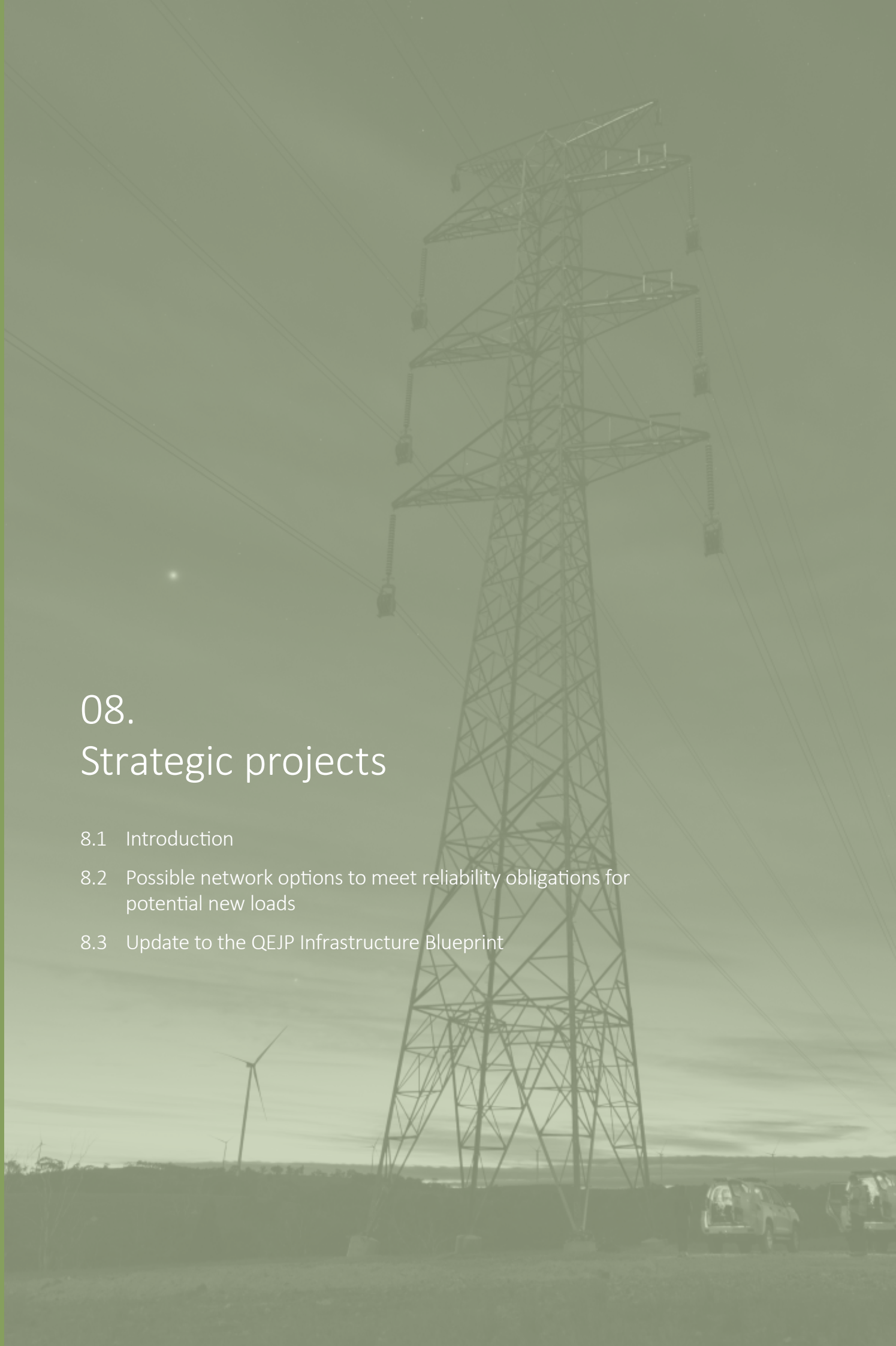


08.
Strategic projects

This chapter discusses plausible new loads within the resource rich areas of Queensland and the associated coastal port facilities, as well as the potential future electrification of mining and industrial processing loads that may cause network limitations to emerge within the 10-year outlook period. It also discusses updates to major projects referenced in the Queensland Energy and Jobs Plan (QEJP).

Key highlights

- Possible loads associated with new industrial processes, including industry based on hydrogen, and electrification of major industrial processes and mining operations, are emerging within the 10-year outlook period.
- Possible network impacts and options are provided for the Northern Bowen Basin coal mining area, North West Mineral Province, Central Queensland to North Queensland (CQ-NQ) and Central West to Gladstone grid sections.
- Through market engagements an opportunity was identified to more efficiently access potential large wind resources along the Great Dividing Range, west of the Calvale to Halys transmission corridor. This requires a revision to stage 2 of the SuperGrid and enables a revised voltage and topology to effect the stage 1 connection of the Borumba Pumped Hydro Energy Storage project.

8.1 Introduction

Chapter 3 provides details of several proposals for large mining, metal processing and other industrial loads whose development status is not yet at the stage that they have been included (either wholly or in part) in Powerlink's Central scenario forecast. These load developments are listed in Table 3.1.

The possible impact these uncertain loads may have on the performance and adequacy of the transmission system is discussed in Section 8.2. This assessment is made taking into account the existing and committed network and those network developments proposed in the QEJP.

In September 2022 the Queensland Government published the QEJP and associated Queensland SuperGrid Infrastructure Blueprint ("Infrastructure Blueprint"). The Infrastructure Blueprint outlines the Optimal Infrastructure Pathway (OIP) to deliver a clean, reliable and affordable power system. The Infrastructure Blueprint is a point in time plan with the underlying inputs, assumptions and future scenarios continually monitored as the market evolves and available information improves as part of detailed design and planning phases. The Queensland Government is required to update its Infrastructure Blueprint every two years with the OIP to reflect new infrastructure investments, changing market conditions, and the market outlook. The next update to the Infrastructure Blueprint is scheduled for May 2025.

8.1.1 Stakeholder and community engagement

Powerlink is committed to genuine and timely stakeholder engagement and as described in Section 1.8.1, all engagement activities are undertaken in accordance with our Stakeholder Engagement Framework and Community Engagement Strategy. Where applicable, planning approval for transmission lines will be facilitated under the Ministerial Infrastructure Designation process, as per the Queensland Planning Act 2016 and where new easements are required Powerlink will apply the new SuperGrid Landholder Payment Framework that significantly boosts payments to landholders hosting new transmission infrastructure and offers payments to landholders on neighbouring adjacent properties.

8.2 Possible network options to meet reliability obligations for potential new loads

The proposals for the connection of new industrial processing loads, including new industry based on hydrogen, and electrification of major industrial processes and mining operations are emerging as the broader economy transforms to a lower carbon future.

In North Queensland there is considerable interest from customers investigating electrification to their mining operations in the Northern Bowen Basin. Approximately 40km south of Townsville the Lansdown Eco Industrial Precinct has been envisioned to become Northern Australia's foremost precinct for advanced manufacturing, processing, technology and emerging industries. Also in North Queensland, Powerlink is working towards final approval by the Queensland Government of the CopperString 2032 project. This will connect the current NWMP load to the National Electricity Market (NEM).

More broadly across the state, there is also the potential for conversion of existing industrial and manufacturing processes from coal, gas and/or diesel to electricity. Many of these loads are in the Gladstone zone. New industry loads based on hydrogen are also potentially located in the Gladstone and Townsville zones.

These potential loads, including possible locations, are listed in Table 3.1. Together, these loads have the potential to significantly impact the performance of the transmission network supplying these areas, including power transfers that exceed the capability of the network. This could be due to plant ratings, voltage stability and/or transient stability. However, all of these loads will have a positive impact on the minimum load issues discussed in Section 3.2. This is particularly the case since the load profile for these mining, metal processing and industrial loads are typically relatively flat.

Powerlink has analysed the impact of these new loads on power transfers and assessed the adequacy of the network capability to meet the required needs. Where the capability of the regulated network is forecast to be exceeded, network developments that could be required to meet those needs have been identified. Options to address the network limitations can also include demand side management (DSM) and non-network solutions.

This section focuses on the most likely network development options only. As the proposed loads become committed, detailed planning analysis will inform and optimise the project scopes and cost estimates. Powerlink will undertake the relevant approval process to identify the preferred option (which may include a non-network option or component) that maximises the present value of the net economic benefit to all those who produce, consume and transport electricity in the market.

The emergence and magnitude of network limitations resulting from the commitment of these loads will also depend on the location, type and capacity of new or withdrawn generation. For the purpose of this assessment the existing and committed generation in tables 7.1 and 7.2 has been taken into account when discussing the possible network limitations. However, where current interest in connecting further variable renewable energy (VRE) generation has occurred, that has the potential to materially impact the magnitude of the emerging limitation, this is also discussed in the following sections.

The emergence and magnitude of network limitations resulting from the commitment of these loads will also depend on the relative timing of the new high voltage SuperGrid transmission system that is required to transport large quantities of renewable energy and storage across the state. Powerlink will also consider these potential limitations holistically with any emerging condition based drivers as part of the longer term planning process and in conjunction with the Integrated System Plan (ISP) and QEJP.

Details of feasible network options are provided in sections 8.2.1 to 8.2.4, for the transmission grid sections potentially impacted by the possible new large loads in Table 3.1.

8.2.1 Northern Bowen Basin coal mining area

Based on Powerlink's Central scenario forecast discussed in Chapter 3, and the committed generation listed in tables 7.1 and 7.2, network limitations are forecast to exceed network reliability requirements established under Powerlink's planning standard (refer to Section 6.9.3).

There have also been early discussions on new and expanded mining operations and on electrification of existing mining processes in the Northern Bowen Basin in line with global efforts to reduce carbon emissions. To achieve this, mines will need to replace diesel fuel within their operations through the introduction of a modern electrified mining fleet or the substitution of diesel fuel with hydrogen. Either way, fuel substitution may lead to significant increases in electrical demand and require significant supplies of renewable electricity. Early discussions with proponents indicate that significant investment in renewable energy supply is unlikely to be "behind the meter". As such, new and expanded mining operations, combined with electrification of existing mining processes could see load increase by up to approximately 600MW. These loads have not reached the required development status to be included in Powerlink's Central scenario forecast for this Transmission Annual Planning Report (TAPR).

This additional load within the Northern Bowen Basin area would result in voltage and thermal limitations on the 132kV transmission system upstream of their connection points. Critical contingencies include an outage of a 132kV transmission line between Nebo and Moranbah substations, or the 132kV transmission line between Lilyvale and Dysart substations (refer to Figure 6.11).

The impacts these loads may have on the CQ-NQ grid section and possible network solutions to address these is discussed in Section 8.2.4.

Possible network solutions

Mining operations in the Northern Bowen Basin rely heavily on the existing 132kV network to deliver electricity to the area. Much of this infrastructure has limited thermal capacity. To address the potential shortfall in capacity in the transmission and distribution networks, consultation with the customers in the Bowen Basin is required to assess the likely decarbonisation pathways under consideration (electrification or hydrogen), in order to forecast the potential energy demand, VRE supply, and transmission requirements.

Given this 132kV network is west of the existing 275kV backbone it is unlikely that the Queensland SuperGrid Infrastructure can address the local supply limitations within the Northern Bowen Basin. Components of the Infrastructure Blueprint may however address resulting CQ-NQ grid section limitations, depending on the relative timings of the load increase and Infrastructure Blueprint augmentations.

Depending on the magnitude and location of load, possible network options to, and within the Northern Bowen Basin may include one or more of the following:

- Installation of flow control devices on the 132kV network to improve the sharing of power flow in the Northern Bowen Basin
- Construction of new 132kV transmission lines between the Nebo, Broadlea and Peak Downs areas
- Construction of 132kV transmission line between Moranbah and a future substation north of Moranbah
- Advance the rebuild of the 132kV transmission lines that supply the Northern Bowen Basin area as higher capacity 132kV lines with associated capacitive compensation for voltage control. The existing 132kV lines are forecast to reach their end of technical service in the 2040s.

Powerlink has a vacant transmission corridor between Nebo and Broadlea and a double width easement from Moranbah to north of Newlands substations. New strategic easements would need to be obtained to deliver the other network options described above.

8.2.2 CopperString 2032

In March 2023, the Queensland Government announced that it will build and own the network to the NWMP (referred to as CopperString 2032 and formerly known as the CopperString 2.0 project). Powerlink is currently working with impacted landholders, equipment suppliers and Construction Partners to finalise the scope, estimate and construction schedule for final project approval by the Queensland Government.

The CopperString 2032 project will allow the NWMP to access lower cost electricity sources from the NEM. The existing NWMP load that would directly connect to the NEM is approximately 160MW.

During the development of this project there has been significant interest in connecting new mining loads within the NWMP (including existing load supplied from separate islanded systems) and at various locations along the length of the project. In consideration of this load potential proceeding, the scope of the initial project has been designed to support approximately 450MW of load. As further load commits, augmentation of the CopperString 2032 network and/or to Energy Queensland's network in the NWMP will be required.

As outlined in Section 2.4.1, CopperString 2032 will also enable the connection of significant quantities of high quality wind energy in the Hughenden region for export to the coastal Queensland transmission system. The Hughenden region has been named the Flinders Renewable Energy Zone (REZ) within the draft Queensland Government REZ Roadmap (refer Section 2.4.1). As a result, the section of CopperString 2032 between Hughenden and the coastal Queensland transmission system (south of Ross Substation) is planned to be constructed at 500kV which will enable higher levels of hosting and transfer of renewable energy to the interconnected eastern transmission system.

Possible network solutions

CopperString 2032 involves building approximately 840 km of new electricity transmission line from near Townsville to Mount Isa and includes the following core transmission infrastructure components:

- 360km of 500kV double circuit transmission line from Townsville to Hughenden
- 400km of 330kV double circuit transmission line from Hughenden to Cloncurry
- 100km of 220kV double circuit transmission line from Cloncurry to Mount Isa
- Establishment of new substations, and installation of transformers and reactive plant.

CopperString 2032 will connect to a new 500/275kV substation south of Powerlink's existing Ross Substation by cutting into two of the existing 275kV circuits between Strathmore and Ross substations (refer to Figure 2.5).

8.2.3 Lansdown Eco Industrial Precinct

The Lansdown Eco Industrial Precinct (LEIP) is located near Woodstock, 40km south of Townsville. The 2200-hectare (22km^2) precinct is primarily a high impact industrial zone away from residential areas. It is a "greenfield development" with the vision to become Northern Australia's foremost precinct for advanced manufacturing, processing, technology, and emerging industries. A Taskforce was established by the Office of the Coordinator-General (OCG) in March 2023 to assist Townsville City Council accelerate the development of the LEIP to service the proponents that have been allocated land within the precinct.

There have been early discussions with possible tenants of the LEIP, including for hydrogen production facilities, energy chemicals and quartz manufacturing.

The impacts of this additional load south of Townsville may have on the CQ-NQ grid section and possible network solutions to address these is discussed in Section 8.2.4.

Possible network solutions

This is a "greenfield" development area with significant potential load. Table 3.1 has assumed a possible load within the 10-year outlook of up to approximately 1,000MW. Supply to this precinct would be at 275kV by establishing a 275/132kV substation (including lower voltage as required) at the LEIP:

- by cutting into two of the existing 275kV circuits between Strathmore and Ross substations, and
- depending on load growth and relative timing, reinforcement via a second double circuit 275kV line from the Copperstring 2032 500/275kV most eastern substation to LEIP. This could increase the network capacity between the CopperString network and LEIP to approximately 3GW.

Components of the Infrastructure Blueprint may also address resulting CQ-NQ grid section limitations, depending on the relative timings of the load increase and Infrastructure Blueprint augmentations.

8.2.4 CQ-NQ grid section transfer limit

Based on Powerlink's Central scenario forecast outlined in Chapter 3 and the existing and committed generation listed in tables 7.1 and 7.2, network limitations impacting reliability are not forecast to occur within the 10-year outlook period.

Midday power transfer levels are reversing from northern to southern transfers. The incidence of light loading on the transmission system is forecast to increase as additional VRE generators are fully commissioned in North Queensland (NQ) (refer to tables 7.1 and 7.2). Voltage control is therefore becoming increasingly challenging and leading to high voltage violations. As outlined in Section 9.3, Powerlink completed a RIT-T consultation recommending the installation of a 275kV shunt reactor at the Broadsound Substation. This reactor was commissioned in June 2024 (refer to Table 9.3).

As discussed in sections 8.2.1 to 8.2.3, there is the likelihood of significant additional load in North Queensland from new and expanded mines and electrification of existing mining operations in the Northern Bowen Basin, the connection of the NWMP to the NEM through CopperString 2032 and development of new load within the Lansdown Eco Industrial Precinct may proceed (refer to Table 3.1).

These could result in an increase in northern Queensland demand of greater than 1,000MW. However, the majority of these loads have not reached the required development status to be included in Powerlink's Central scenario forecast for this TAPR.

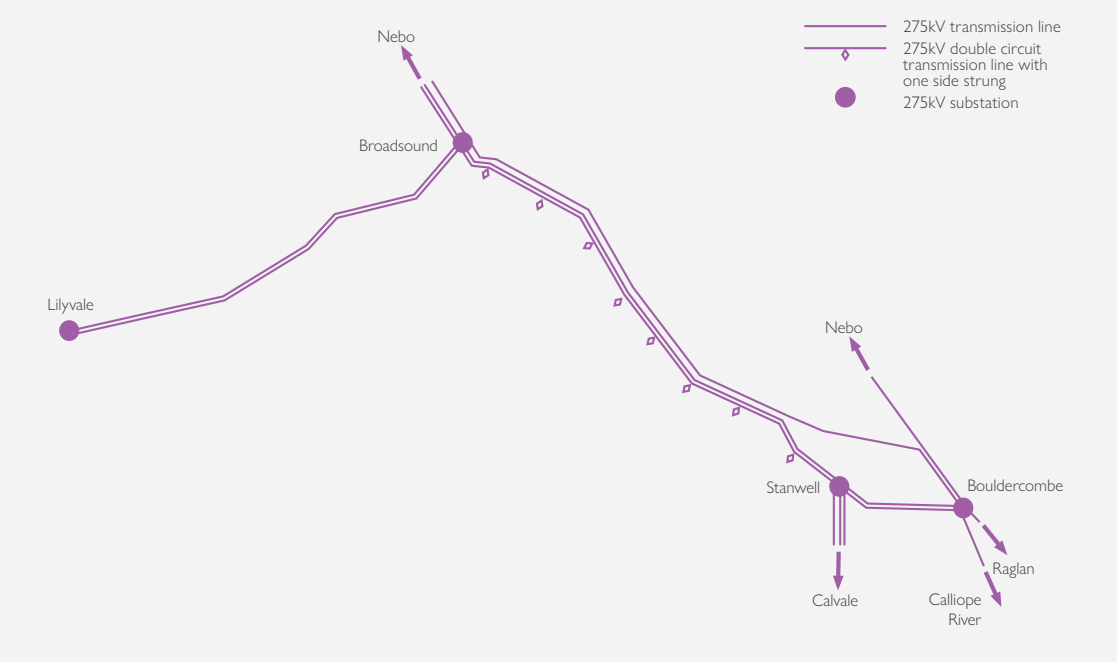
Network limitations on the CQ-NQ grid section may occur if a portion of these new loads commit. Power transfer capability into northern Queensland is limited by thermal ratings, voltage and transient stability. Thermal limitations may occur on the Bouldercombe to Broadsound 275kV line following a critical contingency of a Stanwell to Broadsound 275kV transmission line. Voltage and transient stability limitations may occur following the trip of the Townsville gas turbine or fault and trip of a 275kV transmission line supplying northern Queensland.

Network congestion between central Queensland and north Queensland will require dispatch of additional, out-of-merit-order generation in North Queensland. As generation costs are higher in northern Queensland, due to reliance on liquid fuels, it may be economic to advance the timing of augmentation to deliver positive net market benefits.

Possible network solutions

In 2002, Powerlink constructed a 275kV double circuit transmission line from Stanwell to Broadsound with one circuit strung (refer to Figure 8.1). A feasible network solution to increase the power transfer capability to northern Queensland is to string the second side of this transmission line. No easement is required for this scope of work.

Figure 8.1 Stanwell/Broadsound area transmission network



Components of the Infrastructure Blueprint between Central and Northern Queensland may also address the CQ-NQ grid section limitations, depending on the relative timings of the load increase and Infrastructure Blueprint augmentations.

Powerlink will also consider the emerging condition based drivers as part of the planning process to ensure the most cost effective solutions are delivered for customers, including working with the proponent to identify mutually beneficial non-network options.

8.2.5 Gladstone grid section transfer limit

Based on Powerlink's Central scenario forecast discussed in Chapter 3, there is approximately 1,800MW of additional load expected to connect in the Gladstone zone by 2034. This load is associated with electrification of components of the existing industrial processes and initial stages of hydrogen development within the area.

While Powerlink has no connection point commitments from any direct connect customers in the Gladstone zone at the time of the publication of 2024 TAPR, Powerlink is engaging with customers that appear committed to decarbonising their existing fossil fuelled operations and processes - with some level of uncertainty over timeframes. There has also been a significant number of enquiries for the connection of new industrial processing loads in the Gladstone zone. The magnitude and timing of new and/or electrification load is uncertain. The quantity could range from 3.3GW to over 7.7GW (refer to Table 3.1).

With reduced operation of Gladstone Power Station (GPS) as the electricity industry transforms to a lower carbon future, in combination with electrification of existing industrial processes, and development of new industry load, there will be a significant impact on the transmission capacity required to maintain reliability of supply in the Gladstone zone and power system security.

In July 2024, Powerlink commenced consultation on the Gladstone Project as a candidate Priority Transmission Investment (PTI) under the Energy (Renewable Transformation and Jobs) Act 2024 (ERTJ Act). This consultation is being undertaken to ensure that on-going reliability and security of supply is available to meet forecast electrical load in the Gladstone area and support the decarbonisation of major industries in anticipation of the closure of the Gladstone Power Station. Further details on this consultation, consultation paper and next steps are available on Powerlink's website[1].

Aligned with this need, the Gladstone Project has also been declared a Queensland Actionable Project in Australian Energy Market Operator's (AEMO) 2024 Integrated System Plan (ISP).

Connecting additional load in the Gladstone zone will require further investment in transmission, both into and within the Gladstone zone. The additional transmission capacity required to meet this increase in load will only be considered in the context of the main network supplying the Gladstone zone. Network limitations downstream of the main transmission system would also need to be assessed based on specific customer load.

The network augmentations will also be considered holistically with end of technical life drivers and alignment with hosting renewable energy generation.

Possible network solutions

Subject to shareholding Minister approval, the initial stages of Powerlink's plan are to increase the transmission capacity to the Gladstone area are outlined in the recently published "Gladstone Project - Candidate Priority Transmission Investment – Consultation Paper". This consultation paper provides an overview of the objectives Powerlink seeks to achieve by investing in the Gladstone Project, and the timeframes by which each element of the project need to be completed to meet those objectives.

The projects described in this consultation paper are the initial stages of possible development. They provide sufficient power transfer capability to reliably supply the forecast electrical load in the Gladstone area in anticipation of the closure of the Gladstone Power Station and support the initial decarbonisation of major industries in the Gladstone area. The initial transmission projects proposed include:

- build a new 275kV high capacity double-circuit line between Calvale and Calliope River and install a new 275/132kV transformer at Calliope River Substation. These projects are required to reliably supply the forecast electrical load in the Gladstone area in anticipation of the closure of the Gladstone Power Station.

[1] Refer PTI Gladstone project.

- rebuild Bouldercombe to Calliope River transmission line as a 275kV high capacity double circuit line and rebuild Calliope River to Larcom Creek transmission line as a 275kV high capacity double circuit line. These projects are required to support the decarbonisation of major industries in the Gladstone area.

Both the new Calvale to Calliope River and Bouldercombe to Larcom Creek transmission lines traverse a common area west of Gladstone. Powerlink is in the process of acquiring land suitable for establishing a major new substation in this area. These new 275kV circuits could be switched at this new substation (establishing high capacity double circuit spokes to Larcom Creek and Calliope River respectively). The 275kV bus could be a feasible alternative to, or defer the need for, the rebuild between Calliope River to Larcom Creek substations.

The amount of additional load that may be supplied in the Gladstone zone following these works will depend on the relative distribution of the load between the Larcom Creek, Calliope River and Wurdong substation and location of new generation development. Further network augmentations would be required within the Gladstone zone as the load increases. Feasible network solutions include:

- constructing a new high capacity 275kV double circuit transmission line between Stanwell and Bouldercombe substations.
- establishing the 500/275kV substation west of Gladstone and associated 500kV connections to deliver power from variable renewable energy generation and firming resources
- additional 275kV connections from the 500/275kV Gladstone West Substation to Calliope River and/or Larcom Creek
- additional 275kV tie capacity between Calliope River and Larcom Creek substations.

Managing power transfers on the existing lower rated 275kV single circuit between Calvale and Wurdong substations will also need to be addressed as the supply/demand balance changes in the Gladstone zone. This circuit was initially constructed in two stages. Firstly in 1987 the western section was built from Calvale Substation to a tee point (on feeder 812 between Bouldercombe to Calliope River) at Cedar Vale (west of Gladstone). Then in 1998 the tee was disconnected, and the single circuit line was extended to Wurdong Substation coincident with the expansion of the Boyne Island Smelter. Options to address limitations across this circuit include:

- installation of flow control devices (e.g. SmartValve[2] or phase shifting transformer) at Wurdong Substation
- restring with high temperature conductor (HTC)
- rebuild whole or sections[3] of the circuit as a new high capacity 275kV double circuit transmission line.

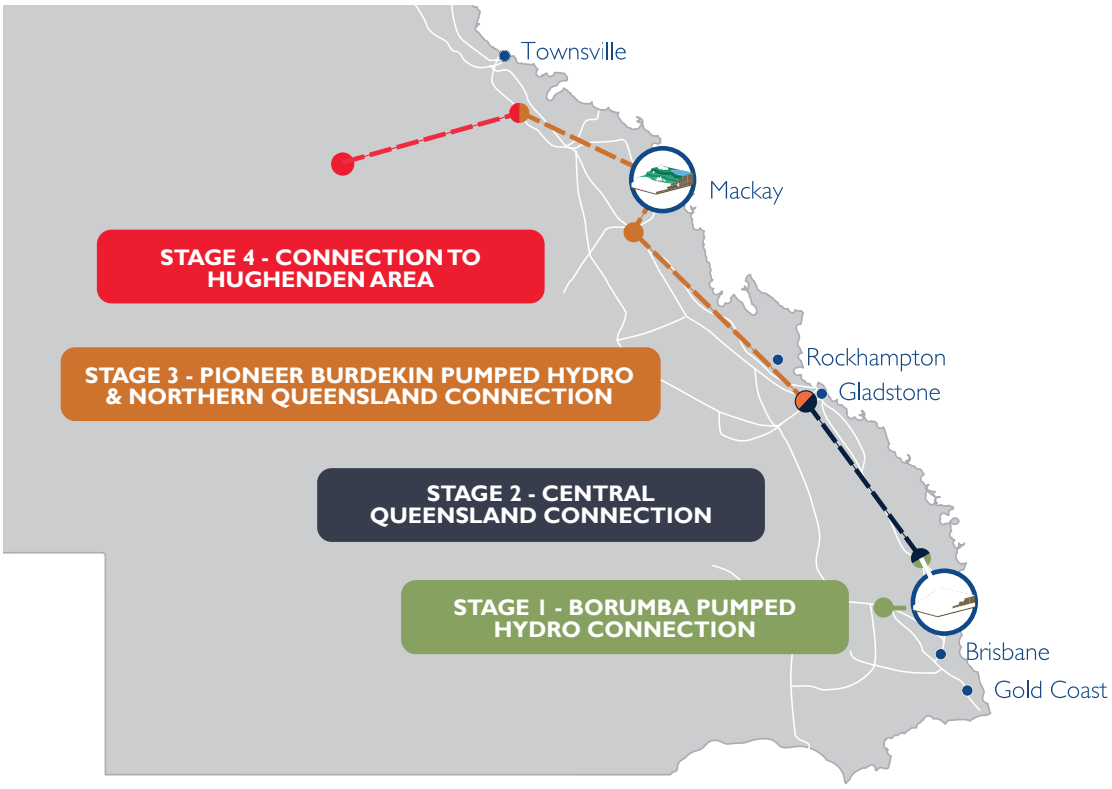
Powerlink will also consider the emerging condition-based drivers as part of the planning process to ensure the most cost effective solutions are delivered for customers, including working with the proponent to identify mutually beneficial non-network options.

8.3 Update to the QEJP Infrastructure Blueprint

As outlined in Section 2.4, the Queensland Government's QEJP and Infrastructure Blueprint identified the need to establish a high capacity backbone transmission network to enable the connection of renewable generation and large-scale Pumped Hydro Energy Storage (PHES) to support the decarbonisation of the energy system (refer to Figure 8.2). The SuperGrid Strategy demonstrated that establishing the high capacity transmission backbone at 500kV was the lowest cost solution for electricity customers under the majority of credible scenarios.

[2] SmartValve™ is an advanced power flow control solution developed by SmartWires.
[3] If the circuit is switched in the future 500/275kV substation west of Gladstone.

Figure 8.2 Original Queensland Blueprint SuperGrid Stages



Note:

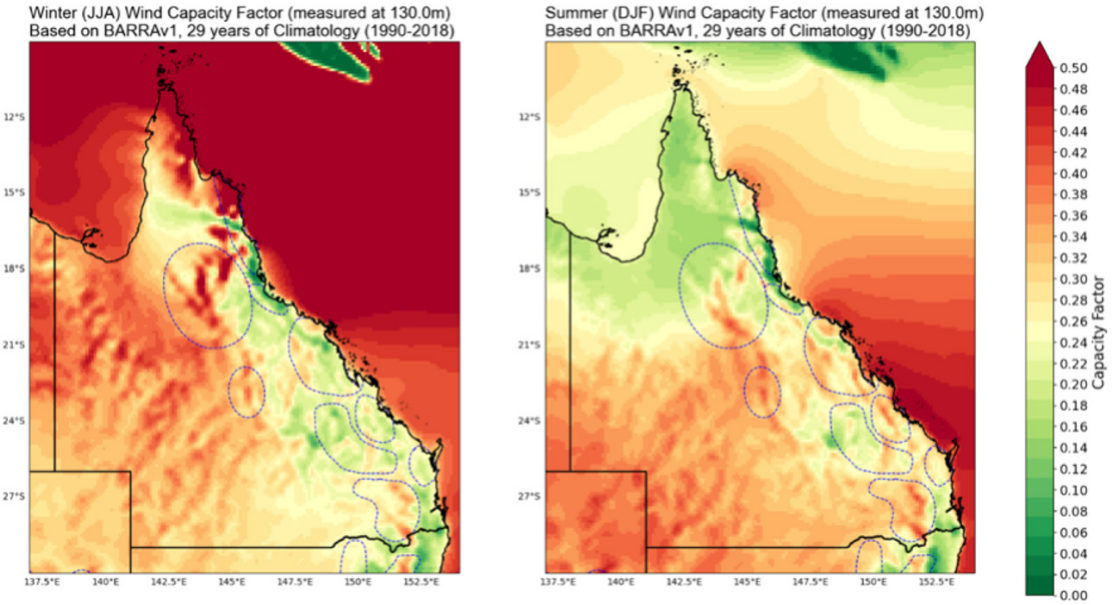
(1) The Infrastructure Blueprint is a point in time plan scheduled to be updated in May 2025.

The ability to connect wind generation and PHES is the fundamental role of the transmission network of the future. Wind generation and PHES must be located where the wind resources and topography enable them. By comparison, there is far more flexibility in the location of large-scale solar and batteries.

The wind resources along the Great Dividing Range offer consistently higher capacity factor than those along the coast for both summer and winter seasons (refer to Figure 8.3). This has been reinforced through market engagements.

In response Powerlink identified an opportunity to more efficiently access potential large wind resources along the Great Dividing Range, west of the Calvale to Halys transmission corridor, whilst delivering greater power transfer capability and assist in the supply of significant new load predicted in the Gladstone zone (refer to Section 8.2.5). This requires changing Stage 2 of the SuperGrid from the original coastal alignment to a more inland route. The western Central Queensland to South Queensland (CQ-SQ) transmission development can also be built in stages and paced to align with interest for renewable connections.

Figure 8.3 Seasonal wind capacity factor data (1)



Note:

(1) Bureau of Meteorology.

Subject to shareholding Minister approval, the establishment of a transmission line of up to 500kV along an inland corridor between South Queensland and Central Queensland also enables the first stage of the SuperGrid transmission backbone from Halys to Woolooga to be constructed at 275kV rather than 500kV as the western 500kV transmission line effectively supplants the proposed coastal 500kV transmission line between Woolooga and Gladstone (refer to Stage 2 in Figure 8.2).

Powerlink will commence a consultation on the Queensland SuperGrid South project as a candidate PTI under the ERTJ Act (refer to Section 6.16).