2024 Enhanced Locational Information (ELI) Report

June 2024

A report for the National Electricity Market

Important notice

Purpose

This report has been published to implement the Energy Security Board (ESB) 'enhanced information' transmission access reforms. The report is intended to support more informed investment and decision-making processes in the National Electricity Market, by collating public metrics and indicators that represent important locational characteristics of the power system. This report includes only publicly available information from existing AEMO, industry, and stakeholder publications.

AEMO publishes this *Enhanced Locational Information (ELI) Report* pursuant to its functions in section 49(2)(c) of the National Electricity Law. This publication is generally based on information available to AEMO as at 30 April 2024, unless otherwise indicated.

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Version control

Version	Release date	Changes
1.0	07/06/2024	Initial release.

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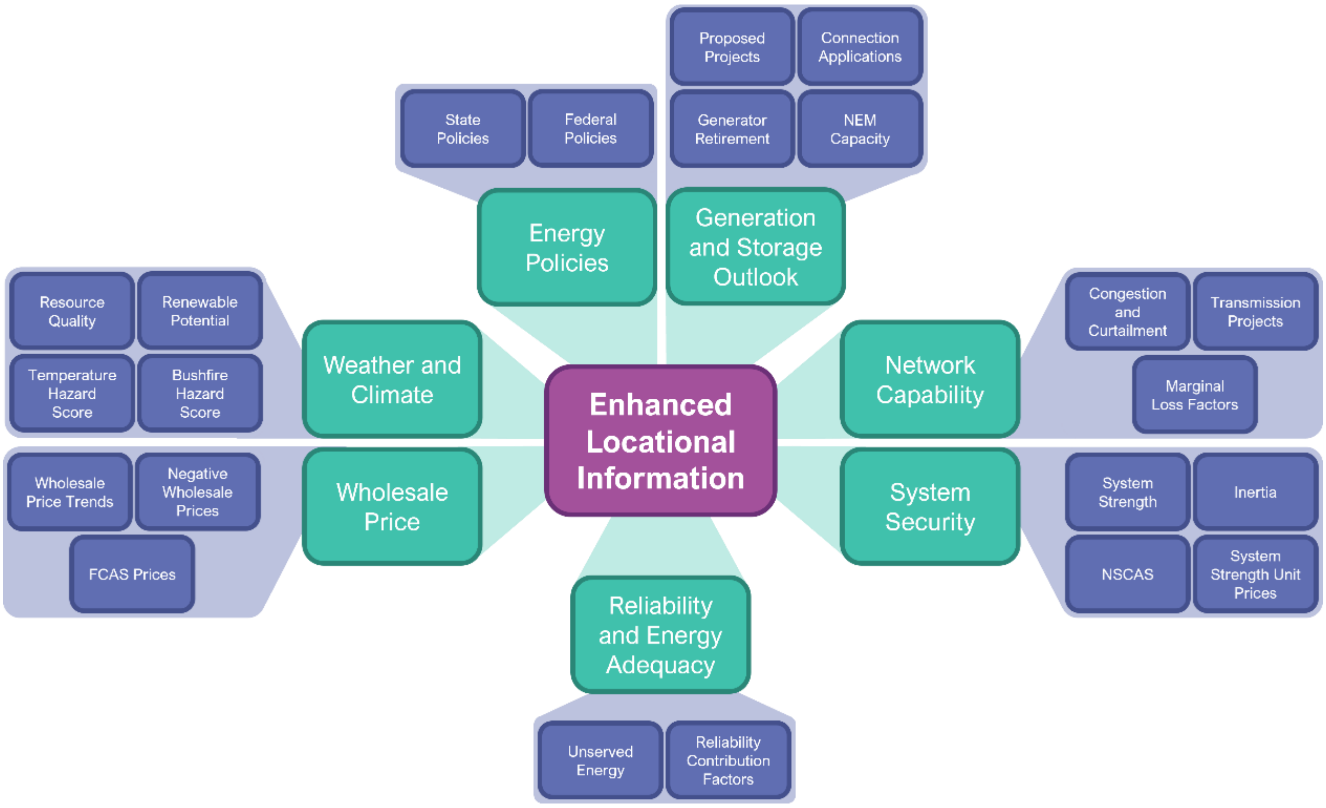
Executive summary

The energy transition is fundamentally changing the way that electricity is produced, consumed, and transported across the National Electricity Market (NEM). As the system moves further from its historical dependence on large synchronous generation, new challenges are emerging for maintaining system security and reliability. This presents a range of new risks and new opportunities for project developers; however, the most efficient decisions need to balance a range of complex technical and economic considerations across both geographical and electrical locations.

The NEM provides strong signals and mechanisms to help guide new investment towards the most efficient and cost-effective locations. However, the effectiveness of these signals can be limited if they are difficult to access, difficult to interpret, or difficult to compare across competing locations. This inaugural Enhanced Locational Information (ELI) Report aims to increase the transparency and accessibility of such signals by comparing a spectrum of associated locational metrics with graphic representation, as summarised in Figure 1.

Figure 1 Overview of indicator types considered in the 2024 ELI Report



Investment opportunities are available in all regions, however proponents must carefully consider competing investment signals

Opportunities exist across all regions for renewable energy and storage projects to provide energy, capacity, and network support services. These investment needs are bolstered by strong policy incentives, continued growth in peak demand, proximity to major loads, and the withdrawal of existing supply sources.

However, some network locations are reaching high levels of generator curtailment, and investors will need to consider factors such as access to high-quality renewable resources, network congestion, network losses, security requirements, future network, and competing projects nearby.

Thermal generation continues to withdraw, creating opportunities for new supply investment

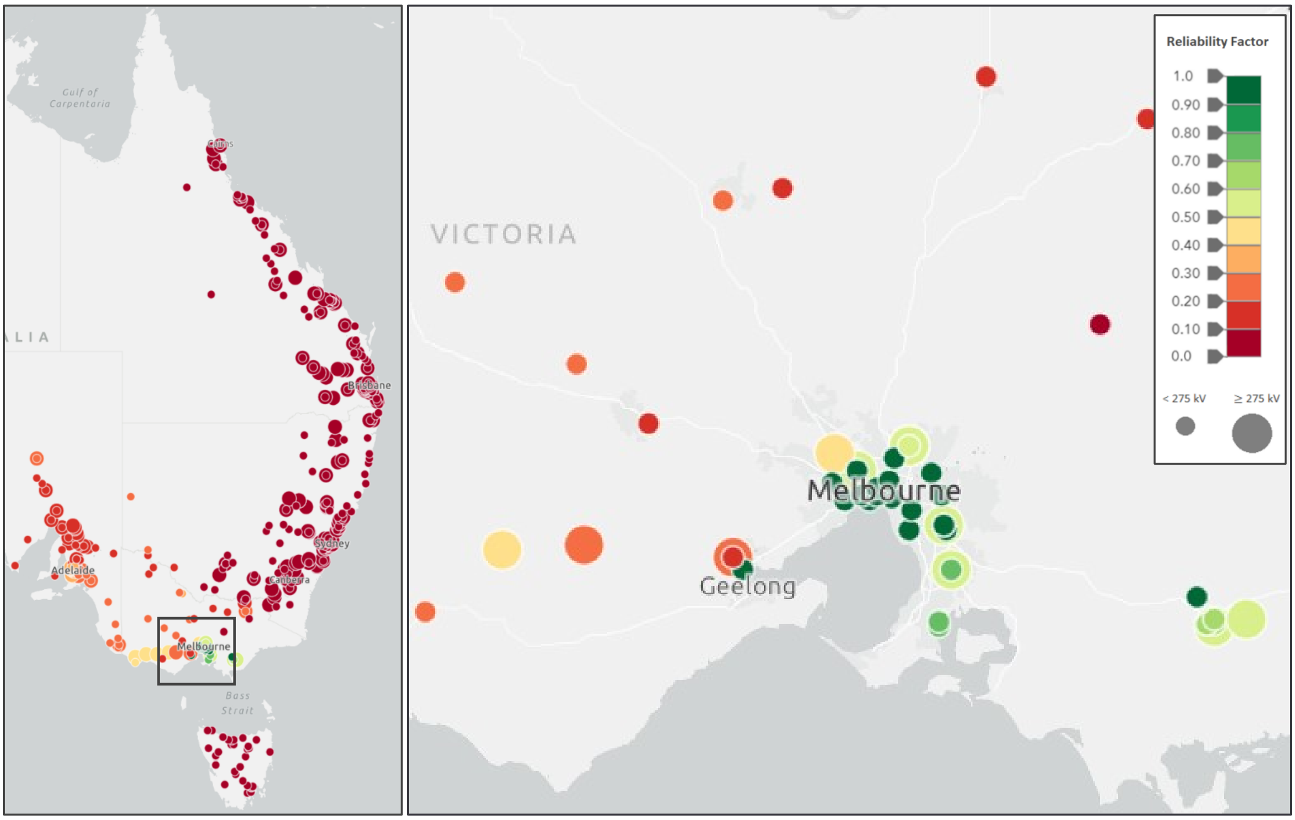
While new generation and storage projects are being deployed at pace, the existing fleet of coal-fired power stations are beginning to reach end-of-life. All but one of the remaining fleet have announced retirement plans between now and 2051. AEMO's Draft 2024 *Integrated System Plan* (ISP) projected that the remaining coal fleet may need to close several times faster than this under the *Step Change* scenario, with results indicating up to 90% of the coal fleet retiring by 2035.

As these existing thermal units withdraw, opportunities are emerging for alternative sources of supply to support power system reliability. The latest update to the 2023 *Electricity Statement of Opportunities* (ESOO) forecasts that reliability shortfalls will remain in all mainland NEM regions over the coming decade unless new supplies are built, with gaps emerging in Victoria and New South Wales as early as 2024-25.

The effectiveness of reliability-based investments are heavily influenced by network location

Opportunities to contribute towards reliability needs are strongly impacted by network congestion and the distribution of system load at times of peak demand. In 2024, AEMO has studied these locational reliability contribution factors to identify the expected reliability impact of new supplies. Figure 2, an example of this analysis for Victoria in 2029-30, highlights strong impacts at connection points in the Melbourne 220 kilovolts (kV) network.

Figure 2 ESOO Central scenario, locational reliability factors for Victorian USE, 2029-30



These results indicate that transmission capacity into Melbourne may be subject to congestion during Melbourne supply adequacy risks, signalling that coordinated network and supply-side investments may need to work in unison when addressing this emerging risk. This 2024 ELI report includes similar analysis for all regions, under both an ESOO Central scenario and an actionable transmission sensitivity.

State and federal energy policy is driving investment and reshaping the energy landscape

State and federal governments are united in their efforts to decarbonise Australia and have committed to strong transition targets, including an 82% renewable generation target by 2030, and a net zero emissions target by 2050.

As part of these efforts, new offshore renewable energy zones (REZs) have been declared across the southern and eastern coasts, and a Capacity Investment Scheme (CIS) is progressing to further bolster investment in renewable and clean dispatchable capacity across the country.

These policies will have a significant impact on the volume and geography of new generation and storage investment projects. As of February 2024, there were over 20 gigawatts (GW) of connection projects already at application stage, and AEMO is aware of over 280 GW of future proposed projects under consideration as of April 2024. These projects comprise 63% grid-scale wind and solar generation and a further 33% battery or pumped hydro storage, representing a predominantly renewable future fleet.

Some network locations are now experiencing significant levels of congestion and curtailment, presenting both risks and opportunities for new service providers.

While reliability presents significant opportunities for new energy providers, a reliable power system requires more than just sufficient levels of installed capacity and available energy. The system itself must also maintain an underlying set of security and stability services that ensure the generated energy can be transported and delivered safely, while maintaining a system that is stable and resilient against disturbances. Applying the physics of the power system can result in congestion, curtailment, network losses, and new opportunities for network support services.

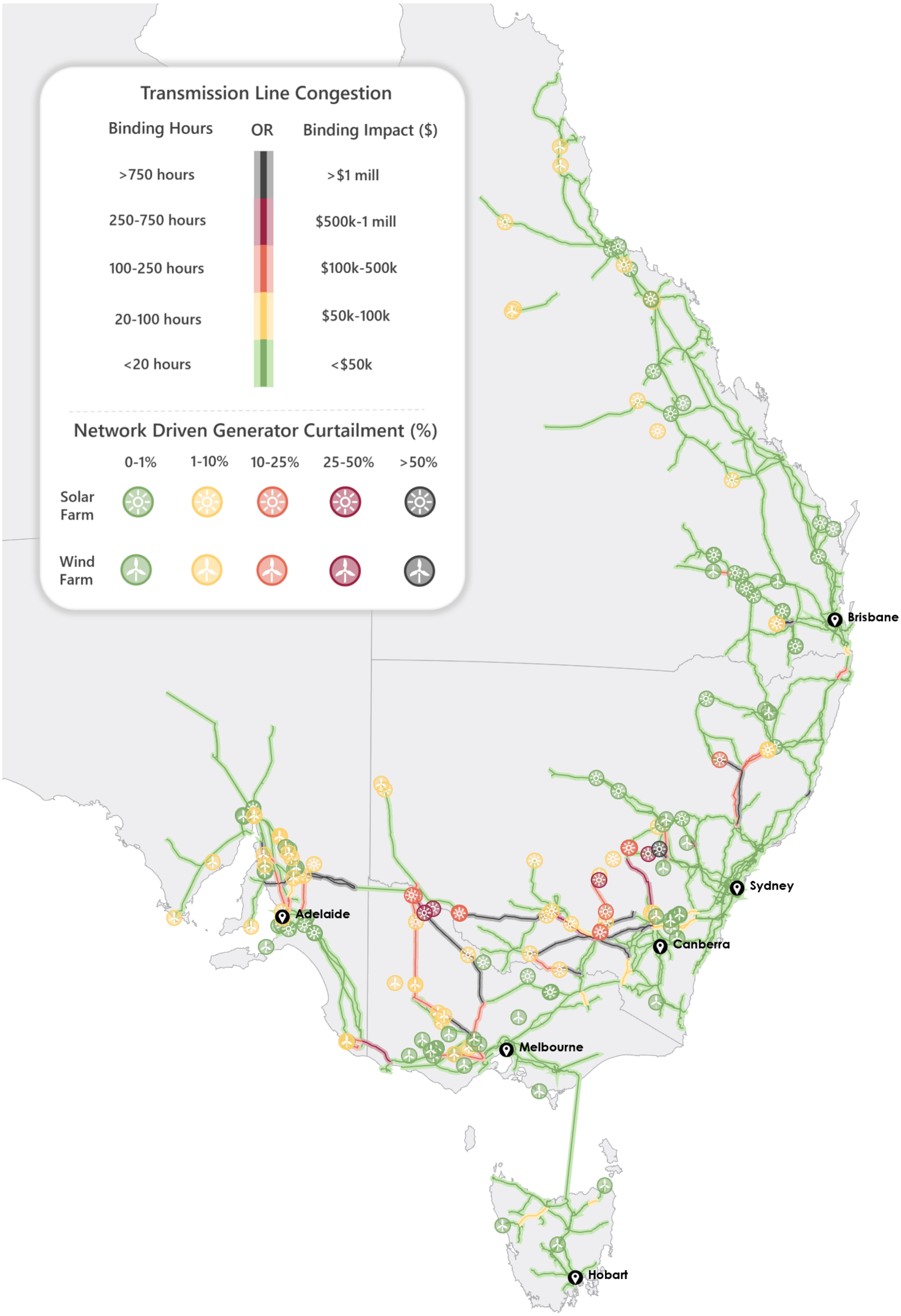
In 2023, approximately half of all grid-scale wind and solar generation experienced network-driven curtailment of less than 1%. Grid-scale wind generation across the NEM averaged 1.4% network curtailment but was as high as 9.0% for some units. Curtailment of solar generation ranged higher than this, averaging 4.6% with several solar farms experiencing very high levels of curtailment above 25%.

Figure 3 presents an overview of NEM congestion and curtailment outcomes for calendar year 2023. It shows that high curtailment was mainly concentrated in specific areas (particularly Western New South Wales and North West Victoria), and illustrates that most transmission lines did not experience significant congestion.

The most severe network congestion arose in areas with high levels of generation connected in locations that were originally designed to service demand rather than supply. These high network congestion areas broadly overlap with the areas experiencing high levels of generation curtailment.

While the ELI Report is intended to draw together a diverse set of locational signals and help inform proponent decisions, it is not intended to be a substitute for detailed project design work, tailored power system analysis, and fulsome economic modelling customised to specific proponent goals, assumptions, and risk tolerances.

Figure 3 Overview of NEM congestion and curtailment for calendar year 2023



AEMO is seeking feedback on the scope and value of information in this report

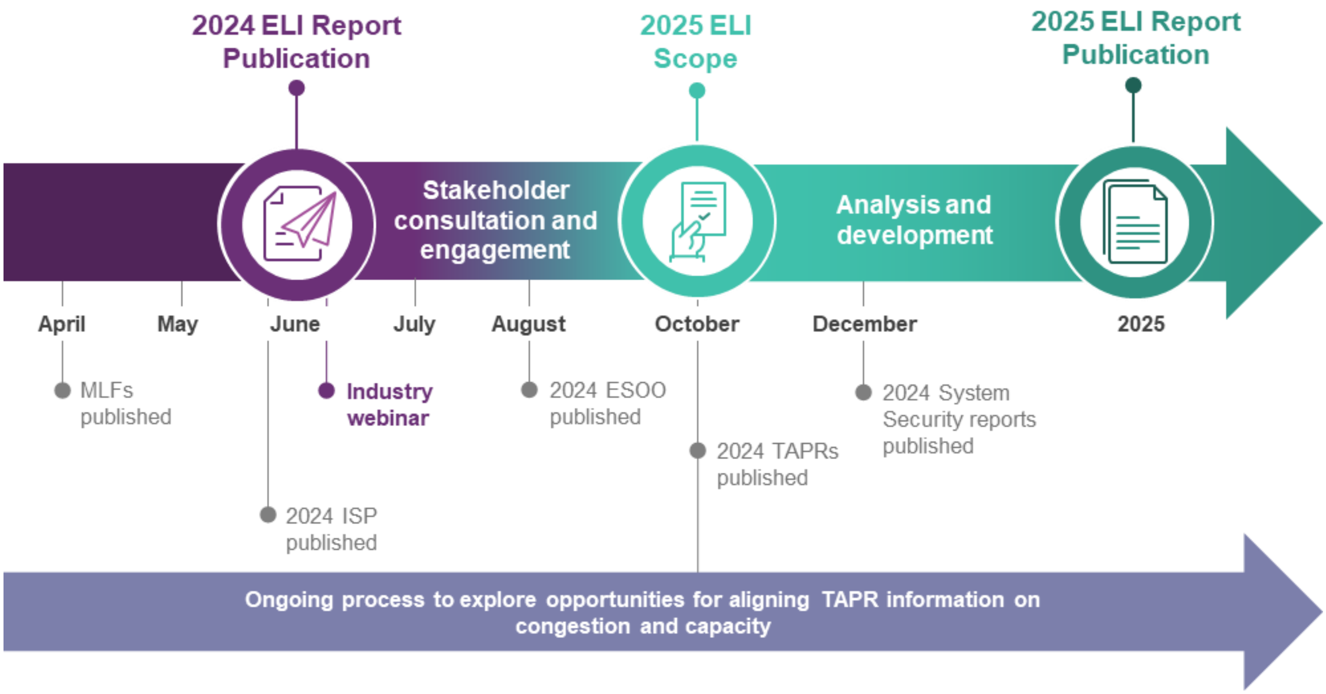
AEMO welcomes stakeholder submissions on the usefulness of the 2024 ELI Report, and on potential improvements or additional information sources that would be valuable to stakeholders in future ELI Reports.

Stakeholders should make written submissions to planning@aemo.com.au by 12 July 2024. This may include feedback on:

- whether the locational data presented in the 2024 ELI Report is useful for initial screening and early-stage analyses about where to locate projects in the NEM. If not, how could this be improved?
- the types of additional analysis or locational signals that would be useful to include in the 2025 ELI Report.
- Any other suggestions for improvements to the ELI Report or the presentation of data contained within.

AEMO's process and expected timeline for consultation leading up to the publication of the 2025 ELI Report are outlined in Figure 4. Future dates may be adjusted, and additional steps may be included as needed through the consultation process.

Figure 4 Indicative timeline of ELI consultation activities and publications



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1 Introduction

In February 2023, Energy Ministers agreed to implement enhanced information reforms to provide participants in the National Electricity Market (NEM) with better information on the optimal location for new investments[1].

This inaugural Enhanced Locational Information (ELI) Report represents a key deliverable from these reforms and provides a collection of metrics and indicators that represent important locational characteristics of the power system, and which may be relevant to inform better regulatory, generator investment, or transmission augmentation decisions.

This 2024 ELI Report draws on existing sources of publicly available information from AEMO and industry datasets. To further enhance this information over time, AEMO is using the initial ELI Report as an invitation for written submissions on the utility of the current information presented, and on the scope of additional information that could provide value as part of future ELI publications. Consultation details are provided in Section 8.

In parallel, AEMO is working with transmission network service providers (TNSPs) through joint planning activities to review and better align the information and methodologies used to assess congestion and hosting capacity information as part of the regional Transmission Annual Planning Reports (TAPRs). That work will continue ahead of the 2024 TAPR publications, with further reporting of those outcomes in the 2025 ELI Report.

1.1 Context

The NEM is changing at a speed and scale never before seen, transforming the way electricity is generated, transported, and consumed. The pace of this change is still accelerating, and traditional ways of operating are being challenged as system security and reliability become increasingly complex.

As the system moves away from a historical dependence on synchronous generation, the energy future is expected to be built on low-cost renewable energy, dynamic firming technology, new network infrastructure, and adaptive operating strategies. This shift will have a significant impact on the locational signals and optimal investment decisions across the NEM.

Instantaneous renewable penetration reached a new record level of 72.1% on 24 October 2023[2]. This record included a 41% contribution from distributed photovoltaics (PV), 12% from wind, and 17% from grid-scale solar. The maximum renewable potential[3] in Q4 2023 reached 99.7% on 1 October 2023.

Figure 5 shows the past and forecast generation mix to supply energy usage in the NEM to 2039-40 under the *Integrated System Plan* (ISP) *Step Change* scenario[4].

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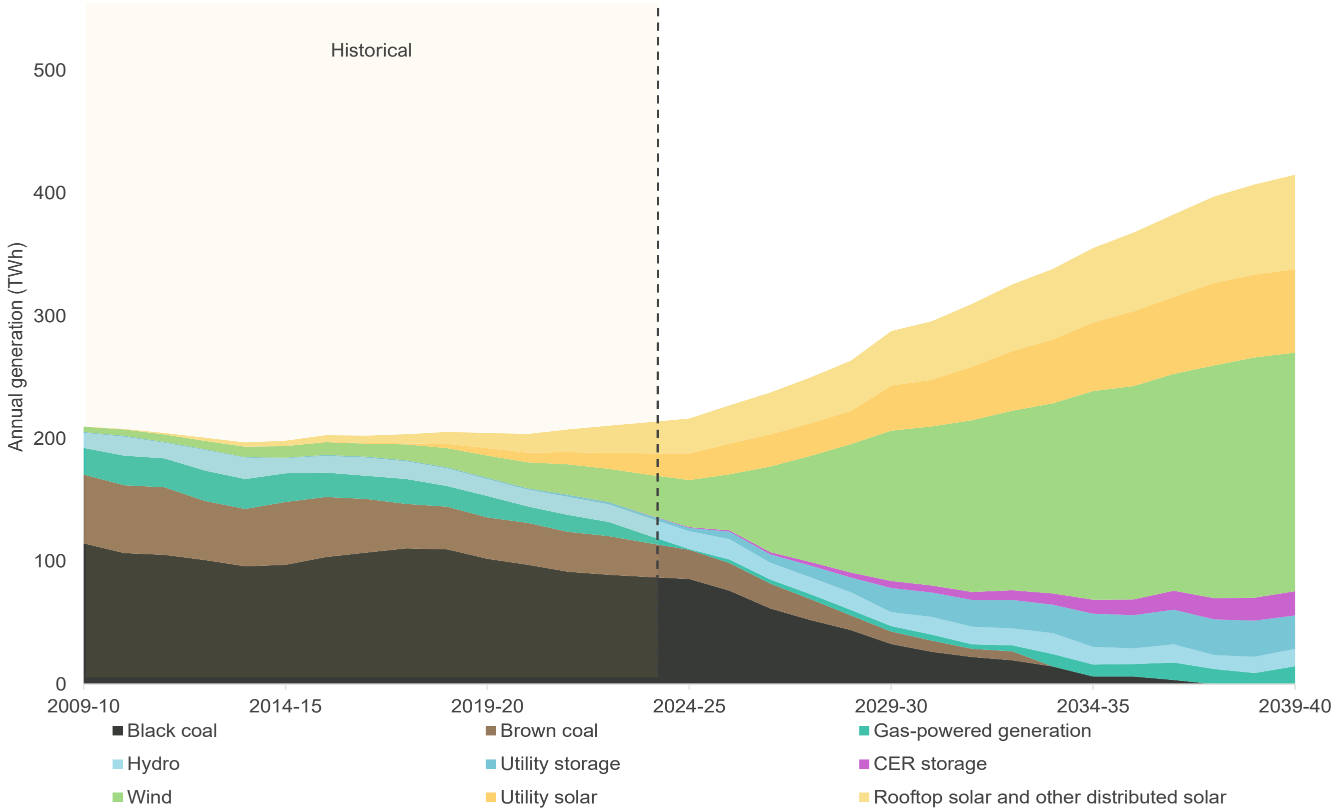
[1] Energy Security Board. Transmission access reform Enhanced Locational Information, June 2023, at https://www.datocms-assets.com/32572/1688514855-enhanced-locational-information-final-decision-paper.pdf.

[2] AEMO. *Quarterly Energy Dynamics* Q4 2023, January 2024, at https://aemo.com.au/-/media/files/major-publications/qed/2023/quarterly-energy-dynamics-q4-2023.pdf.

[3] Renewable *potential* in an operating interval refers to the total available energy from variable renewable energy (VRE) sources, even if not necessarily dispatched, expressed as a percentage of the total NEM supply requirement.

[4] AEMO. Draft 2024 *Integrated System Plan*, December 2023, at https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2023/draft-2024-isp-consultation/draft-2024-isp.pdf?la=en.

Figure 5 Actual and forecast generation mix in the NEM, 2009-10 to 2039-30, *Step Change* scenario (terawatt hours (TWh)



Notes: Annual generation for 2023-24 has been estimated for the full financial year. The forecast gas-powered generation includes some potential hydrogen and biomass capacity. "CER storage" means consumer energy resources (CER) such as batteries and electric vehicles (EVs).

1.2 Scope of content

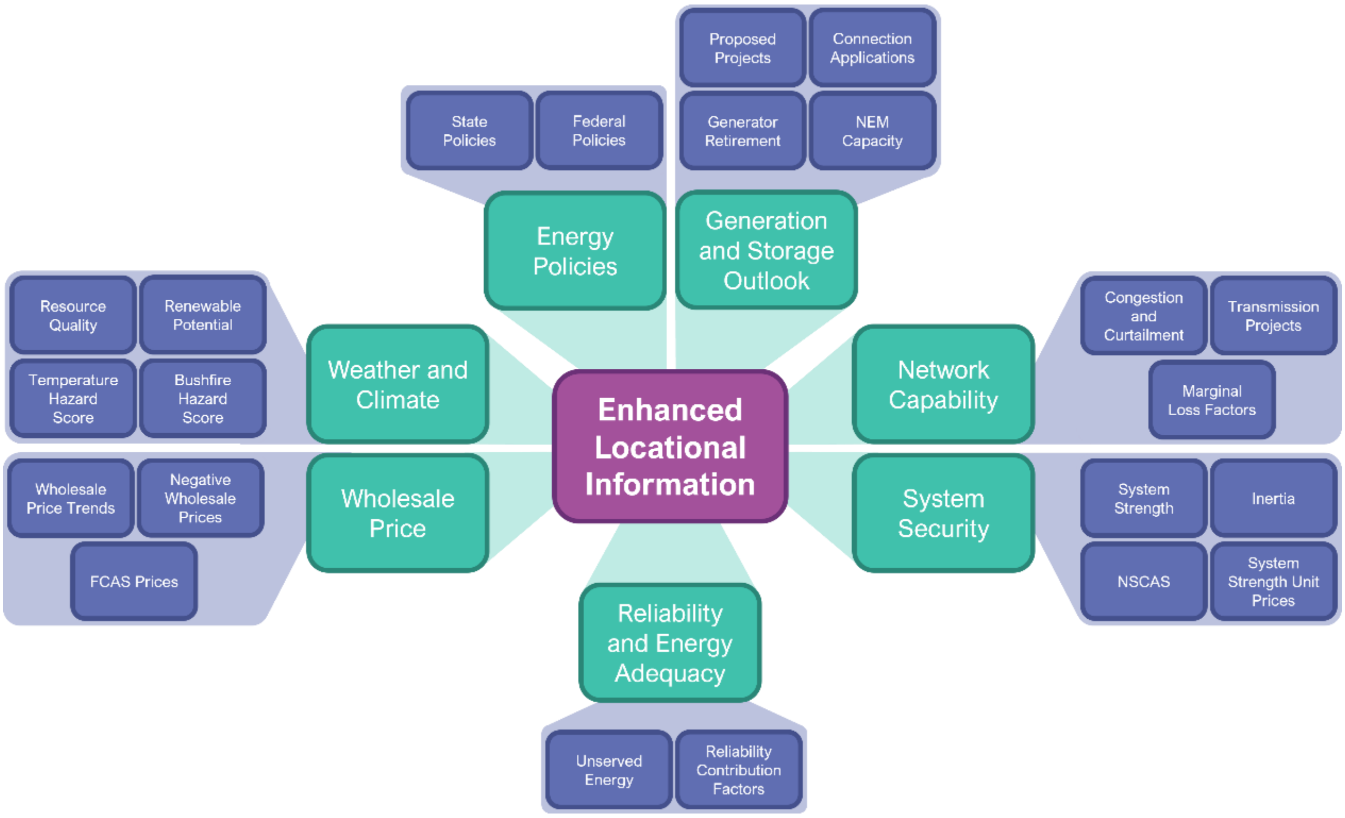
The NEM provides a diverse set of signals and mechanisms to help guide investment decisions by incentivising new services and infrastructure in the most efficient and cost-effective locations. However, the effectiveness of these signals can be reduced if they are difficult to access, difficult to interpret, or difficult to compare across competing locations.

The 2024 ELI Report draws together a wide range of publicly available information on the power system[5], and overlays these indicators geographically to extract insights that may be relevant to informing better regulatory or investment decisions.

Figure 6 provides an overview of the categories and types of information considered in this report; further details on the associated inputs, assumptions, and data sources are presented in Appendix A1 and Appendix A2.

[5] The 2024 ELI Report does not include data related to the sub-transmission or distribution networks.

Figure 6 Overview of indicator types considered in the 2024 ELI Report



1.3 Structure of this report

The 2024 ELI Report contains the following information:

- A summary of key locational indicators and characteristics at a NEM-wide level (Section 2).
- A more granular exploration of these indicators for each region is presented in the following sections in this report, supported by detailed renewable energy zone (REZ) assessment scorecards in the appendices:
  - New South Wales (Section 3).
  - Queensland (Section 4).
  - South Australia (Section 5).
  - Tasmania (Section 6).
  - Victoria (Section 7).
- An overview of next steps related to consultation and planning for the 2025 ELI Report (Section 8).
- A summary of related resources and additional sources of information (Appendix A1).
- A summary of indicator definitions and methodologies used in this report (Appendix A2).
- Detailed REZ scorecard assessments for each region across the NEM (Appendix A3 to Appendix A7).

2 NEM-wide indicators

Opportunities exist across all regions for renewable energy and storage projects to provide energy, capacity, and system security services. This is bolstered by strong policy incentives, continued growth in peak demand, and withdrawal of existing generation sources.

However, some locations are now reaching high levels of generator curtailment and investors will need to consider factors such as access to high quality renewable resources, network congestion, network losses, future network developments, security remediation requirements, and the impact of neighbouring projects.

This chapter summarises key locational indicators relating to:

- National energy policies (Section 2.1).
- Generation and storage outlook (Section 2.2).
- Network capability (Section 2.3).
- System security requirements and shortfalls (Section 2.4).
- Reliability and energy adequacy (Section 2.5).
- Wholesale price indicators (Section 2.6).

2.1 National energy policies

State and federal governments are united in their efforts to decarbonise Australia and have committed to strong transition targets. These policies will shape the energy landscape and are an important consideration for new transmission, generation, and storage projects. Key national energy policies and commitments include:

- Nationwide emission reduction of 43% below 2005 levels by 2030 and net zero by 2050[6].
- Commitment to achieve an 82% share of renewable generation by 2030[7].
- Offshore REZs declared for Gippsland, Hunter, Southern Ocean, Illawarra and Bass Strait[8].
- Support for major transmission projects under the Rewiring the Nation framework[9].
- Specific regional energy policies and targets, described in the regional chapters on this report.
- The Capacity Investment Scheme seeking tenders for renewable and clean dispatchable capacity projects[10].

[6] *Climate Change Act 2022* (Cth) section 10, at https://www.legislation.gov.au/C2022A00037/latest/text.
[7] Australian Government. *Powering Australia Plan*, at https://www.dcceew.gov.au/energy/strategies-and-frameworks/powering-australia.
[8] At https://www.dcceew.gov.au/energy/renewable/offshore-wind/areas.
[9] At https://www.dcceew.gov.au/energy/renewable/rewiring-the-nation.
[10] *Capacity Investment Scheme*, at https://www.dcceew.gov.au/energy/renewable/capacity-investment-scheme.

2.2 Generation and storage outlook

Pipeline of generation and storage projects

Table 1 shows the scale of the current generation pipeline as the sum of nameplate capacity for all generation and storage projects, aggregated according to their current commitment status[11].

Table 1 New generation pipeline as of April 2024 Generation Information (gigawatts (GW))

	Existing generation (GW)	In Commissioning generation (GW)	Committed generation (GW)	Anticipated generation (GW)	Proposed generation (GW)
New South Wales	20.1	0.4	6.1	2.8	84.4
Queensland	17.9	0.1	2.5	3.8	82.9
South Australia	7.0	0.1	0.3	0.7	17.5
Tasmania	3.3	0.0	0.0	0.0	12.6
Victoria	15.7	0.0	2.2	1.5	82.6
Total	**64.0**	**0.6**	**11.2**	**8.8**	**280.0**

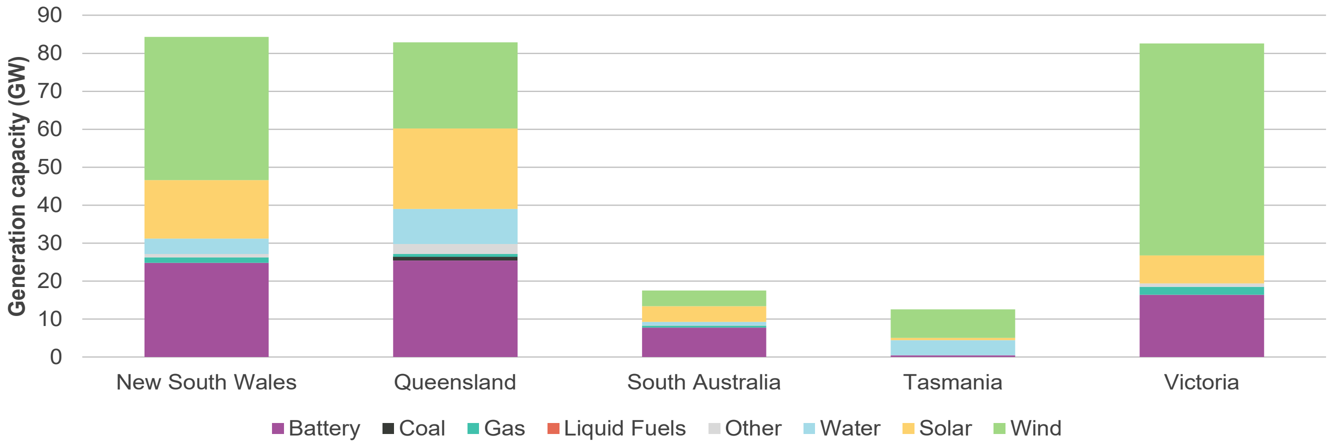
Proposed generation and storage projects

There is a substantial volume of proposed projects at early stages of development. Figure 7 provides a breakdown of these projects by region and technology.

Of note, 63% of proposed projects are variable renewable energy (VRE) generation projects, while storage projects (battery or pumped hydro) account for about 33%. Approximately 22 gigawatts (GW) of additional dispatchable capacity – including thermal projects, pumped hydro, and batteries – were added to the pipeline between the 2022 and 2023 *Electricity Statement of Opportunities* (ESOO) publications.

Further details, including capabilities of proposed generating units, are on AEMO's Generation Information page.

Figure 7 Proposed projects by NEM region and type of generation or storage as of April 2024 Generation Information (GW)

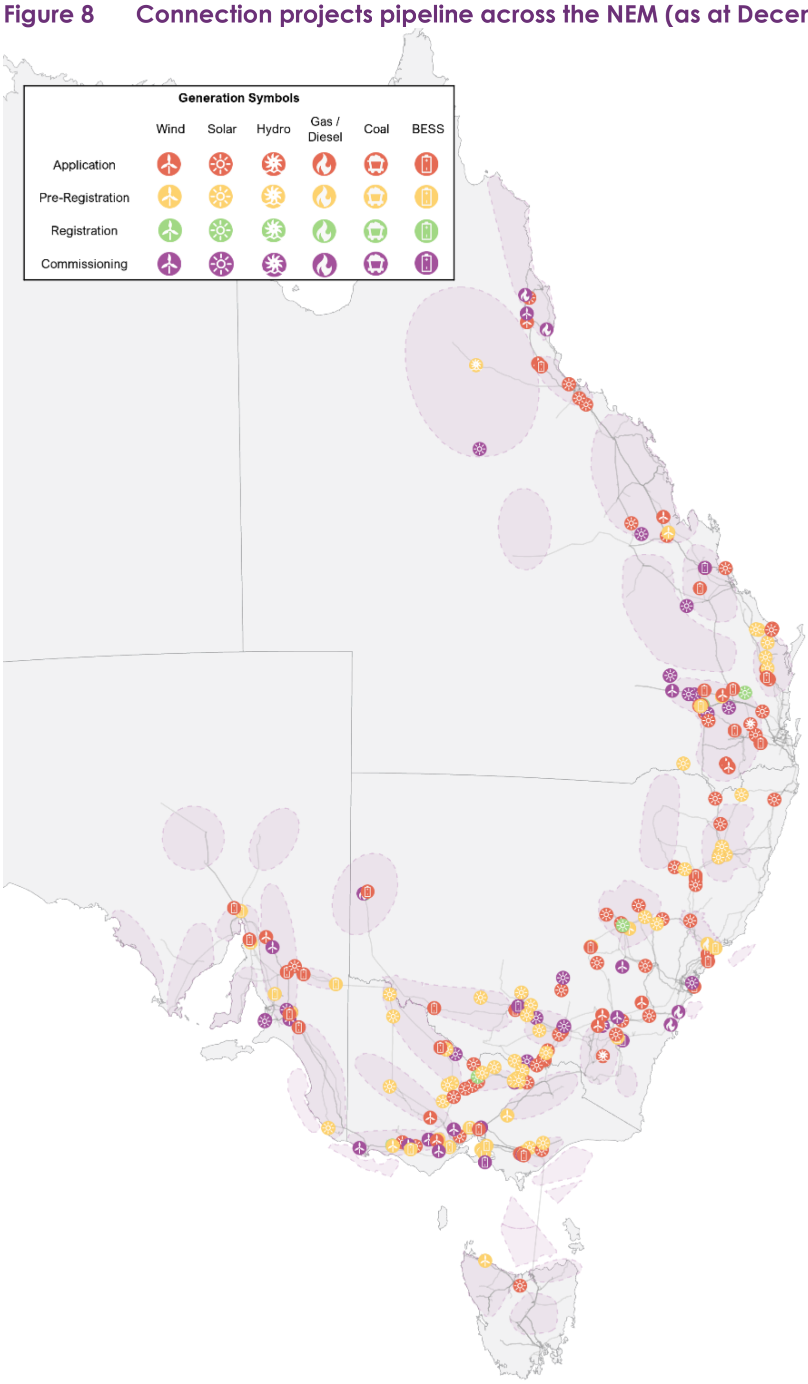


[11] AEMO, Generation Information, April 2024, at https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-planning-data/generation-information.

Connection applications

Figure 8 presents the staging of new connections applications progressing towards or undergoing commissioning in December 2023. As of February 2024, there were 20 GW of connection projects in the application stage, 19 GW in the pre-registration or registration stages, and 2 GW undergoing commissioning[12].

Figure 8 Connection projects pipeline across the NEM (as at December 2023)



Note: Indicative generation is based on 22 December 2023 NEM generation maps. See https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/participate-in-the-market/network-connections/nem-generation-maps.

[12] Connection application metrics are based on the February 2024 NEM Connections Scorecard, at https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/participate-in-the-market/network-connections/connections-scorecard.

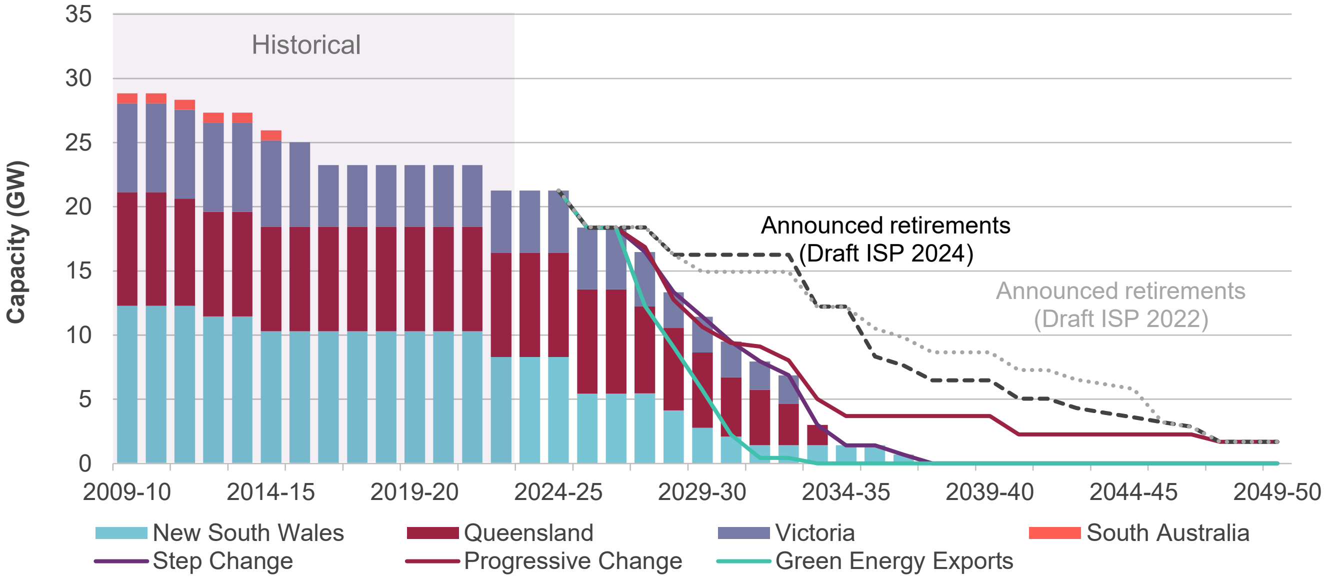
Generator decommissioning

Many critical system security and reliability needs were once met predominantly by a fleet of baseload coal-fired power stations. However, as these units age they become less reliable, more expensive to maintain, and less competitive against renewable energy resources.

In the past decade alone, 10 major coal-fired power stations have retired, and all but one of the remaining fleet have announced retirements between now and 2051, with about half announcing retirements by 2035[13].

The Draft 2024 ISP suggested that the remaining coal fleet may need to close several times faster than this under the *Step Change* scenario, with results indicating that about 90% of the NEM's coal fleet could retire by 2034-35[14]. Figure 9 presents this rapid decline in both historical and ISP forecast levels of available coal capacity.

Figure 9 Actual and forecast coal generation capacity in the NEM, *Step Change* scenario, 2009-10 to 2049-50 (GW)



Capacity outlook

AEMO's Draft 2024 ISP selected an optimal development path (ODP) that sets out the capacity of new generation, firming, storage and transmission needed in the NEM through to 2050.

Under forecasts for the *Step Change* scenario, the ODP calls for investment that would:

- Triple grid-scale VRE by 2030 and increase it seven-fold by 2050.
- Focus grid-scale VRE generation in REZs.
- Almost quadruple levels of firming capacity.

[13] Up to date collection of closure timings available at https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-planning-data/generation-information.

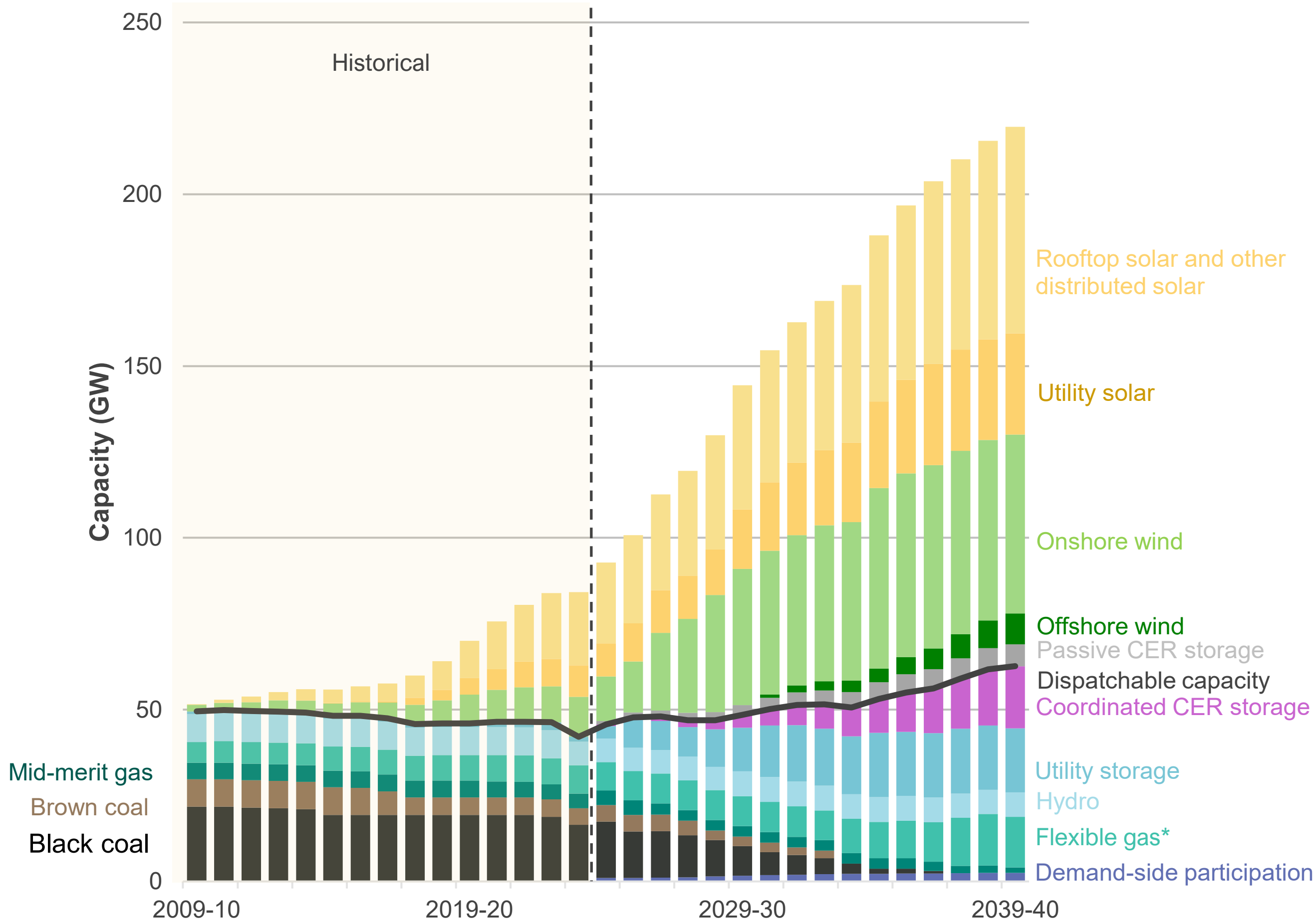
[14] For further information, see Section 4.1 of AEMO's Draft 2024 ISP, December 2023, at https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2023/draft-2024-isp-consultation/appendices/a5-network-investments.pdf?la=en.

Over the next decade, this modelling highlights that more wind capacity is needed to complement the strong uptake of distributed PV. Once there is sufficient storage and network investment to take advantage of cheaper solar resources, grid-scale solar development accelerates out to the end of the modelling horizon.

Figure 10 presents the modelled NEM capacity projections by technology until 2039-40, and Figure 11 provides a high-level breakdown of this forecast capacity expansion by region.

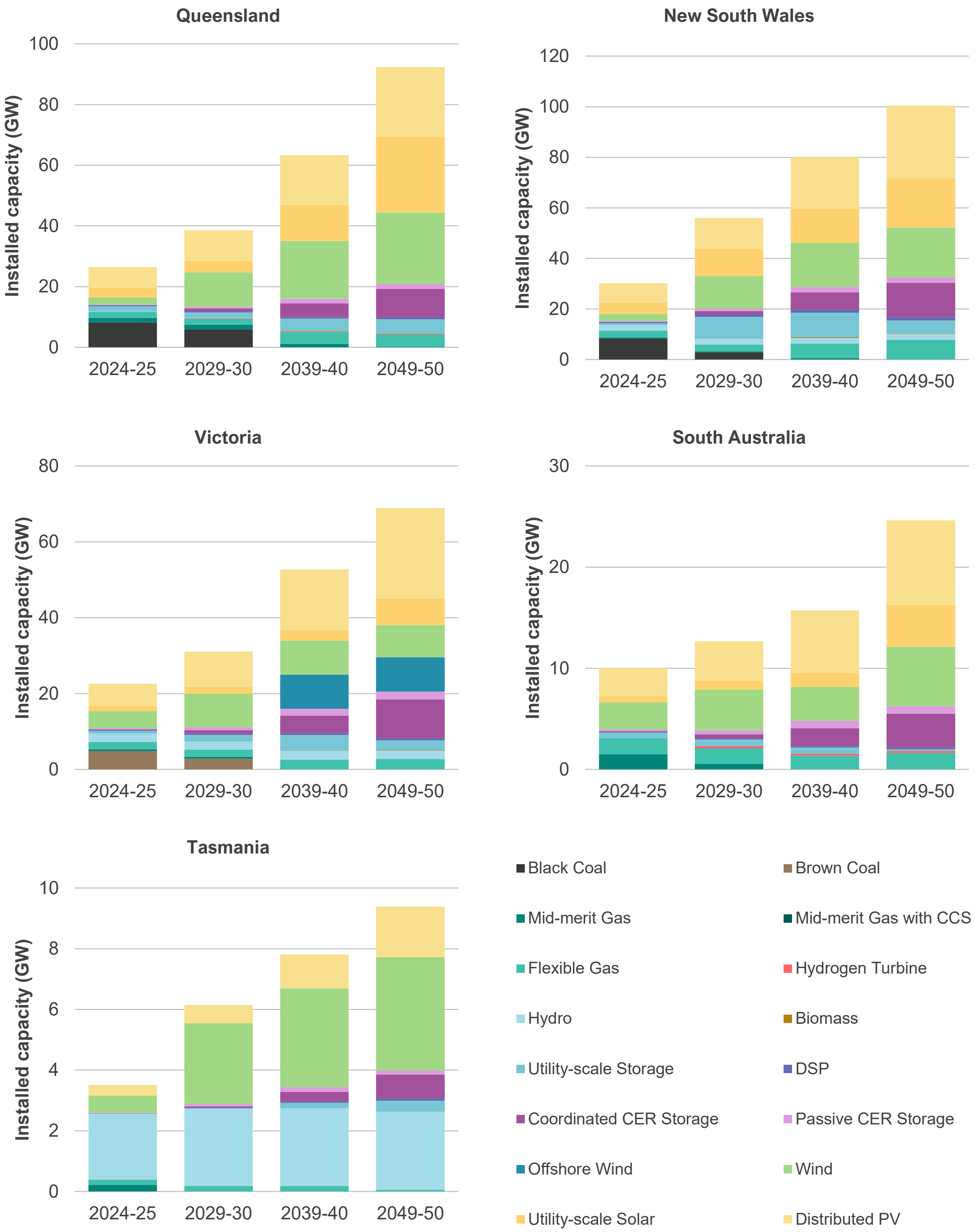
More detailed regional summaries and commentary are provided in the regional chapters.

Figure 10 Actual and forecast capacity in the NEM, *Step Change* scenario, 2009-10 to 2039-40 (GW)



Notes: Flexible gas includes gas-powered generation, and potential hydrogen and biomass capacity. "CER storage" means consumer energy resources such as batteries and EVs.

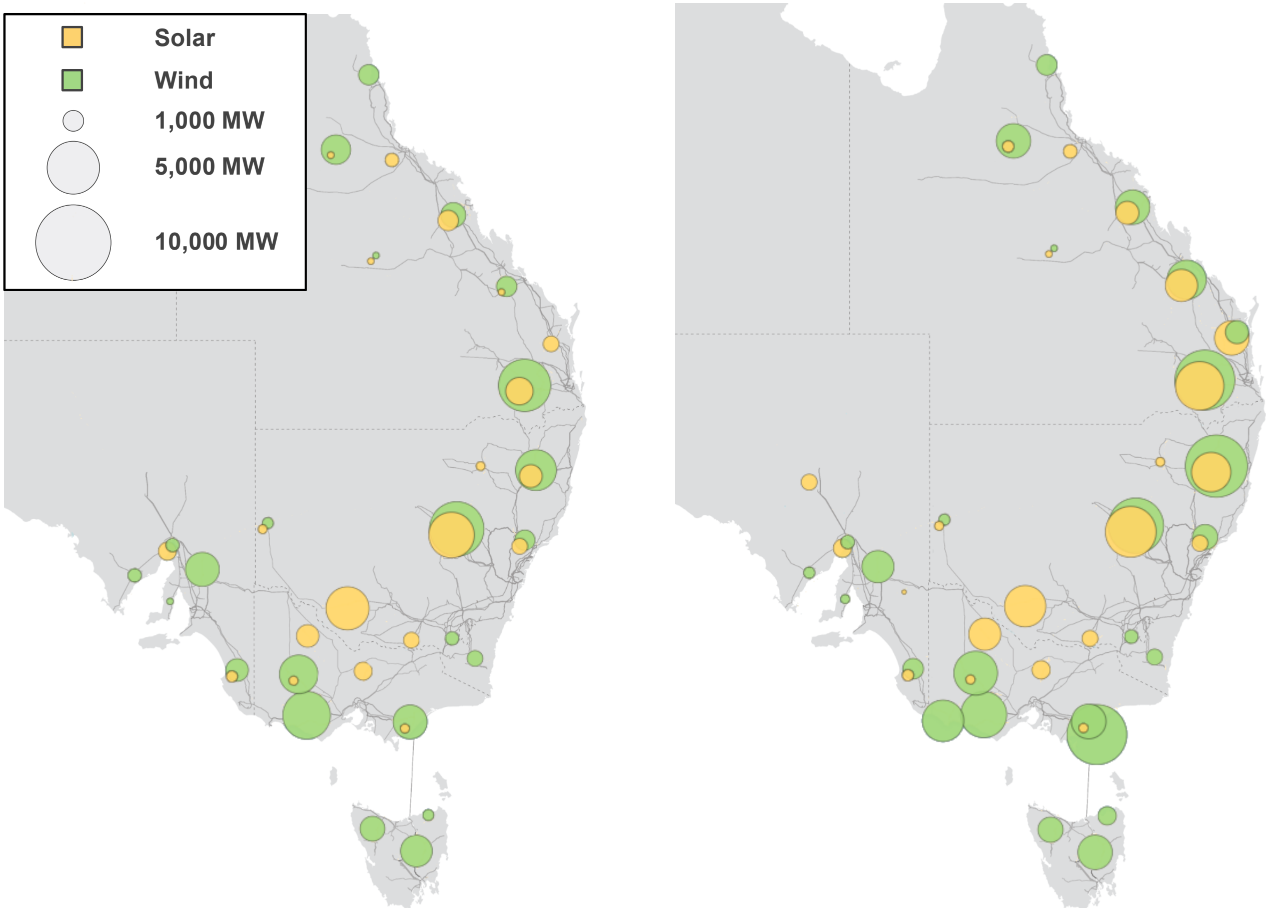
Figure 11 Forecast regional generation capacity for selected years, *Step Change* scenario, 2024-25 to 2049-50 (GW)



REZ development and geographic dispersion

Figure 12 shows the projected VRE build levels across the NEM forecast in the Draft 2024 ISP. This level of geographical dispersion, and the network projects that sit beneath it (see Section 2.3), emphasise the importance of efficient, coordinated and priority development of REZ candidates.

Figure 12 Projected VRE build in the Draft 2024 ISP *Step Change* scenario in 2029-30 (left) and 2039-40 (right)



2.3 Network capability

Congestion and curtailment

In 2023, curtailment[15] of semi-scheduled wind generation across the NEM ranged from 0.0% to 9.0% and averaged 1.4%. Solar curtailment was higher, ranging from 0.0% to 50.7% and averaging 4.6%. Figure 13 below illustrates the high variability in curtailment levels across the NEM.

[15] "Curtailment" in this report refers to energy that was not generated due to reasons other than market prices, for example, due to any kind of network constraint (including stability constraints), and may include system normal or outage constraints. It does not, however, capture every possible means of generator limitation. For more information including a detailed explanation of how curtailment was calculated, see Appendix A2.3.1.

Most semi-scheduled generators, particularly wind farms, experienced low curtailment. Approximately half of semi-scheduled generators experienced curtailment less than 1%, while several solar farms experienced very high curtailment above 25%.

Figure 13 Average curtailment of semi-scheduled wind and solar generation in the NEM, calendar year 2023

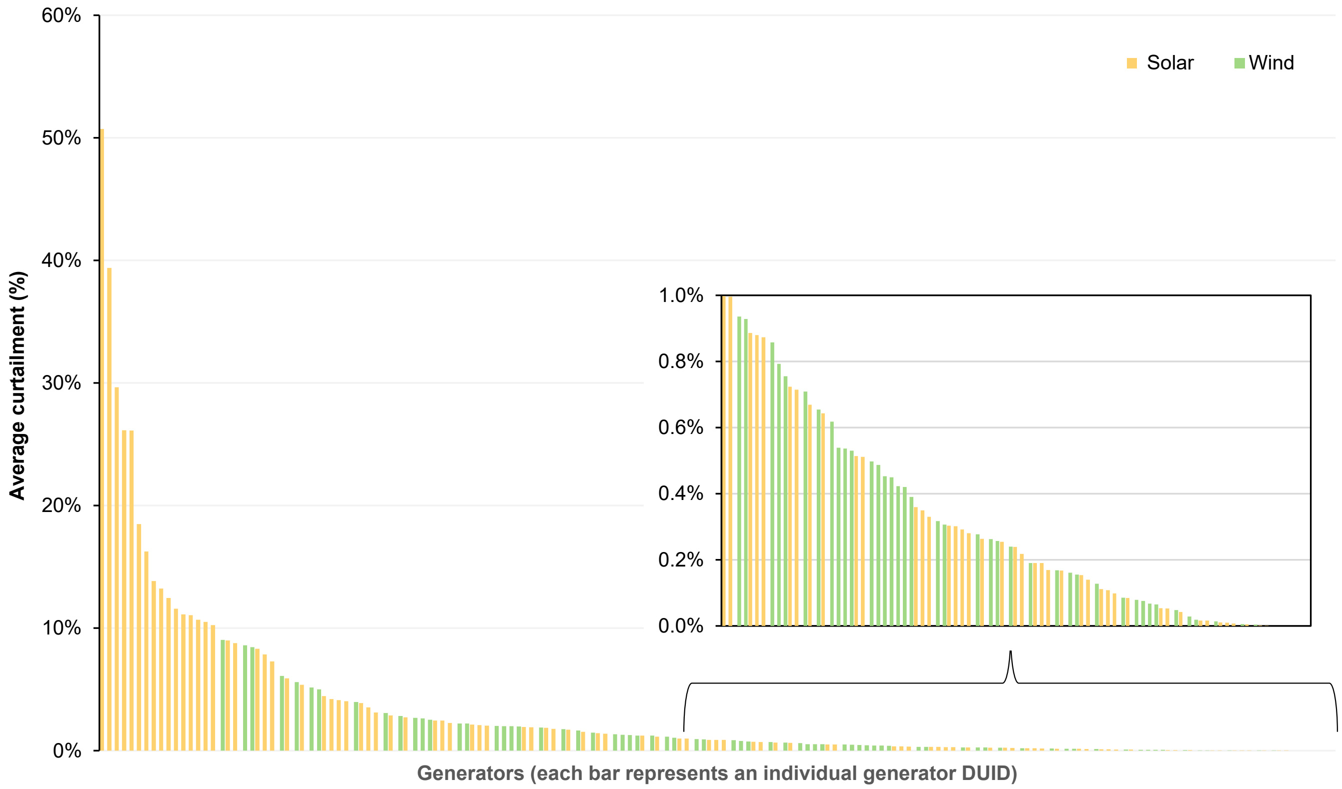


Figure 14 shows the geographic distribution of semi-scheduled generation curtailment, illustrating that high curtailment was mainly concentrated in certain areas (particularly Western New South Wales and North West Victoria) rather than being evenly distributed throughout the NEM.

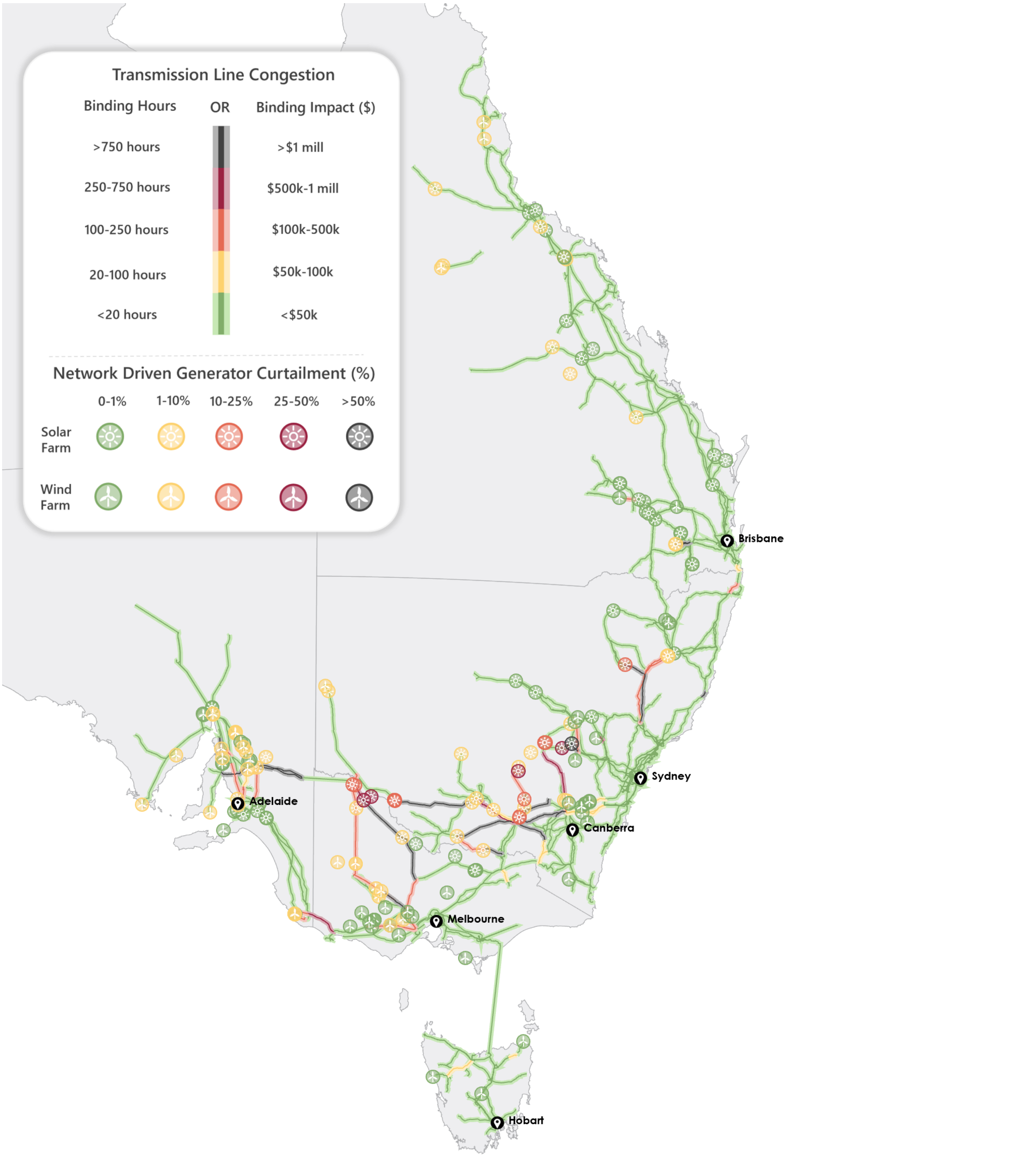
Figure 14 also illustrates transmission congestion for 2023[16]. Most transmission lines did not experience significant congestion. However, severe congestion did arise in some areas, including those with high levels of generation connected to locations originally constructed for servicing demand (such as North West Victoria and Western New South Wales).

These high congestion areas broadly overlap with the areas experiencing high levels of generation curtailment. Additionally severe congestion arose on some parts of the network on inter-regional flow paths.

A more granular exploration of generation curtailment and transmission congestion for each region is presented in the following sections in this report, supported by detailed REZ assessment scorecards in the associated regional appendices.

[16] Not all sources of congestion can be allocated to individual network elements in a way that would be meaningful as a locational signal (for example, some types of stability limitation). See Appendix A2.2.3 for a detailed explanation of inclusions and exclusions related to this map.

Figure 14 Overview of NEM congestion and curtailment for calendar year 2023

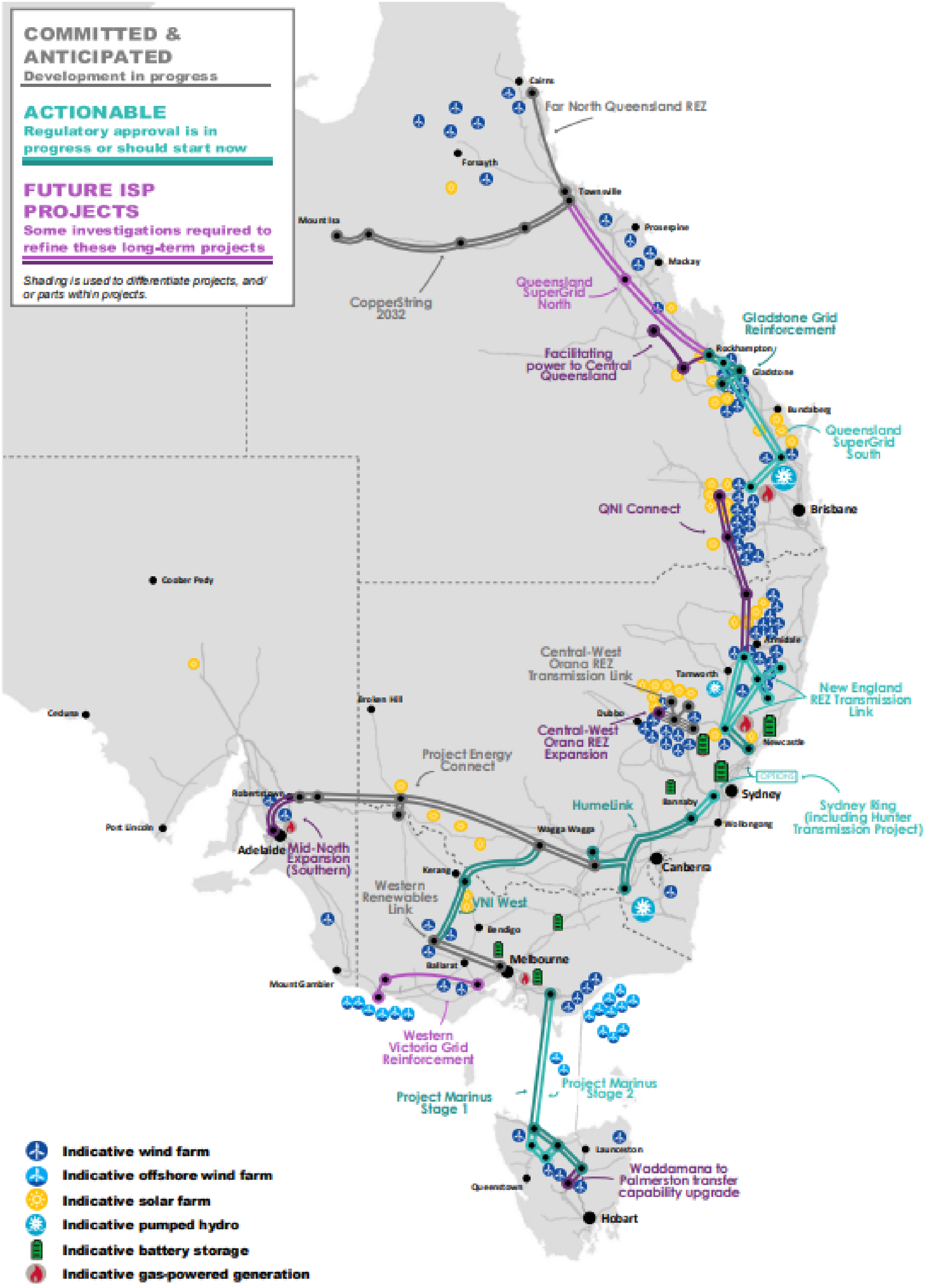


Note: This map does not capture all forms of congestion in the NEM. See Appendix A2.2.3 for a detailed explanation of inclusions and exclusions.

Committed, actionable, and future transmission projects

The Draft 2024 ISP projects a need for close to 10,000 km of transmission by 2050. Figure 15 shows the latest overview of committed, anticipated, actionable, and future ISP projects as part of the ODP[17].

Figure 15 Transmission projects in the optimal development path (Draft 2024 ISP)



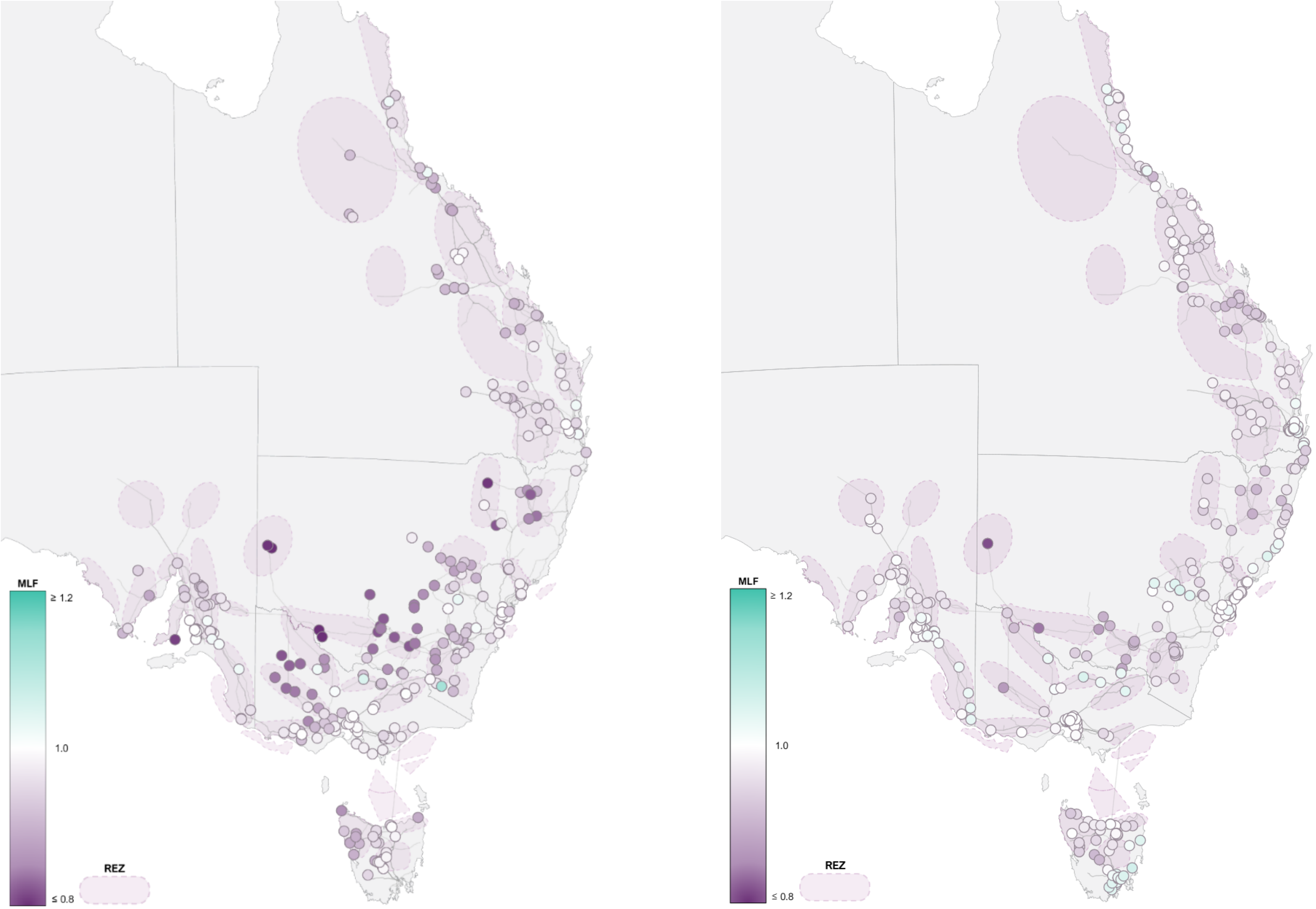
[17] Further details about transmission projects are available at https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-planning-data/transmission-augmentation-information.

Marginal loss factors (MLFs)

MLFs represent the marginal network losses associated with transporting power across the network and impact the spot price applicable for energy at certain locations. Figure 16 presents AEMO's latest MLF calculations, which will apply to existing connection points during the 2024-25 year[18].

[18] https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/market-operations/loss-factors-and-regional-boundaries

Figure 16 Overview of NEM marginal loss factors for generation (left), and loads (right)



2.4 System security shortfalls and requirements

AEMO considers the need for any power system security and reliability services in the NEM over the coming five to 10 years as part of its obligations to assess system strength requirements, inertia shortfalls, and network support and control ancillary services (NSCAS) needs.

The 2023 studies identified two new NSCAS gaps in Victoria and South Australia, but did not identify any new system strength or inertia shortfalls beyond those already declared. All gaps and shortfalls declared for the 2023-24 period have active remediation strategies in place while longer-term solutions are being progressed.

Figure 17 provides an overview of the currently declared system security shortfalls across the NEM. The shortfall sizes depend heavily on the timing of several major generation, transmission, and REZ development projects.

Figure 17 Currently declared system security shortfalls in the NEM

System Strength	Inertia	NSCAS
7 shortfalls across 3 regions	**3 shortfalls** across 3 regions	**2 shortfalls** across 2 regions

In the longer term, existing levels of system security services would be expected to decline rapidly without additional investment, primarily driven by the withdrawal or decommitment of existing thermal generation sources. The efficient levels of system strength that must be delivered are based on projected inverter-based resources (IBR) in the Draft 2024 ISP *Step Change* scenario (see Figure 10 in Section 2.2 for forecast capacity in the NEM by technology).

However, on and from 2 December 2025 (for system strength), the TNSP that is the System Strength Service Provider (SSSP) in each region will be required to procure sufficient system strength services capable of being enabled by AEMO to meet the totality of regional requirements. On and from 2 December 2027, the TNSP that is the Inertia Service Provider in each region will be required to procure sufficient inertia network services capable of being enabled by AEMO to meet the totality of regional requirements[19]. This could provide commercial opportunities for new projects or technologies capable of providing these services.

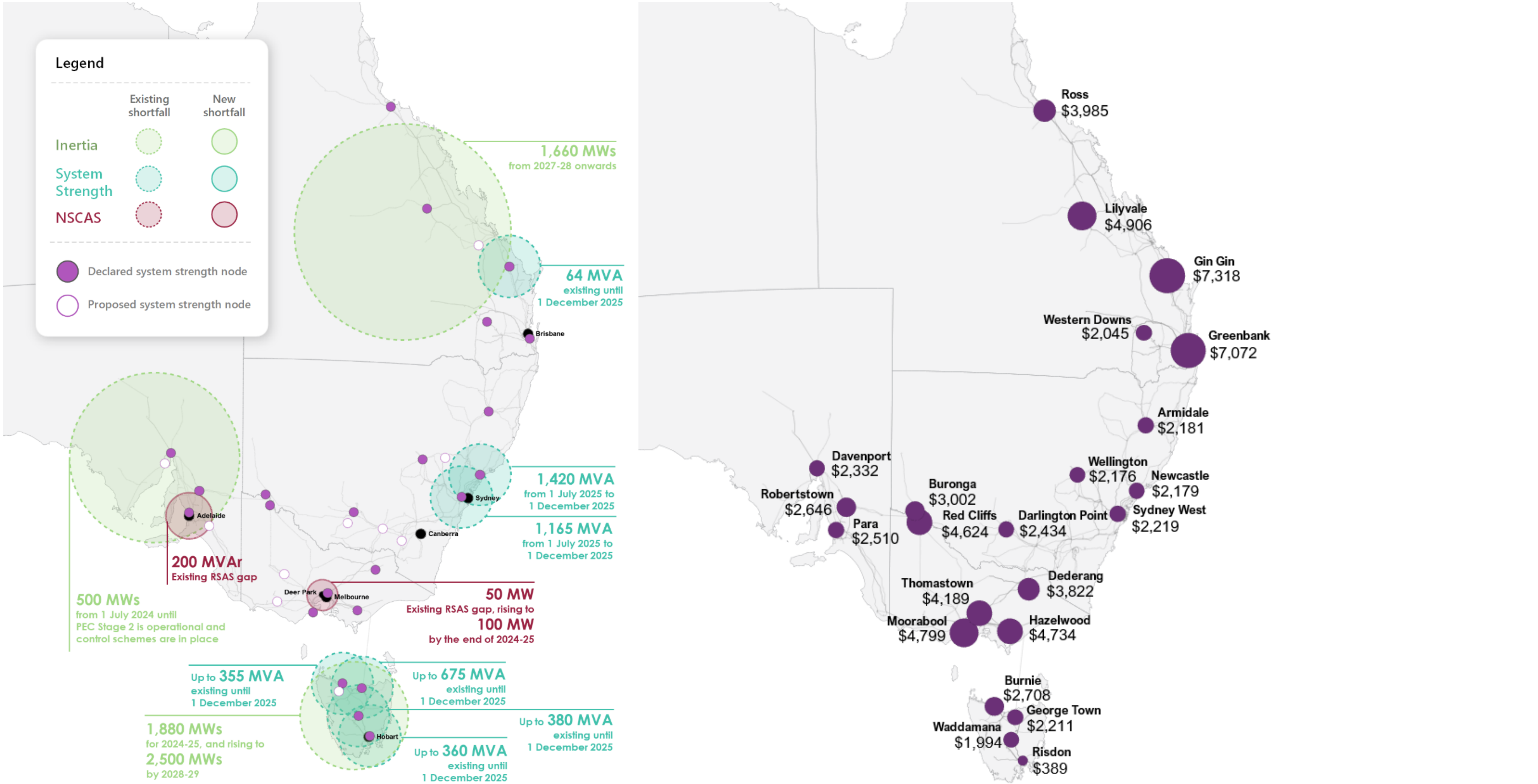
System strength nodes and prices

SSSPs in each region are required to deliver services to address identified shortfalls. System strength charges reflect the costs imposed on SSSPs to remediate any adverse impacts of connecting parties on system strength[20]. From 15 March 2023, parties that apply to connect to the network of a SSSP could elect to pay an annual system strength charge for access to centralised system strength services or to self-remediate their system strength impact.

[19] AEMC, National Electricity Amendment (Improving security frameworks for the energy transition) Rule 2024, at https://www.aemc.gov.au/rule-changes/improving-security-frameworks-energy-transition.

[20] The *System Strength Impact Assessment Guidelines* (SSIAG) prescribe how SSSPs assess the impact of a connection to system strength. See https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2022/ssrmiag/amendment/system-strength-impact-assessment-guidelines-v21.pdf?la=en.

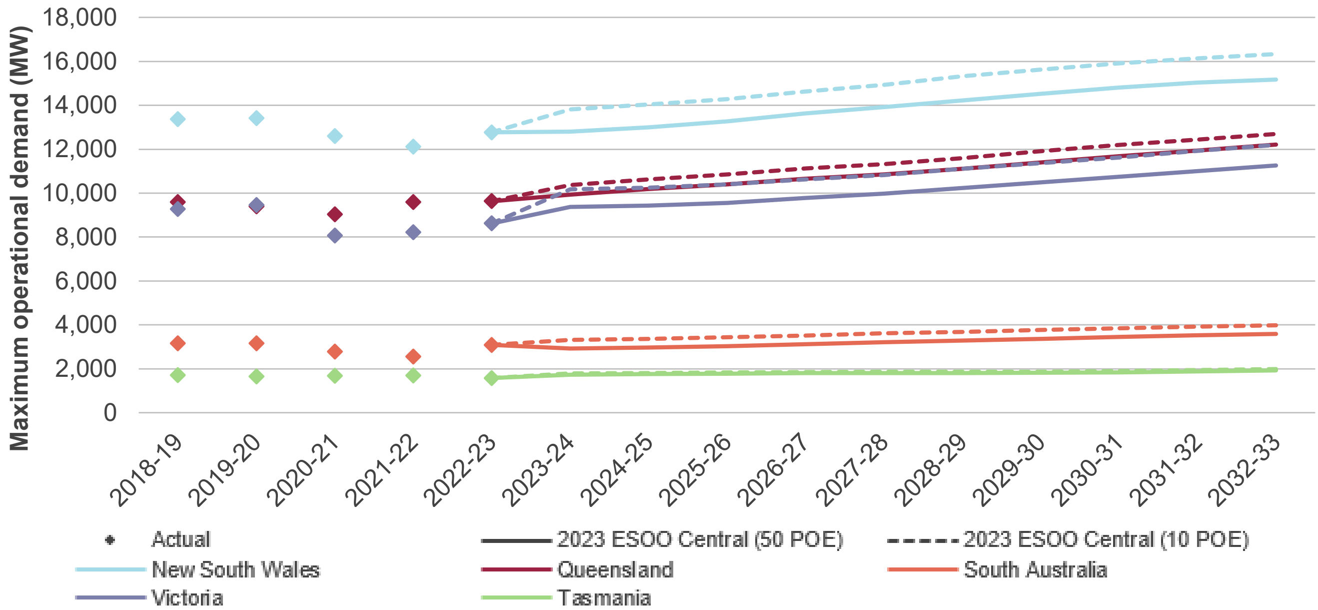
Figure 18 Overview of system security shortfalls across the NEM (left), and system strength nodes and unit prices for 2024-25 (right)



2.5 Reliability and energy adequacy

Reliability shortfalls can signal the need for further capacity investment to meet operational demands. Figure 19 shows the forecast regional growth in maximum operational demand until 2032-33, based on the 2023 ESOO.

Figure 19 Actual and forecast annual maximum operational demand (sent-out), 2023 ESOO Central scenario

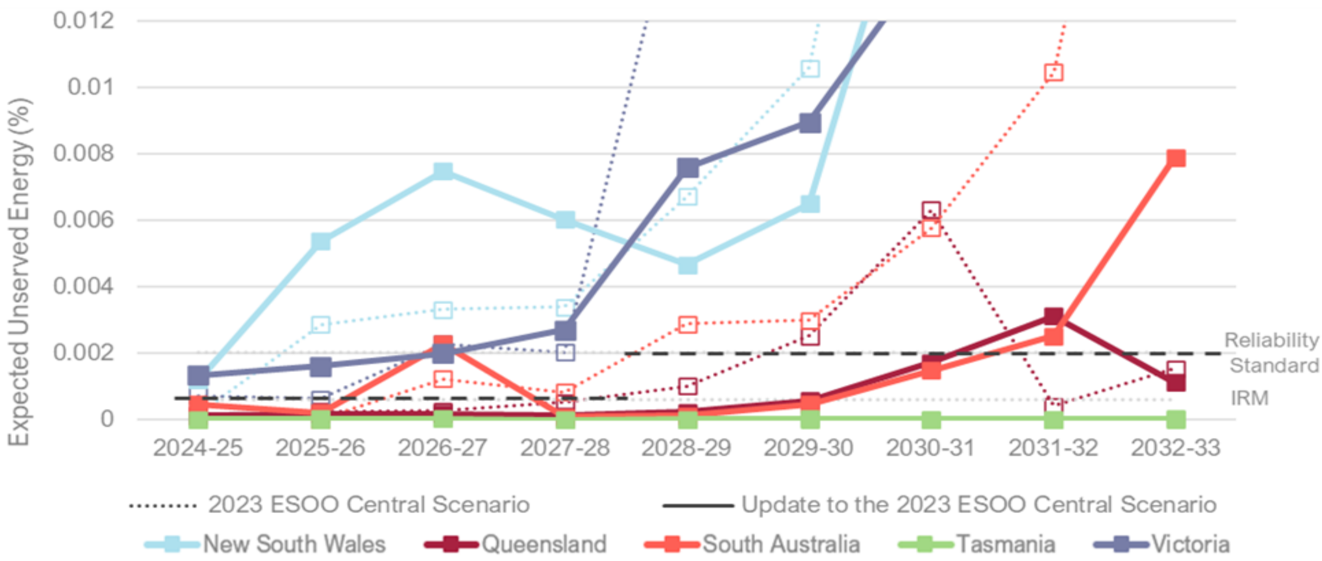


POE: probability of exceedance, the likelihood that the forecast will be met or exceeded. A 10% POE forecast, expected to be met or exceeded one in 10 years, represents more extreme conditions than a 50% POE forecast, expected to be met or exceeded one year in two.

Unserved energy

The May Update to the 2023 ESOO forecasts reliability gaps in all mainland regions in the next decade under the ESOO Central scenario. The magnitude of these outcomes is shown in Figure 20.

Figure 20 Updated ESOO Central scenario, all regions, 2024-25 to 2032-33, expected unserved energy (%)



2.6 Wholesale price indicators

This section presents trends in wholesale energy and frequency control spot prices, which may complement the generator curtailment and MLFs presented earlier when considering the potential viability of a given location.

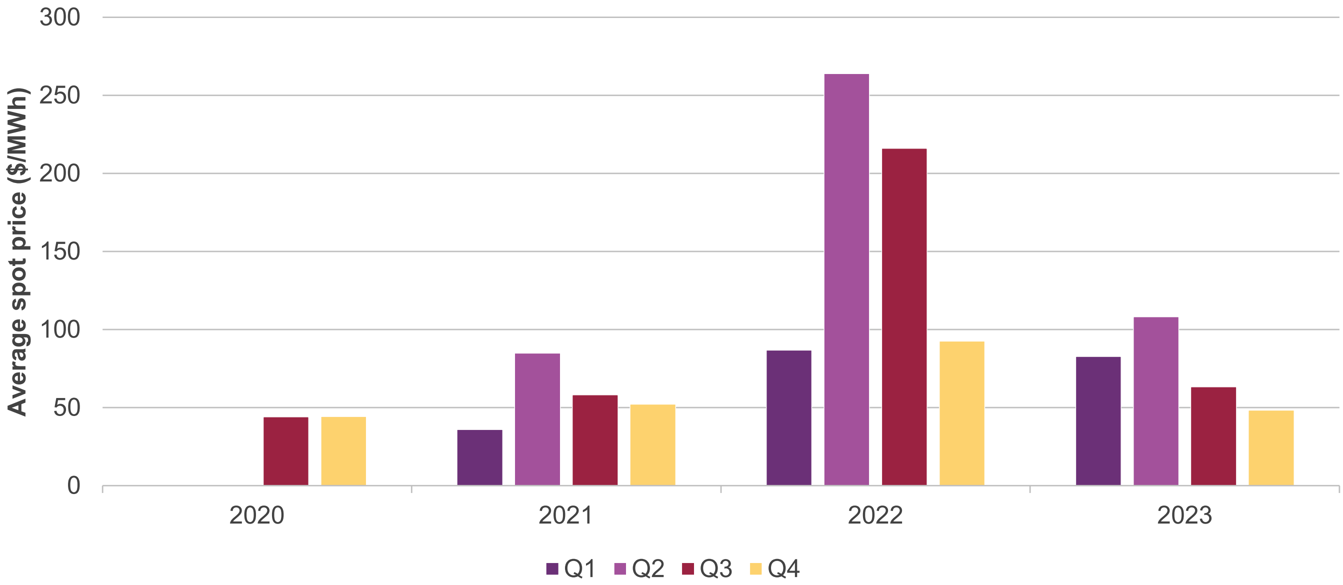
Noteworthy NEM-wide and regional pricing trends are presented in this section; AEMO's *Quarterly Energy Dynamics* report provides substantially more granular analysis on emerging pricing and market trends.

Wholesale electricity price trends

Average electricity wholesale prices have fallen since their peaks in mid-2022[21], with spot prices across the NEM averaging $48/megawatt hour (MWh) in Q4 2023. This reflects a year-on-year decline of $44/MWh (-48%). Regional average prices for Q4 2023 ranged between $26/MWh in Victoria to $68/MWh in Queensland.

Figure 21 shows quarterly average spot price trends for the NEM over the past three years.

Figure 21 Average NEM spot prices – quarterly since Q3 2020 ($/MWh)

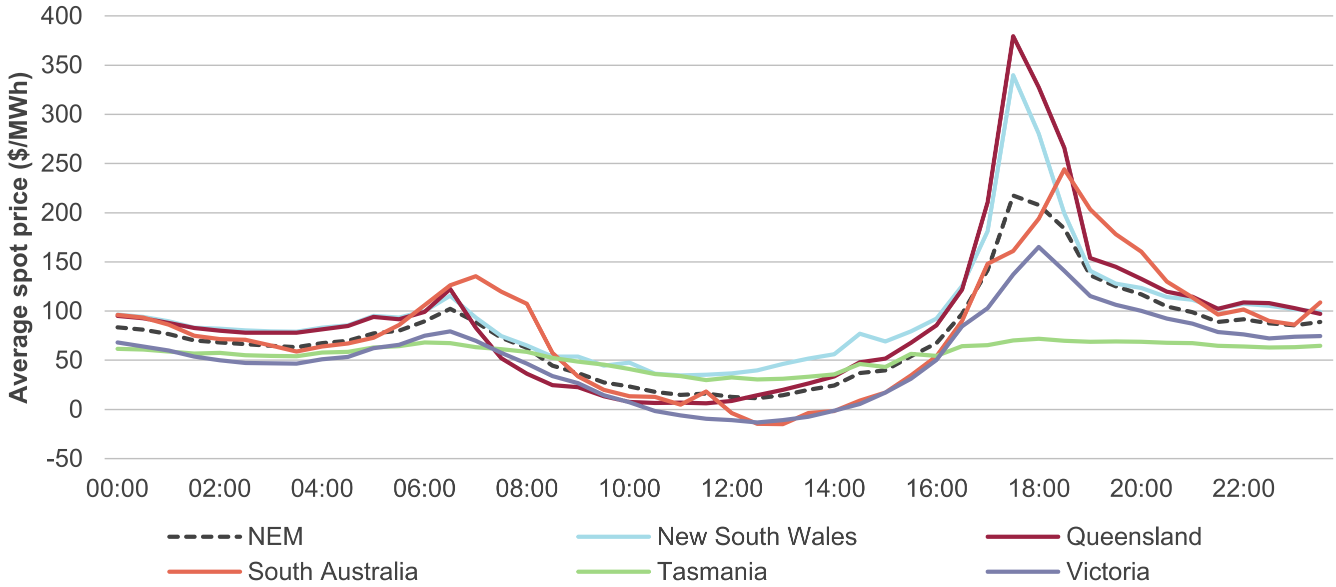


While average spot prices are an important indicator, different technologies have different operating patterns across the day, which may result in different average exposure to spot prices. For example, prices are often depressed during the day when distributed PV is at its maximum, but rise sharply over the evening peak demand after sunset.

Figure 22 highlights the regional time-of-day spot prices for the 2023 calendar year. Prices were low during the day and highest during the evening peak.

[21] In 2022, wholesale prices reached their highest recorded quarterly averages in Q2 and Q3. Price volatility was attributed to low coal-fired output driving high levels of gas-fired generation, which both raised electricity prices and put pressure on local gas markets; see *Quarterly Energy Dynamics* Q3 2022 at https://aemo.com.au/-/media/files/major-publications/qed/2022/qed-q3-2022.pdf?la=en.

Figure 22 Half-hourly average spot prices in the NEM for calendar year 2023 by time of day ($/MWh)



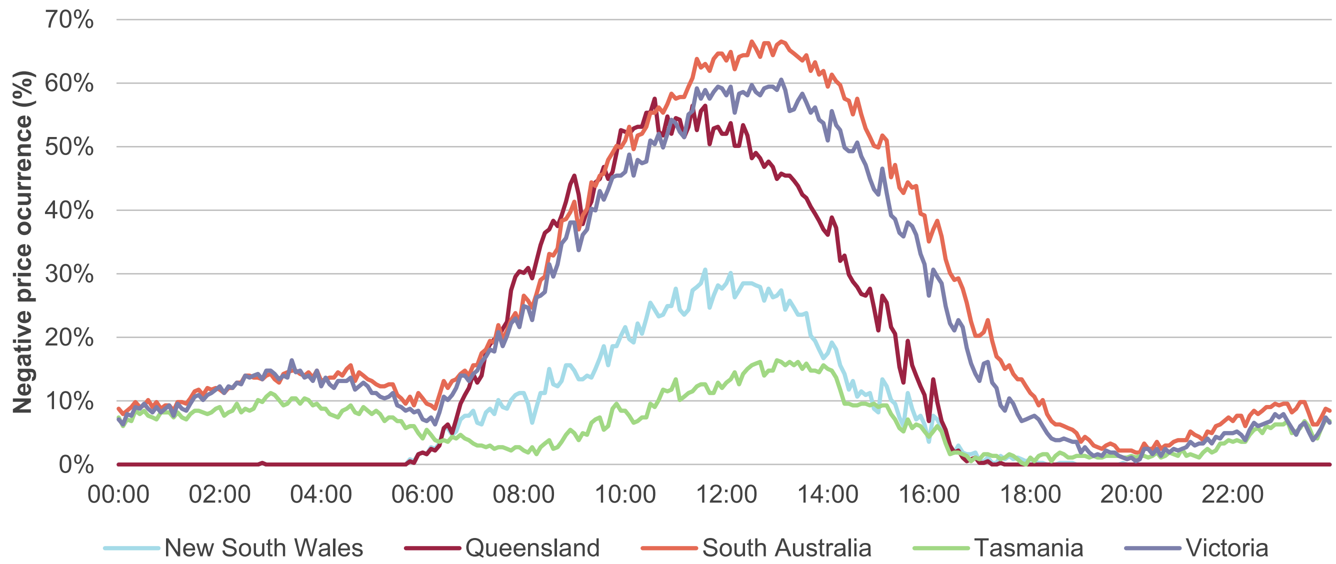
Negative wholesale electricity prices

In Q4 2023, 20% of dispatch intervals across the NEM recorded negative or zero prices (referred as "negative price occurrence"), marking a new high compared to any previous quarter.

All NEM regions except Tasmania have been experiencing increasingly frequent negative price occurrences over the past five years. Negative price occurrence continues to be concentrated during daylight hours, reflecting higher grid-scale solar supply and reduced daytime operational demand.

Figure 23 highlights the magnitude of these negative price occurrences for each region across the 2023 calendar year. More detailed information on time-of-day prices is presented in the subsequent regional chapters.

Figure 23 Negative price occurrence in the NEM for calendar year 2023 by time of day

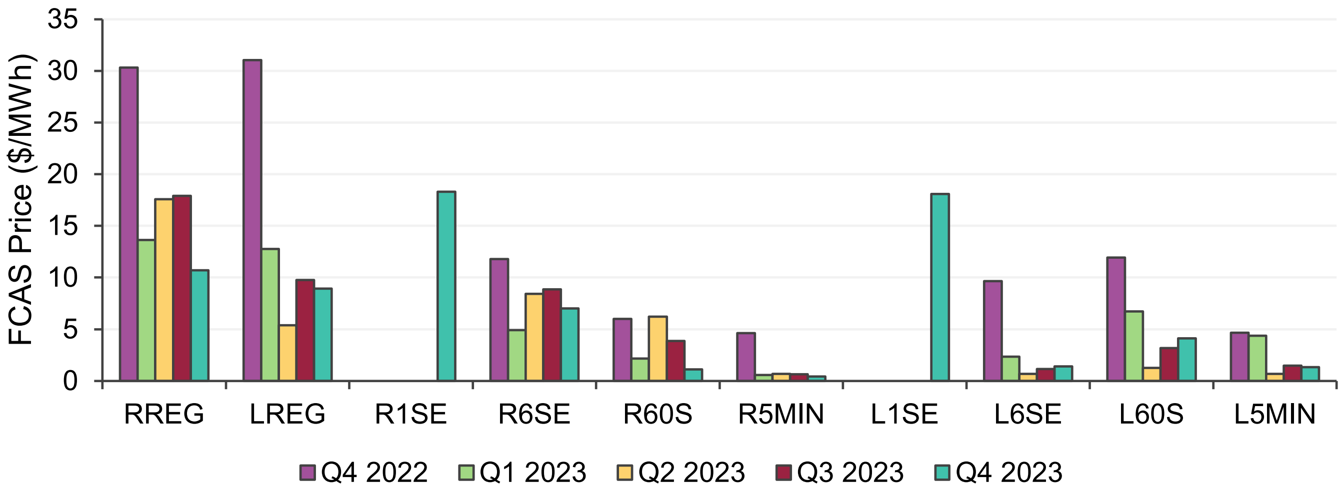


Frequency control ancillary service (FCAS) prices

In the first quarter of the very fast FCAS market's operation, the NEM-wide average price for one-second contingency raise was $18.3/MWh, the highest of all the FCAS services for Q4 2023, followed by one-second contingency lower at $18.1/MWh. The quarterly price trends for all FCAS markets are shown in Figure 24.

NEM-wide average prices for the existing FCAS services in Q4 were generally lower than in preceding quarters.

Figure 24 Quarterly NEM average FCAS prices by service ($/MWh)



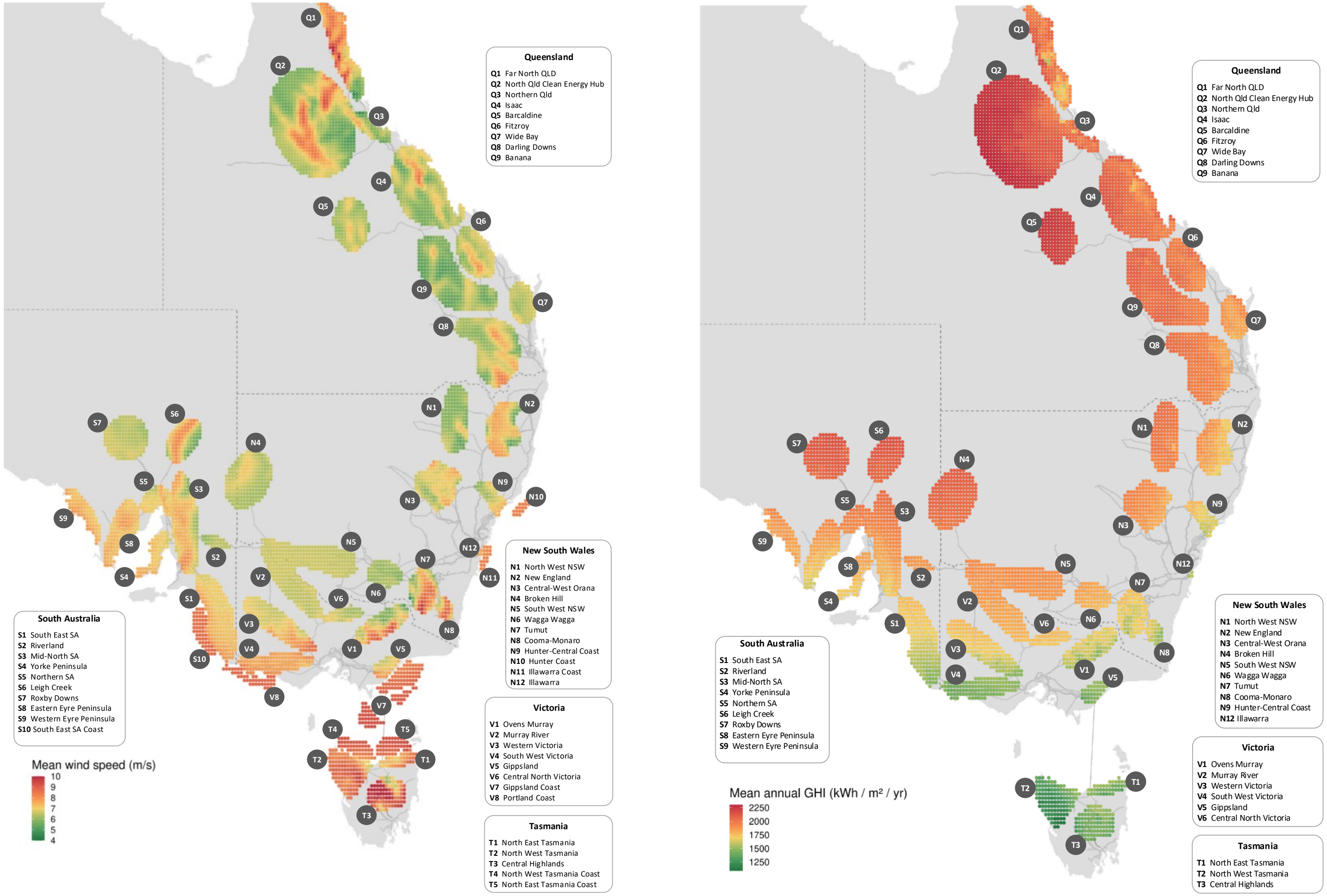
2.7 Resource quality

Renewable resource quality and other weather variables are key inputs into estimating likely generation availability for solar and wind generators. AEMO collects this data as part of its *Inputs, Assumptions and Scenarios Report* (IASR).

The latest wind and solar resource quality information for each REZ is shown in Figure 25. This data is obtained from several sources, including:

- Wind speed (at hub height) reanalysis data from the European Centre for Medium-Range Weather Forecasts.
- Solar irradiance reanalysis data from Solcast.
- Temperature and ground-level wind speed observation data from the Bureau of Meteorology (BoM).
- Historical generation and weather measurements from SCADA data provided by participants.

Figure 25 Wind resource quality as average wind speed at hub height (left) and solar resource quality as global horizontal irradiance (right)



Source: AEMO. 2023 IASR, July 2023, at https://aemo.com.au/-/media/files/major-publications/isp/2023/2023-inputs-assumptions-and-scenarios-report.pdf.

3 New South Wales

This chapter summarises key locational indicators relating to:

- Regional energy policies (Section 3.1).
- Generation and storage outlook (Section 3.2).
- Network capability (Section 3.3).
- System security requirements and shortfalls (Section 3.4).
- Reliability and energy adequacy (Section 3.5).
- Wholesale price indicators (Section 3.6).

Appendix A3 contains detailed indicators for each New South Wales REZ, including weather and climate scores.

3.1 Regional energy policies

Regional energy policies shape the energy landscape and are an important consideration for new transmission, generation, and storage projects. In New South Wales, key energy policies and commitments include:

- REZs declared under the New South Wales *Electricity Infrastructure Investment Act 2020* (NSW EII Act) [22].
- Emissions reduction targets of 50% by 2030, 70% by 2035 and net zero by 2050, under the *Climate Change (Net Zero Future) Act 2023* (NSW)[23].
- Construction of new renewable generation to produce up to 8 GW in New England REZ, 3 GW in Central-West Orana REZ[24], and 1 GW elsewhere by end of 2029, directed to be carried out under the NSW EII Act.
- Construction of long-duration storage infrastructure with at least 16 GWh of storage and 2 GW of capacity by 2030 directed to be carried out under the NSW EII Act.
- Consideration of transmission development options, including REZs and priority transmission infrastructure projects (PTIPs) directed to be carried out under the NSW EII Act.
- The Australian Capital Territory emissions reduction targets of 50-60% by 2025 (from 1990 levels), 65-75% by 2030, 90-95% by 2040 and net zero by 2045[25].
- The New South Wales Roadmap tender to provide support to renewable generation projects across New South Wales[26].

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[22] At https://legislation.nsw.gov.au/view/html/inforce/current/act-2020-044.

[23] *Climate Change (Net Zero Future) Act 2023* (NSW), section 9. At https://legislation.nsw.gov.au/view/whole/html/inforce/current/act-2023-048.

[24] In December 2023 the New South Wales Government increased the intended network capacity of the Central-West Orana REZ to 6 GW. See https://gazette.legislation.nsw.gov.au/so/download.w3p?id=Gazette_2023_2023-580.pdf.

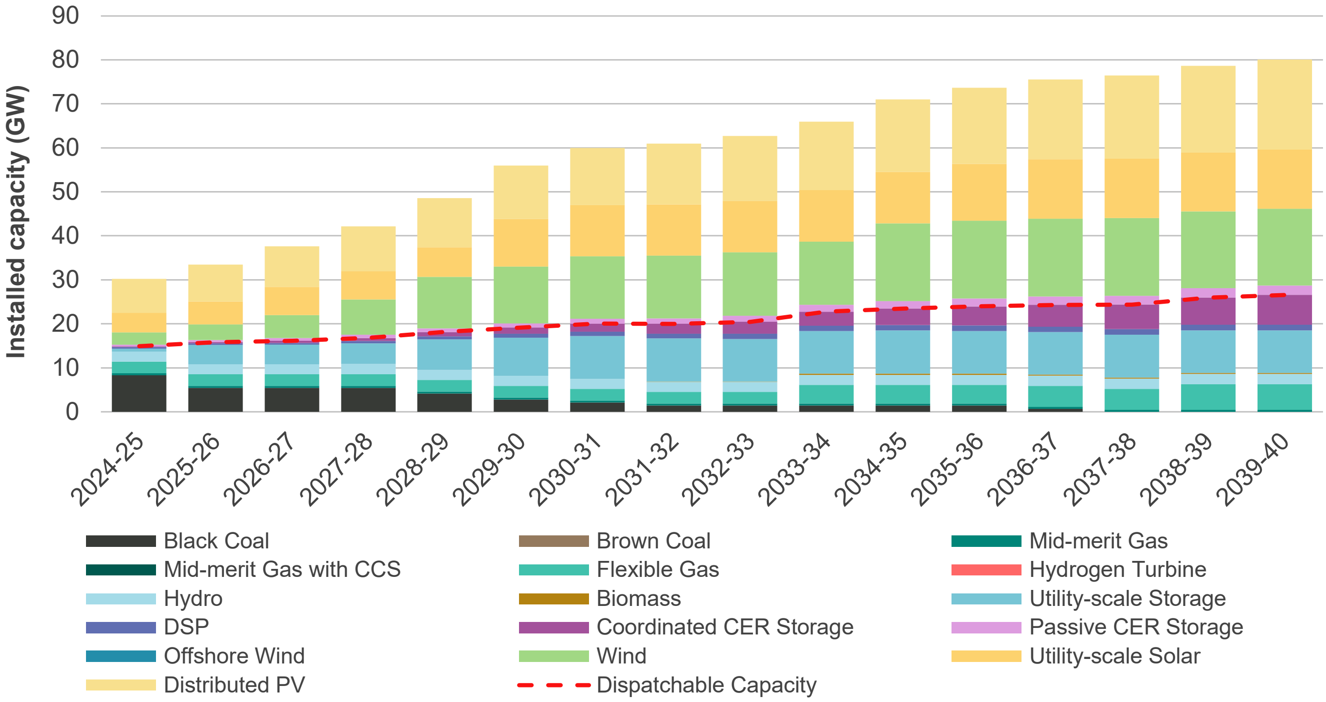
[25] ACT Government. *ACT Climate Change Strategy*, at https://www.climatechoices.act.gov.au/policy-programs/act-climate-change-strategy.

[26] New South Wales Government. *Electricity Infrastructure Roadmap*, at https://www.energy.nsw.gov.au/nsw-plans-and-progress/major-state-projects/electricity-infrastructure-roadmap.

3.2 Generation and storage outlook

Figure 26 shows the projected capacity by technology for New South Wales until 2040. See Figure 10 (in Section 2.2) for historical and forecast capacity by technology in the NEM.

Figure 26 Forecast capacity for New South Wales, *Step Change*, 2024-25 to 2039-40 (GW)



3.3 Network capability

Historical generation curtailment due to network limitations

Curtailment outcomes for semi-scheduled VRE generators in New South Wales in 2023 are illustrated in Figure 27 and further detailed in Appendix A3. Notable insights from this data include:

- Curtailment of wind farms in New South Wales ranged from 0.0% to 2.6% and averaged 0.8%.
- Curtailment of solar farms was generally significantly higher than this, ranging from 0.1% to 50.7% and averaging 7.2%.
- Certain areas had greater prevalence of curtailment than others, such as the 132 kilovolts (kV) network north of Wagga Wagga, and the 132 kV network south of Wellington. However, there was significant variation in curtailment outcomes even for nearby projects, such as Molong Solar Farm (50.7%) and Parkes Solar Farm (13.8%), which both connect to the 132 kV network south of Wellington.
- Areas with generally lower solar curtailment included the 132 kV network north of Wellington. However, even areas showing low historical curtailment may be dispatching generation close to network limits, and additional generation may lead to increases in curtailment.

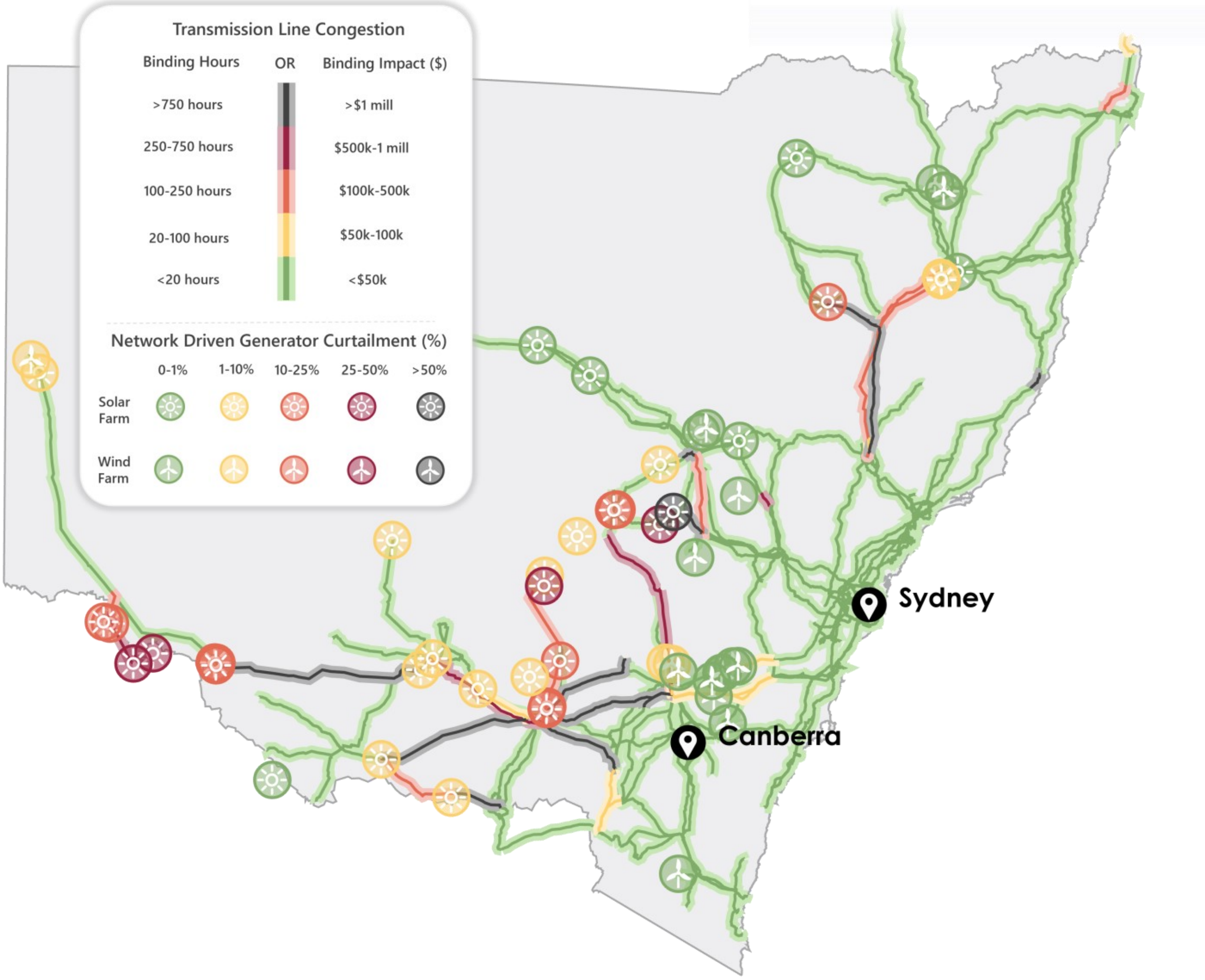
Historical grid congestion

New South Wales experienced significant transmission congestion in 2023 across a wide area of the state, and at voltage levels from 132 kV to 330 kV. Areas of high congestion included:

- Parts of the 132 kV network near Wellington, Tamworth, Yass, and Wagga.
- The 220 kV and 330 kV flow path from Balranald to Darlington Point to Wagga to Lower Tumut.
- The 330 kV flow path from Armidale to Liddell in the southward direction.
- Constrained import from Victoria to maintain voltage and transient stability.

Figure 27 also provides an overview of congestion outcomes for New South Wales in 2023.

Figure 27 Congestion and curtailment in New South Wales – calendar year 2023



Note: Not all sources of congestion can be allocated to individual network elements in a way that would be meaningful as a locational signal (for example some types of stability limitation). See Appendix A2.2.3 for a detailed explanation of inclusions and exclusions related to this map.

Forecast VRE curtailment and economic offloading

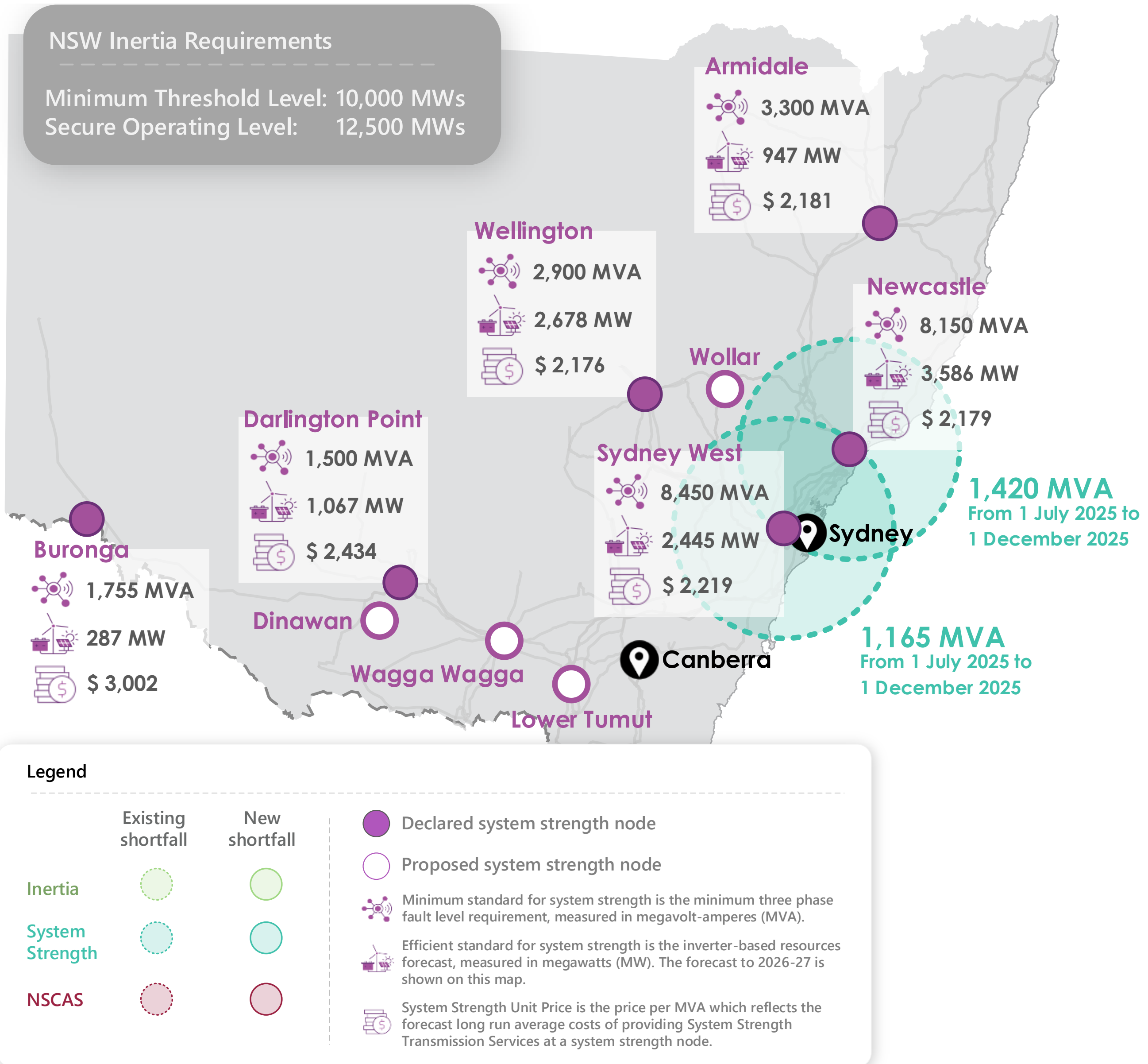
Appendix A3 includes forecasts of VRE curtailment and economic offloading for each New South Wales REZ from 2025 to 2027, based on analysis completed for the Draft 2024 ISP. This data indicates that average curtailment is forecast to range from 0% to 10.9% across the different REZs by 2027 and to remain relatively stable from 2025 to 2027 for most REZs in the region.

These forecasts are an indication of potential curtailment outcomes under ISP modelling assumptions and cannot be relied on as predictions of curtailment for specific projects.

3.4 System security shortfalls and requirements

An overview of the system security needs across New South Wales is shown in Figure 28 below.

Figure 28 System security needs in New South Wales



NSCAS

In 2023, AEMO confirmed the existing reliability and security ancillary service (RSAS) gap of 2 megavolt amperes reactive (MVAr) reactive power absorption in the Coleambally area. Transgrid has temporary operating measures in place to manage this gap and is progressing long-term remediation through a regulatory investment test for transmission (RIT-T). AEMO considers that this gap is closed but will continue to monitor its status.

Inertia

There are no identified inertia shortfalls in New South Wales. Projected levels of inertia are expected to decline over the long-term planning horizon, but strong interconnection with neighbouring regions means New South Wales is not considered sufficiently likely to island. The inertia requirements for New South Wales up to 2026-27 are summarised in Table 2.

Table 2 Inertia requirements and shortfalls, New South Wales (megawatt seconds (MWs)

	2024-25		2025-26		2026-27	
	Requirement	Shortfall	Requirement	Shortfall	Requirement	Shortfall
NSW secure operating level (MWs)	12,500	-	12,500	-	12,500	-

System strength

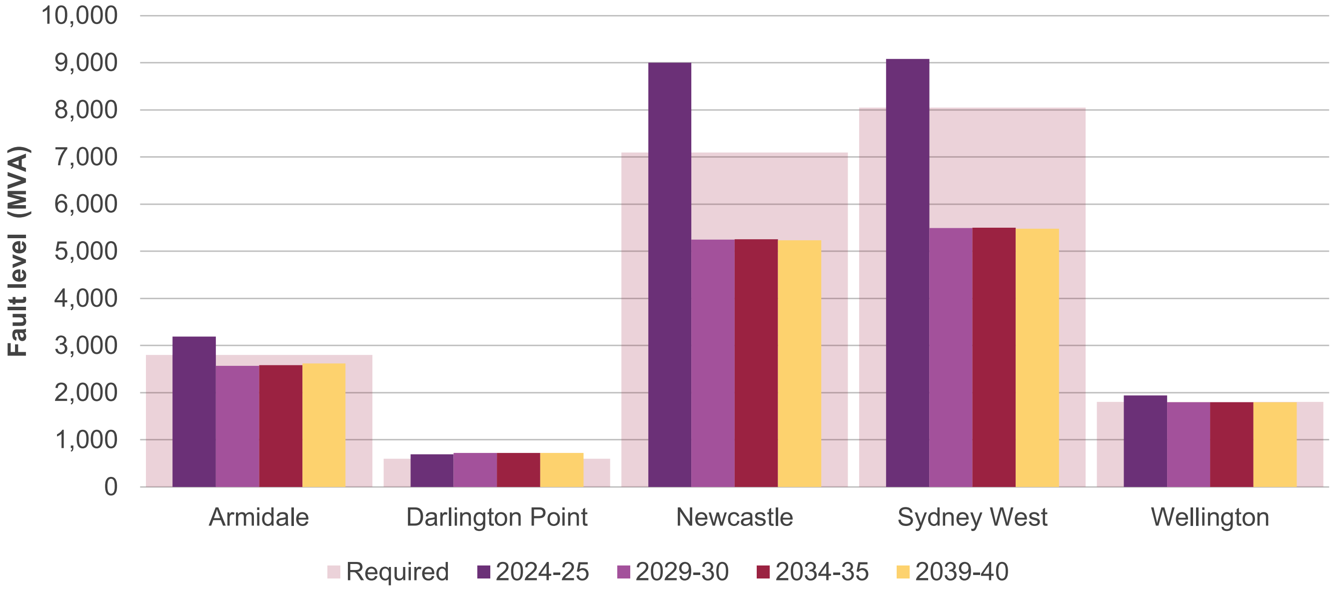
In 2023, the declared shortfalls at Newcastle and Sydney West increased in magnitude to 1,420 megavolt amperes (MVA) and 1,165 MVA respectively. Transgrid is progressing a RIT-T to address these shortfalls, and as part of its longer-term system strength RIT-T. The system strength shortfalls and requirements for New South Wales to 2026-27 are summarised in Table 3.

Table 3 System strength shortfalls and requirements, New South Wales (MVA)

Node	Minimum three phase fault current (MVA)					
	2024-25		2025-26		2026-27	
	Requirement	Shortfall	Requirement	Shortfall	Requirement	Shortfall
Armidale 330 kV	3,300	0	3,300	0	3,300	-
Buronga 220 kV	1,755	-	1,755	-	1,755	-
Darlington Point 330 kV	1,500	0	1,500	0	1,500	-
Newcastle 330 kV	8,150	0	8,150	1,420	8,150	-
Sydney West 330 kV	8,450	0	8,450	1,165	8,450	-
Wellington 330 kV	2,900	0	2,900	0	2,900	-

Declining utilisation of synchronous generation is expected to further reduce synchronous fault levels at some nodes, while major network projects like the Sydney Ring will provide relief at others. Fault level reductions based on the Draft 2024 ISP modelling are summarised in Figure 29. This modelling suggests that almost all the necessary fault level remediation will be required in the coming decade.

Figure 29 Projected and required level of fault current available at least 99% of the time, New South Wales (MVA)



3.5 Reliability and energy adequacy

The May 2024 Update to the 2023 ESOO identifies reliability gaps in New South Wales across the entire study horizon in the Central scenario. Table 4 summarises these results for the next five years, and presents forecast demand, expected USE, and the magnitude of expected gaps against both the reliability standard and the interim reliability measure (IRM).

Table 4 New South Wales reliability and energy adequacy metrics, 2023 ESOO Central scenario (MW)

	Forecast maximum operational demand 50% POE (MW)	Forecast minimum operational demand 50% POE (MW)	Expected USE (%)	Reliability gaps and equivalent gaps against the reliability standard (MW)	Reliability gaps and equivalent gaps against the IRM (MW)
2024-25	12,998	3,063	0.0012	0	270
2025-26	13,266	2,804	0.0054	510	1,040
2026-27	13,631	2,649	0.0075	695	1,230
2027-28	13,919	2,385	0.0060	595	1,135
2028-29	14,223	2,016	0.0047	480	1,050

3.5.1 Locational reliability factors

Figure 30 and Figure 31 show the relative reliability benefits of generators located at various connection points across the NEM for the ESOO Central scenario, and an actionable transmission sensitivity in 2029-30 with a focus on times of unserved energy in New South Wales.

Connection points in the Sydney and Newcastle areas are shown to have a 100% relative benefit, while those further south, west, and coastal north are shown to have reduced reliability benefits due to network congestion at times of New South Wales reliability risk. Additional transmission developments, including HumeLink and Hunter

Transmission Project, significantly increase transfer capacity within New South Wales in the sensitivity, however generator projects that are already considered committed or anticipated fully utilise this additional capacity.

Figure 30 ESOO Central scenario, locational reliability factors for New South Wales USE, 2029-30

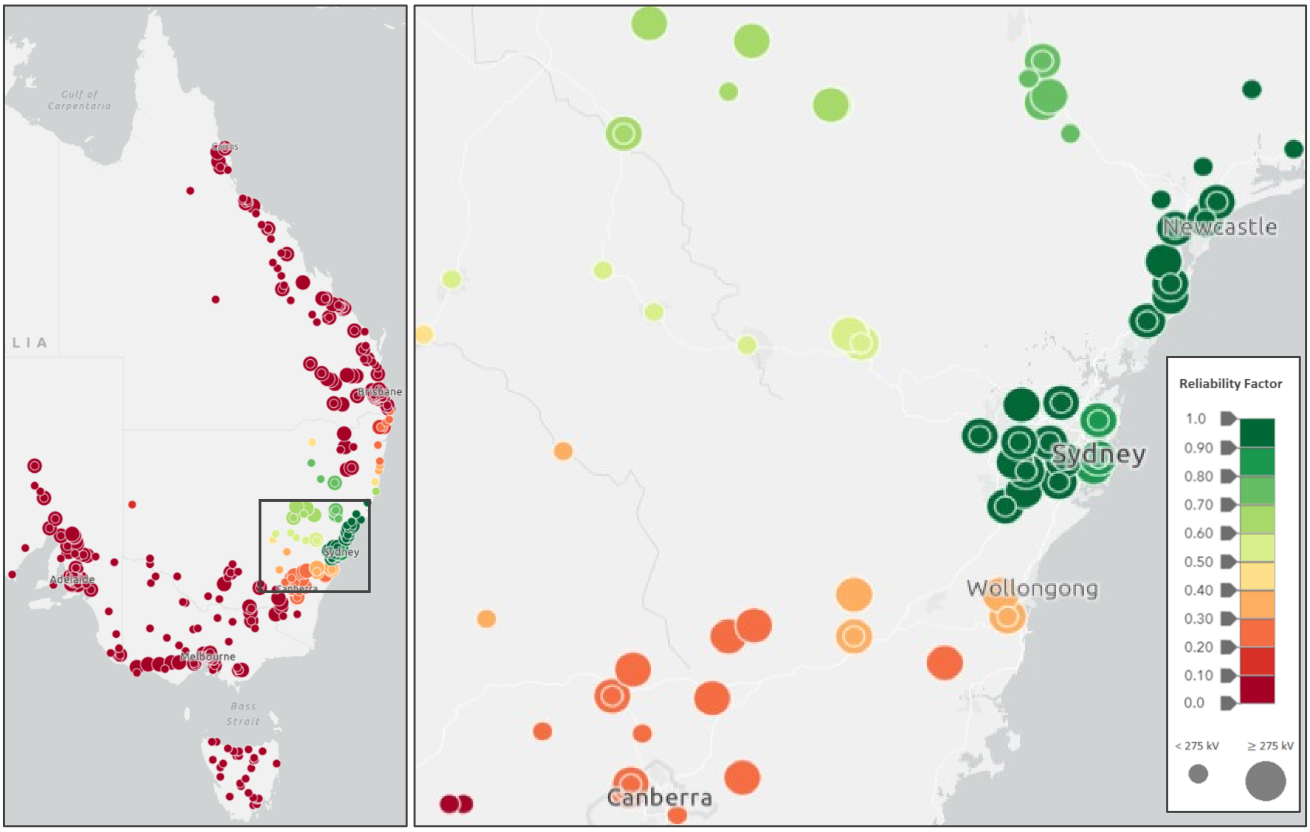
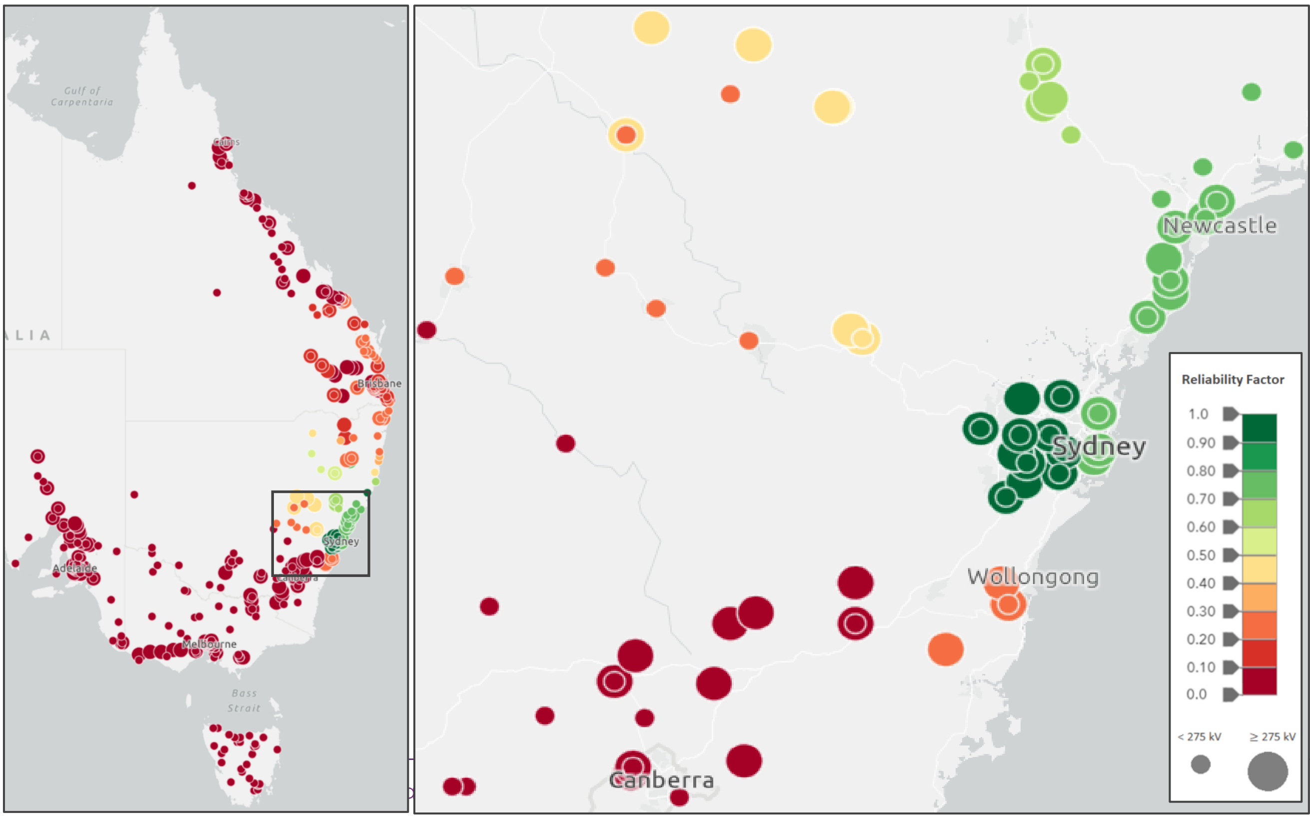


Figure 31 *Actionable transmission sensitivity*, locational reliability factors for New South Wales USE, 2029-30



3.6 Wholesale price indicators

Figure 32 shows the average quarterly spot price in New South Wales over the past four years. In 2023, the average regional spot price was $96/MWh. However, for the same year, negative prices occurred approximately 25% of the time during the daily period from 1000 hrs to 1400 hrs. Figure 33 provides the time-of-day negative price occurrence and half-hourly average spot price in New South Wales for calendar year 2023.

Figure 32 Average New South Wales spot prices – quarterly since Q3 2020 ($/MWh)

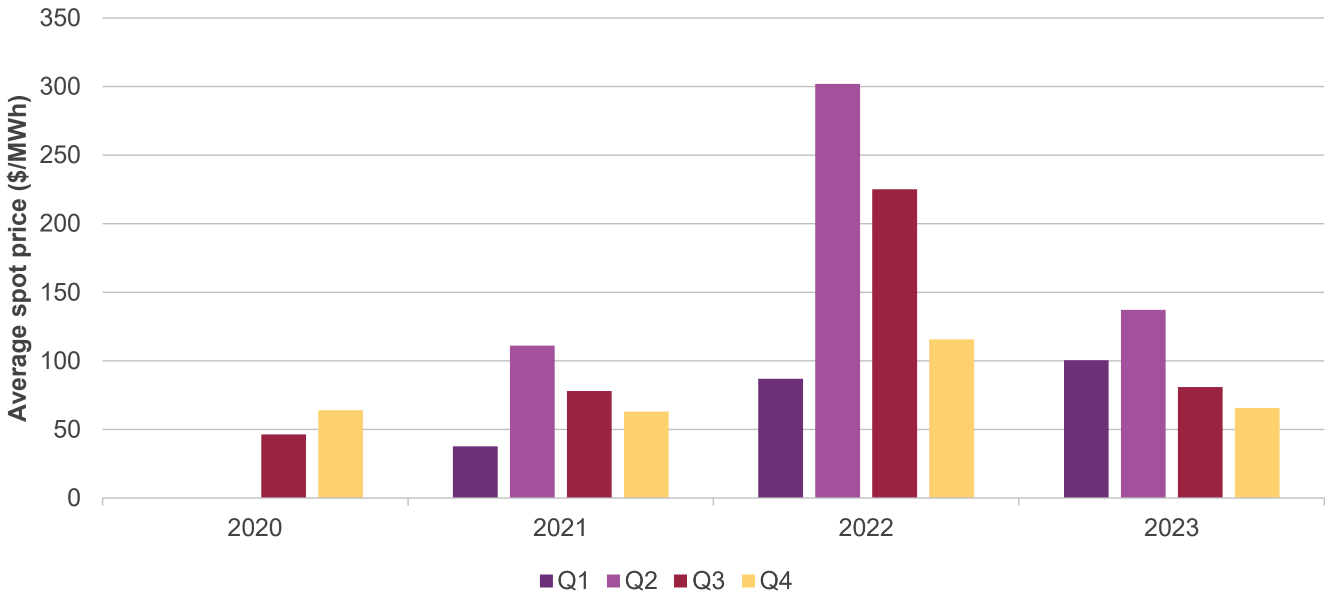
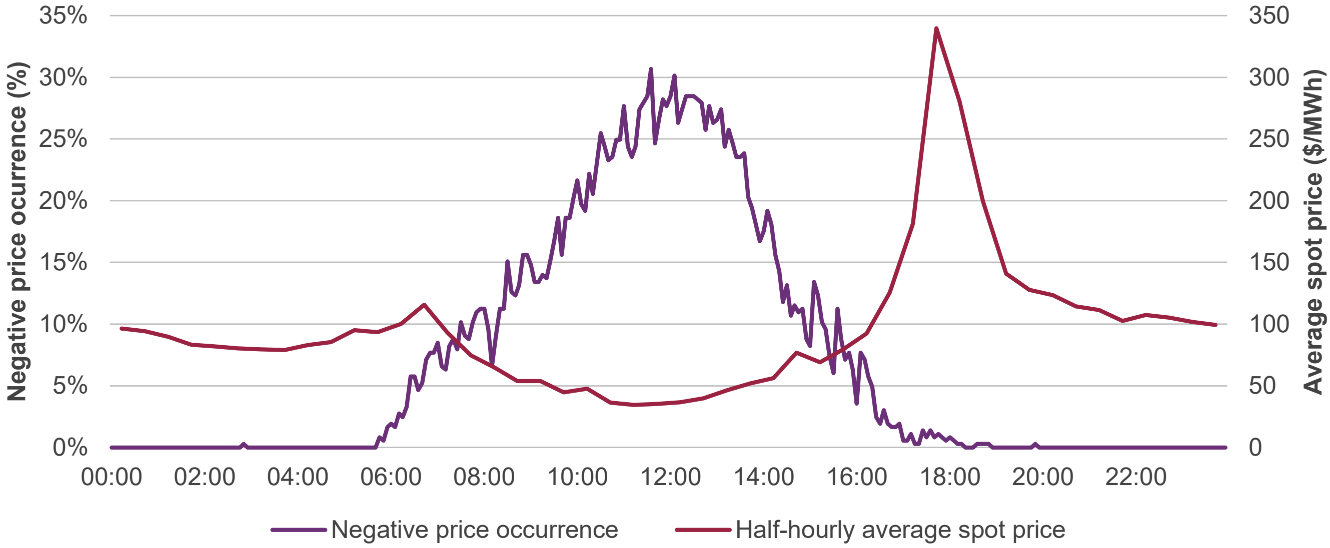


Figure 33 Negative price occurrence and half-hourly average spot price in New South Wales for calendar year 2023 by time of day



4 Queensland

This chapter summarises key locational indicators for Queensland, relating to:

- Regional energy policies (Section 4.1).
- Generation and storage outlook (Section 4.2).
- Network capability (Section 4.3).
- System security requirements and shortfalls (Section 4.4).
- Reliability and energy adequacy (Section 4.5).
- Wholesale price indicators (Section 4.6).

Appendix A4 contains detailed indicators for each Queensland REZ, including weather and climate scores.

4.1 Regional energy policies

In Queensland, key energy policies and commitments include:

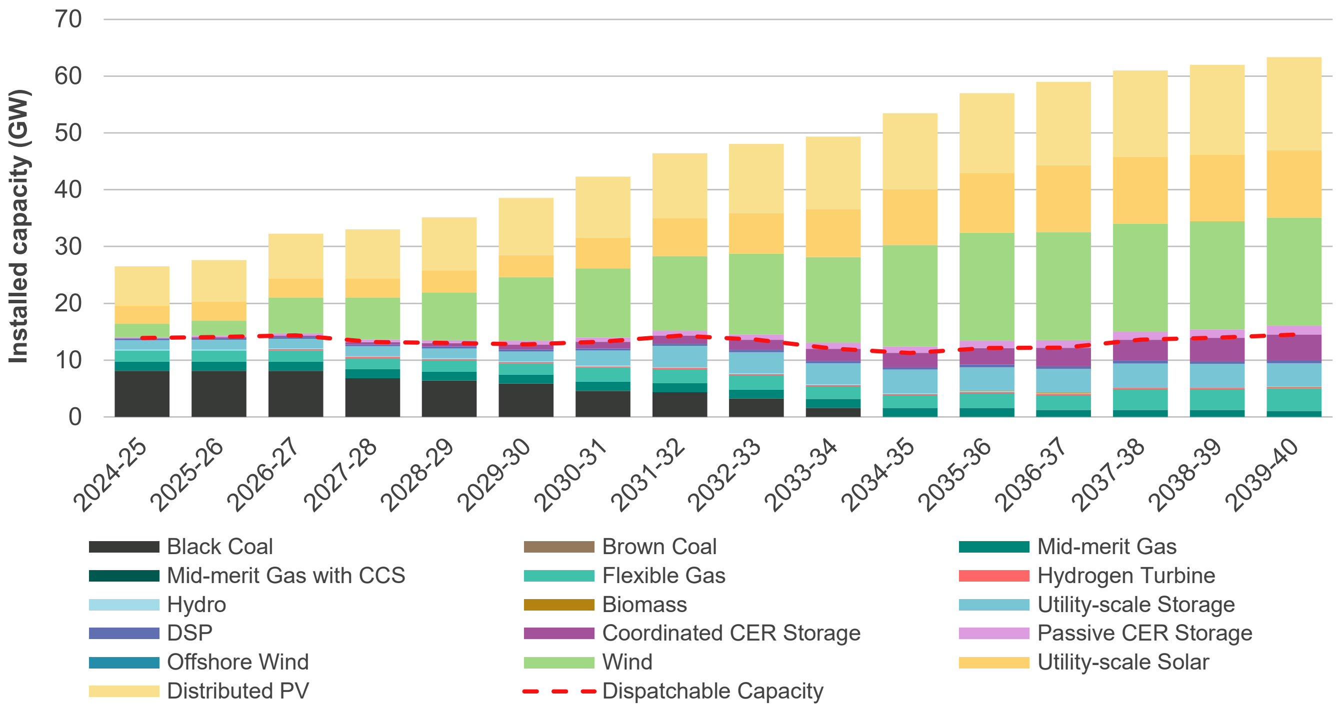
- Development of Borumba Pumped Hydro Energy Storage (now classified as an anticipated project)[27].
- REZ proposals as per the Queensland Energy and Jobs Plan REZ Roadmap[28].
- Expansion of the Queensland Renewable Energy Target (QRET) to 50% by 2030, 70% by 2032, and 80% by 2035 under the Queensland Energy and Jobs Plan[29] (legislated under the *Energy (Renewable Transformation and Jobs) Act 2024*).
- Queensland-wide emissions reduction targets of 30% below 2005 levels by 30 June 2030, 75% by 30 June 2035 and net zero by 30 June 2050[30] (legislated under the Clean Economy Jobs Act 2024).
- Transmission development options and infrastructure, as described in the SuperGrid Infrastructure Blueprint[31].

4.2 Generation and storage outlook

Figure 34 shows the projected capacity by technology for Queensland until 2040. See Figure 10 (in Section 2.2) for historical and forecast capacity by technology in the NEM.

[27] At https://qldhydro.com.au/projects/borumba/.
[28] At https://www.epw.qld.gov.au/__data/assets/pdf_file/0036/49599/REZ-roadmap.pdf.
[29] At https://www.legislation.qld.gov.au/view/html/asmade/act-2024-015.
[30] At https://www.legislation.qld.gov.au/view/pdf/asmade/act-2024-016.
[31] At https://www.epw.qld.gov.au/__data/assets/pdf_file/0030/32988/queensland-supergrid-infrastructure-blueprint.pdf.

Figure 34 Forecast capacity for Queensland, *Step Change* scenario, 2024-25 to 2039-40 (GW)



4.3 Network capability

Historical generation curtailment due to network limitations

Curtailment outcomes for semi-scheduled VRE generators in Queensland in 2023 are illustrated in Figure 35 and further detailed for each REZ in Appendix A4. Notable insights from this data include:

- Curtailment of wind farms in Queensland ranged from 0.0% to 2.0% and averaged 0.6%.
- Curtailment of solar farms was similar to this, ranging from 0.0% to 3.9% and averaging 0.8%.

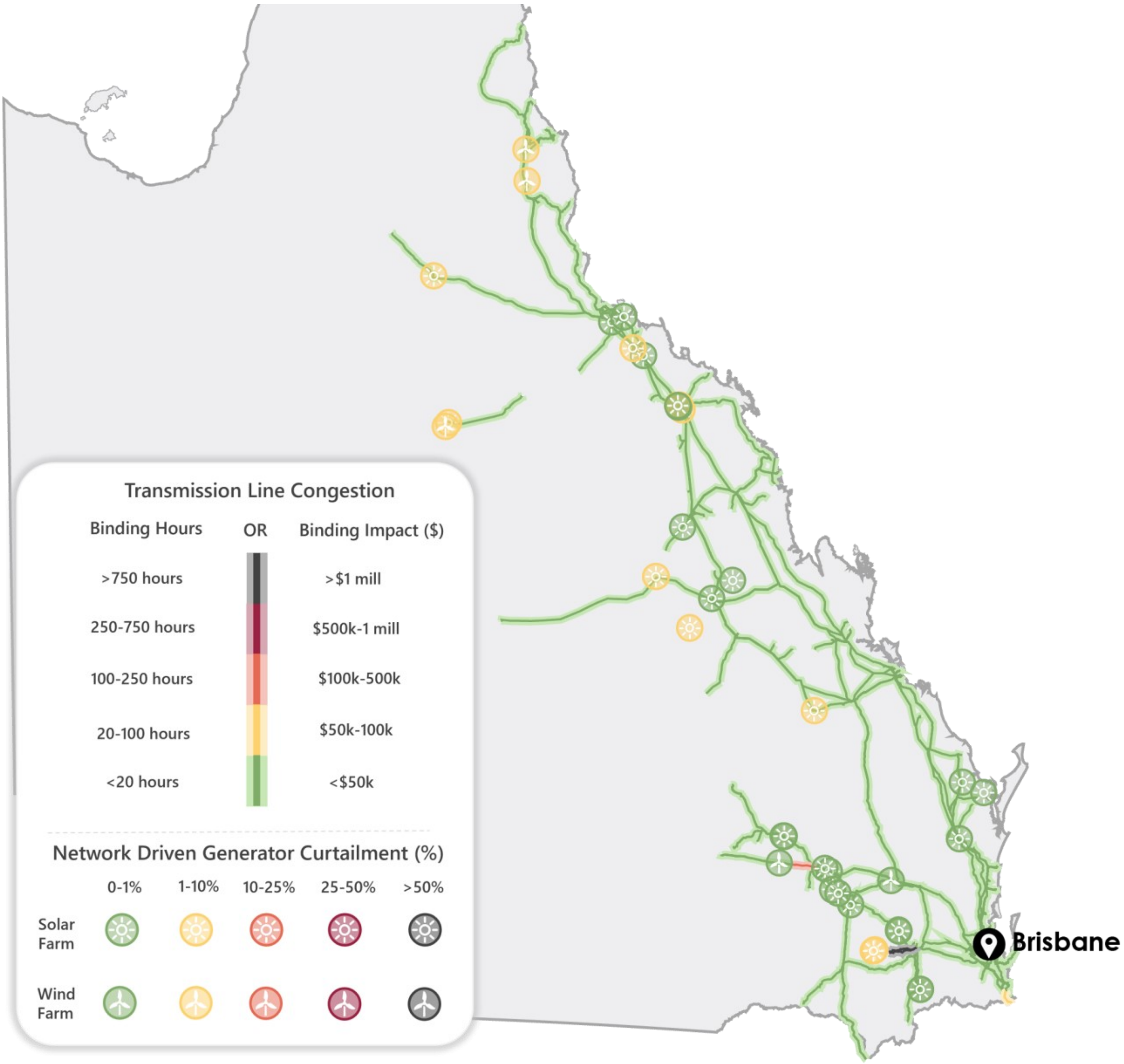
Historical grid congestion

Queensland experienced only light transmission congestion in 2023. Areas of notable congestion included:

- The 110 kV Yarranlea to Middle Ridge line (eastward flow).
- The 66 kV lines connecting to Emerald.
- The 132 kV Drillham to Columboola (eastward flow).
- The 110 kV Terranora to Mudgeeraba lines (northward flow).

Figure 35 also provides an overview of congestion outcomes for Queensland in 2023.

Figure 35 Congestion and curtailment in Queensland – calendar year 2023



Note: Not all sources of congestion can be allocated to individual network elements in a way that would be meaningful as a locational signal (for example some types of stability limitation). See Appendix A2.2.3 for a detailed explanation of inclusions and exclusions related to this map.

Forecast VRE curtailment and economic offloading

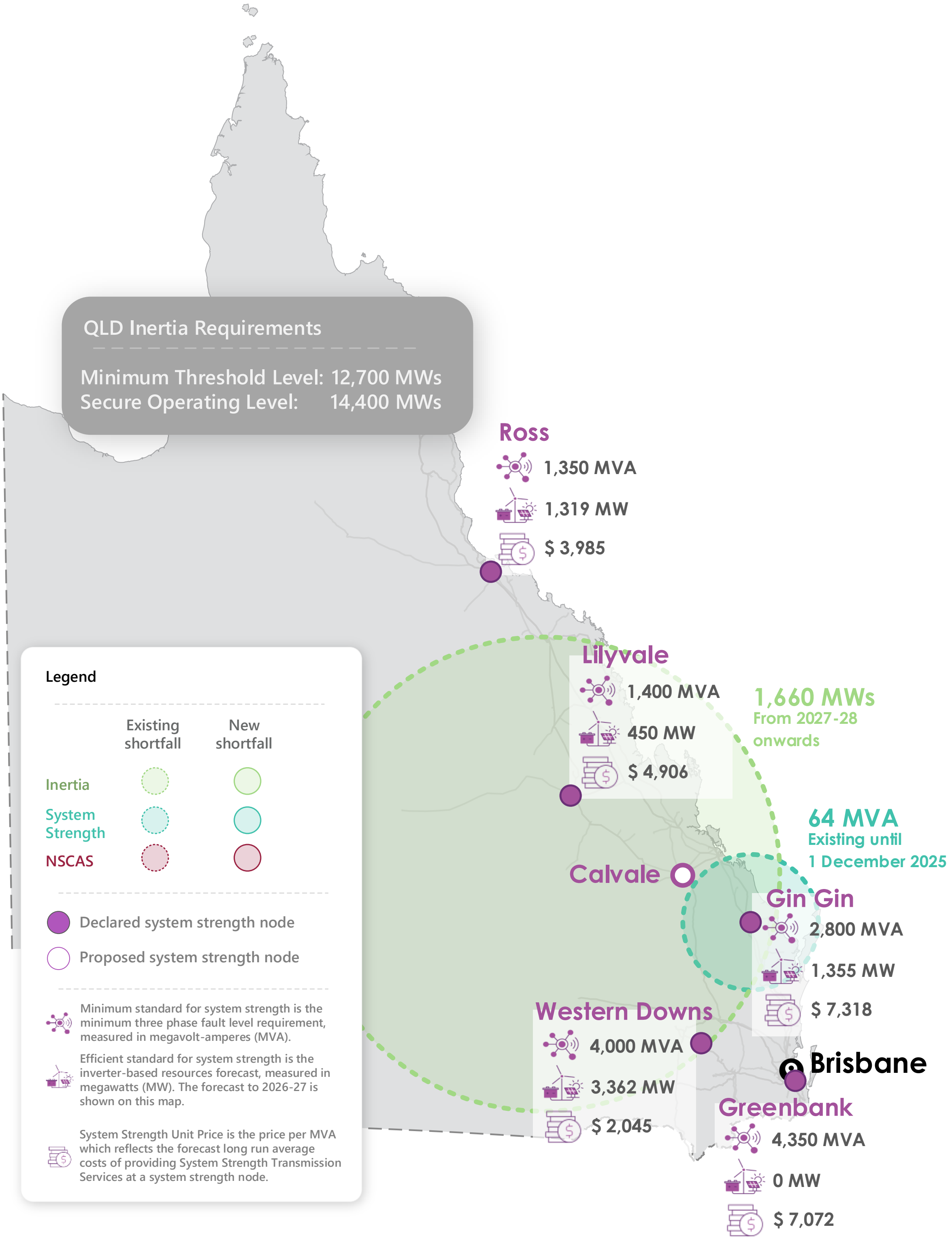
Appendix A4 includes forecasts of VRE curtailment and economic offloading for each Queensland REZ from 2025 to 2027, based on analysis completed for the Draft 2024 ISP. This data indicates that average curtailment is forecast to range from 0% to 0.2% across the different REZs by 2027 and to remain relatively stable from 2025 to 2027 for all REZs in the region.

These forecasts are an indication of potential curtailment outcomes under ISP modelling assumptions and cannot be relied on as predictions of project curtailment for specific projects. Curtailment outcomes will be dominated by highly variable short-term factors such as weather, system conditions, and new generator connections.

4.4 System security shortfalls and requirements

An overview of the system security needs across Queensland is shown in Figure 36.

Figure 36 System security needs in Queensland



NSCAS

In 2023, AEMO confirmed an existing RSAS gap of 120 MVAr reactive power absorption in Southern Queensland. Powerlink has a network support agreement in place, with further remediation expected from late 2024.

System Strength

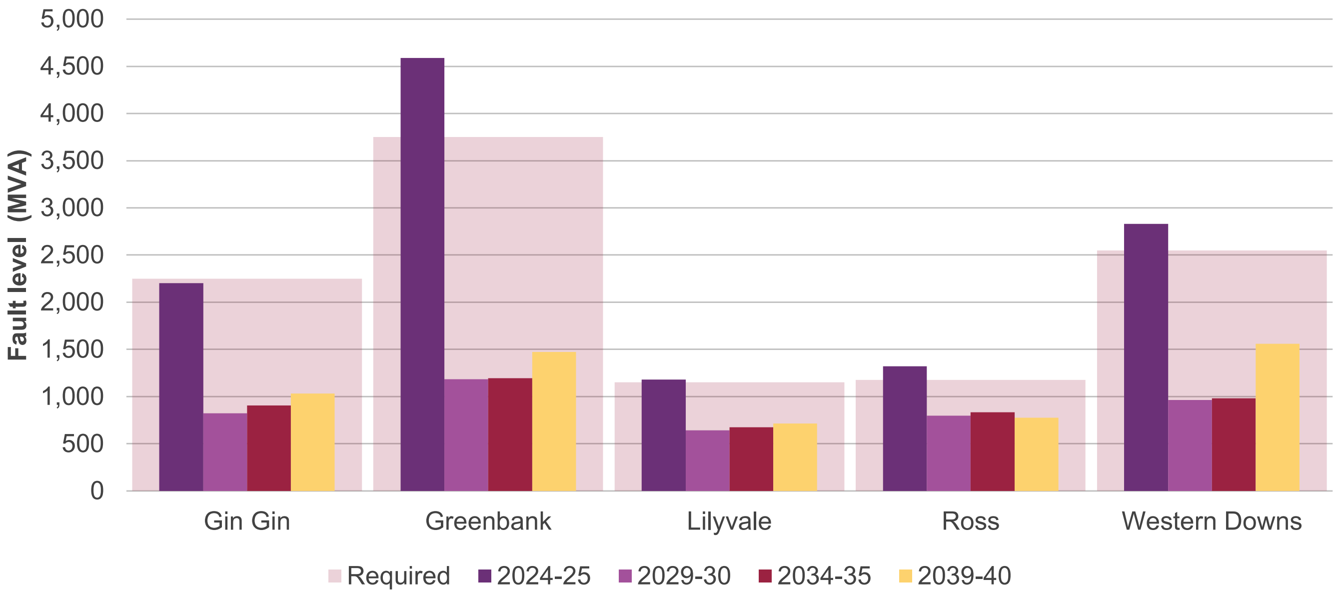
In 2023, AEMO confirmed an existing shortfall of 64 MVA at Gin Gin until 1 December 2025. Powerlink has entered commercial arrangements to remediate this need from 1 July 2025, with operational processes in place for the interim. The shortfalls and requirements for Queensland to 2026-27 are summarised in Table 5.

Table 5 System strength shortfalls and requirements (MVA)

Node	Minimum three phase fault current (MVA)					
	2024-25		2025-26		2026-27	
	Requirement	Shortfall	Requirement	Shortfall	Requirement	Shortfall
Gin Gin 275 kV	2,800	50	2,800	50	2,800	-
Greenbank 275 kV	4,350	0	4,350	0	4,350	-
Lilyvale 132 kV	1,400	0	1,400	0	1,400	-
Ross 275 kV	1,350	0	1,350	0	1,350	-
Western Downs 275 kV	4,000	0	4,000	0	4,000	-

Decreased utilisation of synchronous generation is expected to reduce synchronous fault levels at all nodes in the region, with most associated remediation investment likely needed over the coming decade. Substantial investment in wind and solar IBR, particularly near the Gin Gin and Western Downs nodes, will drive ongoing investment in system strength services. Fault level reductions based on the Draft 2024 ISP modelling are summarised in Figure 37

Figure 37 Projected and required level of fault current available at least 99% of the time, Queensland (MVA)



Inertia

In 2023, AEMO identified a change in the inertia shortfall previously identified for Queensland, which now occurs from 2027-28 at a level of up to 1,660 megawatt seconds (MWs). This is linked to changes in the announced timing of several major generation and transmission projects, which have impacted expected generation dispatch patterns.

The inertia requirements for Queensland up to 2026-27 are summarised in Table 6.

Table 6 Inertia requirements and shortfalls (MWs)

	2024-25		2025-26		2026-27	
	Requirement	Shortfall	Requirement	Shortfall	Requirement	Shortfall
QLD secure operating level (MWs)	14,400	-	14,400	-	14,400	-

4.5 Reliability and energy adequacy

Reliability risks are forecast to remain within the relevant standard until 2031-32 in the Central scenario. Table 7 shows forecast demand, expected USE, and the reliability gap assessments against the reliability standard and the IRM.

Table 7 Queensland reliability and energy adequacy metrics, 2023 ESOO Central scenario (MW)

	Forecast maximum operational demand 50% POE (MW)	Forecast minimum operational demand 50% POE (MW)	Expected USE (%)	Reliability gaps and equivalent gaps against the reliability standard (MW)	Reliability gaps and equivalent gaps against the IRM (MW)
2024-25	10,187	2,678	0.0001	0	0
2025-26	10,406	2,549	0.0002	0	0
2026-27	10,661	2,418	0.0002	0	0
2027-28	10,851	2,214	0.0001	0	0
2028-29	11,106	2,021	0.0002	0	0

4.5.1 Locational reliability factors

Figure 38 and Figure 39 show the relative reliability benefits of generators located at various connection points across the NEM for the ESOO Central scenario in 2029-30 and an *Actionable transmission* sensitivity in 2029-30 with a focus on times of unserved energy in Queensland.

Connection points between the Gold Coast and Gladstone are shown to have a 100% relative reliability benefit, while those west of Brisbane are shown to have reduced reliability benefits due to congestion in transmission networks at time of Queensland reliability risk.

Figure 38 ESOO Central scenario, locational reliability factors for Queensland USE, 2029-30

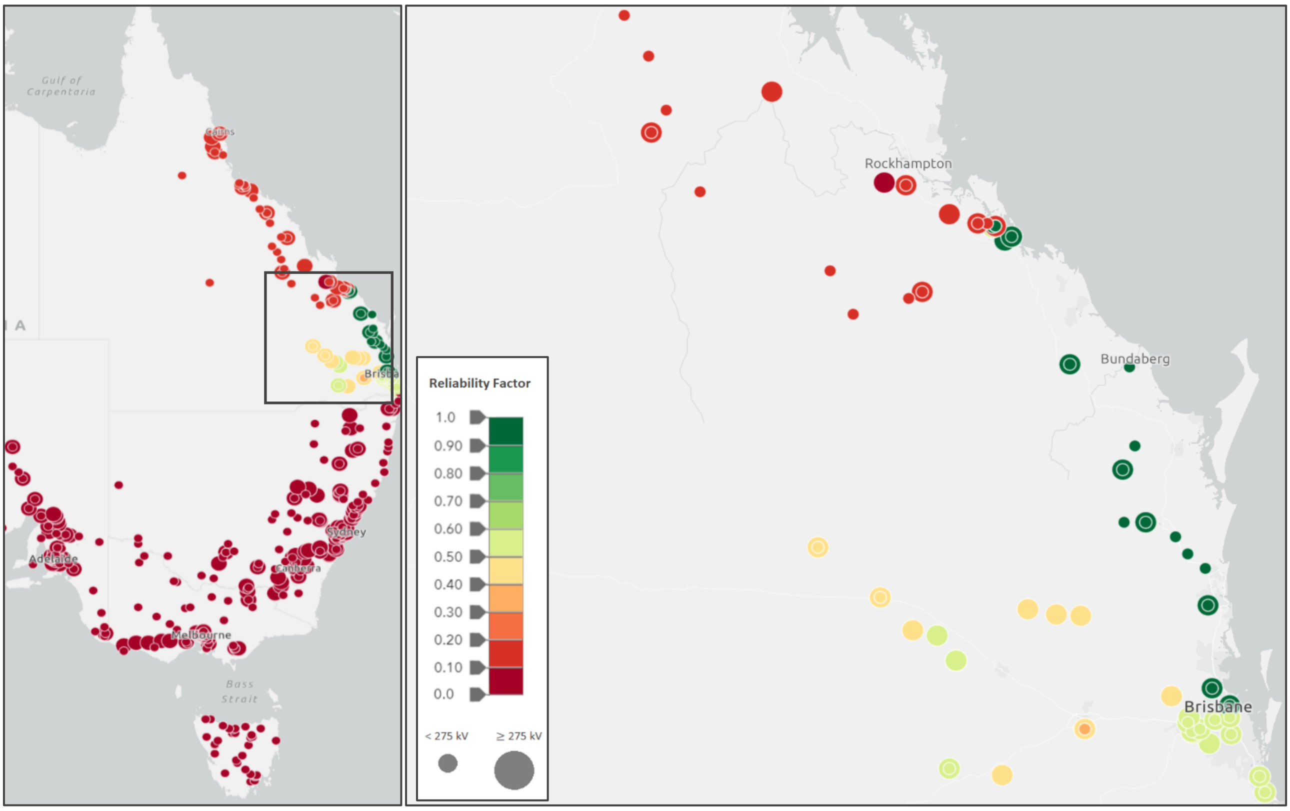
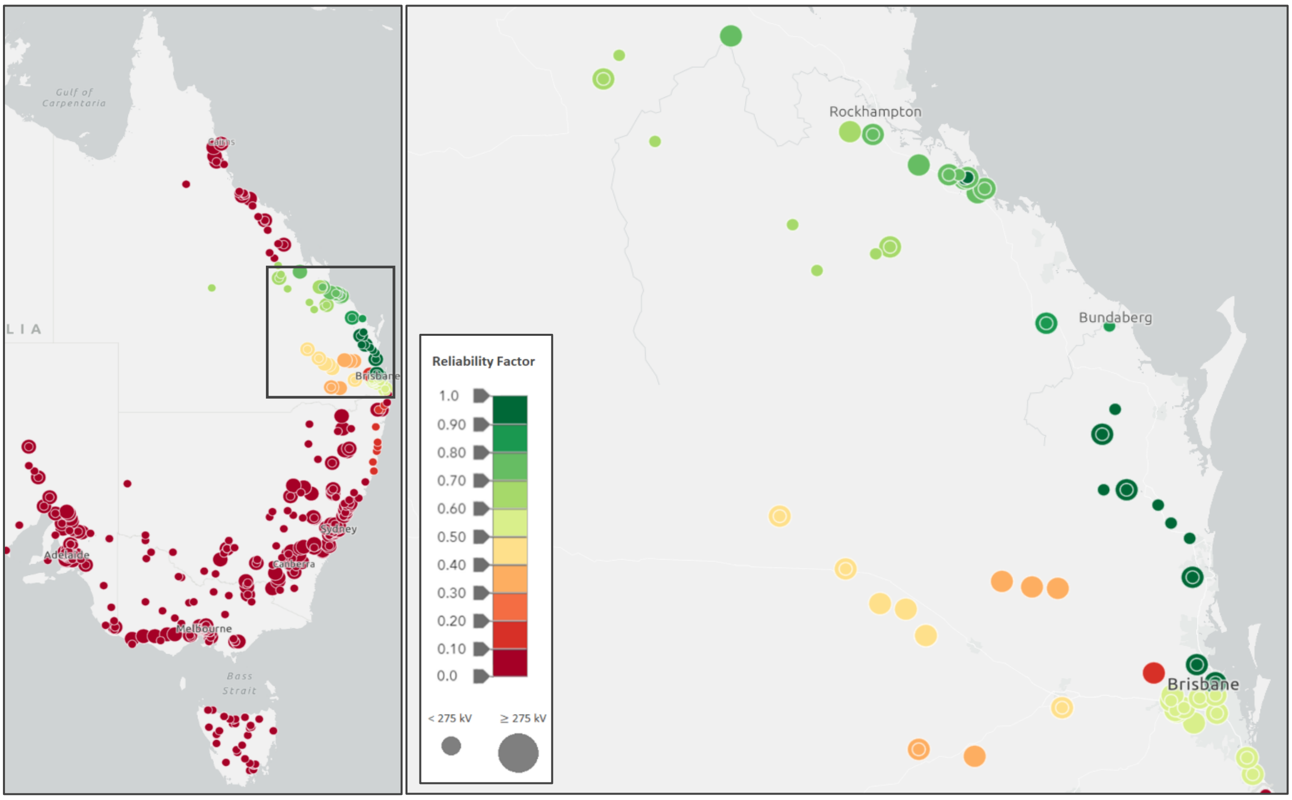


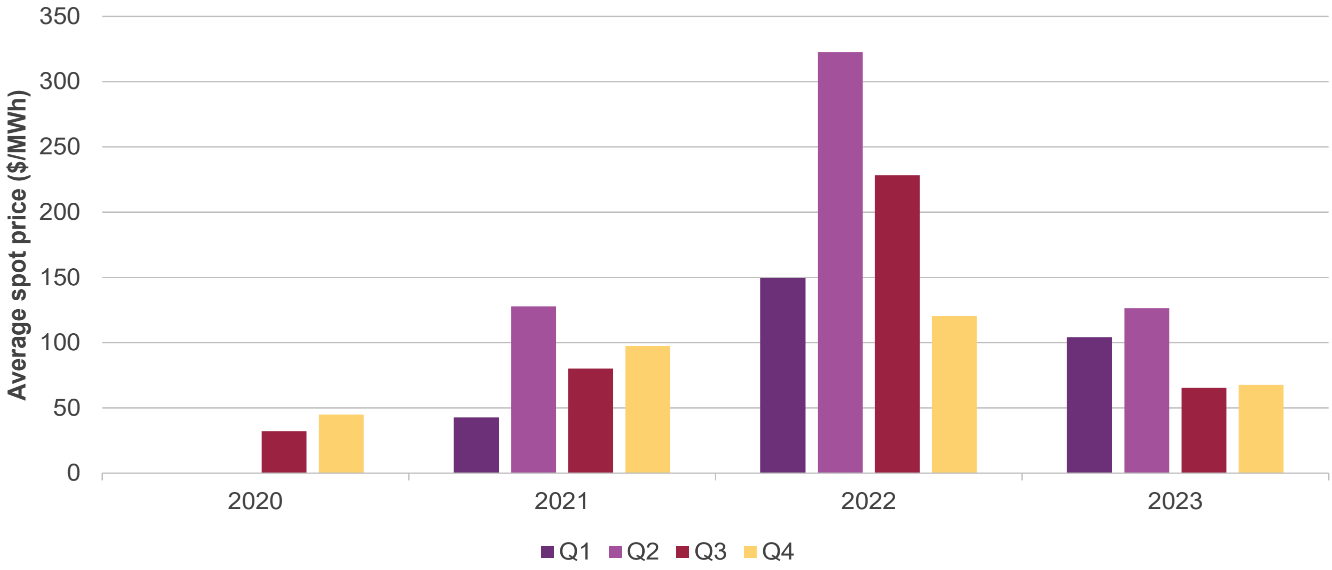
Figure 39 *Actionable transmission sensitivity*, locational reliability factors for Queensland USE, 2029-30



4.6 Wholesale price indicators

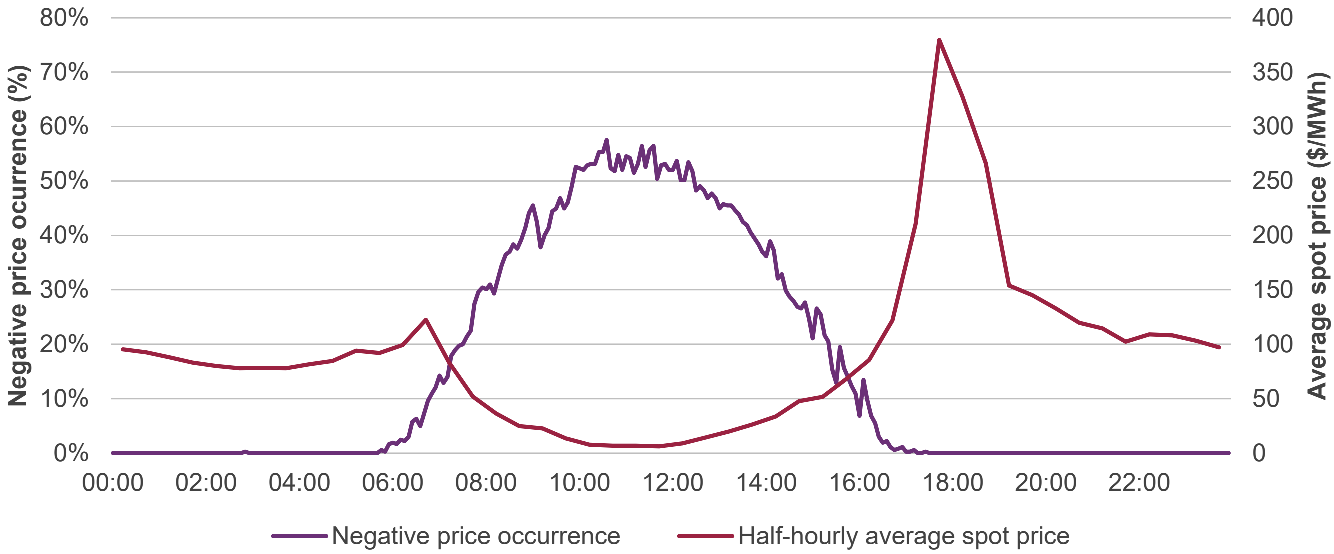
Figure 40 shows the average quarterly spot price in Queensland over the past four years. Average electricity wholesale prices have been on a downward trend since their peaks in Q2 2022, with the spot price for Queensland averaging $91/MWh in 2023.

Figure 40 Average Queensland spot prices – quarterly since Q3 2020 ($/MWh)



Queensland has been experiencing increasingly frequent negative price occurrences over the past five years. Negative prices occurred approximately 50% of the time during the daily period of 1000 hrs to 1400 hrs. These continue to be concentrated during daylight hours, reflecting higher solar supply and reduced daytime demand. Figure 41 highlights the magnitude of negative price occurrences and half-hourly average spot price across 2023. Prices were low during the day and rose sharply as solar generation fell in the late afternoon and evening peak.

Figure 41 Negative price occurrence and half-hourly average spot price in Queensland– calendar year 2023



5 South Australia

This chapter summarises key locational indicators relating to:

- Regional energy policies (Section 5.1).
- Generation and storage outlook (Section 5.2).
- Network capability (Section 5.3).
- System security requirements and shortfalls (Section 5.4).
- Reliability and energy adequacy (Section 5.5).
- Wholesale price indicators (Section 5.6).

Appendix A5 contains detailed indicators for each South Australian REZ, including weather and climate scores.

5.1 Regional energy policies

In South Australia, key energy policies and commitments include:

- Target by 2050 to reduce greenhouse gas emissions by 60% from 1990 levels under the *Climate Change and Greenhouse Emissions Reduction Act 2007* (SA)[32].
- Establishing hydrogen production, generation and storage capacity in South Australia's Whyalla region as per the Hydrogen Jobs Plan[33].

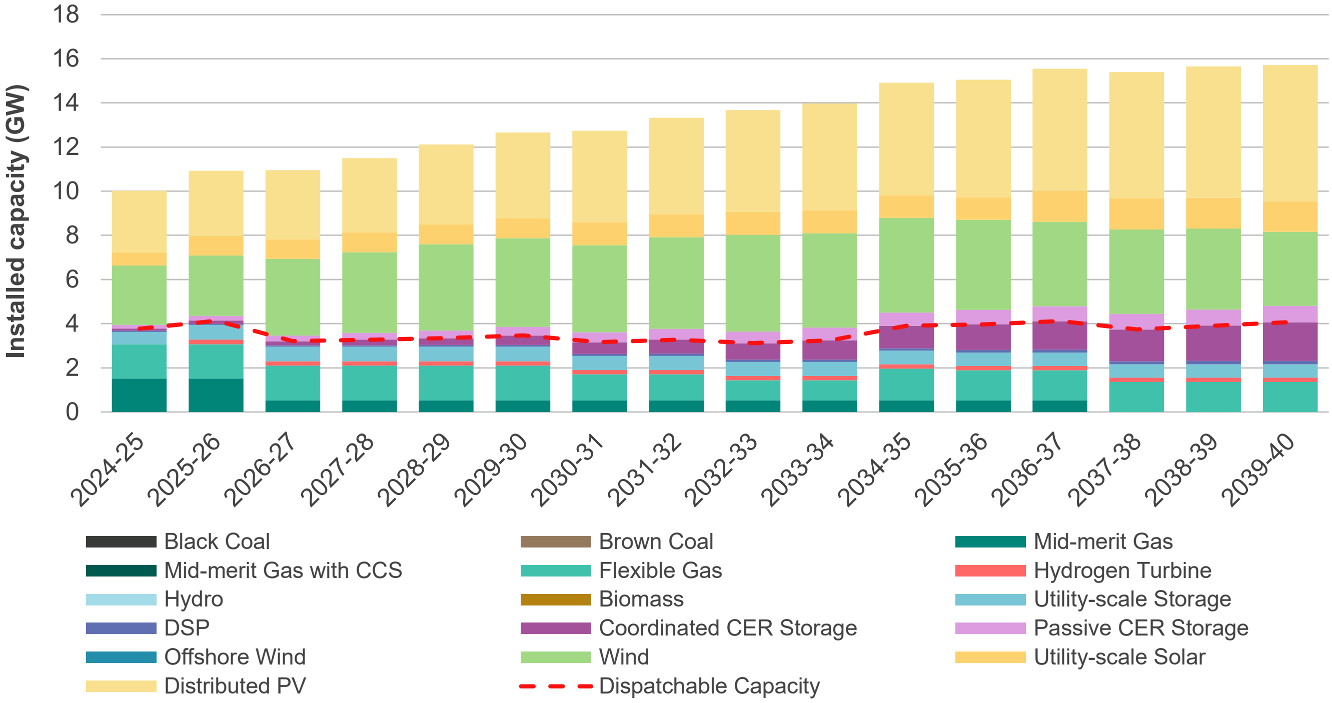
5.2 Generation and storage outlook

Figure 42 shows the projected capacity by technology for South Australia until 2040. Refer to Figure 10 (in Section 2.2) for historical and forecast capacity by technology in the NEM.

[32] Section 3, at https://www.legislation.sa.gov.au/__legislation/lz/c/a/climate%20change%20and%20greenhouse%20emissions%20reduction%20act%202007/current/2007.22.auth.pdf. The South Australian Government is amending the *Climate Change and Greenhouse Emissions Reduction Act 2007* to update the greenhouse gas emission reduction and renewable electricity targets. This to reflect commitments to reach net zero greenhouse gas emissions by 2050, at least 50% net emissions reduction on 2005 levels by 2030, and 100% net renewable electricity generation by 2030. For further information, see https://www.environment.sa.gov.au/topics/climate-change/climate-change-legislation.

[33] Government of South Australia. *Whyalla Hydrogen Power Facility*, at https://www.ohpsa.sa.gov.au/projects/hydrogen-jobs-plan/whyalla-hydrogen-power-facility.

Figure 42 Forecast capacity for South Australia, *Step Change* scenario, 2024-25 to 2039-40 (GW)



5.3 Network capability

Historical generation curtailment due to network limitations

Curtailment outcomes for semi-scheduled VRE generators in South Australia in 2023 are illustrated in Figure 43. Further detailed breakdowns of these results by REZ are provided in Appendix A5.

Notable insights from this data include:

- Curtailment of wind farms in South Australia ranged from 0.0% to 9.0% and averaged 2.0%.
- Curtailment of solar farms was generally lower than this, ranging from 0.0% to 4.4% and averaging 0.5%.
- There was significant variation in curtailment outcomes even for nearby projects (such as Willogoleche Wind Farm (8.4%) and The Bluff Wind Farm (0.3%) which both connect to the 275 kV network north of Robertstown).

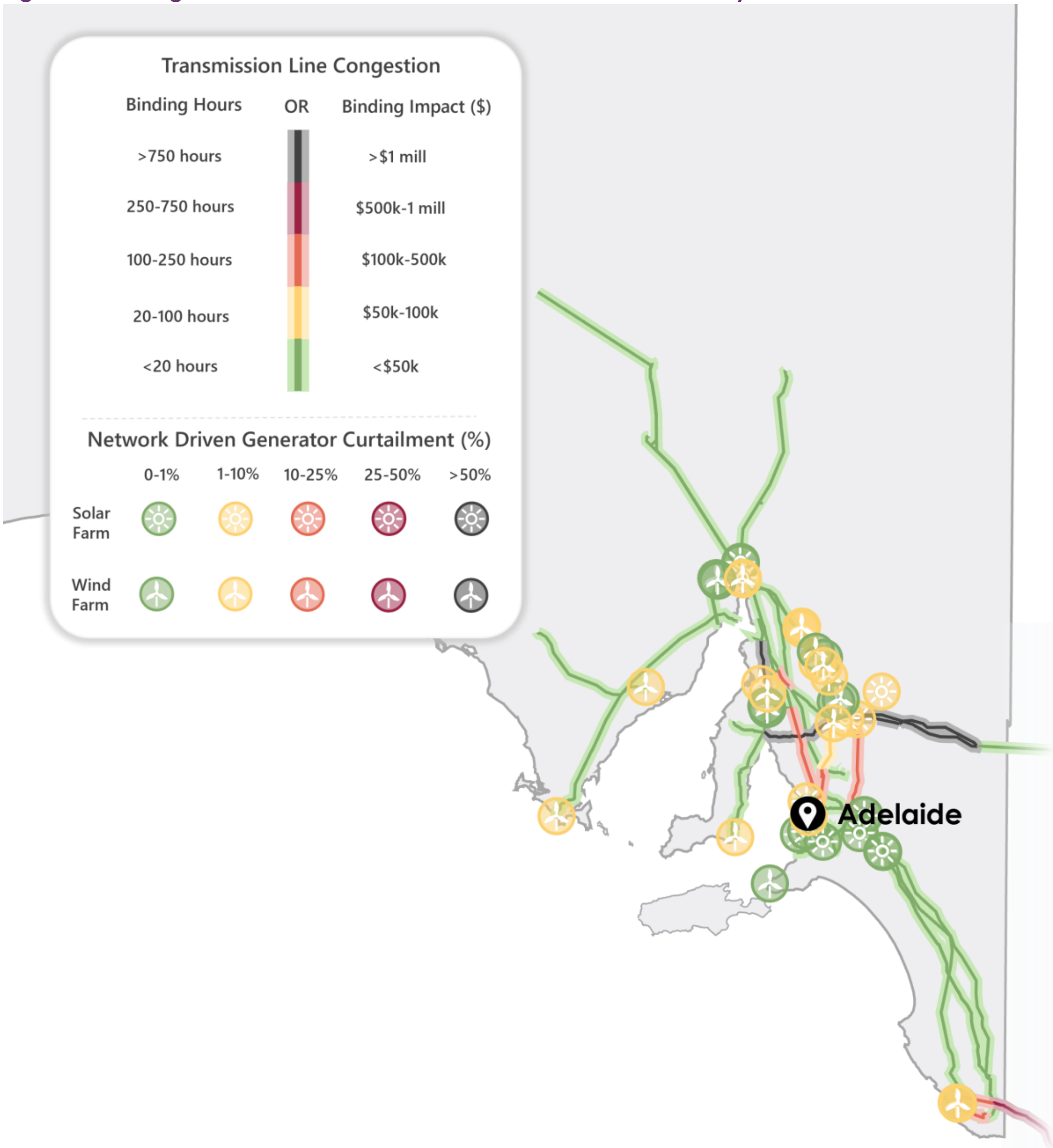
Historical grid congestion

South Australia experienced significant transmission congestion in 2023, predominantly on the interconnectors and in the centre of the network, affecting mostly 132 kV and 275 kV lines. Areas of high congestion included:

- Both eastward and westward flow on the Murraylink direct current (DC) interconnector.
- 132 kV Monash to North West Bend lines (westward flow).
- The 132 kV North West Bend to Robertstown lines (westward flow).
- The 132 kV Snowtown to Bungama line (northward) and the 132 kV Waterloo to Hummocks line (eastward).
- Constrained import from Victoria over Heywood due to interconnector upgrade testing limits.

Figure 43 provides an overview of congestion outcomes for South Australia in 2023.

Figure 43 Congestion and curtailment in South Australia – calendar year 2023



Note: Not all sources of congestion can be allocated to individual network elements in a way that would be meaningful as a locational signal (for example some types of stability limitation). See Appendix A2.2.3 for a detailed explanation of inclusions and exclusions related to this map.

Forecast VRE curtailment and economic offloading

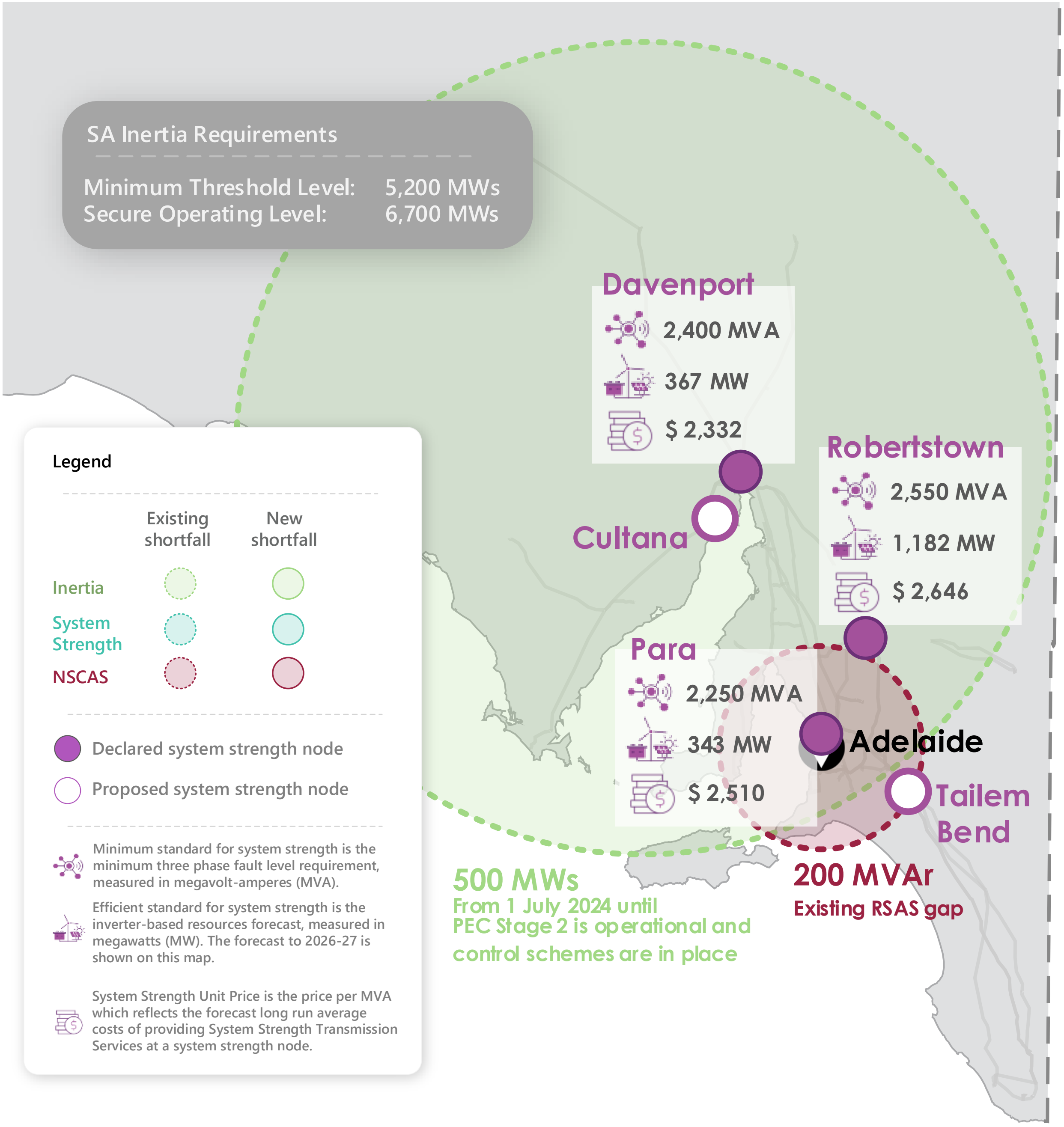
Appendix A5 includes forecasts of VRE curtailment and economic offloading for each South Australian REZ from 2025 to 2027, based on analysis completed for the Draft 2024 ISP. This data forecasts average curtailment of 0.0% across South Australian REZs during this period.

These forecasts are an indication of potential curtailment outcomes under ISP modelling assumptions and cannot be relied on as predictions of project curtailment for specific projects. Curtailment outcomes will be dominated by highly variable short-term factors such as weather, system conditions, and new generator connections.

5.4 System security shortfalls and requirements

Figure 44 presents an overview of the current system security requirements and declared shortfalls for the South Australian region.

Figure 44 System security needs in South Australia



NSCAS

In 2023, AEMO declared an NSCAS gap for voltage control in South Australia. This drew on the latest limits advice from ElectraNet and clarified a need to maintain synchronous generating units online for voltage control.

ElectraNet is progressing a RIT-T which is expected to close this voltage control gap, and subsequently to allow operation with fewer synchronous generating units online once paired with Project EnergyConnect (PEC) and an adequate demonstration of grid reference in South Australia.

Inertia

ElectraNet now has sufficient fast frequency response (FFR) contracts in place to address existing inertia shortfalls until 1 July 2025. In 2023, AEMO declared a reduced shortfall of 500 MWs from 1 July 2024.

This could be met by equivalent FFR contracts, or by further registrations in the 1-second FCAS market. The inertia requirements for South Australia up to 2026-27 are summarised in Table 8.

Table 8 Inertia requirements and shortfalls (MWs)

	2024-25		2025-26		2026-27	
	Requirement	Shortfall*	Requirement	Shortfall	Requirement	Shortfall
SA secure operating level (MWs)	6,700	500 (Early) - (Late)	6,700	-	6,700	-

* A significant transition happens within this year, following the expected commissioning of PEC Stage 2, and associated control schemes.

System strength

AEMO has not identified any system strength shortfalls in South Australia, for the period to 1 December 2025. The system strength shortfalls and requirements for South Australia up to 2026-27 are summarised in Table 9.

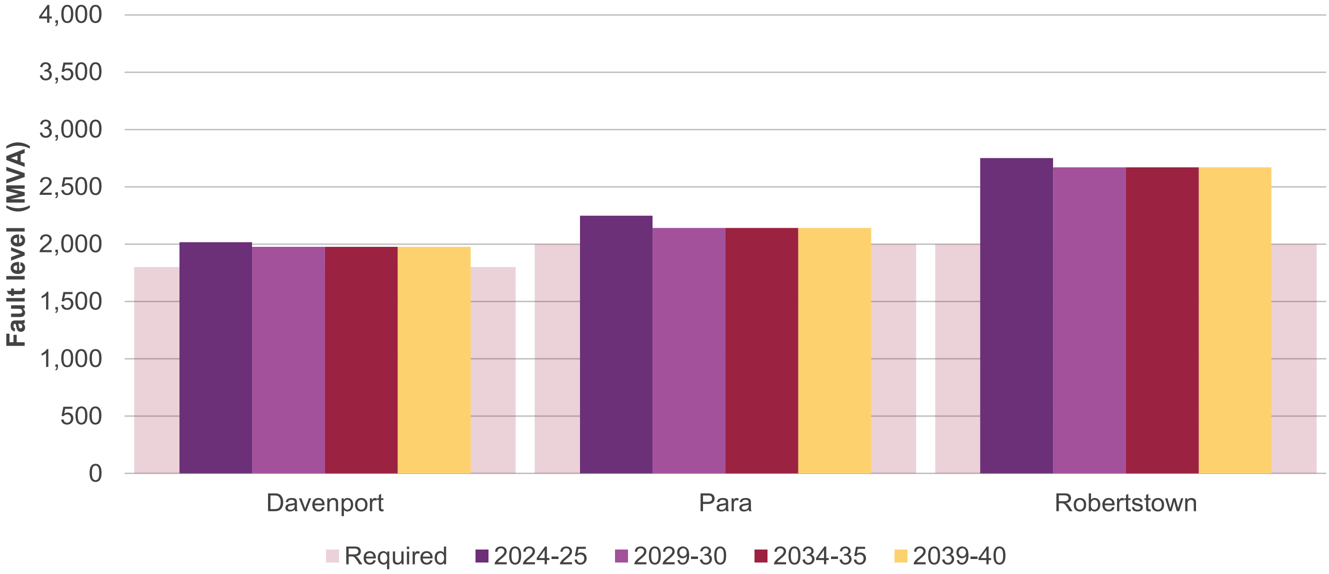
Table 9 System strength shortfalls and requirements (MVA)

Node	Minimum three phase fault current (MVA)					
	2024-25		2025-26		2026-27	
	Requirement	Shortfall	Requirement	Shortfall	Requirement	Shortfall
Davenport 275 kV	2,400	0	2,400	0	2,400	-
Para 275 kV	2,250	0	2,250	0	2,250	-
Robertstown 275 kV	2,550	0	2,550	0	2,550	-

Four large synchronous condensers in South Australia provide sufficient fault current to meet minimum requirements, however significant IBR build across all three nodes will require corresponding investment in system strength services across the horizon.

Fault level reductions based on the Draft 2024 ISP modelling are summarised in Figure 45.

Figure 45 Projected and required level of fault current available at least 99% of the time, South Australia (MVA)



5.5 Reliability and energy adequacy

The May 2024 Update to the 2023 ESOO identified reliability risks above the reliability standard in South Australia in 2026-27 in the Central scenario. However, from 2027-28, PEC Stage 2 is expected to release full transfer capacity, decreasing reliability gaps below the relevant standard until gas generator retirements worsen the outlook beyond 2030. Table 10 summarises the latest ESOO results in South Australia for the next five years, and presents forecast demand, expected unserved energy, and the magnitude of expected gaps against both the reliability standard and the IRM.

Table 10 South Australia reliability and energy adequacy metrics, 2023 ESOO Central scenario (MW)

	Forecast maximum operational demand 50% POE (MW)	Forecast minimum operational demand 50% POE (MW)	Expected USE (%)	Reliability gaps and equivalent gaps against the reliability standard (MW)	Reliability gaps and equivalent gaps against the IRM (MW)
2024-25	2,966	-159	0.0005	0	0
2025-26	3,033	-225	0.0002	0	0
2026-27	3,122	-265	0.0023	35	305
2027-28	3,218	-330	0.0001	0	0
2028-29	3,285	-450	0.0001	0	0

5.5.1 Locational reliability factors

Figure 46 and Figure 47 show the relative reliability benefit of generators located at various connection points across the NEM for the ESOO Central scenario and an actionable transmission sensitivity in 2029-30 with a focus on times of unserved energy in South Australia. Most locations within South Australia are shown to have a high reliability benefit, with only those on the Yorke and Eyre peninsulas shown to have reduced reliability benefits. Additional transmission developments significantly increase transfer capacity across southern Australia in the *Actionable transmission* sensitivity.

Figure 46 ESOO Central scenario, locational reliability factors for South Australian USE, 2029-30

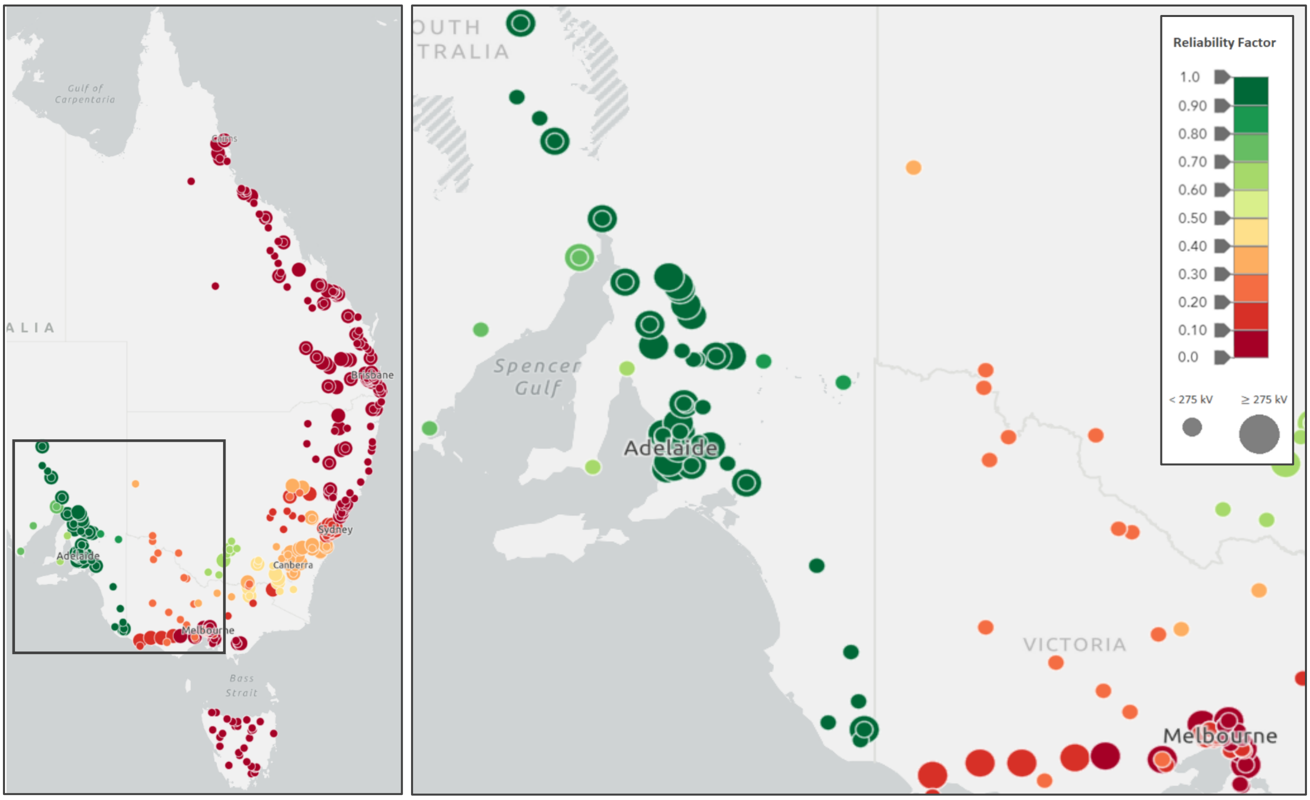
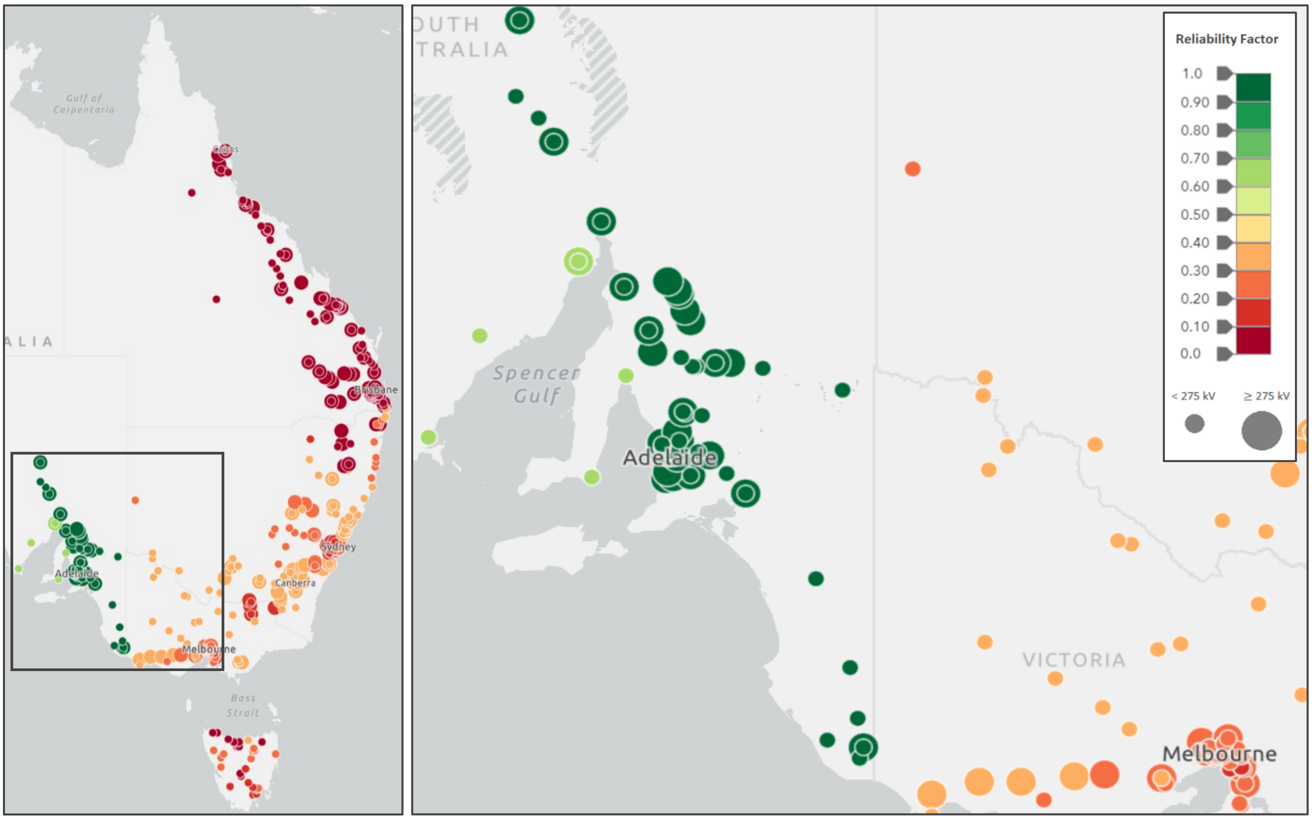


Figure 47 *Actionable transmission* sensitivity, locational reliability factors for South Australian USE, 2029-30



5.6 Wholesale price indicators

Figure 48 shows the average quarterly spot price in South Australia over the past four years. In 2023, the average regional spot price was $80/MWh.

For the same year, negative prices occurred approximately 61% of the time during the daily period of 1000 hrs to 1400 hrs. Figure 49 provides the time-of-day negative price occurrence and half-hourly average spot price in South Australia for calendar year 2023.

Figure 48 Average South Australian spot prices – quarterly since Q3 2020 ($/MWh)

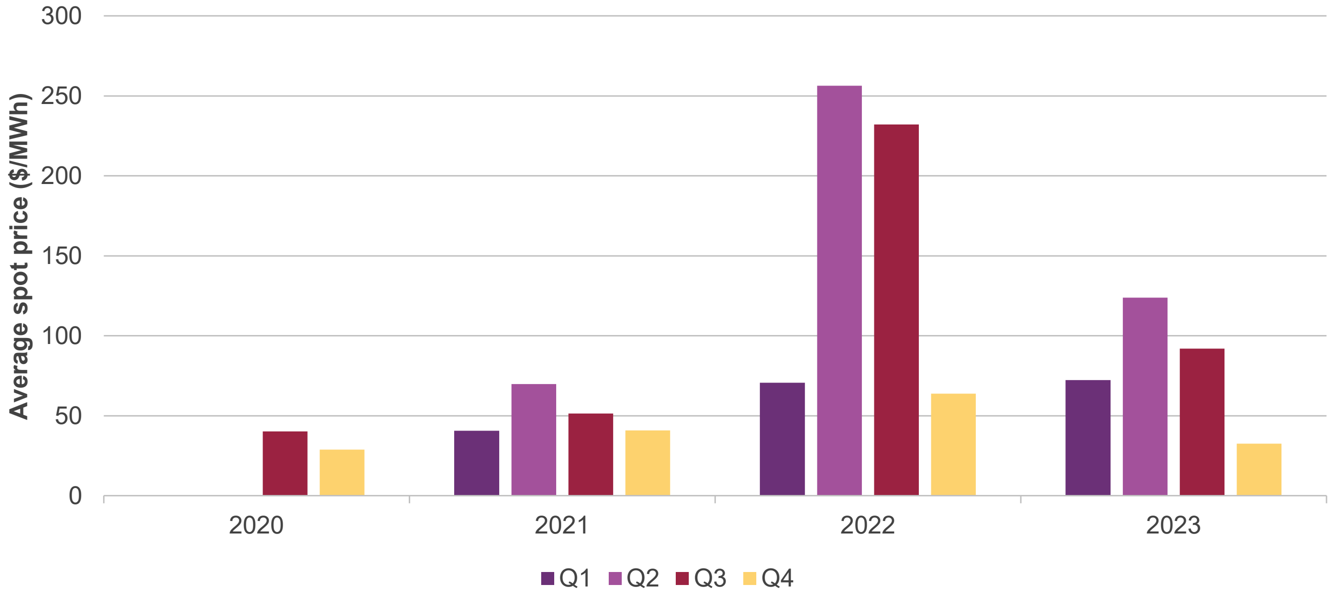
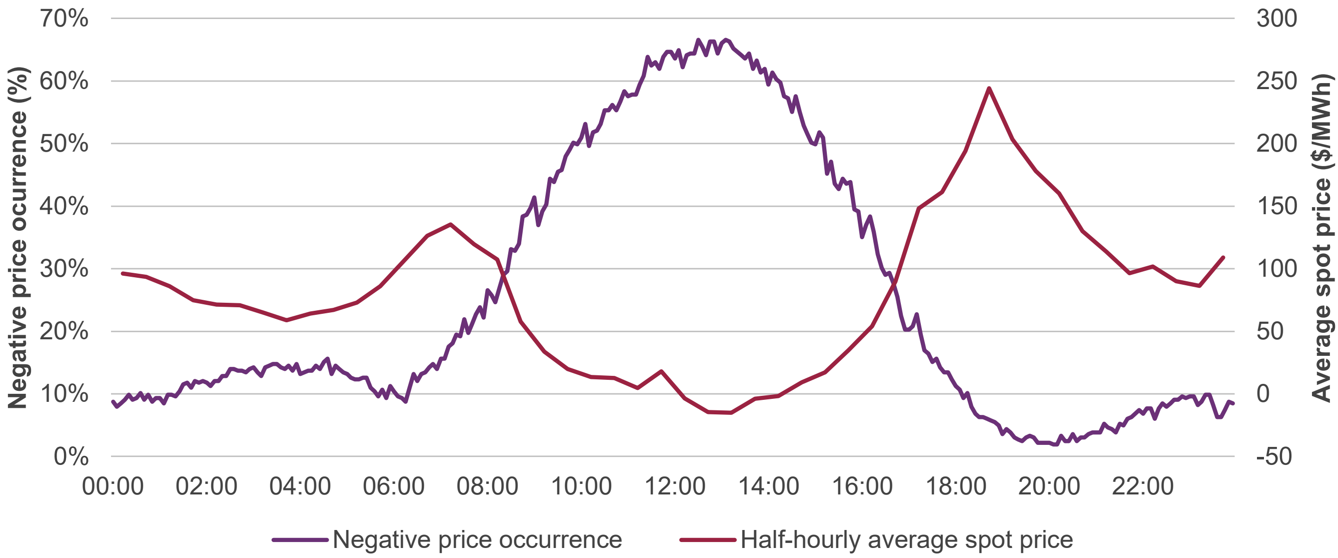


Figure 49 Negative price occurrence and half-hourly average spot price in South Australia – calendar year 2023



6 Tasmania

This chapter summarises key locational indicators for Tasmania relating to:

- Regional energy policies (Section 6.1).
- Generation and storage outlook (Section 6.2).
- Network capability (Section 6.3).
- System security requirements and shortfalls (Section 6.4).
- Reliability and energy adequacy (Section 6.5).
- Wholesale price indicators (Section 6.6).

Appendix A6 contains detailed indicators for each Tasmanian REZ, including weather and climate scores.

6.1 Regional energy policies

In Tasmania, key energy policies and commitments include:

- Renewable generation targets of 15,570 GWh in a calendar year by 2030 and 21,000 GWh in a calendar year by 2040, under the *Energy Co-ordination and Planning Act 1995* (Tas)[34].
- The Battery of the Nation (BOTN) pumped hydro project, which will be considered as a generation development option[35].

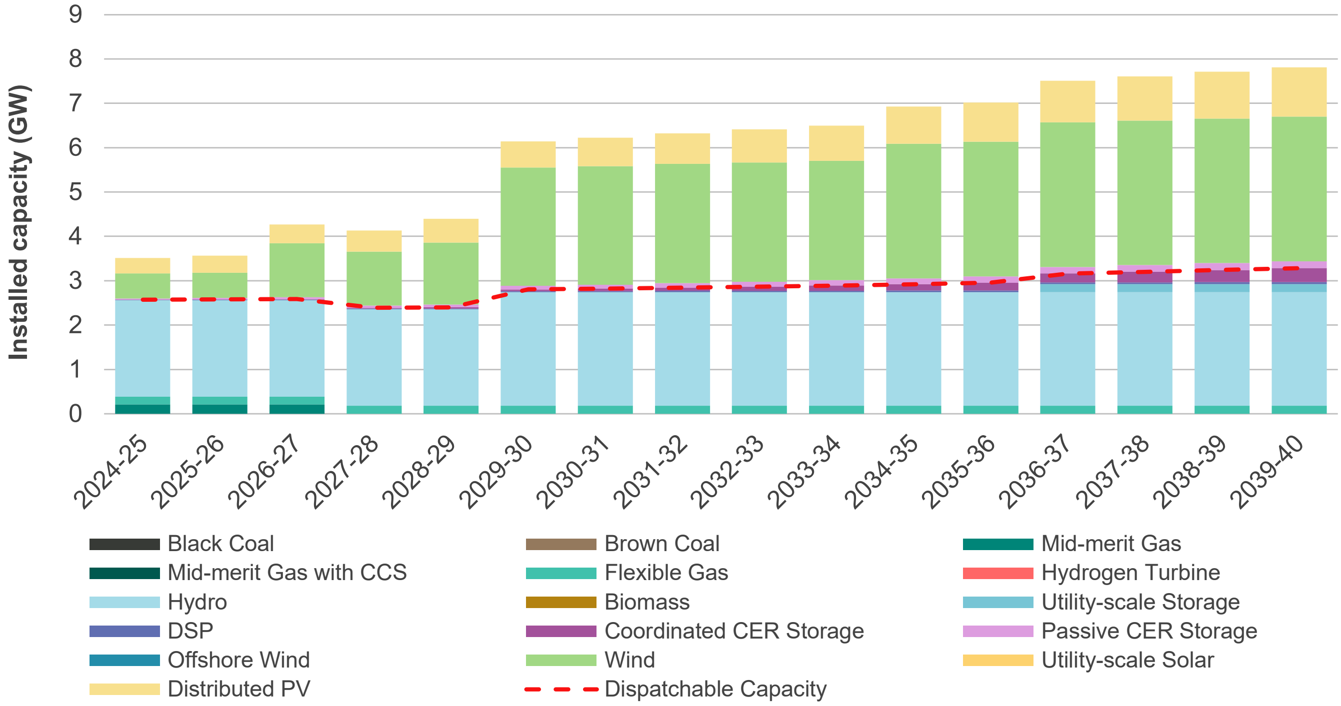
6.2 Generation and storage outlook

Figure 50 shows the projected capacity by technology for Tasmania until 2040. Refer to Figure 10 (in Section 2.2) for historical and forecast capacity by technology in the NEM.

[34] Section 3C, at https://www.legislation.tas.gov.au/view/whole/html/inforce/current/act-1995-047.

[35] At https://www.hydro.com.au/clean-energy/battery-of-the-nation.

Figure 50 Forecast capacity in Tasmania, *Step Change* scenario, 2024-25 to 2039-40 (GW)



6.3 Network capability

Historical generation curtailment due to network limitations

Curtailment outcomes for semi-scheduled VRE generators in Tasmania in 2023 are shown in Figure 51 and further detailed in Appendix A6.

Notable insights from this data include that the curtailment of all three generators was low. However, even areas showing low historical curtailment may be dispatching generation close to network limits. Additional generation may lead to increases in curtailment.

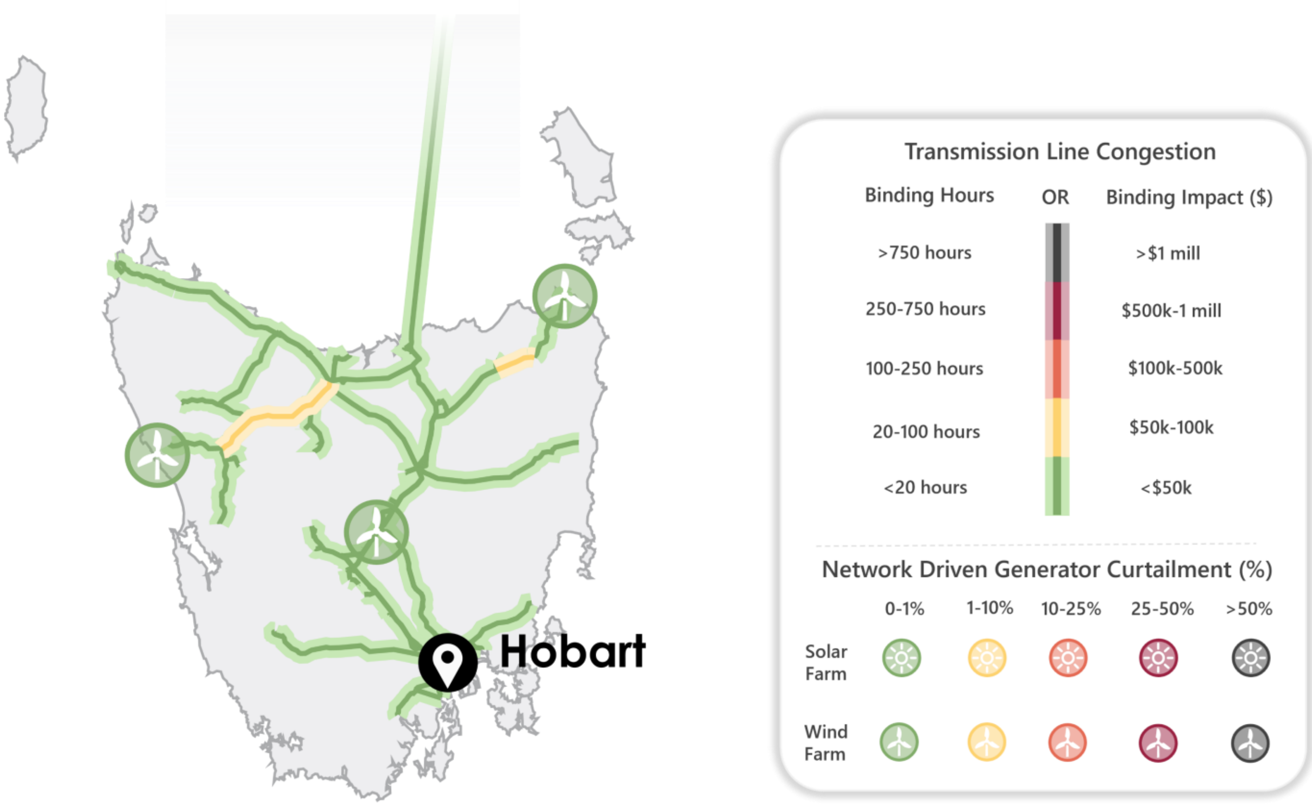
Historical grid congestion

Tasmania experienced minimal transmission congestion across the state in 2023. Areas of congestion included:

- Constrained transfer from 220 kV Farrell to 220 kV Sheffield to maintain transient stability.
- Constrained transfer from 220 kV Sheffield to 220 kV Palmerston to maintain transient stability.
- The 110 kV Derby to Scottsdale Tee line (westward flow).
- Basslink flowing in a northward direction.

Figure 51 provides an overview of congestion outcomes for Tasmania in 2023.

Figure 51 Congestion and curtailment in Tasmania – calendar year 2023



Note: Not all sources of congestion can be allocated to individual network elements in a way that would be meaningful as a locational signal (for example some types of stability limitation). See Appendix A2.2.3 for a detailed explanation of inclusions and exclusions related to this map.

Forecast VRE curtailment and economic offloading

Appendix A6 includes forecasts of VRE curtailment and economic offloading for each Tasmania REZ from 2025 to 2027, based on analysis completed for the Draft 2024 ISP.

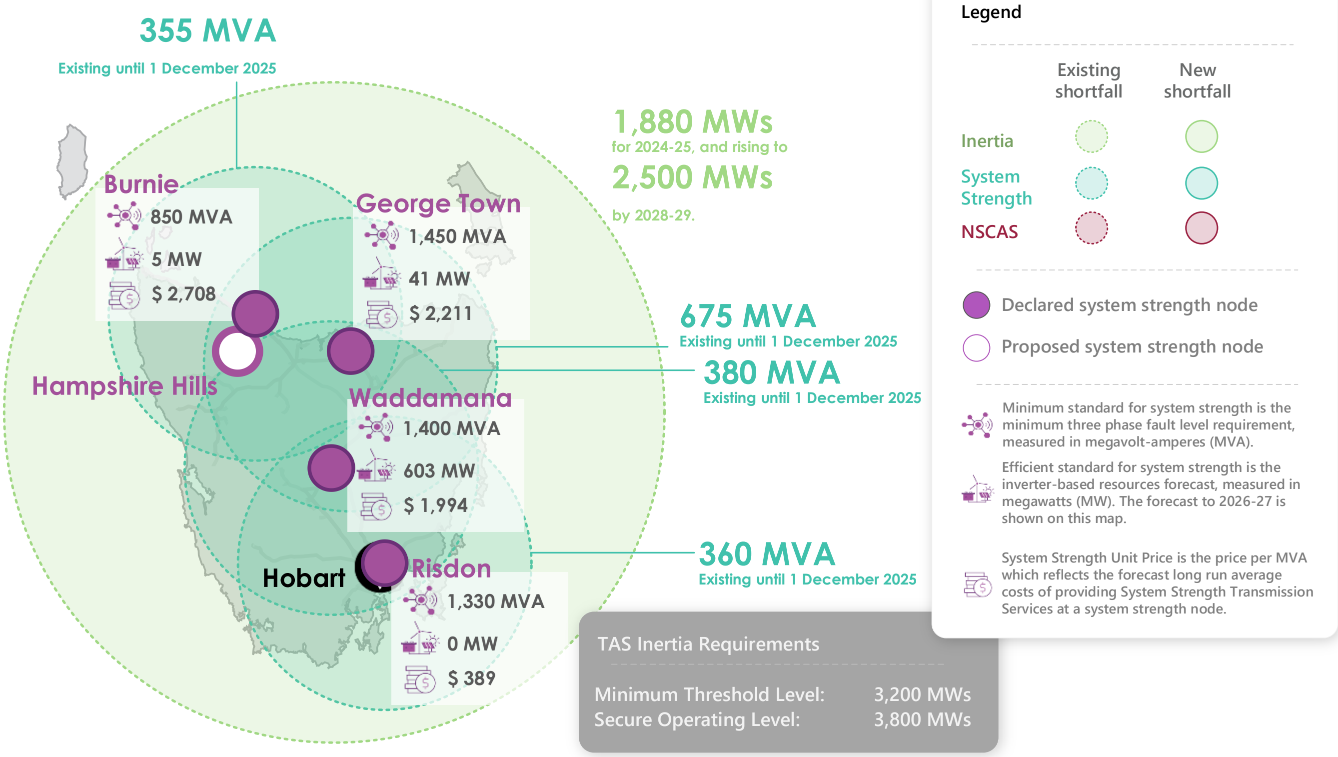
This data indicates that average curtailment is forecast to range from 0% to 1.3% across the different REZs by 2027 and to remain relatively stable from 2025 to 2027 for most REZs in the region.

These forecasts are an indication of potential curtailment outcomes under ISP modelling assumptions and cannot be relied on as predictions of project curtailment for specific projects. Curtailment outcomes will be dominated by highly variable short-term factors such as weather, system conditions, and new generator connections.

6.4 System security shortfalls and requirements

Figure 52 presents an overview of the current system security requirements and declared shortfalls for the Tasmanian region.

Figure 52 System security needs in Tasmania



NSCAS

AEMO has not identified any NSCAS gaps in Tasmania over the five-year outlook period. AEMO acknowledges that TasNetworks is procuring system strength and inertia services in response to requirements in those planning frameworks, and that these may support other power system security needs in the region.

Inertia

TasNetworks has sufficient inertia support contracts in place to address existing inertia shortfalls until April 2024. Beyond that time, a reduced shortfall of 1,880 MWs has been identified by AEMO for 2024-25, which rises to 2,500 MWs across the five-year period.

Table 11 Inertia requirements and shortfalls (MWs)

	2024-25		2025-26		2026-27	
	Requirement	Shortfall	Requirement	Shortfall	Requirement	Shortfall
SA secure operating level (MWs)	3,800	1,880	3,800	1,840	3,800	2,570

System strength

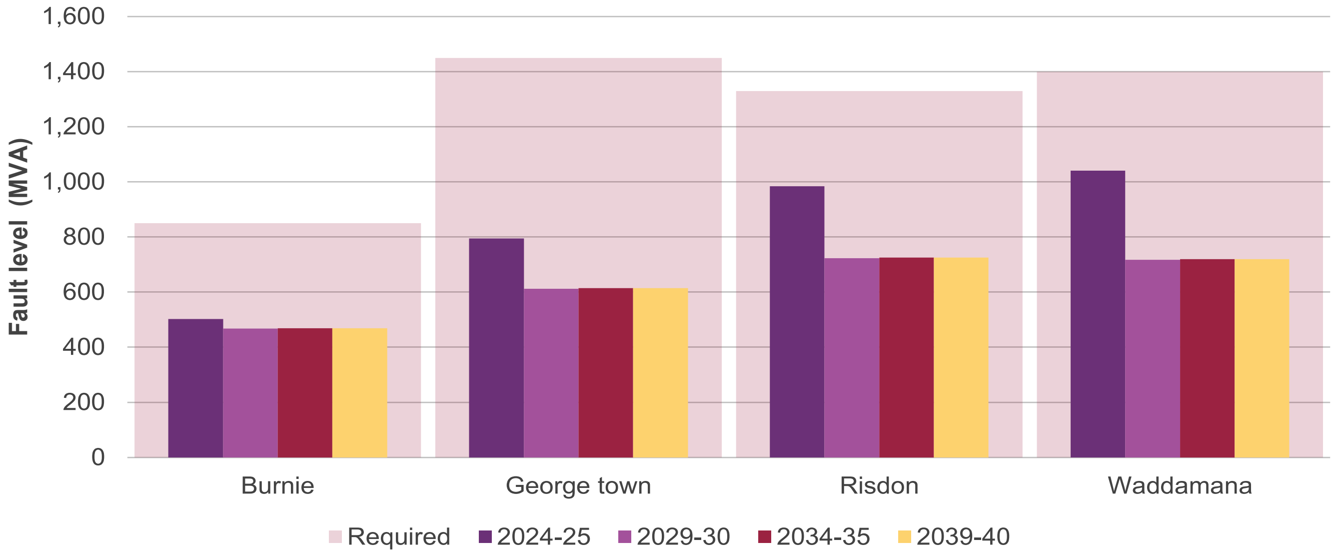
In 2023, AEMO confirmed an ongoing shortfall at all four nodes in Tasmania; however, TasNetworks now has sufficient network support agreements in place to provide system strength and inertia services until 2 December 2025. The system strength shortfalls and requirements for Tasmania up to 2026-27 are summarised in Table 12.

Table 12 System strength shortfalls and requirements (MVA)

Nodes	2024-25		2025-26		2026-27	
	Requirement	Shortfall	Requirement	Shortfall	Requirement	Shortfall
Burnie 110 kV	850	350	850	355	850	-
George Town 220 kV	1,450	655	1,450	675	1,450	-
Risdon 110 kV	1,330	350	1,330	355	1,330	-
Waddamana 220 kV	1,400	360	1,400	380	1,400	-

Fault level reductions based on the Draft 2024 ISP modelling are summarised in Figure 53. The magnitude of future system strength shortfalls in Tasmania is driven primarily by growth in local IBR and changes in energy exports to the mainland, which combine to impact utilisation of local synchronous hydro generation.

Figure 53 Projected and required level of fault current available at least 99% of the time, Tasmania (MVA)



6.5 Reliability and energy adequacy

The May 2024 update to the 2023 ESOO did not identify any reliability risks outside the reliability standard or IRM in Tasmania over the study horizon in the Central scenario. Table 13 summarises these latest ESOO results and demand forecasts.

Table 13 Tasmanian reliability and energy adequacy metrics, 2023 ESOO Central scenario (MW)

	Forecast maximum operational demand 50% POE (MW)	Forecast minimum operational demand 50% POE (MW)	Expected USE (%)	Reliability gaps and equivalent gaps against the reliability standard (MW)	Reliability gaps and equivalent gaps against the IRM (MW)
2024-25	1,754	837	0.0000	0	0
2025-26	1,783	819	0.0000	0	0
2026-27	1,803	821	0.0000	0	0
2027-28	1,810	793	0.0000	0	0
2028-29	1,813	764	0.0000	0	0

6.6 Wholesale price indicators

Figure 54 shows the average quarterly spot price in Tasmania over the past four years. In 2023, the average regional spot price was $56/MWh. Negative prices occurred approximately 13% of the time during the daily period of 1000 hrs to 1400 hrs. Figure 55 provides the time-of-day negative price occurrence and half-hourly average spot price in Tasmania for calendar year 2023.

Figure 54 Average Tasmanian spot prices – quarterly since Q3 2020 ($/MWh)

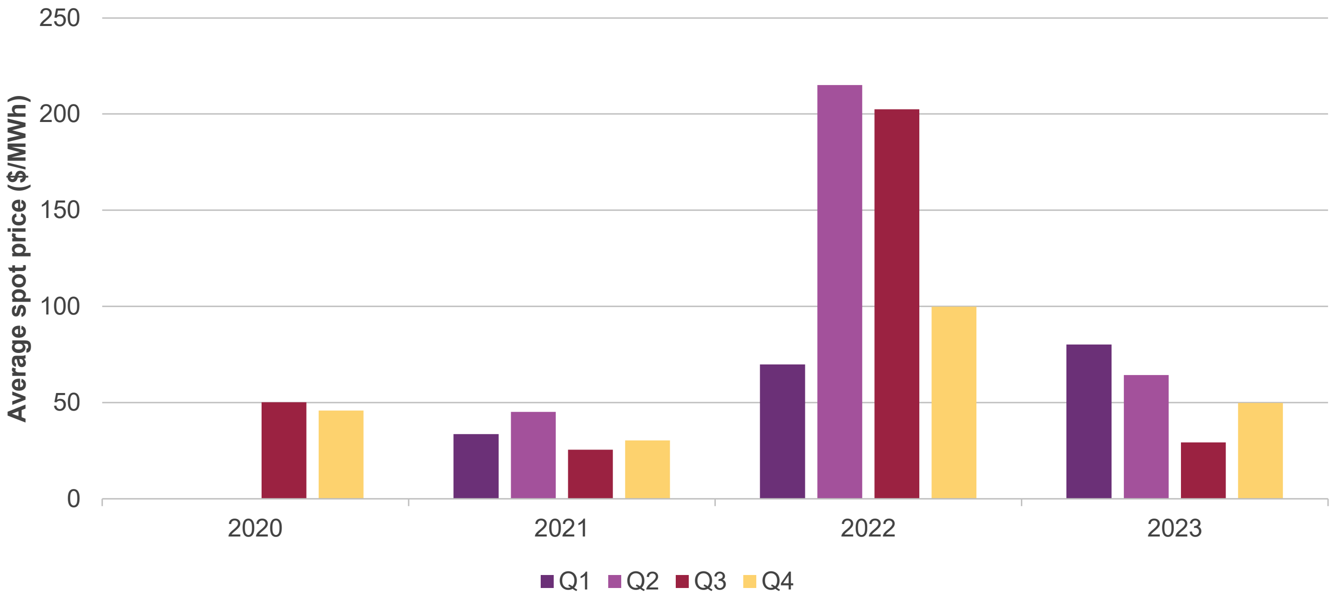
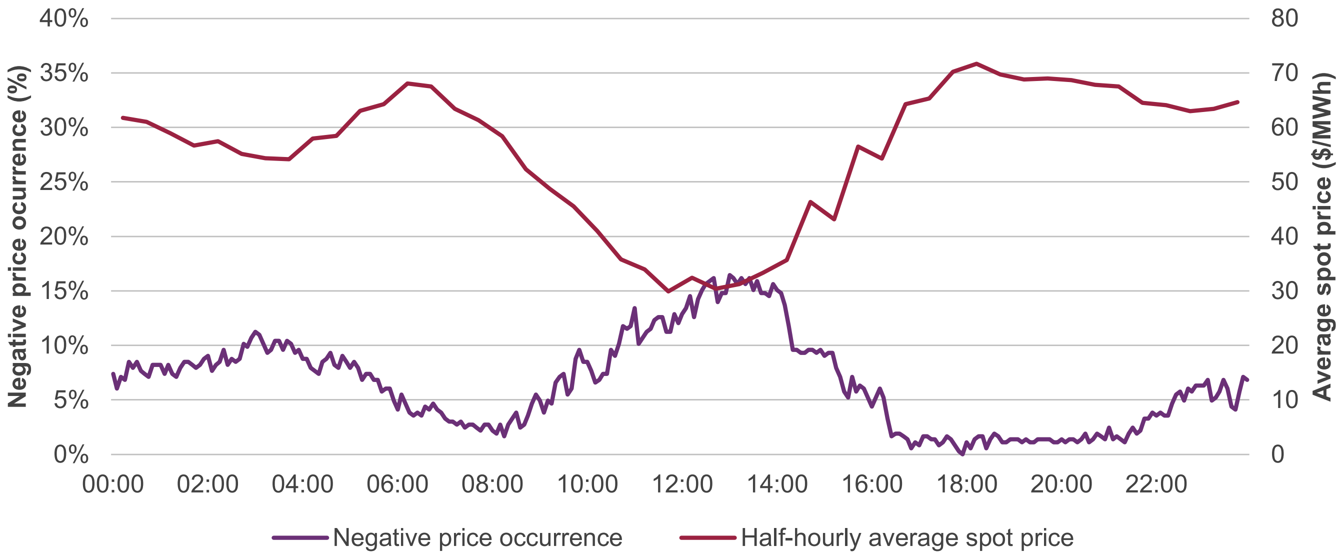


Figure 55 Negative price occurrence and half-hourly average spot price in Tasmania – calendar year 2023



7 Victoria

This chapter summarises key locational indicators relating to:

- Regional energy policies (Section 7.1).
- Generation and storage outlook (Section 7.2).
- Network capability (Section 7.3).
- System security requirements and shortfalls (Section 7.4).
- Reliability and energy adequacy (Section 7.5).
- Wholesale price indicators (Section 7.6).

Appendix A3 contains detailed indicators for each Victorian REZ, including weather and climate scores.

7.1 Regional energy policies

Regional energy policies shape the energy landscape and are an important consideration for new transmission, generation, and storage projects. In Victoria, key energy policies and commitments include:

- Emissions reduction target of 28-33% below 2005 levels by 2025, 45-50% by 2030, 75-80% by 2035 and net zero by 2050 under Victoria's *Climate Change Act 2017*[36]; and the net zero emission target by 2045 (legislation pending).
- Victorian Renewable Energy Target (VRET) of 40% by 2025, 65% by 2030 and 95% by 2035 under the *Renewable Energy (Jobs and Investment) Act 2017*[37].
- Storage target of 2.6 GW by 2030 and 6.3 GW by 2035 (legislation pending).
- Targets of 2 GW by 2032, 4 GW by 2035, and 9 GW by 2040 as stated in the Offshore Wind Policy Directions Paper and Implementation Strategy Statements One and Two (legislation pending).
- Consideration of various transmission development options, including coordinating the planning and development of REZs through VicGrid, supported by the *National Electricity (Victoria) Act 2005* (NEVA)[38].

7.2 Generation and storage outlook

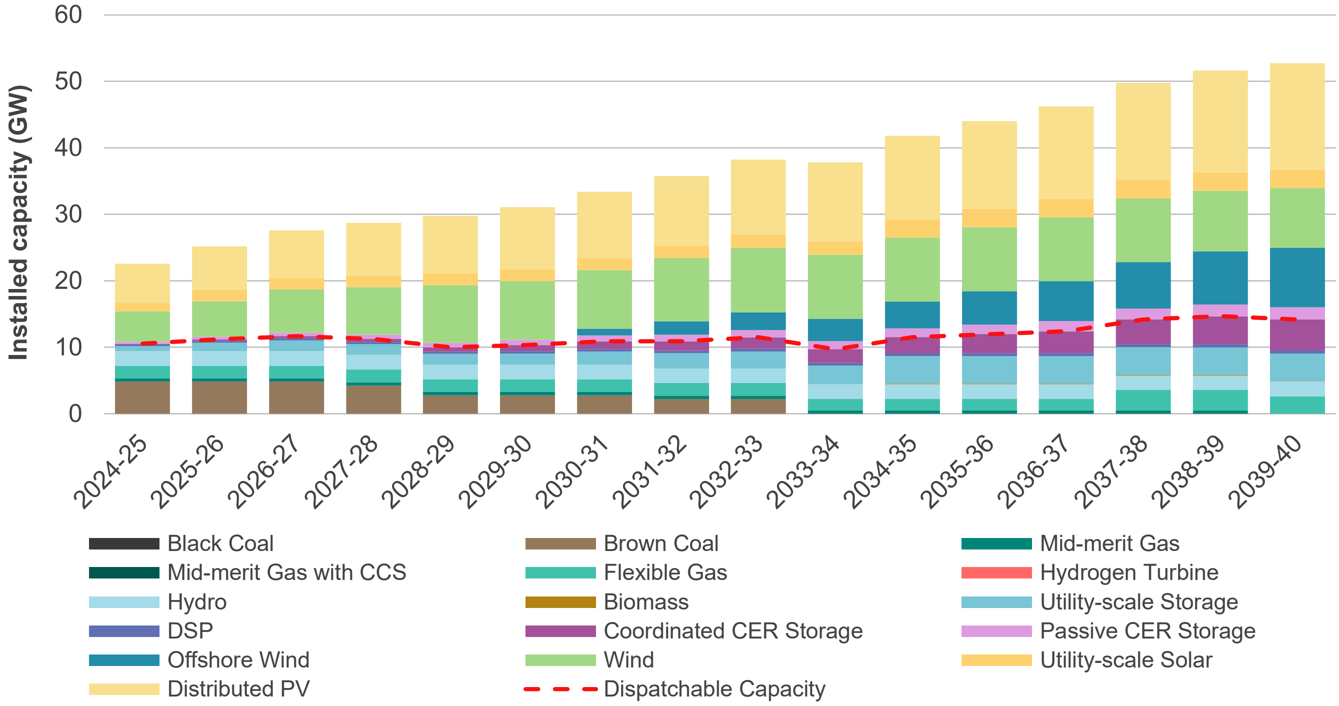
Figure 56 shows the projected capacity by technology for Victoria until 2040. Refer to Figure 10 (in Section 2.2) for historical and forecast capacity by technology in the NEM.

[36] At https://content.legislation.vic.gov.au/sites/default/files/2023-05/17-5aa009-authorised.pdf.

[37] Section 7, at https://content.legislation.vic.gov.au/sites/default/files/2024-03/17-56aa003-authorised.pdf.

[38] At https://content.legislation.vic.gov.au/sites/default/files/2024-05/05-8aa035-authorised.pdf.

Figure 56 Forecast capacity in Victoria, *Step Change* scenario, 2024-25 to 2039-40 (GW)



7.3 Network capability

Historical generation curtailment due to network limitations

Curtailment outcomes for semi-scheduled VRE generators in Victoria in 2023 are shown in Figure 57. Further detailed breakdowns of these results by REZ are presented in Appendix A7. Notable insights include:

- Curtailment of wind farms in Victoria ranged from 0.0% to 8.6% and averaged 1.7%.
- Curtailment of solar farms was generally higher than this, ranging from 0.0% to 29.6% and averaging 9.8%.
- Certain areas had greater prevalence of curtailment than others, such as the Wemen and Red Cliffs 66 kV networks. However, in some instances there was significant variation in curtailment outcomes, even for nearby projects (for example, Yatpool Solar Farm (18.5%) and Karadoc Solar Farm (10.5%)).
- Areas with generally lower curtailment included the 500 kV network west of Moorabool. However, even areas with low historical curtailment may be close to network limits, with further generation leading to curtailment.

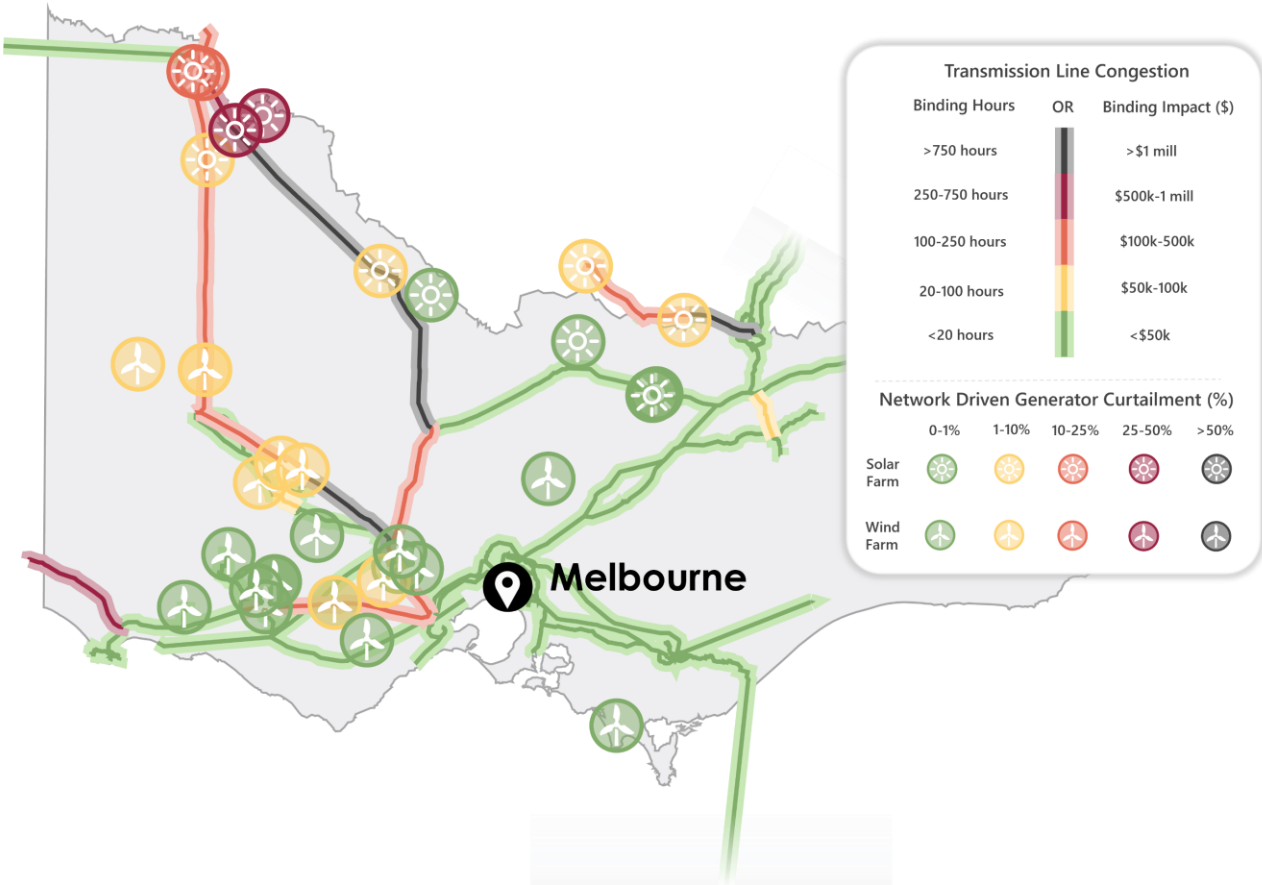
Historical grid congestion

Victoria experienced significant transmission congestion in 2023 across a wide area of the state, and at voltage levels from 220 kV to 330 kV. Areas of high congestion included:

- The 220 kV flow paths from Red Cliffs to Kerang to Bendigo, and Ararat to Waubra to Ballarat in the southward direction.
- Constrained export to South Australia over the Heywood interconnector due to upgrade testing constraints.
- Constrained export to New South Wales related to managing voltage and transient stability.

Figure 57 provides an overview of congestion outcomes for Victoria in 2023.

Figure 57 Congestion and curtailment in Victoria – calendar year 2023



Note: Not all sources of congestion can be allocated to individual network elements in a way that would be meaningful as a locational signal (for example some types of stability limitation). See Appendix A2.2.3 for a detailed explanation of inclusions and exclusions related to this map.

Forecast VRE curtailment and economic offloading

Appendix A7 includes forecasts of VRE curtailment and economic offloading for each Victorian REZ from 2025 to 2027, based on analysis completed for the Draft 2024 ISP.

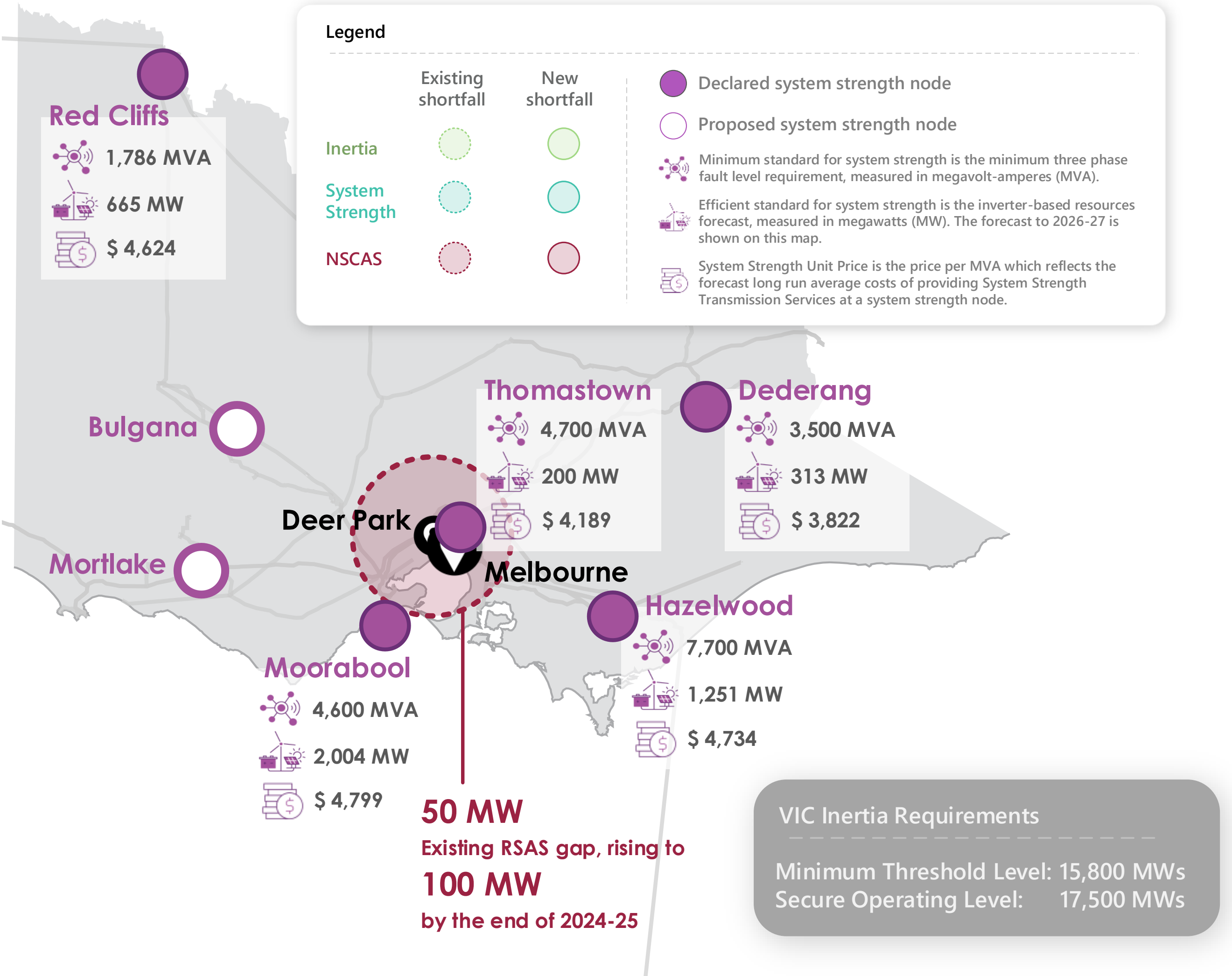
This data forecasts average curtailment of 0.0% across the different REZs from 2025 to 2027, except for the Murray River REZ which is forecast to decline from 10.1% in 2025 to 0.0% in 2027, and the Western Victoria REZ which is forecast to decline from 1.3% in 2025 to 0.7% in 2027.

These forecasts are an indication of potential curtailment outcomes under ISP modelling assumptions and cannot be relied on as predictions of project curtailment for specific projects. Curtailment outcomes will be dominated by highly variable short-term factors such as weather, system conditions, and new generator connections.

7.4 System security shortfalls and requirements

Figure 58 presents an overview of the current system security requirements and declared system strength, inertia, and NSCAS shortfalls for the Victorian region.

Figure 58 System security needs in Victoria



NSCAS

In 2023, AEMO declared an NSCAS gap for thermal loading and voltage stability near Deer Park. This relates to projected demand growth, and AEMO Victorian Planning (AVP) has committed to pre-feasibility work on the thermal limitations, while progressing voltage needs through a broader Voltage Management RIT-T.

Inertia

Projected levels of available inertia are already below minimum secure operating levels. However, strong interconnection with neighbouring regions means that Victoria is not considered sufficiently likely to island. The inertia requirements for Victoria up to 2026-27 are summarised in Table 14.

Table 14 Inertia requirements and shortfalls (MWs)

	2024-25		2025-26		2026-27	
	Requirement	Shortfall	Requirement	Shortfall	Requirement	Shortfall
Secure operating level (MWs)	17,500	-	17,500	-	17,500	-

System strength

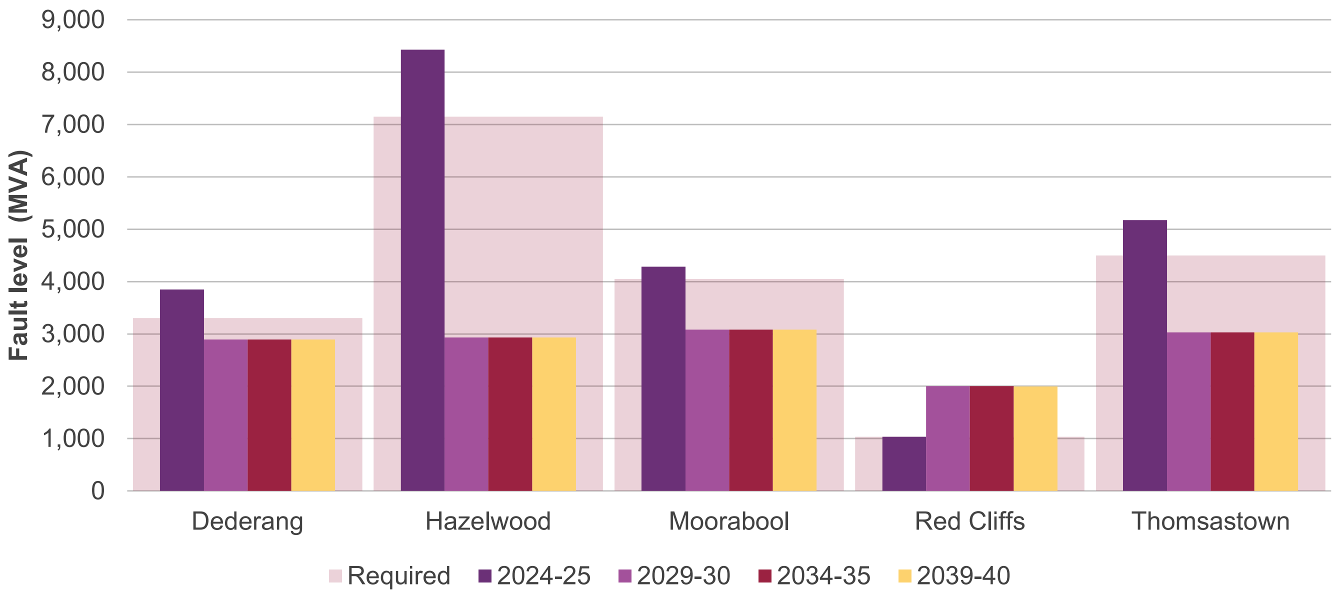
AEMO has not identified any system strength shortfalls in Victoria for the period to 1 December 2025. The system strength shortfalls and requirements for Victoria up to 2026-27 are summarised in Table 15.

Table 15 System strength shortfalls and requirements (MVA)

Node	Minimum three phase fault current (MVA)					
	2024-25		2025-26		2026-27	
	Requirement	Shortfall	Requirement	Shortfall	Requirement	Shortfall
Dederang 220 kV	3,500	0	3,500	0	3,500	-
Hazelwood 500 kV	7,700	0	7,700	0	7,700	-
Moorabool 220 kV	4,600	0	4,600	0	4,600	-
Red Cliffs 220 kV	1,786	0	1,786	0	1,786	-
Thomastown 220 kV	4,700	0	4,700	0	4,700	-

Declining utilisation of synchronous generation is expected to reduce synchronous fault levels at most system strength nodes in Victoria. Most of the investment needed to address these issues will likely be required within the coming decade. However, substantial IBR growth will continue to drive investment in system strength services over the longer term. Fault level reductions based on the Draft 2024 ISP modelling are summarised in Figure 59.

Figure 59 Projected and required level of fault current available at least 99% of the time, Victoria (MVA)



Power system oscillations in the West Murray Zone

The West Murray Zone (WMZ) is an area of the NEM that encompasses the interconnected transmission and distribution networks in south-west New South Wales and north-west Victoria. This area has been historically low in system strength, owing to its remoteness from major synchronous generators in Victoria and New South Wales, and unprecedented integration of renewable IBR in this area, all using grid-following technology.

These two factors have resulted in technical operational challenges in the region[39]. One of these challenges is the frequent occurrence of sub-synchronous power system oscillations, despite the improvements made in the power system to mitigate previously declared system strength gaps in this area.

While firmware changes have helped mitigate a 17 hertz (Hz) oscillation, new modes of oscillation around 25 Hz have recently been observed and are still under investigation. Voltage unbalances in this part of the grid and have made it difficult to identify the root cause of these oscillations and implement mitigation measures.

7.5 Reliability and energy adequacy

The May 2024 Update to the 2023 ESOO identifies reliability gaps in Victoria across the entire horizon in the Central scenario. The announced withdrawal of South Australian gas generators increases reliability risks from 2024-25 onwards in both South Australia and Victoria, which are traditionally tightly connected for reliability purposes.

Table 16 summarises the latest ESOO results in Victoria over the next five years, and presents the underlying forecast demand, expected unserved energy, and magnitude of expected gaps against the reliability standard and the IRM.

Table 16 Victorian reliability and energy adequacy metrics, 2023 ESOO Central scenario (MW)

	Forecast maximum operational demand 50% POE (MW)	Forecast minimum operational demand 50% POE (MW)	Expected USE (%)	Reliability gaps and equivalent gaps against the reliability standard (MW)	Reliability gaps and equivalent gaps against the IRM (MW)
2024-25	9,435	1,022	0.0013	0	245
2025-26	9,561	655	0.0016	0	335
2026-27	9,777	350	0.0020	0	400
2027-28	9,978	8	0.0027	120	530
2028-29	10,231	-299	0.0076	885	1,585

7.5.1 Locational reliability factors

Figure 60 and Figure 61 show the relative reliability benefits of generators located at various connection points across Victoria and the NEM for the ESOO Central scenario and an *Actionable transmission* sensitivity in 2029-30 with a focus on times of unserved energy in Victoria.

Many connection points within the Melbourne 220 kV network have a 100% relative reliability benefit, while those on the 500 kV network are shown to have approximately half this impact, indicating that transmission capacity into Melbourne through the 500/330/220 kV networks is subject to congestion during Melbourne reliability risks.

Additional transmission developments significantly increase transfer capacity in the Actionable transmission sensitivity. As a result, connection points in Victoria, South Australia and Tasmania are shown to have significantly more benefit than in the Central scenario.

[39] AEMO, *Connections in Low System Strength Zones*, at https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/participate-in-the-market/network-connections/connections-in-low-system-strength-zones.

Figure 60 ESOO Central scenario, locational reliability factors for Victorian USE, 2029-30

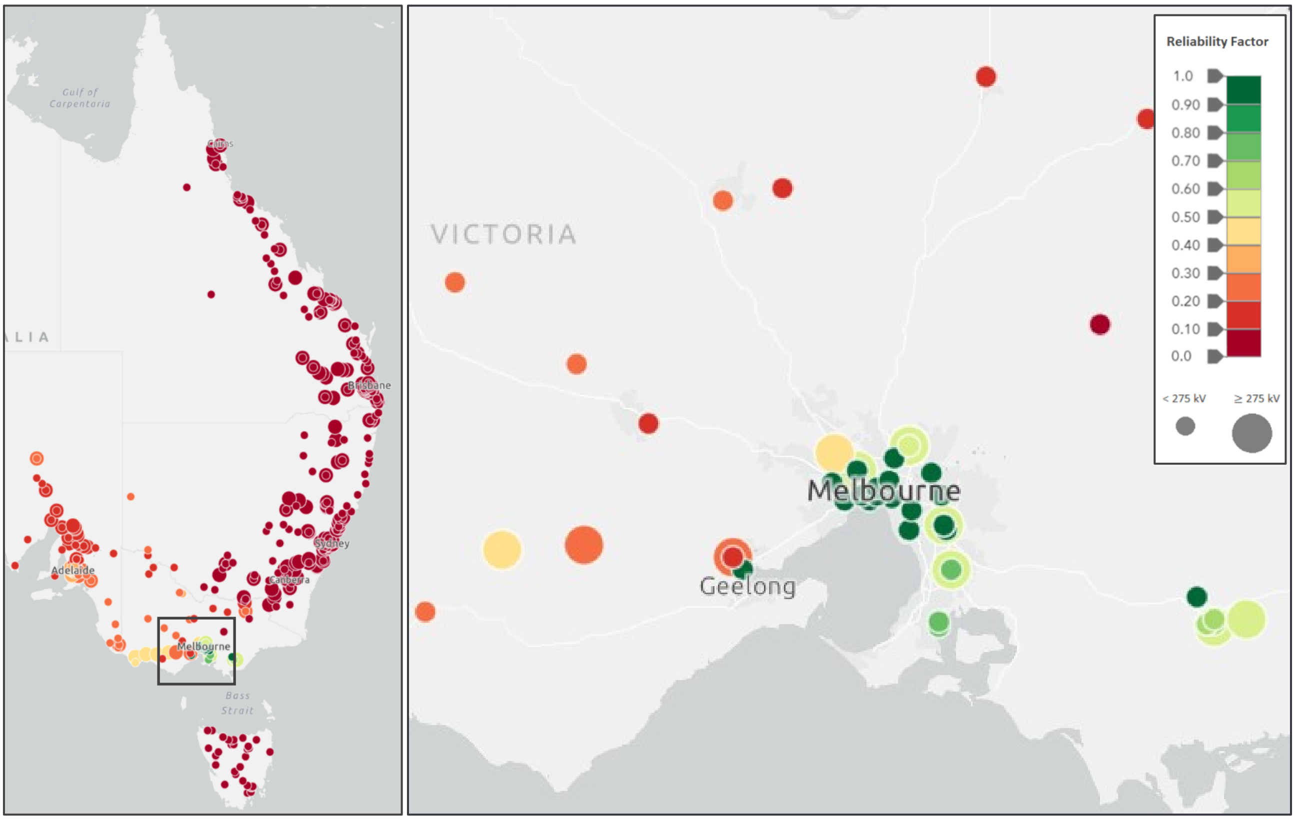
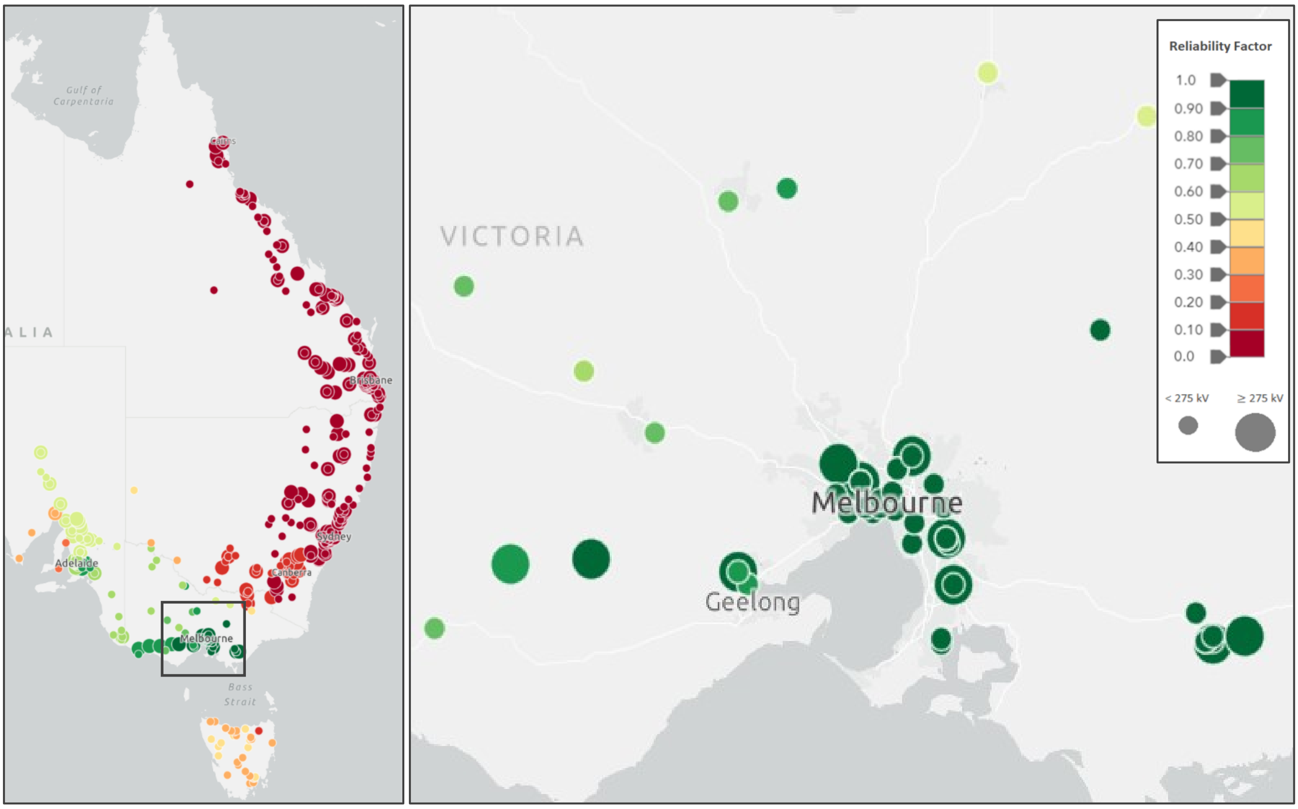


Figure 61 *Actionable transmission* sensitivity, locational reliability factors for Victorian USE, 2029-30



7.6 Wholesale price indicators

Figure 62 shows the average quarterly spot price in Victoria over the past four years. In 2023, the average regional spot price was $55/MWh.

For the same year, negative prices occurred approximately 55% of the time during the daily period of 1000 hrs to 1400 hrs. Figure 63 provides the time-of-day negative price occurrence and half-hourly average spot price in Victoria for calendar year 2023.

Figure 62 Average Victorian spot prices – quarterly since Q3 2020 ($/MWh)

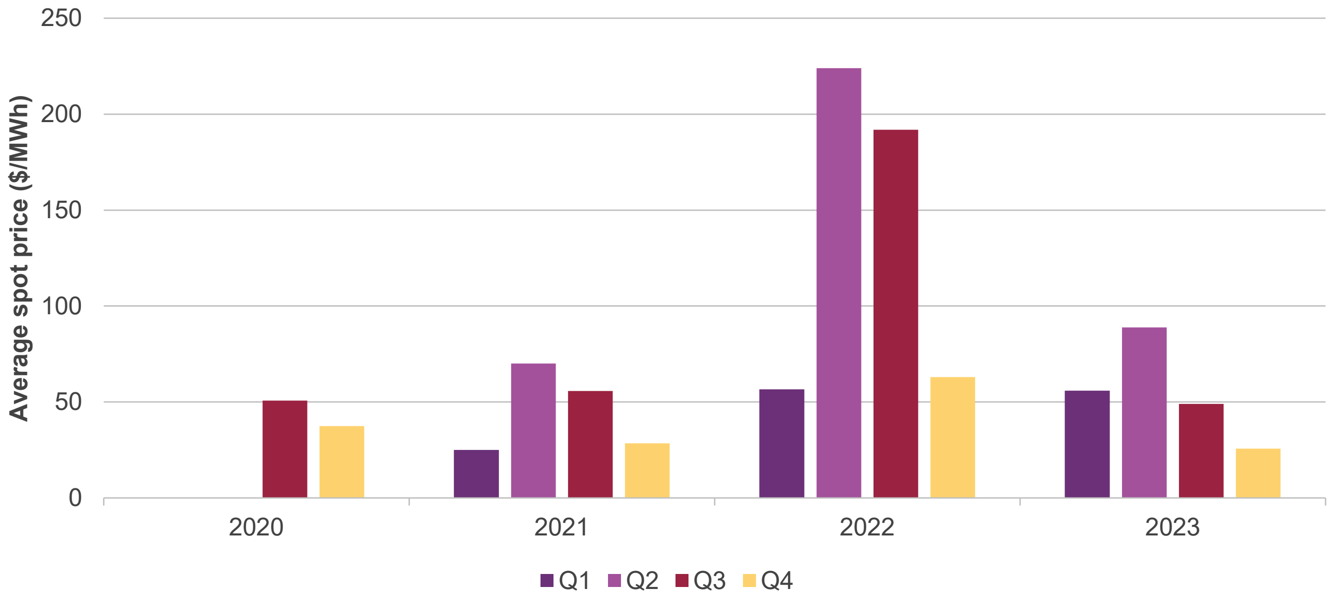
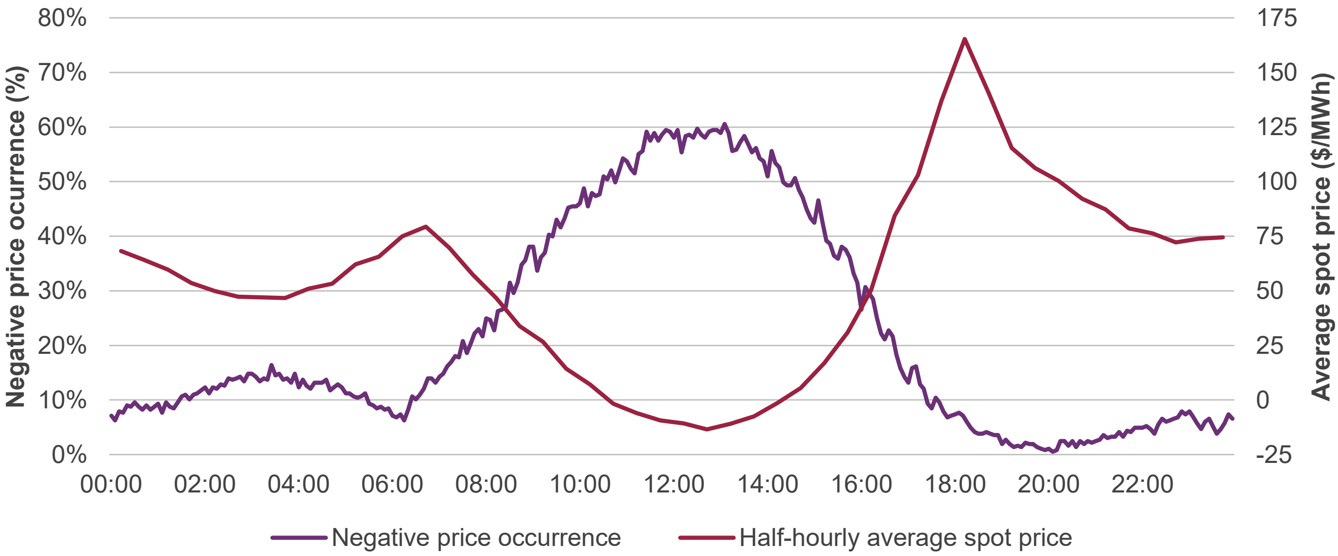


Figure 63 Negative price occurrence and half-hourly average spot price in Victoria – calendar year 2023



8 Next steps

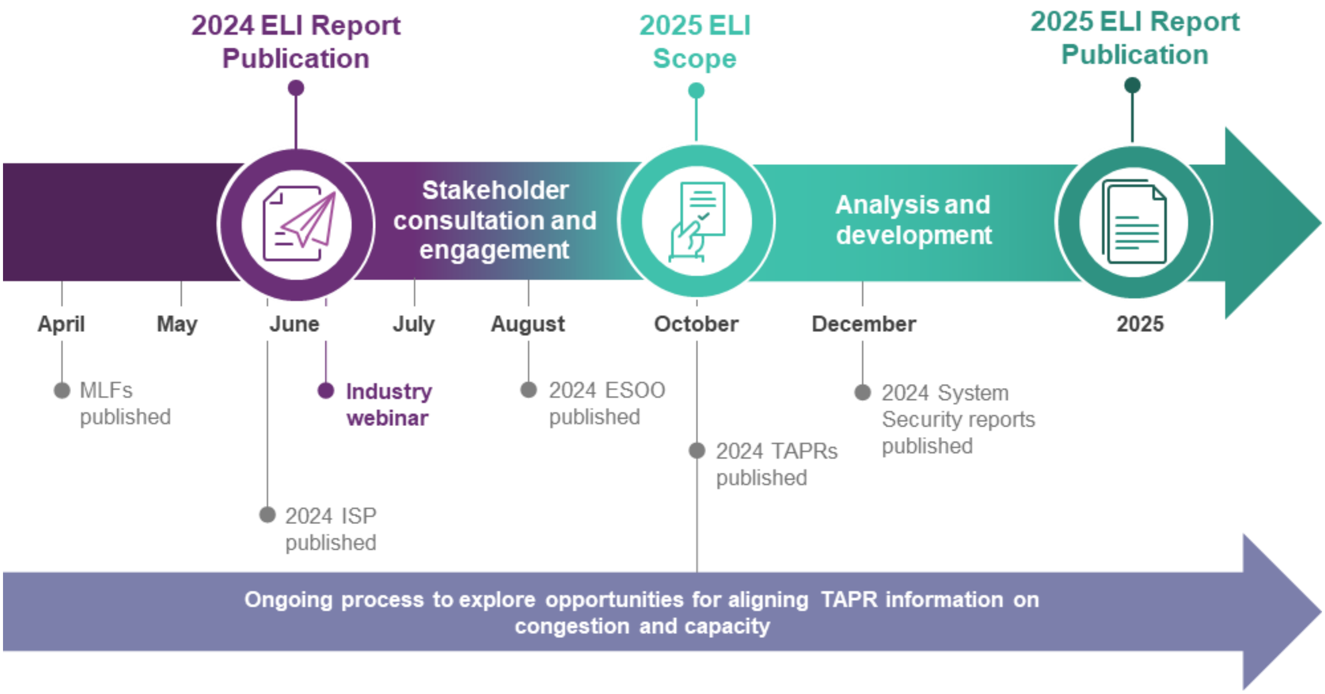
This inaugural ELI Report has been published to implement the Energy Security Board's (ESB's) 'enhanced information' transmission access reforms. This report will be open for consultation to understand its usefulness to stakeholders and to suggest improvements, prior to the second ELI Report being published in 2025.

Subsequent reports will be published annually, with stakeholder feedback sought on each publication. It is envisioned that the scope of the ELI Report will evolve over time, depending on stakeholder feedback through consultation.

In parallel, AEMO will undertake ongoing work with TNSPs through joint planning arrangements to ensure that future iterations of ELI and TAPRs depict a consistent and valuable picture of locational information across the NEM. This includes alignment on the calculation methodologies for congestion and hosting capacity.

The indicative timeline and activities for the ELI Report are summarised in Figure 64.

Figure 64 Indicative timeline of activities and publications



8.1 Stakeholder consultation process

AEMO welcomes written submissions from stakeholders on the usefulness of the 2024 ELI Report. Feedback from the 2024 ELI Report will be used to inform the scope and design of the 2025 ELI Report.

AEMO's process and expected timeline for consultation leading up to the publication of the 2025 ELI Report are outlined in Table 17. Future dates may be adjusted, and additional steps may be included as needed, as the consultation progresses.

Table 17 Consultation process and timeline

Date	Event	Purpose
7 June 2024	2024 ELI Report published	Consult on the 2024 ELI Report and invite written submissions.
June 2024	Webinar	A public webinar on the 2024 ELI Report and proposals for future reports, with stakeholder feedback encouraged.
12 July 2024	Written submissions close	Written comments from all stakeholders.
Q4 2024	2025 ELI Report scope established	To inform analysis and modelling activities for the 2025 ELI Report.
Mid-2025	2025 ELI Report published	2025 ELI Report published, as informed from stakeholder feedback.

AEMO welcomes and encourages written submissions from all stakeholders on any aspect of the 2024 ELI Report. AEMO particularly welcomes responses to the following questions:

Consultation questions

1. Is the locational data in the ELI Report presented useful for initial screening and early-stage analyses about where to locate projects in the NEM? If not, how could this be improved?
2. What types of additional analysis or locational signals would be useful to include in the 2025 ELI Report?
3. Are there any other suggested improvements to the ELI Report, or the presentation and overlay of the included datasets that might improve their usefulness or insightfulness?

Written submissions providing feedback on the 2024 ELI Report open 7 June 2024. All stakeholders are invited to provide a written submission, which should be sent in PDF format to planning@aemo.com.au by 6.00 pm (AEST) on Friday, 12 July 2024.

Before making a submission, please read and take note of AEMO's consultation submission guidelines[40]. AEMO requests that, where possible, submissions should provide supporting information for any views that are put forward. AEMO will publish submissions on its website, subject to materiality and confidentiality requirements. Please identify any parts of your submission that you wish to remain confidential and explain why.

[40] At https://aemo.com.au/consultations.

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Abbreviations

Abbreviation	Term
AEMO	Australian Energy Market Operator
CIS	Capacity Investment Scheme
ESOO	*Electricity Statement of Opportunities*
FCAS	frequency control ancillary service/s
FFR	fast frequency response
GW	gigawatt/s
Hz	hertz
IASR	*Inputs, Assumptions and Scenarios Report*
IBR	inverter-based resources
IRM	Interim Reliability Measure
ISP	*Integrated System Plan*
kV	kilovolt/s
MLF	marginal loss factor
MW	megawatt/s
MWh	megawatt hour/s
MWs	megawatt-second/s
NEM	National Electricity Market
NSCAS	network support and control ancillary services
NSP	network service provider
ODP	optimal development path
POE	probability of exceedance
PV	photovoltaics
QED	*Quarterly Energy Dynamics*
REZ	renewable energy zone
RIT-T	regulatory investment test for transmission
SCADA	supervisory control and data acquisition
TAPR	Transmission Annual Planning Report
TNSP	transmission network service provider
VRE	variable renewable energy