CHAPTER 6

Future network development

6 Future network development

Key highlights

- Powerlink continues to be proactive and adapt to shifts in an increasingly uncertain, technically complex and dynamic operating environment.
- The proposed future network developments discussed in the 2022 Transmission Annual Planning Report (TAPR) do not include the investment in new transmission that is needed under the energy transformation as discussed in the Queensland Energy and Jobs Plan (QEJP) released in September 2022. The work to integrate these investments with the existing network asset risks is well underway.
- To deliver positive outcomes for customers, Powerlink applies a flexible and integrated approach to efficient investment decision-making, taking into consideration multiple factors including:
  - assessing whether an enduring need exists for assets and investigating alternate network configuration opportunities and/or non-network solutions, where feasible, to manage asset and network risks, including the potential impacts of the energy transformation
  - the role of emerging technologies and assessing a range of technical factors and dynamic changes in Powerlink's operating environment to ensure network resilience
  - enabling opportunities for the connection of new firming generation and variable renewable energy (VRE generation) where technically and economically feasible to deliver positive benefits to customers
  - actively seeking opportunities to implement more cost-effective solutions whenever possible, such as transmission line refits that avoid or delay the need to establish new transmission network infrastructure.
- The changing generation mix may lead to increased constraints across critical grid sections. Powerlink will consider these potential constraints holistically as part of the planning process and in conjunction with the findings of the most recent Integrated System Plan (ISP) and the QEJP.
- Powerlink has undertaken the necessary preparatory activities that informed the analysis for the 2022 ISP and QEJP.

6.1 Introduction

Powerlink Queensland as a Transmission Network Service Provider (TNSP) in the National Electricity Market (NEM) and as the appointed Jurisdictional Planning Body (JPB) by the Queensland Government is responsible for transmission network planning for the national grid within Queensland. Powerlink's obligation is to plan the transmission system to reliably and economically supply load while managing risks associated with the condition and performance of existing assets in accordance with the requirements of the National Electricity Rules (NER), Queensland's Electricity Act 1994 (the Act) and its Transmission Authority.

The NER (Clause 5.12.2(c)(3)) requires the TAPR to provide 'a forecast of constraints and inability to meet the network performance requirements set out in schedule 5.1 or relevant legislation or regulations of a participating jurisdiction over one, three and five years'. In addition, there is a requirement (Clause 5.12.2(c)(4)) to provide estimated load reductions that would defer forecast limitations for a period of 12 months and to state any intent to issue request for proposals for augmentation, replacement of network assets or non-network alternatives. The NER (Clause 5.12.2(c)) also requires the TAPR to be consistent with the TAPR Guidelines and include information pertinent to all proposed:

- augmentations to the network (Clause 5.12.2(c)(5))
- replacements of network assets (Clause 5.12.2(c)(5))
- network asset retirements or asset de-ratings that would result in a network constraint in the 10-year outlook period (Clause 5.12.2(c)(1A)).

This chapter on proposed future network developments contains:

- discussion on Powerlink's integrated planning approach to network development

- information regarding assets reaching the end of their service life and options to address the risks arising from ageing assets remaining in-service, including asset reinvestment, non-network solutions, potential network reconfigurations, asset retirements or de-ratings
- identification of emerging future limitations[1] with potential to affect supply reliability including estimated load reductions required to defer these forecast limitations by 12 months (Clause 5.12.2(c)(4)(iii))
- a statement of intent to issue request for proposals for augmentation, the proposed replacement of ageing network assets or non-network alternatives identified as part of the annual planning review (Clause 5.12.2(c)(4)(iv))
- a summary of network limitations over the next five years (Clause 5.12.2.(c)(3))
- details in relation to the need to address the risks arising from ageing network assets remaining in-service and those limitations for which Powerlink intends to address or initiate consultation with market participants and interested parties
- the manner in which proposed augmentations and the replacement of network assets relate to the Australian Energy Market Operator (AEMO)'s most recent ISP (Clause 5.12.2.(c)(6))
- a table summarising possible connection point proposals.

Where appropriate, all transmission network, distribution network or non-network alternatives are considered as options for investment. Submissions for non-network alternatives are invited by contacting networkassessments@powerlink.com.au.

6.2 ISP alignment

The 2022 ISP published by AEMO in June 2022 provides an independent, strategic view of the efficient development of the NEM transmission network to 2050.

Powerlink will proactively monitor the changing outlook for the Queensland region and take into consideration the impact of emerging technologies, withdrawal of coal-fired generation and the integration of VRE and firming generation in future transmission plans. These plans may include:

- reinvesting in assets to extend their end of technical service life
- removing some assets without replacement
- determining optimal sections of the network for new connection (in particular renewable generation) as discussed in detail in Chapter 10 and where applicable, in conjunction with the ISP
- replacing existing assets with assets of a different type, configuration or capacity
- investing in assets to maintain planning standards and deliver efficient market outcomes
- investing is assets and/or non-network solutions to meet Powerlink's obligations for system strength and voltage control (refer to Section 6.8 and Chapter 10)
- non-network solutions.

Given the energy transformation, there is the potential for significant expansion of the transmission network over the next 10 years and beyond. While not included in the 2022 TAPR analysis, this work is well underway and insights are provided in Powerlink's 'Actioning the Queensland Energy and Jobs Plan'. The 2023 TAPR will incorporate the QEJP in conjunction with the ISP to inform Powerlink's planning activities.

[1] Identification of forecast limitations in this chapter does not mean that there is an imminent supply reliability risk. The NER requires identification of limitations which are expected to occur some years into the future, assuming that demand for electricity is consistent with the forecast in this TAPR.

6.3 Flexible and integrated approach to network development

Powerlink's planning for future network development will focus on pursuing flexible solutions which can adapt to the changing environment. This approach will deliver positive outcomes for customers while ensuring the ongoing safe and reliable supply of electricity and may also include optimising the network topography based on the analysis of future network needs due to:

- forecast demand
- energy transformation, including the integration of VRE and new firming generation
- new customer access requirements including the development of Renewable Energy Zones (REZs)
- potential power system development pathways signalled in the ISP and QEJP
- anomalies in Powerlink's operating environment or changes in technical characteristics (e.g. minimum demand, system strength, inertia, voltage limitations) during the transformation to more VRE generation
- existing network configuration
- safety, condition and compliance based risks related to existing assets.

This planning process includes consideration of a broad range of options to address identified needs described in Table 6.1. Irrespective of the option or range of options used to address an identified need, where Powerlink identifies that there is a credible option greater than $7 million[2], Powerlink is required to undertake a Regulatory Investment Test for Transmission (RIT-T). The RIT-T describes the need, the credible options identified and defines the requirements for non-network alternatives.

[2] The Regulatory Investment Test for Transmission (RIT-T) cost threshold increased from $6 million to $7 million from 1 January 2022 (refer to the AER's 2021 Cost Threshold Review Determination).

Table 6.1 Examples of planning options

Option	Description
Augmentation	Increases the capacity of the existing transmission network, e.g. the establishment of a new substation, installation of additional plant at existing substations or construction of new transmission lines. This is driven by the need to meet prevailing network limitations and customer supply requirements, or where there may be net economic benefits to customers. An increase in network capacity may also unlock synergies to support the development of REZ.
System services	The assessment of future network requirements to meet overall power system performance standards and support the secure operation of the power system. This includes the provision of system strength services, inertia and reactive power services.
Reinvestment	Asset reinvestment planning ensures that existing network assets are assessed for their enduring network requirements in a manner that is economic, safe and reliable. This may result in like-for-like replacement, network reconfiguration, asset retirement, line refit or replacement with an asset of lower capacity. Condition and risk assessment of individual components may also result in the staged replacement of an asset where it is technically and economically feasible.
Network reconfiguration	The assessment of future network requirements may identify the reconfiguration of existing assets as the most economical option. This may involve asset retirement coupled with the installation of plant or equipment at an alternative location that offers a lower cost substitute for the required network functionality.
Asset de-rating or retirement	May include strategies to de-rate, decommission and/or demolish an asset and is considered in cases where needs have diminished in order to achieve long-term economic benefits.
Line refit	Powerlink utilises a line reinvestment strategy called line refit to extend the service life of a transmission line and provide cost benefits through the deferral of future transmission line rebuilds. Line refit may include structural repairs, foundation works, replacement of line components and hardware, abrasive blasting and painting.
Transformer refit	Powerlink utilises a transformer reinvestment strategy called transformer refit to extend the service life of a transformer to provide cost benefits through the deferral of the timing for a future transformer replacement. Transformer refit may include replacement of components such as high voltage bushings, tap changers and instruments, addressing sources of oil leaks such as replacement of gaskets and main lid sealing, replacement of transformer oil, and addressing radiator corrosion.
Non-network alternatives	Non-network solutions are not limited to, but may include network support and system services from existing and/or new generation, demand side management (DSM) initiatives (either from individual providers or aggregators), and other forms of technologies (such as battery installations). These solutions may reduce, negate or defer the need for network investments.
Operational measures	Network constraints may be managed during specific periods using short-term operational measures, e.g. switching of transmission lines or redispatch of generation in order to defer or negate network investment.

6.4 Forecast capital expenditure

The energy industry is going through a period of transformation driven by shifts in economic outlook, customer behaviour, government policy and regulation and emerging technologies that have reshaped the environment in which Powerlink delivers its transmission services. This has been further impacted by the COVID-19 pandemic.

In this rapidly changing environment, Powerlink is focusing on a staged, least regret and integrated approach to future network planning to ensure the transmission network is fit-for-purpose and able to meet customers' needs as the broader economy transforms to a lower carbon future. This includes assessing the enduring need for key ageing assets that are approaching the end of their technical service life and maintaining power system security. Powerlink's planning process considers alternative investment options such as network reconfiguration to manage asset condition or to address network limitations as well as non-network solutions where economic and technically feasible. Powerlink also maintains a focused and strategic approach in determining when it is appropriate to refit or replace ageing transmission assets and how to implement these works cost-effectively, such as targeted asset replacement or staged works that avoid or delay the need to establish new transmission network infrastructure. This approach is aimed at delivering positive outcomes for customers.

The proposed future network developments discussed in the 2022 TAPR do not include or take into account the investment in new transmission that is needed under the energy transformation as discussed in the QEJP released in September 2022.

6.4.1 External economic factors and transmission network investments

The external environment in which Powerlink operates is becoming more complex. Rising inflation and interest rates, and an ongoing disruption to supply chains and materials shortages due to COVID-19 and geopolitical impacts, continue to be a challenge. These global factors, coupled with domestic factors, such as a strong demand and a tight labour market with unemployment rates around generational lows[3], are contributing to an upward pressure on prices.

The economic impact of supply constraints, coupled with the increasing inflation rate in Australia which has risen to its highest levels since the early 1990s[4], is affecting infrastructure project costs. A market sounding report by Energy Networks Australia (ENA) has observed supply chain pressures resulting in up to 40% increases in capital expenditure and at least a 5% increase in operational pressure for major projects[5]. This included cost increases occurring across labour, fuel, logistics, steel, cement, copper, aluminium, and other key commodities.

While recognising these complexities, Powerlink is focused on identifying supply risks and delivering solutions to ensure customers continue to receive cost-effective and efficient services in this uncertain environment.

6.5 Forecast network limitations

As outlined in Section 1.8.1, under its Transmission Authority, Powerlink must plan and develop its network so that it can supply the forecast maximum demand with the system intact. The planning standard, which came into effect from July 2014, permits Powerlink to plan and develop the network on the basis that some load may be interrupted during a single network contingency event. Forward planning allows Powerlink adequate time to identify emerging limitations and to implement appropriate network and/or non-network solutions to maintain transmission services which meet the planning standard.

Emerging limitations may be triggered by thermal plant ratings (including fault current ratings), protection relay load limits, voltage stability and/or transient stability. Appendix E lists the indicative maximum short circuit currents and fault rating of the lowest rated plant at each Powerlink substation and voltage level, accounting for committed projects listed in Chapter 11 and existing and committed generation listed in Chapter 8.

Based on AEMO's Step Change scenario forecast discussed in Chapter 3, the maximum demand for electricity is expected to have mild growth with an average annual increase of 2% over the next 10 years.

3 Reserve Bank of Australia – Statement on Monetary Policy (August 2022).
4 Reserve Bank of Australia – Statement on Monetary Policy (August 2022).
5 Energy Networks Australia - Market sounding report on transmission.

AEMO's Step Change scenario forecast includes 500MW of new electrification load in the Gladstone zone by 2030. This would lead to network limitations on the main transmission system into the Gladstone zone. Notwithstanding this potential new load, Powerlink does not anticipate undertaking any significant augmentation works during this period based on load growth alone. However, the changing generation mix may lead to increased constraints across critical grid sections. Powerlink will consider these potential constraints, including the effects of falling minimum demand, holistically with the emerging condition based drivers as part of the planning process and in conjunction with the most recent ISP and the QEJP.

In Powerlink's Revenue Determination 2023-27[6], projects that could be triggered by the commitment of large mining or industrial block loads were identified as contingent projects. Contingent projects and their triggers are discussed in detail in Chapter 9.

In accordance with the NER, Powerlink undertakes consultations with AEMO, Registered Participants and interested parties on feasible solutions to address forecast network limitations through the RIT-T process. Solutions may include provision of network support from existing and/or new generators, DSM initiatives (either from individual providers or aggregators), other forms of technology (such as battery installations) and network augmentations.

6.5.1 Summary of forecast network limitations within the next five years

Powerlink has identified that due to declining minimum demand, changing nature of load and increasing penetration of VRE generation, there is an emerging need for additional reactive plant in various zones in Queensland to manage potential over-voltages. Table 6.2[7] summarises limitations identified in Powerlink's transmission network and noted in AEMO's December 2021 System Security Reports: System Strength, Inertia and NSCAS and May 2022 Update to 2021 System Security Reports.

[6] Information on Powerlink's Revenue Proposal for the regulatory period is available on Powerlink's website.
[7] Refer to NER Clause 5.12.2(c)(3).

Table 6.2 Limitations in the five-year outlook period

Limitation	Zone	Reason for anticipated limitation	Time limitation may be reached			Reference
			1-year outlook (2022/23)	3-year outlook (up to 2025/26)	5-year outlook (up to 2027/28)	
System strength shortfall at Gin Gin	Central West	AEMO declared system strength shortfall December 2021	From 31 March 2023 (2)			Section 6.8
Reactive power absorption gap in southern Queensland	Moreton	AEMO declared gap December 2021	Immediate gap (2)			Section 6.8
Managing voltages in Queensland	Central West		2020/21 project in progress (1)			Table 11.6
	Moreton		2022/23 (2)(3)			Section 6.11.4

Notes:

(1) The network risk associated with this limitation is currently being managed through a range of short-term operational measures until such time as the preferred option identified in the RIT-T, installation of a 275kV bus reactor at Broadsound Substation, is commissioned in June 2023.

(2) Refer to AEMO's December 2021 System Security Reports and Update to 2021 System Security Reports and Powerlink's Expression of Interest (EOI), Request for System Security Services in central, southern and the broader Queensland regions which is currently in progress to address the declared System Strength and NSCAS requirements and discussed in sections 6.8 and 10.4.1.

The short-term solution for the reactive power requirement to meet the immediate gap in southern Queensland is being addressed through the Request for System Security Services in central, southern and the broader Queensland EOI process. Taking the outcome of the EOI into consideration, it is expected that the longer term solution will be considered as part of the RIT-T process to manage voltages in south-east Queensland currently in progress.

(3) The network risk associated with this limitation is currently being managed through a range of operational measures and is anticipated to be further supported by the outcome of Powerlink's EOI (refer to note 2) until such time as the preferred option identified in the current RIT-T is implemented and/or a non-network solution identified through the RIT-T process is implemented.

Based on AEMO's Step Change scenario forecast discussed in Chapter 3 there are no other network limitations forecast to occur in Queensland in the next five years[8].

6.5.2 Summary of forecast network limitations beyond five years

The timing of forecast network limitations may be influenced by a number of factors such as load growth, industrial developments (including electrification of existing industrial processes), new and retiring generation, the planning standard and joint planning with other Network Service Providers (NSP). As a result, it is possible for the timing of forecast network limitations identified in a previous year's TAPR to change. However, there were no forecast network limitations identified in Powerlink's transmission network in the 2021 TAPR which fall into this category in 2022.

Based on AEMO's Step Change scenario forecast there is approximately 500MW of additional load connected in the Gladstone zone by 2031. This load is associated with electrification of existing customer's processes. The impact of this additional load is discussed in sections 6.10.2 and 9.2.3.

[8] Refer to NER Clause 5.12.2(c)(3).

6.6 Consultations

Network development to meet forecast demand is dependent on the location and capacity of generation developments and the pattern of generation dispatch in the competitive electricity market. Uncertainty about the generation pattern creates uncertainty about the power flows on the network and subsequently, which parts of the network will experience limitations. This uncertainty is a feature of the competitive electricity market and historically has been particularly evident in the Queensland region.

Proposals for transmission investments (which includes reinvestment and augmentations) over $7 million are progressed under the provisions of clauses 5.16.3 and 5.16.4 (not actionable ISP projects) and 5.16A (actionable ISP projects) of the NER. In particular, for projects which are not actionable ISP projects and taking into consideration the QEJP where appropriate, should action be considered necessary, Powerlink will:

- notify of anticipated limitations or risks arising from ageing network assets remaining in-service within the timeframe required for action
- seek input, initially via the TAPR, on potential solutions to network limitations which may result in transmission network or non-network investments in the 10-year outlook period
- issue detailed information outlining emerging network limitations, including system strength and inertia shortfalls, or the risks arising from ageing network assets remaining in-service to assist non-network solutions as possible genuine alternatives to network investments to be identified
- consult with AEMO, Registered Participants and interested parties on credible options (network or non-network) to address emerging limitations or the risks arising from ageing network assets remaining in-service
- carry out detailed analysis on credible options that Powerlink may propose to address identified network limitations or the risks arising from ageing network assets remaining in-service
- consult with AEMO, Registered Participants and interested parties on all credible options (network and non-network) and the preferred option
- implement the preferred option in the event an investment (network and/or non-network) is found to satisfy the RIT-T.

Alternatively, transmission investments may be undertaken under the funded augmentation provisions of the NER (Clause 5.18).

It should be noted that the information provided regarding Powerlink's network development plans may change and should be confirmed with Powerlink before any action is taken based on the information contained in this TAPR or the accompanying TAPR templates[9].

Based on customer feedback, the 2022 TAPR portal information has been expanded to include additional information and links to relevant public documentation to further assist customers.

6.6.1 Current consultations – proposed transmission investments

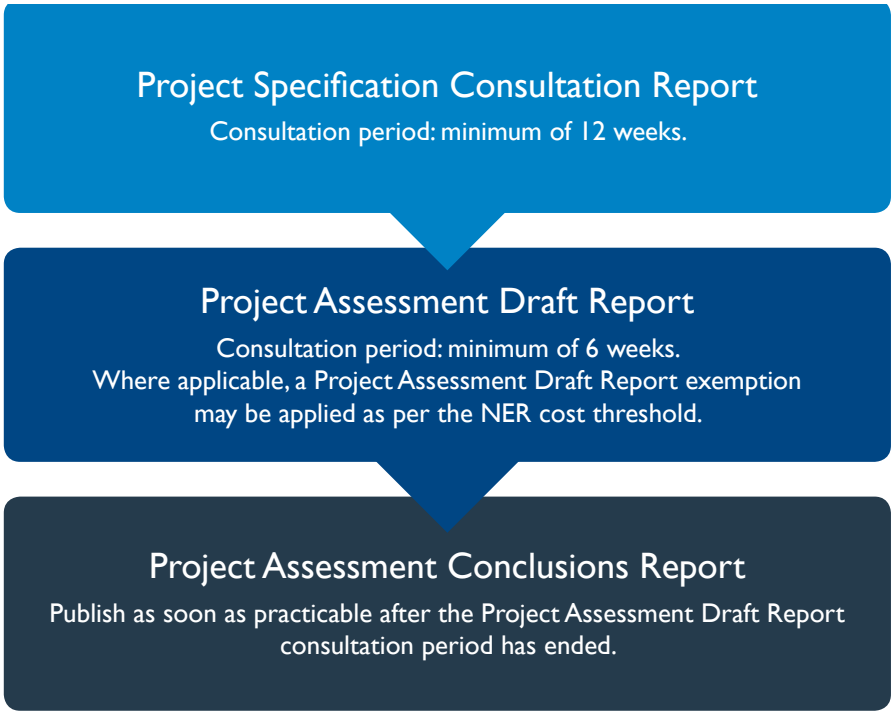
Commencing August 2010, proposals for transmission investments over $7 million addressing network limitations (augmentation works) are progressed under the provisions of Clause 5.16.4 of the NER. In September 2017 this NER requirement, to undertake a RIT-T, was extended[10] to include the proposed replacement of network assets. In July 2018 this was further extended to include proposed investments required to meet system strength and inertia shortfalls[11]. More recently, from 1 July 2020 a new process is in place for projects which have been identified in AEMO's ISP as actionable ISP projects (Clause 5.16A).

Powerlink carries out separate consultation processes for each proposed new transmission investment over $7 million by utilising the applicable RIT-T consultation process. The majority of RIT-T consultations undertaken by Powerlink relate to projects which are not actionable ISP projects (refer to Figure 6.1).

9 In accordance with the AER's TAPR Guidelines published in December 2018 and made available in Powerlink's TAPR portal.
10 Replacement expenditure planning arrangements Rule 2017 No. 5.
11 A RIT-T exemption applies if the inertia or system strength services must be made available less than 18 months after the notice is given by AEMO under clauses 5.20B.3(c) and 5.20C.2(c).

6 Future network development

Figure 6.1 Overview of the RIT-T consultation process for projects which are not actionable ISP projects



The consultations completed since publication of the 2021 TAPR are listed in Table 6.3 (refer also to Table 11.6).

Table 6.3 RIT-T consultations completed since publication of the 2021 TAPR

Consultation
Maintaining reliability of supply in the Cairns region – Stage 1
Addressing the secondary systems condition risks at Innisfail
Addressing the secondary systems condition risks at Chalumbin
Maintaining reliability of supply in the Tarong and Chinchilla local areas

RIT-T consultations currently underway are listed in Table 6.4

Table 6.4 RIT-T consultations currently underway

Consultation (1)	Reference
Managing voltages in South East Queensland	Section 6.11.4
Managing power transfer capability and reliability of supply at Redbank Plains	Section 6.11.4

Note:
(1) The consultations reflect the RIT-T status as at 30 September 2022.

Other consultations (non RIT-T) currently underway since publication of the 2021 TAPR are listed in Table 6.5.

Table 6.5 Other consultations currently underway since publication of the 2021 TAPR[12]

Consultation	Reference
Request for power system security services in central, southern and the broader Queensland region	Section 6.8

Registered Participants and interested parties are referred to the consultation documents which are published and made available on Powerlink's website for further information.

6.6.2 Future consultations – proposed transmission investments

Anticipated consultations

Notwithstanding consideration of the QEJP and power system security requirements, Powerlink's capital expenditure program of work in the 10-year outlook period will focus on investment in the transmission network to manage the risks arising from ageing assets remaining in-service. These emerging risks are discussed in Section 6.9 to 6.11. Table 6.6 summarises consultations Powerlink anticipates undertaking within the next 12 months under the Australian Energy Regulator's (AER) RIT-T to address either the proposed investment in a network asset or limitation.

Table 6.6 Anticipated consultations in the forthcoming 12 months (to October 2023)

Consultation (1)	Reference
Addressing the secondary systems condition risks at Tangkam	Section 6.11.1
Addressing the secondary systems condition risks at Mudgeeraba	Section 6.11.5

Note:

(1) The anticipated consultations listed in Table 6.6 reflect the RIT-T status as at 30 September 2022.

Future ISP projects

The 2022 ISP did not identify any 'actionable' projects within Queensland. However, the 2022 ISP did identify several projects that are part of the optimal development path and may become actionable in future ISPs. Further to the three preparatory activities reports previously provided to AEMO[13], two additional projects were nominated for Preparatory Activities by 30 June 2023. These include:

- Darling Downs REZ Expansion
- QNI Connect (500kV option Powerlink and Transgrid).

Preparatory activity reports for these projects will be provided to AEMO by 30 June 2023 and are discussed further in Section 9.3. The commencement for consultation for these projects will be triggered by future ISPs and considered in conjunction with the QEJP[14].

6.6.3 Connection point proposals

Planning of new or augmented connections involves consultation between Powerlink and the connecting party, determination of technical requirements and completion of connection agreements. New connections can result from joint planning with the relevant Distribution Network Service Provider (DNSP)[15] or be initiated by generators or customers.

Table 6.7 lists connection works that are anticipated to be required within the 10-year outlook period.

12 Power System Security Consultations

13 Preparatory Activities reports for Central to Southern Queensland, Gladstone Grid Reinforcement and QNI connect were provided to AEMO by 30 June 2021.

14 Refer to Section 5.16A.3.

15 In Queensland, Energex and Ergon Energy (part of the Energy Queensland Group) and Essential Energy are the DNSPs.

6 Future network development

Table 6.7 Connection point commitments[16]

Connection point name (1) (2)	Proposal	Zone
Clarke Creek Wind Farm	New wind farm	Central West
Bouldercombe Battery Energy Storage System (BESS)	New BESS	Central West

Notes:

(1) When Powerlink constructs a new line or substation as a non-regulated customer connection (e.g. conventional generator, renewable generator, mine or industrial development), the costs of acquiring easements, constructing and operating the transmission line and/or substation are paid for by the company making the connection request.

(2) The listed connection point commitments are in progress (refer to Table 11.1).

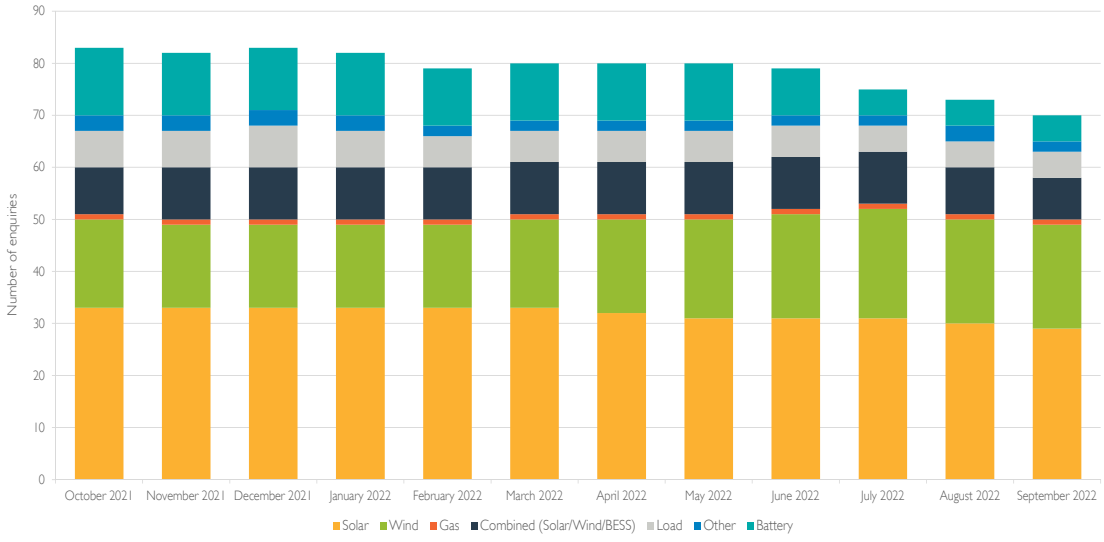
It should be noted that while not fully at the stage where the project can be classified as committed under the NER[16] at the time of publication of the 2022 TAPR, Powerlink has signed an agreement for the construction of assets for the connection of the MacIntyre Wind Precinct proposed renewable development to the transmission network in south-west Queensland[17]. More information on this project is available on Powerlink's website.

Table 6.8 summarises connection point activities[18] undertaken by Powerlink since publication of the 2021 TAPR (refer also to figures 6.2 and 6.3). Further details on potential new generation connections are available in the relevant TAPR template located on Powerlink's TAPR portal as noted in Appendix B.

Table 6.8 Connection point activities

Generator Location	Number of Applications	Number of Connection Agreements	Generator Type and Technology
North	5	0	Solar, Wind, Hydro, Storage
Central	7	2	Solar, Wind, Storage
South	20	0	Solar, Wind, Storage
Total	32	2	

Figure 6.2 Customer enquiries per month since publication of the 2021 TAPR

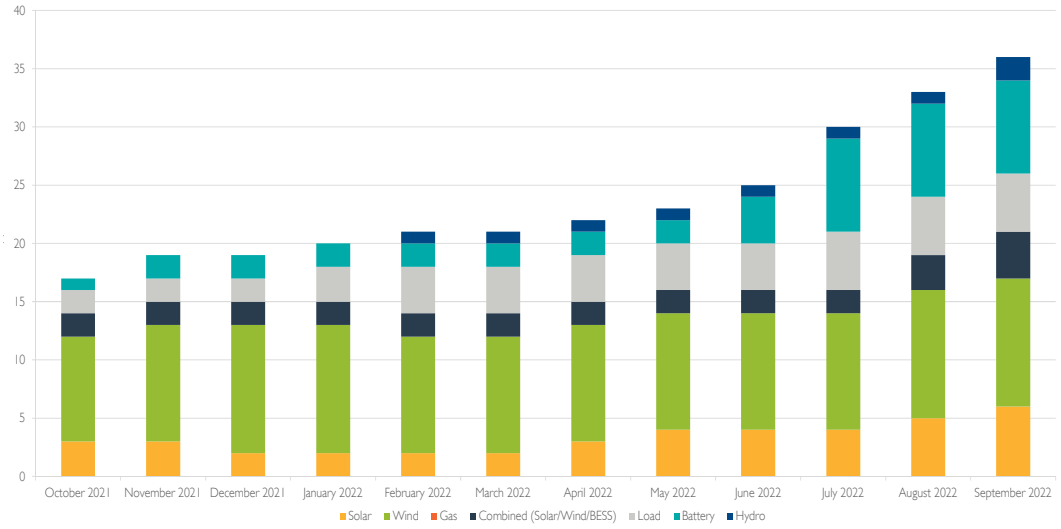


16 AEMO's definition of 'committed' from the System Strength Impact Assessment Guidelines (effective 1 July 2018) has been adopted for connection point proposals identified in the TAPR.

17 As not included in Table 6.7, the MacIntyre and Karara Wind Farms are included in the connection point activities as noted in Table 6.8.

18 More broadly, key connection information in relation to the NEM can be found on AEMO's website.

Figure 6.3 Cumulative customer applications per month since publication of the 2021 TAPR



6.7 Proposed network developments

The proposed future network developments discussed in the 2022 TAPR do not include the investment in new transmission that is needed under the energy transformation as discussed in the QEJP recently released in September 2022. Notwithstanding this, Powerlink's capital expenditure program of work will also focus on the risks arising from the condition and performance of existing aged assets, as well as emerging limitations in the capability of the network as the broader economy transforms to a lower carbon future.

As the Queensland transmission network experienced considerable growth in the period from 1960 to 1980, there are now a large number of transmission assets ranging from 40 to just beyond 60 years old. It has been identified that a number of these assets are approaching the end of their technical service life and investment in some form is required within the 10-year outlook period in order to manage emerging risks related to safety, reliability and other factors.

In conjunction with condition assessments and risk identification, as assets approach their anticipated end of technical service life, possible investment options undergo detailed planning studies to confirm alignment with future investment, optimisation and delivery strategies. These studies have the potential to provide Powerlink with an opportunity to:

- improve and further refine options under consideration
- identify other options from those originally specified, including a consideration of the broader energy transformation where appropriate, which may deliver a greater benefit to customers.

Information regarding possible investment alternatives, network limitations and anticipated timing is updated annually within the TAPR and includes discussion on significant changes which have occurred since publication of the previous year's TAPR.

Where applicable, in relation to proposed expenditure for the replacement of network assets or network augmentations, Powerlink will consult with AEMO, Registered Participants and interested parties on feasible solutions identified through the RIT-T. The latest information on RIT-T publications can be found on Powerlink's website.

6 Future network development

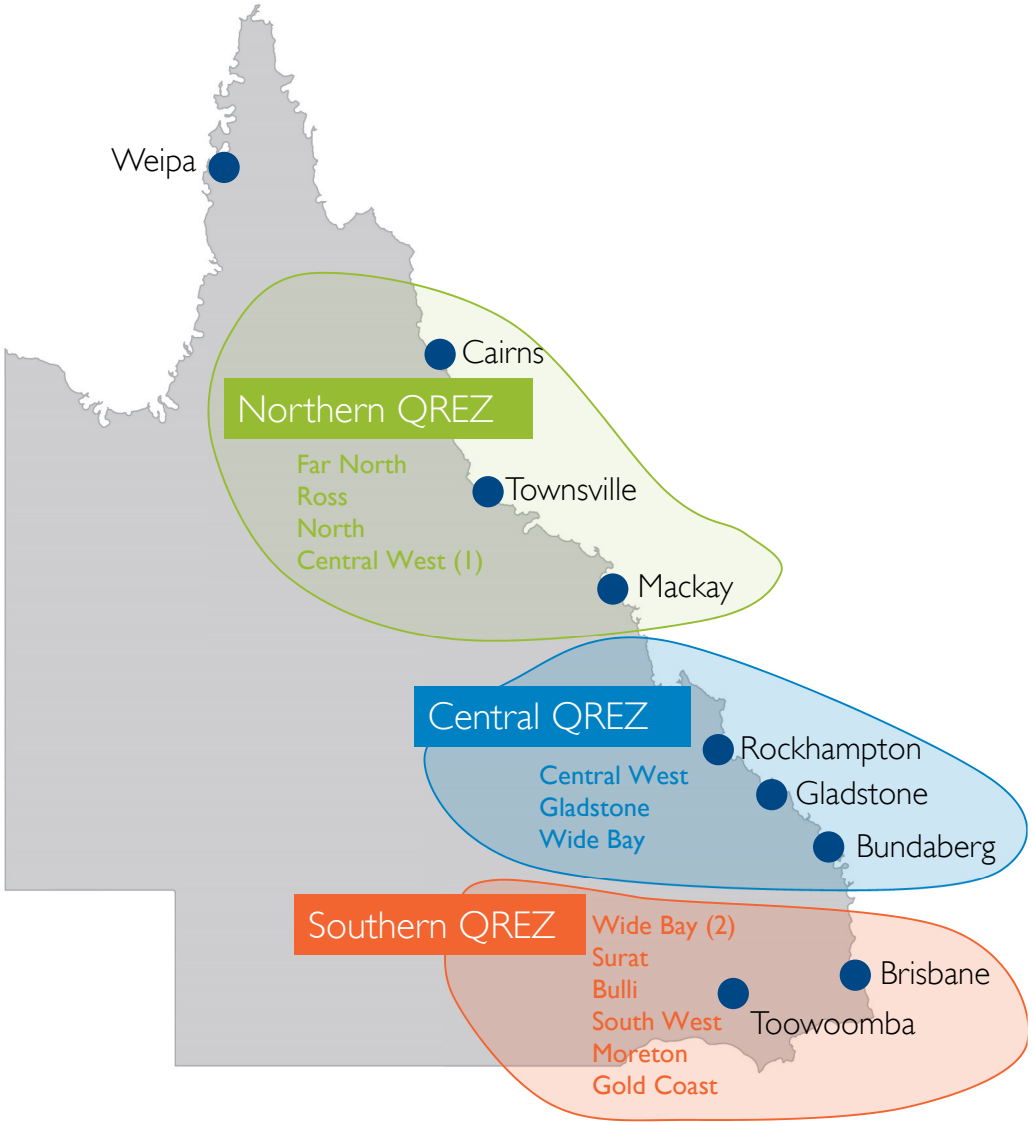
Proposed network developments discussed within this chapter identify the most likely network solution, although this has the potential to change with ongoing detailed analysis of asset condition and risks, network requirements, the dynamic impacts of energy transformation or as a result of RIT-T consultations. The indicative cost of potential projects is also updated each year to keep pace with external project cost increases that are being experienced broadly across many industries (refer to Section 6.4.1). On balance, where there may be other factors materially influencing the updated indicative cost, such as a more granular view of condition and project scope, these factors are noted in the relevant summary table included at the end of each zone discussion.

Other than the outcomes set out in the 2021 System Security Reports and May 2022 Update (refer to Section 6.8) and based on the current information available, Powerlink considers all of the possible network developments discussed in this chapter are outside of the scope of the most recent ISP and Power System Frequency Risk Review (PSFRR). Powerlink also reviews the rating of assets throughout the transmission network periodically and has not identified any required asset de-ratings that would result in a system limitation as part of the 2022 annual planning review.

6.7.1 Geographical context

An analysis of investment needs and potential limitations has been performed across Powerlink's standard geographic zones (refer to sections 6.9 to 6.11). Given the rapid pace of the energy transformation, to provide geographical context, the reinvestment needs and network limitations are aligned with the Queensland Renewable Energy Zones (QREZ) development areas as shown in Figure 6.4.

Figure 6.4 Queensland Renewable Energy Zones



6.7.2 Investment context, timeframes and description

Against the backdrop of a rapidly changing electricity sector, Powerlink's planning overview (10-year outlook period of the TAPR) includes consideration of a range of options to address identified needs. In this context, when considering the replacement of existing assets in conjunction with the broader network topography, Powerlink may identify potential network reconfigurations or other options which would be economically assessed under the RIT-T (if applicable). These options may identify opportunities to develop the transmission network in such a way as to realise synergies and efficiencies as the broader economy transforms to a lower carbon future, delivering positive outcomes for customers.

Information in relation to potential projects, alternatives and possible commissioning needs will be revised annually within the TAPR based on the latest information available at the time.

For clarity, possible network investments (which includes reinvestment and augmentations) have been separated into two periods.

6 Future network development

Possible network investments within five years

This includes the financial period from 2022/23 to 2027/28 for possible near-term investments when:

- confirmation of the enduring network need and timing occurs
- detailed planning studies are underway or have recently been finalised.

Possible network investments within six to 10 years

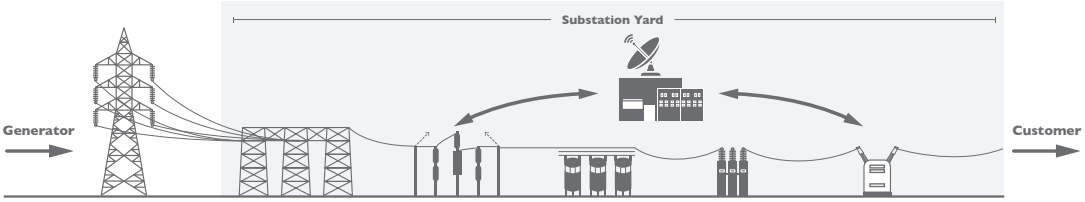
This includes the financial period from 2028/29 to 2032/33, for possible medium to long-term investments. Powerlink takes a balanced, prudent and proportionate approach to the consideration of investment needs to address the risks arising from network assets in the medium to long-term and undertakes detailed planning analysis and condition assessment closer to the possible investment date, typically within five years.

In addition, due to the current dynamic operating environment, there is less certainty regarding the needs or drivers for investments in these later years of the annual planning review period. As a result, considerations in this period have a greater potential to change when compared to near-term investments. Possible investment considerations within six to 10 years will need to be flexible in order to adapt to externally driven changes as the broader economy transforms to a lower carbon future and customer behaviours continue to change. Any significant adjustments which may occur as a result of changes will be updated and discussed in subsequent TAPRs.

Powerlink also takes a value-driven approach to the management of asset risks to ensure an appropriate balance between reliability and the cost of transmission services which ultimately benefits customers. Each year, taking the most recent assessment of asset condition and risk into consideration, Powerlink reviews possible commissioning dates and where safe, technically feasible and prudent, capital expenditure is delayed. As a result, there may be timing variances between the possible commissioning dates identified in the 2021 TAPR and 2022 TAPR and TAPR Templates. Significant timing differences are noted in the analysis of the program of work within this chapter (refer to sections 6.9 to 6.11).

The functions performed by the major transmission network assets discussed in this chapter are illustrated in Figure 6.5.

Figure 6.5 The functions of major transmission assets



Transmission line

A transmission line consists of tower structures, high voltage conductors and insulators and transports bulk electricity via substations to distribution points that operate at lower voltages.

Substation

A substation, which is made up of primary plant, secondary systems, telecommunications equipment and buildings, connects two or more transmission lines to the transmission network and usually includes at least one transformer at the site.

A substation that connects to transmission lines, but does not include a transformer, is known as a switching station.

- **Substation bay**
  A substation bay connects and disconnects network assets during faults and also allows maintenance and repairs to occur. A typical substation bay is made up of a circuit breaker (opened to disconnect a network element), isolators and earth switches (to ensure that maintenance and repairs can be carried out safely), and equipment to monitor and control the bay components.

- **Static VAR Compensator (SVC)**
  A SVC is used where needed, to smooth voltage fluctuations, which may occur from time-to-time on the transmission network. This enables more power to be transferred on the transmission network and also assists in the control of voltage.

- **Capacitor Bank**
  A capacitor bank maintains voltage levels by improving the 'power factor'. This enables more power to be transferred on the transmission network.

- **Transformer**
  A transformer is used to change the voltage of the electricity flowing on the network. At the generation connection point, the voltage is 'stepped up' to transport higher levels of electricity at a higher voltage, usually 132kV or 275kV, along the transmission network. Typically at a distribution point, the voltage is 'stepped down' to allow the transfer of electricity to the distribution system, which operates at a lower voltage than the transmission network.

- **Bus reactor**
  A bus reactor is used to control voltages on the high voltage system. Bus reactors are used especially during light load conditions to manage high voltages which may occur on the network.

Secondary systems

Secondary systems equipment assists in the control, protection and safe operation of transmission assets that transfer electricity in the transmission network.

Telecommunication systems

Telecommunication systems are used to transfer a variety of data about the operation and security of the transmission network including metering data for AEMO.

6.8 Power system security requirements

In May 2022 Powerlink published an Expression of Interest (EOI), Request for Power System Security Services in central, southern and broader Queensland regions. The EOI requested submissions from potential solution providers to ascertain and evaluate options (both non-network and network) to meet the power system security requirements identified in the AEMO's 2021 System Security Reports: System Strength, Inertia and NSCAS and Update to 2021 System Security Reports published on 17 December 2021 and 11 May 2022 respectively.

The EOI requested potential non-network solutions to address AEMO's declared shortfalls of:

- an immediate system strength shortfall of up to 90MVA at the Gin Gin 275kV fault level node, located in the Wide Bay zone, to be addressed from 31 March 2023
- an NSCAS gap of 120MVAr, more specifically a Reliability and Security Ancillary Service (RSAS) gap[19], in southern Queensland to be addressed immediately and rising to 250MVAr by 2026.

Submissions closed on the 24 June 2022 and Powerlink is currently clarifying submission information and performing technical and economic feasibility assessments for the declared shortfalls. Further information will be published by early 2023 once all offers have been fully evaluated and discussed in the 2023 TAPR.

6.9 Northern region

The Northern region includes proposed network investments located within the Far North, Ross and North zones and broadly aligns with the Northern QREZ development area stretching between Mackay and Cairns, encompassing the northern most extent of Powerlink's transmission network. The Northern region also includes a number of candidate REZ areas in north Queensland identified in the 2022 ISP optimal development pathway (refer to Figure 9.2).

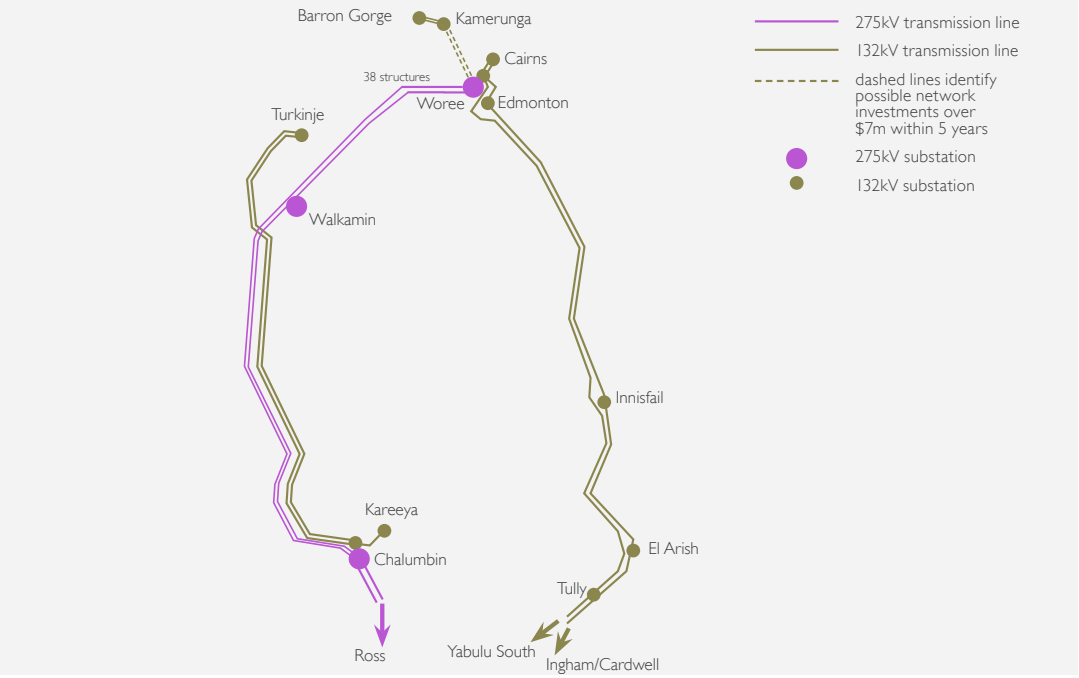
6.9.1 Far North zone

Existing network

The Far North zone is supplied by a 275kV transmission network with major injection points at Chalumbin and Woree, and a coastal 132kV network from Yabulu South to Tully to Woree. This network supplies the Ergon Energy distribution network feeding the surrounding areas of Turkinje and Cairns, from Tully to Cooktown. The network also connects various renewable generators including the hydro power stations at Barron Gorge and Kareeya, and Mt Emerald Wind Farm near Walkamin (refer to Figure 6.6).

[19] Reliability and Security Ancillary Service (RSAS) gap.

Figure 6.6 Far North zone transmission network



Possible load driven limitations

Based on AEMO's Step Change scenario forecast discussed in Chapter 3, there is no additional capacity forecast to be required as a result of network limitations in the Far North zone within the next five years to meet reliability obligations.

Possible network investments within five years

Network investments (which include reinvestments and augmentations) in the Far North zone are related to addressing the risks arising from the condition of the existing network assets, which without corrective action, would result in Powerlink being exposed to breaching a number of its jurisdictional network, safety, environmental and Rules obligations.

By addressing the condition of these existing assets, Powerlink is seeking to ensure it can deliver a safe, cost-effective and reliable supply of electricity to customers in the Far North zone into the future. This may result in like-for-like replacement, non-network solutions, network reconfiguration, asset retirement, line refit or replacement with an asset of lower capacity.

Transmission lines

Woree to Kamerunga 132kV transmission lines

Potential consultation	Maintaining reliability of supply to Cairns northern beaches area
Project driver	Emerging condition risks due to structural corrosion
Project timing	December 2026
Proposed network solution	Maintaining 132kV network topology by replacing the existing double circuit transmission line with a new double circuit transmission line on a new easement from Woree to Kamerunga substations at an estimated cost of $42 million, by December 2026

The Woree to Kamerunga 132kV double circuit transmission lines were constructed in 1963. Originally connected to Cairns, it provides critical supply to the Cairns northern beaches region, as well as connecting the Barron Gorge Hydro Power Station (PS) to the 275kV network.

In 2014, life extension works were performed on certain components of this transmission line that were nearing the end of their technical service life. However, it is anticipated that reinvestment will again be required by 2026. The location of the existing structures poses access and construction work challenges. A possible end of technical service life strategy for this transmission line is replacement on a new easement. Investigations for easement alternatives are currently underway.

Possible network solutions

- Maintaining the existing 132kV network topography by replacing the existing double circuit transmission line with a new double circuit transmission line from Woree and Kamerunga substations by December 2026[20]
- Network reconfiguration by establishing two single circuit 132kV transmission lines between Woree and Kamerunga substations, or via Cairns North Substation, by December 2026.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Potential non-network solutions would need to provide supply to the 22kV network of up to a peak 70MW, and up to a peak 1,200MWh per day on a continuous basis. It should be noted that this transmission line also facilitates the Barron Gorge Hydro PS connection in the area.

Ross to Chalumbin to Woree 275kV transmission lines

Potential consultation	Maintaining reliability of supply in the Cairns region Stage 2 - Addressing the condition risks of the transmission towers between Ross and Chalumbin
Project driver	Emerging condition risks due to structural corrosion
Project timing	December 2029
Proposed network solution	Refit the double circuit transmission line between Ross and Chalumbin substations, at an estimated cost of $72 million, by December 2029

The bulk supply of electricity to the Cairns region in Far North Queensland is provided by generators in Central and Northern Queensland, via a 132kV coastal network and a 275kV inland network, as well as a 'run of the river' hydro power station north of Cairns at Barron Gorge, which is connected to the 132kV network. The majority of supply to the Cairns region is delivered through the inland 275kV network to Ross, near Townsville. From Ross it is transferred via a 275kV transmission line to Chalumbin, continuing via a second 275kV transmission line from Chalumbin to the Woree Substation on the outskirts of Cairns. These 275kV transmission lines also provide connections to the Mt Emerald Wind Farm, committed Kaban Wind Farm and Kareeya Power Station (PS). As a result of the funded augmentation consultation undertaken by Powerlink to facilitate the development of Stage 1 of the Northern QREZ, establishment of a 3rd 275kV connection into Woree Substation is expected to be completed in November 2023.

Due to the environmental sensitivities and geographic conditions which occur in the Cairns region, to ensure reliability of supply to customers, the delivery of the required renewal works will be complex and need to be completed outside of summer peak load and the wet season.

The Chalumbin to Woree section of line was built in 1998 and is approximately 140km in length. While the condition of a large majority of the line is consistent with its age, this is not the case for the final 16km into Cairns between Davies Creek and Bayview Heights. To address the more complex and advanced condition risks of this section of the transmission line, in June 2022 Powerlink completed a RIT-T, Maintaining reliability of supply in the Cairns region Stage 1- Addressing the condition risks of the transmission towers between Davies Creek and Bayview Heights. The Project Assessment Conclusions Report (PACR) identified the preferred option for implementation, refit of the 37 towers through the selective replacement of corroded members and components, along with the painting of all 37 towers (refer to Table 11.6).

[20] This excludes easement costs yet to be determined.

The double circuit 275kV transmission line between Ross and Chalumbin substations is 244km in length and comprises 528 steel lattice towers. The line was commissioned in 1989 and traverses the rugged terrain of the NQ tropical rain forest, passing through environmentally sensitive, protected areas and crossing numerous regional roads and rivers. This section of the transmission line is deteriorating at a slower rate than assets assessed under Stage 1 works due to its location on the western side of the Great Dividing Range. A potential reinvestment for this section (based on the most recent condition assessment) is expected around 2029 (refer to Table 6.10).

Possible non-network solutions

The Ross to Chalumbin transmission lines provide injection to the north area of close to 400MW at peak and up to 3,000MWh per day.

It should be noted that the network configuration also facilitates generator connections in the area and provides system strength and voltage support for the region.

Substations

Edmonton 132/22kV Substation

Potential consultation	Addressing the secondary systems condition risks at Edmonton
Project driver	Condition driven replacement to address emerging obsolescence and compliance risks on 132kV secondary systems
Project timing	June 2026
Proposed network solution	Selected replacement of secondary systems at an estimated cost of $6 million by June 2026

Edmonton Substation, established in 2005, is an essential 132kV switching station and bulk supply point for Ergon Energy that provides supply to coastal communities between Townsville and Cairns and support to the Cairns area in the event of a contingency on the 275kV lines supplying FNQ. The majority of Edmonton secondary systems are anticipated to reach end of technical service life around 2026.

Possible network solutions

- Selected replacement of secondary systems components by June 2026
- Full replacement of secondary systems components by June 2026.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Potential non-network solutions would need to provide supply to the 22kV network at Edmonton of up to 55MW at peak and up to 770MWh per day. The non-network solution would be required for a contingency and to be able to operate on a continuous basis until normal supply is restored. Supply would also be required for planned outages.

Possible network investments in the Far North zone within five years

As assets approach their anticipated end of technical service life, the potential projects and alternatives (options) listed in Table 6.9 will be subject to detailed analysis to confirm alignment with future investment, optimisation and delivery strategies. This analysis provides Powerlink with an additional opportunity to assess the needs and timing of asset replacement works, further refine options or consider other options, including the associated delivery strategies, from those described in Table 6.9.

Table 6.9 Possible network investments in the Far North zone within five years

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative cost
Transmission lines					
Rebuild the 132kV transmission line between Woree and Kamerunga substations	New 132kV double circuit transmission line	Maintain supply reliability to the Far North zone	December 2026	Two 132kV single circuit transmission lines (1)	$42m
Substations					
Tully 132/22kV transformer replacement	Replacement of the transformer	Maintain supply reliability to the Far North zone	June 2024	Life extension of the existing transformer or a non-network alternative of up to 15MW at peak and up to 100MWh per day on a continuous basis to provide supply to the 22kV network at Tully	$6m(2)
Edmonton 132kV secondary systems replacement	Full replacement of 132kV secondary systems	Maintain supply reliability to the Far North zone	June 2026	Selected replacement of 132kV secondary systems (1)	$6m
Barron Gorge 132kV secondary systems replacement	Full replacement of 132kV secondary systems	Maintain supply reliability to the Far North zone	December 2026	Selected replacement of 132kV secondary systems	$4m
Turkinje 132kV primary plant replacement	Selected replacement of 132kV primary plant	Maintain supply reliability to the Far North zone	December 2026	Full replacement of 132kV primary plant	$4m

Notes:

(1) The envelope for non-network solutions is defined in Section 6.9.1.

(2) At the time of publication of the 2022 TAPR, Powerlink does not anticipate the most expensive credible option will reach the RIT-T cost threshold of $7m.

Possible network investments within six to 10 years

As a result of the annual planning review, Powerlink has identified that the following investments are likely to be required to address the risks arising from network assets reaching end of technical service life and to maintain reliability of supply in the North zone from around 2028/29 to 2032/33 (refer to Table 6.10).

Table 6.10 Possible network investments in the Far North zone within six to 10 years

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative costs
Transmission Lines					
Line refit works on the 275kV transmission lines between Ross and Chalumbin substations	Staged line refit works on steel lattice structures	Maintain supply reliability to the Far North and Ross zones	Staged works by December 2029 (1)	New transmission line (2)	$72m
Substations					
Kamerunga 132/22kV transformer replacement	Replacement of the transformer	Maintain supply reliability to Cairns northern beaches area	December 2028	Significant load transfers in distribution network Early replacement with higher capacity transformer by 2023 triggered by load growth	$6m (3)
Chalumbin 275kV and 132kV primary plant replacement	Selected replacement of 275kV and 132kV primary plant	Maintain supply reliability to the Far North zone	December 2028	Full replacement of all 275kV and 132kV primary plant and secondary systems	$7m
275/132kV substation establishment to maintain supply to Turkinje substation	Establishment of 275/132kV switching substation near Turkinje including two transformers	Maintain supply reliability to Turkinje area	June 2029	Refit of the Chalumbin to Turkinje 132kV transmission line	$39m
Woree 275kV and 132kV secondary systems replacement	Selected replacement of 275kV and 132kV secondary systems	Maintain supply reliability to the Far North zone	June 2029	Full replacement of 275kV and 132kV secondary systems	$17m
El Arish 132kV secondary systems replacement	Selected replacement of 132kV secondary systems	Maintain supply reliability to the Far North zone	June 2031	Full replacement of 275kV and 132kV secondary systems	$5m

Notes:

(1) The change in timing of the network solution from the 2021 TAPR is based upon updated information on the condition of the assets.

(2) The envelope for non-network solutions is defined in Section 6.9.1.

(3) Compared to the 2021 TAPR, the change in the estimated cost of the proposed network solution is based upon updated information in relation to the construction costs of recently completed projects.

Possible asset retirements in the 10-year outlook period[21]

Retirement of the 132kV transmission line between Chalumbin and Turkinje substations.

Condition assessment has identified emerging condition risks arising from the condition of the 132kV transmission line between Chalumbin and Turkinje around 2029. At this time, an option would be to establish a 275kV Substation at Turkinje and cut into an existing 275kV Chalumbin to Woree circuit via a new 275kV DC line constructed from Turkinje. Should this option eventuate, there will be an opportunity to retire the existing 132kV transmission line from Chalumbin to Turkinje.

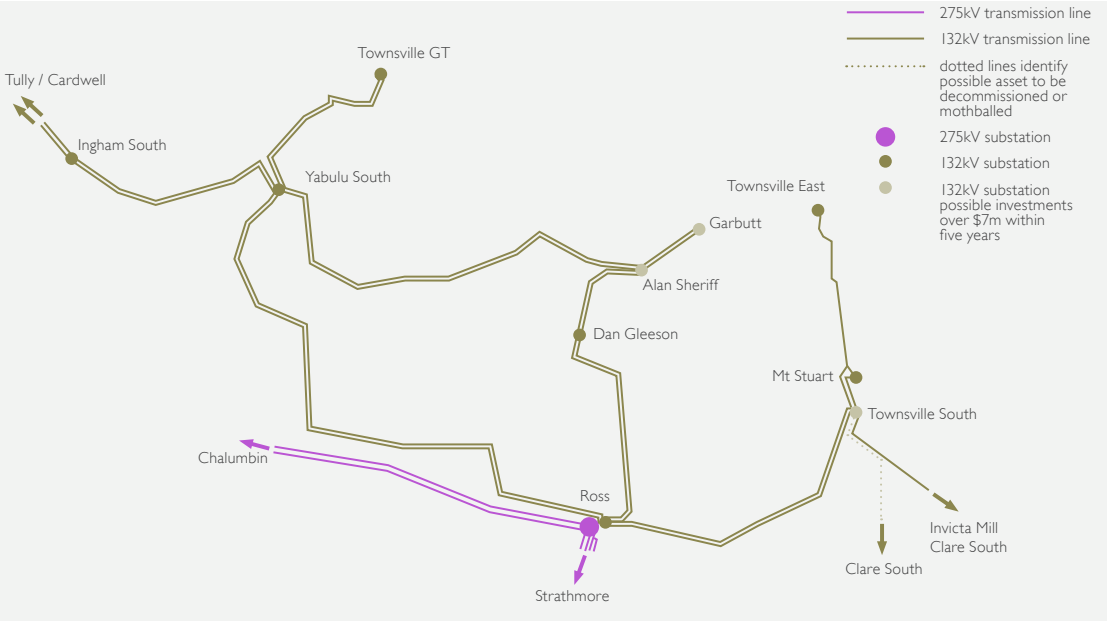
Refer Table 11.7 for confirmed asset retirements in the Far North zone and Table 6.30 for possible asset retirements beyond the 10-year outlook period.

6.9.2 Ross zone

Existing network

The 132kV network between Collinsville and Townsville was developed in the 1960s and 1970s to supply mining, commercial and residential loads. The 275kV network within the zone was developed more than a decade later to reinforce supply into Townsville and FNQ. Parts of the 132kV network are located closer to the coast in a high salt laden wind environment leading to accelerated structural corrosion (refer to figures 6.7 and 6.8).

Figure 6.7 Northern Ross zone transmission network



[21] Operational works, such as asset retirements, do not form part of Powerlink's capital expenditure budget.

Figure 6.8 Southern Ross zone transmission network

Possible load driven limitations

Based on AEMO's Step Change scenario forecast discussed in Chapter 3, there is no additional capacity forecast to be required as a result of network limitations in the Ross zone within the next five years to meet reliability obligations.

Possible network investments within five years

Network investments (which includes reinvestment and augmentations) in the Ross zone are related to addressing the risks arising from the condition of the existing network assets, which without corrective action, would result in Powerlink being exposed to breaching a number of its jurisdictional network, safety, environmental and Rules' obligations.

By addressing the condition of these existing assets, Powerlink is seeking to ensure it can safely deliver an adequate, economic, and reliable supply of electricity to meet the load requirements of customers in the Ross zone into the future. This may result in like-for-like replacement, non-network solutions, network reconfiguration, asset retirement, line refit or replacement with an asset of lower capacity.

Substations

Alan Sherriff 132kV Substation

Potential consultation	Addressing the secondary systems condition risks at Alan Sherriff
Project driver	Condition driven replacement to address emerging obsolescence and compliance risks on 132kV secondary systems
Project timing	June 2025
Proposed network solution	Selected replacement of secondary systems at estimated cost of $12 million by June 2025

Alan Sherriff Substation was established in 2002 as a two transformer substation, and replaced the 132kV switching functions at Garbutt in 2004. The substation is a major injection point into Ergon Energy's 66kV distribution network providing supply to the Townsville area.

Possible network solutions

- Selected replacement of secondary systems.
- Full replacement of all secondary systems.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Potential non-network solutions would need to provide supply to the 11kV network in north east Townsville of up to 25MW at peak and up to 450MWh per day. Reconfiguration of the 132kV network at Alan Sherriff, and of the Townsville 66kV network around Townsville, would be required to facilitate removal of Alan Sherriff Substation.

Ingham South 132kV Substation

Potential consultation	Addressing the secondary systems condition risks at Ingham South
Project driver	Condition driven replacement to address emerging obsolescence and compliance risks on 132kV secondary systems
Project timing	June 2026
Proposed network solution	Full replacement of secondary systems at an estimated cost of $6 million by June 2026

Ingham South Substation was established in 2005 and is a major injection point into Ergon Energy's 66kV distribution network providing supply to the Ingham area. The secondary systems installed are anticipated to reach end of technical service life around 2026.

Possible network solutions

- Selected replacement of the secondary systems components by June 2026
- Full replacement of all secondary systems and associated panels in a new building by June 2026.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Potential non-network solutions would need to provide supply to the 66kV network at Ingham South of up to 20MW and up to 280MWh per day. The non-network solution would be required for a contingency and to be able to operate on a continuous basis until normal supply is restored. Supply would also be required for planned outages.

Garbutt 132kV Substation

Potential consultation	Addressing the secondary systems condition risks at Garbutt
Project driver	Condition driven replacement to address emerging obsolescence and compliance risks on 132kV secondary systems.
Project timing	June 2026
Proposed network solution	Selected replacement of secondary systems at an estimated cost of $10 million by June 2026

Garbutt Substation was established in the 1950s as a 132/66kV bulk supply and transformation point to the distribution network. In the early 1960s three bays were added to the substation, and in 1978 two power transformers replaced the previous units. In 2004, the substation was rebuilt in a transformer ended configuration, with the switching function established at Alan Sherriff.

Possible network solutions

- Selected replacement of secondary systems
- Full replacement of all secondary systems.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Potential non-network solutions would need to support the 66kV network in north east Townsville of up to 110MW at peak and up to 800MWh per day.

Townsville South 132kV Substation

Potential consultation	Addressing the secondary systems condition risks at Townsville South
Project driver	Condition driven replacement to address emerging obsolescence and compliance risks on 132kV secondary systems
Project timing	June 2028
Proposed network solution	Selected replacement of secondary systems at an estimated cost of $16 million by June 2028

Townsville South is a major substation supplying the city of Townsville, the major industrial load of Sun Metals Zinc Refinery and serving as a connection point for the Mt Stuart Power Station (PS).

Possible network solutions

- Selected replacement of secondary systems
- Full replacement of all secondary systems.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Potential non-network solutions would need to provide supply to Townsville East and Townsville South (including Sun Metals) of up to 150MW at peak and up to 3000MWh per day. It would also need to facilitate the connection of Mt Stuart PS.

Possible network investments in the Ross zone within five years

As assets approach their anticipated end of technical service life, the potential projects and alternatives (options) listed in Table 6.10 will be subject to detailed analysis to confirm alignment with future investment, optimisation and delivery strategies. This analysis provides Powerlink with an additional opportunity to assess the needs and timing of asset replacement works, further refine options or consider other options, including the associated delivery strategies, from those described in Table 6.11.

Table 6.11 Possible network investments in the Ross zone within five years

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative cost
Substations					
Alan Sherriff 132kV secondary systems replacement	Selected replacement of 132kV secondary systems	Maintain supply reliability to the Ross zone	June 2025	Full replacement of 132kV secondary systems (1)	$12m
Ingham South 132kV secondary systems replacement	Full replacement of 132kV secondary systems	Maintain supply reliability to the Ross zone	June 2026	Selected replacement of 132kV secondary systems (1)	$6m
Garbutt 132kV secondary systems replacement	Full replacement of 132kV secondary systems	Maintain supply reliability to the Ross zone	June 2026 (2)	Selected replacement of 132kV secondary systems	$10m (3)
Townsville East 132kV secondary systems replacement	Staged replacement of secondary systems	Maintain supply reliability to the Ross zone	June 2028	Full replacement of secondary systems	$4m
Townsville South 132kV secondary systems replacement	Selected replacement of 132kV secondary systems	Maintain supply reliability to the Ross zone	June 2028	Full replacement of 132kV secondary systems	$16m

Notes:

(1) The envelope for non-network solutions is defined in this Section 6.9.2.

(2) The change in timing of the network solution from the 2021 TAPR is based upon updated information on the condition of the assets.

(3) Compared to the 2021 TAPR, the change in the estimated cost of the proposed network solution is based upon updated information in relation to the construction costs of recently completed projects.

Possible network investments within six to 10 years

As a result of the annual planning review, Powerlink has identified that the following investments are likely to be required to address the risks arising from network assets reaching end of technical service life and to maintain reliability of supply in the Ross zone from around 2028/29 to 2032/33 (refer to Table 6.12).

Table 6.12 Possible network investments in the Ross zone within six to 10 years

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative cost
Transmission lines					
Line refit works on the 132kV transmission line between Townsville South and Ross substations	Targeted line refit works on steel lattice structures	Maintain supply reliability to the Ross zone	December 2029 (1)	New 132kV transmission line Targeted line refit works on steel lattice structures with painting	$4m
Line refit works on the 132kV transmission line between Ross and Dan Gleeson substations	Line refit works on steel lattice structures	Maintain supply reliability to the Ross zone	December 2029 (1)	New 132kV transmission line	$8m
Line refit works on the 132kV transmission line between Dan Gleeson and Alan Sherriff substations	Line refit works on steel lattice structures	Maintain supply reliability to the Ross zone	December 2028	New 132kV transmission line	$4m
Substations					
Yabulu South 132kV secondary systems replacement	Selected replacement of 132kV secondary systems	Maintain supply reliability to the Ross zone	June 2029	Full replacement of 132kV secondary systems	$7m
Clare South 132kV secondary systems replacement	Selected replacement of 132kV secondary systems	Maintain supply reliability to the Ross zone	June 2029	Full replacement of 132kV secondary systems	$12m
Ross 275/132kV secondary systems replacement	Selected replacement of secondary systems	Maintain supply reliability to the Ross zone	June 2030	Full replacement of secondary systems	$8m
Bowen North 132kV secondary systems replacement	Selected replacement of secondary systems	Maintain supply reliability to the Ross zone	June 2031	Full replacement of 132kV secondary systems	$4m

Note:

(1) The change in timing of the network solution from the 2021 TAPR is based upon updated information on the condition of the assets.

Possible asset retirements in the 10-year outlook period

Current planning analysis has not identified any potential asset retirements in the Ross zone within the 10-year outlook period.

Refer to Table 6.30 for possible asset retirements beyond the 10-year outlook period.

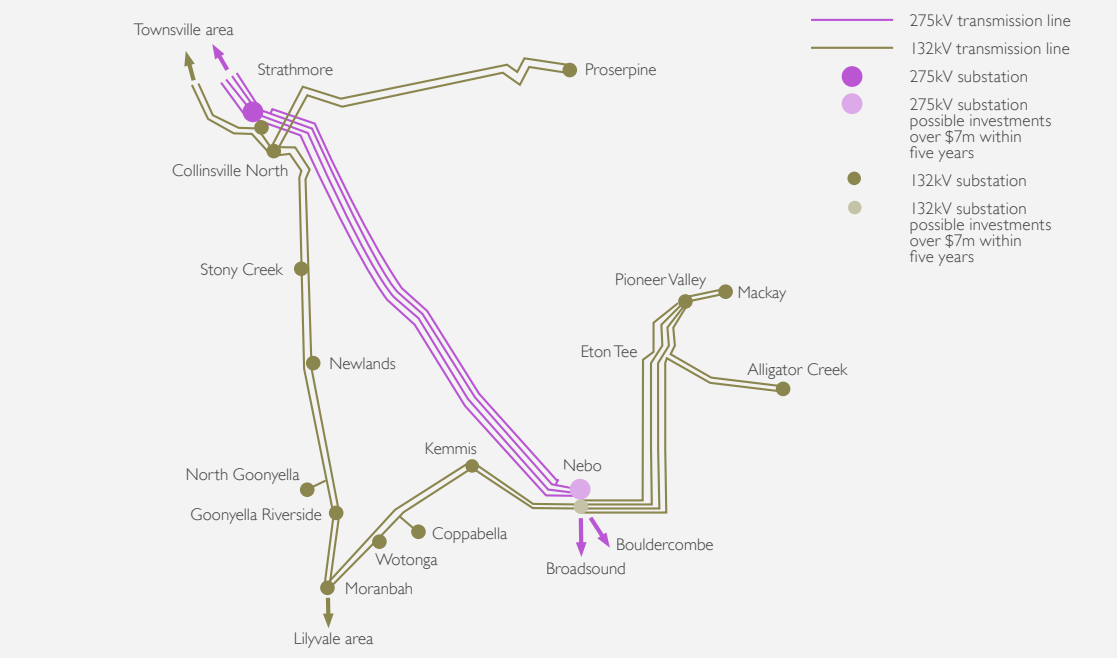
6.9.3 North zone

Existing network

Three 275kV circuits between Nebo (in the south) and Strathmore (in the north) substations form part of the 275kV transmission network supplying the North zone. Double circuit inland and coastal 132kV transmission lines supply regional centres and infrastructure related to mines, coal haulage and ports arising from the Bowen Basin mines (refer to Figure 6.9).

The coastal network in this zone is characterised by transmission line infrastructure in a corrosive environment which make it susceptible to premature ageing.

Figure 6.9 North zone transmission network



Possible load driven limitations

Based on AEMO's Step Change scenario forecast discussed in Chapter 3, there is no additional capacity forecast to be required as a result of network limitations in the North zone within the next five years to meet reliability obligations.

High voltages associated with light load and low power transfer conditions are currently managed with existing reactive sources. However, midday power transfer levels are forecast to reduce as additional VRE generators are commissioned in north Queensland. As a result, voltage control is forecast to become increasingly challenging for longer durations. This is discussed in Section 8.6.2.

Possible network investments within five years

Network investments (which includes reinvestment and augmentations) in the North zone are related to addressing the risks arising from the condition of the existing network assets, which without corrective action, would result in Powerlink being exposed to breaching a number of its jurisdictional network, safety, environmental and Rules' obligations.

By addressing the condition of these existing assets, Powerlink is seeking to ensure it can safely deliver an adequate, economic, and reliable supply of electricity to meet the load requirements of customers in the North zone into the future. This may result in like-for-like replacement, non-network solutions, network reconfiguration, asset retirement, line refit or replacement with an asset of lower capacity.

Substations

Strathmore 275/132kV Substation

Potential consultation	Addressing the Static VAr Compensator (SVC) secondary systems condition risks at Strathmore
Project driver	SVC secondary systems condition risks at Strathmore Substation
Project timing	June 2026
Proposed network solution	Full replacement of secondary systems associated with the SVC at Strathmore at an estimated cost of $6 million by June 2026

Strathmore Substation was established in 2001. The substation is a major injection point to supply Ergon Energy's distribution network and Powerlink's direct connected customers in the Northern Bowen Basin. It consists of 275kV and 132kV switchyards.

Possible network solutions

- Selected replacement of the secondary systems associated with the SVC
- Full replacement of all secondary systems associated with the SVC
- Full replacement of secondary systems associated with the SVC and selected secondary systems for the 275kV and 132kV switchyard.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Potential non-network solutions would need to provide dynamic voltage support of up to 150MVAr capacitive and 80MVArs inductive.

Possible network investments in the North zone within five years

As assets approach their anticipated end of technical service life, the potential projects and alternatives (options) listed in Table 6.13 will be subject to detailed analysis to confirm alignment with future investment, optimisation and delivery strategies. This analysis provides Powerlink with an additional opportunity to assess the needs and timing of asset replacement works, further refine options or consider other options, including the associated delivery strategies, from those described in Table 6.13.

Table 6.13 Possible network investments in the North zone within five years

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative cost
Substations					
Alligator Creek 132kV primary plant replacement	Selected replacement of 132kV primary plant	Maintain supply reliability to the North zone	June 2024	Full replacement of 132kV primary plant	$4m
North Goonyella 132kV secondary systems replacement	Full replacement of 132kV secondary systems	Maintain supply reliability to the North zone	December 2023	Selected replacement of 132kV secondary systems	$5m
Strathmore SVC secondary systems replacement	Full replacement of secondary systems	Maintain supply reliability to the Ross zone	June 2026	Staged replacement of secondary systems (1)	$6m
Kemmis 132/66kV transformer replacement	Replacement of one 132/66kV transformers	Maintain supply reliability to the North zone	June 2028	Establish 66kV supply from surrounding network	$6m (2)

Notes:

(1) The envelope for non-network solutions is defined in Section 6.9.3.

(2) Compared to the 2021 TAPR, the change in the estimated cost of the proposed network solution is based upon updated information in relation to condition and scope of works.

Possible network investments within six to 10 years

As a result of the annual planning review, Powerlink has identified that the following reinvestments are likely to be required to address the risks arising from network assets reaching end of technical service life and to maintain reliability of supply in the North zone from around 2028/29 to 2032/33 (refer to Table 6.14).

Table 6.14 Possible network investments in the North zone within six to 10 years

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative cost
Transmission lines					
Line refit works on the 132kV transmission line between Nebo Substation and Eton tee	Line refit works on steel lattice structures	Maintain supply reliability to the North zone	December 2029 (1)	New transmission line	$33m
Substations					
Alligator Creek SVC and 132kV secondary systems replacement	Full replacement of 132kV secondary systems	Maintain supply reliability to the North zone	June 2029 (1)	Staged replacement of 132kV secondary systems	$16m
Pioneer Valley 132kV primary plant replacement	Selected replacement of 132kV secondary systems equipment	Maintain supply reliability to the North zone	December 2028	Full replacement of 132kV secondary systems	$5m
Strathmore 275kV and 132kV secondary systems	Selected replacement of 275 and 132kV secondary systems in a new prefabricated building	Maintain supply reliability to the North zone	December 2028	Selected replacement of 275kV and 132kV secondary systems in existing panels	$15m
Mackay 132/33kV transformer replacement	Replacement of one 132/33kV transformer	Maintain supply reliability to the North zone	June 2030	Establish 33kV supply from surrounding network	$6m (2)

Notes:

(1) The revised timing from the 2021 TAPR is based upon the latest condition assessment.

(2) Compared to the 2021 TAPR, the change in the estimated cost of the proposed network solution is based upon updated information in relation to the construction costs of recently completed projects.

Possible asset retirements within the 10-year outlook period

Pioneer Valley to Eton tee 132kV transmission line

Subject to the outcome of further analysis, Powerlink may retire this inland transmission line at the end of its service life anticipated around 2027. Should it proceed, the retirement will also result in the 132kV network reconfiguration from Nebo to Pioneer Valley and Alligator Creek substations, essentially creating a separate double circuit line into each substation.

Refer to Table 11.7 for assets which have been identified for retirement at the time of publication of the 2022 TAPR and Table 6.30 for possible asset retirements beyond the 10-year outlook period.

6.10 Central region

The Central region includes proposed network investments located within the Central West and Gladstone zones that broadly aligns with the Central QREZ proposed development area. It incorporates some of Powerlink's largest industrial customers and significant coal-fired generation together with considerable opportunities for the development of new industries. The transmission network in this region is pivotal to supply power to northern and southern Queensland and plays a major role in supporting industry, rail systems and mines. The Central region also includes a number of candidate REZ areas identified in the 2022 ISP optimal development pathway (refer to Section 2.3.4 and Figure 9.2).

The Central QREZ development area has high quality solar and wind resources and has long-term hydrogen potential and existing energy-intensive industries that are seeking to decarbonise through either electrification of existing processing facilities and/or conversion to loads powered by VRE generation. Together, new VRE generation, electrification of existing industries and new large loads have the potential to significantly impact the performance of the transmission network in the Central region, including power transfers reaching the secure limits of the transmission system (refer to section 9.2.3).

As discussed in Section 6.11.1, the utilisation of the transmission network in this region depends on both the generation dispatch and supply and demand balance within the Central West and Gladstone zones, and northern and southern Queensland. In addition, the significant increase in VRE generation is changing the generation mix and impacting the operation of existing coal-fired generators within the region, which, in turn, is further effecting the utilisation of existing transmission infrastructure. This has been most evident across the Central to North Queensland and Central to South Queensland grid sections (refer sections 8.6.2 and 8.6.5 respectively) and the Queensland to NSW interconnector (QNI). A change in utilisation has implications for investment in the transmission network, including the Central to South Queensland transmission link, and the Gladstone area 275kV transmission network between the generation rich nodes of Calvale, Stanwell and Calliope River substations. Several potential investments for the Central region are outlined in sections 9.3.2 and 9.3.3.

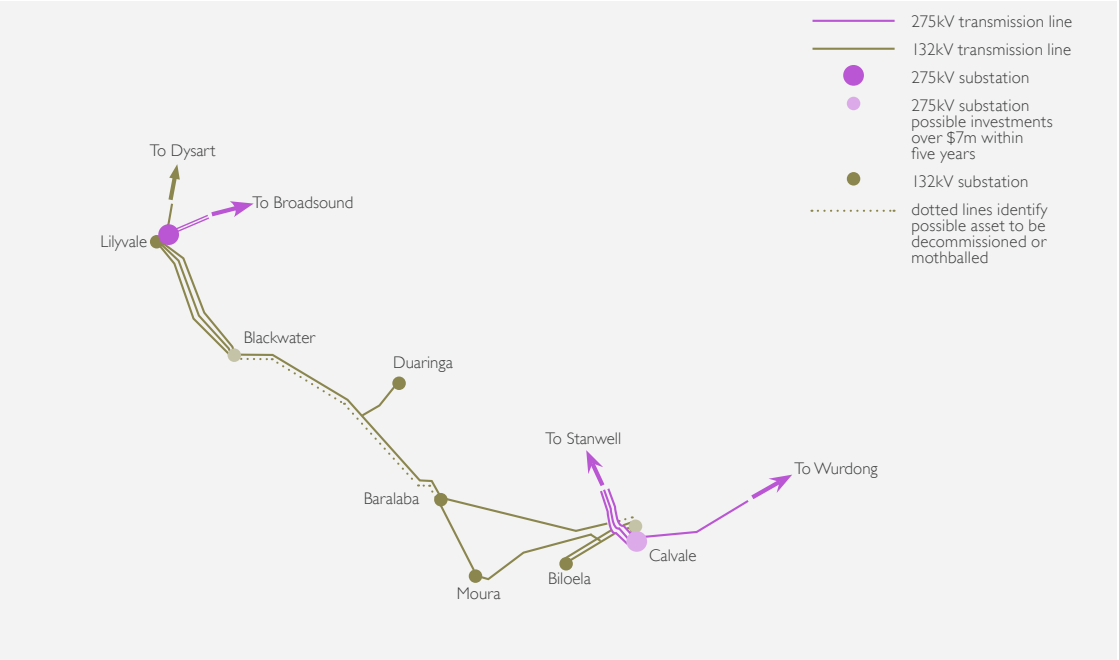
As a result, the Central region has the potential to have significantly changed requirements for transmission infrastructure in the 10-year outlook period. Given Powerlink's integrated planning approach, these requirements may result in the need for new investments that impact the proposed future network and non-network solutions identified in the geographical zones located within the region (refer to sections 6.10.1 to 6.11.1), the 'Actioning the Queensland Energy and Jobs Plan' and will be updated in subsequent TAPRs.

6.10.1 Central West zone

Existing network

The Central West 132kV network was developed between the mid-1960s and late 1970s to meet the evolving requirements of mining activity in the southern Bowen Basin. The 132kV injection points for the network are taken from Calvale and Lilyvale 275kV substations. The network is located more than 150km from the coast in a dry environment making infrastructure less susceptible to corrosion. As a result transmission lines and substations in this region have met (and in many instances exceeded) their anticipated service life but will still require replacement or rebuilding in the near future (refer to Figure 6.10).

Figure 6.10 Central West 132kV transmission network



Possible load driven limitations

Based on AEMO's Step Change scenario forecast discussed in Chapter 3 and the committed generation described in tables 8.1 and 8.2, there is no additional capacity forecast to be required in the Central West zone within the next five years to meet reliability obligations.

Possible network investments within five years

Network investments (which includes reinvestment and augmentations) in the Central West zone are related to addressing the risks arising from the condition of the existing network assets, which without corrective action, would result in Powerlink being exposed to breaching a number of its jurisdictional network, safety, environmental and Rules' obligations.

By addressing the condition of these existing assets, Powerlink is seeking to ensure it can safely deliver an adequate, economic, and reliable supply of electricity to meet the load requirements of customers in the Central West zone into the future. This may result in like-for-like replacement, non-network solutions, network reconfiguration, asset retirement, line refit or replacement with an asset of lower capacity.

Substations

Calvale 275/132kV Substation

Potential consultation	Maintaining reliability of supply at Calvale
Project driver	Addressing the 275kV primary plant condition risks
Project timing	June 2028
Proposed network solution	Selected primary plant replacement at Calvale Substation at an estimated cost of $16 million by June 2028

Calvale Substation was established in the 1980s and is a critical part of the Central West Queensland transmission network and provides connection to Callide B and Callide C generators. Selected primary plant is anticipated to reach end of technical service life around 2028.

Possible network solutions

- Selected primary plant replacement by June 2028
- Full primary plant replacement by June 2028.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Potential non-network solutions would need to provide supply to Moura and Biloela loads of more than 100MW on the 132kV network, and up to 2,000MWh per day on a continuous basis. However, Calvale Substation is also a major transmission node in Central Queensland connecting power flows between northern, central and southern Queensland. It also facilitates Callide B and Callide C generation connection, and also provides voltage support for the region.

Broadsound 275kV Substation

Potential consultation	Maintaining reliability of supply at Broadsound
Project driver	Addressing the 275kV primary plant condition risks
Project timing	December 2027
Proposed network solution	Selected primary plant replacement at Broadsound Substation at an estimated cost of $16 million by December 2027

Broadsound Substation was first established in 1983. Further extensions have been made with additions of 275kV feeders to the West, South and North. Selected primary plant is anticipated to reach end of technical service life around 2027.

Possible network solutions

- Selected primary plant replacement by December 2027
- Full primary plant replacement by December 2027.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Potential non-network solutions would need to provide supply to Lilyvale and Blackwater loads of up to 250MW, and up to 6,000MWh per day on a continuous basis. Broadsound Substation is primarily a major transmission node connecting power flows between North and Central Queensland, and also provides voltage support for the region.

Possible network investments in the Central West zone within five years

As assets approach their anticipated end of technical service life, the potential projects and alternatives (options) listed in Table 6.15 will be subject to detailed analysis to confirm alignment with future investment, optimisation and delivery strategies. This analysis provides Powerlink with an additional opportunity to assess the needs and timing of asset replacement works, further refine options or consider other options, including the associated delivery strategies, from those described in Table 6.15.

Table 6.15 Possible network investments in the Central West zone within five years

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative cost
Transmission lines					
Line refit works on the 132kV transmission line between Calvale, Biloela and Moura	Line refit works on the 132kV transmission line and repair selected foundations	Maintain supply reliability to the Central West zone	June 2025	Rebuild the 132kV transmission lines as a double circuit from Callide A to Moura Line refit works on the 132kV transmission line and repair all foundations	$5m
Substations					
Blackwater 132kV primary plant replacement	Selected replacement of 132kV primary plant	Maintain supply reliability to the Central West zone	June 2025	Full replacement of 132kV primary plant	$3m
Biloela 132kV secondary systems replacement	Selected replacement of 132kV secondary systems	Maintain supply reliability to the Central West zone	June 2025	Full replacement of 132kV secondary systems	$4m
Broadsound 275kV secondary systems replacement	Selected replacement of 275kV secondary systems	Maintain supply reliability to the Central West zone	June 2027	Full replacement of 275kV secondary systems	$4m
Broadsound 275kV primary plant replacement	Selected replacement of 275kV primary plant	Maintain supply reliability to the Central West zone	December 2027(1)	Full replacement of 275kV primary plant	$16m
Lilyvale 132kV secondary systems replacement	Selected replacement of 132kV secondary systems	Maintain supply to the Central West zone	June 2028 (1)	Full replacement of 132kV secondary systems	$3m
Calvale 275kV primary plant replacement	Selected replacement of 275kV primary plant	Maintain supply reliability to the Central West zone	June 2028 (1)	Full replacement of 275kV primary plant	$16m (2)

Notes:

(1) The change in timing of the network solution from the 2021 TAPR is based upon updated information on the condition of the assets.

(2) Compared to the 2021 TAPR, the change in the estimated cost of the proposed network solution is based upon updated information in relation to condition and scope of works.

Possible network investments within six to 10 years

As a result of the annual planning review, Powerlink has identified that the following investments are likely to be required to address the risks arising from network assets reaching end of technical service life and to maintain reliability of supply in the Central West zone from around 2028/29 to 2032/33 (refer to Table 6.16).

Table 6.16 Possible network investments in the Central West zones within six to 10 years

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative cost
Transmission lines					
Line refit works on the 275kV transmission line between Bouldercombe and Nebo substations	Line refit works on the 275kV transmission line	Maintain supply reliability in the Central West zone and Northern region	December 2029	Stanwell to Broadsound 2nd side stringing New 275kV transmission line between Bouldercombe and Broadsound substation	$31m
Substations					
Blackwater 132kV secondary systems replacement	Selected replacement of 132kV secondary systems	Maintain supply reliability in the Central West zone	June 2029	Full replacement of 132kV secondary systems	$14m
Nebo 132kV and 275kV secondary systems replacement	Selected replacement of 132kV and 275kV secondary systems	Maintain supply reliability to the Central West and North zones	June 2030	Full replacement of 132kV and 275kV secondary systems	$10m
Nebo SVC secondary systems replacement	Selected replacement of secondary systems	Maintain supply reliability to the Central West zone and Northern region	June 2030	Full replacement secondary systems	$6m

Possible asset retirements within the 10-year outlook period[22]

Calvale to Moura to Baralaba 132kV transmission lines

Subject to the outcome of further analysis and RIT-T consultation, a new 132kV double circuit transmission line may be constructed between Calvale and Moura substations at the end of technical service life of the existing transmission line within the 10-year outlook period. The reconfiguration allows Powerlink to mothball the existing single circuit transmission lines between Callide and Baralaba, and Baralaba and Moura substations at the end of their technical service lives and retired from service.

Baralaba to Blackwater 132kV transmission line

The 132kV inland transmission line was constructed in the mid-1960s to support the loads in the Central West area. Due to reconfiguration in the area, this transmission line is disconnected at the Baralaba substation, and may be retired from service at the end of technical service life within the 10-year outlook period.

Refer to Table 6.30 for possible asset retirements beyond the 10-year outlook period.

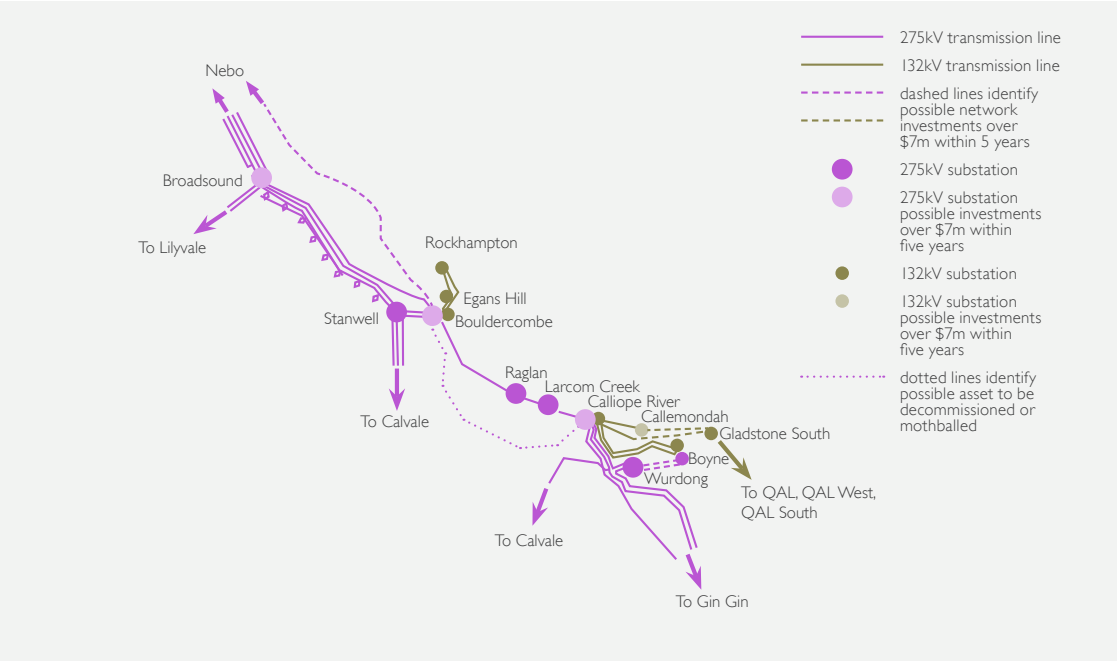
6.10.2 Gladstone zone

Existing network

The Gladstone 275kV network was initially developed in the 1970s with the Gladstone Power Station (PS) and has evolved over time with the addition of the Wurdong Substation and supply into Boyne Smelters Limited (BSL) in the early 1990s (refer to Figure 6.11).

[22] Operational works, such as asset retirements, do not form part of Powerlink's capital expenditure budget.

Figure 6.11 Gladstone transmission network



Possible load driven limitations

Based on AEMO's Step Change scenario forecast discussed in Chapter 3, there is approximately 500MW of additional load connected in the Gladstone zone by 2031. This load is associated with electrification of a component of the existing industrial processes within the area. While Powerlink has no commitment from any direct connect customers to electrify industrial process, Powerlink is in early discussions with corporations that have committed to decarbonisation of their existing fossil fuelled operations and processes. Therefore, for this TAPR, any additional capacity forecast to be required to meet this increase in load will only be considered in the context of the main 275kV network supplying the Gladstone zone. Network limitations downstream of the main transmission system cannot be assessed without specific customer identification.

The committed VRE generation in tables 8.1 and 8.2 in NQ is expected to increase the utilisation of this grid as generation in the Gladstone zone or southern Queensland is displaced. In addition, the new electrification loads and any other new loads have the potential impose significant limitations impacting market outcomes as well as reliability of supply obligations. Possible network solutions to address these issues are outlined in Section 9.3.3.

Notwithstanding this additional electrification load and any future new loads and taking into account the committed generation described in tables 8.1 and 8.2, there is no additional capacity forecast to be required in the Central West zone within the next five years to meet reliability obligations.

Possible network investments within five years

Network investments (which includes reinvestment and augmentations) in Gladstone zone are related to addressing the risks arising from the condition of the existing network assets, which without corrective action, would result in Powerlink potentially breaching a number of its jurisdictional network, safety, environmental and Rules obligations.

By addressing the condition of these existing assets, Powerlink is seeking to ensure it can deliver a safe, cost-effective and reliable supply of electricity to meet the load requirements of customers in the Gladstone zone into the future. This may result in like for like replacement, non-network solutions, network reconfiguration, asset retirement, line refit or replacement with an asset of lower capacity.

Transmission lines

Larcom Creek to Calliope 275kV transmission lines

Potential consultation	Maintaining reliability of supply in the Gladstone region
Project driver	Emerging condition risks due to structural corrosion
Project timing	June 2026
Proposed network solution	Rebuild the 275kV transmission line between Calliope River and Larcom Creek substations as double circuit high capacity transmission line turning in one circuit at an estimated cost of $35 million, by June 2026

The transmission line between Calliope River and Larcom Creek was constructed in 1977 and is located in CQ immediately adjacent to the Gladstone industrial area. This built section covers the distance between Calliope River and Larcom Creek via Yarwun substations. A proportion of the transmission line traverses tidal marine environment and due to its proximity to the large-scale industrial areas and the coast it is constantly exposed to high levels of salt laden air and industrial pollutants.

Possible network solutions

- Line refit works on steel lattice structures between Mt Miller near Calliope River and Larcom Creek
- Rebuild the 275kV transmission line between Calliope River and Larcom Creek as single circuit transmission line construction
- Rebuild the 275kV transmission line between Calliope River and Larcom Creek as double circuit transmission line construction and turn-in one circuit to Larcom Creek substation
- Rebuild the 275kV transmission line between Calliope River and Larcom Creek as double circuit transmission line construction and turn-in both circuits to Larcom Creek substation.

The proposed network solution is heavily influenced by the energy transformation. There are several drivers, yet to be committed, that can have a material impact on the transmission capability required into the Gladstone zone. A number of corporations have committed to the decarbonisation of existing fossil fuelled operations and processes either through electrification or clean fuel substitution. This will have the impact of materially changing the supply and demand balance of the Gladstone zone necessitating greater investment in transmission capability. Refitting this low capacity 275kV line or constructing a new higher capacity single circuit 275kV line is not aligned with this broader strategy.

Constructing a new high capacity 275kV double circuit line may also allow for the retirement of the more western 275kV single circuit line between Calliope River and Boulder combe substations when this line reaches its end of technical service life or converted into a connection asset for one of several wind farm proponents in the area.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Potential non-network solutions would need to provide supply to 66kV and 132kV loads at Yarwun and Raglan of up to 160MW and up to 3,200MWh per day. The non-network solution would be required for a contingency and to be able to operate on a continuous basis until normal supply is restored. Supply would also be required for planned outages.

Wurdong to Boyne Island 275kV transmission line

Potential consultation	Maintaining reliability of supply in the Gladstone region
Project driver	Emerging condition risks due to structural corrosion
Project timing	December 2025
Proposed network solution	Refit the single circuit transmission line between Wurdong and Boyne substations, at an estimated cost of $11 million, by December 2025

The transmission line provides supply to the Boyne Smelter from the Wurdong Substation and was constructed in 1991, Due to its proximity to Boyne Smelter, Gladstone industrial precinct and the coast, it is constantly exposed to high levels of salt laden air and industrial pollutants. As a result, particularly in the more exposed locations, a high percentage of galvanised tower bolts and members are exhibiting evidence of extensive corrosion. The line receives additional maintenance to keep it in a serviceable condition.

Possible network solutions

- Line refit works on steel lattice structures
- Rebuild the 275kV transmission line between Wurdong and Boyne as single circuit transmission line construction
- Rebuild the 275kV transmission line between Wurdong and Boyne as double circuit transmission line construction.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Potential non-network solutions would need to provide supply to the 275kV network at Boyne Island of approximately 400MW and approximately 10,000MWh per day. The non-network solution would be required for a contingency and to be able to operate on a continuous basis until normal supply is restored. Supply would also be required for planned outages.

Callemondah to Gladstone South 132kV transmission lines

Potential consultation	Maintaining reliability of supply to Gladstone South
Project driver	Emerging condition risks due to structural corrosion
Project timing	June 2026
Proposed network solution	Rebuild the double circuit transmission line between Callemondah and Gladstone South substations, at an estimated cost of $25 million, by June 2026

The Callemondah to Gladstone South 132kV double circuit transmission line was constructed in 1977. The transmission line facilitates supply to Gladstone South Substation which is an Ergon Energy bulk supply point and the connection point for Queensland Alumina Limited (QAL).

Possible network solutions

- Rebuild the 132kV transmission line between Callemondah and Gladstone South substations
- Line refit works on steel lattice structures.

In making this investment decision Powerlink will also take into account the possible decarbonisation of existing fossil fuelled operations and processes that are currently supplied from this network. This may impact the scale and configuration of the optimal network investment. These development plans will be reported in subsequent TAPRs as more certainty and commitment of these additional loads emerge.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Potential non-network solutions would need to provide supply to the 132kV network at Gladstone South of up to 160MW at peak and up to 1,820MWh per day. The non-network solution would be required for a contingency and to be able to operate on a continuous basis until normal supply is restored. Supply would also be required for planned outages.

Substations

Callemondah 132kV Substation

Potential consultation	Maintaining reliability of supply at Callemondah
Project driver	Addressing the 132kV primary plant and secondary systems condition risks
Project timing	June 2024
Proposed network solution	Selected primary plant and secondary systems replacement at Callemondah Substation at an estimated cost of $7 million by June 2024

Callemondah Substation was established in 1985 and provides supply to the Aurizon supply network. The secondary systems are anticipated to reach end of technical service life around 2024.

Possible network solutions

- Full primary plant and secondary systems replacement by June 2024
- Selected primary plant and secondary systems replacement by June 2024.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Potential non-network solutions would need to provide supply to the 132kV network at Gladstone South and/or Aurizon load at Callemondah, totalling up to 180MW and up to 2,500MWh per day. The non-network solution would be required for a contingency and be able to operate on a continuous basis until normal supply is restored. Supply would also be required for planned outages.

Possible network investments in the Gladstone zone within five years

As assets approach their anticipated end of technical service life, the potential projects and alternatives (options) listed in Table 6.17 will be subject to detailed analysis to confirm alignment with future investment, optimisation and delivery strategies. This analysis provides Powerlink with an additional opportunity to assess the needs and timing of asset replacement works, further refine options or consider other options, including the associated delivery strategies, from those described in Table 6.17.

Table 6.17 Possible network investments in the Gladstone zone within five years

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative cost
Transmission lines					
Line refit works on the 275kV transmission line between Wurdong and Boyne Island	Line refit works on steel lattice structures	Maintain supply reliability in the Gladstone zone	December 2025 (2)	Rebuild the 275kV transmission line between Wurdong and Boyne Island (1)	$11m (3)
Rebuild the 132kV transmission line between Callemondah and Gladstone South Substation	Rebuild the 132kV double circuit transmission line between Callemondah and Gladstone South Substation	Maintain supply reliability in the Gladstone zone	June 2026 (2)	Line refit works on steel lattice structures (1)	$25m (3)
Rebuild the 275kV transmission line between Calliope River and Larcom Creek Substation	Rebuild the 275kV transmission line between Calliope River and Larcom Creek as double circuit transmission line construction and turn-in one circuit to Larcom Creek Substation	Maintain supply reliability in the Gladstone zone	June 2026 (2)	Line refit works on the 275kV transmission line between Larcom Creek substation and Mt Miller near Calliope River (1)	$35m
Substations					
Callemondah selected 132kV primary plant and secondary systems replacement	Selected replacement of 132kV primary plant and secondary systems	Maintain supply reliability in the Gladstone zone	June 2024	Full replacement of 132kV primary plant and secondary systems (1)	$7m
Rockhampton 132kV secondary systems replacement	Selected replacement of 132kV secondary systems	Maintain reliability in Rockhampton	December 2026	Full replacement of 132kV secondary systems	$4m

Notes:

(1) The envelope for non-network solutions is defined in Section 6.10.2.

(2) The change in timing of the network solution from the 2021 TAPR is based upon updated information on the condition of the assets.

(3) Compared to the 2021 TAPR, the change in the estimated cost of the proposed network solution is based upon updated information in relation to the construction costs of recently completed projects.

Possible network investments within six to 10 years

As a result of the annual planning review, Powerlink has identified that the following investments are likely to be required to address the risks arising from network assets reaching end of technical service life and to maintain reliability of supply in the Gladstone zone from around 2028/29 to 2032/33 (refer to Table 6.18).

Table 6.18 Possible network investments in the Gladstone zone within six to 10 years

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative cost
Transmission lines					
Rebuild the 275kV transmission line between Raglan and Larcom Creek substations	Rebuild the 275kV transmission line between Raglan and Larcom Creek as a double circuit line	Maintain supply reliability in the Gladstone zone	June 2030 (2)	Line refit works on steel lattice structures Rebuild the 275kV transmission line between Raglan and Larcom Creek as a single circuit line	$42m
Line refit works on the 132kV transmission line between Bouldercombe substation and Bouldercombe Tee	Line refit works on steel lattice structures	Maintain supply reliability in the Gladstone zone	December 2030	Rebuild the 275kV transmission line between Bouldercombe and Bouldercombe Tee	$3m
Rebuild the 275kV transmission line between Raglan and Bouldercombe substations	Rebuild the 275kV transmission line between Raglan and Bouldercombe	Maintain supply reliability in the Gladstone zone	June 2032 (1)(2)	Line refit works on steel lattice structures Rebuild the 275kV transmission line between Raglan and Bouldercombe as a single circuit line	$79m
Substations					
Larcom Creek 275kV secondary systems replacement	Selected replacement of 275kV secondary systems	Maintain supply reliability in the Gladstone zone	June 2029	Full replacement of the 275kV secondary systems	$8m
Pandoin 132kV secondary systems replacement	Full replacement of the 132kV secondary systems	Maintain supply reliability in the Gladstone zone	June 2030	Selected replacement of 132kV secondary systems	$5m
Bouldercombe 275kV secondary systems replacement	Full replacement of the 275kV secondary systems	Maintain supply reliability in the Gladstone zone	June 2032	Selected replacement of 275kV secondary systems	$25m
Calliope River 275kV secondary systems replacement	Full replacement of the 275kV secondary systems	Maintain supply reliability in the Gladstone zone	June 2032	Selected replacement of 275kV secondary systems	$28m

Notes:

(1) The change in timing of the network solution from the 2021 TAPR is based upon updated information on the condition of the assets.

(2) The required timing for this network investment will depend on the overall supply and demand balance in the Gladstone zone. This is impacted by the future operation of the Gladstone PS and the development of new loads associated with decarbonising existing industrial processes and new industries.

Possible asset retirements within the 10-year outlook period[23]

Callide A to Gladstone South 132kV transmission double circuit line

The 132kV transmission line was constructed in the mid-1960s to support the loads in the Gladstone area. Due to reconfiguration in the area, this transmission line will be retired from service at the end of technical service life within the 10-year outlook period.

Calliope River to Bouldercombe 275kV transmission single circuit line

The 275kV transmission line was constructed in 1980 to support the loads in the Gladstone area. Due to reconfiguration in the area and changed network requirements under some generation and load scenarios within the 10-year outlook period, this transmission line will be decommissioned at end of technical service life. or there may be an opportunity to convert into a connection asset for one of several wind farm proponents in the area.

Refer to Table 6.30 for possible asset retirements beyond the 10-year outlook period.

6.11 Southern region

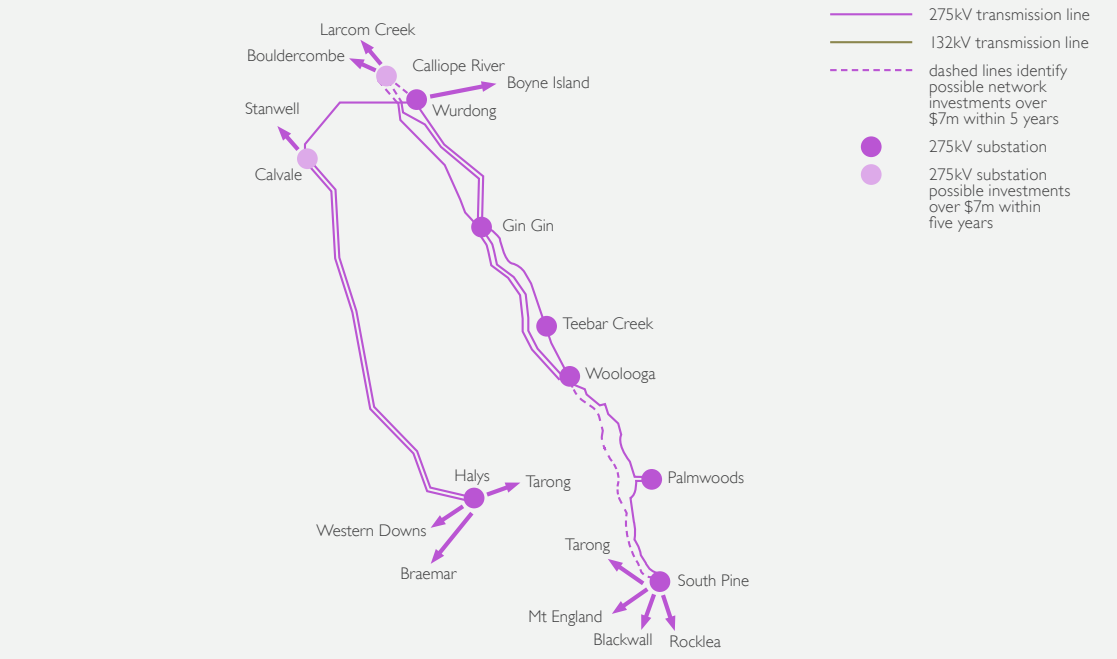
The Southern region includes proposed network investments located within the Wide Bay, South West, Surat, Bulli, Moreton and Gold Coast zones. The region broadly aligns with the Southern QREZ proposed development area. The Southern region includes a diverse range of industries and large load centres with considerable opportunity to connect renewable energy resources such as wind and solar to the transmission network. It is also located close to QNI. The Southern region also includes a number of candidate REZ areas in southern Queensland identified in the ISP (refer to Figure 9.2).

6.11.1 Wide Bay zone

Existing network

The Wide Bay zone supplies loads in the Maryborough and Bundaberg region and also forms part of Powerlink's eastern Central Queensland to South Queensland (CQ-SQ) transmission corridor. This corridor was constructed in the 1970s and 1980s and consists of single circuit 275kV transmission lines between Calliope River and South Pine (refer to Figure 6.12). These transmission lines traverse a variety of environmental conditions and as a result exhibit different corrosion rates and risk profiles.

Figure 6.12 CQ-SQ transmission network



[23] Operational works, such as asset retirements, do not form part of Powerlink's capital expenditure budget.

Possible load driven limitations

Based on AEMO's Step Change scenario forecast discussed in Chapter 3, there is no additional capacity forecast to be required in the Wide Bay zone within the next five years to meet reliability obligations.

Transmission network overview

In the NEM, generators compete for dispatch. Briefly, a generator's dispatch level depends on its bid in relation to other generators' bids, demand and available transmission capacity. Congestion occurs when transmission capacity prevents the optimum economic dispatch. Affected generators are said to be 'constrained' by the amount unable to be economically dispatched. Forecast of market constraint durations and levels are sensitive to highly uncertain variables including changes in bidding behaviour, investment patterns, fuel cost dynamics, plant outages, environmental conditions and demand levels. It is important to note that there is no load at risk or potential for loss of supply to customers associated with network congestion.

In its current form, the CQ-SQ transmission network offers a great deal of flexibility for possible generation dispatches, however occasionally imposes constraints to market operation. In order for power from new and existing NQ and CQ VRE generating systems to make its way to southern Queensland and the southern states, it must be transferred through the CQ-SQ grid section. The utilisation may increase following the commissioning of the QNI Minor project (refer to Section 6.13).

The 2022 ISP identified a potential Central to Southern Queensland network project as a Future ISP project. The ISP modelling identified two stages to expand the transmission capacity across this CQ-SQ. The first stage involves a new mid-point switching substation on the Calvale to Halys 275kV double circuit line, to increase transfer capacity in both directions by approximately 300MW. Under the Step Change scenario forecast the timing for this incremental upgrade is 2028/29. The second stage involves a new double circuit line from Calvale to Wandoan South, to increase transfer capacity to Southern Queensland by approximately 900MW.

Possible network solutions to facilitate efficient market operation are outlined in Section 9.3.2.

Possible network investments within five years

Network reinvestments (which includes reinvestment and augmentations) in the Wide Bay zone are related to addressing the risks arising from the condition of the existing network assets, which without corrective action, would result in Powerlink potentially breaching a number of its jurisdictional network, safety, environmental and Rules' obligations.

By addressing the condition of these existing assets, Powerlink is seeking to ensure it can safely deliver an adequate, economic, and reliable supply of electricity to meet the load requirements of customers in the Wide Bay zone into the future. This may result in like-for-like replacement, non-network solutions, network reconfiguration, asset retirement, line refit or replacement with an asset of lower capacity.

Transmission Lines

CQ-SQ transmission lines

Potential consultation	Maintaining reliability of supply between central and southern Queensland
Project driver	Emerging condition and compliance risks related to structural corrosion
Project timing	June 2026 to December 2032
Proposed network solution	Rebuild of two of the three single circuit transmission lines between Calliope River and Wurdong Tee as a double circuit at an estimated cost of $28 million by June 2026. Line refit works on the remaining single circuit 275kV transmission line between Calliope River Substation and Wurdong Tee at an estimated cost of $6 million by June 2026. Targeted refit of the three single circuit transmission lines between Calliope River (Wurdong Tee) and Gin Gin substations at an estimated cost of $79 million by December 2029. Line refit works on the 275kV transmission single circuit transmission line between Woolooga and South Pine substations at an estimated cost of $38 million by December 2028.

The coastal CQ-SQ transmission network between Calliope River and South Pine substations was progressively developed in the 1970s and 1980s to facilitate power transfer between central and southern Queensland. This corridor provides the major injection points at Gin Gin, Teebar Creek, Woolooga and Palmwoods 275/132kV for the Wide Bay and Sunshine Coast areas. The Ergon Energy 132kV and Energex 132/110kV sub-transmission systems supply bulk supply points in these areas.

The coastal CQ-SQ transmission network assets are expected to reach the end of their technical service life within the next 20 years. A key consideration is that this corridor is comprised solely of single circuit 275kV towers that may make cost-effective refit strategies less viable compared to double circuit tower rebuilds.

With varying distance from the ocean, and localised industrial pollution, the Calliope River to South Pine 275kV single circuit transmission lines are subject to different environmental and atmospheric conditions and have, over time, experienced structural degradation at different rates.

Emerging condition and compliance risks have been identified on the following assets:

Within the next five years:

- Three 275kV single circuit transmission lines from Calliope River to Wurdong Tee built in 1972, 1976 and 1981 (structural repair due to above ground corrosion)
- One 275kV single circuit transmission line from Woolooga to South Pine built in 1972 (structural repair due to above ground corrosion).

Within the next six to 10 years:

- One 275kV single circuit transmission lines from Woolooga to Gin Gin built in 1972 (structural repair due to above ground corrosion)
- Three 275kV single circuit transmission lines from Wurdong Tee to Gin Gin built in 1972, 1976 and 1981 (structural repair due to above ground corrosion)
- One 275kV single circuit transmission line form South Pine to Palmwoods built in 1976 (structural repair due to above ground corrosion).

Possible network solutions

The current long-term network strategy based on existing network topology and requirements is to rebuild two of the 275kV single circuit transmission lines from Calliope River to South Pine as a double circuit. The third circuit between Calliope and Woolooga substations is expected to be economic to maintain in the medium term through targeted refit. When this circuit is dismantled in the longer term, Wurdong would be supplied from Calliope River via a dedicated 275kV double circuit transmission line.

This strategy will be technically and economically reassessed and adjusted to align with future generation and network developments.

Strategies to address the transmission line sections with advanced corrosion in the five-year outlook will be economically assessed in consideration of longer term network needs based on future generation and network requirements. Powerlink and AEMO (through the ISP process) will continue to investigate the impact of large-scale VRE generation investment in the Queensland region on the utilisation and economic performance of the CQ-SQ grid section. Powerlink will consider the emerging and forecast constraints holistically with the emerging condition based drivers as part of the planning process. Such decisions will be undertaken using the RIT-T consultation process, where the benefits of non-network options will also be considered.

The longer term network solution options to address the condition based drivers include:

- network rationalisation (potentially three single circuits to one double circuit) involving a staged program of line rebuild of the coastal corridor as a new double circuit 275kV transmission line at the end of the technical service life of the existing circuits
- network rationalisation (potentially three single circuits to one double circuit) involving a staged rebuild of the coastal corridor as a new double circuit 275kV transmission line at the end of the technical service life of the existing circuits, using a program of targeted line refits to defer rebuild of individual CQ-SQ sections (where this deferral is economic)
- maintaining the existing three single circuit 275kV transmission lines through a combination of stage rebuild and line refit projects
- network rationalisation (potentially three single circuits to one double circuit in sections) of the coastal corridor involving staged line refit and rebuild on the coastal corridor, and reinforcement of the CQ-SQ section via reinforcement of the western CQ-SQ transmission corridor.

Closer to the timing of the investment decision and as part of the option analysis under the RIT-T, Powerlink will consider whether the proposed preferred option will have a material inter-network impact.

Possible non-network solutions

The coastal CQ-SQ transmission network provides essential supply between the generation in central and north Queensland and the loads in southern Queensland. Powerlink would consider proposals from non-network providers that can significantly contribute to reducing the requirement in this region, as this may present opportunities in reconfiguring the network that would otherwise not be able to meet Powerlink's planning standard. Non-network solutions may include, but are not limited to local generation or DSM initiatives in the area.

Possible network investments in the Wide Bay zone within five years

As assets approach their anticipated end of technical service life, the potential projects and alternatives (options) listed in Table 6.19 will be subject to detailed analysis to confirm alignment with future investment, optimisation and delivery strategies. This analysis provides Powerlink with an additional opportunity to assess the needs and timing of asset replacement works, further refine options or consider other options, including the associated delivery strategies, from those described in Table 6.19.

Table 6.19 Possible network investments in the Wide Bay zone within five years

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative cost
Transmission lines					
Rebuild of the transmission line between Calliope River Substation and the Wurdong Tee	New double circuit transmission line for the first 15km out of Calliope River substation	Maintain supply reliability to the CQ-SQ transmission corridor (and Gladstone zone)	June 2026	Refit the two single circuit 275kV transmission lines	$28m
Line refit works on the 275kV transmission line between Calliope River Substation and Wurdong Tee	Refit the single circuit 275kV transmission line between Calliope River Substation and Wurdong Tee	Maintain supply reliability in the CQ-SQ transmission corridor (and Gladstone zone)	June 2026	Rebuild the 275kV transmission line as a double circuit	$6m
Line refit works on the 275kV transmission line between Woolooga and South Pine substations	Refit the 275kV transmission line between Woolooga and South Pine substations	Maintain supply reliability to the Moreton zone	June 2028 (1)	Rebuild the 275kV transmission line between Woolooga and South Pine substations	$38m

Note:

(1) The revised timing from the 2021 TAPR is based upon the latest condition assessment.

Possible network investments within six to 10 years

As a result of the annual planning review, Powerlink has identified that the following investments are likely to be required to address the risks arising from network assets reaching end of technical service life and to maintain reliability of supply in the Wide Bay zone from around 2028/29 to 2032/33 (refer to Table 6.20).

Table 6.20 Possible network investments in the Wide Bay zone within six to 10 years

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative cost
Transmission lines					
Targeted reinvestment in the 275kV transmission lines between Wurdong Tee and Gin Gin substation	Refit the 275kV transmission line between Wurdong Tee and Gin Gin Substation	Maintain supply to the Wide Bay zone	December 2029 (1)	Targeted refit and partial double circuit rebuild of the 275kV transmission line between Wurdong Tee and Gin Gin Substation New 275kV DCST transmission line	$79m
Line refit works on the 275kV transmission line between South Pine and Palmwoods substations	Line refit works on steel lattice structures	Maintain supply to the Wide Bay zone	June 2032	Rebuild 275kV transmission line between South Pine and Palmwoods substations	$13m
Line refit works on the 275kV transmission line between Gin Gin and Woolooga substations	Rebuild the 275kV transmission line between Gin Gin and Woolooga substations	Maintain supply to the Wide Bay zone	December 2032 (1)	Refit the 275kV transmission line between Gin Gin and Woolooga substations	$42m
Substations					
Teebar Creek secondary systems replacement	Full replacement of 132kV and 275kV secondary systems	Maintain supply to the Wide Bay zone	December 2028	Selected replacement of 132kV and 275kV secondary systems	$19m
Woolooga 275kV and 132kV primary plant and secondary systems replacement	Selected replacement of 275kV and 132kV primary plant and full replacement of 132kV and 275kV secondary systems (including SVC)	Maintain supply to the Wide Bay zone	June 2029	Selected replacement of 275kV and 132kV secondary systems	$40m
Palmwoods 275kV and 132kV selected primary plant replacement	Selected replacement of 275kV and 132kV primary plant	Maintain supply to the Wide Bay zone	June 2030	Full replacement of 275kV and 132kV primary plant	$35m
Gin Gin 275kV secondary systems replacement	Selected replacement of 275kV secondary systems	Maintain supply to the Wide Bay zone	June 2031	Full replacement of 275kV secondary systems	$11m

Note:

(1) Compared to the 2021 TAPR, the change in the estimated cost of the proposed network solution is based upon updated information in relation to the construction costs of recently completed projects.

Possible asset retirements within the 10-year outlook period

Current planning analysis has not identified any potential asset retirements in the Wide Bay zone within the next 10 years.

Refer to Table 6.30 for possible asset retirements beyond the 10-year outlook period.

6.11.2 Surat zone

Existing network

The Surat Basin zone is defined as the area north west of Western Downs Substation. The area has significant development potential given the vast reserves of gas and coal and more recently VRE. Utilisation of assets in the area is forecast to continue due to new developments of VRE projects, coal seam gas (CSG) upstream processing facilities by multiple proponents, together with the supporting infrastructure and services (refer to Figure 6.13).

Figure 6.13 Surat Basin North West area transmission network

Possible load driven limitations

Based on AEMO's Step Change scenario forecast discussed in Chapter 3, there is no additional capacity forecast to be required as a result of network limitations in the Surat zone within the next five years to meet reliability obligations.

Possible network investments within the 10-year outlook period

As assets approach their anticipated end of technical service life, the potential projects and alternatives (options) identified as a result of the annual planning review will be subject to detailed analysis to confirm alignment with future investment, optimisation and delivery strategies. This analysis provides Powerlink with an additional opportunity to assess the needs and timing of asset replacement works, further refine options or consider other options, including the associated delivery strategies, from those described in Table 6.21. Powerlink has identified that the following investment is likely to be required to address the risks arising from network assets reaching end of technical service life and to maintain reliability of supply in the Surat zone towards the end of the 10-year outlook period, from around 2028/29 to 2032/33 (refer to Table 6.21).

Table 6.21 Possible network investments in the Surat zone within six to 10 years

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative cost
Substations					
Columboola 132kV secondary systems replacement	Selected replacement of 132kV secondary systems	Maintain supply reliability in the Surat zone	June 2031	Full replacement of secondary systems	$15m

Possible asset retirements within the 10-year outlook period

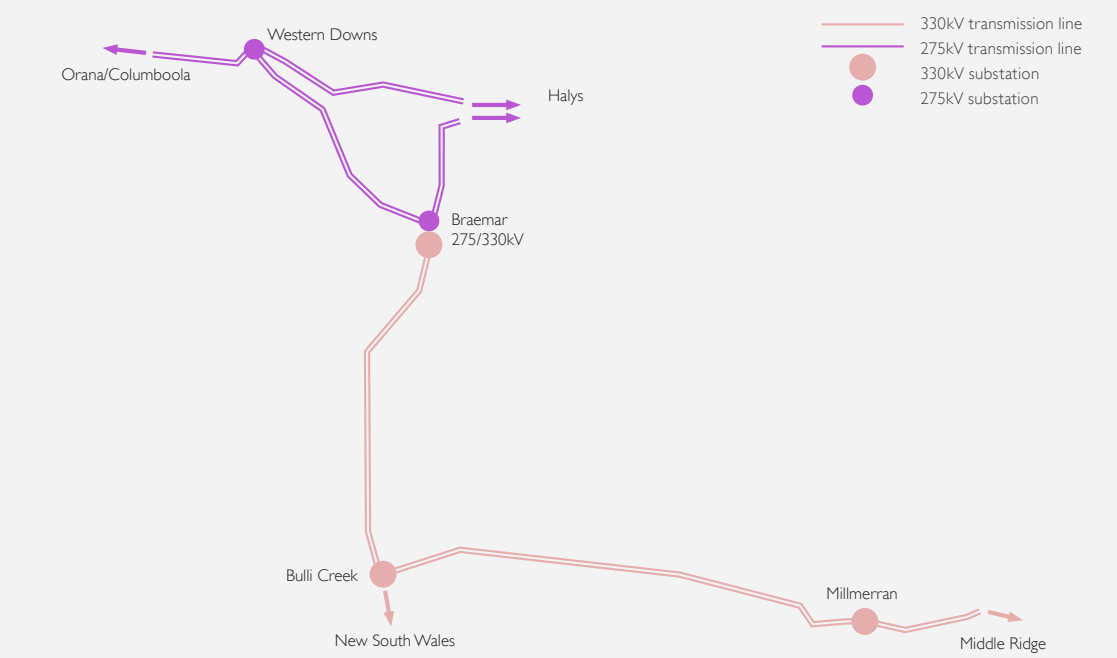
Current planning analysis has not identified any potential asset retirements in the Surat zone within the 10-year outlook period.

6.11.3 Bulli zone

Existing network

The Bulli zone is defined as the area surrounding Goondiwindi and the 330kV and 275kV network south of Kogan Creek Power Station and west of Millmerran Power Station (refer to Figure 6.14).

Figure 6.14 Bulli area transmission network



Possible load driven limitations

Based on AEMO's Step Change scenario forecast discussed in Chapter 3, there is no additional capacity forecast to be required as a result of network limitations in the Bulli zone within the next five years to meet reliability obligations.

Possible network investments in the Bulli zone within five years

As assets approach their anticipated end of technical service life, the potential projects and alternatives (options) identified as a result of the annual planning review will be subject to detailed analysis to confirm alignment with future investment, optimisation and delivery strategies. This analysis provides Powerlink with an additional opportunity to assess the needs and timing of asset replacement works, further refine options or consider other options, including the associated delivery strategies, from those described in Table 6.22. Powerlink has identified that the following investment is likely to be required to address the risks arising from network assets reaching end of technical service life and to maintain reliability of supply in the Bulli zone, from around 2022/23 to 2027/28 (refer to Table 6.22).

Table 6.22 Possible network investments in the Bulli zone within five years

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative cost
Substations					
Millmerran 330kV AIS secondary systems replacement	Selected replacement of 330kV secondary systems	Maintain supply reliability in the Bulli zone	December 2026	Full replacement of secondary systems	$6m

Possible network investments within six to 10 years

As a result of the annual planning review, Powerlink has identified that the following investments are likely to be required to address the risks arising from network assets reaching end of technical service life and to maintain reliability of supply in the Bulli zone from around 2028/29 to 2032/33 (refer to Table 6.23).

Table 6.23 Possible network investments in the Bulli zone within six to 10 years

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative cost
Substations					
Braemar 330kV secondary systems replacement non-iPASS	Selected replacement of 330kV secondary systems	Maintain supply reliability in the Bulli zone	June 2029	Full replacement of secondary systems	$23m
Bulli Creek 330/132kV transformer replacement	Replace one 330/132kV transformer at Bulli Creek Substation	Maintain supply reliability in the Bulli zone	June 2031	Retirement of 330/132kV transformers with non-network support	$7m

Possible asset retirements within the 10-year outlook period

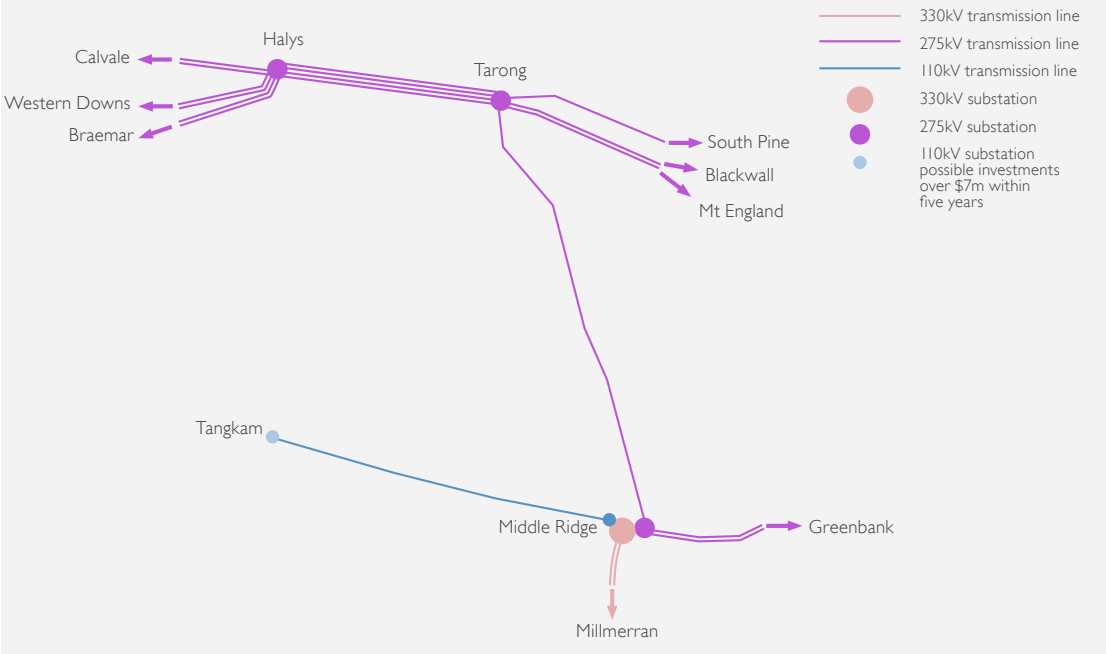
Current planning analysis has not identified any potential asset retirements in the Bulli zone within the 10-year outlook period.

6.11.4 South West zone

Existing network

The South West zone is defined as the Tarong and Middle Ridge areas west of Postman's Ridge (refer to Figure 6.15).

Figure 6.15 South West area 330kV and 275kV network



Possible load driven limitations

Based on AEMO's Step Change scenario forecast discussed in Chapter 3, there is no additional capacity forecast to be required as a result of network limitations in the South West zone within the next five years to meet reliability obligations.

Possible network investments within five years

Network investments (which includes reinvestment and augmentations) in the South West zone are related to addressing the risks arising from the condition of the existing network assets, which without corrective action, would result in Powerlink potentially breaching a number of its jurisdictional network, safety, environmental and Rules' obligations.

By addressing the condition of these existing assets, Powerlink is seeking to ensure it can safely deliver an adequate, economic, and reliable supply of electricity to meet the load requirements of customers in the South West zone into the future. This may result in like-for-like replacement, non-network solutions, network reconfiguration, asset retirement, line refit or replacement with an asset of lower capacity.

Substations

Tangkam 110kV Substation

Anticipated consultation	Addressing the secondary systems condition risks at Tangkam
Project driver	Emerging condition and 110kV secondary systems compliance risks
Project timing	December 2024
Proposed network solution	Full replacement of the 110kV secondary systems at Tangkam Substation at an estimated cost of $15 million by June 2024

Tangkam Substation was established in 1999 as part of the Oakey Gas Turbine Power Station connection.

Possible network solutions

- Full replacement of all 110kV secondary systems in a new building by June 2024
- Full replacement of all 110kV secondary systems in the existing building by June 2024.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Powerlink would consider a non-network option that avoids the proposed replacement of the ageing and obsolete secondary systems. The non-network option would need to replicate, in part or full, the support that Tangkam Substation delivers to customers in the area on a cost-effective basis. To maintain reliability standards, a non-network local generation solution would need to inject up to 70MW at peak and up to 700MWh per day on a continuous basis to supply the 110kV network.

Possible network investments in the South West zone within five years

As assets approach their anticipated end of technical service life, the potential projects and alternatives (options) listed in Table 6.24 will be subject to detailed analysis to confirm alignment with future investment, optimisation and delivery strategies. This analysis provides Powerlink with an additional opportunity to assess the needs and timing of asset replacement works, further refine options or consider other options, including the associated delivery strategies, from those described in Table 6.24.

Table 6.24 Possible network investments in the South West zone within five years

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative cost
Substations					
Tangkam 110kV secondary systems replacement	Full replacement of 110kV secondary systems	Maintain supply reliability in the South West zone	June 2024	Staged replacement of 110kV secondary systems (1)	$15m

Note:

(1) The envelope for non-network solutions is defined in Section 6.11.4.

Possible network investments within six to 10 years

As a result of the annual planning review, Powerlink has identified that the following investments are likely to be required to address the risks arising from network assets reaching end of technical service life and to maintain reliability of supply in the South West zone from around 2028/29 to 2032/33 (refer to Table 6.25).

Table 6.25 Possible network investments in the South West zone within six to 10 years

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative cost
Substations					
Middle Ridge 110kV primary plant replacement	Selected replacement of selected 110kV primary plant	Maintain reliability of supply at Middle Ridge Substation	December 2028	Full replacement of 110kV primary plant	$3m
Middle Ridge 275kV and 110kV secondary systems replacement	Selected replacement of 275kV and 110kV secondary systems	Maintain supply reliability in the South West zone	December 2030	Full replacement of 275kV and 110kV secondary systems	$40m
Tarong 275kV and 66kV secondary systems replacement	Selected replacement of 275kV and 66kV secondary systems	Maintain supply reliability in the South West zone	June 2030	Full replacement of 275kV and 66kV secondary systems	$29m

Possible asset retirements within the 10-year outlook period [24]

Refer to Table 11.7 for confirmed asset retirements in the South West zone and Table 6.30 for possible asset retirements beyond the 10-year outlook period.

6.11.5 Moreton zone

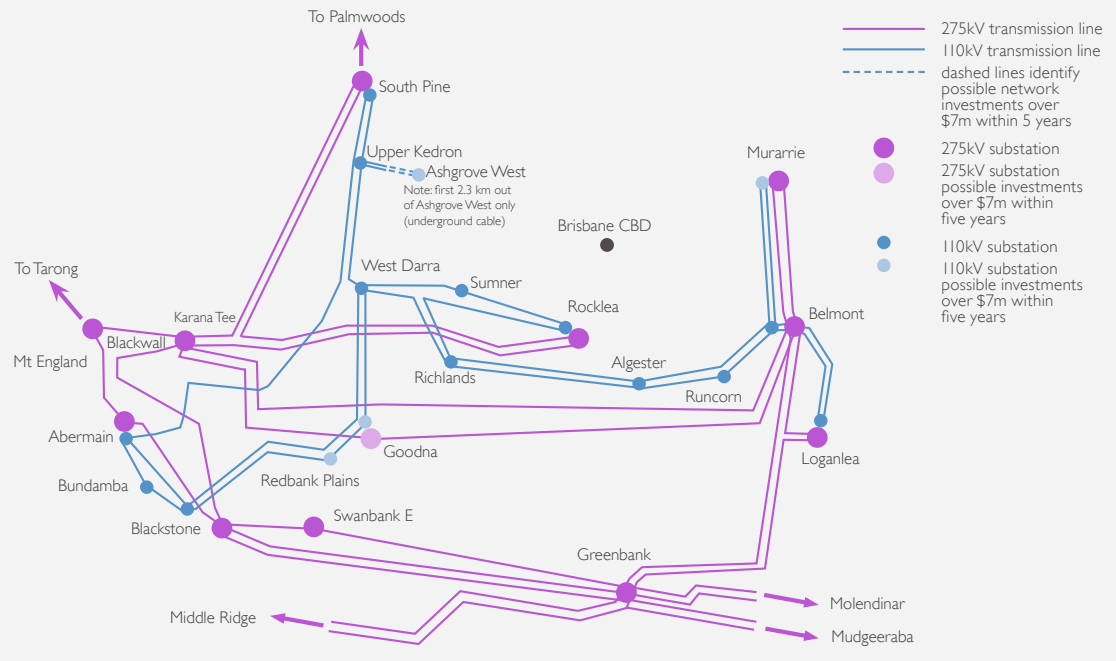
Existing network

The Moreton zone includes a mix of 275kV and 110kV transmission networks servicing a number of significant load centres in SEQ, including the Sunshine Coast, greater Brisbane, Ipswich and northern Gold Coast regions (refer to Figure 6.16).

Future investment needs in the Moreton zone are substantially arising from the condition and performance of 275kV and 110kV assets in the greater Brisbane area. The 110kV network in the greater Brisbane area was progressively developed from the early 1960s and 1970s, with the 275kV network being developed and reinforced in response to load growth from the early 1970s. Multiple Powerlink 275/110kV injection points now interconnect with the Energex network to form two 110kV rings supplying the Brisbane Central Business District (CBD).

[24] Operational works, such as asset retirements, do not form part of Powerlink's capital expenditure budget.

Figure 6.16 Greater Brisbane transmission network



Possible load driven limitations

Based on AEMO's Step Change scenario forecast discussed in Chapter 3 and the committed generation described in tables 8.1 and 8.2, there is no additional capacity forecast to be required in the Moreton zone within the next five years to meet reliability obligations.

Possible network investments to meet power system performance standards in the next five years

Current consultation	Managing voltages in South East Queensland
Project driver	Voltage control during light load conditions
Project timing	December 2025
Proposed network solution	Installation of three 120MVAr bus reactors, one each at Woolooga, Blackstone and Belmont substations, at an estimated cost of $30 million by December 2025

In December 2021 AEMO published the System Strength, Inertia, and Network Support and Control Ancillary Services Report (NSCAS). This report declared an immediate gap of 120MVAr reactive power absorption in Southern Queensland, rising to 250MVAR by 2026. Powerlink worked with AEMO in the preparation of their report and subsequent gap declaration. Prior to this Powerlink had already identified a need for additional reactive power absorption capability in Southern Queensland and commenced a RIT-T process to address this need.

The combination of a declining minimum demand during the day, increasing capacitive nature of the load and the loss of system capacity to absorb reactive power, has created a growing reactive power surplus in both the distribution and transmission networks, during low demand periods. This has resulted in an increased voltage profile and a growing potential for sustained over-voltage events.

High voltages associated with light load conditions are currently managed in South East Queensland (SEQ) with existing reactive sources and operational methods. Voltage control is forecast to become increasingly challenging for longer durations, as minimum demand continues to fall.

Powerlink has identified a need for additional reactive support to:

- Maintain voltages within operational and design limits during minimum demand periods, to maintain the power system in a secure operating state
- Reduce reliability and system strength impacts from the de-energisation of transmission lines.

Possible network solutions

- Installation of three bus reactors, one each at Woolooga, Blackstone and Greenbank substations
- Installation of three bus reactors, one each at Woolooga, Blackstone and Belmont substations
- Installation of 11 reactors on the Energex Network in the Sunshine Coast, Gold Coast and Brisbane areas.

In accordance with the requirements of the RIT-T, Powerlink published a Project Specification Consultation Report (PSCR) (with Project Assessment Draft Report (PADR) exemption) in July 2021 which identified the installation of 120MVAr bus reactors at Woolooga, Blackstone and Belmont substations by 2025 as the preferred network option. Submissions to the PSCR closed on 29 October 2021 and Powerlink anticipates the publication of the PADR in October 2022.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Under system normal conditions, a complete network support solution would need to provide voltage control equivalent to the proposed three reactors across SEQ, at a nominal 360MVArs. Reactive support would be required to be available on a continuous basis, and not coupled to generation output.

Partial network support solutions designed to address the declining minimum day time demand and the increasing leading power factor load characteristic are also encouraged. Where technically and economically feasible, the relevant detailed requirements will be refined with proponents through the submission process and assessed on a case by case basis against the identified need.

The network support must continue to operate as per system normal for planned and unplanned outages. Outages of the network support must be coordinated to ensure that Powerlink is able to maintain system security at all times.

Possible network investments within five years

Network investments (which includes reinvestment and augmentations) in the Moreton zone are related to addressing the risks arising from the condition of the existing network assets, which without corrective action, would result in Powerlink being exposed to breaching a number of its jurisdictional network, safety, environmental and Rules' obligations.

By addressing the condition of these existing assets, Powerlink is seeking to ensure it can safely deliver an adequate, economic, and reliable supply of electricity to meet the load requirements of customers in the Moreton zone into the future. This may result in like-for-like replacement, non-network solutions, network reconfiguration, asset retirement, line refit or replacement with an asset of lower capacity.

Transmission lines

The 110kV and 275kV transmission lines in the greater Brisbane area are located between 20km and 40km from the coast, traversing a mix of industrial, high density urban and semi-urban areas. The majority of assets are reasonably protected from the prevailing coastal winds and are exposed to moderate levels of pollution related to the urban environment. These assets have, over time, experienced structural corrosion at similar rates, with end of technical service life for most transmission line assets expected to occur towards to end of the 2020s and into the early 2030s.

With maximum demand expected to maintain low growth over the next 10 years, and based on the development of the network over the last 40 years, planning studies have identified a number of 110kV transmission line assets that could potentially be retired. Given the uncertainty in future demand growth, Powerlink proposes to implement low cost maintenance strategies to keep the transmission lines in-service for a reasonable period. Future decommissioning remains an option once demand growth is better understood.

Detailed analysis will be ongoing to evaluate the possible retirement of the following transmission lines at the end of technical service life:

- West Darra to Upper Kedron
- West Darra to Goodna
- Richlands to Algester.

This ongoing review, together with further joint planning with Energex, may result in a future RIT-T in the late 2020s.

Underground 110kV cable between Upper Kedron and Ashgrove West

Potential consultation	Maintain reliability of supply to the Brisbane metropolitan area
Project driver	Emerging condition, end of technical service life and compliance risks for the Upper Kedron to Ashgrove West underground cables.
Project timing	June 2026
Proposed network solution	Replacement of the oil-filled cables with new cables in a new easement at an estimated cost of $14 million by June 2026

The 110kV transmission line between Upper Kedron and Ashgrove West substations was established in 1978, as one of the principal sources of supply to the north-west Brisbane area. The transmission line is predominantly overhead, with the final 2.3km long section to Ashgrove West Substation being underground cable.

Possible network solutions

- Replacement of the existing cables with new cables in a new easement by June 2026
- Replacement of existing cables with new cables by June 2026.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

The Upper Kedron to Ashgrove West cables provide supply of up to 220MW at peak to Brisbane's inner north-west suburbs. Powerlink would consider proposals from non-network providers that can significantly contribute to reducing the requirement in this region, as this may present opportunities in reconfiguring the network that would otherwise not be able to meet Powerlink's planning standard. Non-network solutions may include, but are not limited to local generation or DSM initiatives in the area.

Substations

Redbank Plains 110kV Substation

Anticipated consultation	Maintaining power transfer capability and reliability of supply at Redbank Plains Substation
Project driver	Emerging condition risks of the 110kV primary plant and 110/11kV transformers
Project timing	June 2025
Proposed network solution	Refit and life extension of both 110/11kV transformers and replacement of all 110kV primary plant at Redbank Plains Substation at an estimated cost of $8 million by June 2025

Redbank Plains Substation was established to provide electricity to the expanding communities west of Brisbane in 1986 and serves as a bulk supply injection point to the Energex distribution network.

Redbank Plains two 110/11kV 25MVA transformers were installed in 1985 and 1984 respectively. The transformers exhibit aged paper insulation and increased moisture levels in oil, possibly due to the numerous oil leaks from the main tanks. The high voltage bushings are the original porcelain housed oil insulated paper bushings, which have been in-service well past their technical service life.

Possible network solutions

- Refit and life extension of both 110/11kV transformers and replace selected 110kV primary plant by 2025
- Refit and life extension of both 110/11kV transformers by and replace all 110kV primary plant by June 2025
- Replacement of both 110/11kV transformers and replace selected 110kV primary plant by 2025
- Replacement of both 110/11kV transformers and full replacement of 110kV primary plant by June 2025
- Replace/life extend one 110/11kV transformer and engage non-network support by June 2025.

In accordance with the requirements of the RIT-T, Powerlink published a PSCR (with PADR exemption) in April 2022 which identified the refit and life extension of both 110/11kV transformers and replacement of all 110kV primary plant at Redbank Plains Substation by 2025 as the preferred network option. Submissions to the PSCR closed in July 2022 and Powerlink anticipates the publication of the PACR by December 2022.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Potential non-network solutions would need to provide supply to the 11kV network at Redbank Plains of up to 25MW at peak and up to 400MWh per day. The non-network solution would be required for a contingency and to be able to operate on a continuous basis until normal supply is restored. Supply would also be required for planned outages.

Ashgrove West 110kV Substation

Potential consultation	Addressing the secondary systems condition risks at Ashgrove West
Project driver	Emerging condition and 110kV secondary systems compliance risks
Project timing	December 2026
Proposed network solution	Full replacement of the 110kV secondary systems at Ashgrove West Substation at an estimated cost of $9 million by December 2026

Ashgrove West Substation was established in 1979 to meet increased demand in the Brisbane CBD and the expanding residential areas to the north and west of Brisbane.

Possible network solutions

- Full replacement of all of the 110kV secondary systems upfront by December 2026
- Staged replacement on 110kV secondary systems by December 2026.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Ashgrove West is a key substation and part of the network supplying of up to 220MW at peak to Brisbane's inner north-west suburbs. Powerlink would consider proposals from non-network providers that can significantly contribute to reducing the requirement in this region, as this may present opportunities in reconfiguring the network that would otherwise not be able to meet Powerlink's planning standard. Non-network solutions may include, but are not limited to local generation or DSM initiatives in the area.

Murarrie 110kV Substation secondary systems replacements

Potential consultation	Addressing the secondary systems condition risks at Murarrie
Project driver	Emerging condition and 110kV secondary systems compliance risks
Project timing	June 2027
Proposed network solution	Full replacement of the 110kV secondary systems at Murarrie Substation at an estimated cost of $22 million by June 2027

Murarrie Substation was established in 2003 as a bulk supply point to service the industrial load around the Brisbane River and port areas. Murarrie secondary systems were commissioned between 2003 and 2006.

Possible network solutions

- Full replacement of all of the 110kV secondary systems upfront by June 2027
- Staged replacement on 110kV secondary systems by June 2027.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Murarrie Substation provides injection and switching to the CBD and south-eastern suburbs of Brisbane of over 300MW at peak. Powerlink would consider proposals from non-network providers that can significantly contribute to reducing the requirement in this region, as this may present opportunities in reconfiguring the network that would otherwise not be able to meet Powerlink's planning standard. Non-network solutions may include, but are not limited to local generation or DSM initiatives in the area.

Possible network investments in the Moreton zone within five years

As assets approach their anticipated end of technical service life, the potential projects and alternatives (options) listed in Table 6.26 will be subject to detailed analysis to confirm alignment with future investment, optimisation and delivery strategies. This analysis provides Powerlink with an additional opportunity to assess the needs and timing of asset replacement works, further refine options or consider other options, including the associated delivery strategies, from those described in Table 6.26, from around 2022/23 to 2027/28 (refer to Table 6.26).

Table 6.26 Possible network investments in the Moreton zone within five years

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative cost
Transmission Lines					
Replacement of the 110kV underground cable between Upper Kedron and Ashgrove West substations	Replace the 110kV underground cable between Upper Kedron and Ashgrove West substations using an alternate easement	Maintain supply reliability in the Moreton zone	June 2026	In-situ replacement of the 110kV underground cable between Upper Kedron and Ashgrove West substations (1)	$14m
Line refit works on the 110kV transmission line between Belmont and Murarrie substations	Line refit works on steel lattice structures	Maintain supply reliability in the Moreton zone	June 2028	Rebuild the 110kV transmission lines between Belmont and Murarrie substations	$2m
Line refit works on the 110kV transmission line between Richlands and Algester substations	Refit the 110kV transmission line between Richlands and Algester substations	Maintain supply reliability in the Moreton zone	June 2028	Potential retirement of the transmission line between Richlands and Algester substations	$2m
Substations					
Redbank Plains 110kV primary plant and 110/11kV transformer reinvestment	Refit and life extension of both 110/11kV transformers and replacement of selected 110kV primary plant	Maintain reliability of supply at Redbank Plains Substation	June 2025	Full replacement of 110kV primary plant, replace one 110/11kV transformer and engage non-network support (1)	$8m
South Pine 275/110kV transformer life extension	Life extension of a single 275kV/110kV transformer	Maintain supply reliability in the Moreton zone	June 2025	Retirement of a single 275kV/110kV transformer with non-network support	$2m
South-east Queensland bus reactors (2)	Install 275kV bus reactors at Woolooga, Blackstone and Belmont substations	Maintain system voltages within limits	December 2025	Install 275kV bus reactors at Woolooga, Blackstone and Greenbank substations Non-network solution yielding the same voltage control capacity (1)	$32m
Ashgrove West 110kV secondary systems replacement	Full replacement of 110kV secondary systems	Maintain supply reliability in the Moreton zone	December 2026 (3)	Staged replacement of 110kV secondary systems (1)	$9m (4)

Table 6.26 Possible network investments in the Moreton zone within five years (*continued*)

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative cost
Sumner 110kV secondary systems replacement	Full replacement of 110kV secondary systems	Maintain supply reliability in the Moreton zone	June 2027	Staged replacement of 110kV secondary systems	$4m
Murarrie 110kV secondary systems replacement	Full replacement of 110kV secondary systems	Maintain supply reliability in the Moreton zone	June 2027	Staged replacement of 110kV secondary systems (1)	$22m

Notes:

(1) The envelope for non-network solutions is defined in Section 6.11.5.

(2) Proposed preferred option identified in the PSCR.

(3) The change in timing of the network solution from the 2021 TAPR is based upon updated information on the condition of the assets.

(4) Compared to the 2021 TAPR, the change in the estimated cost of the proposed network solution is based upon updated information in relation to the scope of works and the construction costs of recently completed projects.

Possible network investments in the Moreton zone within six to 10 years

As a result of the annual planning review, Powerlink has identified that the following reinvestments are likely to be required to address the risks arising from network assets reaching end of technical service life and to maintain reliability of supply in the Moreton zone from around 2028/29 to 2032/33 (refer to Table 6.27).

Table 6.27 Possible network investments in the Moreton zone within six to 10 years

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative cost
Transmission lines					
Line refit works on the 110kV transmission line between Blackstone and Abermain substations	Refit the 110kV transmission line between Blackstone and Abermain substations	Maintain supply reliability in the Moreton zone	June 2029	Rebuild the 110kV transmission line between Blackstone and Abermain substations	$8m
Line refit works on the 275kV transmission line between Bergins Hill and Karana Downs	Refit the 275kV transmission line between Bergins Hill and Karana Downs substations	Maintain supply reliability in the Moreton zone	June 2030	Rebuild or replace the transmission line between Bergins Hill and Karana Downs substations	$4m
Line refit works on the 275kV transmission line between Karana Downs and South Pine	Refit the 275kV transmission line between Karana Downs and South Pine substations	Maintain supply reliability in the Moreton zone	June 2030	Rebuild the 275kV transmission line between Karana Downs and South Pine substations	$8m
Line refit works on the 110kV transmission lines between Swanbank, Redbank Plains and West Darra substations	Refit the 110kV transmission lines between Swanbank, Redbank Plains and West Darra substations	Maintain supply reliability in the Moreton zone	June 2030	Rebuild the 110kV transmission lines between Swanbank, Redbank Plains and West Darra substations	$11m
Line refit works on the 275kV transmission line between Bergins Hill, Goodna and Belmont substations	Refit the 275kV transmission line between Bergins Hill, Goodna and Belmont substations	Maintain supply reliability in the Moreton zone	December 2030	Rebuild the 275kV transmission line between Bergins Hill, Goodna and Belmont substations	$38m
Line refit works on the 110kV transmission line between West Darra and Upper Kedron substations	Refit the 110kV transmission line between West Darra and Upper Kedron substations	Maintain supply reliability in the Moreton zone	June 2032	Rebuild the 110kV transmission line between West Darra and Upper Kedron substations	$5m
Substations					
Algester 110kV secondary systems replacements	Full replacement of 110kV secondary systems	Maintain supply reliability in the Moreton zone	December 2028	Staged replacement of 110kV secondary systems	$11m
Rocklea 110kV primary plant replacement	Full replacement of 110kV primary plant	Maintain supply reliability in the Moreton zone	December 2028	Staged replacement of 110kV primary plant	$5m

Table 6.27 Possible network investments in the Moreton zone within six to 10 years (***continued***)

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative cost
Bundamba 110kV secondary systems replacement	Full replacement of 110kV secondary systems	Maintain supply reliability in the Moreton zone	December 2028	Staged replacement of 110kV primary plant	$6m
South Pine SVC secondary systems replacement	Full replacement of SVC secondary systems	Maintain supply reliability in the Moreton zone	June 2029 (1)	Staged replacement of SVC secondary systems	$6m
Goodna 110/332kV transformer augmentation	Installation of a 100MVA 110/33kV transformer	Maintain supply reliability in the Moreton zone	June 2029	Installation of a smaller 110/33kV transformer and non-network support	$6m
Goodna 275kV and 110kV secondary systems replacement	Full replacement of 275kV and 110kV secondary systems	Maintain supply reliability in the Moreton zone	June 2029	Staged replacement of 275kV and 110kV secondary systems (1)	$20m
West Darra 110kV secondary systems replacement	Full replacement of 110kV secondary systems	Maintain supply reliability in the Moreton zone	June 2029 (1)	Staged replacement of 110kV secondary systems	$11m
Rocklea 275/110kV transformer replacement	Replacement of one 275/110kV transformer at Rocklea	Maintain supply reliability in the Moreton zone	June 2029 (1)	Life extension of one 275/110kV transformer at Rocklea	$5m
Loganlea 275kV primary plant replacement	Full replacement of 275kV primary plant	Maintain supply reliability in the Moreton zone	June 2029 (1)	Staged replacement of 275kV primary plant	$5m
Greenbank SVC and 275kV secondary systems replacement	Full replacement of 275kV SVC and secondary systems	Maintain supply reliability in the Moreton and Gold Coast zones	June 2029	Staged replacement of 275kV SVC and secondary systems	$33m
Goodna 275kV and 110kV secondary systems replacement	Full replacement of secondary systems	Maintain supply reliability in the Moreton zone	June 2029	Staged replacement of 275kV and 110kV secondary systems	$20m
Mount England 275kV secondary systems and primary plant replacement	Full replacement of 275kV secondary systems and staged replacement of primary plant	Maintain supply reliability in the Moreton zone	June 2029	Staged replacement of 275kV secondary systems and primary plant	$11m
Belmont 110kV and 275kV secondary systems replacement	Full replacement of secondary systems	Maintain supply reliability in the Moreton zone	June 2029	Staged replacement of 275kV and 110kV secondary systems	$24m

Table 6.27 Possible network investments in the Moreton zone within six to 10 years (*continued*)

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative cost
Belmont 33kV and 11kV primary plant replacement	Full replacement of 33kV and 11kV primary plant	Maintain supply reliability in the Moreton zone	December 2029	Staged replacement of 22kV and 11kV primary plant	$5m
South Pine 275kV primary plant replacement	Staged replacement of 275kV primary plant	Maintain supply reliability in the Moreton zone	June 2030	Full replacement of 275kV primary plant	$5m
Abermain 275kV and 110kV secondary systems replacement	Full replacement of 275kV and 110kV secondary systems	Maintain supply reliability in the Moreton zone	June 2030	Staged replacement of 275kV and 110kV secondary systems	$14m
Palmwoods 132kV secondary systems replacement	Full replacement of secondary systems	Maintain supply reliability in the Moreton zone	June 2030	Staged replacement of 132kV secondary systems	$21m
Loganlea 110kV secondary systems replacement non-iPASS	Full replacement of secondary systems	Maintain supply reliability in the Moreton zone	June 2031	Staged replacement of 110kV secondary systems	$22m

Note:

(1) The change in timing of the network solution from the 2021 TAPR is based upon updated information on the condition of the assets.

Possible asset retirements within the 10-year outlook period

Loganlea 110/33kV transformer

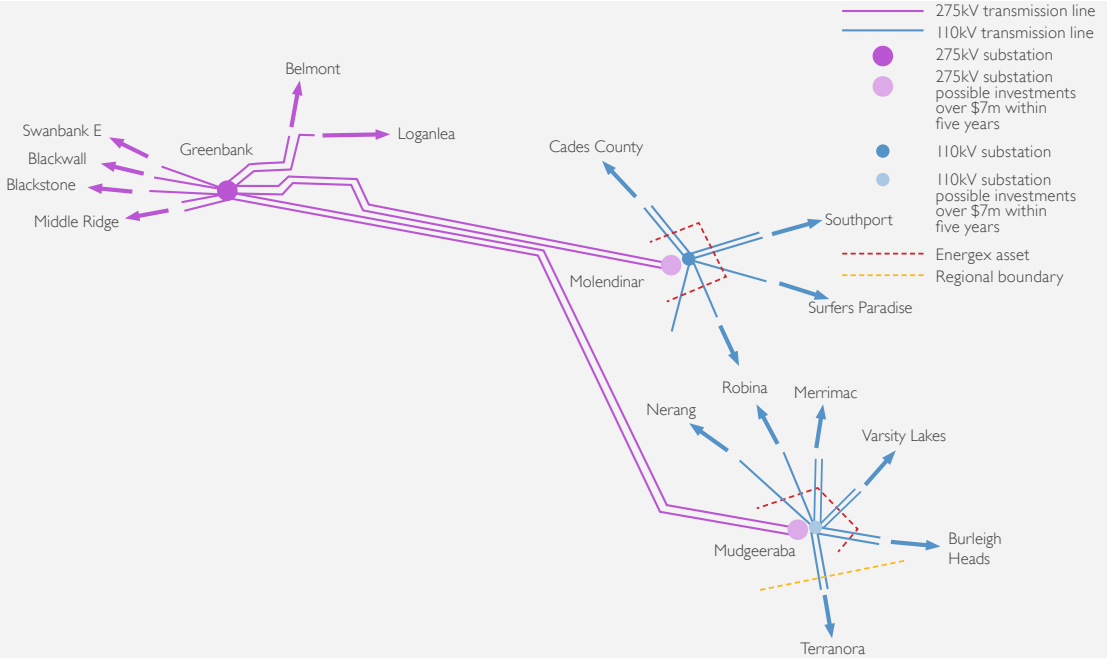
Based on the condition of one of the 110/33kV transformers at Loganlea, it is proposed to retire this transformer at the end of technical service life by June 2023. Powerlink considers that this will not impact on the ability to meet the obligations of Powerlink's reliability criteria. Further joint planning will be undertaken prior to a final decision being made.

6.11.6 Gold Coast zone

Existing network

The Powerlink transmission system in the Gold Coast zone was originally constructed in the 1970s and 1980s. The Molendinar and Mudgeeraba substations are the two major injection points into the area via a double circuit 275kV transmission line between Greenbank and Molendinar substations, and two single circuit 275kV transmission lines between Greenbank and Mudgeeraba substations (refer to Figure 6.17).

Figure 6.17 Gold Coast transmission network



Possible load driven limitations

Based on AEMO's Step Change scenario forecast discussed in Chapter 3, there is no additional capacity forecast to be required as a result of network limitations in the Gold Coast zone within the next five years to meet reliability obligations.

Possible network investments within five years

Network investments (which includes reinvestment and augmentations) in the Gold Coast zone are related to addressing the risks arising from the condition of the existing network assets, which without corrective action, would result in Powerlink being exposed to breaching a number of its jurisdictional network, safety, environmental and Rules' obligations.

By addressing the condition of these existing assets, Powerlink is seeking to ensure it can safely deliver an adequate, economic, and reliable supply of electricity to meet the load requirements of customers in the Gold Coast zone into the future. This may result in like-for-like replacement, non-network solutions, network reconfiguration, asset retirement, line refit or replacement with an asset of lower capacity.

Transmission lines

Greenbank to Mudgeeraba 275kV transmission lines

Potential consultation	Maintaining reliability of supply to the southern Gold Coast area
Project driver	Emerging condition risks due to structural corrosion
Project timing	December 2028
Proposed network solution	Maintain the existing topography by way of a targeted line refit at an estimated cost of $30 million to $53 million by December 2028

The two 275kV single circuit transmission lines were constructed in the mid-1970s and support the supply to Gold Coast and northern NSW.

Possible network solutions

Feasible network solutions to address the risks arising from these transmission lines may include:

- Maintaining the existing 275kV transmission line topography and capacity by way of a targeted line refit by December 2028
- Replacement at the end of technical service life of the existing single circuits between Mudgeeraba and Greenbank with a new double circuit line, through staged rebuild.

To ensure reliability of supply to customers, the required renewal works will need to be completed in stages outside of summer peak load and outage co-ordination will be complex due to the significant renewal program in the Gold Coast area within the 10-year outlook period. Due to these challenges it has been identified that an extended delivery timeframe of at least four years would be required with the potential for works to commence within the next five years.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

The Greenbank to Mudgeeraba 275kV transmission lines provide injection to the southern Gold Coast and northern NSW area. Powerlink is not aware of any non-network proposals in this area that can address this requirement in its entirety. Powerlink would consider proposals from non-network providers that can significantly contribute to reducing the requirement in this region, as this may present opportunities in reconfiguring the network that would otherwise not be able to meet Powerlink's planning standard. Non-network solutions may include, but are not limited to local generation or DSM initiatives in the area.

Substations

Mudgeeraba 275/110kV Substation

Mudgeeraba 110kV Substation was established in 1972 and extended from the 1980s to 2000s to meet load growth and is located within the southern end of zone of the Gold Coast. Further extensions included the establishment of a 275kV switchyard and associated secondary systems in 1992, which was further expanded in 2002. Mudgeeraba 275/110kV Substation is a major connection point for supply to the Gold Coast and northern NSW with the 110kV substation supplying distribution points including Robina, Nerang, Broadbeach, Burleigh and Terranora.

Mudgeeraba 110kV secondary systems

Anticipated consultation	Addressing the secondary systems condition risks at Mudgeeraba
Project driver	Emerging condition risks arising from the condition of the 110kV secondary systems
Project timing	June 2028
Proposed network solution	Staged replacement of secondary systems at an estimated cost of $12 million by June 2028

Possible network solutions

- Staged replacement of the secondary systems components by June 2028
- Full replacement of all secondary systems by June 2028.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Potential consultation	Addressing the primary plant condition risks at Mudgeeraba
Project driver	Emerging risks arising from the condition of the 110kV primary plant
Project timing	June 2028
Proposed network solution	Selected replacement of primary plant at an estimated cost of $20 million by June 2028

Possible network solutions

- Selected replacement of primary plant by June 2028
- Full replacement of all primary plant by June 2028.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Mudgeeraba Substation provides injection and switching to the southern Gold Coast and northern NSW area. Powerlink would consider proposals from non-network providers that can significantly contribute to reducing the requirement in this region, as this may present opportunities in reconfiguring the network that would otherwise not be able to meet Powerlink's planning standard. Non-network solutions may include, but are not limited to local generation or DSM initiatives in the area.

Molendinar 275/110kV Substation

Molendinar 275kV Substation was established in 2003 and is located in the northern end of Gold Coast zone. The Molendinar Substation is supplied from Greenbank Substation by a 275kV double circuit transmission line. There is currently no 275kV bus at Molendinar, with two 275/110kV transformers supplied transformer ended. There is a long-term enduring need to supply the Gold Coast region through Molendinar Substation.

Molendinar 275/110kV Substation

Potential consultation	Addressing the 275kV secondary systems condition risks at Molendinar
Project driver	Emerging condition risks arising from the condition of the 275kV secondary systems
Project timing	December 2027
Proposed network solution	Full replacement of secondary systems at an estimated cost of $23 million by December 2027

Possible network solutions

- Staged replacement of the secondary systems components by December 2027
- Full replacement of all secondary systems by December 2027.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

The Molendinar Substation facilitates supply to the Energex loads of Cades County, Molendinar, Southport, Surfers Paradise and Nerang.

To meet the Molendinar demand, the non-network solution must be capable of delivering up to 336MW of power and 3,490MWh of energy each day.

Possible network investments in the Gold Coast zone within five years

As assets approach their anticipated end of technical service life, the potential projects and alternatives (options) listed in Table 6.28 will be subject to detailed analysis to confirm alignment with future investment, optimisation and delivery strategies. This analysis provides Powerlink with an additional opportunity to assess the needs and timing of asset replacement works, further refine options or consider other options, including the associated delivery strategies, from those described in Table 6.28, from around 2022/23 to 2027/28 (refer to Table 6.28).

Table 6.28 Possible network investments in the Gold Coast zone within five years

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative cost
Substations					
Molendinar 275kV secondary systems replacement	Full replacement of 275kV secondary systems	Maintain supply reliability in the Gold Coast zone	December 2027 (2)	Selected replacement of 275kV secondary systems (1)	$23m
Mudgeeraba 110kV secondary systems replacement	Partial replacement of 110kV secondary systems	Maintain supply reliability in the Gold Coast zone	June 2028 (2)	Full replacement of 110kV secondary systems (1)	$12m
Mudgeeraba 110kV primary plant replacement	Selected replacement of 110kV equipment	Maintain supply reliability in the Gold Coast zone	June 2028 (2)	Staged replacement of 110kV primary plant in existing bays and selected 275kV equipment (1)	$21m

Notes:

(1) The envelope for non-network solutions is defined in Section 6.11.5.

(2) The change in timing of the network solution from the 2021 TAPR is based upon updated information on the condition of the assets.

Possible network investments in the Gold Coast zone within six to 10 years

As a result of the annual planning review, Powerlink has identified that the following reinvestments are likely to be required to address the risks arising from network assets reaching end of technical service life and to maintain reliability of supply in the Gold Coast zone from around 2028/29 to 2032/33. (refer to Table 6.29).

Table 6.29 Possible network investments in the Gold Coast zone within six to 10 years

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative cost
Transmission lines					
Line refit works on the 110kV transmission line between Mudgeeraba Substation and Terranora	Targeted line refit works on steel lattice structures	Maintain supply reliability from Queensland to NSW Interconnector	December 2028	Full line refit New transmission line	$5m
Line refit works on sections of the 275kV transmission line between Greenbank and Mudgeeraba substations	Targeted line refit works on steel lattice structures	Maintain supply reliability in the Gold Coast zone	December 2028	New double circuit 275kV transmission line	$53m
Substations					
Mudgeeraba 275/110kV Transformer Replacement	Replacement of the transformer	Maintain supply reliability to the Gold Coast Region	December 2030	Life extension of the existing transformer	$11m

Possible asset retirements within the 10-year outlook period

Current planning analysis has not identified any potential asset retirements in the Gold Coast zone within the 10-year outlook period.

6.12 Supply demand balance

The outlook for the supply demand balance for the Queensland region was published in the AEMO 2022 Electricity Statement of Opportunity (ESOO)[25]. Interested parties who require information regarding future supply demand balance should consult this document.

6.13 Existing interconnectors

The Queensland transmission network is interconnected to the NSW transmission system through the QNI transmission line and Terranora Interconnector transmission line.

The combined QNI plus Terranora Interconnector maximum northerly capability is limited by thermal ratings, voltage stability, transient stability and oscillatory stability (as detailed in Section 8.6.10).

The capability of these interconnectors can vary significantly depending on the status of plant, network conditions, weather and load levels in both Queensland and NSW. It is for these reasons that interconnector capability is regularly reviewed, particularly when new generation enters or leaves the market or transmission projects are commissioned in either region.

6.13.1 Expanding NSW-Queensland transmission transfer capacity

A RIT-T process to consider investment options on the QNI commenced in November 2018 and was completed in December 2019 with the publication of the 'Expanding NSW-Queensland transmission transfer capacity' PACR. The PACR identified the preferred option as uprating the 330kV Liddell to Tamworth 330kV lines, installing Static VAr Compensators (SVC) at Tamworth and Dumaresq substations and static capacitor banks at Tamworth, Armidale and Dumaresq substations. These project works have now been completed by Transgrid. Inter-network testing, as required by NER 5.7.7, is now progressing to release additional capacity to the market in a staged approach. These tests are expected to continue until mid-2023.

The 2022 ISP identified further upgrades to the QNI capacity as part of the optimal development path. These projects are discussed in detail in Section 9.3.

6.14 Transmission lines approaching end of technical service life beyond the 10-year outlook period

As transmission lines approach their anticipated end of technical service life, detailed planning studies are undertaken to confirm the asset's enduring need taking into consideration asset condition and risk as well as alignment with future investment or possible network optimisation strategies. Options considered may include line refit, targeted and/or staged refit or replacement, upfront replacement or rebuild, network reconfiguration, non-network alternatives, asset de-rating or retirement.

The information contained in Table 6.30, which goes five years beyond the 10-year outlook period of the 2022 TAPR, is provided in good faith26 and is the best information available at the time of TAPR publication. Transmission equipment ratings information is available on AEMO's website and can also be accessed via the TAPR Portal.

Given the rapid speed of the energy transformation, proponents who wish to connect to Powerlink's transmission network are strongly encouraged to contact BusinessDevelopment@powerlink.com.au in the first instance.

[25] Published by AEMO in August 2022.
[26] For completeness, please refer to Powerlink's Disclaimer on page 2.

6 Future network development

Table 6.30 Transmission Lines approaching end of technical service: 10-15 years (July 2033 – June 2038)

Region	Zone	Feeder	Voltage	General location	Anticipated end of technical service life
Northern	Far North	7225	132kV	Between Cairns and Woree substations	2032
Northern	Far North	7165	132kV	Between Chalumbin and Turkinje substations	2036
Northern	Far North	7191	132kV	Proserpine Substation	2036
Northern	Far North	7227	132kV	Between Cairns and Woree substations	2037
Northern	North	7152	132kV	Between Eton and Alligator Creek Substation	2032
Northern	North	7156	132kV	Between Ross and Townsville South substations	2034
Northern	North	8858	275kV	Between Strathmore and Ross substations	2035
Northern	North	820	275kV	Between Bouldercombe and Broadsound substations	2033
Central	North	7124	132kV	Between Moranbah and Dysart substations	2036
Central	Central West	7150	132kV	Between Lilyvale and Dysart substations	2032
Central	Central West	833	275kV	Between Broadsound and Lilyvale substations	2035
Central	Central West	7112	132kV	Between Baralaba and Moura substations	2035
Central	Central West	7109	132kV	Between Baralaba and Calvale substations	2035
Central	Central West	7159	132kV	Between Callide A and Calvale substations	2036
Central	Central West	7161	132kV	Calvale Substation	2037
Central	Central West	851	275kV	Between Calvale Substation and Callide Power Station	2037
Central	Central West	852	275kV	Between Calvale Substation and Callide Power Station	2037
Central	Gladstone	812	275kV	Between Bouldercombe and Calliope River substations	2033
Central	Gladstone	8876	275kV	Between Gladstone and Calliope River substations	2037
Central	Gladstone	8877	275kV	Between Gladstone and Calliope River substations	2032
Central	Gladstone	8878	275kV	Between Gladstone and Calliope River substations	2033
Central	Gladstone	871	275kV	Between Calvale and Wurdong substations	2037
Southern	Wide Bay	8850	275kV	Between Woolooga and Teebar Creek substations	2032
Southern	Wide Bay	810	275kV	Between Woolooga and Palmwoods substations	2036
Southern	South West	831	275kV	Between Tarong and Middle Ridge substations	2032

Table 6.30 Transmission Lines approaching end of technical service: 10-15 years (June 2033 – July 2038) (***continued***)

Region	Zone	Feeder	Voltage	General location	Anticipated end of technical service life
Southern	South West	841	275kV	Between Tarong Power Station and Tarong Substation	2033
Southern	South West	843	275kV	Between Tarong Power Station and Tarong Substation	2035
Southern	Moreton	832	275kV	Between Tarong and South Pine substations	2032
Southern	Moreton	823	275kV	Between Mt England Substation and Wivenhoe Power Station	2034
Southern	Moreton	827	275kV	Between Tarong and Blackwall substations	2035

6 Future network development