

## Executive summary

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 2021 TAPR outlines the key factors impacting Powerlink's transmission network development and operations and discusses 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 low growth for summer maximum demand, and decline in the minimum delivered demand and delivered energy for the transmission network over the 10-year outlook period.

The Queensland transmission network experienced significant growth in the period from the 1960s to the 1980s. The capital expenditure required to manage emerging risks related to assets reaching the end of their technical service life represents the majority of Powerlink's program of work over the outlook period. In line with customer and stakeholder expectations, emphasis will be placed on ensuring that asset reinvestment considers the enduring need and most cost effective option. Network planning studies have focussed on evaluating the enduring need for existing assets and potentially the need for new assets to ensure network resilience in the context of increasing diversity of generation, a relatively flat demand growth 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, as well as the newly formed Revenue Proposal Reference Group, to seek stakeholder input on planning and decision making across a range of topics. We also held an Energy Industry Update in April to provide further detail on energy transformation activities, and development of Powerlink's forward 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 focussed on driving a customer-centric culture and conduct in energy businesses to create price and service delivery improvements for the benefit of customers.

## The transforming energy system

Powerlink is playing an active role in shaping the electricity system, connecting Queenslanders to a world-class energy future by enabling the transformation to a new energy system, underpinned by clean, sustainable and reliable energy. Energy transformation is also presenting new opportunities for communities and local businesses in Queensland along with some technical challenges for the electricity supply chain as Australia moves to an electricity system with much greater levels of Variable Renewable Energy (VRE) generation.

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The rapid uptake of rooftop PV systems is significantly changing the physical nature of daily load flows and the way in which transmission and generation systems are planned and operated. Decreasing minimum demand may lower the amount of synchronous generation that is online and this could further impact on voltage control, system strength and inertia. Additionally, environmental factors, community and corporate expectations and the broader global focus on emissions reduction will drive the decarbonisation and electrification of transport, agriculture, mining and manufacturing sectors. Powerlink has developed the Integrated Electricity Pathways (IEP) to explore key investment options for transmission, energy storage and renewable generation to strategically plan, guide and enable development opportunities in Queensland. This will ensure continued reliability and security of supply of the energy system at the lowest long-run cost to customers.

Powerlink has also been collaborating with the Queensland Government to establish three Queensland renewable energy zones (QREZ) located in northern, central and southern Queensland. In September 2021 Powerlink completed a funded augmentation consultation enabling the development of the first of these QREZ in Northern Queensland, by establishing a third 275kV connection into Woree Substation by November 2023. The development of the Northern QREZ will unlock up to 500MW of renewable capacity.

## Electricity energy and demand forecasts

The 2020/21 summer in Queensland had below average daily maximum and minimum temperatures, particularly in the latter summer months, which saw an overall summer peak delivered demand of 8,479MW at 6pm on 22 February, 287MW below the 2019/20 maximum delivered demand. Operational 'as generated' and native maximum annual demands were also recorded at 6pm on 22 February, with operational 'as generated' reaching 9,473MW, and native demand of 8,929MW. After temperature correction, the 2020/21 summer maximum delivered demand was 8,660MW, 3.6% higher than that forecast in the 2020 TAPR.

The 2021 Queensland minimum delivered demand occurred at 11:30am on 3 October 2021, when only 3,053MW was delivered from the transmission grid (refer to Figure 3.5 for load measurement definitions). Operational 'as generated' minimum demand was recorded at the same time and set a new record for Queensland of 3,784MW, passing the previous minimum record of 3,839MW set in July 2021.

Powerlink has adopted AEMO's 2021 ESOO forecasts in its planning analysis for the 2021 TAPR. The forecast captures impacts of COVID-19 pandemic, growth in rooftop photovoltaic (PV) installations, changing Queensland economic growth conditions, energy efficiency initiatives, battery storage and electric vehicles (EV), electrification and tariffs through Steady Progress, Slow Growth and Hydrogen Superpower 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 Steady Progress scenario, Queensland's delivered energy consumption is forecast to decrease at an average of 1.1% per annum over the next 10 years from 47,421GWh in 2020/21 to 42,377GWh in 2030/31. The reduction is due to anticipated increases in the capacity of distribution connected renewable generation and rooftop PV.

## Electricity demand forecast

Based on the Steady Progress scenario, Queensland's transmission delivered summer maximum demand is forecast to increase at an average rate of 0.8% per annum over the next 10 years, from 8,660MW (weather corrected) in 2020/21 to 9,417MW in 2030/31. Annual minimum transmission delivered demands are expected to decrease in all forecast scenarios presented in the 2021 TAPR. These AEMO 2021 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.

## Future network development

Shifts in customer expectation and dynamic changes in the external environment which is transforming to an electricity system 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.

In addition, initiatives such as the Integrated System Plan (ISP) and IEP inform the future development of the power system and the associated transmission network topography in Queensland and the NEM.

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

- undertake ongoing active customer and stakeholder 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 Steady Progress scenario, 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 new large loads are within the resource rich areas of Queensland and associated coastal port facilities. These loads have the potential to significantly impact the performance of the transmission network supplying, and within, these areas. 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 and Central Queensland to Southern Queensland (CQ-SQ) grid sections. Depending on the emergence of network limitations it may become economical to increase the power transfer capacity to alleviate constraints across these grid sections. 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 the bulk 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. This incremental development approach potentially defers large capital investment and has the benefit of maintaining the existing topography, transfer capability and operability of the transmission network.

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## Renewable energy and generation capacity

To date Powerlink has completed connection of 13 large-scale solar and wind farm projects in Queensland, adding 1,644MW of generation capacity to the grid. In addition, approximately 30 connection applications, totalling about 6,400MW of new generation capacity, have been received and are at varying stages of progress<sup>1</sup>. This includes committed connections for a further 1,635MW of VRE.

To ensure that any adverse system strength impact is adequately addressed, Powerlink is working with customers, suppliers and AEMO to enhance its integrated system strength model for 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 better understand the potential for additional VRE generation in Queensland.

## Grid section and zone performance

During 2020/21, the Powerlink transmission network performed reliably. Record peak transmission delivered demand was recorded for the Wide Bay and Surat zones. Record minimum transmission delivered demand was recorded in the majority of zones.

Inverter-based resources in northern Queensland experienced approximately 2,518 hours of constrained operation during 2020/21. The majority of these constraints occurred prior to Powerlink addressing a fault level shortfall in North Queensland and several VRE customers completing their system strength remediation works.

## Consultation on network reinvestments

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.

## Expanding New South Wales to Queensland transmission transfer capacity

Following the expected completion of the QNI 'minor' upgrade works, the 2020 ISP identified further upgrades to the QNI capacity as part of the optimal development path which would reduce costs and enhance system resilience. The future project was not identified as 'actionable', but may in the future. These development options can also be co-ordinated with REZ developments and can be staged by geography, operating voltage and number of circuits to maximise net economic benefits. Powerlink and TransGrid agreed a lower capacity 330kV transmission line to Armidale South Substation would be more likely to form part of the ISP optimal development path. Therefore, the option developed for the preparatory activities was a staged 330kV double circuit line to the Queensland/NSW border<sup>2</sup>.

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<sup>1</sup> 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.

<sup>2</sup> In lieu of a higher voltage 500kV transmission line.

## Future ISP projects in Queensland

The 2020 ISP identified upgrades in Queensland as part of the optimal development path in the NEM. These future ISP projects, anticipated to become 'actionable' in a future ISP include:

- QNI Medium and Large interconnector upgrades (Powerlink and TransGrid consultation)
- Central to Southern Queensland Transmission Link
- Gladstone Grid Reinforcement.

Preparatory activities for these projects have been provided to AEMO to inform the development of the 2022 ISP.

## System strength services to address fault level shortfall at Ross

Powerlink issued a [request for system strength services](#) in April 2020 seeking expressions of interest (EOI) from market participants for offers for system strength remediation services for a fault level shortfall declared by AEMO at the Ross node. Powerlink received a very positive response to the EOI offering a range of system strength support services and worked closely with AEMO on the proposed remediation approach.

Initially, with AEMO's approval, Powerlink entered into a short-term agreement with CleanCo Queensland to provide system strength services through utilising its assets in Far North Queensland. These contracts were in place until December 2020 giving Powerlink time to develop a longer-term cost effective solution. The contracts also reduced constraints on VRE generators in North Queensland during this period.

In the intervening period, Powerlink worked with several proponents of existing VRE generation plants, and their respective equipment manufacturers, to show that inverter retuning and control system changes could reduce the overall system strength requirement at the Ross node.

Following AEMO's preliminary confirmation in August 2020, Powerlink entered into an agreement with Daydream, Hamilton, Hayman and Whitsunday Solar Farms in northern Queensland to validate the expected positive benefits of inverter tuning. Powerlink also worked with Mt Emerald Wind Farm on control setting changes.

As a result of retuning of the solar farms and an update of the control settings at Mt Emerald Wind Farm, in June 2021 AEMO's analysis found that the system strength requirements at the Ross node had changed and that the minimum fault level requirement at Ross is met and no shortfall remained.

Through consultation and active collaboration with all parties, the outcome of this EOI has delivered positive outcomes to customers by implementing innovative cost-effective technical solutions which removed the need for long-term investment (network or non-network).

## Committed and commissioned projects

During 2020/21, having finalised the necessary regulatory processes for the proposed replacement of network assets, the committed projects for reinvestment across Powerlink's network include:

- Woree secondary systems and Static VAR Compensator (SVC) secondary systems replacement
- Ross 275/132kV primary plant replacement
- Line refit works between Townsville South and Clare South substations
- Townsville South primary plant replacement
- Lilyvale primary plant and transformer replacement
- Egans Hill to Rockhampton transmission line refit
- Bouldercombe primary plant and transformer replacement
- Baralaba secondary systems replacement
- Palmwoods secondary systems replacement
- Tarong secondary systems replacement
- Belmont secondary systems replacement

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- Abermain secondary systems replacement
- Mudgeeraba secondary systems replacement.

Reinvestment project works in 2020/21 include:

- Ingham South transformers replacement
- Dan Gleeson secondary systems replacement
- Kemmis transformer replacement
- Callide A / Calvale 132kV transmission reinvestment.

## 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 demand side management (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 2020 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 expression of interest (EOI) for system strength services in Queensland to address the fault level shortfall at Ross. 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.

## Customer and stakeholder engagement

Powerlink is committed to proactively engaging with stakeholders and customers and seeking their input into business processes and decision making. All engagement activities are undertaken in accordance with Powerlink's Stakeholder Engagement Framework that sets out the principles, objectives and outcomes Powerlink seeks to achieve in its interactions. In particular, Powerlink undertakes a comprehensive biennial stakeholder survey to gain insights about stakeholder perceptions of key factors, its social licence to operate and reputation. Most recently completed as a comprehensive interview style survey with more than 100 stakeholders in November 2020, it provides comparisons between baseline research undertaken in 2012 and year-on-year trends to inform engagement strategies with individual stakeholders. The latest survey also sought specific insights from existing directly-connected customers and renewable proponents on aspects of customer service and delivery, and Powerlink's responsiveness.

Powerlink's April Energy Industry Update online forum provided an opportunity for stakeholders to hear the latest developments and provide input into our decision making. Powerlink hosts a Customer Panel that provides an interactive forum for our stakeholders and customers to give input and feedback to Powerlink regarding our decision making, processes and methodologies. Comprised of members from a range of sectors including industry associations, resources, community advocacy groups, directly connected customers and distribution representatives, the panel provides an important avenue to keep our stakeholders better informed about operational and strategic topics of relevance. The panel met in November 2020, and during 2021 met in March, May, June and October. Key topics for discussion included the 2023-27 Revenue Determination process, projects under the RIT-T process, Powerlink's most recent Energy Charter Disclosure Statement to customers and stakeholders and the development of a best practice guide for landholders and Powerlink to work together. The panel, and its subset Revenue Proposal Reference Group, met regularly to discuss key matters of interest to Powerlink and our customers, allowing for input into a range of topics and future planning.

Powerlink recognises the importance of transparency for stakeholders and customers, particularly when undertaking transmission network planning and engaging in public consultation under the RIT-T process.

Powerlink hosted a [webinar](#) in November 2020 to share the TAPR's highlights and key updates with customers and stakeholders. The online format also provided an opportunity to openly engage with participants through an interactive question and answer session. Powerlink will discuss key highlights of the TAPR with stakeholders at the Transmission Network Forum to be held in November 2021.

## Focus on continuous improvement in the TAPR

As part of Powerlink's commitment to continuous improvement, the 2021 TAPR continues to focus on an integrated approach to future network development and contains detailed discussion on key areas of future expenditure.

The 2021 TAPR:

- discusses emerging challenges and opportunities as the network transforms to much greater levels of VRE generation, including the development of Queensland renewable energy zones (refer to chapters 2, 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) (refer to Chapter 10)
- highlights potential non-network opportunities in the next five years 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 Chapter 7 and Section 1.11.2)
- introduces the [TAPR portal](#), an interactive geographical tool which includes the 2021 TAPR templates data.

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