CHAPTER 9

Strategic projects

9 Strategic projects

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) grid section and supply within South East Queensland.
- The changing generation mix also has implications for investment in the transmission network, both inter-regionally and within Queensland, across critical grid sections.
- The 2022 Integrated System Plan (ISP) and Queensland Energy and Jobs Plan (QEJP) released in September 2022 identify the development of Renewable Energy Zones (REZs) that could impact the utilisation and adequacy of the Gladstone and Central Queensland to South Queensland (CQ-SQ) grid sections, Central West to Gladstone grid section, Darling Downs REZ to South East Queensland and Queensland to New South Wales (NSW) Interconnector (QNI). The 2023 Transmission Annual Planning Report (TAPR) will incorporate the QEJP in conjunction with the ISP to inform Powerlink's planning activities.

9.1 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 the Australian Energy Market Operator's (AEMO) Step Change 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 9.2.

In September 2022 the Queensland Government published the Queensland Energy and Jobs Plan (QEJP), which outlines how it intends to meet the Queensland Renewable Energy Targets, and more broadly achieve transformation to a lower carbon future. Powerlink has worked closely with the Queensland Government in the development of the QEJP, including the establishment of new Queensland Renewable Energy Zones (QREZ) development areas and providing input on the transmission implications of possible developments in the power system.

As outlined in the QEJP, Powerlink will progress the development of a new higher voltage and capacity transmission system (up to 500kV) from north to south Queensland to act as the super highway for efficient large-scale transportation of renewable energy and storage across the State. This new backbone system will be implemented in stages, and provide one of the cornerstones for enabling energy transformation in Queensland. While not captured in the 2022 TAPR given the timing of the release of the QEJP, work is well underway and insights are provided in Powerlink's 'Actioning the Queensland Energy and Jobs Plan'.

This chapter also provides details of AEMO's ISP. The ISP identifies the optimal development path over a planning horizon of at least 20 years for the strategic and long-term development of the national transmission system. The ISP establishes a whole of system plan that integrates generation and transmission network developments. The ISP identifies actionable and future projects, and informs market participants, investors, policy decision makers and consumers on a range of development opportunities.

The 2022 ISP did not identify any actionable projects within Queensland. However, it did identify several projects that are part of the optimal development path and may become actionable in future ISPs. Two projects were nominated for Preparatory Activities.

The 2023 TAPR will incorporate the QEJP in conjunction with the ISP to inform Powerlink's planning activities.

9.2 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. These potential loads, including possible locations, are listed in Table 3.1.

The relevant resource rich areas include the Northern Bowen Basin and the North West Mineral Province (Mt Isa). There is also the potential for new technology loads and for the conversion of existing mining, industrial and manufacturing processes from gas and/or diesel to electricity. Together, these loads have the potential to significantly impact the performance of the transmission network supplying these areas, including power transfers reaching the secure limits of the transmission system.

The potential new industrial processing loads, including new industry based on hydrogen, and electrification of major industrial processes and mining operations are within the existing transmission system footprint. However, the connection of the North West Mineral Province[1] to the interconnected National Electricity Market (NEM) will require transmission network extensions to reach this remote location.

The commitment of some or all of these loads may cause power transfers to 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 2.5. 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 prescribed 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 generation non-network solutions.

This section focuses on the most likely network development options only. As the proposed loads become committed, detailed planning analyses will inform and optimise the project scopes and cost estimates. The Regulatory Investment Test for Transmission (RIT-T) will consult and finally recommend 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 8.1 and 8.2 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. Powerlink will consider these potential limitations holistically with any emerging condition based drivers as part of the longer term planning process and in conjunction with the ISP and QEJP.

Details of feasible network options are provided in sections 9.2.1 to 9.2.4, for the transmission grid sections potentially impacted by the possible new large loads in Table 3.1.

9.2.1 Northern Bowen Basin coal mining area

Based on AEMO's Step Change scenario forecast defined in Chapter 3, and the committed generation listed in tables 8.1 and 8.2, network limitations are not forecast to exceed network reliability requirements established under Powerlink's planning standard.

[1] CopperString 2.0 is being developed by CuString Pty Ltd, a private Townsville based company with a long history in the energy supply industry in North Queensland. Copperstring has now been granted a provisional Transmission Authority.

However, there has been early discussions on electrification of existing mining processes in the Northern Bowen Basin. Electrification load gives consideration to the responses that multi-sector industries will take 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. This may lead to significant increases in electrical demand and also require significant supplies of renewable electricity.

Early discussions on electrification of existing mining processes could see load increase by up to 600MW. These loads have not reached the required development status to be included in AEMO's Step Change scenario forecast for this 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 6.9).

The impacts these loads may have on the CQ-NQ grid section and possible network solutions to address these is discussed in Section 9.2.2.

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.

Feasible network solutions to address the limitations are dependent on the magnitude and location of load. The location, type and capacity of future VRE generation connections in North Queensland (NQ) may also impact on the emergence and severity of network limitations. The type of VRE generation interest in this area is predominately large-scale solar photovoltaic (PV). Given that the coal mine load profile would be expected to be relatively flat, it is unlikely that the day time PV generation profile will be able to fully address the emerging limitations.

Depending on the magnitude and location of load, possible network options may include one or more of the following:

- 132kV phase shifting transformers to improve the sharing of power flow in the Bowen Basin within the capability of the existing transmission assets
- 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 to maintain voltage control. The existing 132kV lines are forecast to reach their end of technical service in the 2040s.

9.2.2 CQ-NQ grid section transfer limit

Based on AEMO's Step Change scenario forecast outlined in Chapter 3 and the existing and committed generation listed in tables 8.1 and 8.2, network limitations impacting reliability are not forecast to occur within the 10-year outlook of this TAPR.

However, 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 NQ. Voltage control is therefore becoming increasingly challenging and leading to high voltage violations. As outlined in Section 11.3 Powerlink has completed a RIT-T recommending the installation of a 275kV shunt reactor at the Broadsound Substation. This reactor is planned to be commissioned in August 2023 (refer to Table 11.3).

As discussed in Section 9.2.1, there is the likelihood of coal mines in the Northern Bowen Basin electrifying their existing mining operations. There is also the potential load in the North West Mineral Province that may require connection to the NEM.

The North West Mineral Province transmission project (Copperstring) proposes to connect Mt Isa and the North West Minerals Province to the NEM at a new substation south of Powerlink's existing Ross Substation. One of the key benefits of the Copperstring project is to allow the North West Minerals Province to access cheaper electricity from the NEM rather than rely on local generation in Mt Isa.

The Copperstring project could also enable further VRE generation in the North Queensland Clean Energy Hub to be connected to the NEM (refer to Figure 9.2) and could result in additional demand of up to 400MW to be supplied from the transmission network in North Queensland.

Therefore, the loads in Table 3.1 could result in a coincident increase in northern Queensland demand of up to 1,010MW but have not reached the required development status to be included in AEMO's Step Change scenario forecast of this TAPR.

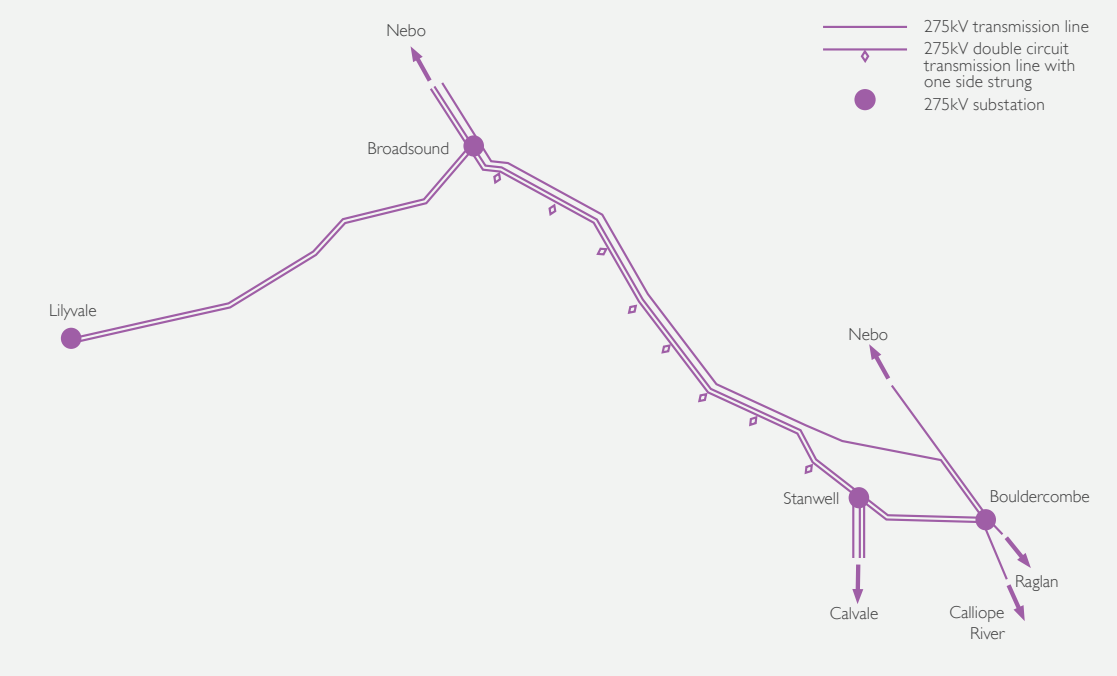
Network limitations on the CQ-NQ grid section may occur if a portion of these new loads commit. Power transfer capability into northern Queensland is limited by thermal ratings and voltage stability. Thermal limitations may occur on the Bouldercombe to Broadsound 275kV line following a critical contingency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

Based on current network analysis, an additional 90MW of load north of Bouldercombe will result in network congestion between Central Queensland and North Queensland that 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. The additional load in northern Queensland that could justify the network augmentation in preference to continued network support could be as low as 250MW.

Possible network solutions

In 2002, Powerlink constructed a 275kV double circuit transmission line from Stanwell to Broadsound with one circuit strung (refer to Figure 9.1). A feasible network solution to increase the power transfer capability to northern Queensland is to string the second side of this transmission line.

Figure 9.1 Stanwell/Broadsound area transmission network



9.2.3 Gladstone grid section transfer limit

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 connection point commitments from any direct connect customers in the Gladstone zone at the time of the publication of 2022 TAPR, Powerlink is engaging in early discussions with customers that have committed to decarbonisation of their existing fossil fuelled operations and processes. There has also been a significant number of enquiries for the connection of new industrial processing loads in the Gladstone zone. As indicated in Table 3.1 the combined potential for additional load may be up to 2,360MW.

With reduced operation of the Gladstone Power Station (PS) as the electricity industry transforms to a lower carbon future, in combination with the electrification of existing industrial processes and/or 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.

The additional transmission capacity 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 would also need to be assessed based on specific customer load.

Possible network solutions

Feasible network solutions to facilitate efficient market operation and deliver reliability of supply obligations in the Gladstone zone may include:

- transmission line augmentation between Calvale and Calliope River substations and rebuild of the transmission line between Larcom Creek and Calliope River substations with a high capacity 275kV double circuit transmission line
- construction of a new high capacity 275kV double circuit transmission line between Boulder combe, Raglan, Larcom Creek and Calliope River
- installation of a third 275/132kV transformer at Calliope River Substation.

9.2.4 Southern Queensland region

Based on AEMO's Step Change scenario forecast defined in Chapter 3, and the committed generation listed in tables 8.1 and 8.2, network limitations are not forecast to exceed network reliability requirements established under Powerlink's planning standard.

However, Powerlink is engaging in discussions with corporations for the development of significant new loads in southern Queensland. Fortescue Future Industries (FFI), Powerlink and Economic Development Queensland (EDQ) have signed an agreement to progress a facility at Gibson Island[2] (Southern Queensland Trade Coast Area) to produce around 50,000 tonnes of renewable hydrogen per year. Connection to Powerlink's transmission network is essential to allow electricity produced by VRE generation to power the proposed hydrogen project.

This hydrogen project will add approximately 650MW to the load in SEQ and connect to Powerlink's Murarrie Substation. Network thermal limitations on the 275kV circuits between Belmont and Murarrie substations and between Blackwall and Belmont substations may occur if this new load commits.

Possible network solutions

Feasible network solutions to deliver reliability of supply to the hydrogen facility include:

- 275kV transmission line augmentation between Blackwall, Belmont and Murarrie substations
- 275kV transmission line augmentation between Belmont and Murarrie substations and installation of SmartValve[3] technology to manage thermal overload between Blackwall and Belmont substations
- Establish a 275kV substation at Nudgee and 275kV cable/s between Nudgee and Murarrie substations.

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. Such decisions will be undertaken using the RIT-T consultation process, where the benefits of non-network options will also be considered, including working with the proponent to identify mutually beneficial non-network options. This may include load flexibility and/or post-contingent interruptability such that investment in network can be deferred or avoided.

Powerlink is also in discussions for development of a large data storage project powered by renewable energy and battery storage[4]. The project is located adjacent to Powerlink's South Pine Substation in North Brisbane. The data centre has a capacity of up to 800MW. In addition, the developer has submitted a planning application for a 2,000MWh Battery energy storage system (BESS).

Depending on the combined operation of the load and BESS, thermal limitations may emerge on the 275kV circuits supplying the South Pine Substation.

Possible network solutions

Feasible network solutions to deliver reliability of supply to the data storage load include:

- 275kV transmission line augmentation between Tarong and South Pine substations
- 275kV or 500kV transmission line augmentation between Halys and South East Queensland (SEQ), including 275kV augmentations within SEQ.

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. Such decisions will be undertaken using the RIT-T consultation process, where the benefits of non-network options will also be considered, including working with the proponent to identify mutually beneficial non-network options. This may include co-ordination of the BESS to minimise the impact of the load on the network. Load flexibility and/or post-contingent interruptability may also deferred or reduce the scale of network investment required.

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2 Refer to Powerlink's website.

3 SmartValve is an innovative, digital power flow control technology that unlocks network capacity by pushing power off overloaded lines or pulling power onto underutilized lines developed by SmartWires.

4 Supernode powered by renewable energy.

9.3 Alignment with AEMO's 2022 Integrated System Plan (ISP)

The 2022 ISP and its optimal development path support Australia's complex and rapid energy transformation towards net zero emissions, enabling low-cost firmed VRE and cost-effective essential transmission services to provide consumers in the NEM with safe and reliable electricity.

The installation of large-scale VRE generation is changing the mix of generation and impacting the utilisation of existing transmission infrastructure. This has been most evident across the Central to NQ and Central to South Queensland grid sections (refer sections 8.6.2 and 8.6.5 respectively) and the Queensland to NSW interconnector (QNI). This has implications for investment in the transmission network both inter-regional and within Queensland.

These impacts have been investigated in AEMO's 2022 ISP. The 2022 ISP identified that to deliver low-cost, secure and reliable energy, investments in transmission are needed. Although no 'actionable' projects were identified for Queensland, several Queensland projects were identified as part of the optimal development path that may become 'actionable' in future ISPs. These projects will be vital to achieving lower cost solutions that meet energy security and reliability, affordability and reduced emissions.

Two projects were nominated for preparatory activities. These include:

- Darling Downs REZ Expansion (Stage 1)
- QNI Connect (500kV option)

Three additional projects were identified as requiring no action as AEMO will leverage the estimated project costs from previous preparatory activities. These include:

- Central to Southern Queensland reinforcement
- Gladstone Grid reinforcement
- QNI Connect (330kV option).

For each project a Preparatory Report will provide the following information:

- Project scope and single line diagrams
- Electrical network parameters
- Ratings of network equipment
- Power transfer limits for the existing network and following the augmentation project
- High level cost estimate.

Preparatory activity reports for the two projects above are to be provided to AEMO by 30 June 2023. This information will be used by AEMO to better inform the optimal development path for the 2024 ISP.

9.3.1 Queensland to NSW Interconnector (QNI)

Increasing the capacity of interconnection between NEM regions is essential in order to take advantage of the geographic diversity of renewable resources so regions can export power when there is local generation surplus, and import power when needed to meet demand. Appropriate intra-regional transmission capacity is required to support these objectives.

Powerlink and Transgrid finalised a Project Assessment Conclusion Report (PACR) on 'Expanding NSW-Queensland transmission transfer capacity' in December 2019. The recommended QNI Minor option included uprating the 330kV Liddell to Tamworth 330kV lines, and installing SVCs 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 2020 ISP identified that the additional transmission capacity would deliver net market benefits from

- efficiently maintaining supply reliability following the closure of further generation and the decline in ageing generator reliability
- facilitating efficient development and dispatch of generation in areas with high quality renewable resources through improved network capacity and access to demand centres
- enabling more efficient sharing of resources and firming services
- enhancing system resilience and optionality.

Building on the QNI Minor project, AEMO's 2020 ISP recommended that Powerlink and Transgrid complete preparatory activities for further QNI interconnector upgrades to be assessed in the 2022 ISP. For the 2022 ISP assessment, Powerlink and Transgrid proposed two 330kV options. One option (stage 1) was a single-circuit strung on a 330kV double-circuit line and the other option (stage 2) was to string the second circuit.

The 2022 ISP identified that further upgrade of the transmission capacity between Queensland and NSW (coined 'QNI Connect') is an integral part of the optimal development plan with a timing as early as 2029-30 in the Hydrogen Export scenario forecast and 2032-33 in the Step Change scenario forecast.

As the likely timing (2032-33) is beyond a practical delivery timing, AEMO has not declared QNI Connect as an actionable project. Rather AEMO has recommended that Powerlink and Transgrid carry out further preparatory activities to better inform options for the 2024 ISP. AEMO requires preparatory activities to be undertaken for a 500kV option for both NSW and Queensland scope. AEMO also requires preparatory activities for the 330kV options for the NSW scope.

Preparatory activities, as outlined in this Section, are to be completed by 30 June 2023 so that estimated costs and capacity improvements can be included in the 2024 Draft ISP.

Possible network solutions

Options to upgrade QNI capacity include both 330kV and 500kV options:

- construction of a double circuit 330kV line (one or two circuits strung) between Powerlink's Braemar Substation and Armidale South via a similar alignment to the existing QNI. The proposed route traverses the Central West Orana (within AEMO's North West NSW) and Darling Downs REZs and connects to intermediate substations with associated supporting plant.
- construction a double circuit 500kV line between Powerlink's Halys Substation and Transgrid's New England REZ transmission and connecting to intermediate substations with associated supporting plant.

9.3.2 CQ-SQ grid section reinforcement

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 of the CQ-SQ grid section is highly dependent on generation and load in Central and North Queensland. As new generation connects in Central and North Queensland, congestion along this corridor may increase and generation may be curtailed.

Upgrading the capacity of QNI may also add to the congestion of this grid section. As outlined in Section 9.3.1, the 2022 ISP has identified a further upgrade of QNI capacity. The utilisation and adequacy of the CQ-SQ grid section is closely linked to the required efficient capacity of interconnection with NSW.

As outlined in Section 6.11.1 there are emerging condition and compliance risks related to structural corrosion on significant sections of the coastal CQ-SQ 275kV network between Calliope River and South Pine substations. Strategies to address the transmission line sections with advanced corrosion in the five year outlook are described in Table 6.19 and within six to 10 years in Table 6.20.

In the 2020 ISP, AEMO recommended Powerlink complete preparatory activities to increase transfer capability from CQ-SQ grid section. For the 2022 ISP, two options were selected. One option makes use of the existing transmission line with a mid-point switching station between Calvale and Halys substations. The other option includes a new double-circuit transmission line. For the 2024 ISP, since no changes are anticipated for this project, AEMO will escalate the estimated cost of the preparatory activities delivered for the 2022 ISP.

The 2022 ISP identified a staged approach to upgrade CQ-SQ as part of the optimal development path. The upgrade is critical for unlocking VRE resources in the North, Isaac, and Fitzroy REZs to deliver efficient market outcomes.

Under the Step Change scenario forecast an incremental upgrade was identified as economic by 2028-29. This involves establishing a mid-point switching station on the Calvale to Halys 275kV transmission line. By 2038-39 a more material upgrade has been identified as economic, involving the construction of a new 275kV double circuit transmission line between Calvale and Wandoan South substations.

Possible network solutions

Feasible network solutions to facilitate efficient market operation may differ in scale. These include:

- establishment of a mid-point switching substation on the 275kV double circuit between Calvale and Halys substations
- construction of a 275kV double circuit transmission line between Calvale and Wandoan South Substation
- construction of a 500kV double circuit transmission line between Central Queensland and Halys Substation
- a grid-scale battery system. A Virtual Transmission Line (VTL) option could comprise of grid-scale batteries on both sides of CQ-SQ, or a grid-scale battery on the south side and a braking resistor or generator tripping scheme on the northern side
- A 1,500MW HVDC bi-pole overhead transmission line from Calvale and South West Queensland.

Powerlink, through the ISP process and modelling associated with the QEJP, will continue to investigate the impact of investment in large-scale VRE generation and firming generation in the Queensland region on the utilisation and economic performance of the CQ-SQ grid section. Powerlink also considers the emerging condition based drivers as part of the integrated planning process to ensure that overall the most cost-effective solutions are delivered for customers. Such decisions will be undertaken using the RIT-T consultation process, where the benefits of non-network options will also be considered.

9.3.3 Gladstone grid section reinforcement

The 275kV network forms a triangle between the generation rich nodes of Calvale, Stanwell and Calliope River substations. This triangle delivers power to the major 275/132kV injection points of Calvale, Bouldercombe (Rockhampton), Calliope River (Gladstone) and Boyne Island substations.

Since there is a surplus of generation within this area, this network is also pivotal to supply power to northern and southern Queensland. As such, the utilisation of this 275kV network depends not only on the generation dispatch and supply and demand balance within the Central West and Gladstone zones, but also in northern and southern Queensland.

The 2022 ISP identified significant increases in VRE generation for the North, Isaac, and Fitzroy REZs (refer to Figure 9.3). With this additional generation and the retirement or reduced generation from Gladstone PS, the transmission network which supplies the Gladstone area will be constrained. As a result, forecast demand at Boyne Island, Calliope River, Larcom Creek and Raglan substations cannot be supplied. If major industrial loads are electrified, or if large hydrogen projects progress, there is a potential for a material shift in the supply-demand balance in the Gladstone area.

In the 2020 ISP, AEMO recommended Powerlink complete preparatory activities for reinforcement of Gladstone grid section. New 275kV transmission lines are proposed to increase the network transfer capability between Central West and Gladstone zones. For the 2024 ISP, since no changes are anticipated for this project, AEMO will escalate the estimated cost from the preparatory activities delivered for the 2022 ISP.

Under the Step Change scenario forecast, the 2022 ISP identified a need to materially upgrade the transmission capacity from Calvale and Bouldercombe substations into the Gladstone zone and also increase the 275/132kV transformation capacity in the Gladstone zone.

Possible network solutions

- Feasible network solutions to facilitate efficient market operation and also deliver reliability of supply obligations in the Gladstone zone may include:
- transmission line augmentation between Calvale and Calliope River substations and rebuild between Larcom Creek and Calliope River substations with a high capacity 275kV double circuit transmission line
- new high capacity 275kV double circuit transmission line between Bouldercombe, Raglan, Larcom Creek and Calliope River
- third Calliope River 275/132kV transformer.

Powerlink, through the ISP process and modelling associated with the QEJP, will continue to investigate the impact that investment in large-scale VRE generation and firming generation, reduced operation of the Gladstone PS and electrification of existing industrial processes and/or development of new industry load will have on the utilisation and economic performance of the Gladstone grid section. Powerlink will also consider the emerging condition based drivers as part of the integrated planning process to ensure that overall the most cost-effective solutions are delivered for customers.

9.3.4 Darling Downs REZ Expansion

The Darling Downs REZ extends from the border of NSW near Dumaresq to Columboola within the Surat zone of Queensland. The Darling Downs REZ has high network capacity and is near QNI and Brisbane. The area has abundant high quality solar and wind resources. A number of large scale and wind projects are already connected or committed within the zone (refer to Table 8.1 and Table 8.2). Furthermore, the ultimate retirement of thermal generation within this REZ will also release network capacity to allow for additional VRE connections. However, given the abundant high quality solar and wind resources in this REZ and that the energy transformation will require much more renewable generation to connect in the REZ, expansion of the Darling Downs REZ will be required.

The Darling Downs REZ connects to South East Queensland (SEQ) across two transmission corridors; a northern corridor that consists of five 275kV transmission circuits from the Tarong Substation to SEQ and a southern corridor that consists of two 330kV transformer ended (330/275kV) circuits between Millmerran and Middle Ridge substations.

The 2022 ISP analysis found that under high demand conditions, this southern corridor can only facilitate 1,300MW into SEQ from generation connected around the Bulli Creek area. This is due to a 300/275kV transformer limitation at the Middle Ridge Substation. Therefore, VRE generation will need to connect around the Halys area to increase the overall VRE hosting capacity of the Darling Downs REZ.

Notwithstanding connection of VRE generation to the more northern regions of the REZ, the 2022 ISP identifies that the Middle Ridge transformer rating is a limitation to the development of the Darling Downs REZ. The 2022 ISP identified the earliest timing for this expansion as 2025-26 in the Hydrogen Export scenario forecast and 2028-29 in the Step Change scenario forecast. The timing of these upgrades will also be influenced by generation retirements and any QNI upgrades. AEMO has identified expansion of the Darling Downs REZ for preparatory activities.

Possible network solutions

- Feasible network solutions to expand the capacity of the Darling Downs REZ include:
- Replacement of the existing 1,300MVA 330/275kV transformer at Middle Ridge with 1,500MVA 330/275kV transformer
- Replacement of both 330/275kV transformers at Middle Ridge with 330/275kV 1500MVA phase-shifting transformers
- Replacement of the existing 1,300MVA 330/275kV transformer at Middle Ridge with 1,500MVA 330/275kV transformer and installation of 1,500MVA 330kV phase-shifting transformers at Tummaville Substation[5]
- Implementation of a Special Protection scheme (SPS) involving pairing a large-scale BESS and generation runback within REZ
- 500kV double-circuit network expansion from of Halys Substation to SEQ.

Powerlink, through the ISP process and modelling associated with the QEJP, will continue to investigate the impact that investment in large-scale VRE generation and reduced operation of the thermal generation in the Darling Downs REZ area has on the utilisation and economic performance of the transmission between the Darling Downs REZ and SEQ. Powerlink will also consider the emerging condition based drivers as part of the integrated planning process to ensure that overall the most cost-effective solutions are delivered for customers.

9.3.5 ISP Renewable Energy Zones

As the NEM transforms away from synchronous generation 44GW and 141GW of VRE is forecast to be installed by 2030 and 2050 respectively under AEMO's Step Change scenario forecast in the 2022 ISP. This is allowing for strong growth in Distributed Energy Resources (DER).

In Queensland, under AEMO's 2022 ISP Step Change scenario forecast, approximately 48GW of new utility-scale wind and solar VRE is projected to be required by 2050 to assist in replacing retiring generation. Figure 9.2, sourced from the 2022 ISP, shows the REZ definitions for the Queensland region. Figure 9.3, also sourced from the 2022 ISP, shows the utility-scale VRE projected for each REZ in Queensland for the Step Change scenario forecast.

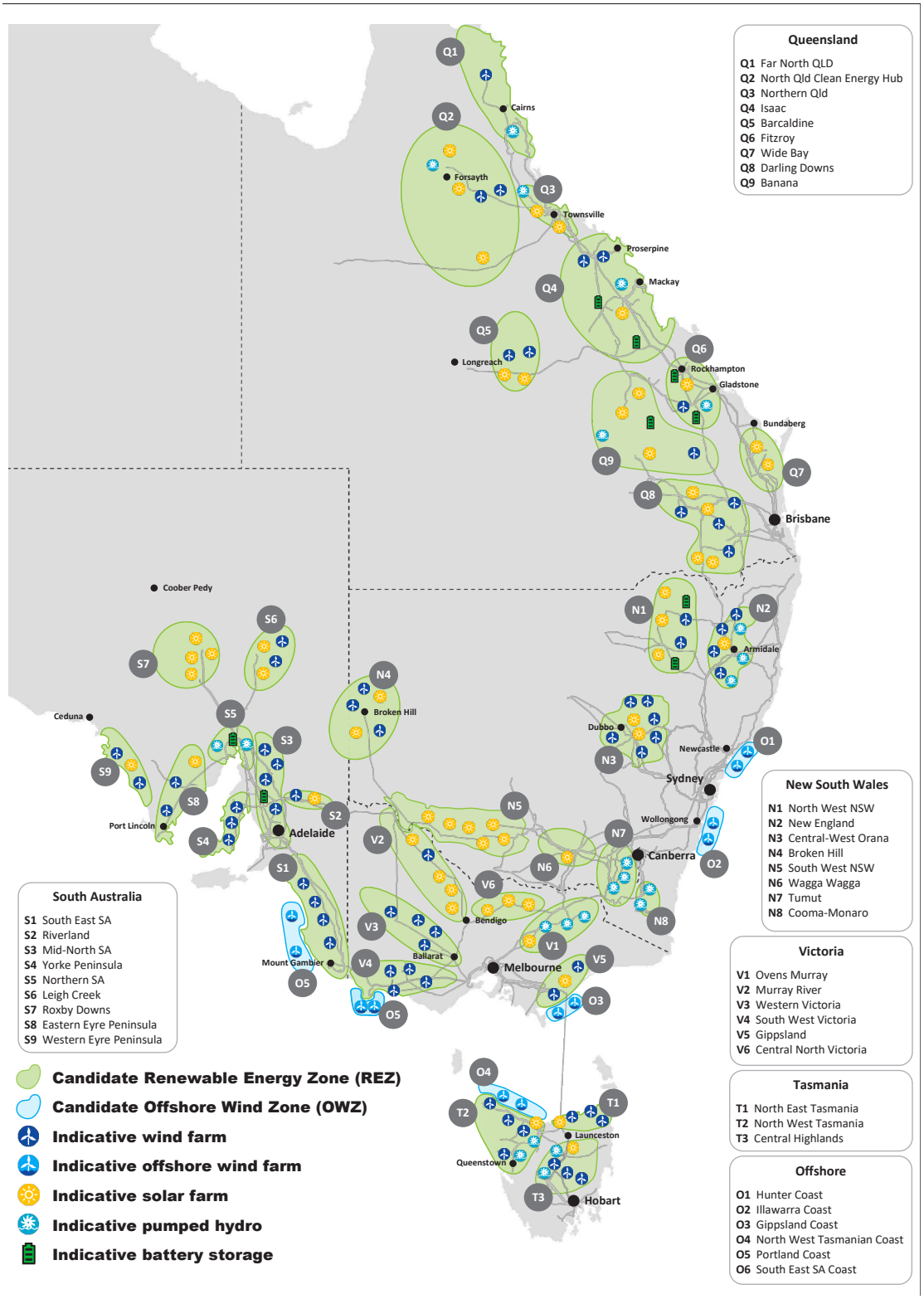
The 2022 ISP modelling shows, under the Step Change scenario:

- All REZs (to different degrees) in Queensland contribute the Queensland developing 48GW of utility-scale VRE by 2050
- Materially, VRE developments are mostly split between the Fitzroy and Darling Downs REZs, with large developments also occurring in the Banana REZ after 2040
- Darling Downs REZ sees the largest amount of projected new VRE capacity, with immediate developments taking advantage of the spare network capacity, and with 4,000MW of new VRE by 2033, and 10,000MW by 2042.
- There is an increase in VRE in the Fitzroy REZ, with over 3,000MW new VRE capacity installed by 2031. By 2040 this has increased to over 10,000MW.
- The Banana REZ is projected to see developments later in the scenario, with 9,500MW new VRE capacity by 2050.

In recognition of the potential value of REZ developments across Queensland and the three Queensland Renewable Energy Zones (QREZ) in the north, central and southern regions[6] that overlay the ISP REZ, the Queensland Government announced $145 million for REZ support (refer to Section 2.3.1). Powerlink will continue to work with Government, AEMO, stakeholders and customers to drive the most efficient and cost-effective outcomes from this process.

5 MacIntyre Wind Precinct project
6 Refer to Figure 6.4.

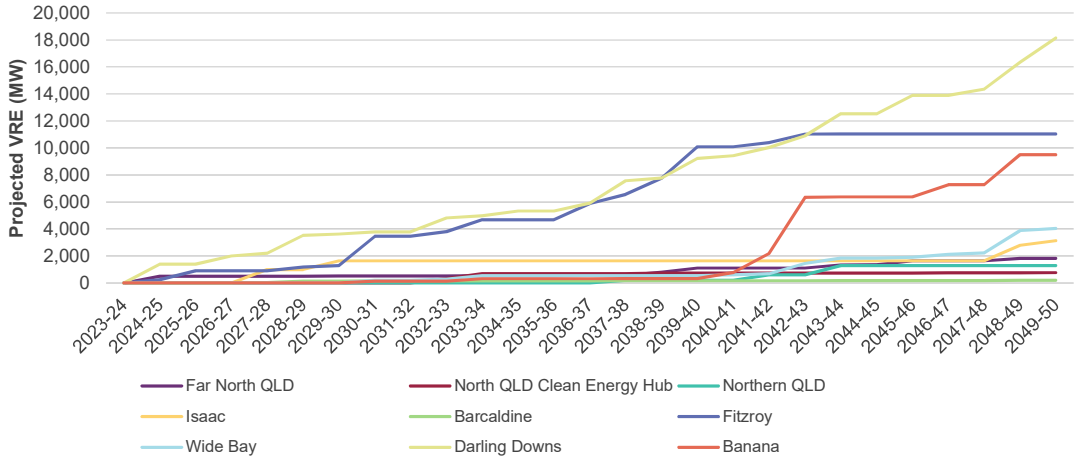
Figure 9.2 2022 ISP Renewable Energy zones



Source: AEMO

9 Strategic projects

Figure 9.3 Queensland utility-scale VRE development in REZs for the Step Change scenario



Source: AEMO