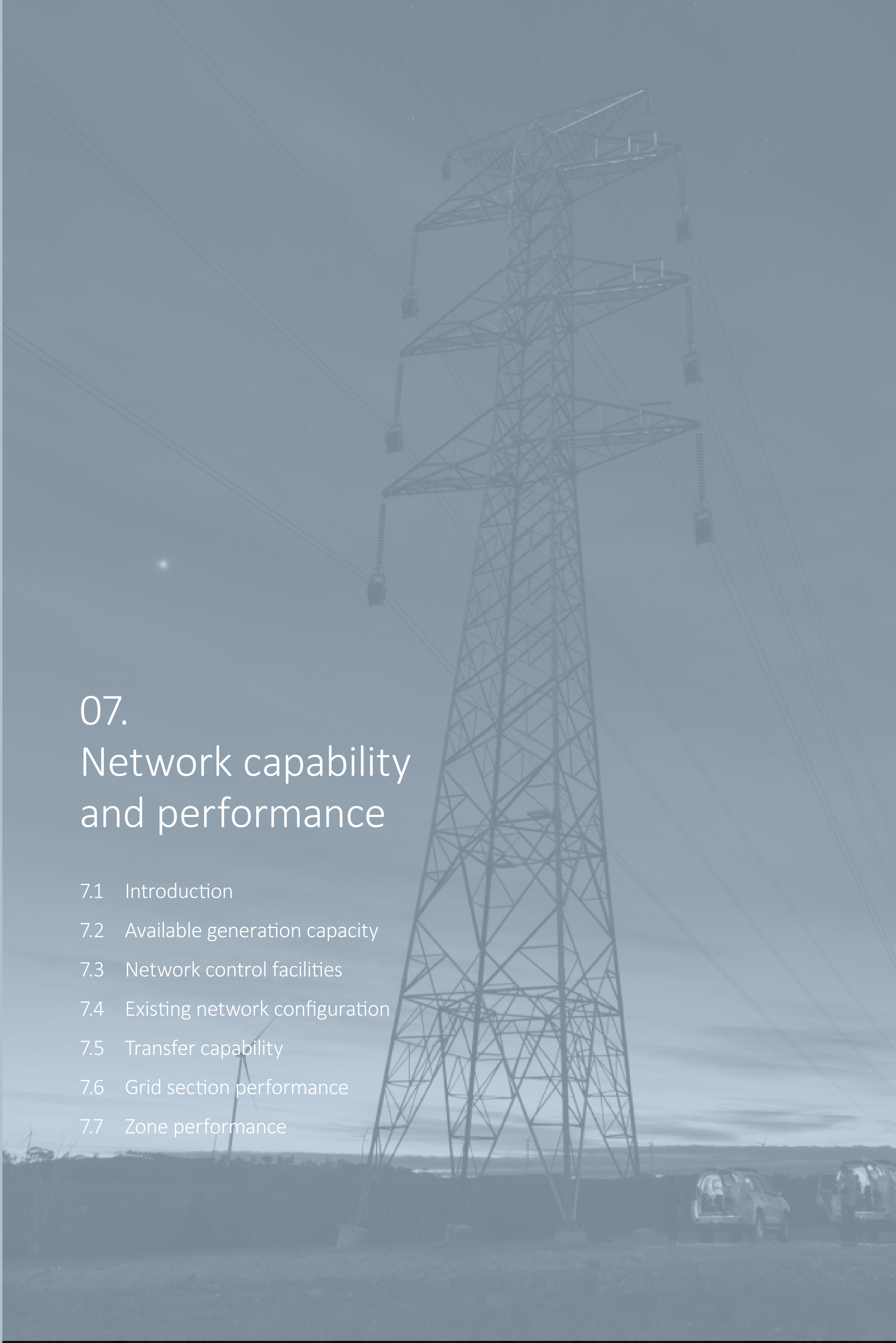


07.
Network capability and performance

This chapter discusses the evolving generation mix and demand profiles and how these changes impact the power flows across the transmission network.

Key highlights

- Generation commitments since the 2023 Transmission Annual Planning Report (TAPR) add 1,930MW to Queensland's semi-scheduled variable renewable energy (VRE) generation capacity taking the total existing and committed semi-scheduled VRE generation capacity to 7,260MW.
- Storage commitments since the 2023 TAPR add 755MW of two hour Battery Energy Storage Systems (BESS).
- Record maximum transmission delivered demands were experienced in Far North, Wide Bay, Surat, Moreton and Gold Coast zones during 2023/24.
- Record minimum transmission delivered demands were recorded in Far North, North, South West, Moreton and Gold Coast zones during 2023/24.
- The transmission network has performed reliably during 2023/24, with Queensland grid sections largely unconstrained.

7.1 Introduction

This chapter on network capability and performance provides:

- an outline of existing and committed generation capacity over the next three years
- a summary of network control facilities configured to disconnect load as a consequence of non-credible events
- single line diagrams of the existing high voltage (HV) network configuration
- background on factors that influence network capability
- zonal energy transfers for the two most recent years
- historical constraint times and power flow duration curves at key sections of Powerlink Queensland's transmission network
- a qualitative explanation of factors affecting power transfer capability at key sections of Powerlink's transmission network
- historical constraint times and load duration curves at key zones of Powerlink's transmission network
- double circuit transmission lines categorised as vulnerable by the Australian Energy Market Operator (AEMO).

The capability of Powerlink's transmission network to meet forecast demand is dependent on a number of factors. Queensland's transmission network is predominantly utilised more during summer than winter. During higher summer temperatures transmission plant has lower power carrying capability which is also when demand is higher as shown in Figure 3.14.

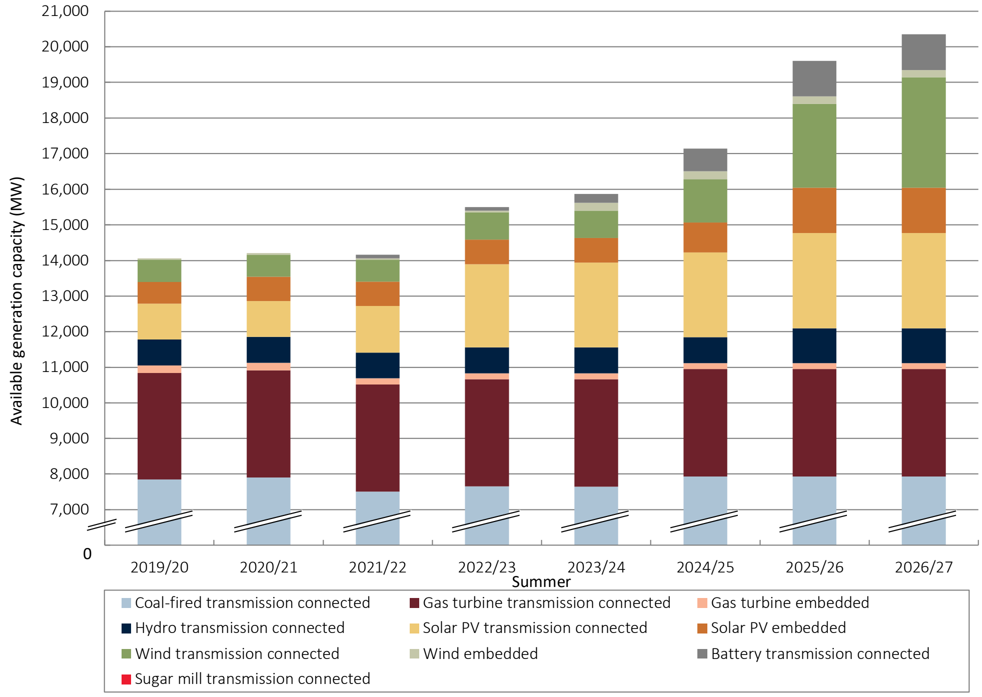
The location and pattern of generation dispatch influences power flows across the Queensland network. Future generation dispatch patterns and interconnector flows are uncertain in the deregulated electricity market and will vary substantially due to output of VRE generation and because of planned or unplanned outages of generation plant. 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 (refer to Table 3.17) and/or when embedded generation output is lower.

7.2 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 systems. Semi-scheduled generation in Queensland is a combination of wind and solar generation.

AEMO's definition of 'committed' from the System Strength Impact Assessment Guidelines[1] (effective 28 June 2024) has been adopted for the purposes of this year's TAPR. During 2023/24, commitments have added 1,930MW of semi-scheduled VRE capacity, taking Queensland's semi-scheduled VRE generation capacity to 7,260MW. In addition to this, 755MW of BESS capacity has been committed, taking the total BESS capacity to 1,005MW. In August 2024, Callide C3 and C4 units began the recommissioning process following long-term outages, bringing an additional 868MW of coal-fired generating capacity back online. Figure 7.1 illustrates the expected changes to available and committed large-scale generation capacity in Queensland from summer 2019/20 to summer 2026/27.

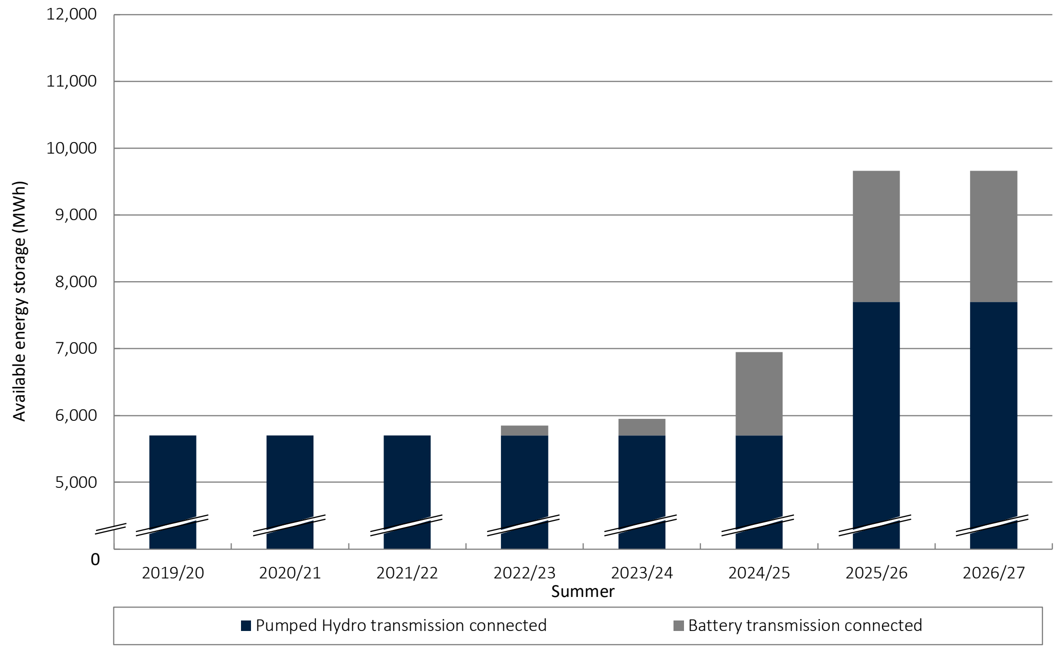
Figure 7.1 Summer available generation capacity by energy source



Storage is an essential component to enable the energy transition. Up until two years ago, Wivenhoe Pumped Storage Hydroelectric Power Station was the only transmission connected energy storage in Queensland. However, recent years have seen the rapid roll out of BESS across the National Electricity Market (NEM). In Queensland, Wandoan, Bouldercombe, Chinchilla and Western Downs batteries are online or in commissioning with others committed. Additionally, the Kidston pumped hydro station is committed and under construction and various pumped hydro stations are in the development pipeline. Figure 7.2 shows the recent increases in energy storage capacity and the new capacity that will be available in the coming years based on project commitments.

1 AEMO, System Strength Impact Assessment Guidelines, June 2024.

Figure 7.2 Available storage capacity by type



7.2.1 Existing and committed transmission connected and direct connect embedded generation

Table 7.1 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 MacIntyre Wind Farm, Lotus Creek Wind Farm, Broadsound Solar Farm, Boulder Creek Wind Farm and Wambo 2 Wind Farm have reached committed status since the 2023 TAPR.

Scheduled transmission connected Greenbank, Ulinda Park, Woolooga and Western Downs BESS have reached committed status since the 2023 TAPR.

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. In accordance with Clause 5.18A of the National Electricity Rules (NER), Powerlink's Register of Large Generator Connections with information on generators connected to Powerlink's network can be found on Powerlink's website.

Table 7.1 Available generation capacity – existing and committed generators connected to the Powerlink transmission network or direct connect customers

Generator	Location	Available capacity MW generated (1) Summer 2024/25	Winter 2025	Summer 2025/26	Winter 2026	Summer 2026/27	Winter 2027
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	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 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 turbine							
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 Hydro Storage (6)	Kidston			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

Table 7.1 Available generation capacity – existing and committed generators connected to the Powerlink transmission network or direct connect customers *(continued)*

Generator	Location	Available capacity MW generated (1) Summer 2024/25	Winter 2025	Summer 2025/26	Winter 2026	Summer 2026/27	Winter 2027
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
Broadsound	Broadsound			296	296	296	296
Lilyvale	Lilyvale	100	100	100	100	100	100
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	125	125	125	125
Edenvale Solar Park	Orana	146	146	146	146	146	146
Western Downs Green Power Hub	Western Downs	400	400	400	400	400	400
Darling Downs	Braemar	108	108	108	108	108	108
Total solar PV		2,383	2,383	2,679	2,679	2,679	2,679
Wind (7)							
Mt Emerald	Walkamin	180	180	180	180	180	180
Kaban	Tumoulin	152	152	152	152	152	152
Lotus Creek	Glencoe					276	276
Clarke Creek	Broadsound	440	440	440	440	440	440
Boulder Creek	Muranu					221	221
Wambo	Halys		245	245	245	245	245
Wambo 2	Halys				247	247	247
Coopers Gap	Coopers Gap	440	440	440	440	440	440
MacIntyre	Tummaville		890	890	890	890	890
Total wind		1,212	2,347	2,347	2,594	3,091	3,091
Battery (7)							
Bouldercombe 2h	Bouldercombe	50	50	50	50	50	50
Woolooga 2h	Woolooga			200	200	200	200
Wandoan 1.5h	Wandoan South	100	100	100	100	100	100
Chinchilla 2h	Western Downs	100	100	100	100	100	100

Table 7.1 Available generation capacity – existing and committed generators connected to the Powerlink transmission network or direct connect customers *(continued)*

Generator	Location	Available capacity MW generated (1)					
		Summer 2024/25	Winter 2025	Summer 2025/26	Winter 2026	Summer 2026/27	Winter 2027
Western Downs 2h	Western Downs	200	200	200	200	200	200
Ulinda Park 2h	Western Downs		155	155	155	155	155
Greenbank 2h	Greenbank	200	200	200	200	200	200
Total battery		650	805	1,005	1,005	1,005	1,005
Sugar mill							
Invicta (5)	Invicta Mill	0	34	0	34	0	34
Total sugar mill		0	34	0	34	0	34
Total all stations		15,923	17,782	17,959	18,775	18,703	19,272

Notes:

(1) Synchronous generator capacities shown are at the generator terminals and are therefore greater than Power Station (PS) 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 PS is an open-cycle, dual-fuel, gas-fired PS. 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 Hydro Storage 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.

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

Table 7.2 summarises the available generation capacity of embedded scheduled and semi-scheduled power stations connected or committed to be connected to Queensland's distribution network.

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.

Table 7.2 Available generation capacity – existing and committed scheduled or semi-scheduled generators connected to the Ergon Energy and Energex (part of the Energy Queensland Group) distribution networks

Generator	Location	Available capacity MW generated					
		Summer 2024/25	Winter 2025	Summer 2025/26	Winter 2026	Summer 2026/27	Winter 2027
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
Total combustion turbine		164	187	164	187	164	187
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	60
Aramara	Aramara		101	101	101	101	101
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	1,178	1,275	1,275	1,275	1,275
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	1,581	1,655	1,678	1,655	1,678

Notes:

(1) Synchronous generator capacities shown are at the generator terminals and are therefore greater than PS 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.

7.2.3 Information of generation and storage projects yet to be committed

The information provided in tables 7.1 and 7.2 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 AEMOs NEM generation maps.

7.3 Network control facilities

Powerlink participated in the 2024 General Power System Risk Review[2] (GPSRR), published by AEMO in July 2024.

No new recommendations were made specifically for Powerlink. However, work is continuing for the following recommendations from previous years:

- Establishment of an Over Frequency Generation Shedding (OFGS) scheme to manage over frequency if Queensland to New South Wales Interconnector (QNI) separates. AEMO and Powerlink are collaborating on the design of this scheme.
- Identification and implementation of measures to restore Under Frequency Load Shedding (UFLS).
- Review and expansion of Wide Area Monitoring, Protection and Control (WAMPAC) for the non-credible loss of both Calvale – Halys 275kV lines. The scheme will be improved to manage higher flows on the Central Queensland to South Queensland (CQ-SQ) grid section and also loss of both Columboola to Western Downs 275kV lines.
- Investigation, and if found viable, design and implementation of a special protection scheme to mitigate the risk of QNI instability and synchronous separation of Queensland following a range of non-credible contingencies.

Powerlink owns other network control facilities that minimise or reduce the consequences of multiple contingency events. Network control facilities owned by Powerlink which may disconnect load following a multiple non-credible contingency event are listed in Table 7.3.

Table 7.3 Powerlink owned network control facilities configured to disconnect load as a consequence of non-credible events during system normal conditions

Scheme	Purpose
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 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

2 AEMO, 2024 General Power System Risk Review, July 2024.

7.4 Existing network configuration

Figures 7.3, 7.4, 7.5 and 7.6 illustrate Powerlink's system intact network as of July 2024.

Figure 7.3 Existing HV network July 2024 – North Queensland

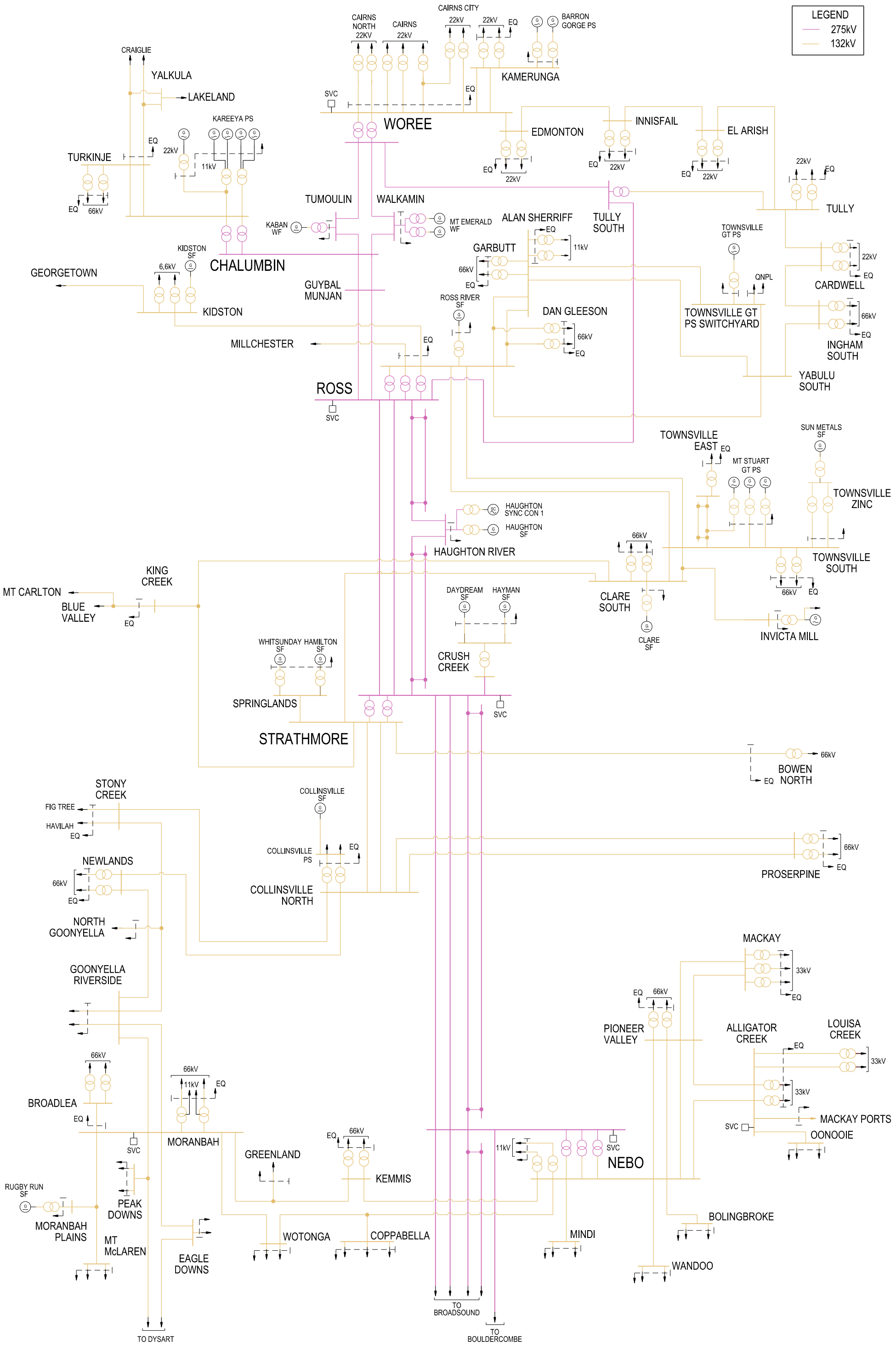


Figure 7.4 Existing HV network July 2024 – Central Queensland

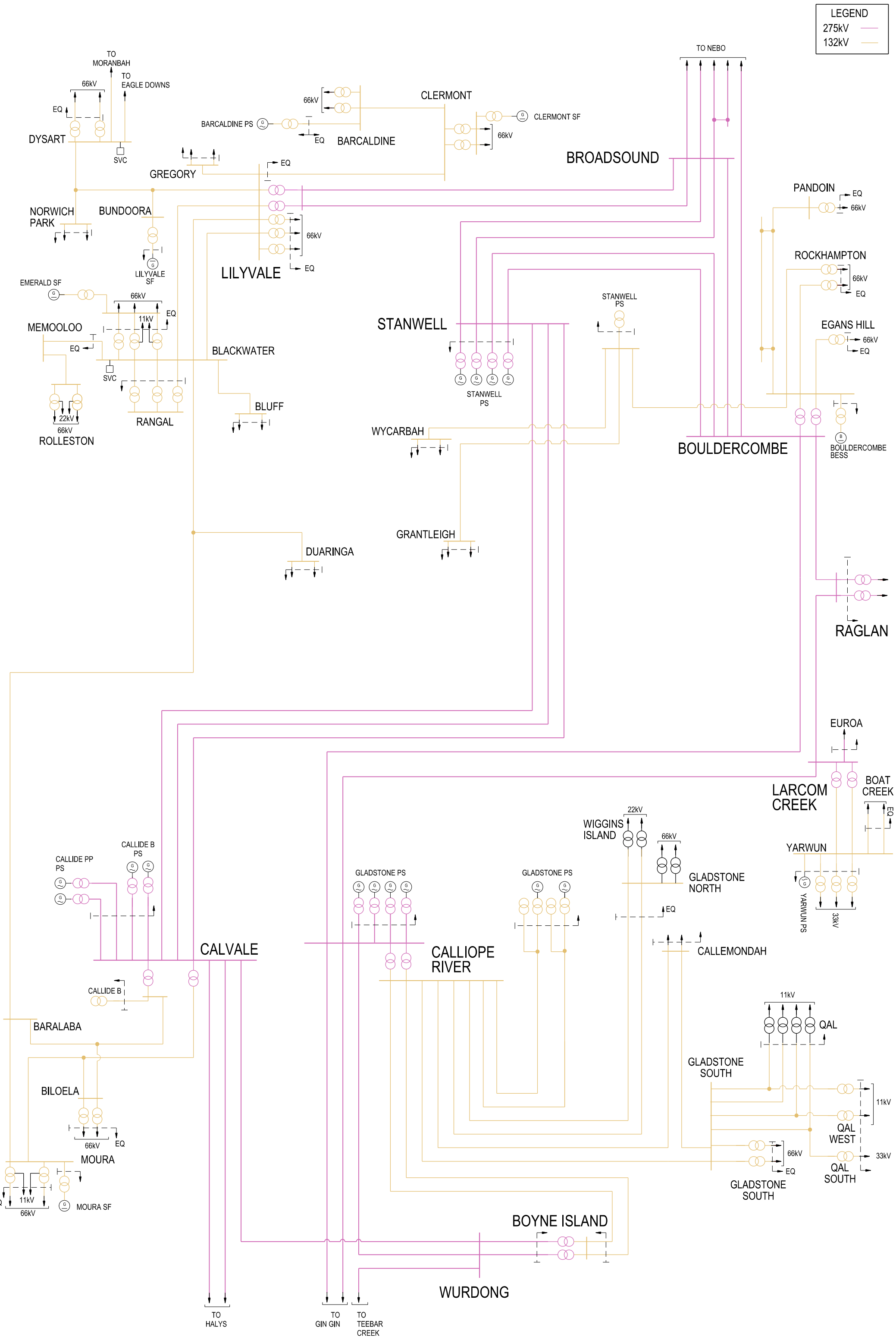


Figure 7.5 Existing HV network July 2024 - South West Queensland

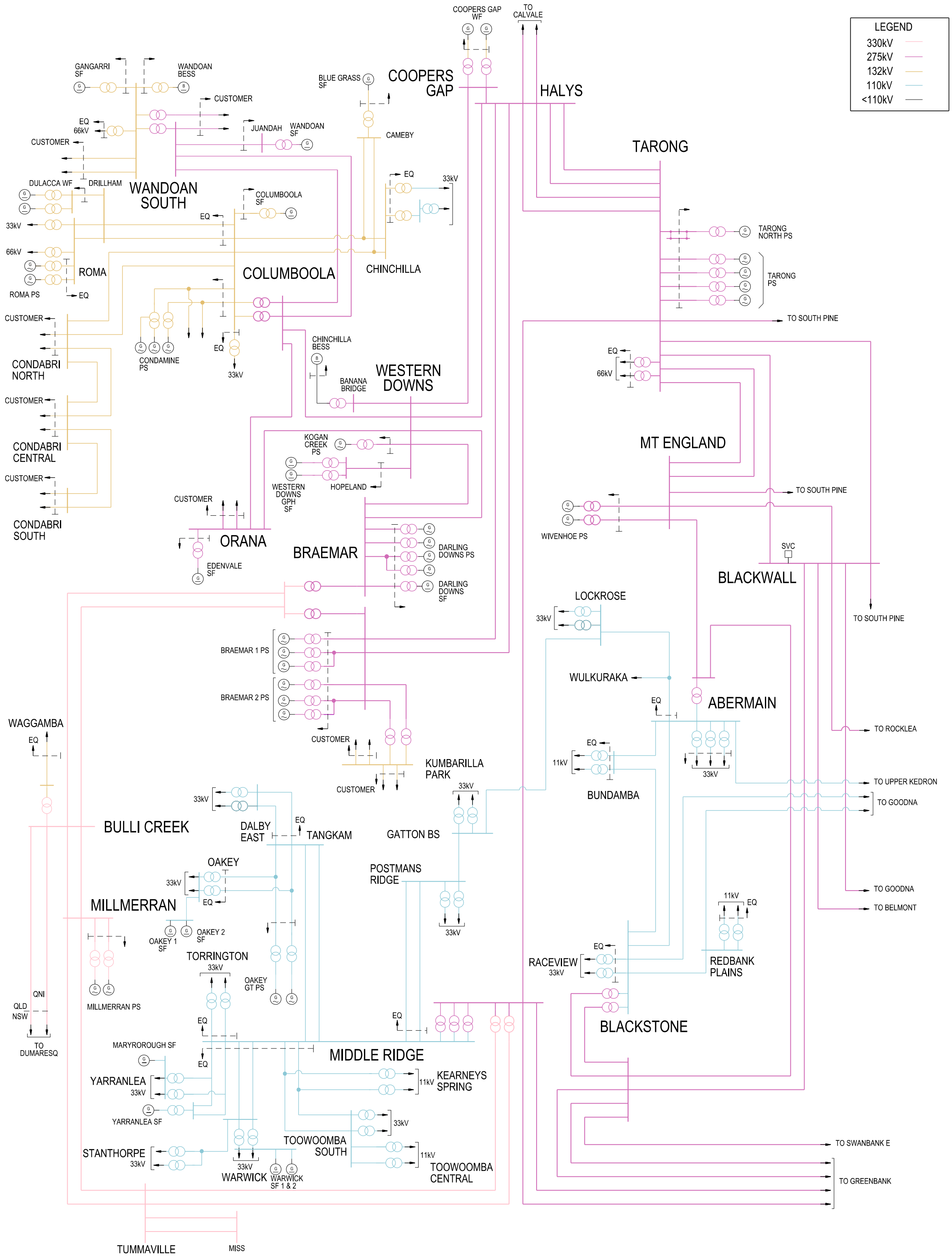
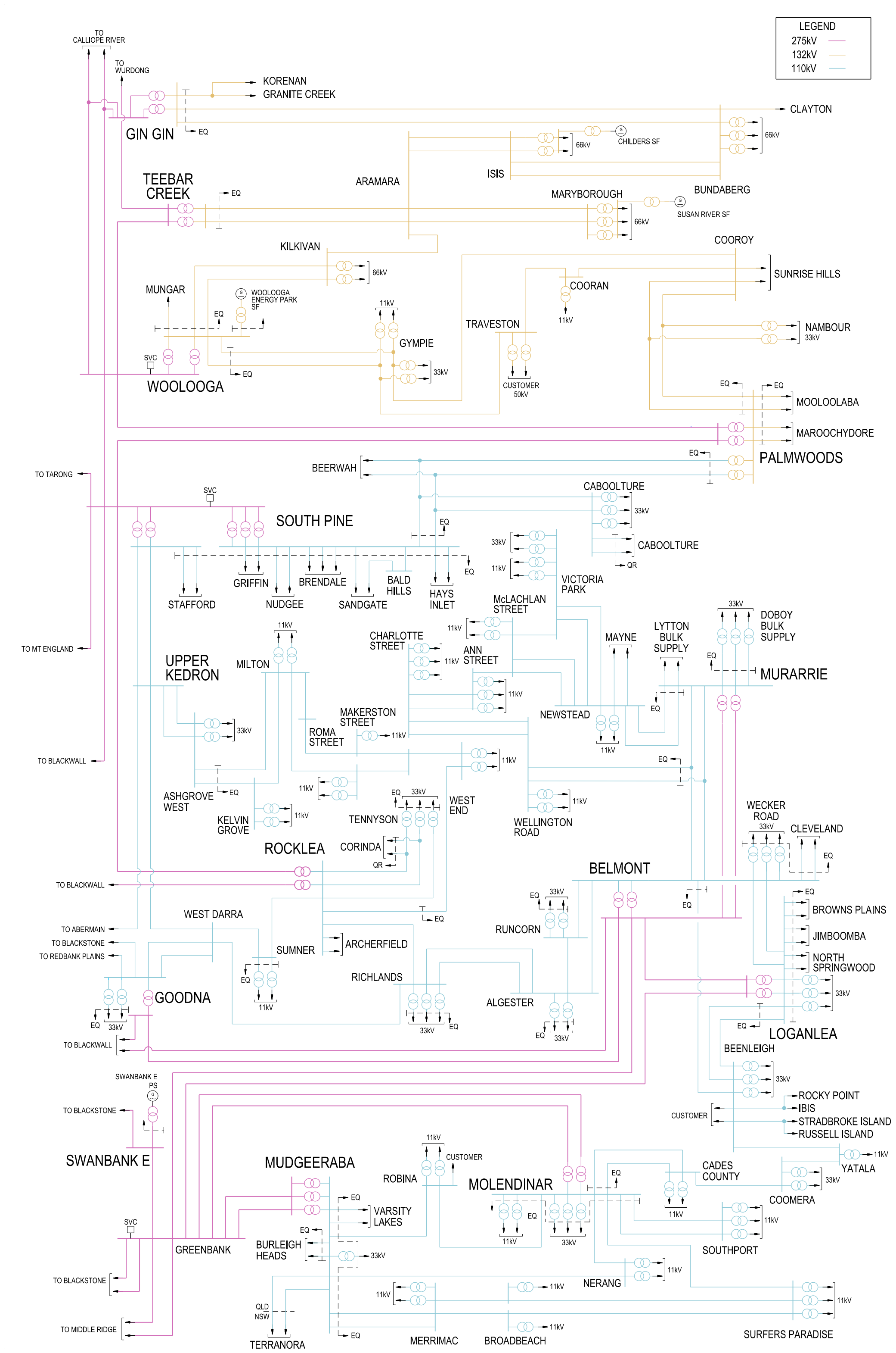


Figure 7.6 Existing HV network July 2024 - South East Queensland



7.5 Transfer capability

7.5.1 Location of grid sections

Powerlink has identified a number of grid sections that allow the assessment of network capability and to forecast limitations in a structured manner. Maximum power transfer capability may be set by 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 F.2 and Figure F.1 in Appendix F define and illustrate the location of relevant grid sections on the Queensland network.

7.5.2 Determining transfer capability

Transfer capability across each grid section varies with different system operating conditions. Transfer limits in the National Electricity Market (NEM) are not generally amenable to definition by a single number. Instead, TNSPs define the capability of their network using multi-term equations. These equations quantify the relationship between system operating conditions and transfer capability, and are implemented into NEMDE, following AEMO's due diligence, for optimal dispatch of generation. In Queensland the transfer capability is highly dependent on which generators are inservice 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 G. 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. Additionally, expected limit improvements for committed works are incorporated in all future planning. Section 7.6 includes a qualitative description of the main system conditions that affect the capability of each grid section.

7.6 Grid section performance

This section is a summary of the changing flows on the key grid sections of the Queensland network and the system conditions with major effects on their transfer capability.

Historical transfer duration curves for the last five years are included for each grid section. Grid section transfers are affected by load, generation and transfers to neighbouring zones. Figures 7.7 and 7.8 provide 2022/23 and 2023/24 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 7.9 provides the changes in energy transfers from 2022/23 to 2023/24. 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 F.3 in Appendix F.

Along with the grid section transfer duration curves, the time that the associated constraint equations have bound over the last 10 years is provided. These are categorised as occurring during intact or outage conditions based on AEMO's constraint description. Constraint times can be associated with a combination of generator unavailability, network outages, unfavourable dispatches and/or high loads. Constraint times do not include occurrences of binding constraints associated with network support agreements. Binding constraints whilst network support is dispatched are not classed as congestion. Although high constraint times may not be indicative of the cost of market impact, they serve as a trigger for the analysis of the economics for overcoming the congestion.

Binding constraint information is sourced from AEMO. Historical binding constraint information is not intended to imply a prediction of constraints in the future.

Figure 7.7 2022/23 zonal electrical energy transfers (GWh)

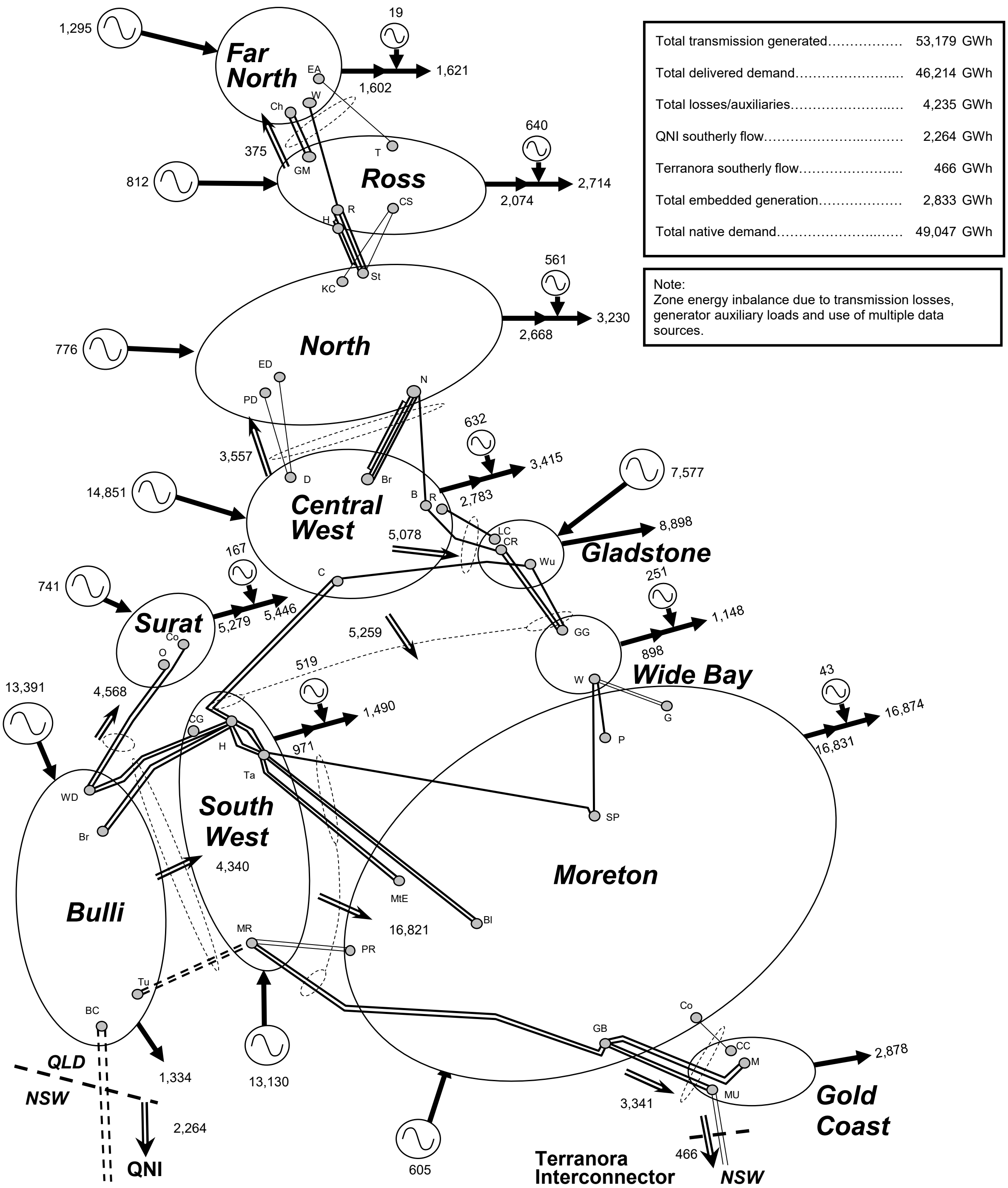


Figure 7.8 2023/24 zonal electrical energy transfers (GWh)

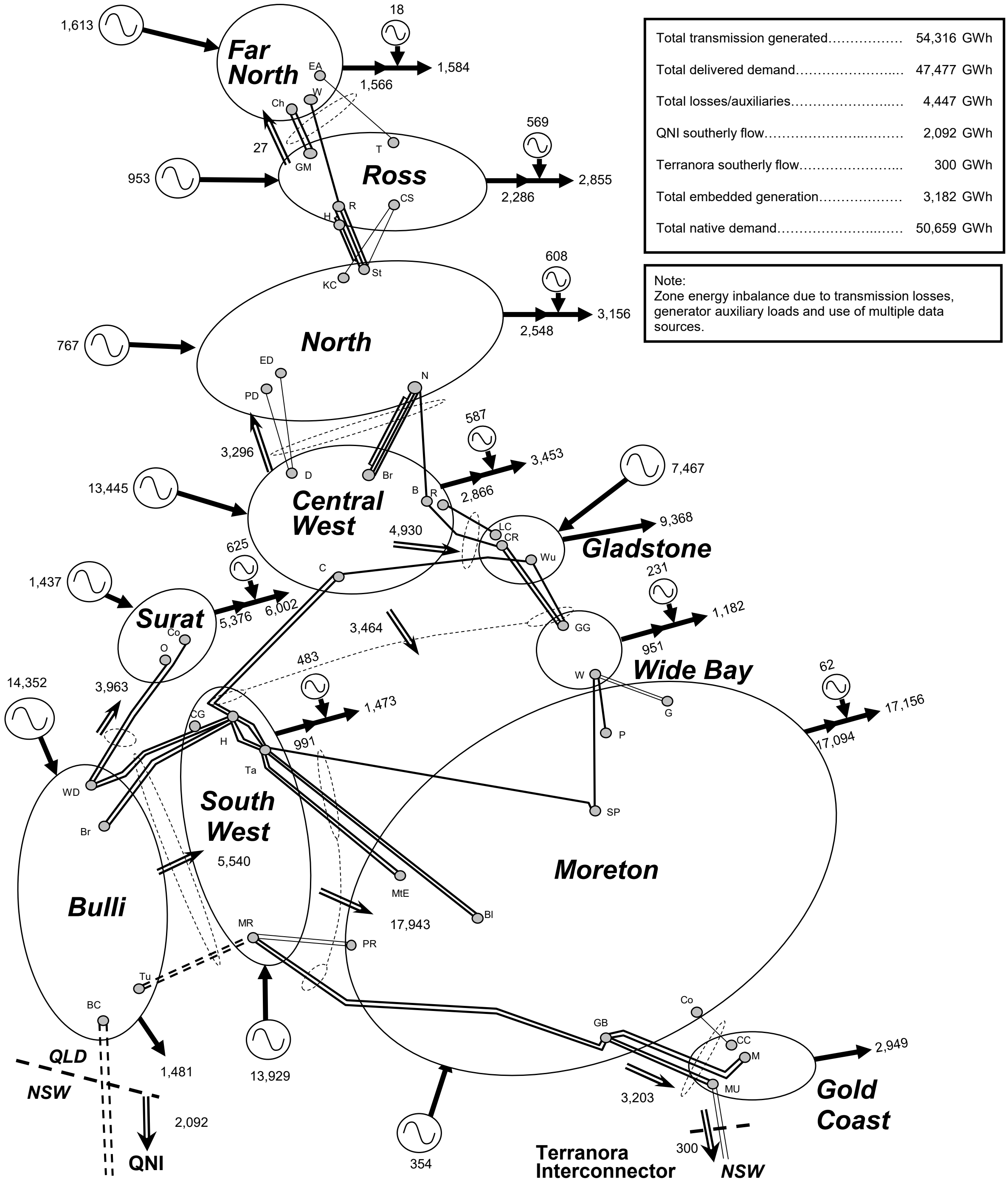
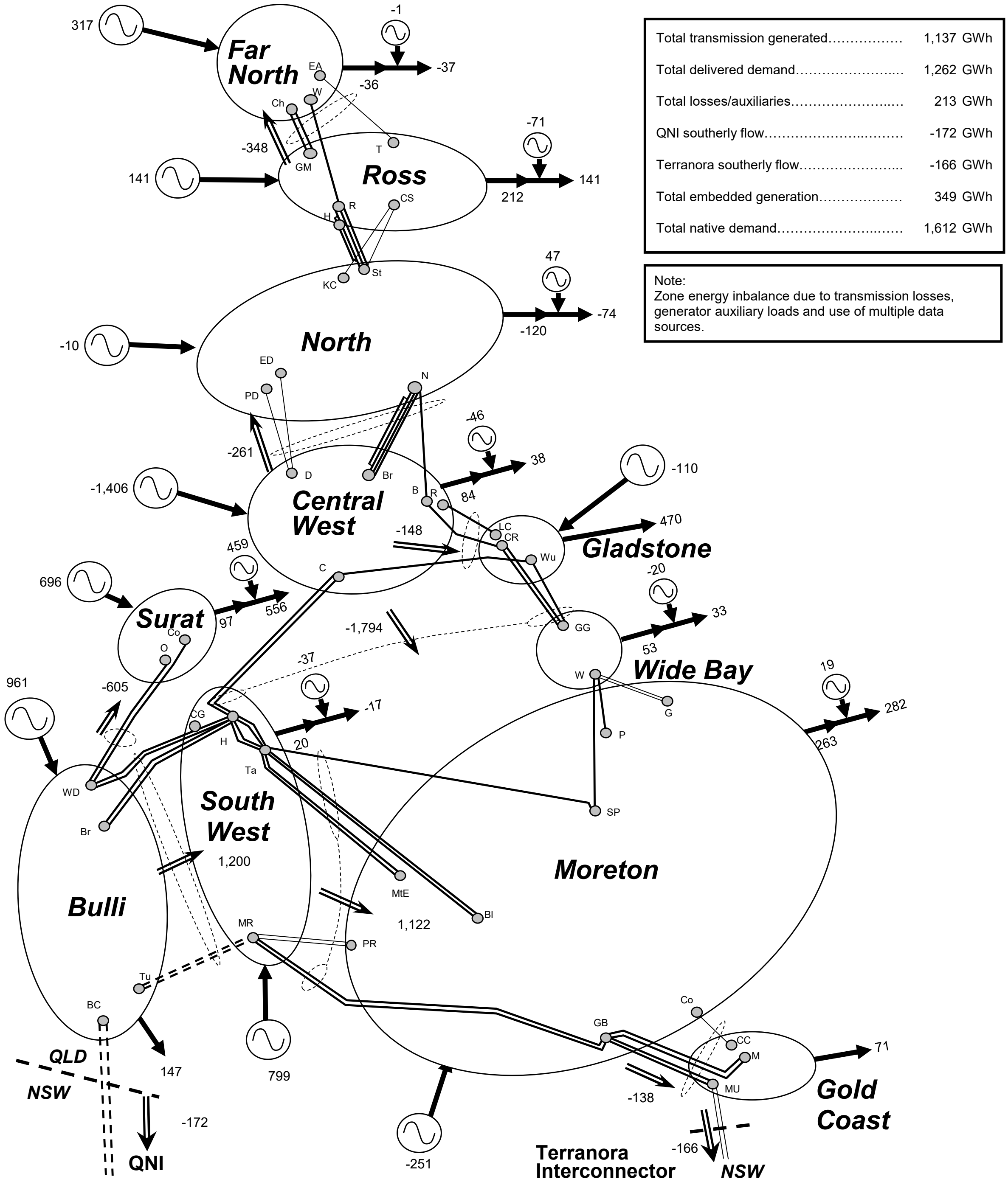


Figure 7.9 Change in zonal electrical energy transfers (GWh)



7.6.1 Far North Queensland grid section

Maximum power transfer across the Far North Queensland (FNQ) grid section is set by voltage stability associated with an outage of the Ross to Woree tee Tully South 275kV circuit. This circuit was established by energising one side of the existing 132kV coastal double circuit transmission line at 275kV, creating a third 275kV transmission line into Woree Substation in Cairns. This augmentation is part of the Far North Queensland Renewable Energy Zone (REZ) development.

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

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

Local hydro 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, due to its distributed and reactive nature, increases in delivered demand erode reactive margins at greater rates than they were created by the additional local generation. Limiting power transfers are thereby lower with the increased local generation but a greater load can be delivered.

The FNQ grid section was constrained for a single, five minute dispatch interval in 2023/24. The historical duration of constrained operation for the FNQ grid section is summarised in Figure 7.10.

Figure 7.10 Historical FNQ grid section constraint times

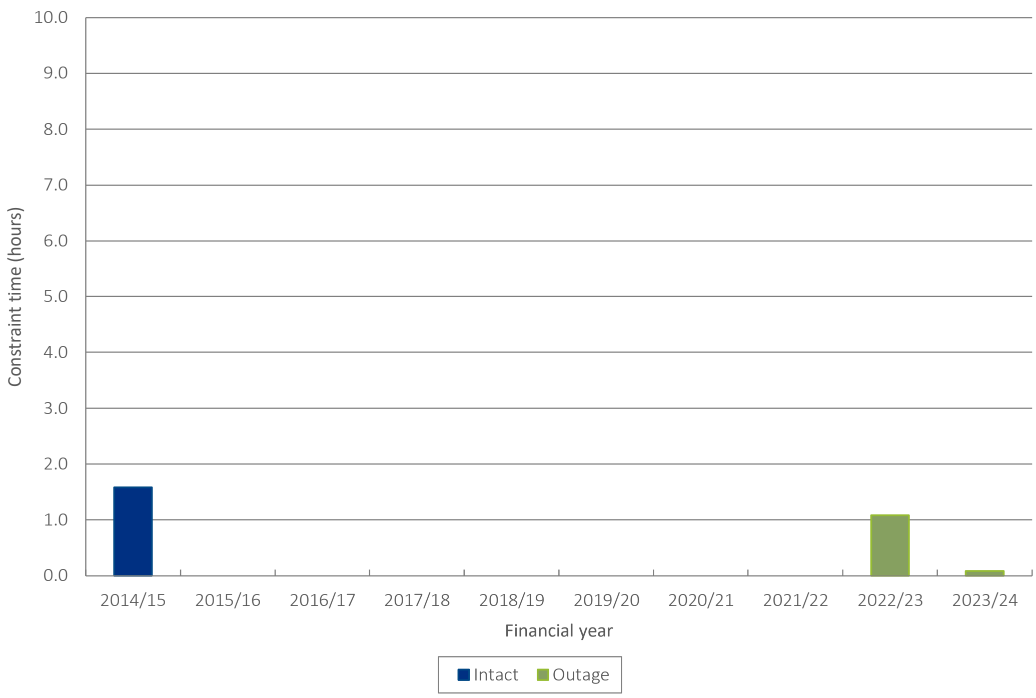
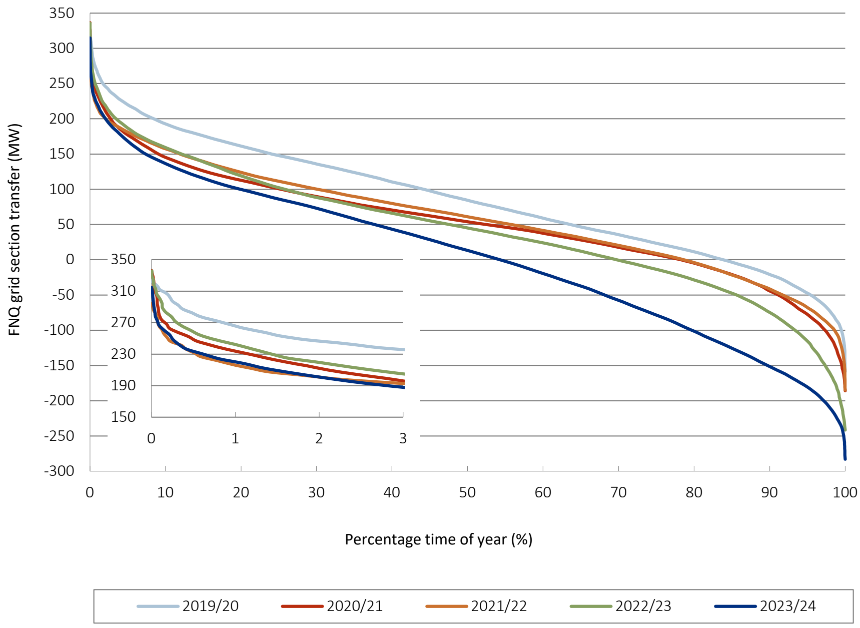


Figure 7.11 provides historical transfer duration curves showing the FNQ grid section is increasingly flowing in the southerly direction during 2023/24. This year the continued increase in the available generation in the Far North zone has resulted in a corresponding decrease in northerly delivered energy across the Far North Queensland grid section (refer to figures 7.7, 7.8 and 7.9).

Figure 7.11 Historical FNQ grid section transfer duration curves



7.6.2 Central Queensland to North Queensland grid section

Maximum power transfer across the Central Queensland to North Queensland (CQ-NQ) grid section may be set by thermal ratings associated with an outage of a Stanwell to Broadsound 275kV circuit, under certain prevailing ambient conditions. 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 G.2 of Appendix G 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 2023/24. The historical duration of constrained operation for the CQ-NQ grid section is summarised in Figure 7.12.

Figure 7.12 Historical CQ-NQ grid section constraint times

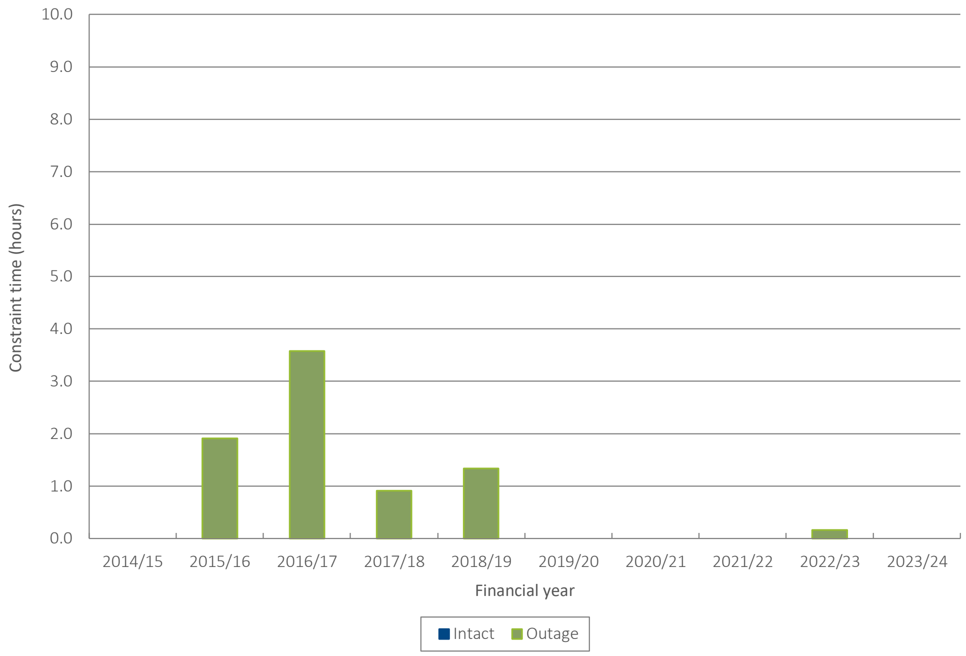


Figure 7.13 provides historical transfer duration curves showing decreases in energy transfer over recent years. This decrease is predominantly attributed to the addition of renewable generation in the Far North, Ross and North zones. Despite reductions in total energy transfer, the peak power transfer in 2023/24 is similar to previous years.

Figure 7.13 Historical CQ-NQ grid section transfer duration curves

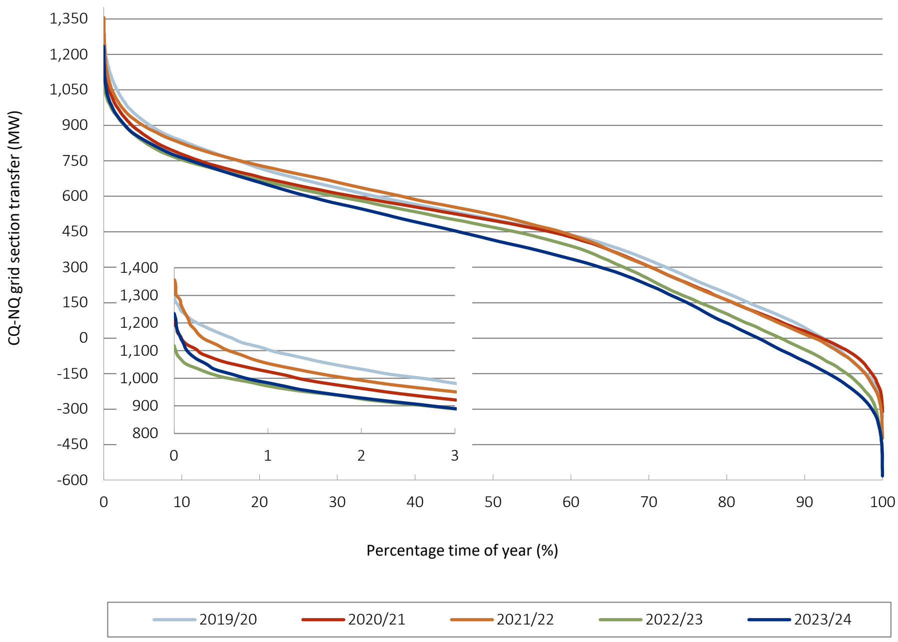
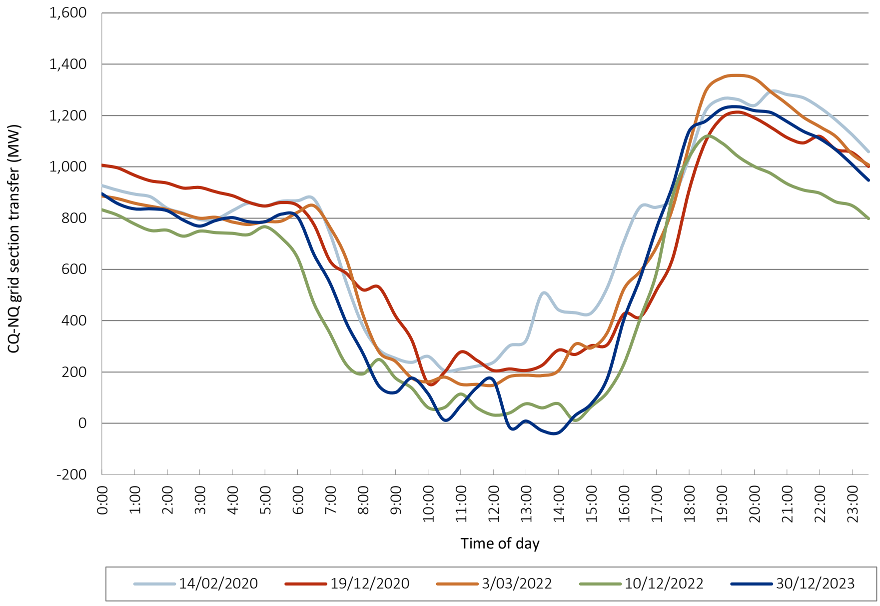


Figure 7.14 provides a different view of the altered power flows experienced over the last years for the day corresponding to the annual peak CQ-NQ transfer. This shows the impact of solar generation in creating minimum demands and network transfers during the middle of the day.

Figure 7.14 Historical CQ-NQ peak grid section transfer daily profile



These midday reductions in transfers have introduced operational challenges in voltage control. In June 2024, Powerlink commissioned a 126MVAr bus reactor at Broadsound to address these challenges.

7.6.3 North Queensland system strength

System strength is a measure of the ability of a power system to remain stable under normal conditions and to return to a steady state condition following a system disturbance. System strength can be considered low in areas with low levels of synchronous generation and deteriorates further with high penetration of inverter-based resources.

Powerlink has determined that the dominant limitation to VRE 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 as between 8Hz and 15Hz.

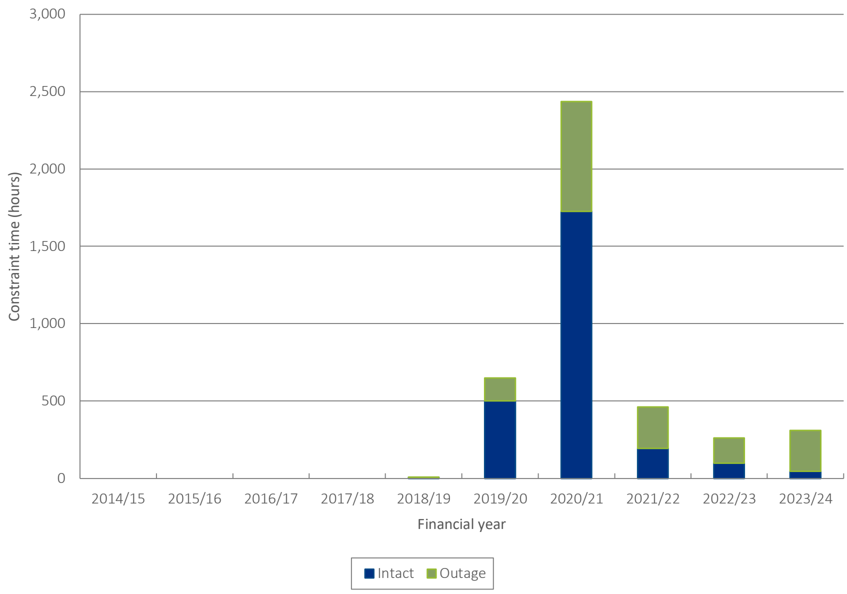
North Queensland (NQ) has been the focus of system strength limitations in Queensland due to the high number of VRE plants and relatively low synchronous fault levels. Electromagnetic Transient-type (EMT-type) analysis has been performed to determine the system conditions that could result in unstable operation of VRE plant. The limit equations in Table G.3 of Appendix G reflect the output of this analysis. The limit equations show that the following variables have a significant effect on NQ system strength:

- number of synchronous units online in CQ and NQ
- NQ demand
- status of Haughton Synchronous Condenser.

The historical duration of constrained operation for inverter-based resources in NQ is summarised in Figure 7.15. During 2023/24, inverter-based resources in NQ experienced 310 hours of constrained operation, of which 46 hours occurred during intact system conditions.

In December 2021, AEMO declared a fault level shortfall at the Gin Gin node in the Wide Bay zone. Subsequently Powerlink initiated an Expression of Interest (EOI) for services to address this fault level shortfall. Powerlink reviewed all submissions to the EOI and concluded that a non-network solution to modify the Townsville Power Station to allow it to operate in synchronous condenser mode when not generating was the least cost option. Powerlink has entered into a System Strength Services Agreement with the power station owner, Ratch Australia, to facilitate modification of the power station by mid-2025[3].

Figure 7.15 Historical NQ system strength constraint times



7.6.4 Gladstone grid section

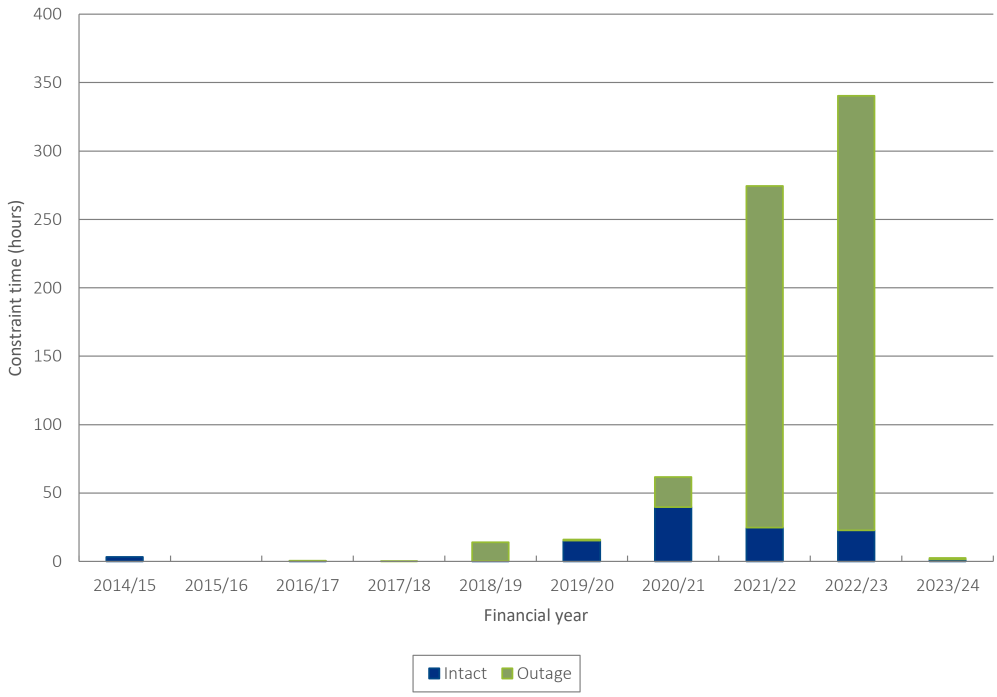
Maximum power transfer across the Gladstone grid section is set by the thermal rating of the Bouldercombe to Raglan, Larcom Creek to Calliope River, Calvale to Wurdong or the Calliope River to Wurdong 275kV circuits.

If the rating would otherwise be exceeded following a critical contingency, generation is constrained to reduce power transfers. Powerlink makes use of dynamic line ratings and rates the relevant circuits to take account of prevailing ambient weather conditions to maximise the available capacity of this grid section and, as a result, reduce market impacts. The appropriate ratings are updated in National Electricity Market Dispatch Engine (NEMDE).

The historical duration of constrained operation for the Gladstone grid section is summarised in Figure 7.16. During 2023/24, the Gladstone grid section experienced 3 hours of constrained operation, with 2 hours during intact system conditions.

3 Powerlink, Request for Power System Security Services – Final Report Part 2 – System Strength at Gin Gin, January 2024.

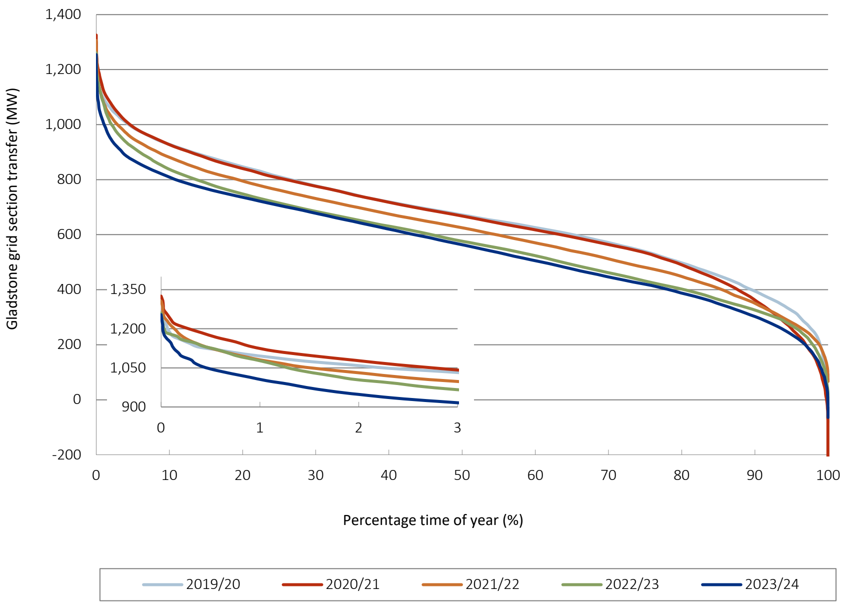
Figure 7.16 Historical Gladstone grid section constraint times



Power flows across this grid section are highly dependent on the balance of generation and demand in Gladstone and transfers to between Central Queensland (CQ) and SQ. Figure 7.17 provides historical transfer duration curves showing slightly decreased utilisation in 2023/24 compared to 2022/23. Even though demand increased and generation decreased in the Gladstone zone, this was more than offset by the decrease in CQ-SQ grid section flows resulting in lower Gladstone grid section flows (refer to figures 7.7, 7.8 and 7.9).

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 with potential new loads and generation changes. The Gladstone Project has been declared a Queensland Actionable Project in AEMO's 2024 Integrated System Plan (ISP) and consultation has begun for this project to be a Priority Transmission Investment (PTI). See Section 8.2.5 for more detail.

Figure 7.17 Historical Gladstone grid section transfer duration curves



7.6.5 Central Queensland to Southern Queensland grid section

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

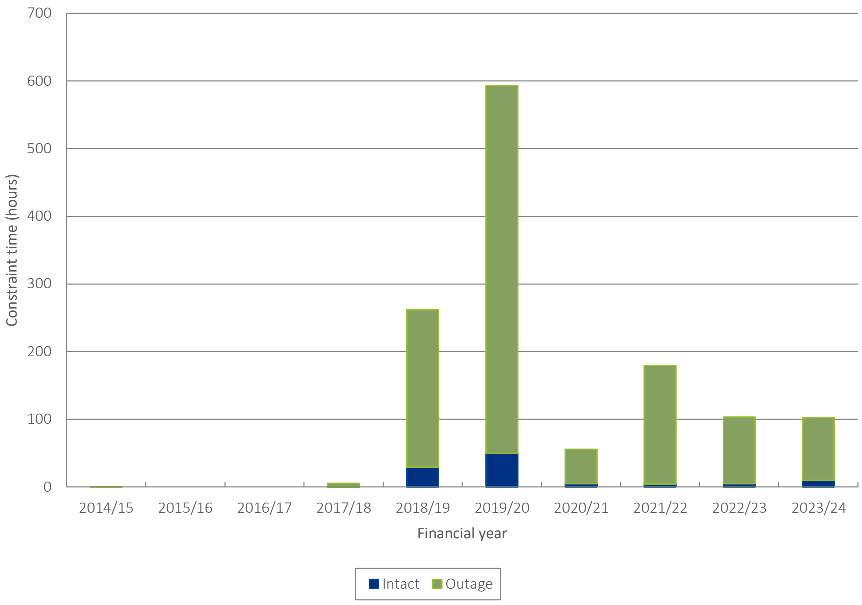
The voltage stability limit is set by insufficient reactive power reserves in the Central West and Gladstone zones following a contingency. More generating units online in these zones increase reactive power support and therefore transfer capability.

The limit equation in Table G.4 of Appendix G 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 PS generation.

The historical duration of constrained operation for the CQ-SQ grid section is summarised in Figure 7.18. During 2023/24, the CQ-SQ grid section experienced 103 hours of constrained operation. Constrained operation was due to outages associated with planned maintenance activities. Only 10 hours of constrained operation was during intact system conditions.

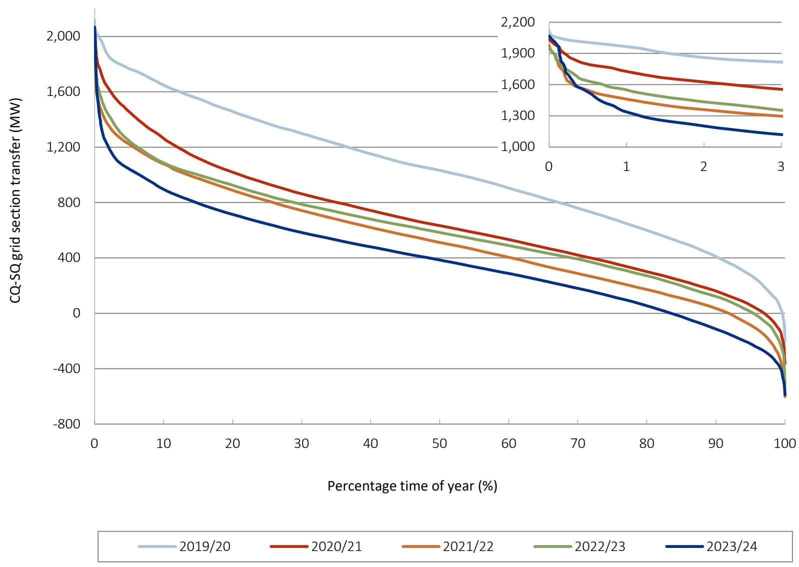
Figure 7.18 Historical CQ-SQ grid section constraint times



As discussed in Chapter 2, augmentation of the network between SQ and CQ is part of the Queensland SuperGrid. This augmentation will increase transfer limits on this grid section, support new load developments and increase the hosting capacity of renewable generation in these regions.

Figure 7.19 provides historical transfer duration curves showing the lowest transfers over the last five years. In the 2023/24 year there was a decrease in output from generation in central Queensland, but this was offset by an increase in output from generation in south Queensland (refer to figures 7.7, 7.8 and 7.9).

Figure 7.19 Historical CQ-SQ grid section transfer duration curves



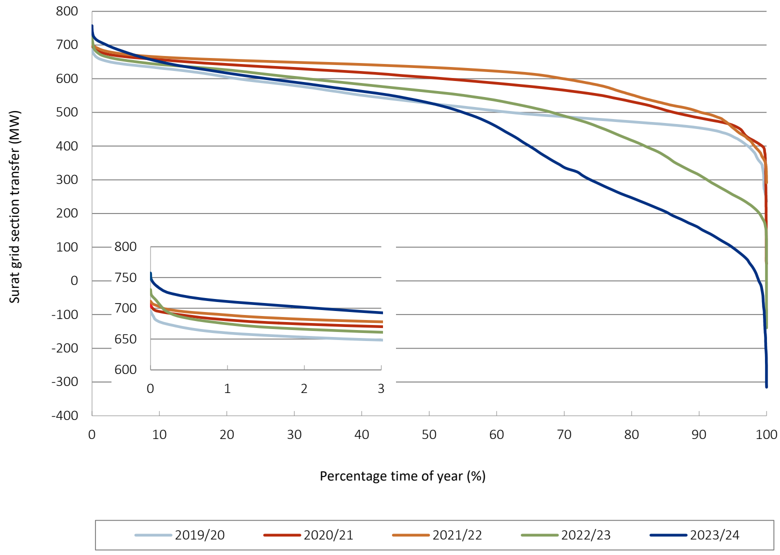
The eastern single circuit transmission lines of CQ-SQ traverse a variety of environmental conditions that have different rates of corrosion resulting in varied risk levels across the transmission lines. Depending on transmission line location, it is expected that sections of lines will be at end of technical service life from the next five to 10 years.

7.6.6 Surat grid section

The maximum power transfer across the Surat grid section is set by voltage stability associated with insufficient reactive power reserves in the Surat zone following an outage of a Western Downs to Orana 275kV circuit[4]. 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 7.20 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.

Figure 7.20 Historical Surat grid section transfer duration curve



7.6.7 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 historical duration of constrained operation for the SWQ grid section is summarised in Figure 7.21. After many years of unconstrained operation, the SWQ grid section experienced four and a half hours of constrained operation in 2023/24. Constrained operation was due to outages associated with planned maintenance activities.

4 The Orana Substation is connected to one of the Western Downs to Columboola 275kV transmission lines (refer to Figure 7.5).

Figure 7.21 Historical South West Queensland grid section constraint times

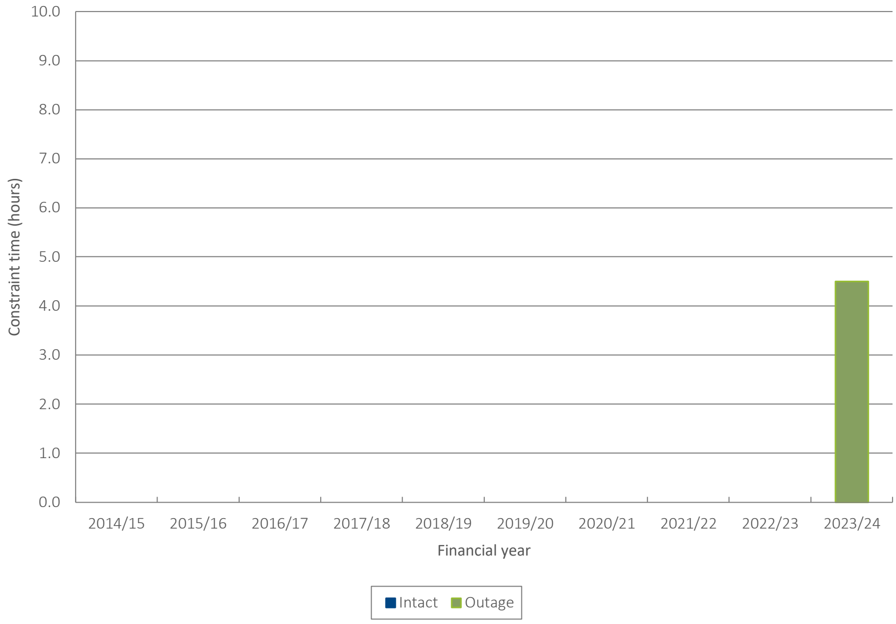
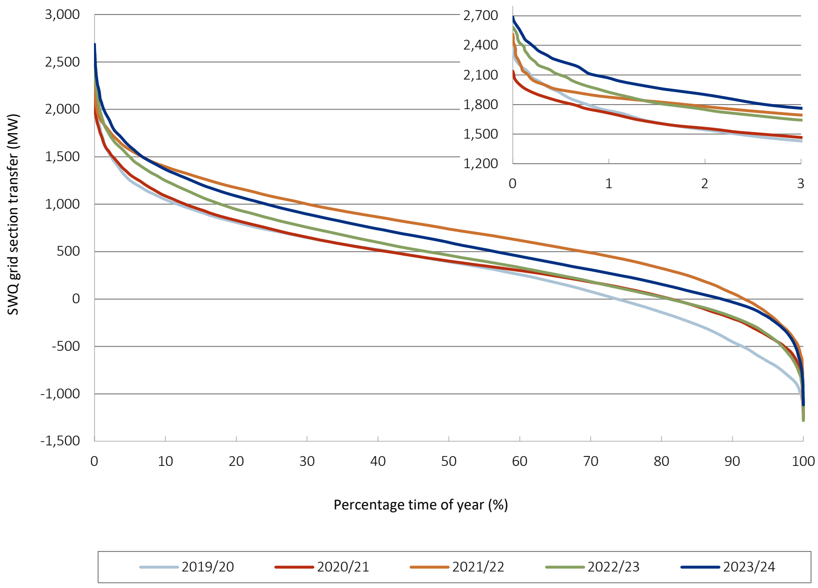


Figure 7.22 provides historical transfer duration curves for the SWQ grid section. Flows have increased compared to 2022/23 due to lower CQ-SQ flows and higher generation in the Bulli and Surat zones (refer to figures 7.7, 7.8 and 7.9).

Figure 7.22 Historical SWQ grid section transfer duration curves



AEMO's 2024 Integrated System Plan[5] (ISP) identified stage 1 of the Darling Downs REZ Expansion as a future ISP project. This project involves an upgrade to the transformer capacity at Middle Ridge Substation. However, the ISP identified that this increase in capacity would not be required before 2034/35.

7.6.8 Tarong grid section

Maximum power transfer across the Tarong grid section is set by 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.

[5] AEMO, 2024 Integrated System Plan (ISP), June 2024.

Limit equations in Table G.5 of Appendix G 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 (SEQ) demand. This is because reactive margins increase with additional local generation, allowing further load to be delivered before reaching minimum allowable reactive margins. However, due to its distributed and reactive nature, increases in delivered demand erode reactive margins at greater rates than they were created by the additional local generation. Limiting power transfers are thereby lower with the increased local generation but a greater load can be delivered.

The Tarong grid section was unconstrained in 2023/24. The historical duration of constrained operation for the Tarong grid section is summarised in Figure 7.23. Constraint times have been minimal over the last 10 years.

Figure 7.23 Historical Tarong grid section constraint times

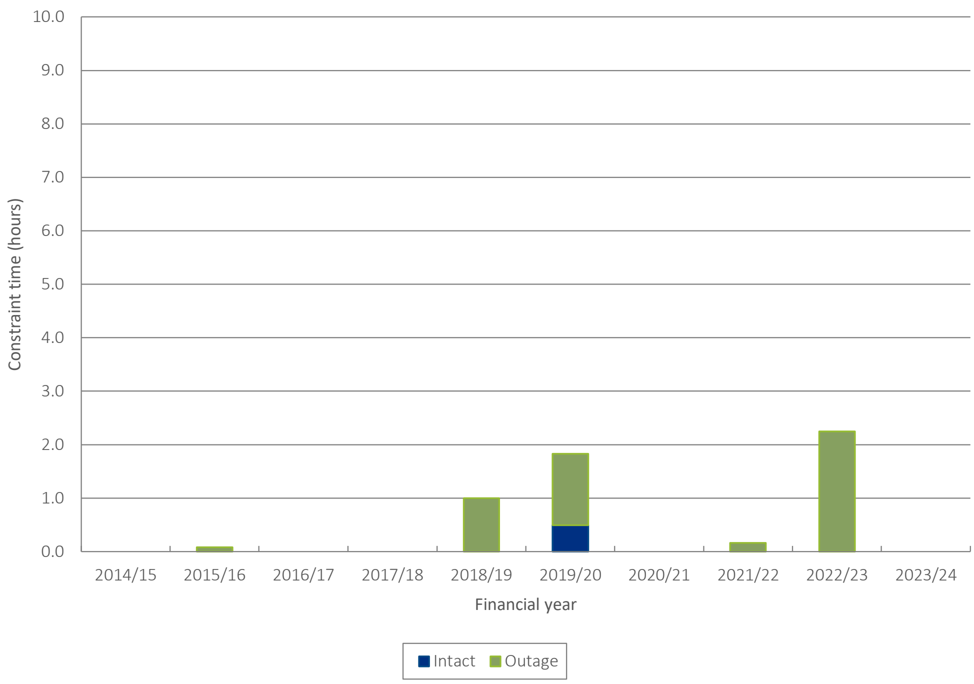
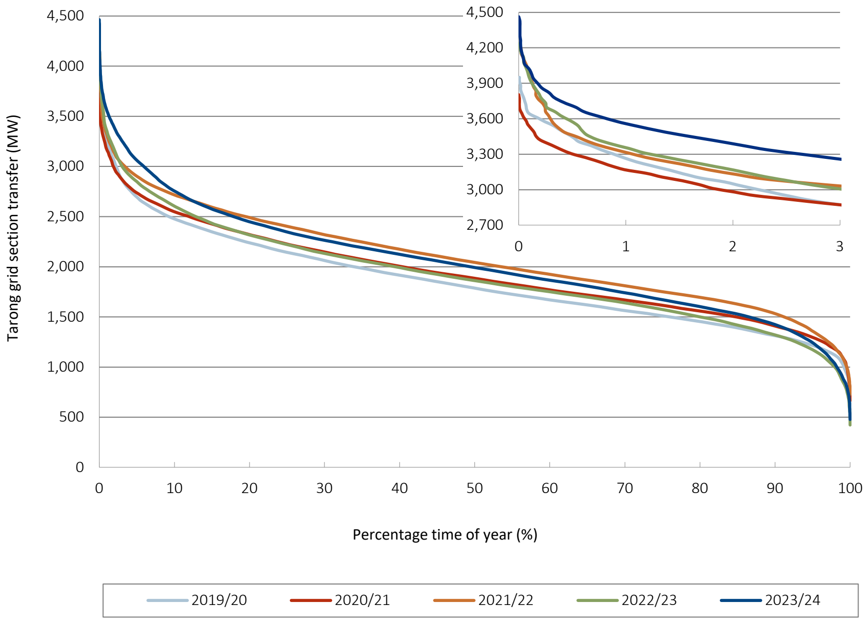


Figure 7.24 provides historical transfer duration curves for the Tarong grid section. Similar to the SWQ grid section, flows have increased compared to 2022/23 due to lower CQ-SQ flows and higher generation in the South West, Bulli and Surat zones (refer to figures 7.7, 7.8 and 7.9).

Figure 7.24 Historical Tarong grid section transfer duration curves



7.6.9 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 G.6 of Appendix G 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. However, due to its distributed and reactive nature, increases in delivered demand erode reactive margins at greater rates than they were created by the reduction in Terranora Interconnector southerly transfer. Limiting power transfers are thereby lower with reduced Terranora Interconnector southerly transfer but a greater load can be delivered.

The historical duration of constrained operation for the Gold Coast grid section is summarised in Figure 7.25. After many years of unconstrained operation, the Gold Coast grid section experienced 20 minutes of constrained operation in 2023/24. Constrained operation was due to outages associated with planned maintenance activities.

Figure 7.25 Historical Gold Coast Queensland grid section constraint times

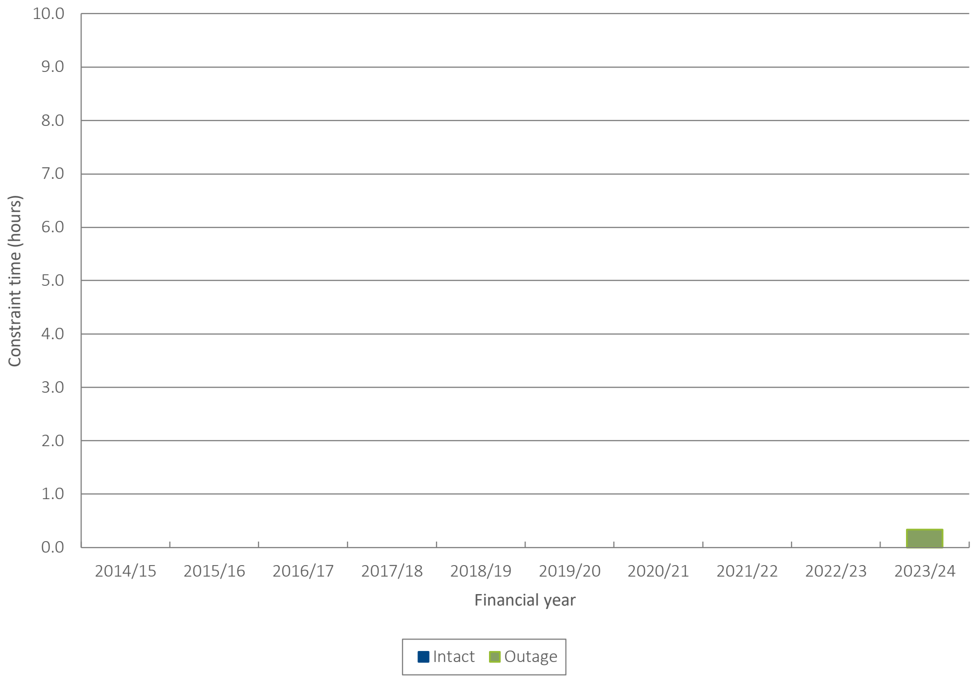
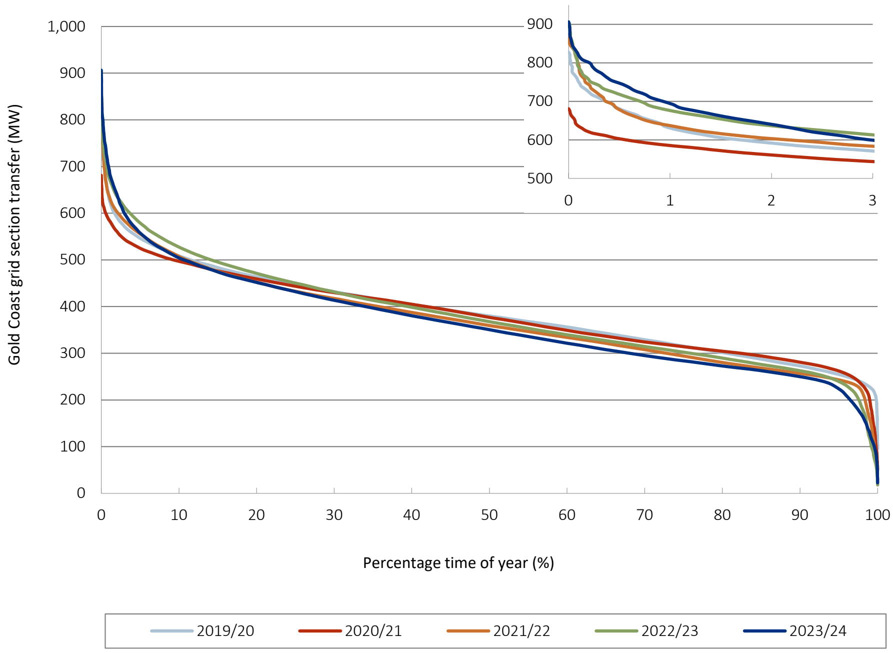


Figure 7.26 provides historical transfer duration curves showing changes in grid section transfer demands and energy in line with changes in transfer to northern NSW and changes in Gold Coast loads (refer to figures 7.7, 7.8 and 7.9).

Figure 7.26 Historical Gold Coast grid section transfer duration curves



7.6.10 QNI and Terranora interconnector

The transfer capability across QNI is limited by voltage stability, transient stability, oscillatory stability, and line thermal rating considerations. The capability across QNI at any particular 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 includes 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 contained in these Monthly Constraint Reports. The Monthly Constraint Report 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 New South Wales (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 complete and inter-network testing activities, as required by NER 5.7.7, are progressing.

AEMO's 2024 Integrated System Plan[6] (ISP) considered the QNI Connect project that would increase transfer capacity between Queensland and New South Wales. This project has been deemed an Actionable Project and Powerlink will be working with Transgrid to commence the Regulatory Investment Test for Transmission (RIT-T) process.

7.7 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[7]
- 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[8]) 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.

6 AEMO, 2024 Integrated System Plan (ISP), June 2024.
7 AEMO, List of Vulnerable Transmission Lines, effective March 2024.
8 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.

Statewide delivered energy has increase slightly from 2022/23 to 2023/24. Many zones experienced either record maximum demand or record minimum demand (both is some cases). This is a trend that has continued from recent years driven by the growth of rooftop photovoltaic (PV). As at 30 June 2024 there was 6,400MW of rooftop PV generating capacity in the state[9]. This is an increase of 817MW over the year. The following sections show load duration curves for each zone. See Figure 3.16 for annual transmission delivered demand load duration curves for the Queensland region as a whole.

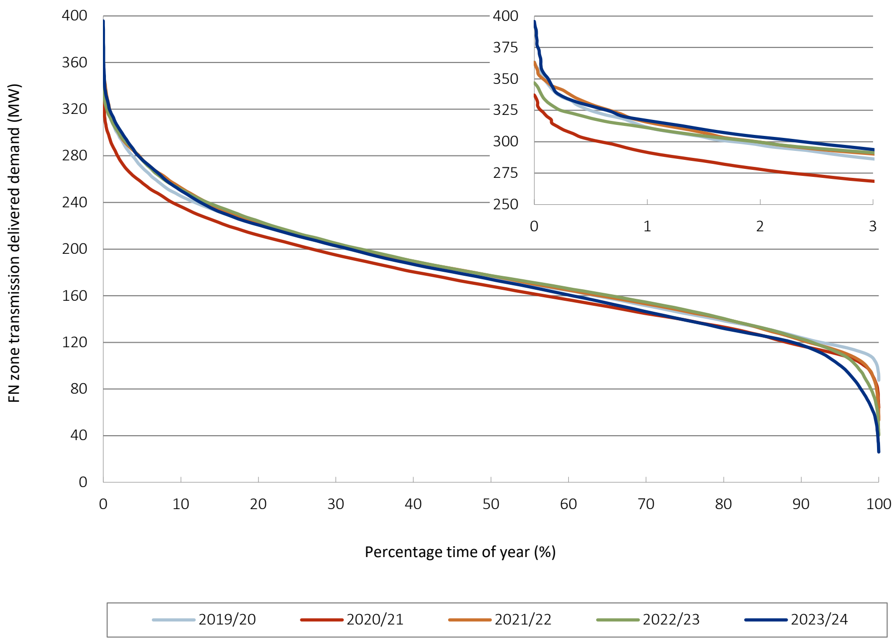
7.7.1 Far North zone

The Far North zone experienced one load loss for a single network element outage during 2023/24. The total duration of the outage was 14 minutes and approximately 7MWh of energy was lost. The load loss was caused by the loss of a single element outage which then triggered the Edmonton Special Protection Scheme. This scheme was put in place to manage FNQ voltages during the period where the Ross to Woree tee Tully South 275kV feeder was operational without the Tully South transformer. Since the commissioning of the Tully South transformer in June 2024 this Edmonton Special Protection Scheme has been disarmed.

The Far North zone includes the non-scheduled embedded generator Lakeland Solar and Storage as defined in Figure 3.9. This embedded generator provided 18GWh during 2023/24.

Figure 7.27 provides historical transmission delivered load duration curves for the Far North zone. Energy delivered from the transmission network has decreased by 2.2% between 2022/23 and 2023/24. The maximum transmission delivered demand in the zone was 396MW, which is the highest maximum demand in the last decade. The minimum transmission delivered demand in the zone was 26MW, which is the lowest minimum demand on record.

Figure 7.27 Historical Far North zone transmission delivered load duration curves



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

- Chalumbin to Turkinje 132kV double circuit transmission line, last tripped November 2022.
- Ross to Woree tee Tully South 275kV circuit and Cardwell to Tully 132kV circuit, last tripped February 2024. These lines share the same transmission towers.

[9] Clean Energy Regulator, Postcode data for small-scale installations – all data, data as at 31/08/2024, August 2024.

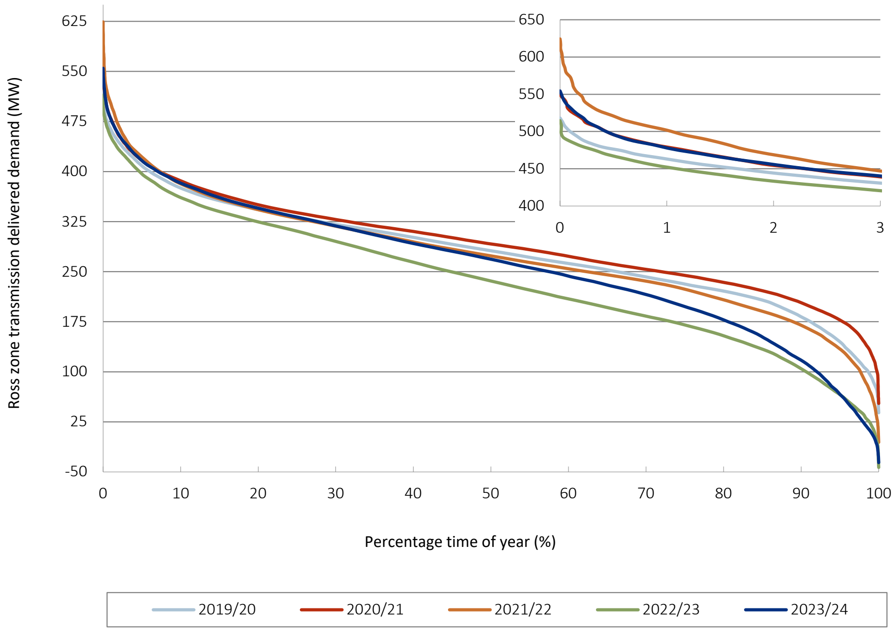
7.7.2 Ross zone

The Ross zone experienced no load loss for a single network element outage during 2023/24.

The Ross zone includes the scheduled embedded Townsville PS 66kV component (steam turbine component of the CCGT), semi-scheduled distribution connected embedded Kidston Solar Farm, Kennedy Energy Park and direct connected embedded Sun Metals Solar Farm, and the significant non-scheduled embedded generators Hughenden Solar Farm and Pioneer Mill as defined in Figure 3.9. These embedded generators provided 569GWh during 2023/24.

Figure 7.28 provides historical transmission delivered load duration curves for the Ross zone. Energy delivered from the transmission network has increased by 10.2% between 2022/23 and 2023/24. The increase in energy delivered is due to the combination of increase in native load and decrease in energy from embedded generation. The peak transmission delivered demand in the zone was 555MW, which is below the highest maximum demand over the last five years of 624MW set in 2021/22. The minimum transmission delivered demand in the zone was -36MW, which is the slightly higher than the record minimum set last year.

Figure 7.28 Historical Ross zone transmission delivered load duration curves



As a result of double circuit outages associated with lightning strikes, AEMO includes the Ross to Chalumbin 275kV double circuit transmission line in the vulnerable list. This double circuit tripped due to lightning in January 2020 and again in November 2022.

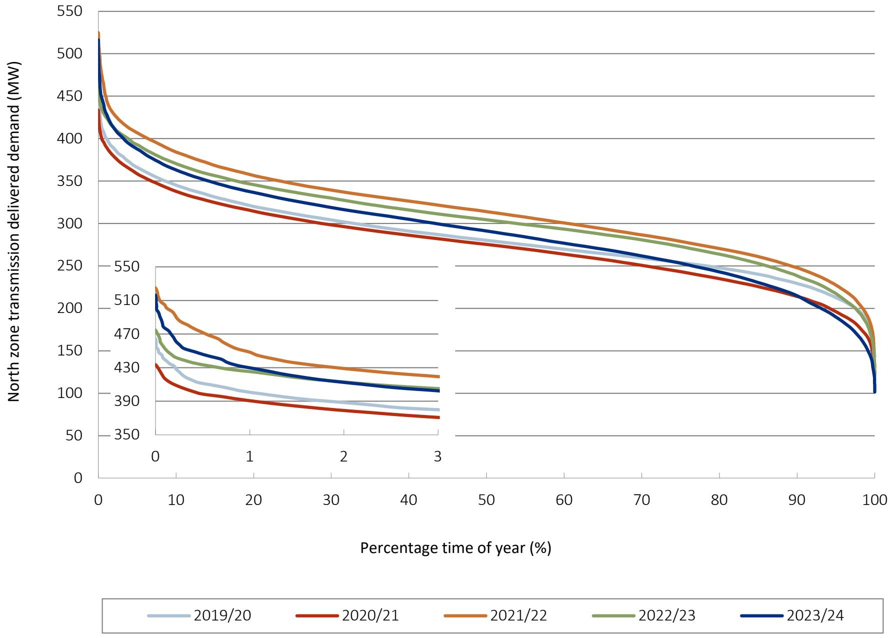
7.7.3 North zone

The North zone experienced two load losses for a single network element outage during 2023/24. The total duration of the outages was approximately 3 hours and 5MWh of energy was lost. The loads impacted by these outages are supplied by a single radial connection under intact system conditions.

The North zone includes semi-scheduled embedded generator Collinsville Solar Farm and significant nonscheduled embedded generators Moranbah North, Moranbah and Racecourse Mill as defined in Figure 3.9. These embedded generators provided 608GWh during 2023/24.

Figure 7.29 provides historical transmission delivered load duration curves for the North zone. Energy delivered from the transmission network has decreased by 4.5% between 2022/23 and 2023/24. The peak transmission delivered demand in the zone was 516MW, below the highest maximum demand over the last five years of 525MW set in 2021/22. The minimum transmission delivered demand in the zone was 101MW, which is the lowest minimum demand in the last five years.

Figure 7.29 Historical North zone transmission delivered load duration curves



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 tipped November 2022
- Strathmore to Clare South and Strathmore to Clare South tee King Creek 132kV double circuit transmission line, last tripped December 2023.

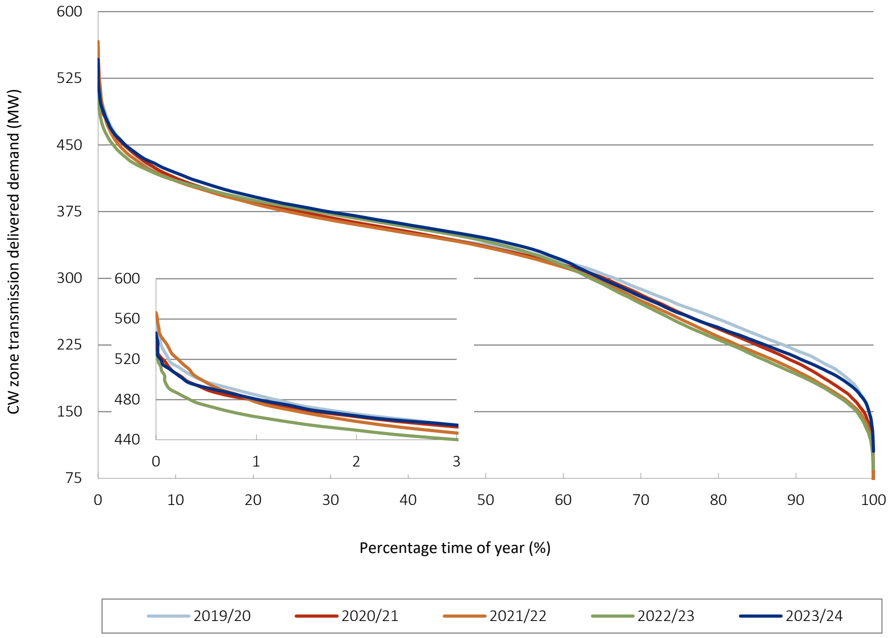
7.7.4 Central West zone

The Central West zone experienced no load loss for a single network element outage during 2023/24.

The Central West zone includes the scheduled embedded Barcaldine generator, semi-scheduled embedded generators Clermont Solar Farm, Emerald Solar Farm and Middlemount Solar Farm and significant non-scheduled embedded generators Barcaldine Solar Farm, Longreach Solar Farm, German Creek and Oaky Creek as defined in Figure 3.9. These embedded generators provided 587GWh during 2023/24.

Figure 7.30 provides historical transmission delivered load duration curves for the Central West zone. Energy delivered from the transmission network has increased by 3.0% between 2022/23 and 2023/24, which is the highest in the last five years. The peak transmission delivered demand in the zone was 546MW, below the highest maximum demand over the last five years of 566MW set in 2021/22. The minimum transmission delivered demand in the zone was 105MW, which is higher than the lowest minimum demand over the last decade, which was 64MW recorded in 2020/21.

Figure 7.30 Historical Central West zone transmission delivered load duration curves



EDL has advised AEMO of its intention to retire Oaky Creek non-scheduled embedded generators in 2025.

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

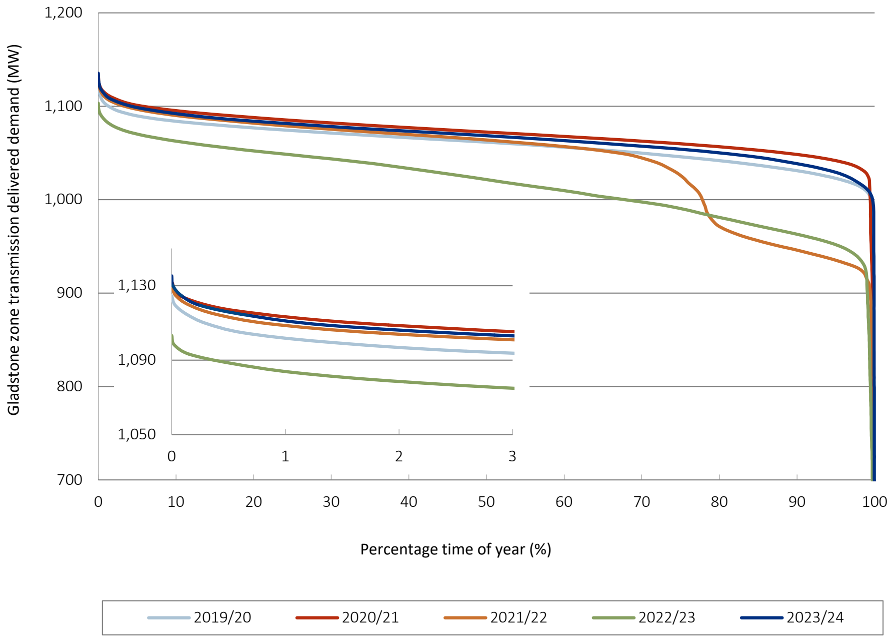
7.7.5 Gladstone zone

The Gladstone zone experienced no load loss for a single network element outage during 2023/24.

The Gladstone zone contains no scheduled, semi-scheduled or significant non-scheduled embedded generators as defined in Figure 3.9.

Figure 7.31 provides historical transmission delivered load duration curves for the Gladstone zone. Energy delivered from the transmission network has increased by 2.9% between 2022/23 and 2023/24 which is the highest in the last five years. The peak transmission delivered demand in the zone was 1,135MW, which is the highest maximum demand over the last five years. Minimum demand coincides with small periods when one or more of potlines at Boyne Smelters Limited (BSL) are out of service. The minimum transmission delivered demand in the zone was 616MW.

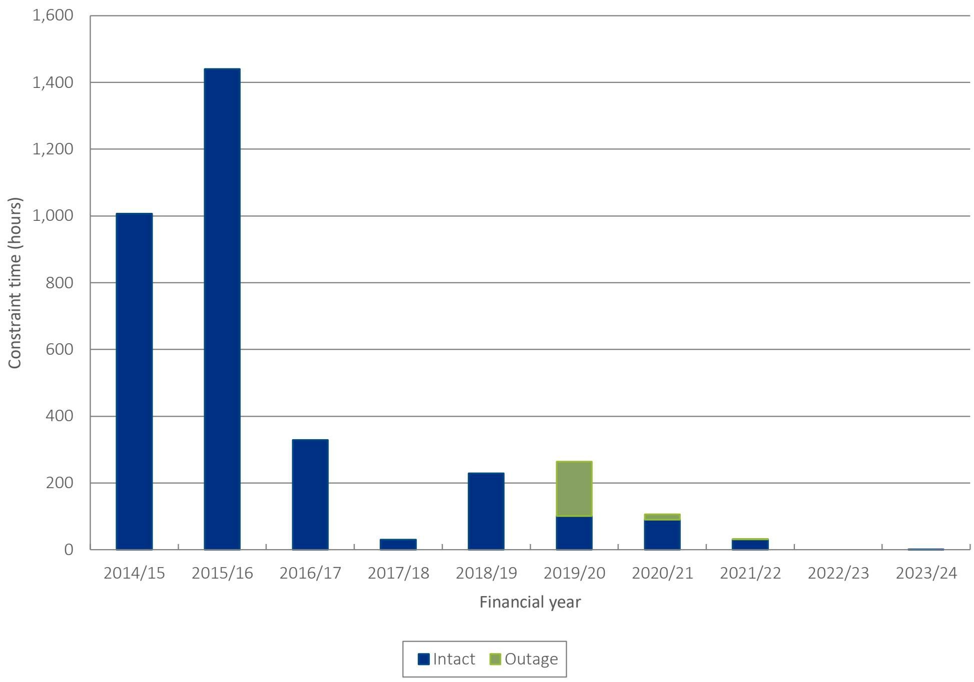
Figure 7.31 Historical Gladstone zone transmission delivered load duration curves



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 within BSL's substation. The constraint limits generation from Gladstone PS, 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 7.32. During 2023/24, the feeder bushing constraint experienced 20 minutes of constrained operation.

Figure 7.32 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.

7.7.6 Wide Bay zone

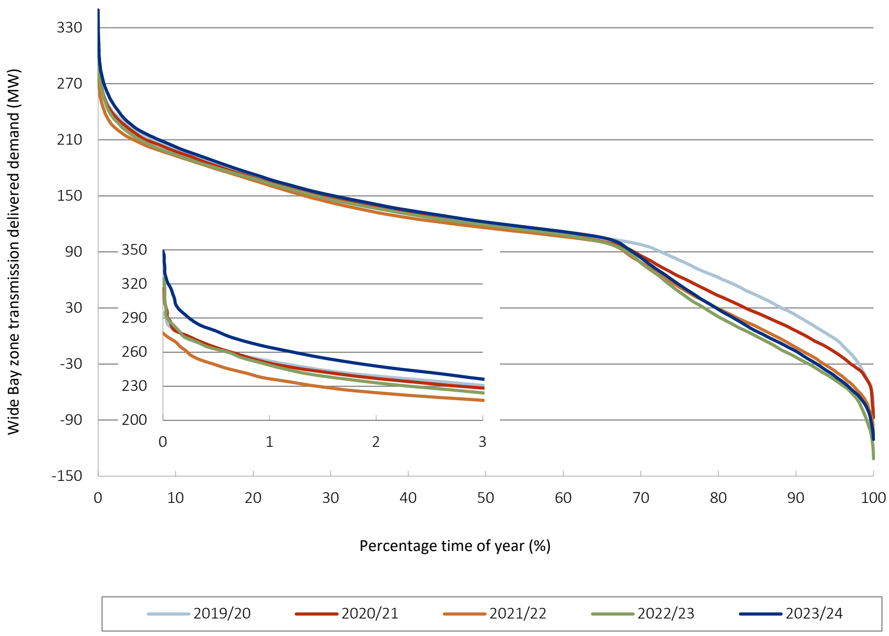
The Wide Bay zone experienced no load loss for a single network element outage during 2023/24.

The Wide Bay zone includes the semi-scheduled embedded generators Childers Solar Farm and Susan River Solar Farm, and significant non-scheduled embedded generator Isis Central Sugar Mill as defined in Figure 3.9. These embedded generators provided 231GWh during 2023/24.

Figure 7.33 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 5.9% between 2022/23 and 2023/24. The peak transmission delivered demand in the zone was 349MW, which is highest maximum demand in the last decade. The minimum transmission delivered demand in the zone was -111MW, which is higher than the lowest minimum demand over the last decade, which was -131MW recorded in 2022/23.

Figure 7.33 Historical Wide Bay zone transmission delivered load duration curves



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

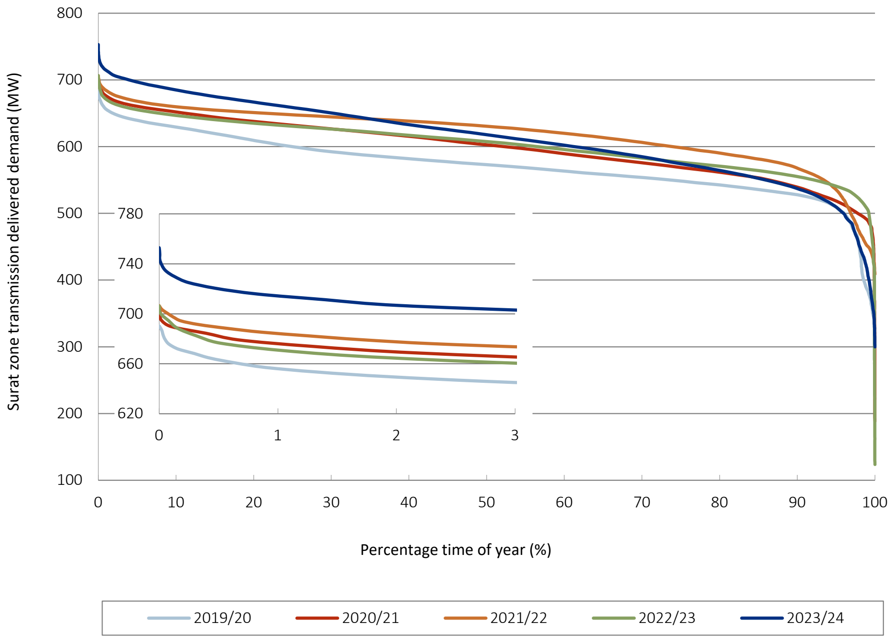
7.7.7 Surat zone

The Surat zone experienced no load loss for a single network element outage during 2023/24.

The Surat zone includes the scheduled embedded Roma and direct connected embedded Condamine generators, semi-scheduled Dulacca Wind Farm and significant non-scheduled embedded generator Baking Board Solar Farm as defined in Figure 3.9. These embedded generators supplied 625GWh during 2023/24.

Figure 7.34 provides historical transmission delivered load duration curves for the Surat zone. Energy delivered from the transmission network has increased by 1.8% between 2022/23 and 2023/24. The peak transmission delivered demand in the zone was 753MW, which is a record maximum demand for the zone. The minimum transmission delivered demand in the zone was 300MW.

Figure 7.34 Historical Surat zone transmission delivered load duration curves



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

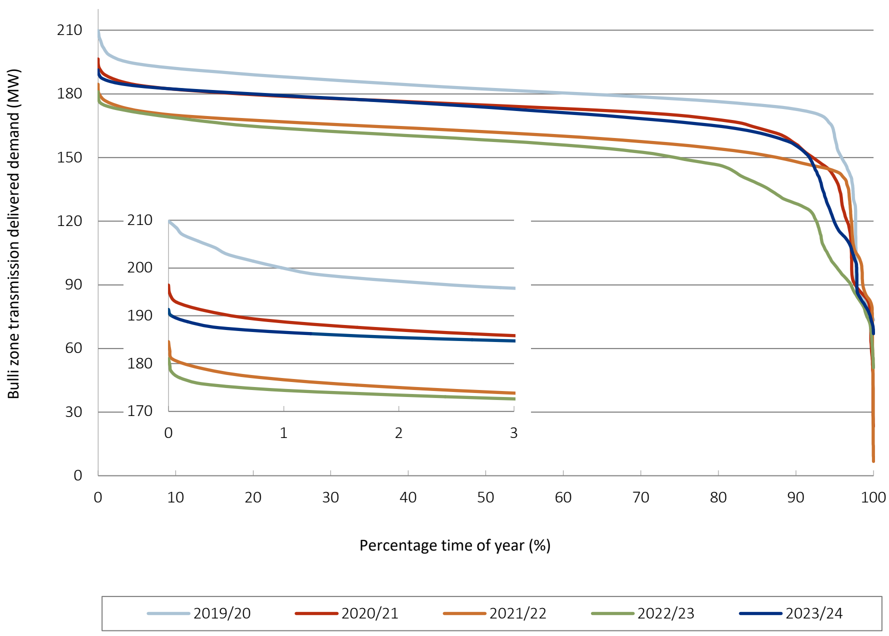
7.7.8 Bulli zone

The Bulli zone experienced no load loss for a single network element outage during 2023/24.

The Bulli zone contains no scheduled, semi-scheduled or significant non-scheduled embedded generators as defined in Figure 3.9.

Figure 7.35 provides historical transmission delivered load duration curves for the Bulli zone. Energy delivered from the transmission network has increased by 11.0% between 2022/23 and 2023/24, returning to historical typical levels. The peak transmission delivered demand in the zone was 191MW which is below the highest maximum demand over the last five years of 210MW set in 2019/20. The minimum transmission delivered demand in the zone was 67MW.

Figure 7.35 Historical Bulli zone transmission delivered load duration curves



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

7.7.9 South West zone

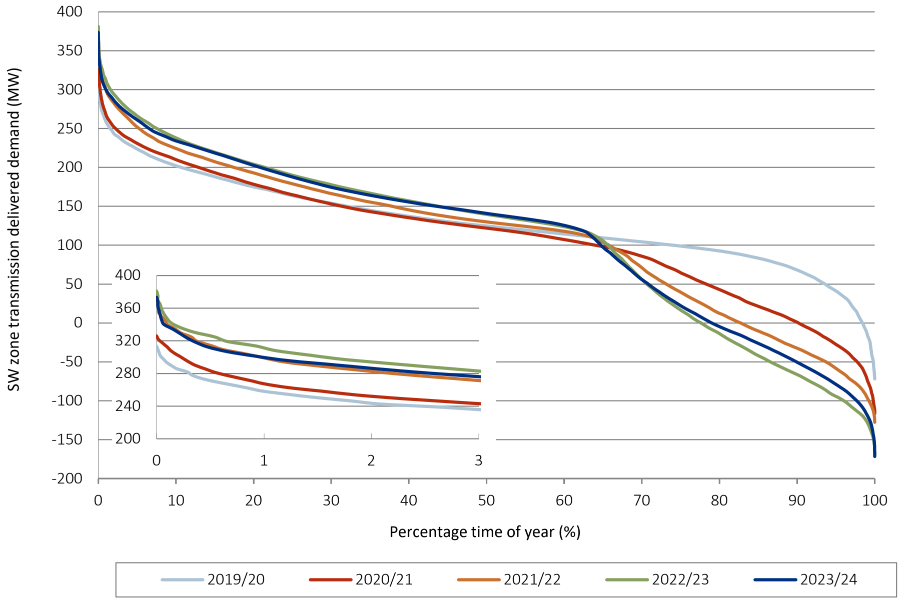
The South West zone experienced no load loss for a single network element outage during 2023/24.

The South West zone includes the semi-scheduled embedded generators Oakey 1 Solar Farm, Oakey 2 Solar Farm, Yarranlea Solar Farm, Maryrorough Solar Farm and Warwick Solar Farm as defined in Figure 3.9. These embedded generators provided 483GWh during 2023/24.

Figure 7.36 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 2.0% between 2022/23 and 2023/24, to the lowest level in the last decade. The peak transmission delivered demand in the zone was 372MW, which is slightly below the record maximum demand of 381MW recorded in 2022/23. The minimum transmission delivered demand in the zone was -172MW, which is the lowest demand on record.

Figure 7.36 Historical South West zone transmission delivered load duration curves



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

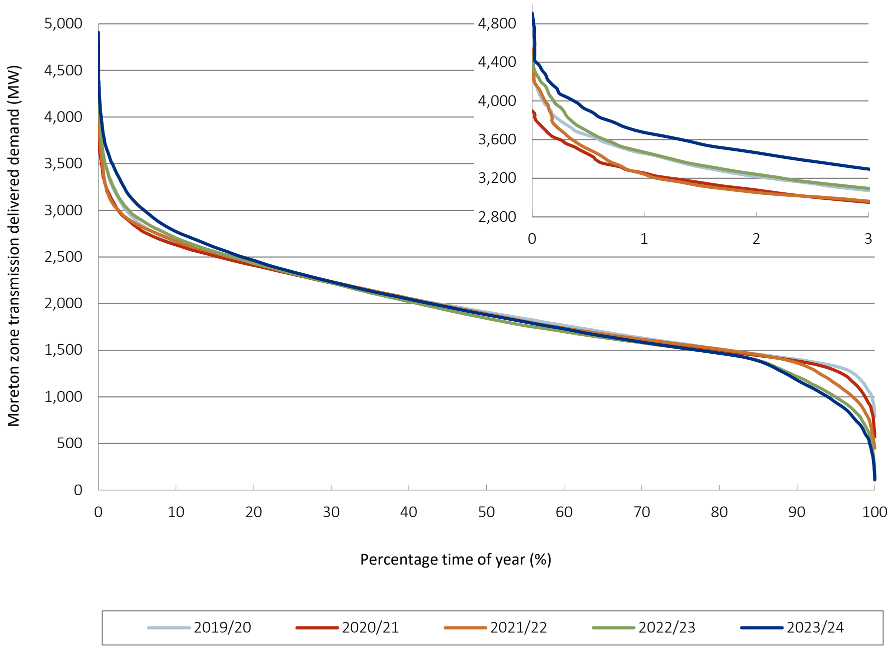
7.7.10 Moreton zone

The Moreton zone experienced no load loss for a single network element outage during 2023/24.

The Moreton zone includes the significant non-scheduled embedded generators Sunshine Coast Solar Farm, Bromelton and Rocky Point as defined in Figure 3.9. These embedded generators provided 62GWh during 2023/24.

Figure 7.37 provides historical transmission delivered load duration curves for the Moreton zone. Energy delivered from the transmission network has increased by 1.6% between 2022/23 and 2023/24. The peak transmission delivered demand in the zone was 4,908MW, which is highest maximum demand on record. The minimum transmission delivered demand in the zone was 110MW, which is the lowest demand on record. In late 2024 a bus reactor is expected to be commissioned at Belmont Substation.

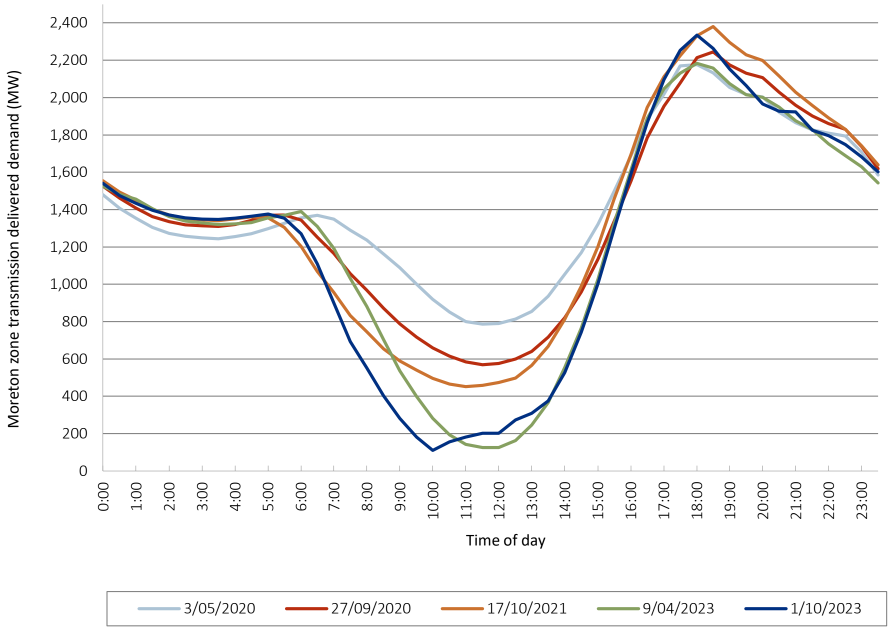
Figure 7.37 Historical Moreton zone transmission delivered load duration curves



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 2021, AEMO identified an Network Support and Control Ancillary Service (NSCAS) gap of up to 250 Megavolt Ampere reactive (MVAr) of reactive power absorption in the southern Queensland. Due to this gap, Powerlink initiated an EOI to identify network and non-network options to address this gap. Powerlink has now entered into a Network Support Agreement with CleanCo Queensland to address the immediate gap. In late 2024 a bus reactor will be commissioned at Belmont Substation to address the long-term reactive requirements.

Figure 7.38 provides the daily load profile for the minimum transmission delivered days for the Moreton zone over the last five years. This Figure shows that in 2023/24 the minimum demand would have been significantly lower without Energy Queensland managing demand in the middle of the day. The figure also highlights the increasing gap between minimum and maximum demand on these days.

Figure 7.38 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.

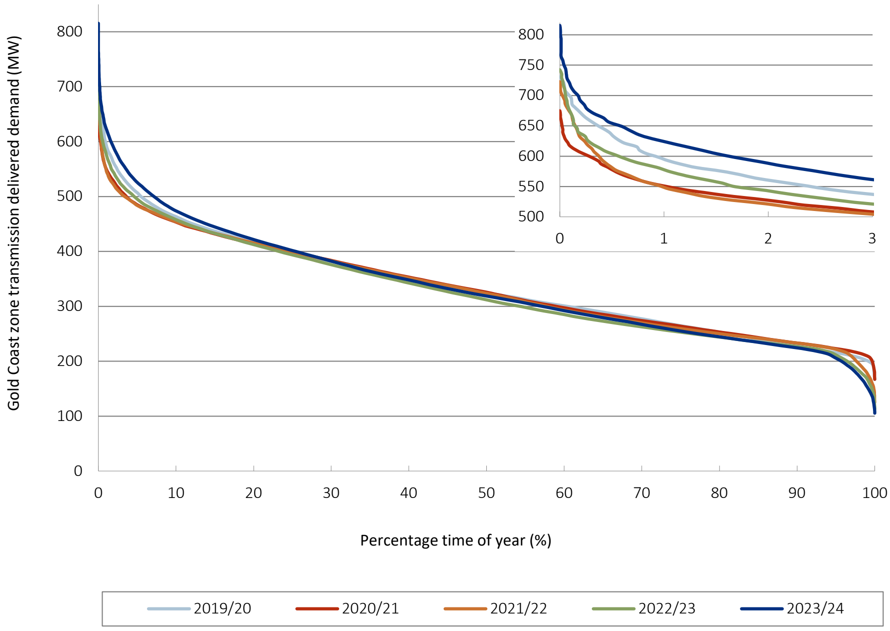
7.7.11 Gold Coast zone

The Gold Coast zone experienced no load loss for a single network element outage during 2023/24.

The Gold Coast zone contains no scheduled, semi-scheduled or significant non-scheduled embedded generators as defined in Figure 3.9.

Figure 7.39 provides historical transmission delivered load duration curves for the Gold Coast zone. Energy delivered from the transmission network increased by 2.5% between 2022/23 and 2023/24. The peak transmission delivered demand in the zone was 815MW, which is the highest maximum demand on record. The minimum transmission delivered demand in the zone was 105MW which is the lowest demand on record.

Figure 7.39 Historical Gold Coast zone transmission delivered load duration curves



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