2021 Transmission Annual Planning Report

OVERVIEW

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This Transmission Annual Planning Report (TAPR) Overview briefly summarises the key information contained within the 2021 TAPR and references where more detailed information can be located. The 2021 TAPR, associated supporting material as well as access to the TAPR portal containing the TAPR templates, can be found on Powerlink's website.

1. Overview

Powerlink is committed to proactively engaging with stakeholders and customers and seeking their input into Powerlink's business processes and decision-making. All engagement activities are undertaken in accordance with Powerlink's Stakeholder Engagement Framework which sets out the principles, objectives and outcomes Powerlink seeks to achieve in its interactions. The TAPR is just one avenue that Powerlink uses to communicate information about transmission planning in the National Electricity Market (NEM). Through the TAPR, Powerlink aims to increase stakeholder and customer understanding and awareness of its business practices, including load forecasting and transmission network planning.

The 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 over a 10-year outlook period. In particular, the TAPR:

- outlines the key factors impacting Powerlink's transmission network development and operations
- 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 and provide value to customers
- includes information on electricity energy and demand forecasts, committed generation and potential network and non-network developments
- provides estimates of transmission grid capability
- discusses public consultations regarding the replacement of network assets, potential network augmentations, future Integrated System Plan (ISP) projects and system strength requirements
- provides an update on the status of committed and commissioned projects and
- discusses Powerlink's customer and stakeholder engagement activities undertaken since the publication of the 2020 TAPR.

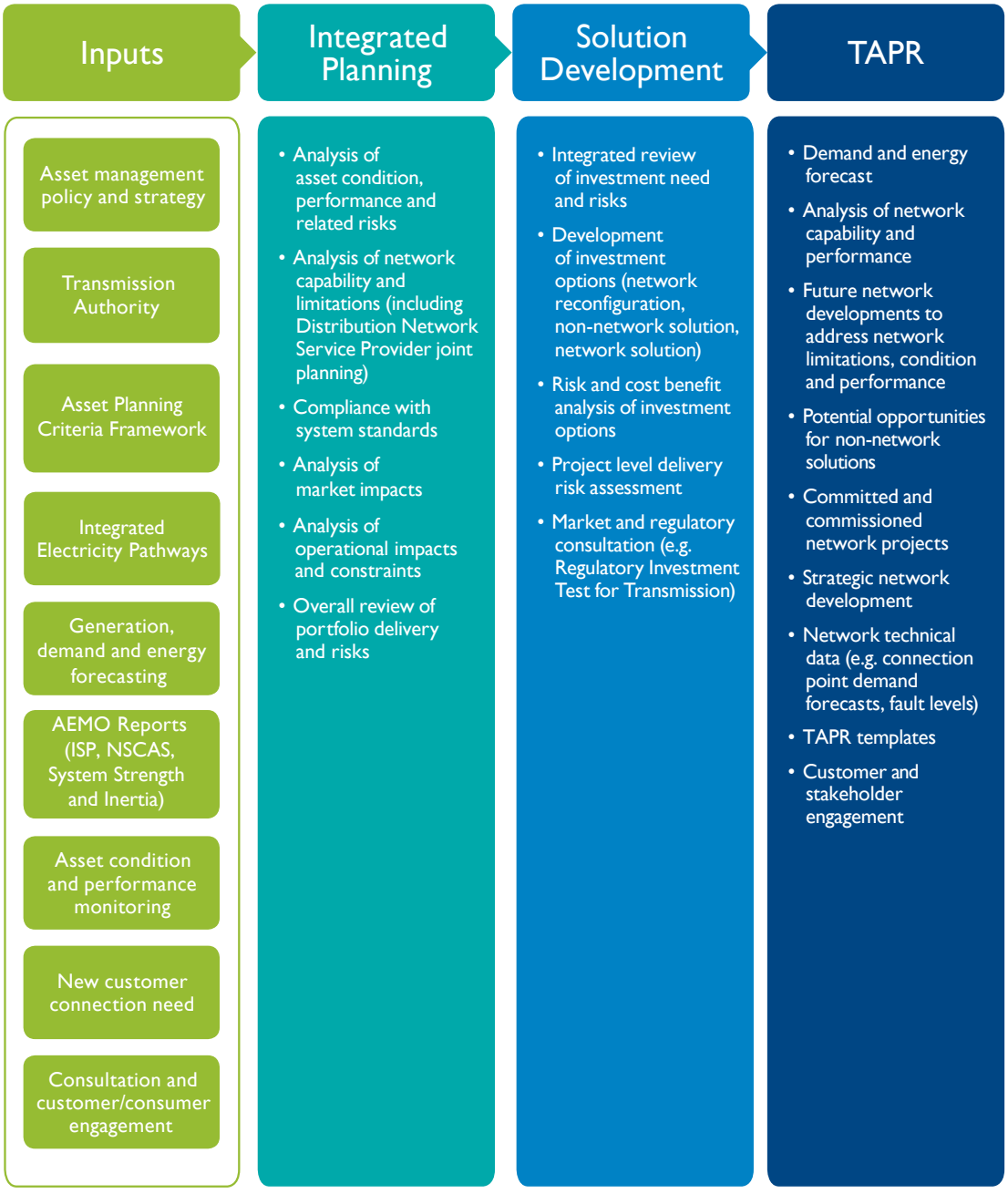
Powerlink is responsible for planning the transmission network within Queensland, and inter-regionally.

Significant inputs to the network planning process are the:

- forecast of customer electricity demand (including DSM) and its location
- location, capacity and arrangement of existing, new and retiring generation (including embedded generation)
- condition and performance of assets and an assessment of risks arising from ageing network assets remaining in service
- assessment of future network capacity to meet the required planning criteria and efficient market outcomes, including limiting transmission losses to the extent possible, system strength and the potential to facilitate future storage requirements to help address minimum demand.

Powerlink's integrated planning approach takes into account both network capacity needs and end of technical service life related issues. More information on Powerlink's planning processes and reinvestment criteria is available in Chapter 1.

Overview of Powerlink's TAPR planning process



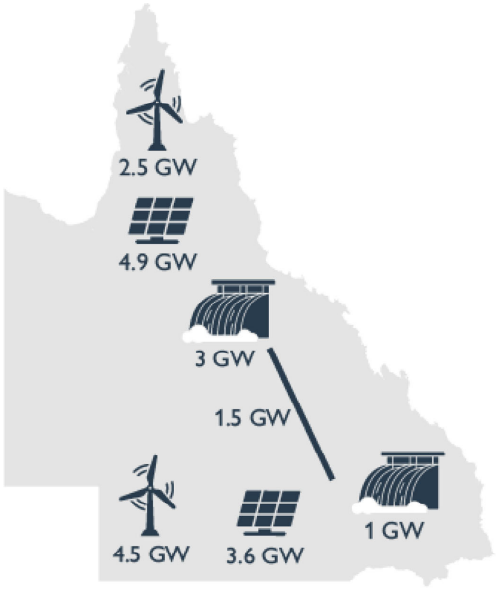
2. The transforming energy system

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.

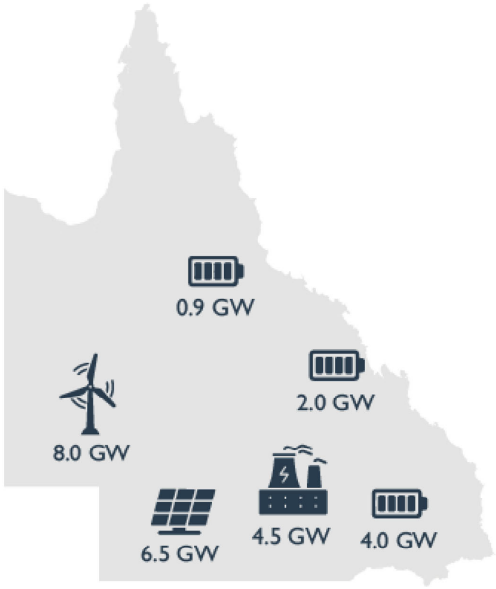
Queensland has one of the highest penetration of rooftop photovoltaic (PV) systems in the world with almost 40% of households having installations compared to 25% only five years ago[1]. The installation of rooftop PV in Queensland is increasing at significantly higher rates than recent forecasts. The current installation rate is approximately 800MW per annum. The high uptake of largescale VRE generation within the distribution networks together with the significant uptake of rooftop PV is changing the transmission delivered daily load. A noticeable change has been in the pattern of minimum demand, shifting from the very early morning to the middle of the day. As embedded and rooftop PV capacity increases, the minimum daytime demand set during the winter and spring seasons will continue to decrease (refer to chapters 2 and 3).

Powerlink developed the Integrated Electricity Pathways (IEP) and has actively engaged with key stakeholders to explore key investment options for transmission, energy storage and renewable generation against a range of changing sensitivities such as rooftop solar installations, generation portfolios, load developments, and future fuel prices.

IEP Development Pathways



Pathway 1 - Development of significant pumped hydro in southern and northern Queensland, complemented by large-scale solar PV. This pathway, across a number of sensitivities is the optimal least cost option.

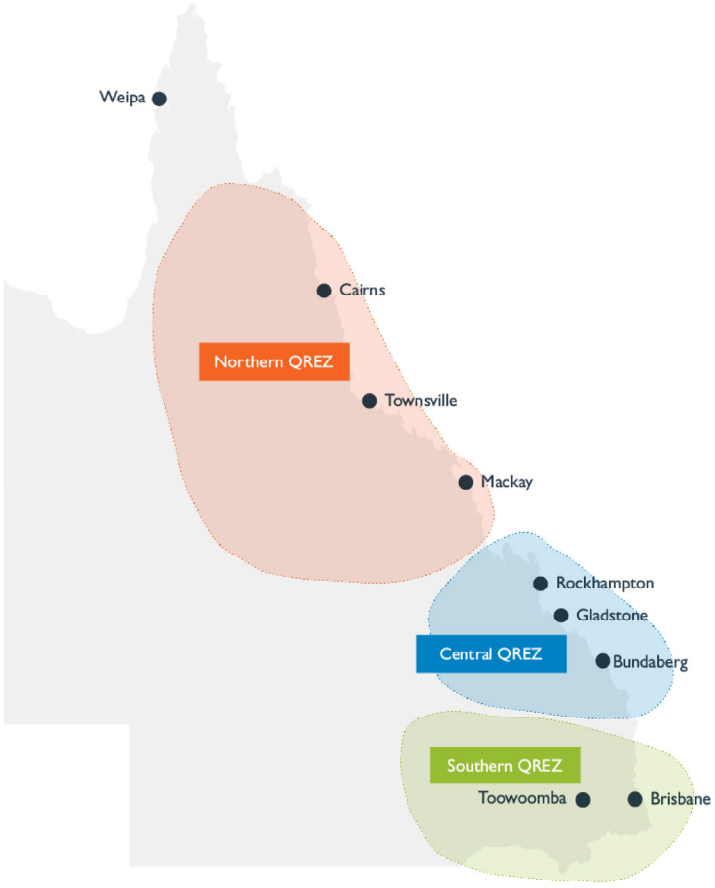


Pathway 2 - Development of batteries concentrated around loads in southern Queensland, complemented with additional gas generation.

[1] Australian PV Institute (APVI) Solar Map, funded by the ARENA.

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.

Queensland Renewable Energy Zones



Northern QREZ

- Good quality wind and capacity factors
- Diverse generation to Southern Queensland and the rest of the NEM
- Queensland Government investing in transmission infrastructure to establish Northern QREZ of up to 500MW capacity
- Neoen's 151MW Kaban Wind Farm as foundational proponent

Central QREZ

- Energy hub of the State with substantial coal fired generation, large loads and export terminals
- Potential renewable energy opportunities and loads converting to renewable energy
- Strong interest in large-scale renewable generation

Southern QREZ

- Large load centres with high capacity interconnector
- Good mixture of energy sources
- Strong transmission network
- Powerlink is working with proponents to develop first stages of Southern QREZ

Queensland is an attractive location for grid scale VRE generation development projects as it is rich in a diverse range of renewable resources – solar, wind, geothermal, biomass and hydro. The output of wind and PV solar energy sources are intermittent, and vary depending on a range of factors including weather conditions, cloud cover and extent of daylight hours. There is a need to firm renewable energy supply to ensure the supply and demand balance is maintained in a reliable and cost effective manner. Energy storage is one of the means of addressing the complexities of demand and supply balance associated with the intermittency of VRE.

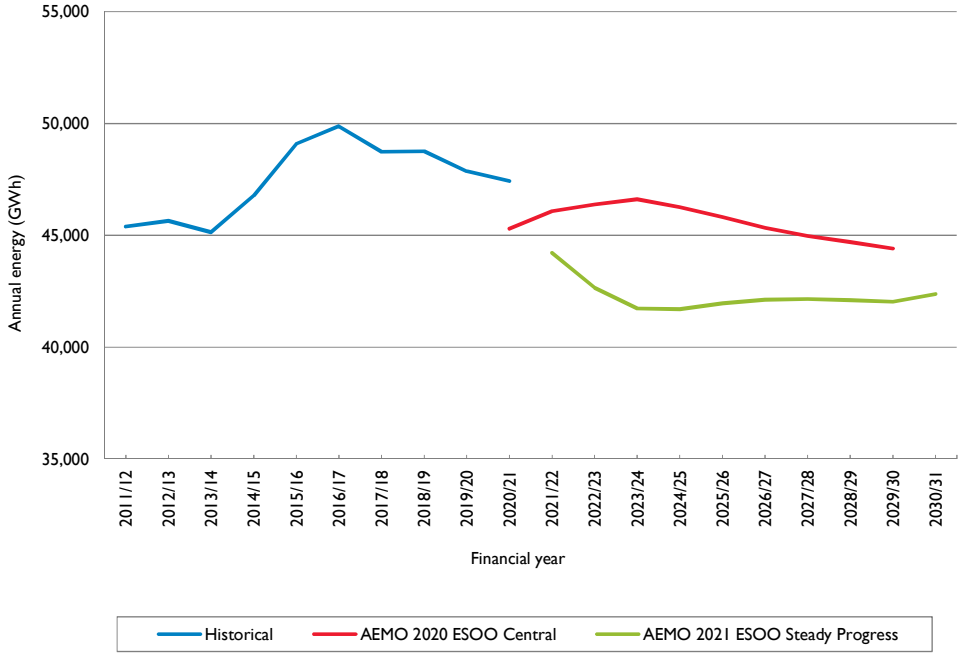
More information on energy transformation, QREZ, the IEP and future load characteristics is available in Chapter 2.

3. 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 6:00pm on 22 February, 287MW below the 2019/20 maximum delivered demand. Operational 'as generated' and native maximum annual demands were also recorded at 6:00pm 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 the 2020 TAPR forecast.

Powerlink has adopted AEMO's 2021 ESOO forecasts in its planning analysis for the 2021 TAPR.

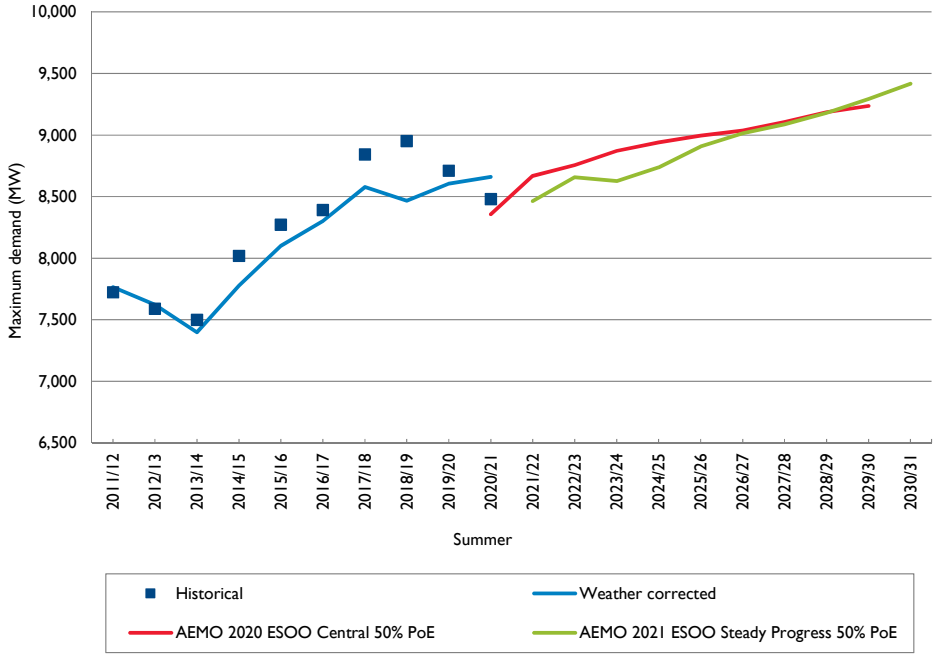
Comparison of AEMO's 2020 ESOO Central scenario energy forecast with the 2021 ESOO Steady Progress scenario (1)



(1) AEMO's 2021 ESOO forecast has been converted from 'operational sent-out' to 'transmission delivered' for the purposes of comparison. Refer to Figure 3.5 for further details.

Major differences between the 2021 forecast and the 2020 forecast can generally be attributed to natural variation in peaks below the connection point level, which can result in displaying an associated variation in year on year changes at the connection point level, and with changes in the growth in the lower levels of the network rather than from any network configuration changes or significant block loads. The forecast uptake of Distributed Energy Resources (DER) has increased for the 2021 forecast when compared to the 2020 forecast. Changes in proposed block loads also account for differences. These, combined with yearly load variations affecting the start values are the major cause of the differences observed between the two forecasts.

Comparison of AEMO's 2020 ESOO Central scenario demand forecast with the 2021 ESOO Steady Progress scenario (1)



(1) AEMO's 2021 ESOO forecast has been converted from 'operational sent-out' to 'transmission delivered' for the purposes of comparison. Refer to Figure 3.5 for further details.

The 2021 TAPR reports on the Slow Growth, Steady Progress and Hydrogen Superpower scenario forecasts provided by AEMO and aligned to the 2021 ESOO. Demand forecasts are also prepared to account for seasonal variation. These seasonal variations are referred to as 10% PoE, 50% PoE and 90% PoE forecasts. They represent conditions that would expect to be exceeded once in 10 years, five times in 10 years and nine times in 10 years respectively.

Forecast average annual growth rates for the Queensland region over the next 10 years under Slow Growth, Steady Progress and Hydrogen Superpower scenarios.

	AEMO future scenario growth outlooks		
	Slow Growth	Steady Progress	Hydrogen Superpower
Delivered energy	-3.9%	-1.1%	0.8%
Delivered summer maximum demand (50% PoE)	-0.6%	0.8%	2.2%
Delivered winter maximum demand (50% PoE)	-0.7%	0.7%	2.3%

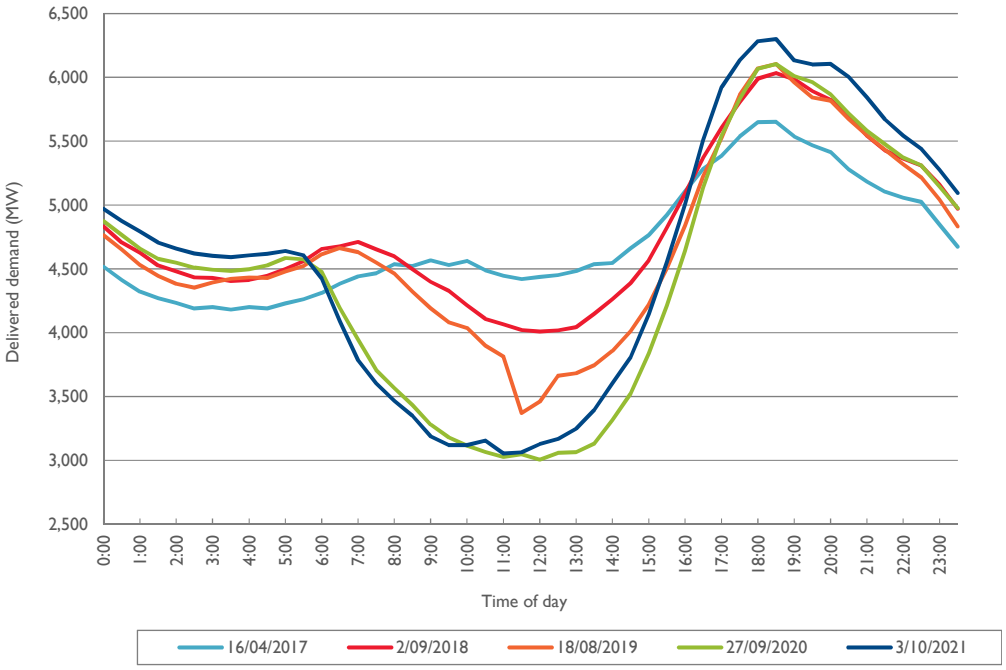
These growth rates refer to transmission delivered quantities. For summer and winter maximum demand, growth rates are based on 50% PoE corrected values for 2020/21 and 2020 respectively.

The installation of small-scale rooftop PV systems and distribution connected solar farms is progressively changing the characteristics of daily demand required to be supplied by the Powerlink transmission system.

Daily minimum demands have typically occurred during the night when industries and commercial premises are mostly closed and households are sleeping. While the cumulative effect of small-scale renewable energy has reduced maximum demand and energy consumption, power produced by embedded solar installations has the effect of 'hollowing' the daily demand profile during the day time period. This has resulted in an increasing divergence between minimum and maximum demand which needs to be met and managed by generation and the transmission network.

Queensland set a record minimum operational 'as generated' demand of 3,784MW on 3 October 2021 at 11:30am. This coincided with the minimum transmission delivered demand for 2021 of 3,053MW.

Transmission delivered annual minimum demand for the Queensland region (1)(2)



(1) Minimum demand can be caused by abnormal conditions, as depicted in the 2019 track when lowest demand coincided with a large industrial load being out of service.

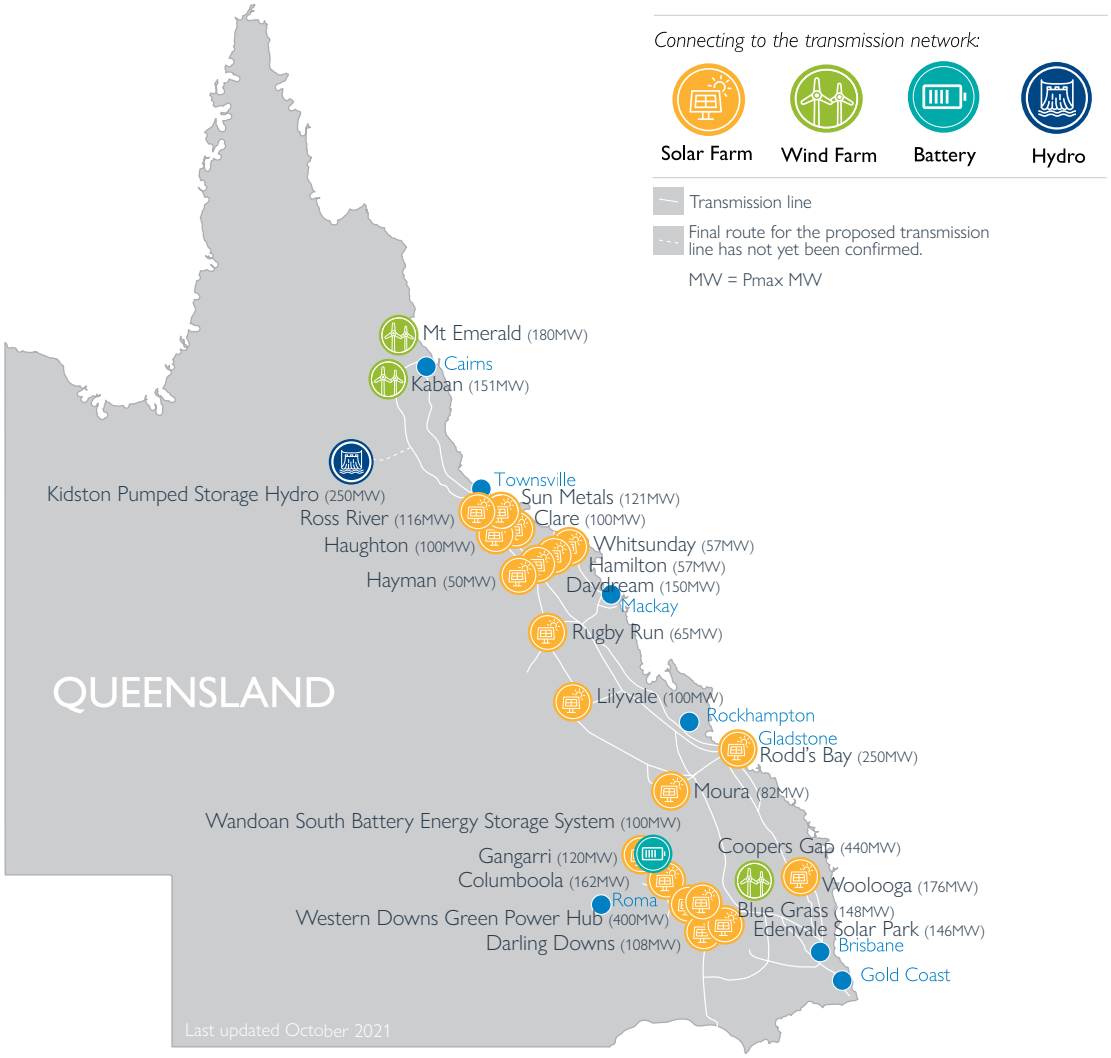
(2) October 2021 trace based on preliminary metering data.

Powerlink is continuing to monitor and assess the impacts of changing load profiles on the transmission network, and is taking an integrated planning approach to address emerging issues and challenges with the transforming energy system. More information on energy and demand projections is available in Chapter 3, Appendix A and the accompanying Customer forecasts of connection point maximum demands (located on Powerlink's website).

4. 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. Approximately 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 1,635MW of VRE.

Committed and existing connection projects since 2018



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 extreme complexity of system strength and how it impacts on managing asynchronous connections and the network in general.

In addition, since publication of the 2020 TAPR, through active collaboration with solar and wind farm proponents and associated equipment manufacturers, Powerlink has implemented innovative cost-effective technical solutions in relation to AEMO's declared system strength fault level shortfall at the Ross node.

Powerlink provides a significant amount of information for parties seeking connection to the transmission network in Queensland, including the Generation Capacity Guide (GCG). This guide is designed to provide proponents with an understanding of the current situation in Queensland with regard to system strength and to outline what it means for project planning. The GCG is published on Powerlink's website separate to the Transmission Annual Planning Report (TAPR) to facilitate updates to the GCG as required to make available the most up to date data for VRE developers. The GCG also includes thermal capacity and congestion information for customers seeking to connect to Powerlink's transmission network.

More information on potential renewable energy connections in Queensland is discussed in Chapter 10.

Proponents who wish to connect to Powerlink's transmission network are encouraged to contact BusinessDevelopment@powerlink.com.au.

Overview of Powerlink's existing network connection process

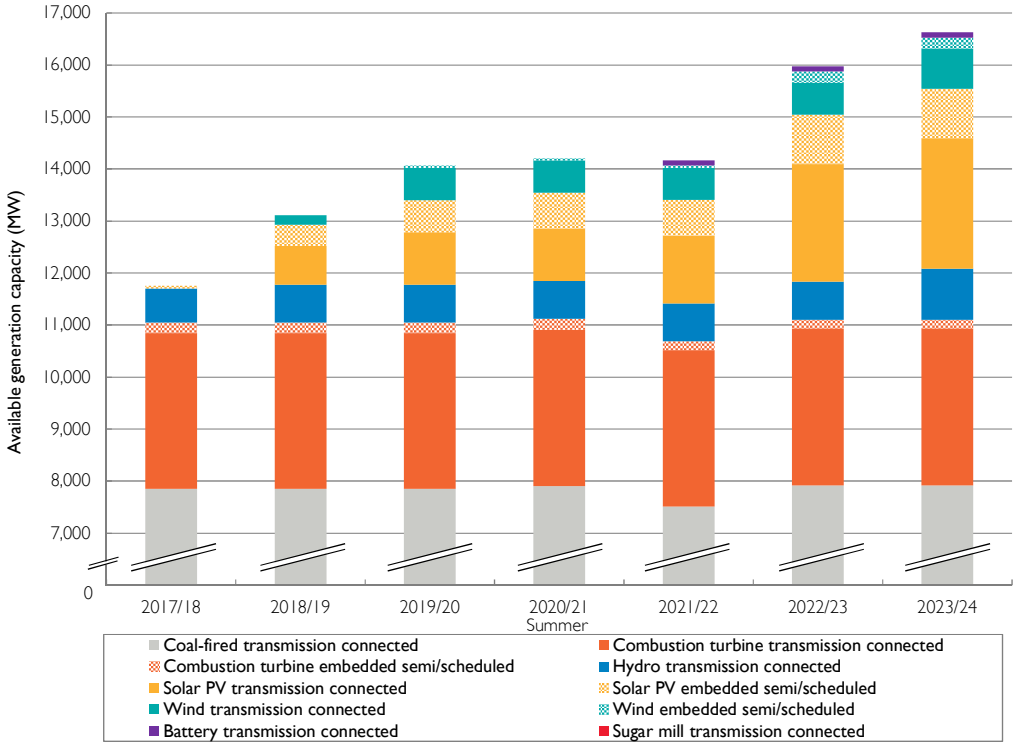
5. Grid section and zone performance

During 2020/21, the Powerlink transmission network performed reliably. Record peak transmission delivered demand was recorded for 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.

Scheduled generation in Queensland is predominantly a combination of coal-fired, gas turbine and hydro-electric generators. During 2020/21, commitments have added 470MW of semi-scheduled VRE capacity, taking Queensland's semi-scheduled VRE generation capacity to 4,444MW.

Summer available generation capacity by energy source



Available generation capacity – existing and committed generators connected to the Powerlink transmission network or direct connect customers

Generator	Location	Available generation capacity (MW) (1)					
		Summer 2021/22	Winter 2022	Summer 2022/23	Winter 2023	Summer 2023/24	Winter 2024
Coal-fired							
Stanwell	Stanwell	1,460	1,460	1,460	1,460	1,460	1,460
Gladstone	Calliope River	1,680	1,680	1,680	1,680	1,680	1,680
Callide B	Calvale	700	700	700	700	700	700
Callide Power Plant	Calvale	434	886	854	886	854	886
Tarong North	Tarong	443	443	443	443	443	443
Tarong	Tarong	1,400	1,400	1,400	1,400	1,400	1,400
Kogan Creek	Kogan Creek PS	720	720	710	750	710	750
Millmerran	Millmerran PS	672	852	672	852	672	852
Total coal-fired		7,509	8,141	7,919	8,171	7,919	8,171
Combustion turbine							
Townsville 132kV	Townsville PS	150	165	150	165	150	165
Mt Stuart	Townsville South	387	400	387	400	387	400
Yarwun (2)	Yarwun	160	155	160	155	160	155
Condamine (3)	Columboola	139	144	139	144	139	144
Braemar 1	Braemar	491	543	501	543	501	543
Braemar 2	Braemar	480	519	480	519	480	519
Darling Downs	Braemar	563	630	563	630	563	630
Oakey (4)	Tangkam	288	346	288	346	288	346
Swanbank E	Swanbank E PS	350	365	350	365	350	365
Total combustion turbine		3,008	3,267	3,018	3,267	3,018	3,267
Hydro-electric							
Barron Gorge	Kamerunga	66	66	66	66	66	66
Kareeya (including Koombooloomba) (5)	Chalumbin	93	93	93	93	93	93
Wivenhoe (6)	Mt. England	570	570	570	570	570	570
Kidston Pumped Hydro Storage	Kidston					250	250
Total hydro-electric		729	729	729	729	979	979
Solar PV (7)							
Ross River	Ross	116	116	116	116	116	116
Sun Metals (3)	Townsville Zinc	121	121	121	121	121	121
Haughton	Haughton River	100	100	100	100	100	100
Clare	Clare South	100	100	100	100	100	100

Available generation capacity – existing and committed generators connected to the Powerlink transmission network or direct connect customers *(continued)*

Generator	Location	Available generation capacity (MW) (1)					
		Summer 2021/22	Winter 2022	Summer 2022/23	Winter 2023	Summer 2023/24	Winter 2024
Whitsunday	Strathmore	57	57	57	57	57	57
Hamilton	Strathmore	57	57	57	57	57	57
Daydream	Strathmore	150	150	150	150	150	150
Hayman	Strathmore	50	50	50	50	50	50
Rugby Run	Moranbah	65	65	65	65	65	65
Lilyvale	Lilyvale	100	100	100	100	100	100
Moura	Moura		82	82	82	82	82
Rodds Bay	South of Wurdong				250	250	250
Woolooga Energy Park	Woolooga		176	176	176	176	176
Bluegrass	Chinchilla		148	148	148	148	148
Columboola	Columboola	162	162	162	162	162	162
Gangarri	Wandoan South	120	120	120	120	120	120
Edenvale Solar Park	Orana			146	146	146	146
Western Downs Green Power Hub	Western Downs		400	400	400	400	400
Darling Downs	Braemar	108	108	108	108	108	108
Total solar PV		1,306	2,112	2,258	2,508	2,508	2,508
Wind (7)							
Mt Emerald	Walkamin	180	180	180	180	180	180
Kaban	Tumoulin				151	151	151
Coopers Gap	Coopers Gap	440	440	440	440	440	440
Total wind		620	620	620	771	771	771
Battery (7)							
Wandoan South 1.5h BESS	Wandoan South	100	100	100	100	100	100
Total battery		100	100	100	100	100	100
Sugar mill							
Invicta (5)	Invicta Mill	0	34	0	34	0	34
Total sugar mill		0	34	0	34	0	34
Total all stations		**13,271**	**14,054**	**14,371**	**15,123**	**14,631**	**15,123**

Notes:

(1) Synchronous generator capacities shown are at the generator terminals and are therefore greater than power station net sent out nominal capacity due to station auxiliary loads and step-up transformer losses. The capacities are nominal as the generator rating depends on ambient conditions. Some additional overload capacity is available at some power stations depending on ambient conditions.

(2) Yarwun is a non-scheduled generator, but is required to comply with some of the obligations of a scheduled generator.

(3) Condamine and Sun Metals are direct connected embedded generators.

(4) Oakey Power Station is an open-cycle, dual-fuel, gas-fired power station. The generated capacity quoted is based on gas fuel operation.

(5) Koombooloomba and Invicta are transmission connected non-scheduled generators.

(6) Wivenhoe Power Station is shown at full capacity (570MW). However, output can be limited depending on water storage levels in the dam.

(7) VRE generators and battery shown at maximum capacity at the point of connection.

More information on the capability and performance of the transmission network in 2020/21 is available in Chapter 8.

6. Future ISP projects in Queensland

The 2020 ISP identified upgrades in Queensland as part of the optimal development path in the NEM. Preparatory activities for the three projects have been provided to AEMO to inform the development of the 2022 ISP.

These future ISP projects, anticipated to become 'actionable' in a future ISP include:

- QNI Medium and Large interconnector upgrades (Powerlink and TransGrid consultation) 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
- Central to Southern Queensland transmission link
- Gladstone grid reinforcement.

7. 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 the 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 Integrated Electricity Pathways (IEP) inform the future development of the power system and the associated network topography of the transmission network in Queensland and the National Electricity Market (NEM).

Based on the Steady Progress 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 the 2021 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 and are discussed in detail in Chapter 9.

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 economically viable to increase the power transfer capacity to alleviate constraints across these grid sections. Feasible network solutions are in discussed Chapter 6.

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.

7.1 Consultations

Powerlink carries out separate consultation processes for each proposed new transmission investment or reinvestment over $6 million by utilising the Regulatory Investment Test for Transmission (RIT-T) consultation process.

RIT-T consultations currently underway include:

- Maintaining reliability of supply in the Cairns region – Stage 1
- Addressing the secondary systems condition risks at Innisfail
- Maintaining reliability of supply in the Tarong and Chinchilla local areas and
- Managing voltages in South East Queensland.

Anticipated RIT-T consultations in the next 12 months include:

- Maintaining reliability of supply at Nebo
- Maintaining reliability of supply in the Gladstone region
- Maintaining reliability to Gladstone South
- Managing power transfer capability and reliability of supply at Redbank Plains and
- Addressing the secondary systems condition risks at Mudgeeraba.

7.2 Forecast network limitations within the next five years

Powerlink has identified that due to declining minimum demand and increasing penetration of VRE generation, there is an emerging need for additional reactive plant in various zones in Queensland to manage potential over-voltages, and meet system strength requirements and as noted in AEMO's 2019 and 2020 Network Support and Control Ancillary Services (NSCAS) reports. The network risk associated with a limitation:

- in the Central West zone is currently being managed through a range of short-term operational measures until such time as the preferred option identified in the RIT-T, installation of a 275k bus reactor at Broadsound Substation, is commissioned in June 2023.
- in the Moreton zone is currently being managed through a range of operational measures until such time as the preferred option identified in the RIT-T which is currently underway (i.e. the staged installation of 120MVAr bus reactors at Woolooga, Blackstone and Belmont substations from June 2022 to December 2025) is complete and/or a non-network solution identified through the RIT-T process is implemented.

Based on AEMO's Steady Progress scenario forecast discussed there are no other network limitations forecast to occur in Queensland in the next five years.

7.3 Summary of possible network investments until December 2025

Information on the need and potential solutions, including the technical envelope for non-network options for possible reinvestments over the 10-year outlook period is discussed in detail in chapters 6 and 7.

Summary of possible network investments until December 2025

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative cost
Transmission lines					
Line refit works on the 275kV transmission lines between Chalumbin and Woree substations (section between Davies Creek and Bayview Heights) (RIT-T underway)	Staged line refit works on steel lattice structures	Maintain supply reliability to the Far North and Ross zones	Staged works by December 2023	New transmission line	$38m
Line refit works on the 132kV transmission line between Callemondah and Gladstone South substations	Rebuild the 132kV transmission line between Callemondah and Gladstone South Substation	Maintain supply reliability in the Gladstone zone	December 2023	Line refit works on steel lattice structures	$17m
Line refit between Larcom Creek and Mt Miller substation	Line refit works on steel lattice structures	Maintain supply reliability in the Gladstone zone	June 2024	Rebuild the 275kV transmission line between Mt Miller and Larcom Creek substation	$10m
Line refit works on the 275kV transmission line between Wurdong and Boyne Island	Line refit works on steel lattice structures	Maintain supply reliability in the Gladstone zone	December 2025	Rebuild the 275kV transmission line between Wurdong and Boyne Island	$10m
Substations					
Tully 132/22kV transformer replacement	Replacement of the transformer	Maintain supply reliability to the Far North zone	June 2024	Life extension of the existing transformer	$5m
Innisfail 132kV secondary systems replacement (RIT-T underway)	Full replacement of 132kV secondary systems	Maintain supply reliability to the Far North zone	December 2024	Replacement of selected secondary systems equipment	$12m
Chalumbin 275/132kV secondary systems replacement	Selected replacement of 132kV secondary systems	Maintain supply reliability to the Far North zone	December 2025	Full replacement of 132kV secondary systems (2)	$10m
Garbutt 132kV secondary systems replacement	Full replacement of 132kV secondary systems	Maintain supply reliability to the Ross zone	June 2025	Selected replacement of 132kV secondary systems	$5m
Alan Sherriff 132kV secondary systems replacement	Selected replacement of 132kV secondary systems	Maintain supply reliability to the Ross zone	June 2025	Full replacement of 132kV secondary systems	$11m
Nebo 132/11kV transformer replacements	Replacement of two 132/11kV transformers	Maintain supply reliability to the North zone	June 2024	Establish 11kV supply from surrounding network	$5m
Alligator Creek 132kV primary plant replacement	Selected replacement of 132kV primary plant	Maintain supply reliability in the North zone	June 2024	Full replacement of 132kV primary plant	$4m

Summary of possible network investments until December 2025 *(continued)*

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative cost
North Goonyella 132kV secondary systems replacement	Full replacement of 132kV secondary systems	Maintain supply reliability to the North zone	December 2023	Selected replacement of 132kV secondary systems	$5m
Blackwater 132kV primary plant replacement	Selected replacement of 132kV primary plant	Maintain supply reliability in the Central West zone	June 2025	Full replacement of 132kV primary plant	$3m
Biloela 132kV secondary systems replacement	Selected replacement of 132kV secondary systems	Maintain supply reliability in the Central West zone	June 2025	Full replacement of 132kV secondary systems	$4m
Lilyvale 132kV secondary systems replacement	Selected replacement of 132kV secondary systems	Maintain supply in the Central West zone	June 2025	Full replacement of 132kV secondary systems	$3m
Line refit works on the 132kV transmission line between Calvale, Biloela and Moura	Line refit works on the 132kV transmission line and repair selected foundations	Maintain supply reliability in the Central West zone	June 2025	Rebuild the 132kV transmission lines as a double circuit from Callide A to Moura	$5m
Callemondah selective 132kV primary plant and secondary systems replacement	Selected replacement of 132kV primary plant and secondary systems	Maintain supply reliability in the Gladstone zone	June 2024	Full replacement of 132kV primary plant and secondary systems	$7m
Chinchilla 132kV substation replacement	Selected replacement of 132kV secondary systems and primary plant and transformer ending from Columboola	Maintain supply reliability in the South West zone	December 2025	Replacement of the entire 132kV secondary systems and switchyard	$11m
Tarong 275/66kV transformers replacement (RIT-T underway)	Replacement of 275/66kV transformers and decommissioning the 275/132kV transformers at Tarong Substation	Maintain supply reliability in the South West zone	December 2025	Life extension of existing transformers	$17m
Tarong 275kV primary plant replacement	Selected replacement of 275kV primary plant	Maintain supply reliability in the South West zone	June 2025	Full replacement of 275kV primary plant	$5m
Millmerran 330kV secondary systems replacement	Selected replacement of 330kV secondary systems	Maintain supply reliability in the Bulli zone	June 2025	Full replacement of secondary systems	$5m
110kV primary plant and 110/11kV transformers replacement	Selected replacement of 110kV primary plant and life extension of two 110/11kV transformers	Maintain reliability of supply at Redbank Plains Substation	June 2024	Full replacement of 110kV primary plant, replace one 110/11kV transformer and engage non-network support	$8m

Summary of possible network investments until December 2025 *(continued)*

Potential project	High level scope	Purpose	Earliest possible commissioning date	Alternatives	Indicative cost
Ashgrove West 110kV secondary systems replacement	Full replacement of 110kV secondary systems	Maintain supply reliability in the Moreton zone	June 2025	Staged replacement of 110kV secondary systems	$6m
South Pine 275/110kV transformer life extension	Life extension of a single 275kV/110kV transformer	Maintain supply reliability in the Moreton zone	June 2025	Retirement of a single 275kV/110kV transformer with non-network support	$2m
South-east Queensland bus reactors (RIT-T underway)	Install 275kV bus reactors at Woolooga, Blackstone and Belmont substations	Maintain system voltages within limits	Commence installation in mid-2022 and complete all sites by 2025	Install 275kV bus reactors at Woolooga, Blackstone and Belmont substations. Non-network solution yielding the same voltage control capacity	$30m
Mudgeeraba 110kV secondary systems replacement	Partial replacement of 110kV secondary systems	Maintain supply reliability in the Gold Coast zone	December 2025	Full replacement of 110kV secondary systems	$11m
Mudgeeraba 110kV primary plant replacement	Selected replacement of 110kVequipment	Maintain supply reliability in the Gold Coast zone	December 2025	Staged replacement of 110kV primary plant in existing bays and selected 275kV equipment	$20m

8. Recently commissioned projects

During 2020/21, Powerlink's efforts have continued to be predominantly directed towards reinvestment in transmission lines and substations across Powerlink's network. Powerlink has completed five projects to connect new VRE and Battery Energy Storage Systems (BESS) developments which are expected to add 958MW of potential generation capacity to the grid.

Commissioned connection works since October 2020

Project (1)	Purpose	Zone	Date commissioned
Woolooga Energy Park Solar Farm	New solar farm (2)	Wide Bay	Quarter 3 2021
Gangarri Solar Farm	New solar farm	Surat	Quarter 4 2020
Columboola Solar Farm	New solar farm (2)	Surat	Quarter 2 2021
Wandoan South Battery	New BESS	Surat	Quarter 2 2021
Western Downs Green Power Hub Solar Farm	New solar farm (2)	Bulli	Quarter 3 2021

(1) When Powerlink constructs a new line or substation as a non-regulated customer connection (e.g. generator, renewable generator, mine or industrial development), the costs of acquiring easements, constructing and operating the transmission line and/or are paid for by the company making the connection request.

(2) Powerlink's scope of works for this project has been completed. Remaining works associated with generation connection are being coordinated with the customer.

Commissioned network reinvestments since October 2020

Project	Purpose	Zone	Date commissioned
Dan Gleeson 132kV secondary systems replacement	Maintain supply reliability in the North zone	Ross	August 2020
Ingham South 132/66kV transformers replacement	Maintain supply reliability in the Ross zone	Ross	August 2021
Kemmis 132/66kV transformer replacement	Maintain supply reliability in the North zone	North	December 2020
Callide A / Calvale 132kV transmission reinvestment	Maintain supply reliability in the Central West zone	Central West	July 2021

9. Description of accompanying technical data

9.1 Appendix A

Appendix A addresses National Electricity Rules (NER) (Clause 5.12.2(c)(1)) which requires the Transmission Annual Planning Report (TAPR) to provide 'the forecast loads submitted by a Distribution Network Service Provider (DNSP) in accordance with Clause 5.11.1 or as modified in accordance with Clause 5.11.1(d)'. This requirement includes a description of:

- the forecasting methodology, sources of input information and assumptions applied (Clause 5.12.2(c)(i)) (refer to Section A.1)
- a description of high, most likely and low growth scenarios (refer to Section A.2)
- an analysis and explanation of any aspects of forecast loads provided in the TAPR that have changed significantly from forecasts provided in the TAPR from the previous year (refer to Section A.3)
- an analysis and explanation of any aspects of forecast loads provided in the TAPR from the previous year which are significantly different from the actual outcome (refer to Section A.4)
- customer forecasts of connection point maximum demands (located on Powerlink's website).

9.2 Appendix B

In accordance with Clause 5.14B.1(a) of the NER, the Australian Energy Regulator's (AER) TAPR Guidelines set out the required format of TAPRs, in particular the provision of TAPR templates to complement the TAPR document. The purpose of the TAPR templates is to provide a set of consistent data across the NEM to assist stakeholders to make informed decisions.

Appendix B discusses the methodology and principles applied to define or explain the different data fields in the templates.

The TAPR template data may be directly accessed on Powerlink's TAPR portal.

9.3 Appendix C

Appendix C provides definitions of illustrations of the 11 geographical zones and eight grid sections referenced in the TAPR. Tables C.1 and C.2 provide detailed definitions of zone and grid sections.

Figures C.1 and C.2 provide illustrations of the zone generation, zone load and grid section definitions.

9.4 Appendix D

Appendix D lists the Queensland intra-regional limit equations, derived by Powerlink, valid at the time of publication. The AEMO defines other limit equations for the Queensland Region in its market dispatch systems.

These equations are continually under review to take into account changing market and network conditions and should be confirmed with Powerlink to confirm the latest form if required.

9.5 Appendix E

Appendix E contains indicative maximum and minimum short circuit currents at Powerlink's substations.

9.6 Appendix F

Appendix F is a glossary which lists standard abbreviations contained within the TAPR.

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