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 those 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 2020 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 transitioning energy system.

The forecasts presented in this TAPR indicate low growth for summer maximum demand and a decline in 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 now reaching the end of 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 past year, with a range of activities undertaken to seek feedback and input into our network investment decision making and planning.

This included holding the 2019 Transmission Network Forum, incorporating related interactive feedback sessions on using non-network solutions to reduce short-term demand peaks and renewable connections and the future transmission network. The 2020 Transmission Network Forum was held in an online format in early September to inform customers and stakeholders on longer term power system planning and the challenges of the energy transition. A key focus of discussion at the 2020 forum included the Queensland Government announcement in early September of $500 million in funding to support Renewable Energy Zone (REZ) development, in addition to $145 million previously announced for REZ support. Stakeholders and customers support Powerlink continuing to work closely with Government in relation to allocation of this funding, which will play a key role in driving economic recovery post the COVID-19 pandemic.

Since 2018, Powerlink as the 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 deliver service improvements for the benefit of customers.

Executive Summary

Electricity energy and demand forecasts

The 2019/20 summer in Queensland had above average daily maximum and minimum temperatures, particularly in the earlier summer months, which saw a new monthly maximum delivered demand (refer to Figure 2.6 for load measurement definitions) for the month of January 2020 and an overall summer peak delivered demand of 8,766MW at 6:00pm on 3 February 2020. Operational 'as generated' and native maximum annual demands were recorded at 5:30pm on 3 February 2020, with operational 'as generated' reaching 9,853MW, and native demand of 9,214MW. After temperature correction, the 2019/20 summer maximum delivered demand was 8,605MW, 0.2% higher than the 2019 TAPR forecast.

Since March 2020 the COVID-19 pandemic has reduced delivered energy consumption on Powerlink's transmission network by an estimated 2.2%.

The 2020 Queensland minimum delivered demand occurred at 12:30pm on 27 September 2020, when only 3,003MW was delivered from the transmission grid. Operational 'as generated' minimum demand was recorded 30 minutes earlier at 12:00pm dropping to 3,860MW. Direct connect loads made up about two-thirds of the demand with Distribution Network Service Providers (DNSPs) customers only making up one-third. Mild weather conditions, during a weekend (Sunday) in combination with strong contribution from rooftop photovoltaic (PV) were contributors to this record minimum demand.

Powerlink has adopted AEMO's 2020 ESOO forecasts in its planning analysis for the 2020 TAPR. The forecast captures the impacts of the COVID-19 pandemic, growth in rooftop PV installations, changing Queensland economic growth conditions, energy efficiency initiatives, battery storage and tariffs through Central, Slow Change and Step Change scenarios. Bottom-up forecasts are derived through reconciliation of AEMO's forecast with those from DNSPs at each transmission connection supply point.

Electricity energy forecast

Based on the Central scenario, Queensland's delivered energy consumption is forecast to decrease at an average of 0.7% per annum over the next 10 years from 47,860GWh in 2019/20 to 44,413GWh in 2029/30. The reduction is due to anticipated increases in the capacity of distribution connected renewable generation and rooftop PV.

Electricity demand forecast

Based on the Central scenario, Queensland's transmission delivered summer maximum demand is forecast to increase at an average rate of 0.7% per annum over the next 10 years, from 8,605MW (weather corrected) in 2019/20 to 9,236MW in 2029/30. Winter minimum transmission delivered demands are expected to decrease at an average rate of 10.5% per annum, from 3,003MW in 2020 to 988MW in 2030.

Changing load profiles

The progressive installation of rooftop PV solar systems and distribution connected solar farms has seen a continued decrease of Queensland transmission delivered demand during the day time. The daily demand profile now tends to follow the characteristic duck curve shape, and this is particularly evident during the winter and spring seasons. Queensland delivered demand during the day is now lower than the night time for a portion of the year, and voltage control devices historically installed to manage light load during the night may no longer be sufficient to manage voltages during the day. The installation of reactive control devices or non-network solutions will be required for voltage control during day time minimum demand periods.

The uptake of embedded PV solar installations is expected to continue, and this will present further challenges to the energy system. 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. There may be opportunities for innovative technologies and storage solutions to assist with smoothing the daily load profile. These type of services could offer a number of benefits to the energy system including reducing the need for additional transmission investment.

Future network development

Shifts in customer expectation and dynamic changes in the external environment which is transitioning to a power system with much greater levels of variable renewable energy (VRE) generation, is reshaping the operating environment in which Powerlink delivers its transmission services. In response to these challenges, Powerlink is focussing on an integrated approach to long-term planning, including the potential development of suitable REZs in Queensland.

In addition, initiatives such as the Integrated System Plan (ISP) inform the future development of the power system and the associated network topography of the transmission network in Queensland and the NEM over the 20-year outlook period or 10-year outlook period of this TAPR.

As well as responding to the ongoing impacts of the COVID-19 pandemic in 2020, 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 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 central 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 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. Within this TAPR, Powerlink has outlined 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 in Queensland. 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 (CQ) to South Queensland (CQ-SQ) grid sections. Depending on the emergence of network limitations it may become economically viable 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.

Renewable energy and generation capacity

To date Powerlink has completed connection of 13 large-scale solar and wind farm projects in Queensland, adding 1,630MW of generation capacity to the grid. During 2019/20 30 connection applications, totalling about 6,400MW of new generation capacity, have been received and are at varying stages of progress. This includes connection agreements for a further 1,338MW 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 transmission network. This work has provided important insights into the extreme 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 2019/20, the Powerlink transmission network performed reliably. Record transmission delivered demand was recorded for Central West, Surat and Bulli zones.

Inverter-based resources in northern Queensland experienced approximately 650 hours of constrained operation during 2019/20. Powerlink is in the process of addressing a system strength shortfall that was declared by AEMO in April 2020.

The CQ-SQ grid section was highly utilised during 2019/20, reflecting higher generation levels in northern Queensland as a result of recently commissioned VRE generators.

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.

Following the Replacement Expenditure Planning Arrangements Rule, which commenced in September 2017, Powerlink continues to make considerable progress in its Regulatory Investment Test for Transmission (RIT-T) program in relation to the replacement of network assets, finalising nine RIT-Ts in this category since the publication of the 2019 TAPR (refer to Chapter 9).

In addition, Powerlink commenced a consultation to seek expressions of interest for system strength services in Queensland to address the fault level shortfall at Ross declared by AEMO in April 2020.

The TAPR also highlights anticipated upcoming RIT-Ts 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 5.6.2). 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

A RIT-T process to consider investment options on the Queensland/New South Wales Interconnector (QNI) commenced in November 2018 and was completed in December 2019 with the publication of the 'Expanding NSW-Queensland transmission transfer capacity' Project Assessment Conclusion Report (PACR). This RIT-T focussed on consideration of the 2018 ISP recommended Group 1 QNI 'minor' upgrade and investigated the near-term options to increase overall net market benefits in the NEM through relieving congestion on the transmission network between New South Wales (NSW) and Queensland. The PACR identified uprating the Liddell to Tamworth transmission lines, installing new dynamic reactive support at Tamworth and Dumaresq, and shunt capacitor banks at Tamworth, Dumaresq and Armidale as the preferred option which is expected to deliver the greatest net benefits. These works are anticipated to be completed by 2022, prior to the closure of Liddell Power Station. Powerlink and TransGrid are investigating the potential benefits of further increases to transmission capacity provided by the QNI 'minor upgrade'.

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 yet identified as 'actionable', but may be so in the future. The proposed project is a staged 500kV line upgrade to share renewable energy, storage, and firming services between the regions after the closure of Eraring or to support REZ developments. Each stage is a 500kV line; the first forecast for completion by 2032-33 and the second by 2035-36.

Future ISP projects in Queensland

The 2020 ISP identified further 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 will be provided by 30 June 2021 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 have been working closely with AEMO on the proposed remediation approach. AEMO approved the approach for the short-term, up until the end of December 2020, and Powerlink has entered into a short-term agreement with CleanCo Queensland to provide system strength services through utilising its assets in FNQ.

In addition, during August 2020 AEMO provided preliminary confirmation that, subject to the final exchange of modelling and other details, inverter tuning could reduce the overall system strength requirement at Ross. Consequently Powerlink has 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 will continue to work closely with proponents of non-network solutions and AEMO to develop more complete and technically feasible short and long-term solutions to the System Strength Shortfall and undertake the relevant formal approval process in accordance with the NER when the optimal solution has been identified.

Executive Summary

Committed and commissioned projects

During 2019/20, having finalised the necessary regulatory processes for the proposed replacement of network assets, the committed projects for reinvestment across Powerlink's network include:

- Kamerunga Substation replacement
- Woree secondary systems and Static VAr Compensator (SVC) secondary systems replacement
- Ingham South transformers replacement
- Ross 275/132kV primary plant replacement
- Dan Gleeson secondary systems replacement
- 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
- Abermain secondary systems replacement
- Line refit works between Townsville South and Clare South substations.

Projects completed in 2019/20 include reinvestment works at:

- Garbutt Substation
- Dysart Substation
- Rocklea Substation
- Line refit works on the 132kV transmission line between Collinsville North and Proserpine substations.

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) will be essential in future years to avoid or delay the need to augment the transmission network in response to any increase in maximum demand.

Since the publication of the 2019 TAPR, Powerlink has continued to engage with non-network providers, customers and other stakeholders. Powerlink also participated in a large number of informal discussions with potential non-network solution providers during April/May 2020 in relation to the EOI for system strength services in Queensland to address the fault level shortfall at Ross to provide clarification and support prior to the lodgement of formal submissions. 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 our Stakeholder Engagement Framework that sets out the principles, objectives and outcomes Powerlink seeks to achieve in our interactions. In particular, Powerlink undertakes a comprehensive bi-ennial stakeholder survey to gain insights about stakeholder perceptions of key factors, its social licence to operate and reputation. Most recently completed as a 'pulse check' survey in November 2019, 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.

Since the publication of the 2019 TAPR, Powerlink has engaged with stakeholders and customers in various ways through a range of forums. In September 2019, more than 100 customer, community advocacy group, government and industry representatives attended Powerlink's annual Transmission Network Forum. The forum provided updates on the state of the network and 2019 TAPR highlights, followed by interactive breakout sessions on using non-network solutions to reduce short-term demand peaks and managing renewable connections in the transmission network of the future. Powerlink held its 2020 Transmission Network Forum in an online format in early September attended by approximately 250 people, with topics including longer term power system planning and the challenges of the energy transition.

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. The panel met in July and February 2020, and December, August and June 2019. Key topics for discussion included the upcoming Revenue Determination process, transmission pricing consultation and Powerlink's first Energy Charter Disclosure Statement to customers and stakeholders. The panel was also engaged to provide input on the asset reinvestment criteria, which enabled Powerlink to refine the criteria with customer input.

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. A major stakeholder activity undertaken for RIT-Ts since the publication of the 2019 TAPR was the expanding NSW – Queensland transmission transfer capacity RIT-T stakeholder webinar.

Powerlink and TransGrid held a joint webinar in October 2019 to share the findings contained in the Project Assessment Draft Report (PADR), Expanding NSW-Queensland Transmission Transfer Capacity 'minor' Group 1 2018 ISP actionable project, as the second stage of the RIT-T process. The webinar provided an opportunity outside of the formal consultation process to engage with and respond to questions from a wide range of stakeholders including consumer advocates, customer representatives, and market participants. This RIT-T has since been completed (refer to Section 5.7.14).

Powerlink intends to host a webinar in late 2020 to share the TAPR's highlights and key updates with customers and stakeholders.

Focus on continuous improvement in the TAPR

As part of Powerlink's commitment to continuous improvement, the 2020 TAPR continues to focus on an integrated approach to future network development and contains detailed discussion on key areas of future expenditure.

Executive Summary

The 2020 TAPR:

- discusses emerging challenges as the network transitions to much greater levels of VRE generation (Chapters 2, 5, 7 and 8)
- provides information in relation to joint planning and Powerlink's approach to asset management (refer to Chapters 3 and 4)
- discusses possible future network asset investments for the 10-year outlook period (refer to Chapter 5)
- 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 5)
- continues the discussion on the potential for generation developments (in particular VRE generation) first introduced in 2016 (refer to Chapter 8)
- contains a quick reference guide on where to locate information on potential non-network opportunities in the TAPR, grouped by investment type (refer to Appendix F) 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 1.9.2 and 5.7)
- includes links to the 2020 TAPR templates and discusses the context, methodology and principles applied for the development of the Queensland transmission network data (refer to Appendix B).