Network capability and performance

06

This chapter discusses how changes to Queensland's generation mix and demand profiles impact the power flows across the transmission network.

Key highlights

- Generation commitments since the 2024 Transmission Annual Planning Report (TAPR) added 1,026 megawatts (MW) to Queensland's semi-scheduled variable renewable energy (VRE[1]) generation capacity, taking the total existing and committed semi-scheduled VRE generation capacity to 8,290MW.
- Storage commitments since the 2024 TAPR added 1,530MW of two-hour Battery Energy Storage Systems (BESS). Total energy storage from existing and committed BESS now exceeds 6 gigawatt hours (GWh).
- Record maximum and minimum transmission delivered demands were experienced in South West, Moreton, Gold Coast and Bulli zones during 2024/25.
- The transmission network has performed strongly during 2024/25, with Queensland grid sections largely unconstrained.
- Powerlink is continuing to develop the Wide Area Monitoring Protection and Control (WAMPAC) platform to maximise the capability of the network and provide an additional layer of security and resilience to system disturbances and events.

6.1 Introduction

Network capability and performance is central to ensuring the reliability and efficiency of the energy system, and for integrating new generation into the grid. The capability of Powerlink's transmission network is dependent on several factors:

- Weather – Queensland's transmission network is utilised more during summer than winter. During higher summer temperatures transmission plant has lower power carrying capability which is also when demand is higher (refer to Figure 2.15).
- The location and pattern of generation dispatch – future generation dispatch patterns, interconnector and inter-zonal flows are uncertain and will vary substantially due to output of VRE generation.
- Outages – power flows can also vary substantially with planned or unplanned outages of transmission network elements. Power flows may also be higher at times of local area or zone maximum demands[2] and/or when embedded generation output is lower.

The National Electricity Rules (NER) require:

- Transmission Network Service Providers (TNSPs) to analyse the expected future operation of the transmission network, considering relevant loads, future generation, market network service and other relevant data[3]
- TNSPs to conduct an annual planning review, which includes a review of the adequacy of connection points and relevant parts of the transmission network[4]
- the TAPR to include information on control schemes in place to manage network stability and identify the need for new or altered controls[5].

Accordingly, this chapter provides both the historic performance as well as information on the changing generation, load and network flows. This includes:

- an outline of existing and committed generation and storage capacity over the next three years
- single line diagrams of the existing high voltage (HV) network configuration
- zonal energy transfers for the two most recent years
- duration curves of transmission delivered demand for the five most recent years
- duration curves of inter-zonal power flows for the five most recent years
- constraint times for key sections of the transmission network
- a qualitative explanation of factors affecting power transfer capability at key sections of the transmission network

1 In this chapter both VRE and inverter-based resource (IBR) terms are used. VRE refers to renewable energy sources whose output varies with ambient conditions and cannot be fully controlled (e.g. wind and solar photovoltaic (PV)). IBR refers to generation technologies that connect to the grid through power electronic inverters (e.g. wind, solar PV and battery storage).

2 Refer to Table 2.12.

3 National Electricity Rules (NER), clause 5.12.1(a).

4 NER, clause 5.12.1(b)(2).

5 NER, clauses 5.12.2(c)(9) and (9A).

- a high-level summary of loss of supply events caused by credible contingencies in each zone
- double circuit transmission lines categorised as vulnerable by the Australian Energy Market Operator (AEMO)
- a summary of network control facilities configured to disconnect load because of non-credible events.

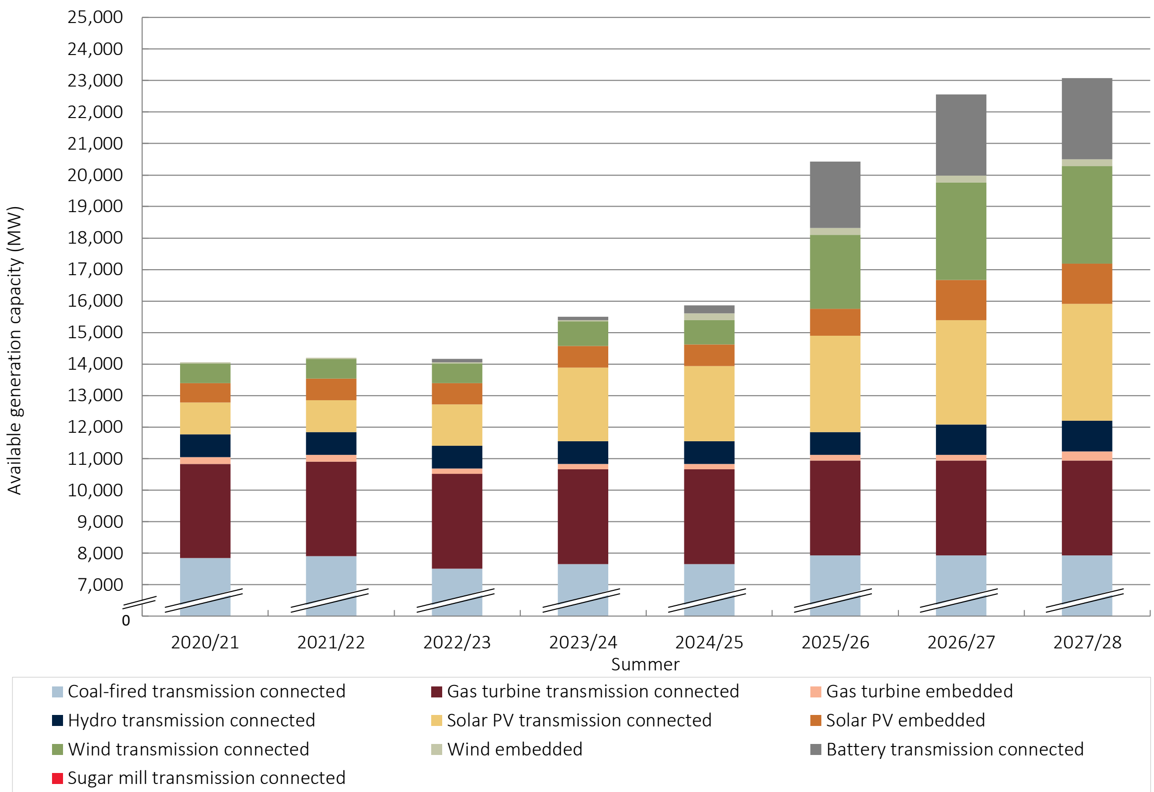
6.2 Available generation capacity

Scheduled generation in Queensland is predominantly a combination of coal fired, gas turbine and hydro-electric generators, with an increasing share coming from battery and pumped hydro energy storage (PHES) systems. Semi-scheduled generation in Queensland is a combination of wind and solar generation.

Powerlink applies AEMO's definition of 'committed' projects from the System Strength Impact Assessment Guidelines. The definition of 'committed' includes that AEMO is satisfied the project meets the requirements of the NER, a connection agreement is in place and a system strength remediation scheme, where required, has been finalised[6].

During 2024/25, commitments have added 1,027MW of semi-scheduled VRE capacity, taking Queensland's semi-scheduled VRE generation capacity to 8,291MW. In addition, 1,530MW of BESS capacity has been committed, taking the total BESS capacity to 2,590MW. Figure 6.1 illustrates the actual and expected changes to available and committed large-scale generation capacity in Queensland from summer 2020/21 to summer 2027/28.

Figure 6.1 Summer available generation capacity by energy source



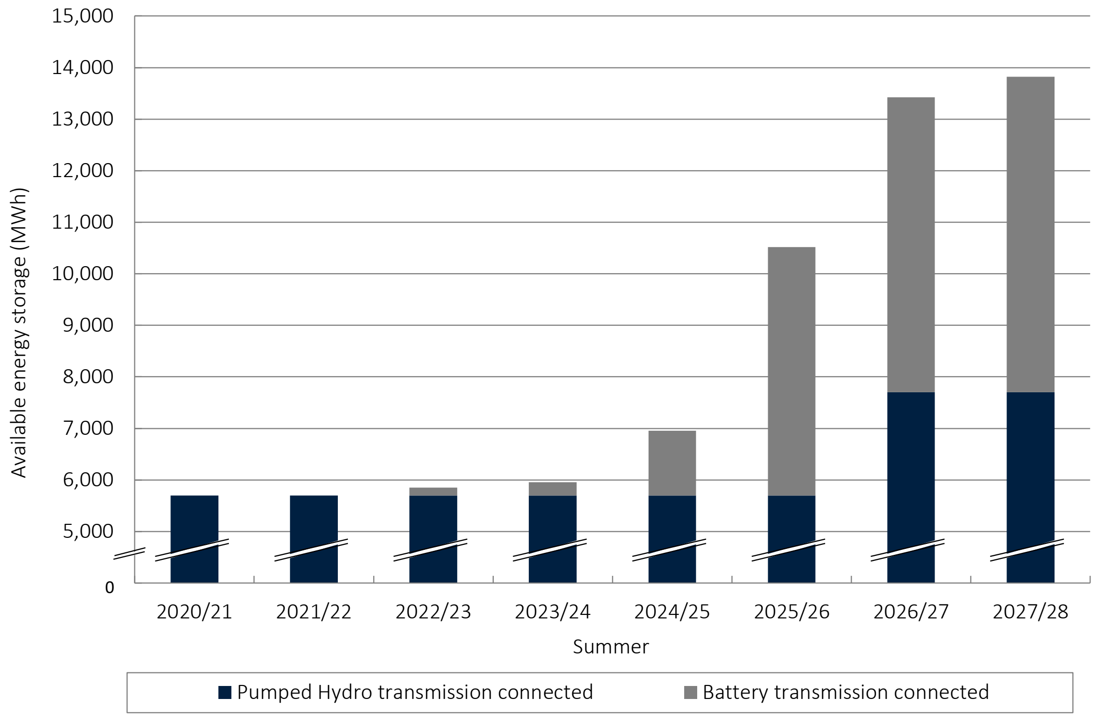
Storage is essential to smooth out variations in supply from VRE generation. Prior to 2022, Wivenhoe Pumped Storage Hydro Power Station was the only transmission-connected energy storage in Queensland. Since then, seven grid-connected batteries have been commissioned or are in commissioning. Additionally, the Punchs Creek Solar Farm recently became the first committed solar generation project to incorporate battery storage and connect to the Powerlink network.

The Kidston Pumped Storage Hydro Project is committed and under construction, and various pumped hydro stations are in the development pipeline. Figure 6.2 shows the recent increases in energy storage capacity and the new capacity that will be available in the coming years based on project commitments.

Total energy storage capacity connected or committed to be connected to the network now exceeds 13GWh with just over 6GWh coming from battery storage.

6 AEMO, System Strength Impact Assessment Guidelines, Version 2.2, June 2024, page 5.

Figure 6.2 Available storage capacity by type



6.2.1 Existing and committed transmission connected and direct connect embedded generation

Table 6.1 summarises the available generation capacity of power stations connected or committed to be connected to Powerlink's transmission network (including the non-scheduled generators at Yarwun, Invicta and Koombooloomba), or to Powerlink's direct connect customers.

Semi-scheduled transmission connected storage at Aldoga Solar Farm and Punchs Creek Solar Farm and BESS have reached committed status since the 2024 TAPR.

Scheduled transmission connected storage at Tarong, Supernode 1 & 2, Brendale and Swanbank BESS have reached committed status since the 2024 TAPR.

Non-scheduled, semi-scheduled and scheduled generators are treated differently in AEMO's central dispatch process[7].

Information in this table has been provided to AEMO by the owners of the generators. Details of registration and generator capacities can be found on AEMO's website. Powerlink's Register of Large Generator Connections, which includes information on generators connected to our network, is available on Powerlink's website[8].

7 AEMO Fact Sheet: Visibility of the Power System.
8 NER, rule 5.18A.

Table 6.1 Available generation capacity – existing and committed generators connected to the Powerlink transmission network or direct connect customers

Generator	Location	Available capacity MW generated Summer 2025/26	Winter 2026	Summer 2026/27	Winter 2027	Summer 2027/28	Winter 2028
Coal-fired (1)							
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	868	932	868	932	868	932
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 Power Station (PS)	710	750	710	750	710	750
Millmerran	Millmerran PS	670	852	670	852	670	852
Total coal-fired		7,931	8,217	7,931	8,217	7,931	8,217
Gas-fired (1)							
Townsville 132kV	Townsville GT 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	501	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 gas turbine		3,018	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 Storage Hydro (6)	Kidston		250	250	250	250	250
Total hydro-electric		729	729	979	979	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
Whitsunday	Strathmore	57	57	57	57	57	57

Table 6.1 Available generation capacity – existing and committed generators connected to the Powerlink transmission network or direct connect customers (*continued*)

Generator	Location	Available capacity MW generated					
		Summer 2025/26	Winter 2026	Summer 2026/27	Winter 2027	Summer 2027/28	Winter 2028
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
Broadsound	Broadsound	296	296	296	296	296	296
Lilyvale	Lilyvale	100	100	100	100	100	100
Aldoga	Larcom Creek	387	387	387	387	387	387
Moura	Moura	82	82	82	82	82	82
Woolooga Energy Park	Woolooga	176	176	176	176	176	176
Blue Grass	Chinchilla	148	148	148	148	148	148
Columboola	Columboola	162	162	162	162	162	162
Gangarri	Wandoan South	120	120	120	120	120	120
Wandoan	Wandoan South	125	125	365	365	365	365
Edenvale Solar Park	Orana	146	146	146	146	146	146
Western Downs Green Power Hub	Western Downs	400	400	400	400	400	400
Punchs Creek (8)	Punchs Creek				400	400	400
Darling Downs	Braemar	108	108	108	108	108	108
Total solar PV		3,066	3,066	3,306	3,706	3,706	3,706
Wind (7)							
Mt Emerald	Walkamin	180	180	180	180	180	180
Kaban	Tumoulin	152	152	152	152	152	152
Lotus Creek	Glencoe			276	276	276	276
Clarke Creek	Broadsound	440	440	440	440	440	440
Boulder Creek	Muranu			221	221	221	221
Wambo	Halys	245	245	245	245	245	245
Wambo 2	Halys		247	247	247	247	247
Coopers Gap	Coopers Gap	440	440	440	440	440	440
MacIntyre	Tummaville	890	890	890	890	890	890
Total wind		2,347	2,594	3,091	3,091	3,091	3,091
Battery (7)							
Bouldercombe 2 hour	Bouldercombe	50	50	50	50	50	50
Woolooga 2 hour	Woolooga		200	200	200	200	200
Wandoan 1.5 hour	Wandoan South	100	100	100	100	100	100

Table 6.1 Available generation capacity – existing and committed generators connected to the Powerlink transmission network or direct connect customers (*continued*)

Generator	Location	Available capacity MW generated Summer 2025/26	Winter 2026	Summer 2026/27	Winter 2027	Summer 2027/28	Winter 2028
Tarong 2 hour	Tarong	300	300	300	300	300	300
Chinchilla 2 hour	Western Downs	100	100	100	100	100	100
Western Downs 2 hour	Western Downs	255	510	510	510	510	510
Ulinda Park 2 hour	Western Downs	155	155	155	155	155	155
Brendale 2 hour	South Pine	205	205	205	205	205	205
Supernode 1 and 2 2 hour and 4 hour	South Pine	520	520	520	520	520	520
Swanbank 2 hour	Blackstone	250	250	250	250	250	250
Greenbank 2 hour	Greenbank	200	200	200	200	200	200
Total battery		2,135	2,590	2,590	2,590	2,590	2,590
Sugar mill							
Invicta (5)	Invicta Mill	0	34	0	34	0	34
Total sugar mill		0	34	0	34	0	34
Total all stations		**19,226**	**20,747**	**20,915**	**21,884**	**21,315**	**21,884**

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 and Kidston Pumped Storage Hydro are shown at full capacity. However, output can be limited depending on water storage levels.

(7) VRE generators and batteries are shown at maximum capacity at the point of connection. The capacities are nominal as the generator rating depends on ambient conditions.

(8) Includes battery storage behind the connection point.

6.2.2 Existing and committed scheduled and semi-scheduled distribution connected embedded generation

Table 6.2 summarises the available generation capacity of embedded scheduled and semi-scheduled power stations connected or committed to be connected to Queensland's distribution network.

Scheduled embedded generation Lockyer Energy Project has reached committed status since the 2024 TAPR.

Information in this table has been provided to AEMO by the owners of the generators. Further details on registration status and generator capacities can be found on AEMO's website.

Table 6.2 Available generation capacity – existing and committed scheduled or semi-scheduled generators connected to the Ergon Energy and Energex distribution networks

Generator	Location	Available capacity MW generated					
		Summer 2025/26	Winter 2026	Summer 2026/27	Winter 2027	Summer 2027/28	Winter 2028
Combustion turbine (1)							
Townsville 66kV	Townsville GT PS	78	82	78	82	78	82
Barcaldine	Barcaldine	32	37	32	37	32	37
Roma	Roma	54	68	54	68	54	68
Lockyer Energy Project	Gatton					116	116
Total combustion turbine		164	187	164	187	280	303
Solar PV (2)							
Kidston	Kidston	50	50	50	50	50	50
Kennedy Energy Park	Hughenden	15	15	15	15	15	15
Collinsville	Collinsville North	42	42	42	42	42	42
Clermont	Clermont	75	75	75	75	75	75
Emerald	Emerald	72	72	72	72	72	72
Middlemount	Lilyvale	26	26	26	26	26	26
Bundaberg	Gin Gin		78	78	78	78	78
Bullyard	Gin Gin			97	97	97	97
Banksia	Isis			60	60	60	60
Aramara	Aramara				104	104	104
Susan River	Maryborough	75	75	75	75	75	75
Childers	Isis	56	56	56	56	56	56
Munna Creek	Kilkivan	120	120	120	120	120	120
Kingaroy	Kingaroy	40	40	40	40	40	40
Maryrorough	Yarranlea	27	27	27	27	27	27
Yarranlea	Yarranlea	103	103	103	103	103	103
Oakey 1	Oakey	25	25	25	25	25	25
Oakey 2	Oakey	55	55	55	55	55	55
Warwick	Warwick	64	64	64	64	64	64
Gunsynd	Waggamba		94	94	94	94	94
Total solar PV		845	1,017	1,174	1,278	1,278	1,278
Wind (2)							
Kennedy Energy Park	Hughenden	43	43	43	43	43	43
Dulacca	Roma	173	173	173	173	173	173
Total wind		216	216	216	216	216	216
Total all stations		**1,225**	**1,420**	**1,554**	**1,681**	**1,774**	**1,797**

Notes:

(1) Synchronous generator capacities shown are at the generator terminals and are therefore greater than the power station's 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) VRE generators shown at maximum capacity at the point of connection. The capacities are nominal as the generator rating depends on ambient conditions.

6.2.3 Information of generation and storage projects yet to be committed

The information in tables 6.1 and 6.2 relate only to existing and committed projects in Queensland. Details of projects at earlier stages of development are available from the Queensland Government's Power Plants Map of Queensland or from AEMO's NEM Generation Maps.

6.3 Network capacity and security

6.3.1 Increasing capacity of the transmission system

Powerlink is continuing to develop the WAMPAC platform to maximise the capability of the network and provide an additional layer of security and resilience to system disturbances and events.

WAMPAC schemes rapidly detect abnormal system conditions across geographically diverse transmission assets and initiates appropriate action to adapt to system conditions. For example, changing the network configuration or altering generation and load characteristics. The speed of operation of WAMPAC enables the platform to be effective in sub-second timeframes and can remediate dynamic conditions to minimise disruption and to significantly reduce the probability of cascading failure.

WAMPAC has been implemented for system protection services across the Central Queensland to South Queensland (CQ-SQ) grid section. Further applications for the technology have been implemented in Northern Queensland to more effectively manage and operate the transmission network during outages. It is also anticipated that WAMPAC will be instrumental in increasing the hosting capacity and mitigating the impacts of network contingencies and planned outages in the future.

New technology is being introduced to optimise the performance and capacity of the high voltage network. Detailed assessments have been completed for the adoption of advanced conductor technology, and Powerlink anticipates utilising this technology within 275 kilovolt (kV) transmission infrastructure in Central and South Queensland to increase the thermal ratings of transmission.

In addition, field trials are underway to test equipment that enables real-time ratings for overhead conductor lines. This takes into account the prevailing weather conditions on critical spans. The aim is to increase the thermal capability of the transmission network the vast majority of the time during periods of elevated wind speeds or reduced ambient temperature or solar irradiation. The Bureau of Meteorology (BOM) has provided advice and weather data to help inform the scope of the trial.

6.3.2 Managing non-credible network events

Powerlink participated in the 2025 General Power System Risk Review (GPSRR), published by AEMO in July 2025[9]. Powerlink continues to work with AEMO to progress work on the priority risks identified in the report.

Work is continuing for the following recommendations from previous years:

- Expansion of WAMPAC for the non-credible loss of both Calvale-Halys 275kV lines. The scheme will be improved to manage higher flows on the CQ-SQ grid section.
- Implementation of a new WAMPAC scheme to manage the non-credible loss of both Columboola to Western Downs 275kV lines resulting in the loss of all loads in the Surat zone.
- The design of the Over Frequency Generator Shedding (OFGS) scheme for Queensland is finalised and Powerlink is engaging with generators to implement the settings.

Powerlink owns other network control facilities that may disconnect load following a non-credible contingency to minimise or reduce the consequences of such events. A list of these facilities is provided in Table 6.3.

9 AEMO, 2025 General Power System Risk Review, July 2025.

Table 6.3 Powerlink network control facilities configured to disconnect load as a consequence of non-credible events during system normal conditions

Scheme	Purpose
Far North Queensland (FNQ) Under Voltage Load Shed (UVLS) scheme	Minimise risk of voltage collapse in FNQ
North Goonyella Under Frequency Load Shed (UFLS) relay	Raise system frequency
Dysart UVLS	Minimise risk of voltage collapse in Dysart area
Eagle Downs UVLS	Minimise risk of voltage collapse in Eagle Downs area
Boyne Island UFLS relay	Raise system frequency
Queensland UFLS inhibit scheme	Minimise risk of Queensland to New South Wales Interconnector (QNI) separation for an UFLS event for moderate to high southern transfers on QNI compared to Queensland demand
CQ-SQ N-2 WAMPAC scheme	Minimise risk of CQ-SQ separation for a non-credible loss of the Calvale to Halys 275kV double circuit transmission line
Tarong UFLS relay	Raise system frequency
Middle Ridge UFLS relays	Raise system frequency
Mudgeeraba Emergency Control Scheme (ECS)	Minimise risk of voltage collapse in the Gold Coast zone

6.4 Existing network configuration

Figures 6.3 to 6.6 illustrate Powerlink's system intact network as of July 2025.

Figure 6.3 Existing HV network, July 2025 – North Queensland

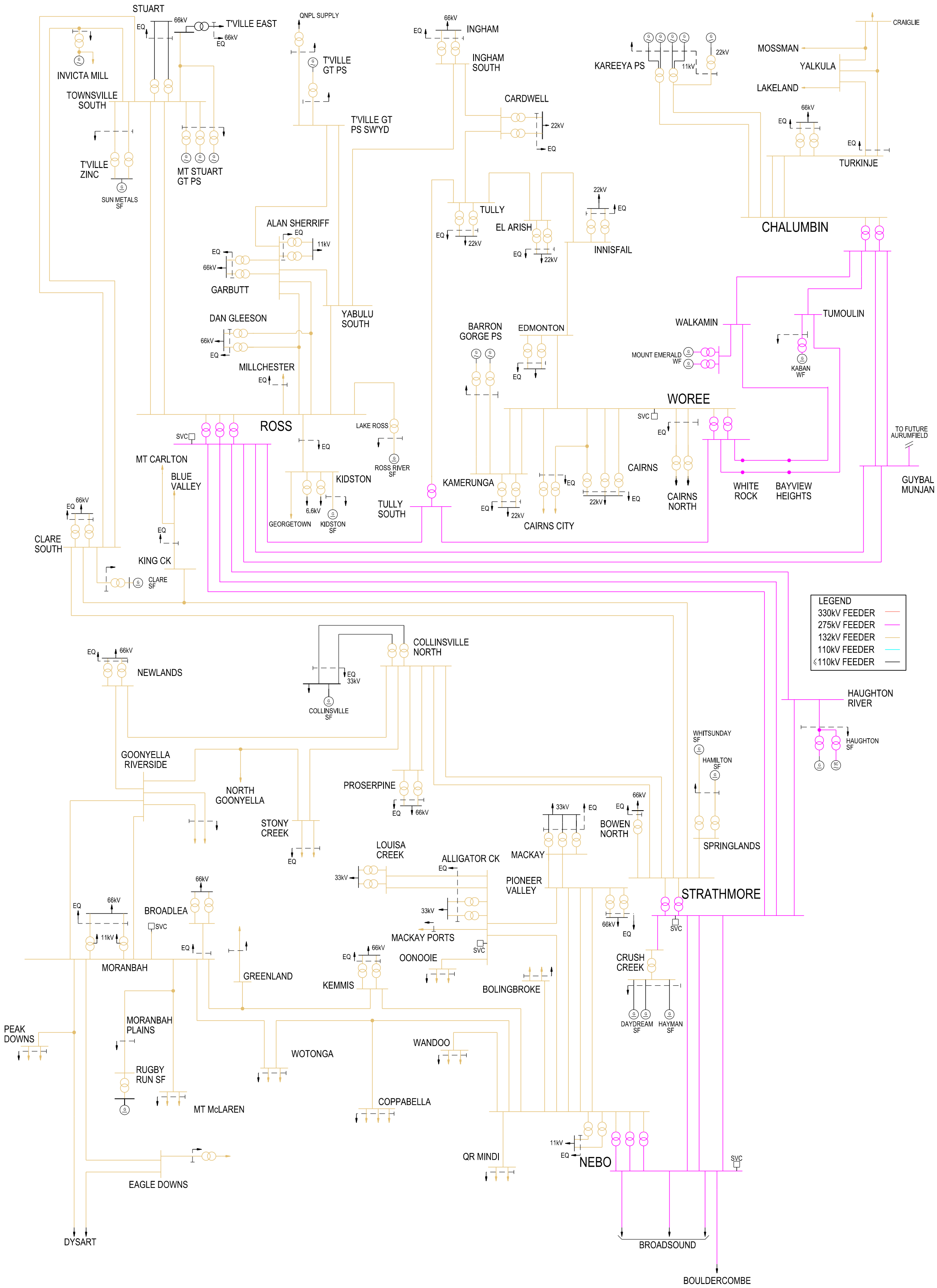


Figure 6.4 Existing HV network, July 2025 – Central Queensland

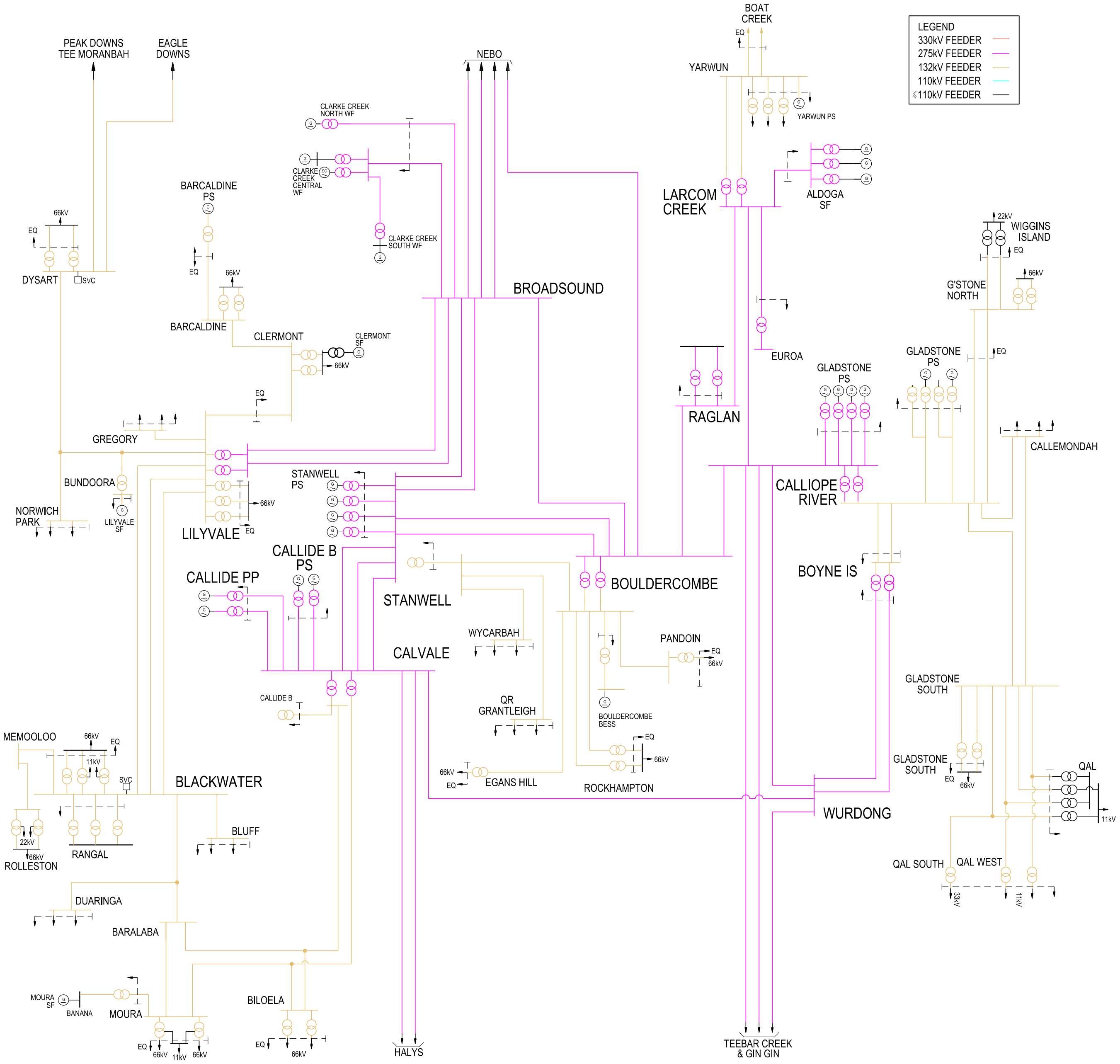


Figure 6.5 Existing HV network, July 2025 – South West Queensland

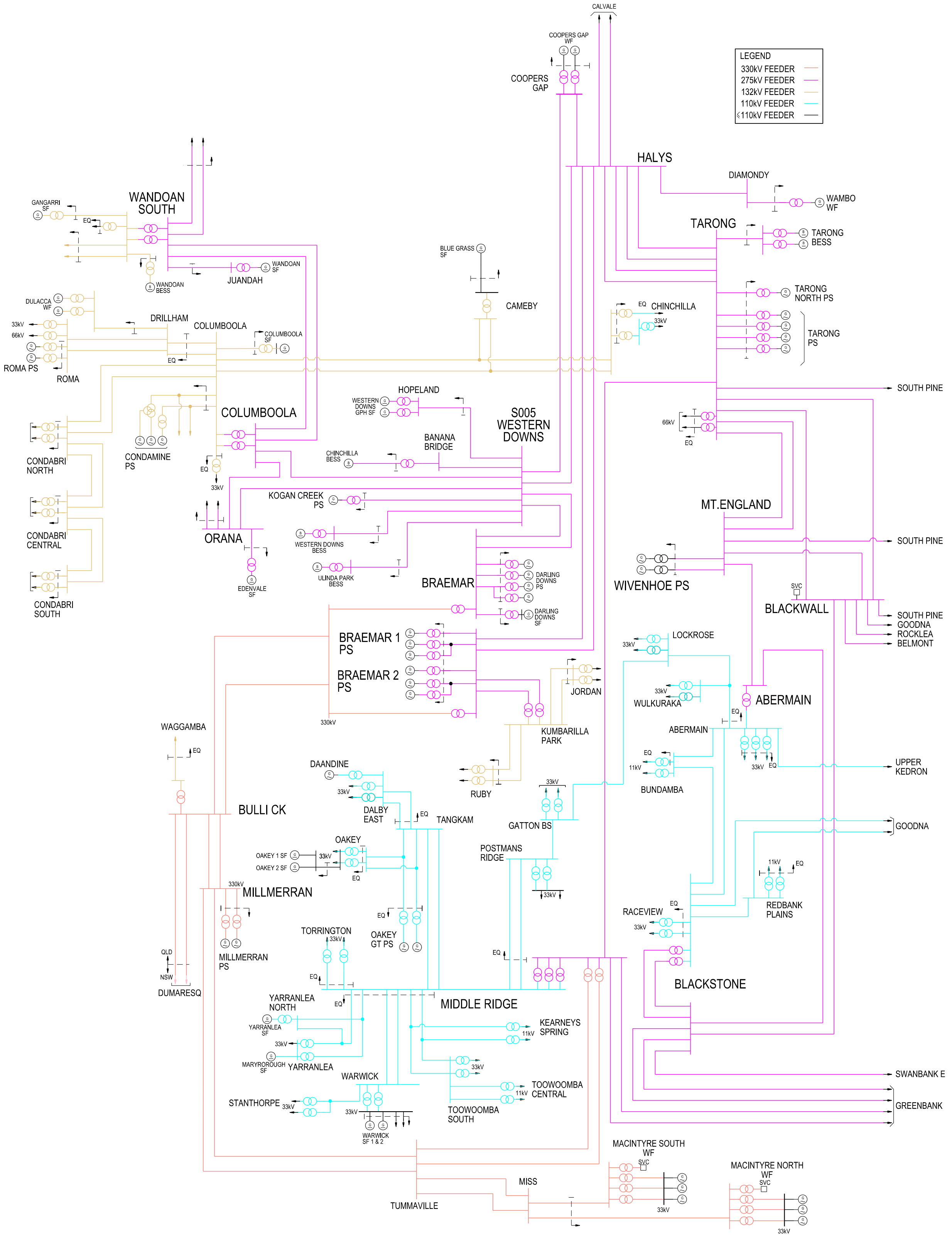
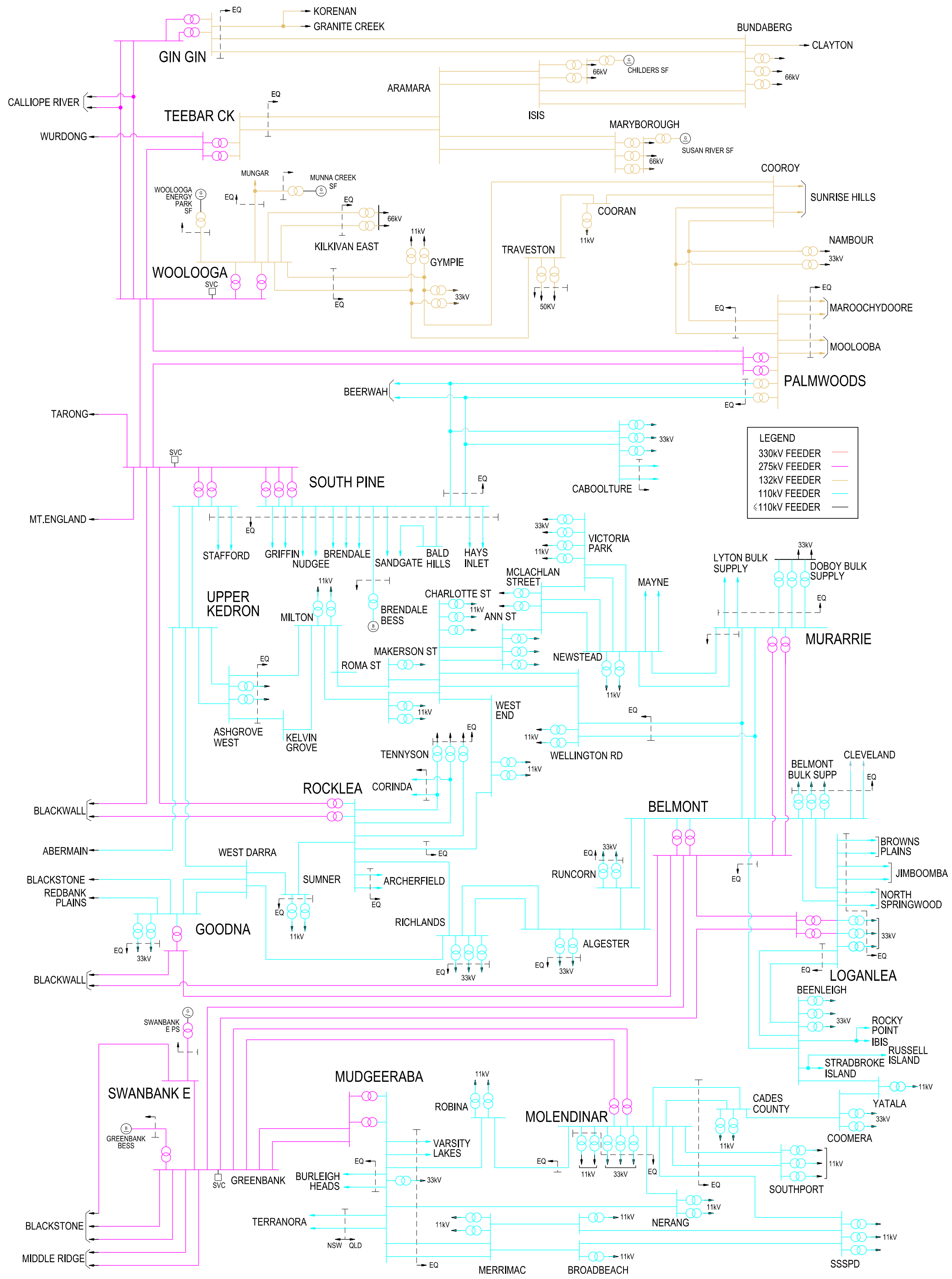


Figure 6.6 Existing HV network, July 2025 – South East Queensland



6.5 Transfer capability

6.5.1 Location of grid sections

Powerlink defines a number of grid sections on the main transmission system. The grid sections are used to measure power transfer between zones (refer to Figure G.1 of Appendix G) and define the maximum secure power transfer capability between zones. This allows the assessment of network capability and to forecast limitations in a structured manner.

The maximum power transfer capability for these sections may be determined by factors such as transient stability, voltage stability, thermal plant ratings, or protection relay load limits. Powerlink develops and maintains limit equations for these grid sections to quantify maximum secure power transfer. AEMO then incorporates these limit equations into constraint equations within the National Electricity Market Dispatch Engine (NEMDE). Table G.2 and Figure G.1 in Appendix G define and illustrate the location of relevant grid sections on the Queensland network.

6.5.2 Determining transfer capability

Transfer capability across each grid section varies with different system operating conditions. Transfer limits in the National Electricity Market (NEM) cannot generally be expressed as a single number. Instead, Transmission Network Service Providers (TNSPs) define the capability of their network using multi-term equations that define the relationship between system operating conditions and allowable flows.

These equations are implemented into NEMDE, following AEMO's due diligence, to ensure secure and optimal dispatch of generation. In Queensland, the transfer capability is highly dependent on which generators are in-service and their dispatch level. The limit equations maximise transmission capability available to electricity market participants under prevailing system conditions.

Limit equations derived by Powerlink are provided in Appendix H. These limit equations are current at the time of publication of this TAPR but will change over time with demand, generation and network development, and/or network reconfiguration. For example, the commissioning of the third 275kV circuit into Cairns in late 2023 triggered an update to the FNQ grid section voltage stability equation. Expected limit improvements for committed works are incorporated in all future planning.

6.6 Grid section performance

This section provides a summary of the changing flows on key grid sections within the Queensland network, along with system conditions that significantly affect their transfer capability. Grid section transfers are affected by load, generation and transfers to neighbouring zones. Historical transfer duration curves for the past five years are included for each grid section.

In addition to grid section transfer duration curves, data is provided on how often the associated constraint equations have bound over the past decade. These are categorised as occurring during intact or outage conditions, based on AEMO's constraint description.

Constraint times typically occur when constraint equations bind due to generator unavailability, network outages, unfavourable dispatches and/or high loads. Occurrences associated with network support agreements are excluded, as binding constraints whilst network support is dispatched are not classed as market congestion. While high constraint times do not directly indicate market cost impact, they provide a key signal for assessing the economics for relieving congestion.

Figures 6.7 and 6.8 provide 2023/24 and 2024/25 zonal energy flows. This includes transmission connected generation, major embedded generators, transmission delivered energy to Distribution Network Service Providers (DNSPs) and direct connect customers as well as energy transfers for each grid section. Figure 6.9 shows the changes in energy transfers from 2023/24 to 2024/25. These figures assist in the explanation of differences between grid section transfer duration curves over the last two years. A breakdown of transmission connected generation by generation type and zone is provided in Table G.3 in Appendix G.

Figure 6.7 2023/24 zonal electricity transfers (GWh)

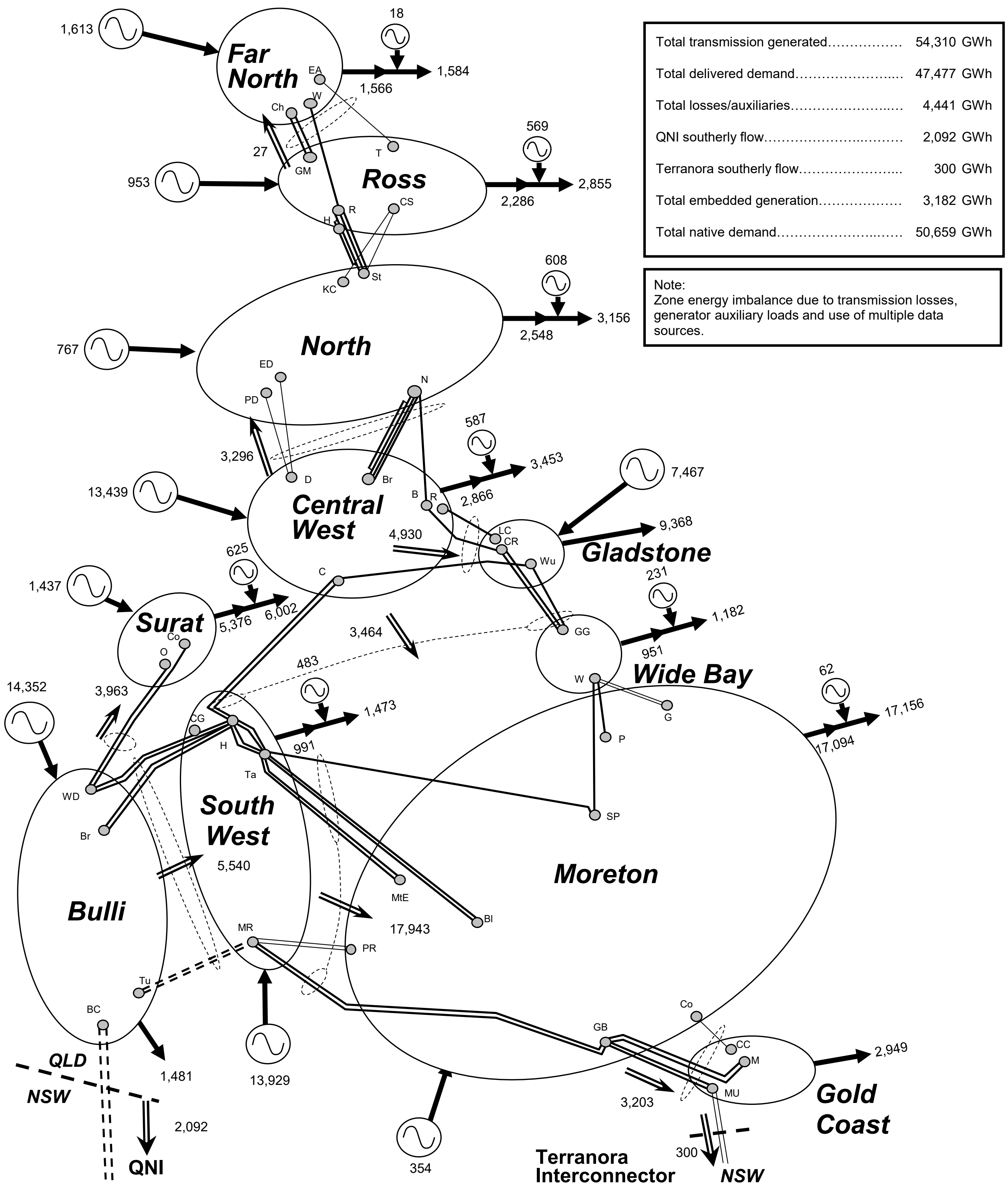


Figure 6.8 2024/25 zonal electricity transfers (GWh)

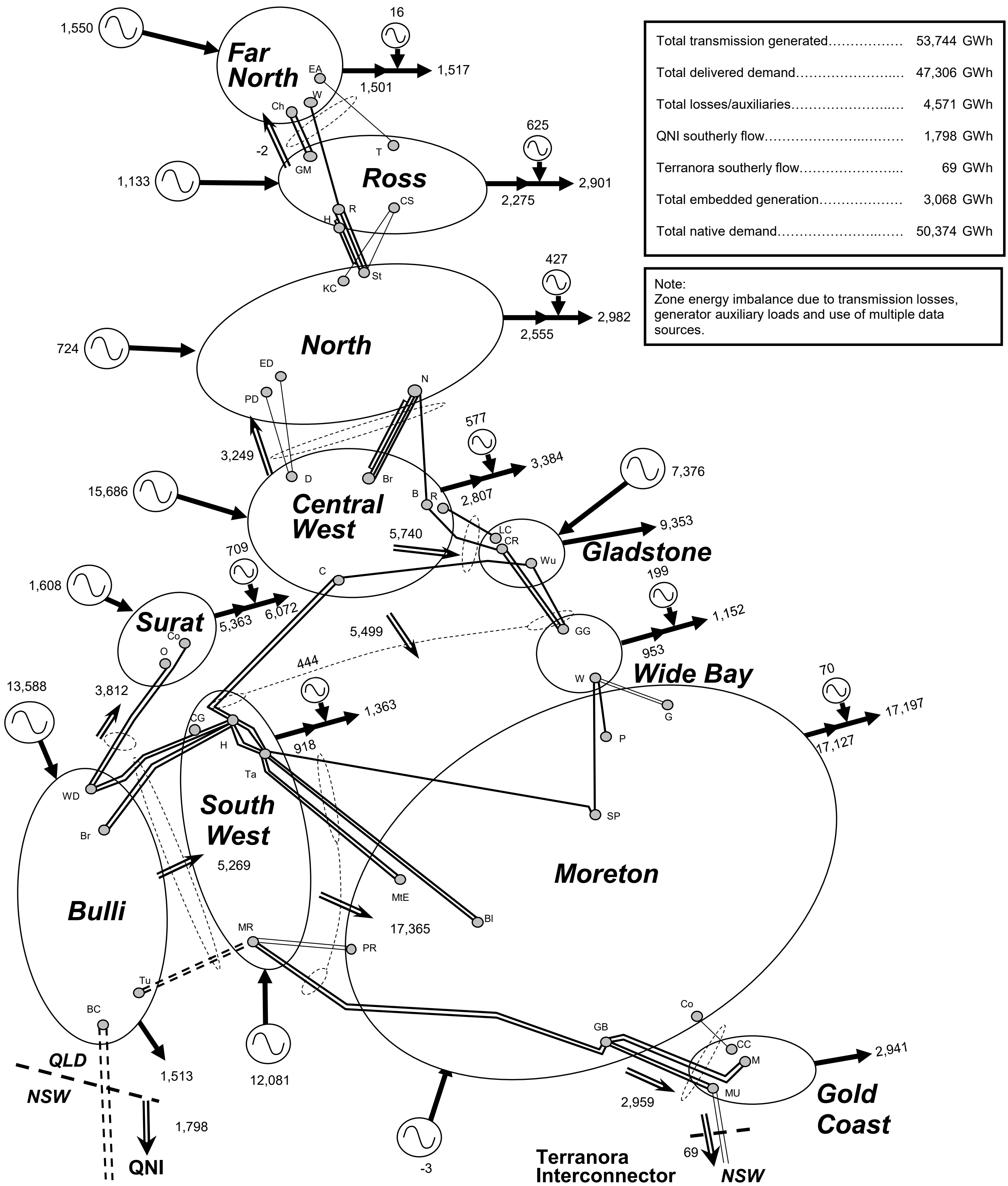
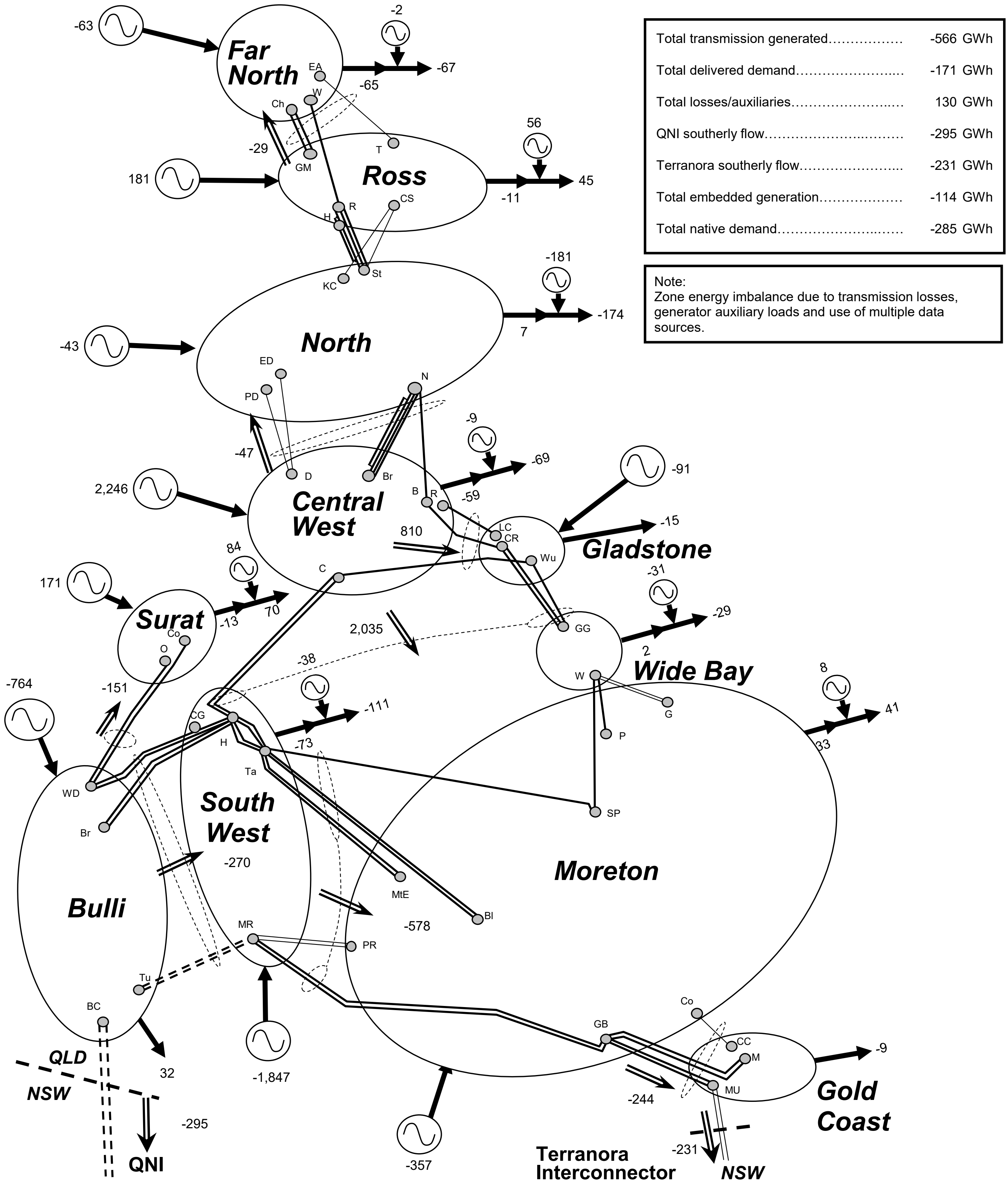


Figure 6.9 Change in zonal electrical energy transfers from 2023/24 to 2024/25 (GWh)



6.6.1 Far North Queensland grid section

The maximum power transfer across the FNQ grid section is set by the voltage stability limit associated with an outage of the Ross to Woree tee Tully South 275kV circuit.

The limit equation in Table H.1 of Appendix H shows that the following variables have a significant effect on transfer capability:

- Far North zone generation
- Far North zone shunt compensation levels.

Local (run of river) hydro-electric and wind generation reduces transfer capability but allows more demand to be securely supported in the Far North zone. This is because reactive margins increase with additional local generation, allowing further load to be delivered before reaching minimum allowable reactive margins.

However, the additional load cannot be increased by the same amount of the additional local generation due to the reactive load component and increased reactive losses from the distributed nature of the load. As a result, limiting power transfers are lower with the increased local generation, but a greater load can be supplied.

The FNQ grid section was unconstrained in 2024/25. The historical duration of constrained operation for the FNQ grid section is summarised in Figure 6.10.

Figure 6.10 Historical FNQ grid section constraint times

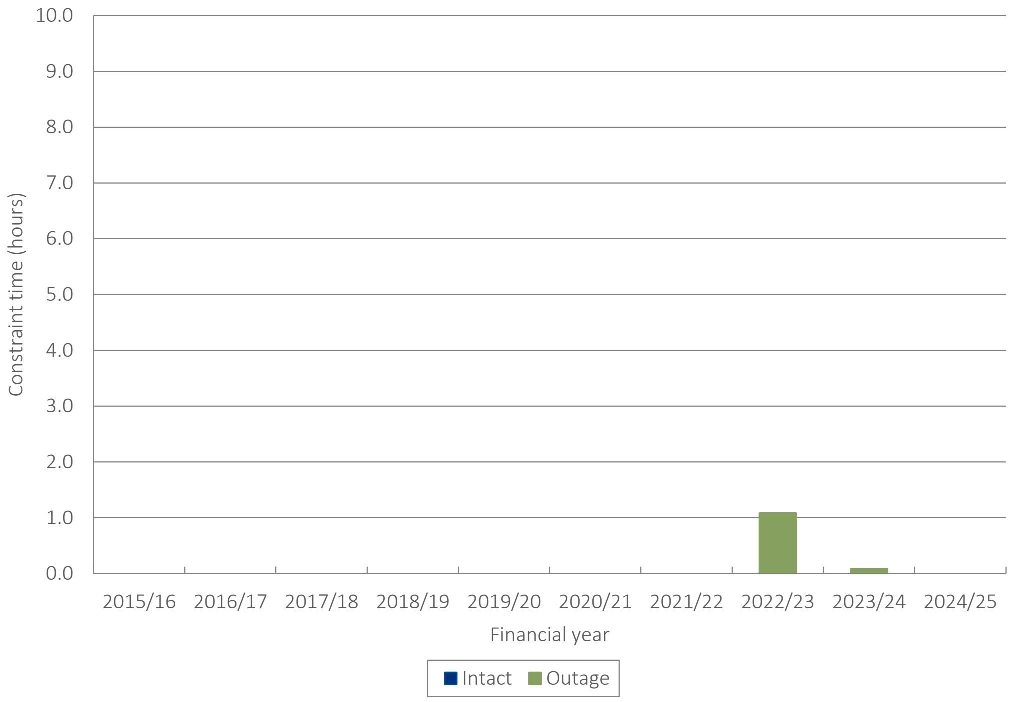
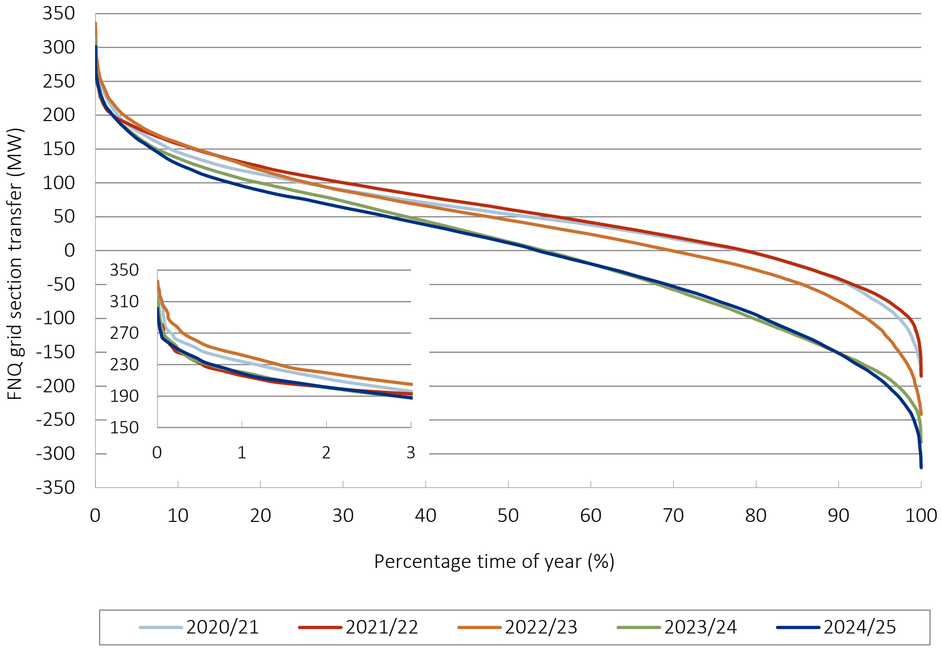


Figure 6.11 provides historical transfer duration curves for the FNQ grid section. The continued increase in generation in the Far North zone has resulted in the zone becoming a net exporter of energy for the first time in 2024/25 (refer to figures 6.7 to 6.9).

Figure 6.11 Historical FNQ grid section transfer duration curves



Note:

(1) Inset figure magnifies top of the curve in main figure.

6.6.2 Central Queensland to North Queensland grid section

The maximum power transfer across the Central Queensland to North Queensland (CQ-NQ) grid section can be set by thermal ratings associated with an outage of a Stanwell to Broadsound 275kV circuit. Power transfers may also be constrained by voltage stability limitations associated with the contingency of the Townsville gas turbine or a Stanwell to Broadsound 275kV circuit.

The limit equations in Table H.2 of Appendix H show that the following variables have a significant effect on transfer capability:

- level of Townsville gas turbine generation
- Ross and North zones shunt compensation levels.

The CQ-NQ grid section was unconstrained in 2024/25. The historical duration of constrained operation for the CQ-NQ grid section is summarised in Figure 6.12.

Figure 6.12 Historical CQ-NQ grid section constraint times

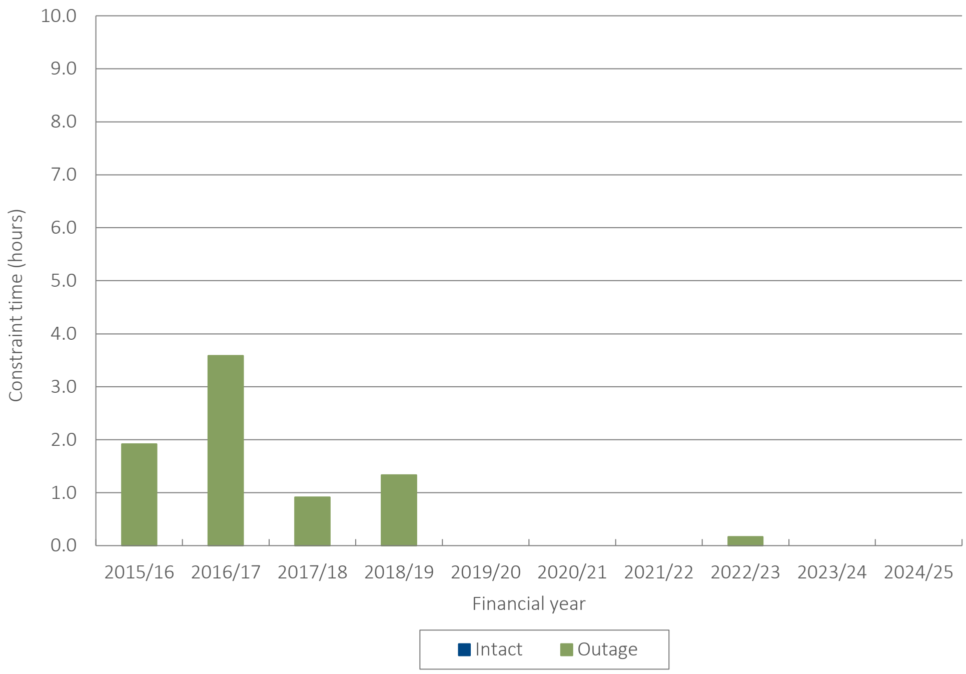
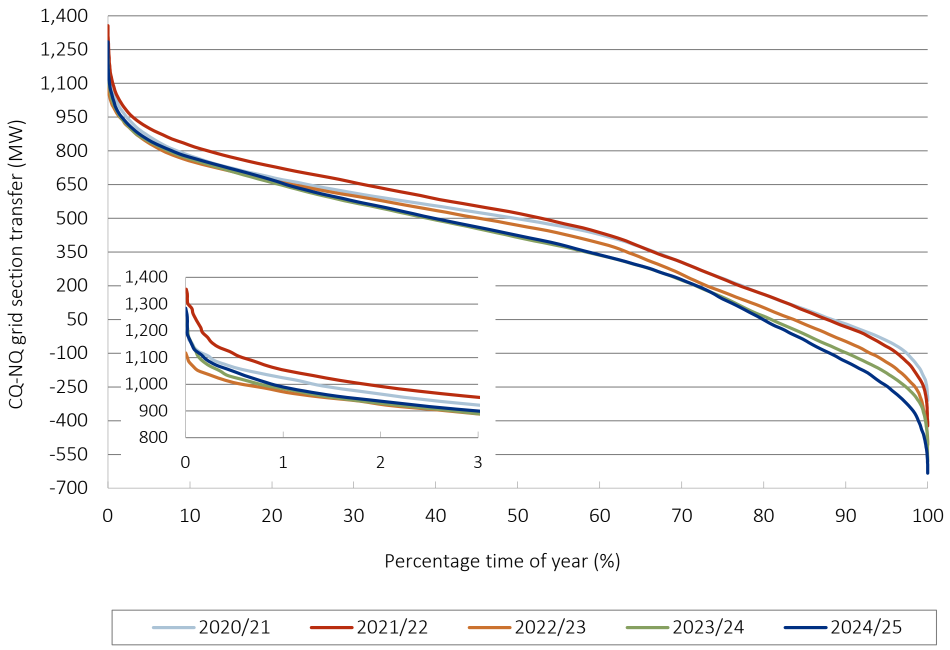


Figure 6.13 provides historical transfer duration curves showing decreases in energy transfer over recent years. This decrease is predominantly attributed to the addition of renewable generation in the Far North, Ross and North zones. Despite reductions in total energy transfer, the peak power transfer in 2024/25 is close to previous years.

Figure 6.13 Historical CQ-NQ grid section transfer duration curves

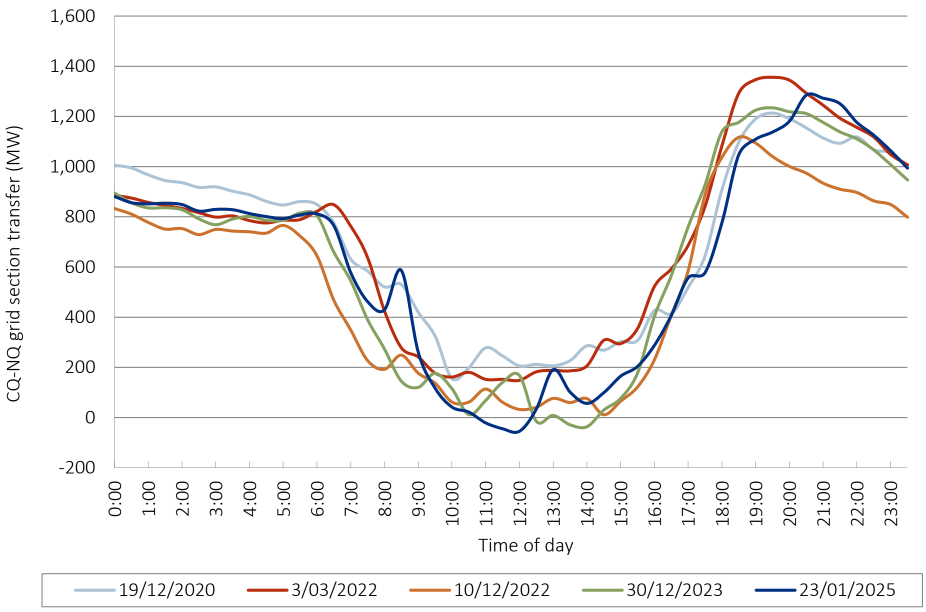


Note:

(1) Inset figure magnifies top of the curve in main figure.

Figure 6.14 provides a different view of the altered power flows experienced over the last five years for the day corresponding to the annual peak CQ-NQ transfer. This shows the impact of solar generation creating minimum demands and network transfers during the middle of the day.

Figure 6.14 Historical CQ-NQ peak grid section transfer daily profile



6.6.3 North Queensland system strength

System strength is typically low in areas with limited synchronous generation, and deteriorates further with high penetration of inverter-based resources (IBR)[10].

Powerlink has determined that the dominant limitation to IBR hosting capacity is the potential for multiple generators, and other transmission connected dynamic plant, to interact in an unstable manner. These dynamic plant control interactions manifest as an unstable or undamped oscillation in the power system voltage. The frequency of the oscillation is dependent on the participating plants but is broadly characterised between 8Hz and 15Hz.

North Queensland's limited synchronous generation and high number of IBR generators, combined with relatively low synchronous fault levels, has made it the focus of system strength limitation in Queensland.

Powerlink has performed Electromagnetic Transient (EMT) analysis to determine the system conditions that could result in unstable operation of IBR plant. The limit equations in Table H.3 of Appendix H reflect the output of this analysis. The limit equations show that the following variables have a significant effect on North Queensland system strength:

- number of synchronous units online in Central and North Queensland
- North Queensland demand
- status of existing synchronous condensers.

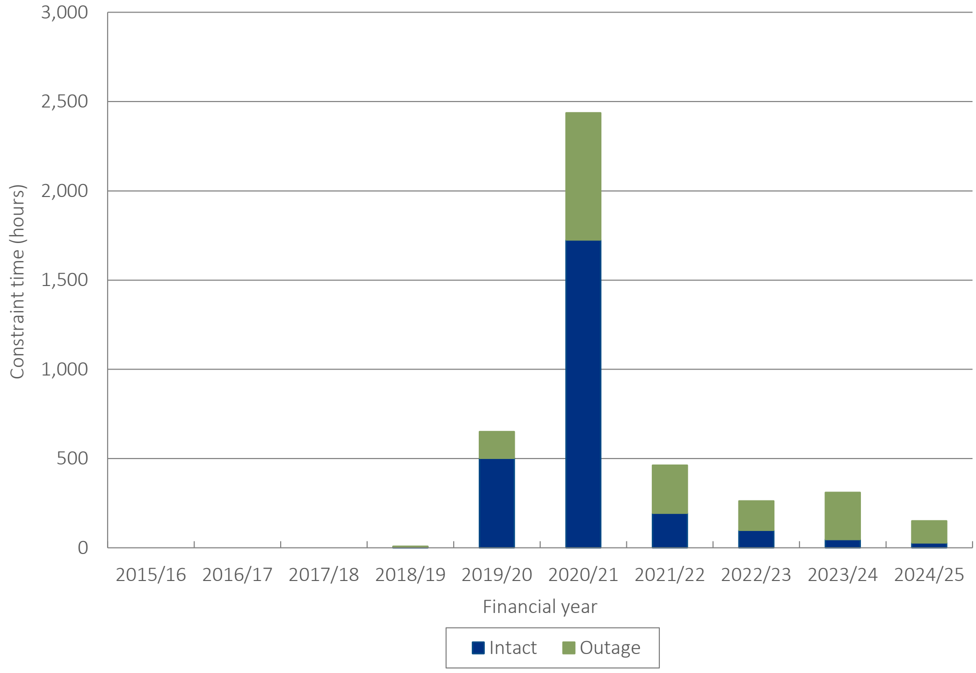
The historical duration of constrained operation for IBR in North Queensland is summarised in Figure 6.15. During 2024/25, IBR in North Queensland experienced 150 hours of constrained operation, of which 123 hours occurred during outage conditions. This is a reduction of approximately 50% compared with the 2023/24 total constraint time.

Powerlink has entered into a System Strength Services Agreement with the owner of the Townsville Power Station to enable modifications to allow the facility to operate in synchronous condenser mode and provide system strength services.

The FNQ System Strength WAMPAC scheme will soon be in service to further reduce the constraint time during outage conditions. This scheme allows IBR to operate at higher levels than were previously allowed when feeders in North Queensland were out of service for maintenance.

10 Refer to Chapter 3 for further discussion of system strength.

Figure 6.15 Historical NQ system strength constraint times



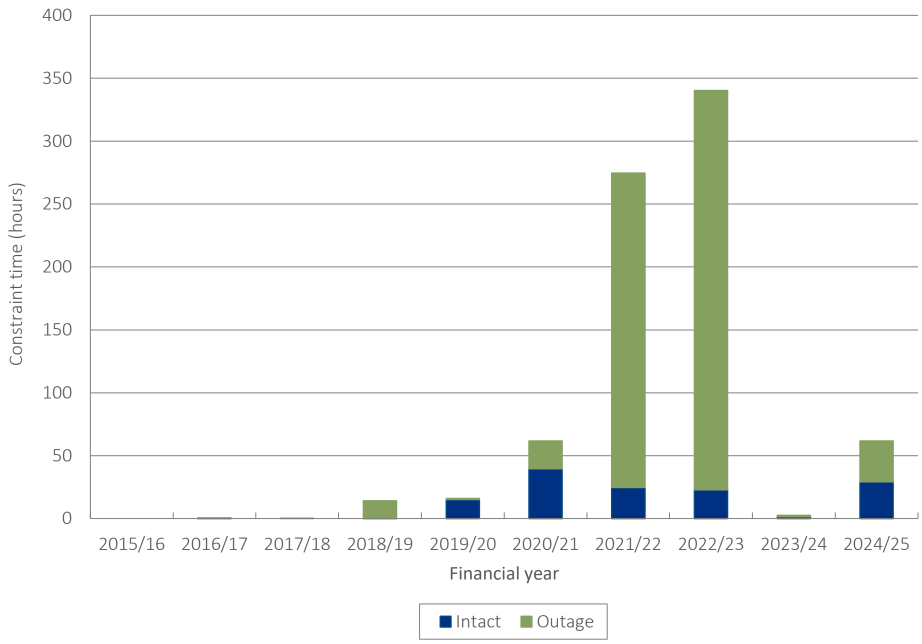
6.6.4 Gladstone grid section

The maximum power transfer across the Gladstone grid section is set by the thermal rating of the Bouldercombe to Raglan, Larcom Creek to Calliope River, Bouldercombe to Calliope River, Calvale to Wurdong or the Calliope River to Wurdong 275kV circuits.

If the rating would otherwise be exceeded following a critical contingency, generation is constrained to reduce power transfers. Powerlink uses dynamic line ratings to assess circuit capacity based on prevailing ambient weather conditions, thereby maximising the available capacity of this grid section and, as a result, reducing market impacts. The appropriate ratings are updated in NEMDE.

The historical duration of constrained operation for the Gladstone grid section is summarised in Figure 6.16. During 2024/25, the Gladstone grid section experienced 54 hours of constrained operation, with approximately half of this time occurring during intact system conditions. These periods of constrained operation coincided with high flows between Central and Southern Queensland.

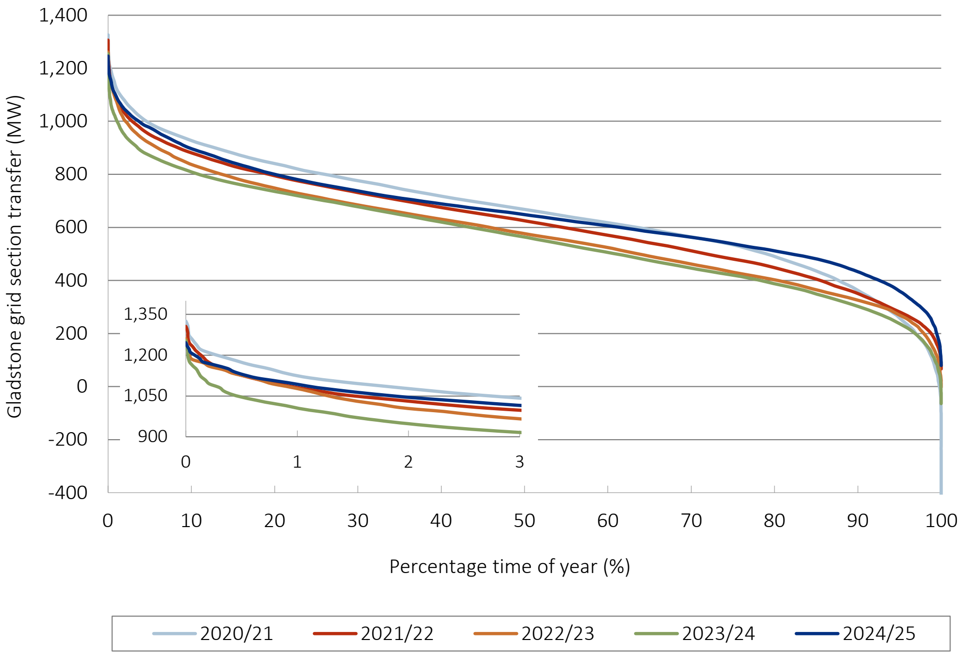
Figure 6.16 Historical Gladstone grid section constraint times



Power flows across this grid section are highly dependent on the balance of generation and demand in Gladstone and transfers between Central Queensland and Southern Queensland. Figure 6.17 provides historical transfer duration curves showing higher average utilisation in 2024/25 compared to the previous two years. This increase in flows is due to a slight decrease in generation in the Gladstone zone and increase in flows between Central Queensland and Southern Queensland (refer to figures 6.7 to 6.9).

Powerlink has developed a strategy to increase the capacity of the Gladstone grid section as the generation and demand balance in the Gladstone zone changes (refer to discussion of the Gladstone Project in Section 5.6.2).

Figure 6.17 Historical Gladstone grid section transfer duration curves



6.6.5 Central Queensland to Southern Queensland grid section

The maximum power transfer across the CQ-SQ grid section is set by transient or voltage stability limitations following a Calvale to Halys 275kV circuit contingency.

The voltage stability limit is set by insufficient reactive power reserves in the Central West and Gladstone zones following a contingency. More generating units online in these zones increase reactive power support and therefore transfer capability.

The limit equation in Table H.4 of Appendix H shows that the following variables have significant effect on transfer capability:

- number of generating units online in the Central West and Gladstone zones
- level of Gladstone Power Station generation.

The historical duration of constrained operation for the CQ-SQ grid section is summarised in Figure 6.18. During 2024/25, the CQ-SQ grid section experienced 20 hours of constrained operation, with approximately half of this time occurring during outage conditions. This is considerably less than previous years primarily due to fewer planned outages on these circuits between Gladstone and Moreton zones.

Figure 6.18 Historical CQ-SQ grid section constraint times

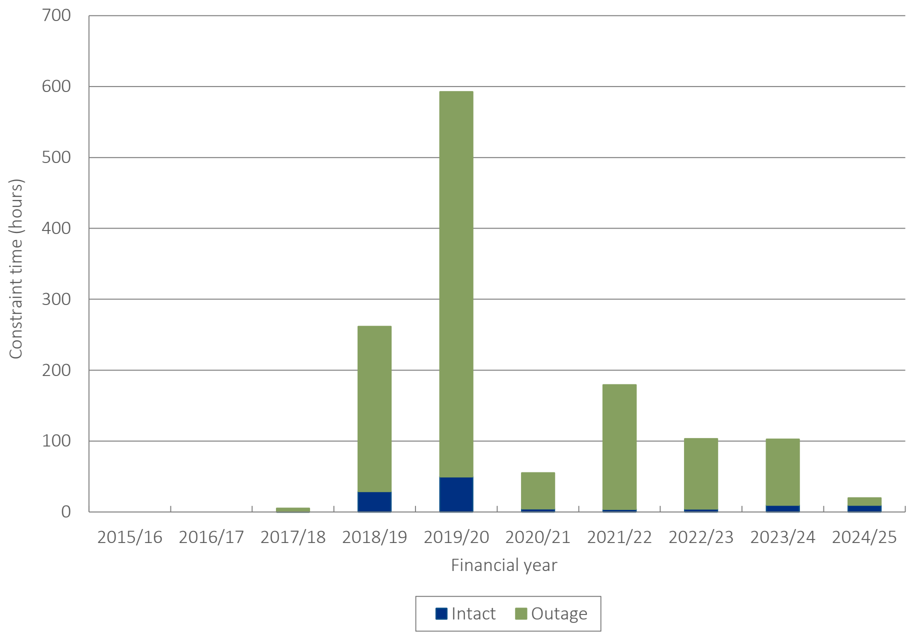
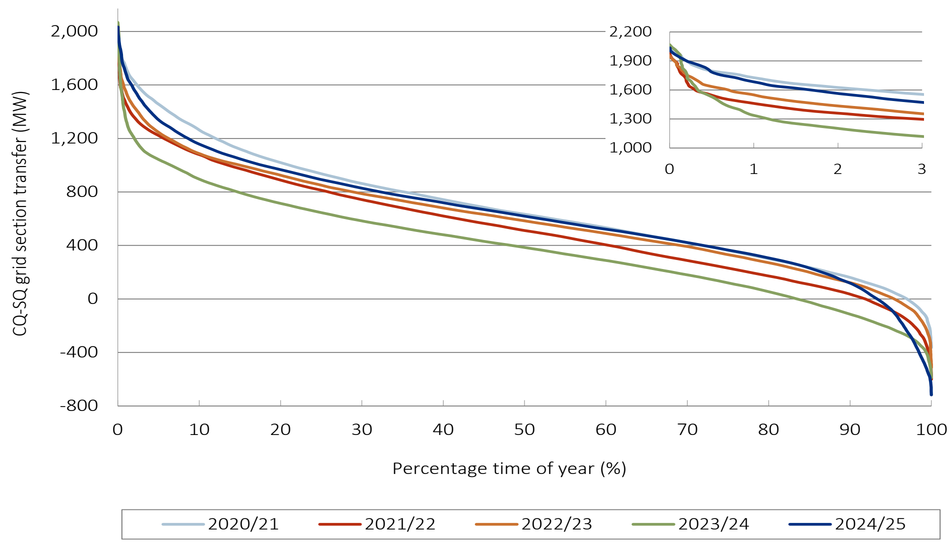


Figure 6.19 provides historical transfer duration curves showing the transfers over the last five years. In the 2024/25 year there was an increase in output from generation in central Queensland largely driven by the return to service of Callide C units. This resulted in the CQ-SQ grid section flows returning to typical historical levels (refer to figures 6.7 to 6.9).

Figure 6.19 Historical CQ-SQ grid section duration curves



Note:

(1) Inset figure magnifies top of the curve in main figure.

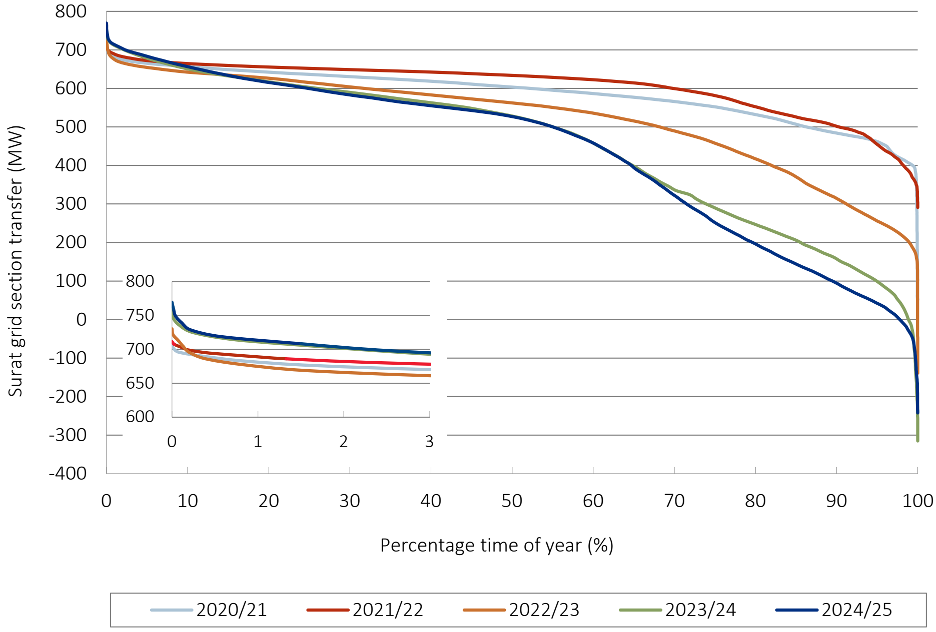
6.6.6 Surat grid section

The maximum power transfer across the Surat grid section is set by the voltage stability associated with insufficient reactive power reserves in the Surat zone following an outage of a Western Downs to Orana 275kV circuit[11]. More generating units online in the zone increases reactive power support and therefore transfer capability. Local generation reduces transfer capability but allows more demand to be securely supported in the Surat zone. There have been no constraints recorded over the history of the Surat grid section.

Figure 6.20 provides the transfer duration curves for the last five years. Energy transfers have reduced in the last year due to the increased output of the solar and wind farms in the Surat zone.

[11] The Orana Substation is connected to one of the Western Downs to Columboola 275kV transmission lines (refer to Figure 6.5).

Figure 6.20 Historical Surat grid section transfer duration curve



Note:

(1) Inset figure magnifies top of the curve in main figure.

6.6.7 South West Queensland grid section

The South West Queensland (SWQ) grid section defines the capability of the transmission network to transfer power from generating stations located in the Bulli zone and northerly flow on QNI to the rest of Queensland. The thermal rating of the Middle Ridge 330/275kV transformer sets maximum power transfer across the SWQ grid section.

The SWQ grid section was unconstrained in 2024/25. The historical duration of constrained operation for the SWQ grid section is summarised in Figure 6.21.

Figure 6.21 Historical South West Queensland grid section constraint times

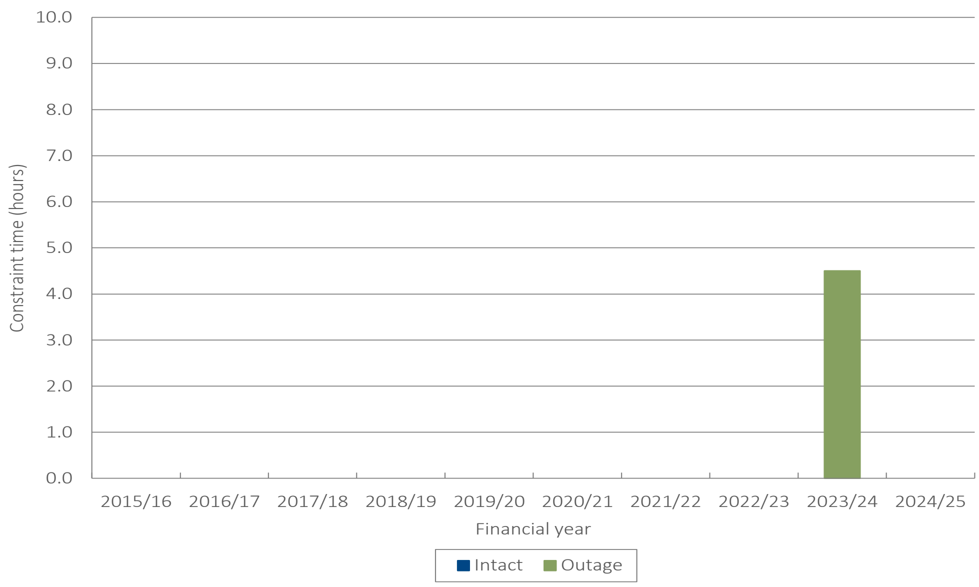
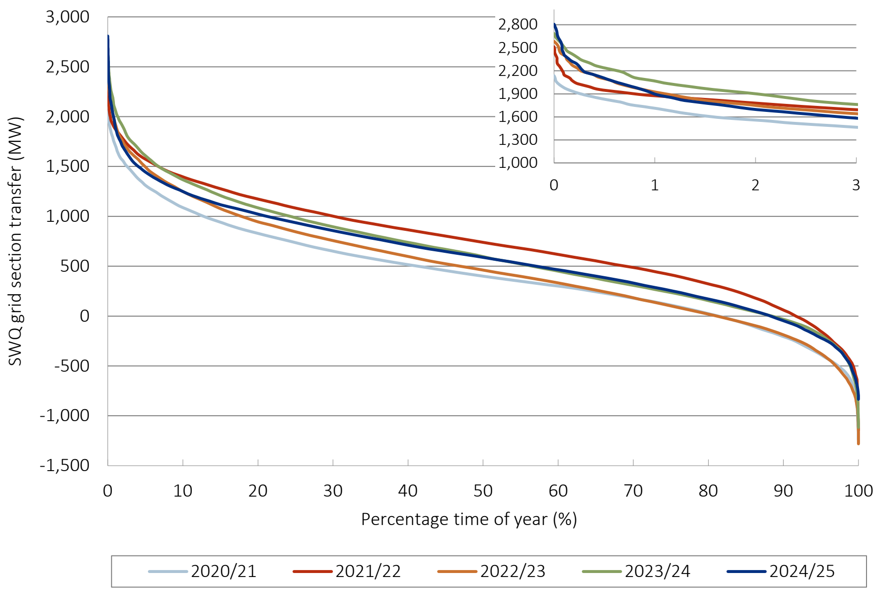


Figure 6.22 provides historical transfer duration curves for the SWQ grid section. Flows in 2024/25 are largely the same as 2023/24 (refer to figures 6.7 to 6.9).

Figure 6.22 Historical SWQ grid section transfer duration curves



Note:

(1) Inset figure magnifies top of the curve in main figure.

AEMO's 2024 ISP identified the Darling Downs Renewable Energy Zone Expansion as a future ISP project. This project involves an upgrade to the transformer capacity at Middle Ridge Substation. The ISP identified that this increase in capacity would not be required before 2034/35[12] in the Step Change scenario.

6.6.8 Tarong grid section

The maximum power transfer across the Tarong grid section is set by the voltage stability associated with the loss of a Calvale to Halys 275kV circuit or a Tarong to Blackwall 275kV circuit. The limitation arises from insufficient reactive power reserves in Southern Queensland.

Limit equations in Table H.5 of Appendix H show that the following variables have a significant effect on transfer capability:

- QNI transfer and South West and Bulli zones generation
- level of Moreton zone generation
- Moreton and Gold Coast zones capacitive compensation levels.

Any increase in generation west of this grid section, with a corresponding reduction in generation north of the grid section, reduces the CQ-SQ power flow and increases the Tarong limit.

Increasing generation east of the grid section reduces the transfer capability, but increases the overall amount of supportable south-east Queensland demand. The additional load cannot be increased by the same amount of the additional generation east of the grid section due to the reactive load component and increased reactive losses from the distributed nature of the load. As a result, limiting power transfers are lower with the increased local generation, but a greater load can be supplied.

The historical duration of constrained operation for the Tarong grid section is summarised in Figure 6.23. During 2024/25, the Tarong grid section experienced almost 3 hours of constrained operation, mostly during intact system conditions. Most of this constrained operation occurred on a single day with unusual market conditions.

[12] AEMO, 2024 Integrated System Plan, June 2024, page 64.

Figure 6.23 Historical Tarong grid section constraint times

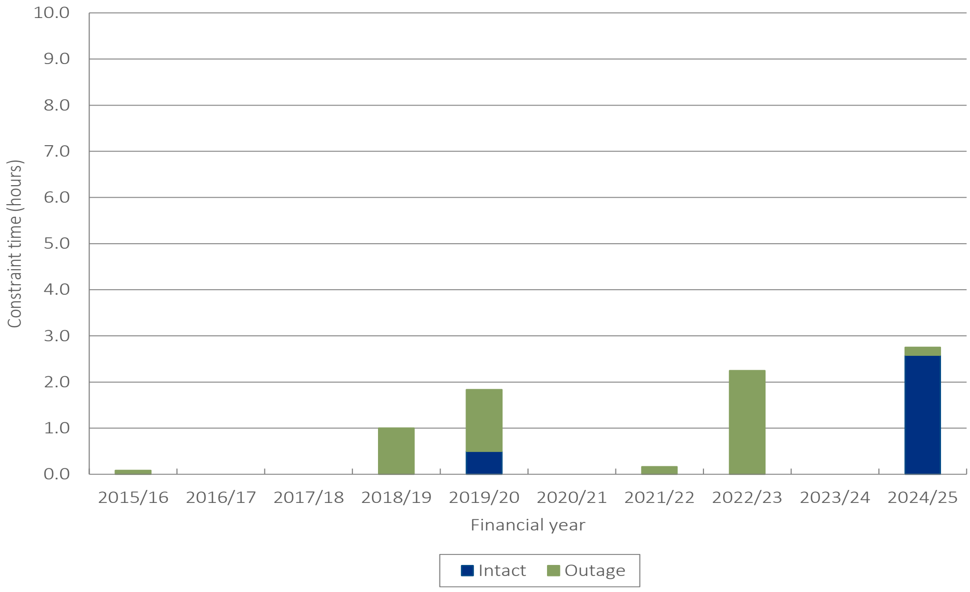
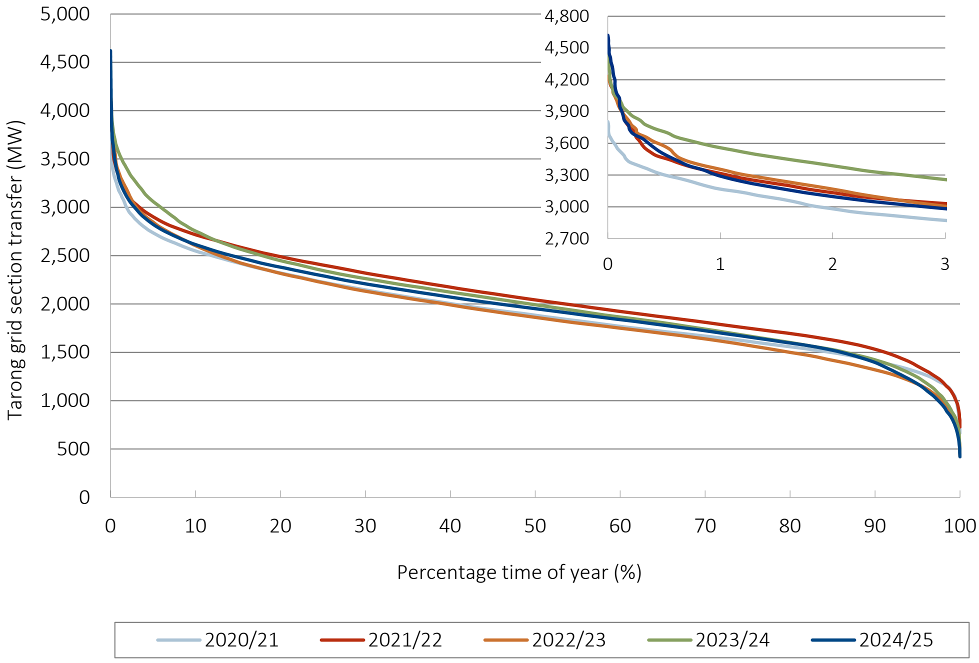


Figure 6.24 provides historical transfer duration curves for the Tarong grid section. There has been a small decrease in Tarong grid section flows this year compared with 2023/24 but they remain similar to historical flows (refer to figures 6.7 to 6.9).

Figure 6.24 Historical Tarong grid section transfer duration curves



Note:

(1) Inset figure magnifies top of the curve in main figure.

6.6.9 Gold Coast grid section

Maximum power transfer across the Gold Coast grid section is set by voltage stability associated with the loss of a Greenbank to Molendinar 275kV circuit, or a Greenbank to Mudgeeraba 275kV circuit.

The limit equation in Table H.6 of Appendix H shows that the following variables have a significant effect on transfer capability:

- number of generating units online in Moreton zone
- level of Terranora Interconnector transmission line transfer
- Moreton and Gold Coast zones capacitive compensation levels
- Moreton zone to the Gold Coast zone demand ratio.

Reducing southerly flow on Terranora Interconnector reduces transfer capability but increases the overall amount of supportable Gold Coast demand. This is because reactive margins increase with reductions in southerly Terranora Interconnector flow, allowing further load to be delivered before reaching minimum allowable reactive margins. The additional load cannot be increased by the same amount of the reductions in southerly Terranora Interconnector flow due to the reactive load component and increased reactive losses from the distributed nature of the load. As a result, limiting power transfers are lower with reduced Terranora Interconnector southerly transfer, but a greater load can be supplied.

The Gold Coast grid section was unconstrained in 2024/25. The historical duration of constrained operation for the Gold Coast grid section is summarised in Figure 6.25.

Figure 6.25 Historical Gold Coast grid section constraint times

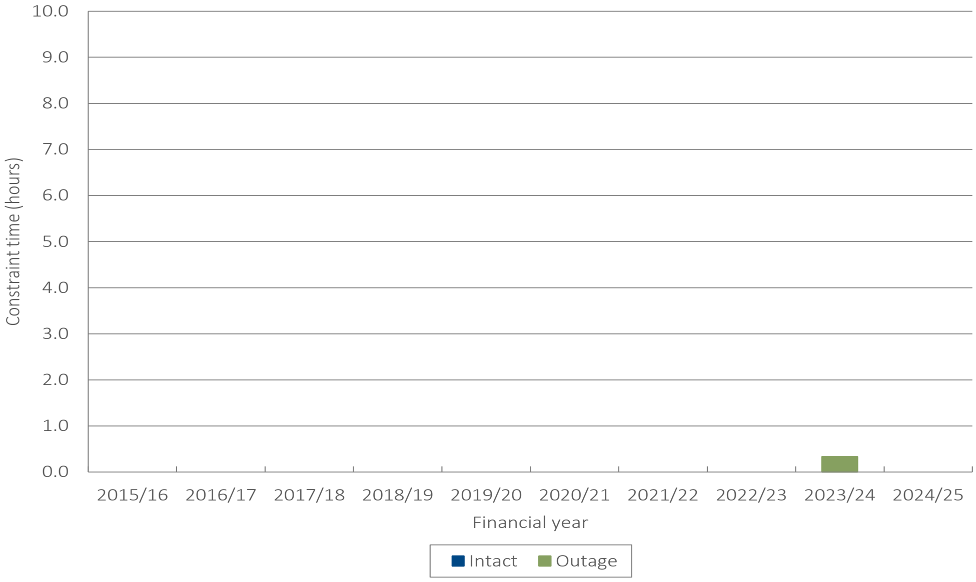
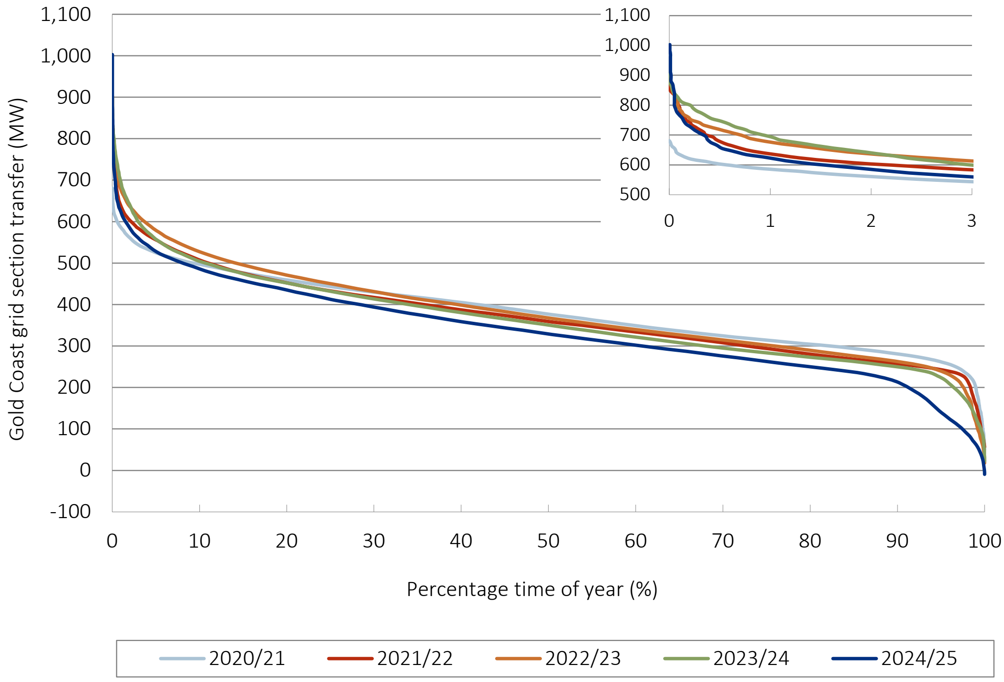


Figure 6.26 provides historical transfer duration curves showing changes in grid section transfer demands and energy are in line with changes in transfer to northern New South Wales (NSW) and changes in Gold Coast loads (refer to figures 6.7 to 6.9). The overall lower flows to the Gold Coast were predominantly the result of lower southerly flows on the Terranora Interconnector.

Figure 6.26 Historical Gold Coast grid section transfer duration curves



Note:
(1) Inset figure magnifies top of the curve in main figure.

6.6.10 QNI and Terranora Interconnector

The transfer capability across QNI is limited by voltage stability, transient stability, oscillatory stability and thermal rating considerations. The capability across QNI at any time is dependent on a number of factors, including demand levels, generation dispatch, status and availability of transmission equipment and operating conditions of the network.

AEMO publishes Monthly Constraint Reports which include a section examining each of the NEM interconnectors, including QNI and Terranora Interconnector. Information pertaining to the historical duration of constrained operation for QNI and Terranora Interconnector is available in these reports, which can be found on AEMO's website.

For intact system operation, the southerly transfer capability of QNI is most likely to be set by the following:

- voltage stability associated with a fault on the Sapphire to Armidale 330kV transmission line in NSW
- thermal capacity of the 330kV transmission network between Dumaresq and Liddell in NSW.

For intact system operation, the combined northerly transfer capability of QNI and Terranora Interconnector is most likely to be set by the following:

- transient and voltage stability associated with transmission line faults in NSW
- transient and voltage stability associated with loss of the largest generating unit in Queensland
- thermal capacity of the 330kV and 132kV transmission network within northern NSW.

The QNI Minor project is now complete and internetwork testing activities, as required by clause 5.7.7 of the NER, are in the final stages, resulting in increased capacity in both north and south flows.

AEMO's 2024 ISP considered the QNI Connect project that would increase transfer capacity between Queensland and NSW. This project has been deemed an actionable project and Powerlink is working with Transgrid to undertake the Regulatory Investment Test for Transmission (RIT-T) process (refer to Section 7.8)[13].

6.7 Zone performance

This section presents, where applicable, a summary of:

- the capability of the transmission network to deliver loads
- historical zonal transmission delivered loads
- intra-zonal system normal constraints
- double circuit transmission lines categorised as vulnerable by AEMO[14]
- Powerlink's management of high voltages associated with light load conditions.

Double circuit transmission lines that experience a lightning trip of all phases of both circuits (where its magnitude or degree is not considered an Exceptional Event[15]) are categorised by AEMO as vulnerable. A double circuit transmission line in the vulnerable list is eligible to be reclassified as a credible contingency event during a lightning storm if a cloud to ground lightning strike is detected close to the line. A double circuit transmission line will remain on the vulnerable list until it is demonstrated that the asset characteristics have been improved to make the likelihood of a double circuit lightning trip no longer reasonably likely to occur or until the Lightning Trip Time Window (LTTW) expires from the last double circuit lightning trip. The LTTW is three years for a single double circuit trip event or five years where multiple double circuit trip events have occurred during the LTTW.

Statewide delivered energy has reduced slightly from 2023/24 to 2024/25. However, many zones observed a widening of the demand spread with either record maximum demand or record minimum demand (both in some cases). This is a trend that has continued from recent years driven by the growth of rooftop solar PV. As at 30 June 2025 there was approximately 7,200MW of rooftop solar PV generating capacity in the state, an increase of 806MW over the year[16].

This year saw a return to service of the Callide C4 unit which resulted in a large increase in energy generation in the Central West zone. There was a corresponding drop in energy generation in the Bulli and South West zones (refer to figures 6.7 to 6.9).

The following sections show load duration curves for each zone[17].

13 AEMO, 2024 Integrated System Plan, June 2024, page 63. The ISP states the Project Assessment Draft Report for the project is due by 25 June 2026.

14 AEMO, List of Vulnerable Transmission Lines, effective April 2025.

15 An Exceptional Event is defined in AEMO's Power System Security Guidelines (SO_OP_3715) as a simultaneous trip of a double circuit transmission line during a lightning storm caused by an event that is far beyond what is usual in magnitude or degree for what could be reasonably expected to occur during a lightning storm.

16 Clean Energy Regulator, Small-scale Installation Postcode Data.

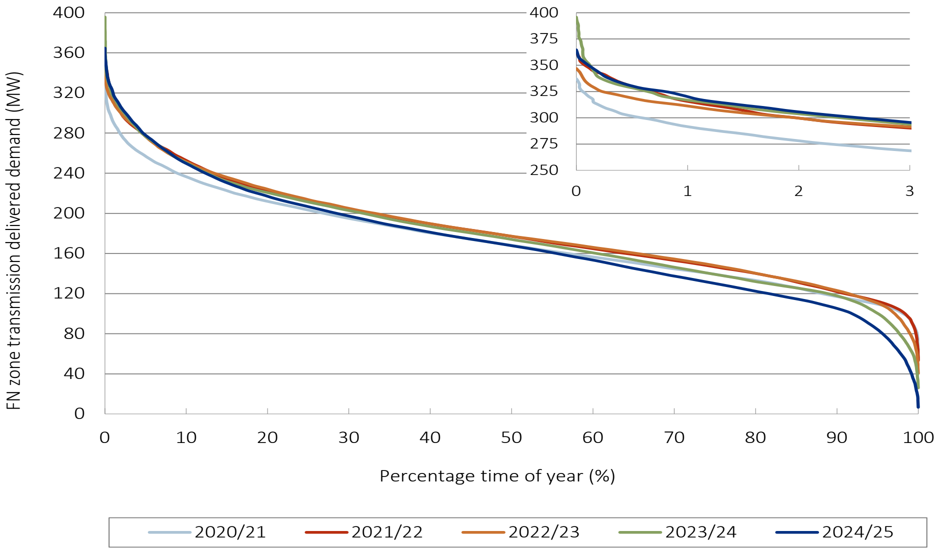
17 Refer to figures 2.17 to 2.19 for annual transmission delivered demand load duration curves for the Queensland region as a whole.

6.7.1 Far North zone

The Far North zone experienced no load loss for a single network element outage during 2024/25. The zone includes the non-scheduled embedded generator, Lakeland Solar and Storage[18], which provided 16GWh during 2024/25.

Figure 6.27 provides historical transmission delivered load duration curves for the Far North zone. Energy delivered from the transmission network has reduced by 4.1% between 2023/24 and 2024/25. The maximum transmission delivered demand in the zone was 365MW, lower than the record set the previous year. The minimum transmission delivered demand in the zone was 7MW, which is the lowest minimum demand on record.

Figure 6.27 Historical Far North zone transmission delivered load duration curves



Note:

(1) Inset figure magnifies top of the curve in main figure.

As a result of double circuit outages associated with lightning strikes, AEMO includes the following double circuits in the Far North zone in the vulnerable list:

- Chalumbin to Turkinje 132kV double circuit transmission line, which tripped in November 2022 and again in January 2025
- Ross to Woree tee Tully South 275kV circuit and Cardwell to Tully 132kV circuit, last tripped in February 2024. These lines share the same transmission towers
- Kamerunga to Barron Gorge Power Station 132kV double circuit transmission line, last tripped in December 2024.

6.7.2 Ross zone

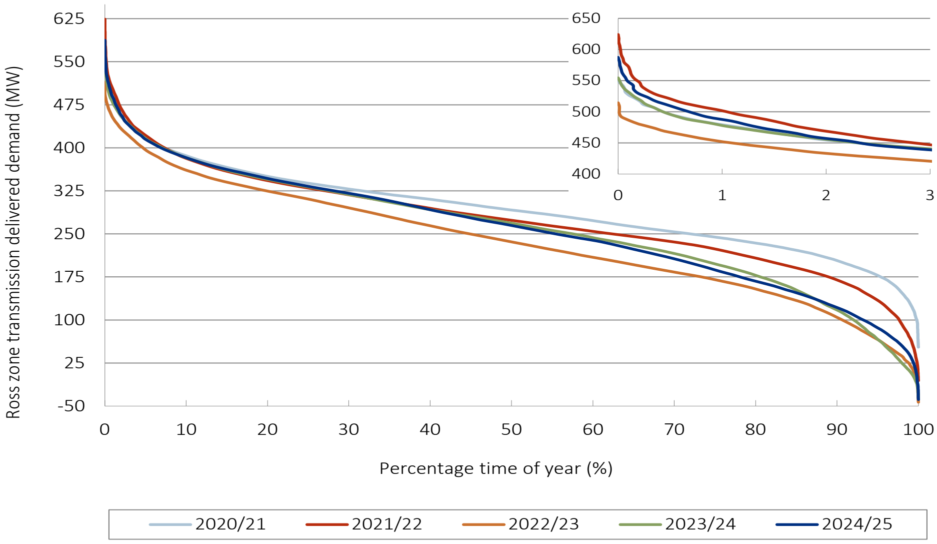
The Ross zone experienced no load loss for a single network element outage during 2024/25.

The Ross zone includes several embedded generators: the scheduled 66kV steam turbine component of the Townsville Power Station (part of a closed-cycle gas turbine system); the semi-scheduled, distribution-connected Kidston Solar Farm, Kennedy Energy Park, and Sun Metals Solar Farm (direct connected); and significant non-scheduled generators such as Hughenden Solar Farm and Pioneer Mill[19]. These embedded generators provided 625GWh during 2024/25.

Figure 6.28 provides historical transmission delivered load duration curves for the Ross zone. Energy delivered from the transmission network has reduced by 0.5% between 2023/24 and 2024/25. Native load in the zone increased but this was offset by the increase in embedded generation. The peak transmission delivered demand in the zone was 587MW, which is lower than the maximum demand over the last five years of 624MW set in 2021/22. The minimum transmission delivered demand in the zone was 39MW, which is the slightly higher than the record minimum set in 2022/23.

[18] Refer to Figure 2.10 for load measurement definitions.
[19] Refer to Figure 2.10 for load measurement definitions.

Figure 6.28 Historical Ross zone transmission delivered load duration curves



Note:

(1) Inset figure magnifies top of the curve in main figure.

As a result of double circuit outages associated with lightning strikes, AEMO includes the following double circuits in the Ross zone in the vulnerable list:

- Ross to Chalumbin 275kV double circuit transmission line. This double circuit tripped due to lightning in January 2020 and again in November 2022
- Ross to Townsville South 132kV double circuit transmission line, last tripped in April 2025.

6.7.3 North zone

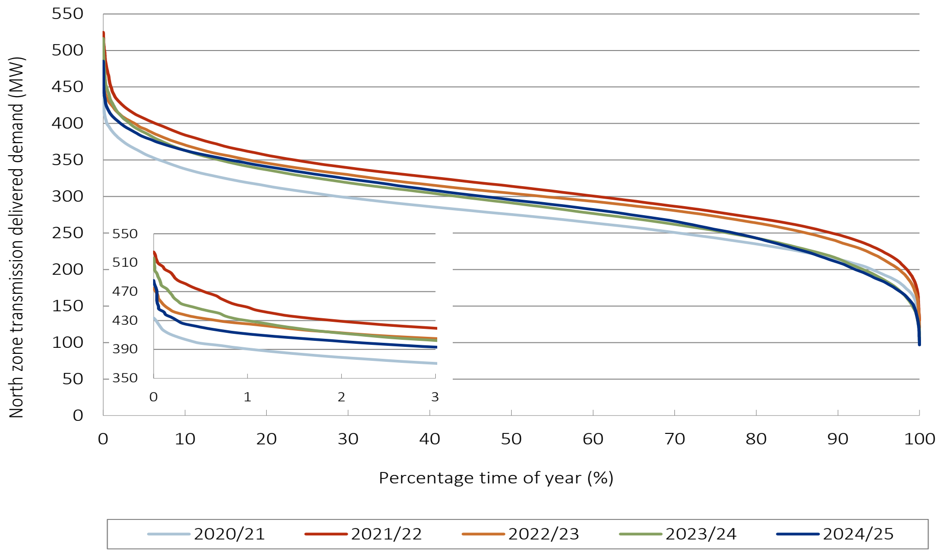
The North zone experienced a single load loss event for a single network element outage during 2024/25. The outage lasted approximately 7 hours, resulting in 27MWh of lost energy. The loads impacted by the outage are supplied by a single radial connection under intact system conditions.

The North zone includes semi-scheduled embedded generator Collinsville Solar Farm and significant non-scheduled embedded generators Moranbah North, Moranbah and Racecourse Mill[20]. These generators provided 427GWh during 2024/25.

Figure 6.29 provides historical transmission delivered load duration curves for the North zone. Energy delivered from the transmission network has increased by 0.3% between 2023/24 and 2024/25. The peak transmission delivered demand reached 485MW, which is lower than maximum demand over the last five years of 525MW set in 2021/22. The minimum transmission delivered demand in the zone was 97MW, which is the lowest minimum demand in the last five years.

[20] Refer to Figure 2.10 for load measurement definitions.

Figure 6.29 Historical North zone transmission delivered load duration curves



Note:

(1) Inset figure magnifies top of the curve in main figure.

As a result of double circuit outages associated with lightning strikes, AEMO includes the following double circuits in the North zone in the vulnerable list:

- Collinsville North to Proserpine 132kV double circuit transmission line, last tripped February 2023
- Collinsville North to Stony Creek and Collinsville North to Newlands lines, last tripped November 2022
- Strathmore to Clare South and Strathmore to Clare South tee King Creek 132kV double circuit transmission line, last tripped December 2023.

6.7.4 Central West zone

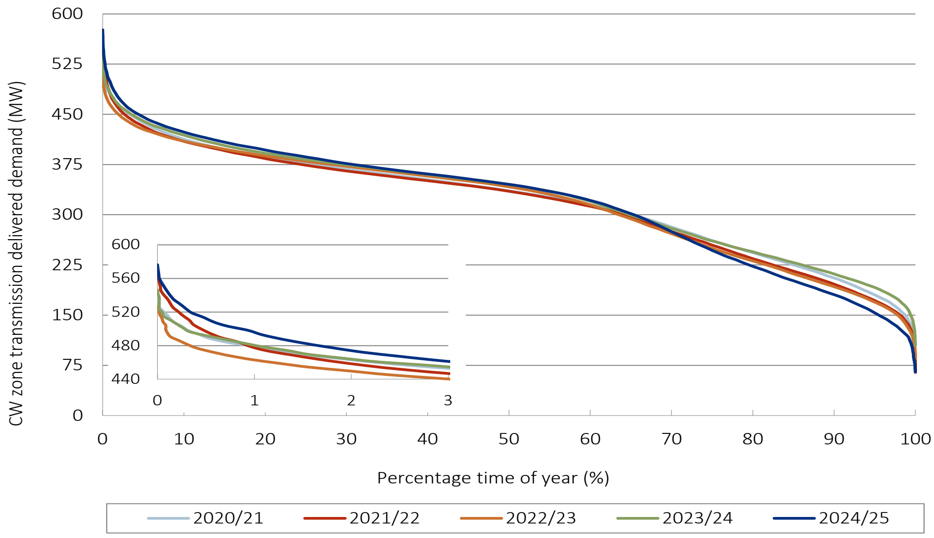
The Central West zone experienced no load loss for a single network element outage during 2024/25.

The Central West zone includes the scheduled embedded Barcaldine generator, semi-scheduled embedded generators Clermont, Emerald and Middlemount solar farms, and significant non-scheduled embedded generators Barcaldine and Longreach solar farms, German Creek and Oaky Creek[21]. These generators provided 577GWh during 2024/25.

Figure 6.30 provides historical transmission delivered load duration curves for the Central West zone. Energy delivered from the transmission network has reduced by 2.1% between 2023/24 and 2024/25. The peak transmission delivered demand in the zone was 576MW, which is the highest maximum demand over the last five years. The minimum transmission delivered demand in the zone was 66MW, which is close to the record minimum demand recorded in 2020/21.

21 Refer to Figure 2.10 for load measurement definitions.

Figure 6.30 Historical Central West zone transmission delivered load duration curves



Note:

(1) Inset figure magnifies top of the curve in main figure.

There are currently no double circuits in the Central West zone in AEMO's lightning vulnerable transmission line.

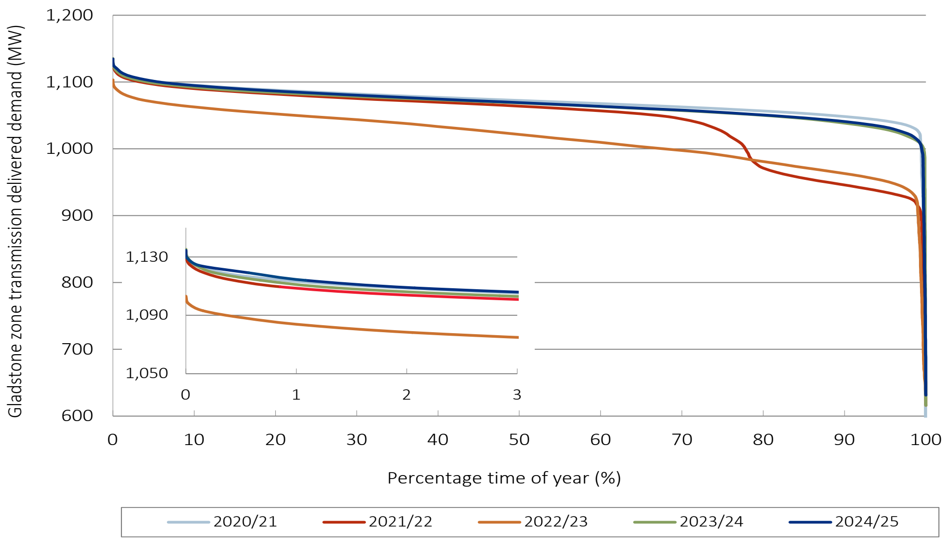
6.7.5 Gladstone zone

The Gladstone zone experienced no load loss for a single network element outage during 2024/25.

The Gladstone zone contains no scheduled, semi-scheduled or significant non-scheduled embedded generators[22].

Figure 6.31 provides historical transmission delivered load duration curves for the Gladstone zone. Energy delivered from the transmission network has reduced by 0.2% between 2023/24 and 2024/25. The peak transmission delivered demand in the zone was 1,135MW, which is equal to the highest maximum demand over the last five years. Minimum demand coincides with short periods when one or more potlines at Boyne Smelters Limited (BSL) are out of service. The minimum transmission delivered demand in the zone was 631MW.

Figure 6.31 Historical Gladstone zone transmission delivered load duration curves



Note:

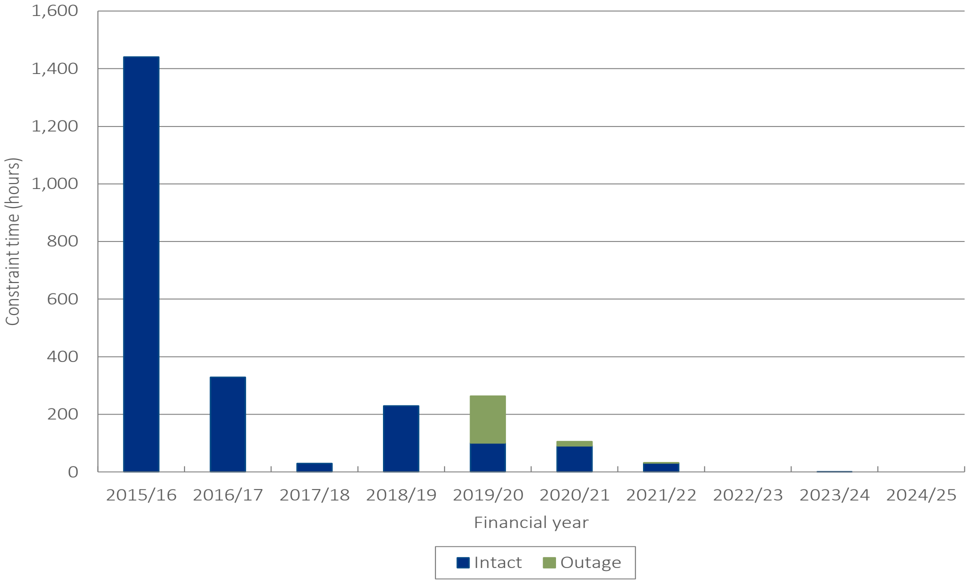
(1) Inset figure magnifies top of the curve in main figure.

22 Refer to Figure 2.10 for load measurement definitions.

Constraints occur within the Gladstone zone under intact network conditions. These constraints are associated with maintaining power flows within the continuous current rating of a 132kV feeder bushing at BSL's substation. The constraint limits generation from Gladstone Power Station, mainly from the units connected at 132kV. AEMO identifies the system intact constraint by constraint identifier Q>NIL_BI_FB. This constraint was implemented in AEMO's market system from September 2011.

Information pertaining to the historical duration of constrained operation due to this constraint is summarised in Figure 6.32. During 2024/25, the feeder bushing constraint did not constrain network dispatch at any time.

Figure 6.32 Historical Boyne Island feeder bushing constraint times



There are currently no double circuits in the Gladstone zone in AEMO's lightning vulnerable transmission line list.

6.7.6 Wide Bay zone

The Wide Bay zone experienced no load loss for a single network element outage during 2024/25.

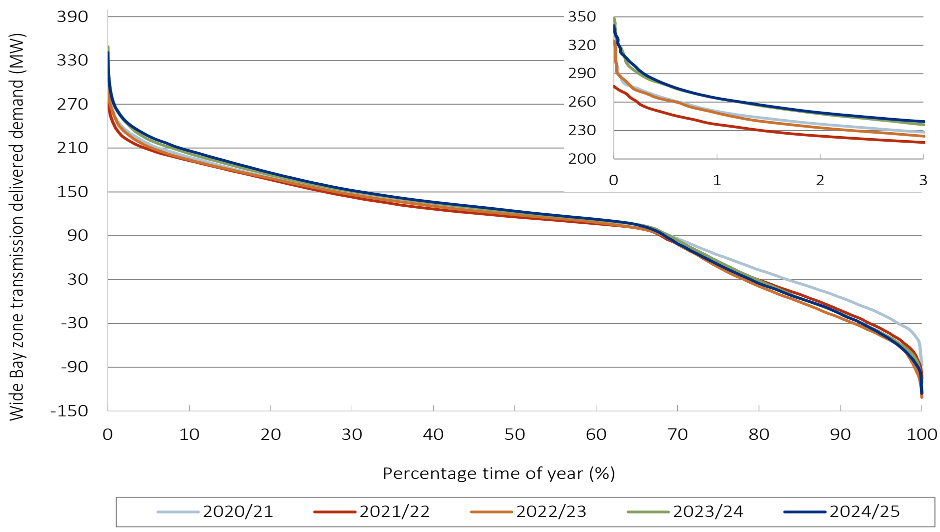
The Wide Bay zone includes the semi-scheduled embedded generators, Childers and Susan River Solar Farms, and a significant non-scheduled embedded generator in the Isis Central Sugar Mill[23]. These generators provided 199GWh during 2024/25.

Figure 6.33 provides historical transmission delivered load duration curves for the Wide Bay zone. The Wide Bay zone is one of three zones in Queensland where the delivered demand reaches negative values, meaning that, at times, the embedded generation exceeds the native load. The transmission network supplying the zone is often operated at zero and near zero loading, and the embedded generation makes use of the transmission network to supply loads in other zones.

While energy has seen significant reductions in recent years, the energy delivered from the transmission network increased by 0.2% between 2023/24 and 2024/25. The peak transmission delivered demand in the zone was 341MW, which is slightly lower than the record maximum demand set in 2023/24. The minimum transmission delivered demand in the zone was -126MW, which is slightly higher than the record minimum demand of -131MW recorded in 2022/23.

[23] Refer to Figure 2.10 for load measurement definitions.

Figure 6.33 Historical Wide Bay zone transmission delivered load duration curves



Note:

(1) Inset figure magnifies top of the curve in main figure.

There are currently no double circuits in the Wide Bay zone in AEMO's lightning vulnerable transmission line list.

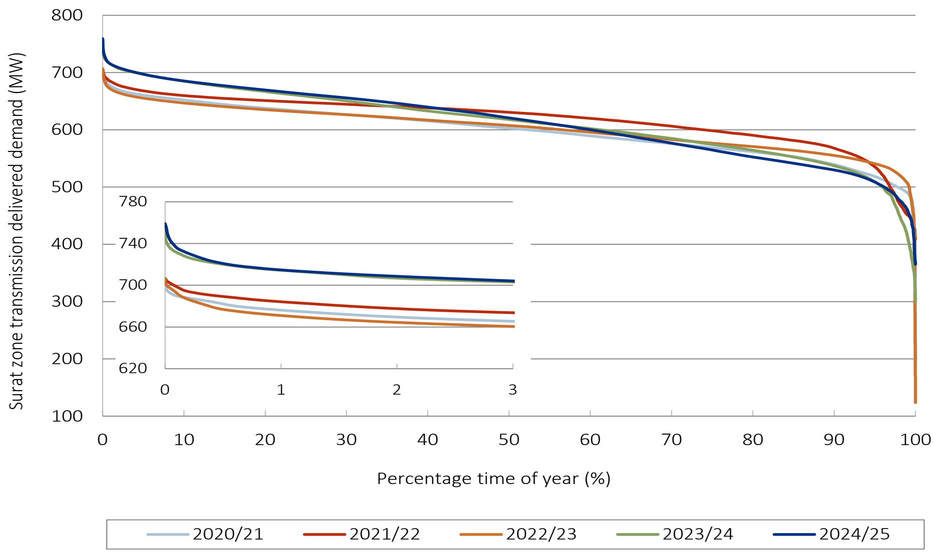
6.7.7 Surat zone

The Surat zone experienced no load loss for a single network element outage during 2024/25.

The Surat zone includes the scheduled embedded Roma generator, the direct connected embedded Condamine generators, the semi-scheduled Dulacca Wind Farm and the significant non-scheduled embedded generator Baking Board Solar Farm[24]. These generators supplied 709GWh during 2024/25.

Figure 6.34 provides historical transmission delivered load duration curves for the Surat zone. Energy delivered from the transmission network has reduced by 0.2% between 2023/24 and 2024/25. The peak transmission delivered demand in the zone was 759MW, which is a record maximum demand for the zone. The minimum transmission delivered demand in the zone was 365MW which is typical for this zone.

Figure 6.34 Historical Surat zone transmission delivered load duration curves



Note:

(1) Inset figure magnifies top of the curve in main figure.

There are currently no double circuits in the Surat zone in AEMO's lightning vulnerable transmission line list.

[24] Refer to Figure 2.10 for load measurement definitions.

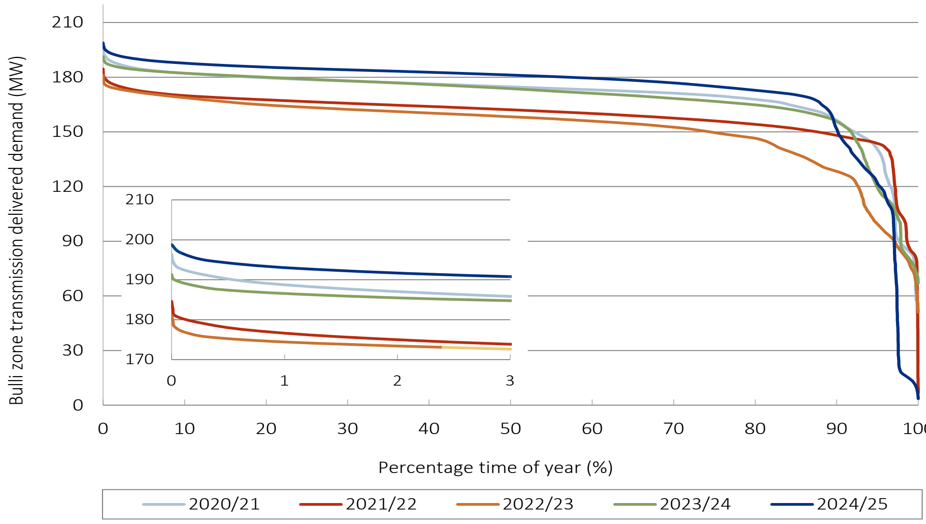
6.7.8 Bulli zone

The Bulli zone experienced no load loss for a single network element outage during 2024/25.

The Bulli zone contains no scheduled, semi-scheduled or significant non-scheduled embedded generators[25].

Figure 6.35 provides historical transmission delivered load duration curves for the Bulli zone. Energy delivered from the transmission network has increased by 2.1% between 2023/24 and 2024/25. The peak transmission delivered demand in the zone was 199MW which is lower than the maximum demand of 210MW set in 2019/20. The minimum transmission delivered demand in the zone was 4MW, which is the lowest demand on record.

Figure 6.35 Historical Bulli zone transmission delivered load duration curves



Note:

(1) Inset figure magnifies top of the curve in main figure.

There are currently no double circuits in the Bulli zone in AEMO's lightning vulnerable transmission line list.

6.7.9 South West zone

The South West zone experienced no load loss for a single network element outage during 2024/25.

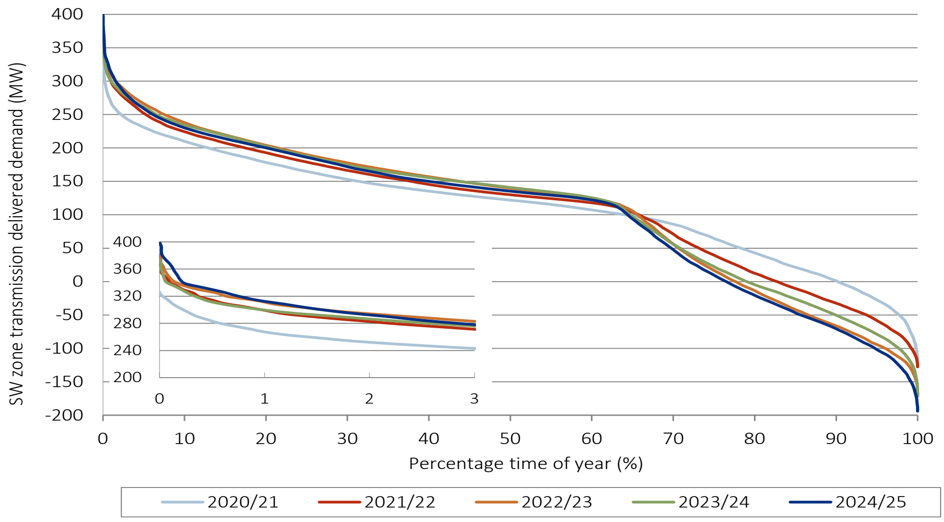
The South West zone includes the semi-scheduled embedded generators Kingaroy, Oakey 1, Oakey 2, Yarranlea, Maryrorough, and Warwick Solar Farms[26]. These generators provided 444GWh during 2024/25.

Figure 6.36 provides historical transmission delivered load duration curves for the South West zone. The South West zone is one of three zones in Queensland where the delivered demand reaches negative values, meaning that the embedded generation exceeds the native load. The transmission network supplying the zone is often operated at zero and near zero loading, and the embedded generation makes use of the transmission network to supply loads in other zones.

Energy delivered from the transmission network has reduced by 7.3% between 2023/24 and 2024/25, to the lowest level in the last decade. The peak transmission delivered demand in the zone was 399MW, a new record maximum demand. The minimum transmission delivered demand in the zone was -194MW, which is the lowest demand on record. A new minimum demand record has been set in this zone every year for the past seven years.

25 Refer to Figure 2.10 for load measurement definitions.
26 Refer to Figure 2.10 for load measurement definitions.

Figure 6.36 Historical South West zone transmission delivered load duration curves



Note:

(1) Inset figure magnifies top of the curve in main figure.

There are currently no double circuits in the South West zone in AEMO's lightning vulnerable transmission line list.

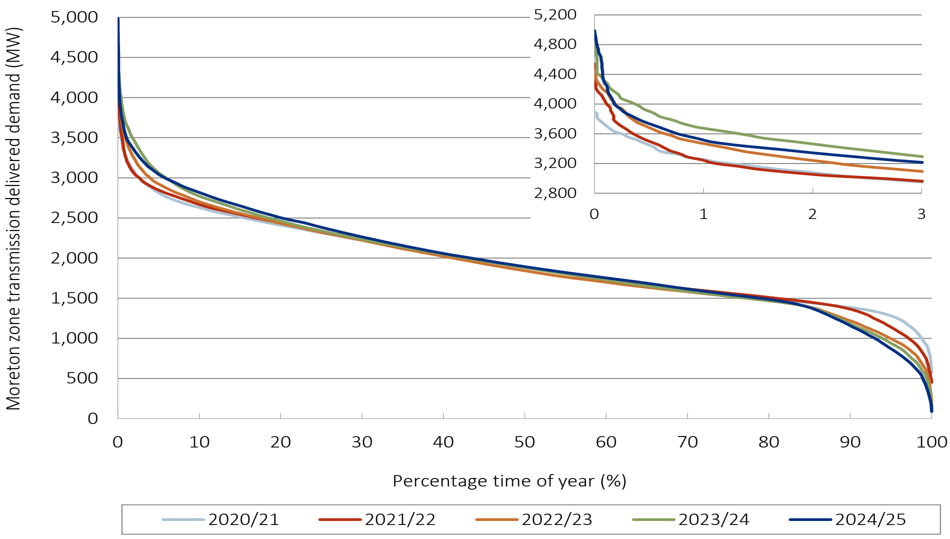
6.7.10 Moreton zone

The Moreton zone experienced no load loss for a single network element outage during 2024/25.

The Moreton zone includes the significant non-scheduled embedded generators Sunshine Coast Solar Farm, Bromelton and Rocky Point[27]. These generators provided 70GWh during 2024/25.

Figure 6.37 provides historical transmission delivered load duration curves for the Moreton zone. Energy delivered from the transmission network increased by 0.2% between 2023/24 and 2024/25. The peak transmission delivered demand in the zone was 4,989MW, which is highest maximum demand on record. The minimum transmission delivered demand in the zone was 89MW, which is the lowest demand on record.

Figure 6.37 Historical Moreton zone transmission delivered load duration curves



Note:

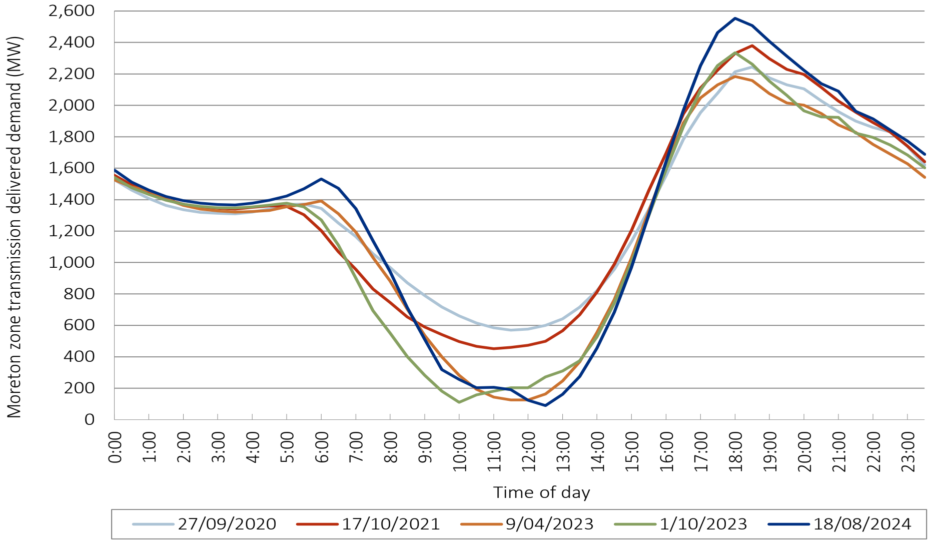
(1) Inset figure magnifies top of the curve in main figure.

High voltages associated with these light load conditions are currently managed with existing reactive sources. However, voltage control within Powerlink's and Energex's network is forecast to become increasingly challenging for longer durations. In October 2024, a bus reactor was commissioned at Belmont Substation to address the long-term reactive requirements.

27 Refer to Figure 2.10 for load measurement definitions.

Figure 6.38 provides the daily load profile for the minimum transmission delivered days for the Moreton zone over the last five years. This figure shows that the difference between the minimum demand and maximum demand on these days is increasing in magnitude. This is resulting in operational challenges to manage the network during periods of rapidly increasing demand.

Figure 6.38 Historical Moreton zone minimum transmission delivered daily profile



There are currently no double circuits in the Moreton zone in AEMO's lightning vulnerable transmission line list.

6.7.11 Gold Coast zone

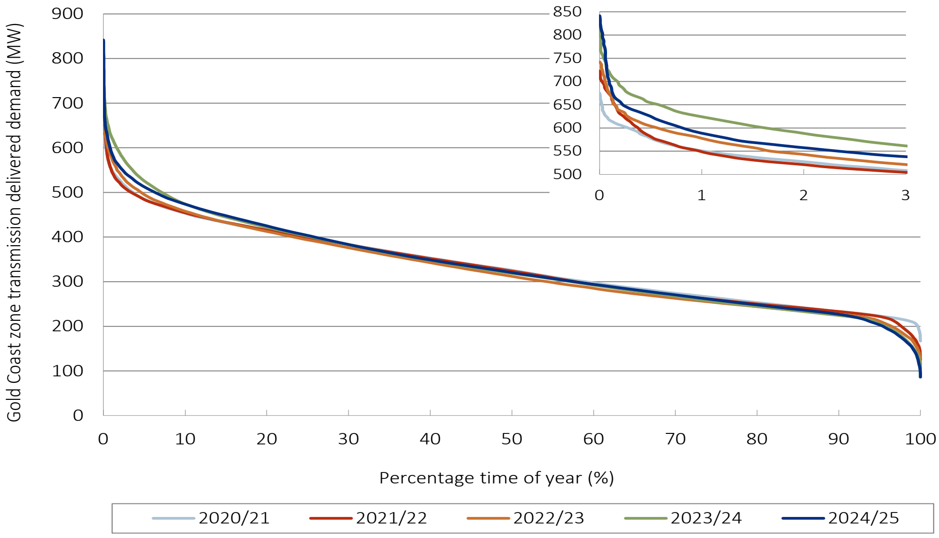
The Gold Coast zone experienced no load loss for a single network element outage during 2024/25.

The Gold Coast zone contains no scheduled, semi-scheduled or significant non-scheduled embedded generators[28].

Figure 6.39 provides historical transmission delivered load duration curves for the Gold Coast zone. Energy delivered from the transmission network reduced by 0.3% between 2023/24 and 2024/5. The peak transmission delivered demand in the zone was 842MW, which is the highest maximum demand on record. The minimum transmission delivered demand in the zone was 86MW which is the lowest demand on record.

[28] Refer to Figure 2.10 for load measurement definitions.

Figure 6.39 Historical Gold Coast zone transmission delivered load duration curves



Note:

(1) Inset figure magnifies top of the curve in main figure.

There are currently no double circuits in the Gold Coast zone in AEMO's lightning vulnerable transmission line list.