

Executive Summary

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Planning and development of the transmission network is integral to Powerlink Queensland meeting its obligations under the National Electricity Rules (NER), Queensland's Electricity Act 1994 and its Transmission Authority.

The Transmission Annual Planning Report (TAPR) is a key part of the planning process and provides stakeholders and customers with important information about the existing and future transmission network in Queensland. The report is targeted at everyone interested or involved in the National Electricity Market (NEM) including the Australian Energy Market Operator (AEMO), Registered Participants and interested parties. The TAPR also provides stakeholders with an overview of Powerlink's planning processes and decision-making on potential future investments.

The TAPR includes information on electricity energy and demand forecasts, committed generation and network developments. It also provides estimates of transmission grid capability and potential network and non-network developments required in the future to continue to meet electricity demand in a timely manner and provide a valued service to our customers.

Overview

The 2022 TAPR outlines the key factors impacting Powerlink's transmission network development and operations. The TAPR also discusses the energy transformation and how Powerlink continues to adapt and respond to dynamic changes in the external environment to meet the challenges of a rapidly changing energy system.

The forecasts presented in this TAPR indicate mild growth for summer maximum demand, and decline in the minimum delivered demand. The forecast delivered energy from the transmission network over the 10-year outlook period remains relatively unchanged but with a slight upward trajectory mainly due to industries beginning to electrify their operations to meet their emission reduction targets.

Powerlink has worked closely with the Queensland Government in the development of the Queensland Energy and Jobs Plan (QEJP) which was released in late September 2022. This work included supporting the establishment of new Queensland Renewable Energy Zones (QREZ), as well as input on the new transmission infrastructure required to support the energy transformation which has the potential to create long-lasting benefits for Queensland communities.

The capital expenditure required to manage emerging risks related to assets reaching the end of their technical service life continues to represent a substantial program of work over the outlook period. As indicated in the QEJP, the impact and increasing momentum of the energy transformation in Queensland will result in the need for additional capital expenditure for network augmentations. As a result, the energy transformation will significantly change the requirements for transmission infrastructure in the outlook period as discussed in Powerlink's 'Actioning the Queensland Energy and Jobs Plan'. While not included in the 2022 TAPR analysis, this work is well underway and the 2023 TAPR will incorporate the QEJP in conjunction with AEMO's Integrated System Plan (ISP) to inform communities, customers and other stakeholders of Powerlink's future planning activities.

Network planning studies for the 2022 TAPR have focused on evaluating the enduring need for existing assets and the possible need for new assets to ensure network resilience in the context of increasing diversity of generation, a mild growth in demand outlook and the potential for network reconfiguration, coupled with alternative non-network solutions.

Powerlink's focus on customer and stakeholder engagement has continued over the last year, with a range of activities undertaken to seek feedback and input into our network investment decision-making and planning. This includes regular meetings of our Customer Panel to seek stakeholder input on planning and decision-making across a range of topics. We also held an Energy Transformation Webinar in March to provide further detail on the development of Powerlink's energy plan for the future.

Since 2018, Powerlink as a founding participant, has committed to the whole of sector Energy Charter initiative. The charter is focused on driving a customer-centric culture and conduct in energy businesses to create price and service delivery improvements for the benefit of customers.

Enabling the energy transformation in Queensland

The transmission system has a critical role to play as a central platform and enabler for the energy transformation. Powerlink is playing an active role by strategically planning the transmission network, guiding and shaping the power system, as Queensland moves to a lower carbon future. This will ensure that the high voltage transmission network is capable of unlocking opportunities and benefits associated with a decarbonised energy system. This will help power economic growth, enable market efficiencies, deliver local benefits to communities and minimise costs to customers.

Potential developments associated with electrification and hydrogen electrical loads are significant, and the Queensland transmission network is expected to play a central role in enabling the decarbonisation of industry and the development of both domestic and export hydrogen markets. Energy storage and pumped hydro projects such as Borumba and Pioneer-Burdekin Pumped Hydro Energy Storage (PHES), together with firming services, will also form an integral part of the future mix of technologies in Queensland.

The continued uptake of rooftop photovoltaic (PV) systems is also significantly changing the daily load flows and the way in which transmission and generation systems are planned and operated. Decreasing minimum demand will lower the amount of synchronous generation that is online and this could further impact on voltage control, system strength and inertia. Orchestration of technologies across the different supply chain levels, including large-scale generation and storage, demand side management (DSM) and time of day shifting, customer energy and storage sources, and electric vehicle (EV) charging will all be key to optimising the utilisation and performance of the energy system.

Electricity energy and demand forecasts

The 2021/22 summer in Queensland had below average daily maximum and minimum temperatures and above average temperatures in March, which saw an overall summer peak delivered demand of 9,031MW at 7.00pm on 8 March, 62MW above the 2020/21 maximum delivered demand. Operational 'as generated' peak was recorded at this same time reaching 10,058MW. Peak native demand was recorded one hour prior at 6pm, reaching 9,326MW. After temperature correction, the 2021/22 summer maximum delivered demand was 8,876MW, 4.9% higher than that forecast in the 2021 TAPR.

The 2022 Queensland minimum delivered demand was recorded at 11.00am on 25 September 2022, when only 2,597MW was delivered from the transmission grid (refer to Figure 3.4 for load measurement definitions). Operational 'as generated' minimum demand was recorded on 11 September 2022 at 1.00pm and set a new record for Queensland of 3,469MW, passing the previous minimum record of 3,784MW set in October 2021.

Powerlink has adopted AEMO's 2022 Electricity Statement of Opportunity (ESOO) forecasts in its planning analysis for the 2022 TAPR. The forecast captures impacts of the COVID-19 pandemic, growth in rooftop PV installations, changing Queensland economic growth conditions, energy efficiency initiatives, battery storage and electric vehicles (EV), electrification and tariffs through Step Change, Slow Change and Hydrogen Export scenarios. Bottom-up forecasts are derived through reconciliation of AEMO's forecast with those from Distribution Network Service Providers (DNSPs) at each transmission connection supply point.

Electricity energy forecast

Based on the Step Change scenario forecast, Queensland's delivered energy consumption is forecast to increase at an average of 0.6% per annum over the next 10 years from 47,405GWh in 2021/22 to 50,201GWh in 2031/32. The increase in energy consumption is mainly due to industries beginning to electrify their operations to meet their emission reduction targets.

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Electricity demand forecast

Based on the Step Change scenario forecast, Queensland's transmission delivered summer maximum demand is forecast to increase at an average rate of 2.0% per annum over the next 10 years, from 8,876MW (weather corrected) in 2021/22 to 10,819MW in 2031/32. Annual minimum transmission delivered demands are expected to decrease in all forecast scenarios presented in the 2022 TAPR. These AEMO 2022 ESOO minimum demand forecasts are provided with simulated solar traces which do not account for economic curtailment or operational measures required to maintain reliability and system security. The anticipated electrification of load, historically supplied by fossil fuels, could see a large increase in demand that may require significant investment in the transmission and distribution networks. Powerlink is committed to working with AEMO and our customers to better understand the future impacts that electrification will have on demand and energy forecasts.

Developing a future network that supports the long-term needs of customers

Shifts in customer expectation and changes in the external environment which is transforming the electricity system to one with much greater levels of VRE generation, is reshaping the operating environment in which Powerlink delivers its transmission services. In response to these challenges, Powerlink is focusing on an integrated approach to long-term planning, including the development of suitable Renewable Energy Zones (REZ) in Queensland.

Given the energy transformation, there is the potential for significant expansion of the transmission network over the next 10 years and beyond. Initiatives such as the ISP and QEJP will inform the future development of the power system and the associated transmission network topography in Queensland and the NEM. Powerlink is adopting a staged planning approach to the transmission network development that provides flexibility to meet future forecast scenarios. This approach enables assumptions to be fully tested prior to phased investment decisions.

As well as responding to the ongoing impacts of COVID-19, Powerlink is also continuing to:

- undertake ongoing active customer, stakeholder and community engagement for informed decision-making and planning
- implement and adopt the recommendations of various market reviews
- adapt to changes in electricity customer behaviour and economic outlook
- ensure its approach to investment decisions delivers positive outcomes for customers
- place considerable emphasis on an integrated, flexible and holistic analysis of future investment needs
- support diverse generation connections
- ensure compliance with changes in legislation, regulations and operating standards
- focus on developing options that deliver a secure, safe, reliable and cost-effective transmission network.

Based on the Step Change scenario forecast, the planning standard and committed network solutions, there are no significant network augmentations to meet load growth forecast to occur within the 10-year outlook period of this TAPR.

There are proposals for large mining, metal processing and other industrial loads including hydrogen that have not reached a committed development status. These loads have the potential to significantly impact the performance and adequacy of the transmission network. This TAPR outlines the potential network investment required in response to these loads emerging in line with a high economic outlook.

Since January 2016, Queensland has seen an unprecedented level of renewable energy investment activity. These investments in VRE generation are changing the energy flows on the transmission network and have increased the utilisation of the Central West to Gladstone grid section. Depending on the emergence of network limitations it may become economical to increase the power transfer capacity to alleviate constraints across this grid section. 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. Feasible network solutions are outlined within the TAPR.

The Queensland transmission network experienced significant growth in the period from the 1960s to the 1980s. The capital expenditure needed to manage the condition risks related to this asset base, some of which is now reaching end of technical service life, represents a sizeable portion of Powerlink's program of work within the outlook period.

Considerable emphasis has been given to a flexible and integrated approach to the analysis of future reinvestment needs and options. Powerlink has systematically assessed the enduring need for assets at the end of their technical service life taking into account future renewable generation and considered a broad range of options including network reconfiguration, asset retirement, non-network solutions or replacement with an asset of lower capacity.

Renewable energy and generation capacity

To date Powerlink has completed connection¹ of 21 large-scale solar and wind farm projects in Queensland, adding 3,030MW of generation capacity to the grid. In addition, approximately 32 connection applications, totalling about 11,000MW of new generation capacity, have been received and are at varying stages of progress. This includes under construction connections for approximately 1,025MW of VRE.

To ensure that any adverse system strength impact is adequately addressed, Powerlink is working closely with customers, suppliers and AEMO to model system strength model in the Queensland network. This work has provided important insights into the complexity of system strength and how it impacts on managing asynchronous connections and the network in general.

Powerlink will apply this integrated system strength model to existing and new connection applications and engage with renewables sector customers to ensure there is adequate system strength in Queensland.

Grid section and zone performance

During 2021/22, the Powerlink transmission network performed reliably. Record peak transmission delivered demand was recorded for the Ross, North, Central West, Surat, South West and Moreton zones. Record minimum transmission delivered demand was recorded in the majority of zones with Ross, Wide Bay and South West zones all experiencing periods of negative transmission delivered demand.

Inverter-based resources in northern Queensland experienced approximately 462 hours of constrained operation during 2021/22. This is a reduction in the constraint times experienced over the last two years. This is due to Powerlink addressing a fault level shortfall in North Queensland and several VRE customers completing their system strength remediation works.

Consultation on network investments

Powerlink is committed to regularly reviewing and developing its transmission network in a timely manner to meet the required levels of reliability and manage the risks arising from aged assets remaining in-service.

The TAPR highlights anticipated upcoming Regulatory Investment Test for Transmission (RIT-T) for which Powerlink intends to seek solutions and/or initiate consultation with AEMO, Registered Participants and interested parties in the near future (refer to Section 6.6.2). To enhance the value and outcomes of the RIT-T process to customers, Powerlink undertakes a range of engagement activities for each RIT-T, determined on a case by case basis. This engagement matrix for RIT-Ts was developed in consultation with Powerlink's Customer Panel.

¹ For the purposes of customer connection statistics, Powerlink defines: 'completed projects' as those for which Powerlink's scope of works has been completed. However generation may not be at full capacity as remaining works associated with generation connection may not yet be complete (e.g. construction and/or commissioning) 'fully operational' as customer connections where all works are complete, commissioned and capable of delivering to full generation potential.

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Expanding New South Wales to Queensland transmission transfer capacity

The QNI 'minor' upgrade construction works are complete and inter-network testing is progressing to release additional capacity to the market in a staged approach. These tests are expected to continue until mid-2023.

Further to the 2020 ISP, the 2022 ISP identified an additional option for the Future ISP Project to further upgrade the transmission capacity between Queensland and New South Wales (NSW) (coined 'QNI Connect'), requiring Preparatory Activities for a 500kV option by 30 June 2023. This is in addition to the information provided as part of the Preparatory Activities for the 2020 ISP, being a staged 330kV double circuit line to the Queensland/NSW border.

Future ISP projects in Queensland

The 2022 ISP identified upgrades in Queensland as part of the optimal development path for the NEM. 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 security, reliability, affordability and reduced emissions.

Two projects were nominated for preparatory activities. These include:

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

Preparatory activities for these projects will be provided to AEMO to inform the development of the 2024 ISP by 30 June 2023.

Power system security services in central, southern and the broader Queensland regions

Powerlink issued a [Request for Power System Security Services](#) in May 2022 seeking Expressions of interest (EOI) from market participants for offers for Network Support and Control Ancillary Services (NSCAS) and system strength remediation services for an NSCAS gap in south east Queensland and fault level shortfall declared by AEMO at the Gin Gin node respectively. Submissions closed on 24 June 2022.

Discussions with proponents of non-network solutions to address the declared shortfalls are continuing as at the publication of the 2022 TAPR and Powerlink continues to work closely with non-network solution proponents and AEMO to meet the declared and long-term power system security service requirements.

Committed and commissioned projects

During 2021/22, having finalised the necessary regulatory processes for the proposed replacement of network assets, the committed projects for investment across Powerlink's network include:

- Establishment of a 3rd connection into Woree (Stage 1 Northern QREZ)
- Broadsound bus reactor
- Woree secondary systems and Static VAr Compensator (SVC) secondary systems replacement
- Cairns secondary systems replacement
- Chalumbin secondary systems replacement
- Line refit works between Townsville South and Clare South substations
- Townsville South primary plant and secondary systems replacement
- Ross 275/132kV primary plant and transformers replacement
- Strathmore transformer establishment and secondary systems replacement
- Nebo primary plant, secondary systems and transformer replacements
- Blackwater transformers replacement
- Lilyvale primary plant and transformer replacement
- Bouldercombe primary plant replacement

- Baralaba secondary systems replacement
- Palmwoods secondary systems replacement
- Tarong secondary systems replacement
- Line refit works between West Darra, Sumner and Rocklea.

Projects completed in 2021/22 include:

- Life extension works between Barron Gorge and Kamerunga substations
- Line refit works between Egans Hill and Rockhampton substations
- Bouldercombe transformer replacement
- Gin Gin Substation rebuild
- Ashgrove West Substation replacement
- Belmont secondary systems replacement.

Stakeholder consultation for non-network solutions

Powerlink engages with non-network providers to expand the potential use of non-network solutions, addressing the future needs of the transmission network, where technically and economically feasible. These may be in the form of an alternative option to like-for-like replacements, as a partial solution in conjunction with a network solution, or to complement an overall network reconfiguration strategy. Non-network solutions such as DSM or battery installation will be essential in future years to avoid or delay the need to invest in the transmission network in response to changing load flows or an increase in maximum demand.

Since the publication of the 2021 TAPR, Powerlink has continued to engage with non-network providers, customers and other stakeholders. In addition, Powerlink also continued the approach to ongoing informal discussions with multiple potential non-network solution providers in relation to the progress of the EOI for power system security services in central, southern and the broader Queensland regions. Sharing information and seeking customer input through activities such as the Transmission Network Forum, webinars and informal meetings assists in broadening customer and stakeholder understanding of our business and provides additional opportunities to seek input on potential non-network solutions.

Engagement with customers, community and other stakeholders

Powerlink is committed to proactively engaging with customers, communities, First Nations Peoples and other stakeholders in seeking their input into Powerlink's business processes and decision-making. All engagement activities are undertaken in accordance with our Stakeholder Engagement Framework and Community Engagement Strategy, which set out the principles, objectives and outcomes Powerlink seeks to achieve in its interactions with stakeholders and the broader communities in which we operate. A number of key performance indicators are used to monitor progress towards achieving Powerlink's stakeholder engagement performance goals. In particular, Powerlink undertakes a comprehensive biennial stakeholder survey to gain insights about stakeholder perceptions of Powerlink, its social licence to operate and reputation. Most recently completed in November 2021, it provides comparisons between baseline research undertaken in 2012 and year-on-year trends to inform engagement strategies with individual stakeholders.

Engaging with communities is an important part of providing electricity transmission services that are safe, reliable and cost-effective. Transmission network infrastructure stays in-service for up to 50 years and Powerlink is focused on building positive relationships and partnering with local communities to deliver benefits for the longer term. In 2021, a new Community Engagement Strategy was developed and implemented to support delivery of the energy transformation and ensure Powerlink was focused on driving mutually beneficial outcomes for impacted communities. We also undertook targeted community engagement research in south-western Queensland to gauge community acceptability of renewable development and transmission infrastructure. The research findings support our engagement going forward and ensure we are focused on key factors that are important to communities. We have now undertaken similar sentiment research in North and Central Queensland. As Powerlink continues to operate and maintain the existing network through to embarking on planning and building the transformational network of the future, local communities will be front and centre in our planning and decision-making.

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Powerlink recognises the importance of transparency for stakeholders, particularly when:

- undertaking transmission network planning
- developing meaningful and relevant data for publication in the TAPR portal in relation to potential future investments
- engaging in public consultation under the RIT-T process.

Powerlink will also discuss the technical information provided in the TAPR with stakeholders at a dedicated session at the Transmission Network Forum to be held in November 2022.

Focus on continuous improvement in the TAPR

As part of Powerlink's commitment to continuous improvement, the 2022 TAPR continues to focus on an integrated approach to future network development and contains detailed discussion on key areas of future expenditure.

The 2022 TAPR:

- discusses emerging challenges as the power system transforms to much greater levels of VRE generation (refer to chapters 2, 3, 6, 9 and 10)
- provides information in relation to joint planning and Powerlink's approach to asset management (refer to chapters 4 and 5)
- discusses possible future network asset investments for the 10-year outlook period (refer to Chapter 6)
- includes the most recent information for the proposed replacement of network assets which are anticipated to be subject to the RIT-T in the next five years (refer to Chapter 6)
- discusses the potential for generation developments (in particular VRE generation) and the challenges related to the management of system strength (refer to chapters 2 and 10)
- contains information on potential non-network opportunities in the next five years, grouped by investment type (refer to Chapter 7) and discusses Powerlink's approach to assisting the development of non-network solutions – specifically, through the ongoing improvement of engagement practices for non-network solution providers and provision of information (refer to sections 1.13.2 and 6.7)
- links to Powerlink's recently improved [TAPR portal](#) website incorporating the 2022 TAPR templates and discusses the context, methodology and principles applied for the development of the Queensland transmission network data (refer to Appendix B)
- provides new and additional information in relation to transmission lines approaching end of technical life which require potential reinvestment or consideration for retirement in the next 10 to 15 years (refer to Section 6.14).