hourly and a moving 24-hour differential cost were determined.

In the context of this RIT-T, the market impact was not significant in comparison to the total risk costs for safety, network and financial costs. Given the market sensitive nature of these costs to the proponent and the limited impact on the outcome of the RIT-T, Powerlink have not included the calculated values in this document.

²⁶ AER, *Regulatory Investment Test for Transmission*, November 2024, paragraphs 7 and 8.

²⁷ AER, *Values of Customer Reliability: Final Report on VCR Values*, December 2024.

²⁸ AER, *Valuing Emissions Reduction: AER Guidance and Explanatory Statement*, May 2024.

²⁹ Queensland Treasury, *Energy Roadmap*, October 2025.

Appendix 4: Market benefits that are not material for this RIT-T assessment

A discussion of each market benefit under the RIT-T that Powerlink considers not to be material is presented below.

- **Changes in voluntary load curtailment:** a cable fault by itself does not affect prices in the wholesale electricity market. It follows that changes in voluntary load curtailment will not be material for the purposes of this RIT-T.
- **Changes in costs for other parties:** the effect of replacing transmission lines under the credible options considered are localised to the substation they are located at and do not affect the capacity of transmission network assets and therefore are unlikely to change generation investment patterns.
- **Differences in the timing of expenditure:** credible options for cable replacement do not affect the capacity of transmission network assets, the way they operate, or transmission flows. Accordingly, differences in the timing of expenditure of unrelated transmission investments are unlikely to be affected.
- **Changes in network losses:** credible options are not expected to provide any changes in network losses as replacing transmission lines does not affect the characteristics of primary transmission assets.
- **Changes in ancillary services cost:** there is no expected change to the costs of Frequency Control Ancillary Services (FCAS), Network Control Ancillary Services (NCAS), or System Restart Ancillary Services (SRAS) due to credible options under consideration. These costs are therefore not material to the outcome of the RIT-T assessment.
- **Competition benefits:** Powerlink does not consider that any of the credible options will materially affect competition between generators, and generators' bidding behaviour and, consequently, considers that the techniques required to capture any changes in such behaviour would involve a disproportionate level of effort compared to the additional insight it would provide.
- **Option value:** Powerlink does not consider that the identified need for the options considered in this RIT-T is affected by uncertain factors about which there may be more clarity in future. As a consequence, option value is not a relevant consideration for this RIT-T.

Appendix 5: Sensitivity analysis

Powerlink has investigated the following sensitivities on key assumptions:

- a range from 3% to 10% discount rate;
- a range from 75% to 125% of base capital expenditure estimates;
- a range from 75% to 125% of base risk cost estimates; and
- a range from 75% to 125% of base operational maintenance expenditure.

As illustrated in Figures A5.1 – A5.4, sensitivity analysis for the NPV relative to the base case shows that varying the discount rate, capital expenditure, total risk costs, and maintenance costs has no impact on the identification of the preferred option. Option 1 is the preferred option under all scenarios tested.

Figure A5.1: Discount rate sensitivity

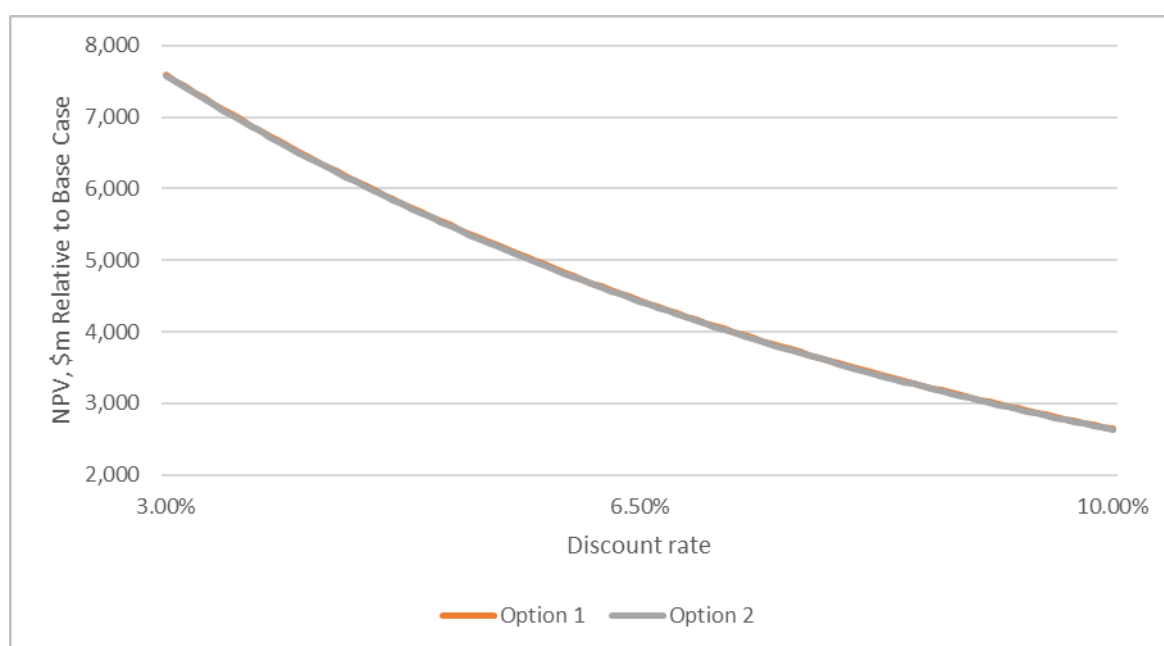


Figure A5.2: Capital cost sensitivity

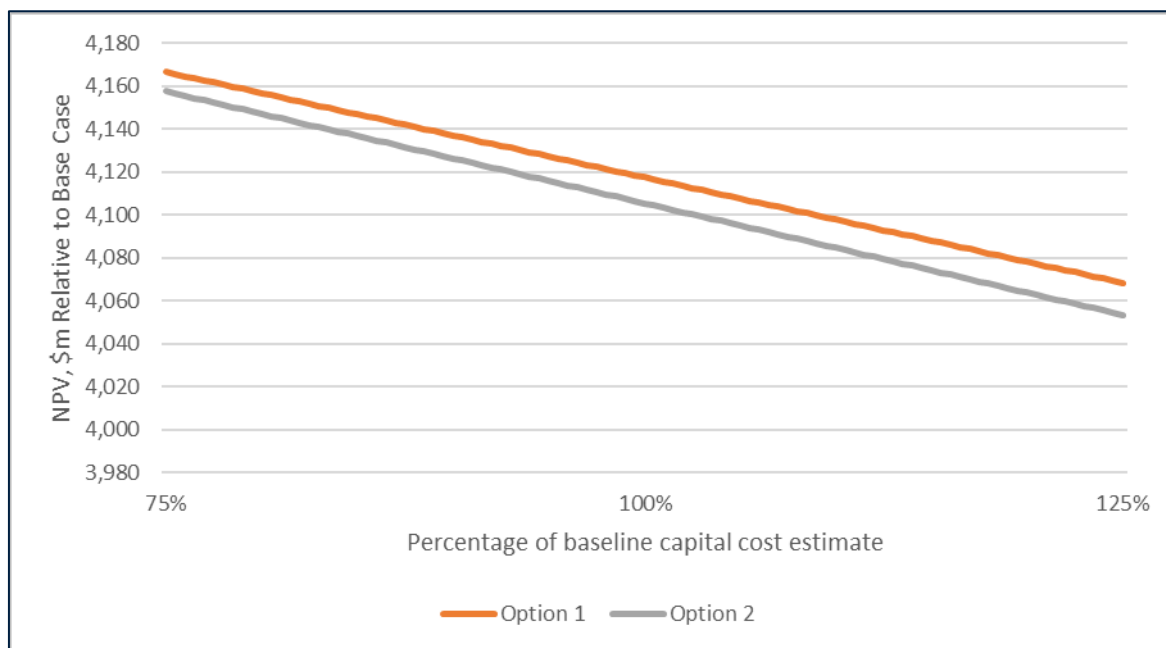


Figure A5.3: Risk cost sensitivity

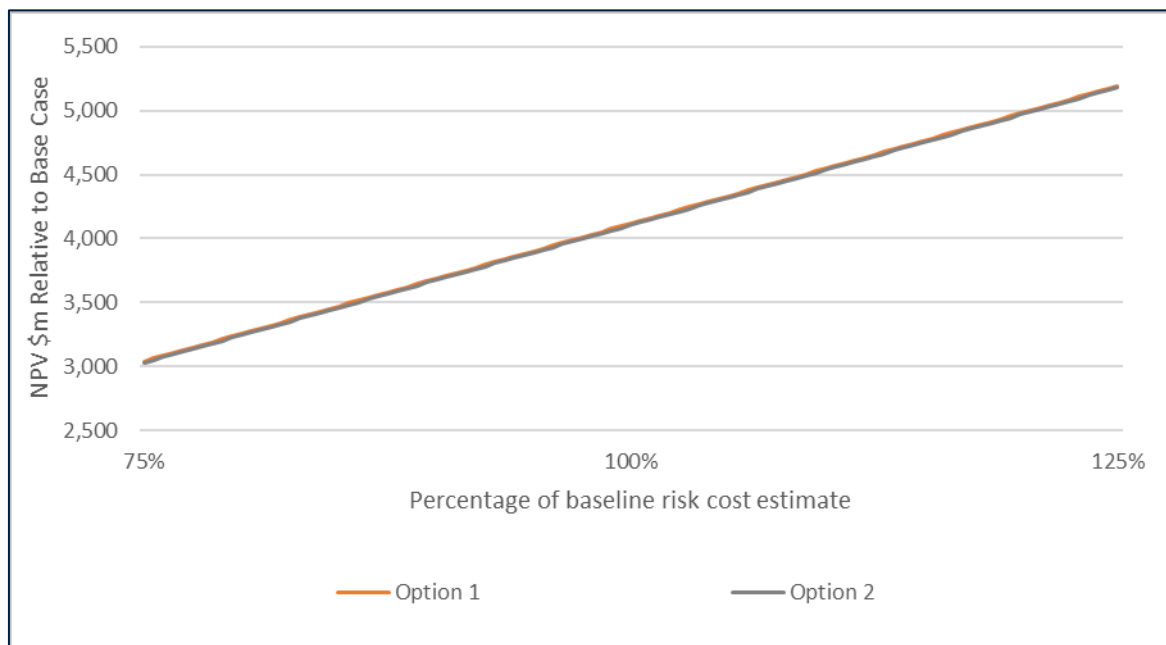
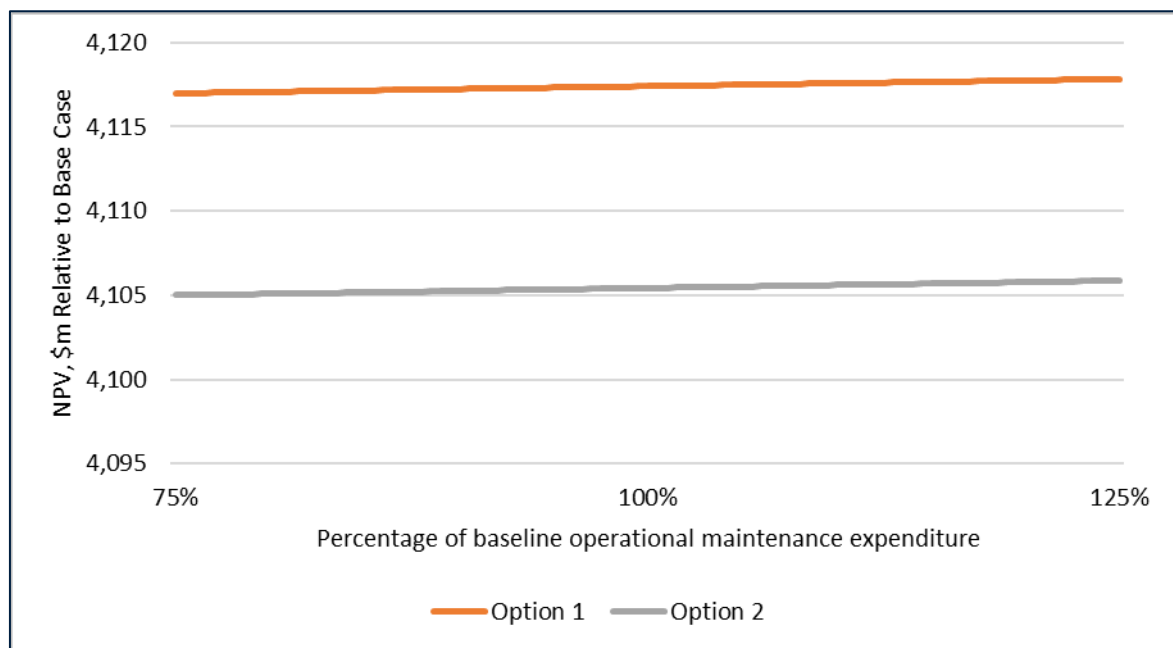
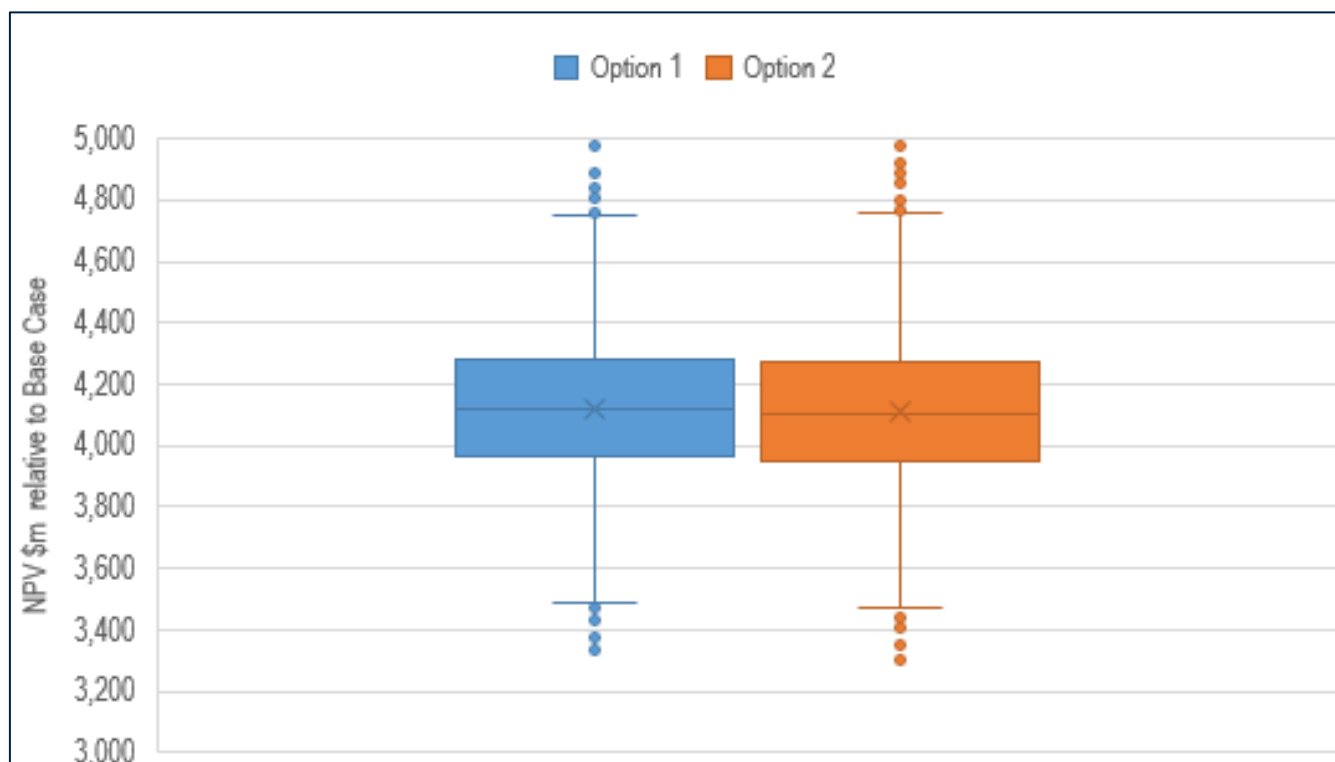


Figure A5.4: Maintenance cost sensitivity



Powerlink also performed a Monte Carlo simulation with multiple input parameters (including capital cost, discount rate and total risk cost) generated for the calculation of the NPV for each option. This process was repeated over 5,000 iterations, each time using a different set of random variables from the probability function. The sensitivity analysis output is presented as a distribution of possible NPVs for each option, as illustrated in Figure A5.5.

Figure A5.5: NPV sensitivity analysis of multiple key assumptions relative to the base case



Note: The box represents the interquartile interval, where 50% of the data is found. The horizontal line through the box is the median and the mean is represented by the cross (X). The two lines outside the box extend to 1.5 times the interquartile range. Data points that are outside of this interval are shown as dots on the graph.

Option 1 is robust over a range of input parameters in combination.

Appendix 6: Compliance Checklists

NER Requirements for RIT-T

Clause 5.16.4(v) of the NER states that a PACR must include the matters detailed in the PSCR/PADR (as required under clause 5.16.4(k)) and summarise and comment on submissions received on the PSCR/PADR. This appendix outlines Powerlink's compliance with PADR/PACR content requirements in each sub-paragraph of clause 5.16.4(k).

Table A6.1: NER Compliance Checklist

Sub-para	Requirement	Section of PACR
(1)	Description of each credible option	3.1
(2)	Summary of and commentary on submissions to the PSCR/PADR ³⁰	N/A
(3)	Quantification of costs, including breakdown of operating and capital expenditure	5.1
	Classes of material market benefit for each credible option	4.2
(4)	Description of methodologies used to quantify each class of material market benefit and cost	4.2, Appendix 3
(5)	Reasons why a class/classes of market benefit are not material	Appendix 4
(6)	Identification and quantification of any class of market benefit estimated to arise outside Queensland	N/A
(7)	Results of NPV analysis for each credible option, and explanation of results	5.4
(8)	Identification of preferred option	5.5
(9)	For the preferred option:	
	(i) details of the technical characteristics	3.1
	(ii) the estimated construction timetable and commissioning date	3.1, 5.1
	(iii) an augmentation technical report from AEMO (if required)	N/A
	(iv) a statement that the preferred option satisfies the RIT-T	6
(10)	RIT reopening triggers	7

N/A denotes not applicable.

³⁰ Neither Powerlink nor Ergon Energy received any submissions in response to the PSCR or PADR for this RIT-T.

RIT-T Application Guidelines Compliance Checklist

The table below outlines Powerlink's compliance with binding requirements included in the RIT-T Application Guidelines.

Table A6.2: RIT-T Application Guidelines Compliance Checklist

Section of Guidelines	Topic	Requirements	Section of PACR
3.2.5	Social licence principles	Consider social licence issues in the identification of credible options and include information about when and how social licence considerations have affected the identification and selection of credible options.	Appendix 2
3.4.3	Value of emissions reduction	The VER, reported in dollars per tonne of emissions (CO ₂ equivalent), is used to value emissions within a state of the world. A RIT-T proponent is required to use the then prevailing VER under relevant legislation or, otherwise, in any administrative guidance.	Appendix 3
3.5	Valuing costs	Costs are the present value of the following direct costs: - Constructing or providing the credible option; - Operating and maintenance costs; - Costs of complying with relevant laws, regulations and administrative requirements; and Costs of removing and disposing of existing assets (particularly for asset replacement programs).	5.4
3.5.3	Social licence costs	Provide the basis for any social licence costs, including any reference to best practice	5.1
3.5A.1	Cost estimation accuracy	Outline cost estimation process (as applicable to stage of the RIT-T)	5.1
3.5A.2	Cost estimation information	Details of inputs, assumptions and methodologies for each credible option (as applicable to the stage of the RIT-T) ³¹	5.1
3.6	Market benefit classes	Apply market benefit classes consistently across all credible options	5
3.7.3	Market benefits	Calculation of changes in Australia's greenhouse gases	N/A
3.8.2	Sensitivities	Sensitivity analysis on all credible options	Appendix 5

³¹ Although the provisions in section 3.5A.2 of the RIT-T Application Guidelines are not included in the table of binding requirements at Appendix C of the Guidelines, Powerlink has added them to the compliance checklist as the provisions are expressed as being binding in section 3.5A.2 of the guidelines.

3.9.4	Contingency allowance	Details of any contingency allowance included in a cost estimate for a credible option	N/A
3.11.2	Concessional finance	Provide sufficient detail about a concessional finance agreement	N/A
4.1	Community engagement	Description of assessment of requirement for community engagement and, as applicable, how engagement has been undertaken and any relevant concerns sought to be addressed, and how the proponent plans to engage with stakeholder groups.	1.5 Appendix 2

Notes:

N/A denotes not applicable.

Maintaining Reliability of Supply to Kamerunga, Cairns and Northern Beaches area



Contact us

Registered office	33 Harold St Virginia Queensland 4014 ABN 82 078 849 233
Postal address	PO Box 1193 Virginia Queensland 4014
Telephone	+61 7 3860 2111 (during business hours)
Email	networkassessments@powerlink.com.au
Website	powerlink.com.au
Social	   