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Friday, 16 February 2024

Ms Merryn York
Executive General Manager System Design
Australian Energy Market Operator

Lodged via email: ISP@aemo.com.au

Dear Merryn,

Draft 2024 Integrated System Plan

Transgrid welcomes the opportunity to respond to the Draft 2024 Integrated System Plan (**ISP**), published by the Australian Energy Market Operator (**AEMO**) on 15 December 2023, to assist advancement of the 2024 ISP.

Transgrid operates and manages the high-voltage electricity transmission network in NSW and the ACT, connecting generators, distributors and major end users. We have an important role in managing one of the key parts of Australia's National Electricity Market (**NEM**) as it transitions to increasing levels of renewables generation.

We remain committed to playing our part in delivering the major transmission investments that will provide significant benefits to consumers. As such, we strongly support AEMO's conclusion that there is a clear need for urgent delivery of all actionable transmission projects.

Transgrid also supports AEMO's efforts to collaboratively consult throughout the ISP process. In particular, we consider that there is significant value in the trusted, comprehensive, and detailed nature of AEMO's ISP. This process should ensure that the final 2024 ISP provides a robust platform to move forward with the critical transmission investments needed to enable Australia's ongoing energy market transformation.

In the attached submission, we highlight a number of matters in relation to the system security, social licence, emissions reductions and demand assumptions that we ask AEMO to consider as it finalises the 2024 ISP. In addition, we raise specific issues relating to major transmission projects, including opportunities to advance projects that have the potential to provide significant net benefits to consumers.

We look forward to continuing to work collaboratively with AEMO on the development of the 2024 ISP. If you require any further information or clarification on this submission, please feel free to contact me or Kasia Kulbacka at Kasia.Kulbacka@transgrid.com.au.

Yours faithfully

Marie Jordan
Executive General Manager of Network

Submission to AEMO Draft 2024 ISP

Executive Summary

This submission provides Transgrid's response to the Australian Energy Market Operator's (**AEMO**) Draft 2024 ISP. Transgrid is proud to be a key partner in delivering critical projects in AEMO's Draft 2024 Integrated System Plan (**ISP**) which underscores the urgent need for the accelerated delivery of essential transmission infrastructure in NSW and Victoria. We are proud to be delivering the key projects needed to realise the Commonwealth Government's clean energy vision and provide cleaner, cheaper and more reliable energy to consumers. The need to remain focused on delivering these projects is driven by the following factors:

- The pace of transition is accelerating as coal plants are closing sooner than expected and emission reduction ambitions continue to rise.
- Transmission investment will play a vital role in facilitating the much-needed growth in renewable generation and storage capacity to provide consumers with access to cheaper, greener renewable energy as soon as practical.

As we continue to play our part in transitioning reliably, Transgrid is focused on delivering the anticipated, committed, and actionable ISP projects. We also acknowledge the essential role of AEMO's 2024 ISP in articulating the case for transmission projects, so that all stakeholders understand the value these projects will provide to electricity consumers.

We are also cognisant of the need to ensure that landowners, communities, and energy consumers support these important projects. In this regard, we welcome AEMO's focus on social licence considerations.

Our submission is structured as follows:

- **Section 1** sets out our views on issues relating to system security, social licence, emissions and demand assumptions.
- **Section 2** sets out our views on specific transmission projects, including opportunities to progress new projects that have the potential to deliver significant net benefits to consumers.

In relation to the matters addressed in Section 1 of our submission, our key points are:

- **System security**. A key concern is the increasing complexity of the power system as we move towards 100% renewable generation. Transgrid considers that the success of the transition could be undermined if the challenges relating to the planning and operation of transmission networks in this new environment are underestimated. We therefore recommend that further work is undertaken to ensure that we have access to the necessary tools, regulatory processes and qualified people to enable timely progress during this critical juncture of the transition.
- **System strength and grid forming batteries**. To optimise the transition, further work is required to ensure that we understand the risks and opportunities available to provide system strength services at the lowest cost to consumers. A similar observation applies to special protection schemes. On each of these matters, we encourage AEMO to undertake further work in collaboration with the industry to fully understand the size and scale of the challenges so that timely solutions can be developed and implemented.

- **Demand assumptions**. We have highlighted a specific issue regarding the updated demand forecasts for the Greater Western Sydney and Illawarra regions, driven principally by the development of a new international airport precinct and a significant increase and growing demand for major data centres in these regions. It will be important for the final 2024 ISP to reflect these latest demand forecasts.
- **Social license**. Given the importance of social license, Transgrid welcomes AEMO's consideration of these issues in the Draft 2024 ISP. We also note our commitment to working with communities, governments and the industry to develop and deliver our projects in ways that provide strong and lasting social legacies for the landowners and communities in which transmission infrastructure is hosted.
- **Emissions reduction policies**. We welcome the focus on emission reduction in accordance with the National Electricity Objective. We encourage AEMO to identify additional emissions reduction related ISP modelling information to help Transmission Network Service Providers (**TNSP**) consider emissions reduction benefits in regulatory investment tests (**RIT-T**).

In relation to the matters in section 2 of our submission, which relates more specifically to particular transmission projects, our key points are:

- **Reinforcing the southern section of the Sydney Ring**. We consider there is a compelling case to recognise the critical need for this infrastructure investment in the final 2024 ISP. **Attachment one** to this submission, sets out a detailed analysis of expected network constraints in the southern section of the Sydney Ring.
- **HumeLink**. We welcome AEMO's confirmation that HumeLink remains an actionable ISP project, critical to the transition, and AEMO's view that maintaining the project's momentum is in the long-term interest of consumers.
- **QNI Connect.** Transgrid recognises the critical role of building and maintaining social licence to successfully deliver a project such as Queensland and NSW Interconnector (**QNI Connect**). The project timing reviews conducted as a refresh to the Preparatory Activities identified that the duration of each option has increased, placing pressure on achieving optimal timing if not progressed imminently.
- **Inland REZ.** We consider that work should be progressed to consider new Inland Renewable Energy Zone (**REZ**) opportunities, that have the potential to complement existing REZ's and provide valuable geographical diversity of renewable energy resources that will increase system resiliency during renewable lulls. For example, we would welcome the opportunity to collaborate with AEMO on developing options for a major inland REZ in NSW for further consideration in the 2026 ISP.

1. System security, operability and other core considerations

Transgrid's system security roadmap

The scale, speed, opportunities and challenges of the transition required to meet government emission reduction targets is enormous. Australia is targeting a world-first large-scale grid transformation. The system continues to evolve from the historically more static and predictable to one dominated by variable renewable energy incorporating a wider range of technologies, more diverse geographical locations, higher variance in demand and embedded generation, and greater reliance on storage and active management of power flows. All of this adds complexity,

risk and volume to the work of the teams planning, building and operating our transitioning grid to design an optimised suite of solutions and best outcomes for communities and consumers.

As demonstrated in our recently published System Security Roadmap, Transgrid is proactively exploring the challenges and increasing complexity of the transition. Our Roadmap outlines our three-pillar plan to transform the State's power system and ensure the secure operation of the grid, at up to 100% instantaneous renewables, over the next decade. The three pillars include:

- **Energy Reliability** – How we will develop large-scale transmission infrastructure to support new renewable generation and storage as coal generators are moth-balled and retired.
- **System Security** – How we will deploy system security infrastructure and services to keep the grid operating within a safe technical envelope.
- **Operability** – How we as an industry, and within Transgrid, will develop our people, processes and tools to meet the increased volume and complexity of work required to successfully plan, manage and operate a grid powered by renewables.

The 2022 ISP stated that *"Uplifting System Operator and Network Service Provider capabilities in operational systems, processes, real-time monitoring, and power system modelling will be essential to have the tools to maintain secure operation of the NEM power system".* Transgrid supports AEMO's efforts in continuing this work through its Engineering Framework and AEMO's Draft 2024 ISP. This includes the identification of a rapidly growing need for coordinated investment in system security services across the National Electricity Market (**NEM**). These services are necessary to enable delivery of the development plans considered in the ISP and are crucial to maintaining a secure and resilient power system throughout the energy transition.

Transgrid supports AEMO's efforts in setting out a clear and trusted path for the transition. These efforts could be extended by including consideration of system security and operability risks in the ISP and other related documentation, including the Engineering Framework. In particular, there will be significant operability challenges to plan, manage and operate a more complex power system, at up to 100% instantaneous renewables. If system security and operability risks are not comprehensively addressed, Australia's clean energy transition will be beset by costly uncertainty and delays.

Addressing these risks should include recommending reforms to make network and system security planning more proactive and enable key parties, including AEMO and TNSPs, to manage system security through the transition. With longer-term reform still in development, we encourage AEMO to continue to engage with TNSPs, as it has been actively doing to date, to develop appropriate system security and operability frameworks to ensure the network can be securely operated. This should include consideration of the required improvements, and regulatory reforms to enable them, including the tools, processes and people required to successfully deliver the transition.

System strength

With regards to the quantum and timing of new capacity entry, we encourage further collaboration between AEMO, EnergyCo and Transgrid to better align Inverter Based Resource forecasts for NSW REZs. For example, AEMO forecasts 2,170MW of solar generation built in the South West REZ by 2030, whereas EnergyCo, in its Draft South West REZ Access Scheme Declaration, is actively seeking to facilitate additional entry in this REZ, as suggested by the proposed access scheme limits of 3.98GW of wind and solar.

As the NSW System Strength Service Provider (under the National Electricity Rules (**NER**)), Transgrid is required to use AEMO's forecast as an input in planning for system strength solutions. However, if there is a materially different expectation (or policy-driven objective) of

renewable generation connection levels, then planning for system strength in NSW will become increasingly fragmented from the NER framework (and increasingly complicated to implement).

Grid-forming batteries for system strength

Grid-forming batteries hold promise to provide significant system strength benefit, particularly to stabilise voltage waveforms of new connecting Inverter Based Resources, as is being explored through AEMO's Voluntary Grid Forming Specifications, and Transgrid's system strength RIT-T process.

AEMO's ISP currently considers that all batteries are grid following, with synchronous condensers utilised to provide sufficient system strength services. We believe there is an opportunity, once sufficient understanding of grid-forming batteries is known, to incorporate forecasts of their levels (and benefits) for system strength and inertia. By doing this, we expect that the ISP may identify additional co-optimisation benefits for consumers that involve a greater uptake of large-scale (grid forming) batteries, which provide co-benefits of system security and energy market services.

The need for special protection schemes

Section S5.1.8 of the NER requires consideration of non-credible contingencies including double circuit faults that could potentially endanger the stability of the power system. For some projects, this may require emergency controls to minimise disruption and to significantly reduce the probability of cascading failure. The implementation of special protection schemes is typically considered to be the lowest cost solution, although it may introduce complexity, leading to reliability risk.

Transgrid recommends that AEMO considers conducting an independent analysis of the benefits and risks of special protection schemes against the need to advance network infrastructure to mitigate these risks, recognising in particular, the social licence impacts.

Social licence

Transgrid supports the efforts of AEMO to consider social licence more explicitly in the Draft 2024 ISP, including through sensitivity analysis detailed in Appendix 8 of the Draft 2024 ISP. AEMO's initiatives in relation to social licence considerations are in line with recent efforts by the government and the energy market bodies, across multiple review and reform processes, to improve the social licence frameworks in the NEM.

We strongly believe that genuine community and stakeholder engagement is paramount to a successful transition to net-zero. Effective engagement and responding to impacted communities, First Nations and landholders' needs are fundamental to building and maintaining the social licence needed to expand the transmission grid to support the transition to net zero.

Transgrid engages with all landowners, communities and stakeholders by seeking their perspectives, keeping them informed, enabling them to provide meaningful and informed feedback and facilitating their contribution to the design of impact mitigation measures. Our commitment is illustrated by our community and stakeholder engagement process on the NSW-side of the Victoria and NSW Interconnector West (**VNI West**) project.

VNI west is a proposed high-capacity 500 kV double-circuit overhead transmission line between NSW and Western Victoria. Transgrid is currently midway through a program of dedicated community information sessions on the draft route report which is a fundamental pillar of social licence development. These sessions provide communities with the opportunity to discuss community, environmental and technical issues with subject-matter experts before we finalise the route and commence work on a detailed environmental assessment.

Emissions reduction policies

Transgrid supports inclusion of recently announced emission reduction targets for NSW and QLD for inclusion in the final 2024 ISP. This includes the legislated targets for economy-wide emission reductions of 70% and 75% by 2035 for QLD and NSW, respectively.

We consider these targets should drive reduced emission budgets available for use within the ISP. This will help support accelerated and urgent investment in transmission infrastructure.

Given the recent introduction of an emissions reduction objective in the national energy objectives and corresponding updates to the energy rules by the Australian Energy Market Commission (AEMC), we encourage AEMO to consider providing additional emissions-related ISP data to better inform RIT-Ts. This could include:

- Any value of emissions reduction used in the ISP and sensitivities to these values.
- More detailed breakdowns of emissions budgets for the electricity sector.
- Emissions budgets or other related information to help quantify emissions reduction benefits broader than the electricity sector given the rules have recently been updated to require RIT cost benefit assessments to consider a broader scope of beneficiaries.

Improving demand assumptions for the Sydney, Newcastle and Wollongong region

Transgrid is observing the year-on-year evolution in demand forecasts for the Greater Western Sydney and Illawarra regions, driven by the development of a new international airport precinct and unprecedented interest in connections from large-scale spot loads, particularly new data centres and industrial/manufacturing facilities.

Increasing enquiries and applications for new major load connections are a leading indicator that future demand growth in these regions will be out of step with expectations set by traditional demand forecasting methods. Joint planning with distribution networks suggests that new connection enquiries across the Greater Western Sydney and Illawarra regions may exceed expectations by several gigawatts by the early-2030's.

The increasing complexity of managing embedded generation and its impacts on demand is an area Transgrid strongly supports further engagement across the industry and government bodies to optimise the balance of enabling the benefits and managing whole of system risks through the transition as long term solutions (for example storage and virtual power plant etc) are implemented.

The Draft 2024 ISP and its supporting methodologies do not clearly account for the potential for substantial, localised increases in demand due to data centres and industrial/manufacturing facilities. Transgrid encourages AEMO to consider these factors in the final ISP. To support this, further analysis of load growth in Greater Western Sydney is included in Attachment 1, including discussion of how this growth influences the need to increase transmission capacity from southern NSW to the Sydney, Newcastle, Wollongong (**SNW**) region.

2. Network Development

Reinforcing the southern section of the Sydney Ring

The Draft 2024 ISP recognises the need to develop the Sydney Ring to increase capacity into the SNW load centres. The northern section of the Sydney Ring, the Hunter Transmission Project (**HTP**), was identified as an actionable project in the 2022 ISP and is proceeding as an actionable NSW project, with scheduled completion in 2027-28. Transgrid supports the need to

develop HTP and recognises its critical role in enabling access to capacity from the Central West Orana and New England REZs, and from Queensland.

Transgrid considers it critical that the southern section of the Sydney Ring be reinforced to support the future reliability and operability of the NSW power system, and access the full capacity of southern generation, including the expanded Snowy Hydro scheme, South-West REZ and interstate via Project EnergyConnect and VNI West. This view is supported by Transgrid's detailed planning studies of the NSW power system, which suggest that the Draft 2024 ISP is overly reliant on generation in Northern and Central NSW to meet growing demand to the south and west of Sydney. Transgrid's detailed planning studies demonstrate a need to augment the southern network by the early 2030s to ensure future reliability of the power system for NSW consumers.

In support of this view, Attachment one sets out a detailed analysis of expected network constraints in the southern section of the Sydney Ring, describes the underlying need to increase transfer capacity to SNW, proposes additional options to augment the southern section of the Sydney Ring, and outlines potential opportunities to incorporate these findings into the final 2024 ISP.

It is recommended that in response to these issues, AEMO should consider:

1. Recognising in the final 2024 ISP that new infrastructure is required to increase transfer capacity via the southern section of the Sydney Ring. This is needed to support load growth, particularly in Western Sydney and the Illawarra, and to address future constraints on generation in southern NSW.
2. Additional transmission expansion options as potential solutions to increase transfer capacity in the southern section of the Sydney Ring.
3. Reviewing demand growth forecasts, with a particular focus on expected load growth in major industrial centres such as Western Sydney and the Illawarra. This recommendation reflects early indications that growth in these regions may be significantly higher than is reflected in current forecasts.
4. Aligning system planning models and approaches with current observations of the network, and the expectations of system operators. This includes reviewing how the ISP models power flows into SNW from central, southern and northern NSW, particularly under high demand conditions, and developing constraint equations that reflect contribution coefficients from generators and loads.

Transgrid recognises the significant benefit in continuing to work collaboratively with AEMO to explore these issues and potential solutions through network studies and would welcome the opportunity to engage further through joint planning activities.

HumeLink

Transgrid supports HumeLink's continued inclusion as a critical actionable ISP project and AEMO's view *that maintaining the project's momentum is in consumers' long-term interest*.[1] We also agree with AEMO's observation in its 2024 ISP that transmission projects such as HumeLink will provide

[1] AEMO, Appendix 6. Cost Benefit Analysis – Appendix to the Draft 2024 Integrated System Plan for the National Electricity Market, 15 December 2023, p 41.

better access to deep storage that can mitigate renewable droughts and balance energy across seasons.[2] AEMO notes that HumeLink will also provide value through:[3]

- Increasing transfer capacity and stability limits between the Snowy Mountains and major load centres (Sydney, Newcastle, Wollongong) to support NSW as coal-fired power stations retire avoiding the need for more dispatchable firming capacity and generation and,
- facilitating the development of renewable generation in Southern NSW.

We therefore welcome AEMO's feedback loop confirmation, provided on 21 December 2023, which confirmed that the:

- HumeLink project addresses the relevant identified need and aligns with the ODP specified in the most recent ISP and,
- total cost of the project, $4.88 billion ($2022-23), does not change the status of the actionable ISP project as part of the ODP specified in the most recent ISP.[4]

Transgrid has been progressing the development of the project steadily since completion of the RIT-T, through our Stage 1 early works activities, which were approved by the Australian Energy Regulator (**AER**). We have recently submitted our Contingent Project Application (**CPA**) for Stage 2 (Delivery) of the project to the AER.

In addition, Transgrid is in the process of finalising an assessment of whether the recent increase in the estimated capital costs for the HumeLink project constitutes a material change in circumstance that would change the identification of the preferred option in the HumeLink RIT-T. The updated net benefit analysis assessment has assessed three scenarios and applied a 660MW constraint on Snowy 2.0 without HumeLink consistent with AEMO's 2023 Final Inputs, Assumptions and Scenarios (**IASR**).

This updated analysis shows increased net market benefits across all options relative to the RIT-T with no change in the ranking of the preferred option. Transgrid plans to publish this analysis when finalised and welcomes further engagement on the results including with AEMO to understand differences in modelling methodology and outcomes, if any, with ISP cost benefit analysis for HumeLink.

The Draft 2024 ISP confirms that HumeLink continues to provide net benefits to the market and remains a key component of the ODP, taking into account the changes in the costs of HumeLink as well as changes in the costs and timing of other major developments in the NEM more widely, and the revised delivery timing for Snowy 2.0.[5] In addition, Transgrid would like to note that continuing to progress the project as planned is optimal as we understand that the first Snowy 2.0 generating units are expected to start commissioning in July 2027.

QNI Connect

AEMO's Draft 2024 ISP noted that the least-cost development pathway in the Step Change scenario saw the development of QNI Connect, Option 2, to help support Queensland through the closure of its coal fleet. In addition, AEMO noted that:

[2] AEMO, Draft 2024 Integrated System Plan for the National Electricity Market, 15 December 2023, p 64.
[3] AEMO, Appendix 6. Cost Benefit Analysis – Appendix to the Draft 2024 Integrated System Plan for the National Electricity Market, 15 December 2023, p 41.
[4] Integrated System Plan Feedback Loop Notice – HumeLink – 21 December 2023. For more info see *here*
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[5] AEMO, Appendix 6. Cost Benefit Analysis – Appendix to the Draft 2024 Integrated System Plan for the National Electricity Market, 15 December 2023, p 41.

- while QNI Connect, Option 2, is part of the least-cost ODP, efficiency considerations arise in relation to the earlier expansion of the interconnection between New South Wales and Queensland and,
- the development of the Pioneer-Burdekin Pumped Hydro Project delays the need for QNI Connect.

Transgrid considers QNI Connect brings considerable diversification and resilience benefits to the NEM. Timely delivery of QNI Connect also provides mitigation benefits, notably against the risk of delays in delivering large and complex pumped hydro projects, as currently observed.

Transgrid has recently performed additional work on the expected project timings and commissioned market modelling to inform our thinking on the role an expanded interconnection will play in the transition.

- The project timing reviews identified that the duration of each option has increased, placing pressure on achieving in-service date requirements. Transgrid recognises the critical role of building and maintaining social licence to successfully deliver a project such as QNI Connect. Considering the experience of our current project teams, and recent social licence regulatory reforms, early and ongoing community engagement will continue to be critical to support smooth and timely project delivery.
- Considering recent analysis, the project delivery timeline is likely to be extended. This is driven by the complex alignment and integration of this project to the New England REZ and with other planning authorities in the region as well as the extended timeframes required to obtain regulatory and environmental approvals and to comply with biodiversity offset requirements. Noting that the earliest feasible delivery date we previously presented to AEMO contemplates the project gaining actionable status in the 2024 ISP and does not factor in inter-network testing, which we estimate could extend the timeline by 12-18 months.
- Our analysis indicates that if the project only gained actionable status in the ISP 2026, it would not likely meet AEMO's optimal Step Change timing.

Findings from our recent market modelling demonstrate that an increased interconnection between NSW and Queensland will:

- Reduce the required build out of renewables, firming and storage capacity in both states,
- reduce emission outcomes across the NEM and,
- serves to alleviate congestion between states, which reduces the difference in wholesale energy prices.

Inland REZ

Transgrid recognises the abundant renewable resources available in western NSW. Under a Green Energy Exports scenario, currently identified Renewable Energy Zones may become 'exhausted' and we may have to look further afield, to either offshore and/or inland to access additional renewable resources.

As such, we recommend that AEMO engage early in the next ISP process to consider selection of alternative transmission routes and associated costs should be considered to optimise for technical, network, economic and social licence outcomes.

Increased focus on the opportunities available for major inland solar developments will complement existing REZ developments. Transgrid is keen to collaborate with AEMO on developing the idea of a major inland REZ in NSW for further consideration for the 2026 ISP.

Attachment 1: Reinforcing the southern section of the Sydney Ring

Contents

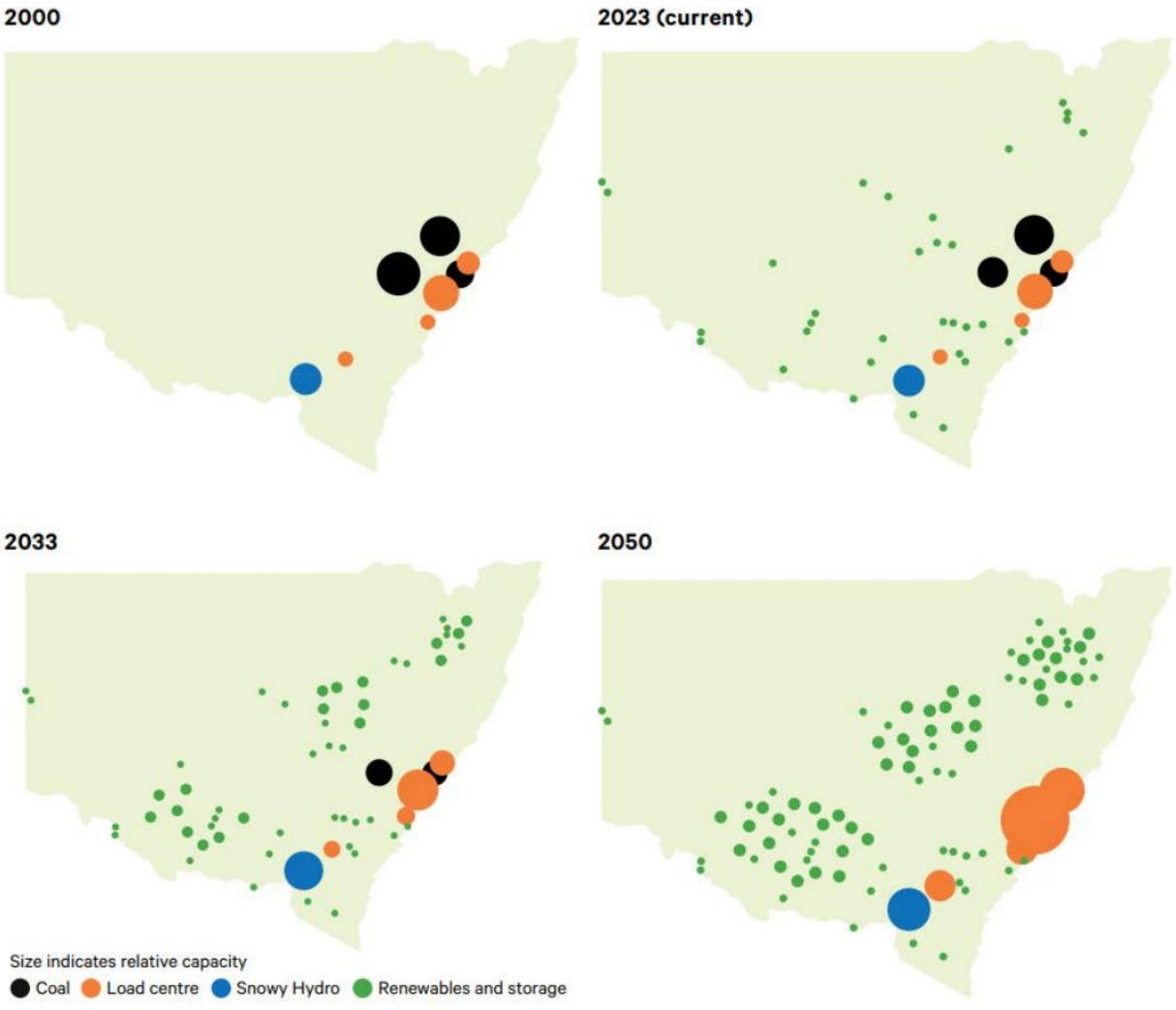
1. The SNW sub-region of the NEM requires additional transfer capacity

1.1. Sydney Ring is critical to increase transfer capacity to major NSW load centres

The Draft 2024 ISP describes the transformation currently underway in the National Electricity Market (NEM). Over the next decade, a large share of coal generation is expected to retire, new sources of generation and capacity will enter the market, and load growth will accelerate.

Parallel shifts are underway in NSW, where the four remaining coal-fired power stations are expected to retire by 2040 and five new Renewable Energy Zones (REZs) are under development. Electricity consumption is expected to increase, driven by fuel switching from liquid fuels and gas to electricity, new types of consumption such as data centres, and population growth. Figure 1 shows how these trends are reshaping loads and electricity supplies in NSW.

Figure 1: The NSW power system in 2000 and 2023, and expected outlook for 2033 and 2050[1]



[1] Transgrid ISP Preparatory Activities – Reinforcing Sydney, Newcastle and Wollongong Supply (Southern Ring).

Transmission infrastructure has a critical role in the energy transition. A new 500 kV transmission backbone is under development that will provide connection from Victoria in the south to Queensland in the north. It will connect over 18GW of new large-scale renewable generation and storage capacity, ensuring this capacity can travel from REZs and regional generators to supply load centres and emerging industries. Strengthening the transmission backbone also applies downward pressure to wholesale electricity prices by improving market access for lowest cost electricity suppliers and makes the power system more resilient to unexpected events, such as early retirement of coal generators, delays to commissioning new generation or storage projects, or high fuel prices.

The Sydney Ring is a key element of the new 500kV transmission backbone. This project focuses on ensuring a reliable and secure supply of electricity to the Sydney, Newcastle, Wollongong (SNW) area of NSW. This area is the location of large urban, commercial and industrial loads that comprise about three quarters of the demand for electricity in NSW. It is also a major economic centre, contributing around a quarter of the value of Australia's total gross domestic product.

The Sydney Ring includes options for augmentation of the northern section, the Hunter Transmission Project (HTP), and the southern section. Figure 2 provides a map of the Sydney Ring, including other key elements of the new transmission backbone in NSW.

Developing the Sydney Ring will enable connection of new generation and capacity with the major load centres in SNW, by linking each REZ to the 500kV transmission backbone that supplies SNW. The project will also enable more capacity to reach SNW via interstate interconnectors and from the expansion of Snowy Hydro. It will play a critical role in supporting the management of project timing, real-time generation availability and system operations risks associated with the energy transition.

1.2. Completing the Sydney Ring requires augmentation in both the north and south

Transgrid sees the development of the new 500kV transmission backbone proceeding in three phases:

- The Southern Superhighway (2024-28), comprising Project EnergyConnect, Humelink and VNI West, will enable greater energy sharing between NSW, South Australia and Victoria and unlock capacity from Snowy Hydro and South West REZ.
- The Sydney Ring (2028-32), comprising HTP and Sydney Ring (South), will reinforce supply to the SNW load centre and unlock capacity from the Central West Orana REZ and alleviate constraints on the existing network as coal generators retire and demand grows.
- The Northern Superhighway (2028-33), comprising the New England REZ Transmission Link and QNI Connect, will unlock supply from the New England REZ and enable greater energy sharing between NSW and Queensland.

The optimal development path (ODP) in the Draft 2024 ISP is generally consistent with this approach. Nearer-term projects are included as Committed and Anticipated or Actionable projects, and QNI Connect as a Future ISP Project. The notable exception is southern section of the Sydney Ring, which is included as an alternative to the HTP.

Figure 2: Key elements of the 500kV transmission backbone, and Sydney Ring[2]

[2] Transgrid Transmission Annual Planning Report 2023.

As the jurisdictional planning body and primary Transmission Network Service Provider for NSW and the ACT, Transgrid undertakes detailed power system modelling of system constraints and required investments in the NSW network. Based on this modelling, Transgrid believes that there is an immediate need to consider reinforcement options for both the northern and southern segments of the Sydney Ring. Alleviating southern constraints by the early-2030s will support the future operability of the NSW electricity system and ensure generation to the south of the SNW sub-region is available to supply growing demand in Western Sydney and the Illawarra.

Transgrid's detailed system modelling shows congestion is expected on the NSW transmission network if constraints south of SNW are not alleviated. The constraints identified in Transgrid's modelling reflect a level of granularity that may not be fully reflected in the long-term capacity expansion model that underpins the ISP. Transgrid's submission aims to demonstrate these constraints and the need for new southern transmission infrastructure to be recognised in the Final 2024 ISP.

2. The southern section of Sydney Ring unlocks generation capacity

2.1. More southern transfer capacity is needed to reliably supply SNW

As the NSW jurisdictional planning body, Transgrid develops detailed system planning models of the NSW transmission network. Transgrid's concerns about insufficient transfer capacity without augmentation of the southern section of the Sydney Ring arise primarily from modelling line flows and constraints using these system planning models, which include a level of detail not represented in the ISP capacity planning model.

Transgrid has developed system planning studies to illustrate challenges arising from a lack of southern transmission capacity between Central NSW (CNSW) and SNW. These studies describe a set of circumstances that could reasonably arise by the early-2030s and examines network constraints that arise in each scenario, and their implications. The three scenarios are not intended to be exhaustive but to demonstrate that additional transfer capacity is required for the southern section of the Sydney Ring. The three system planning studies are:

1. a base case, based on a summer evening peak in 2031/32;
2. a scenario that requires resecuring the network following an n-1 contingency; and,
3. a scenario where 1.5GW of additional load is added in Western Sydney.

Each system planning studies is based on a summer evening peak in 2031/32. The key assumptions include:

- **Load:**
  - NSW peak demand of 15.1GW[3] (an increase of 1.9GW from the 2023 peak of 13.2GW).
  - 760MW[4] of the incremental peak load is allocated directly to Sydney West, with the remainder linearly scaled across the state. This allocation is based on DNSP Bulk Supply Point forecasts.
- **Coal-fired generation:** Mt Piper (1,420MW) is in operation, delivering 80% of maximum output.
- **Gas-fired generation:** gas generation is utilised to maximum capacity, with summer de-rating.

[3] TAPR 2023, 50% POE High case in 2031/32.
[4] Incremental load from 2022/23 actuals (peak demand load) to base case is 1.9GW (15.12GW – 13.22GW). Based on BSP forecasts, Transgrid assumes approximately 40% of incremental load will be concentrated in Western Sydney, with the remainder scaled equally across other areas.

- **Renewable generation and storage:**
  - Solar generation is at 0% and wind generation at 10% of capacity. Analysis of historical data indicates this generation output coincides with times of near-peak demand from time to time.
  - Battery energy storage systems operate at 90% of maximum output.
  - Central West Orana, New England and Hunter Central Coast REZs are generating at combined output of 3.8GW[5], with battery storage assumed to be developed to 40% of REZ capacity.
- **Additional generation:** To account for future generation not represented in Transgrid's system model and assist with quantifying the generation shortfall in SNW, it is assumed there is a fill-in generator in operation near Newcastle, which can be deployed as required to secure the network.

Several indicators of network constraints can be observed through the system planning studies, including the requirement for additional fill-in generation to supply loads in SNW, curtailment of generation in Southern NSW (SNSW), and high loading on 330kV line 39 from Bannaby to Sydney West.

Scenario 1: Base case

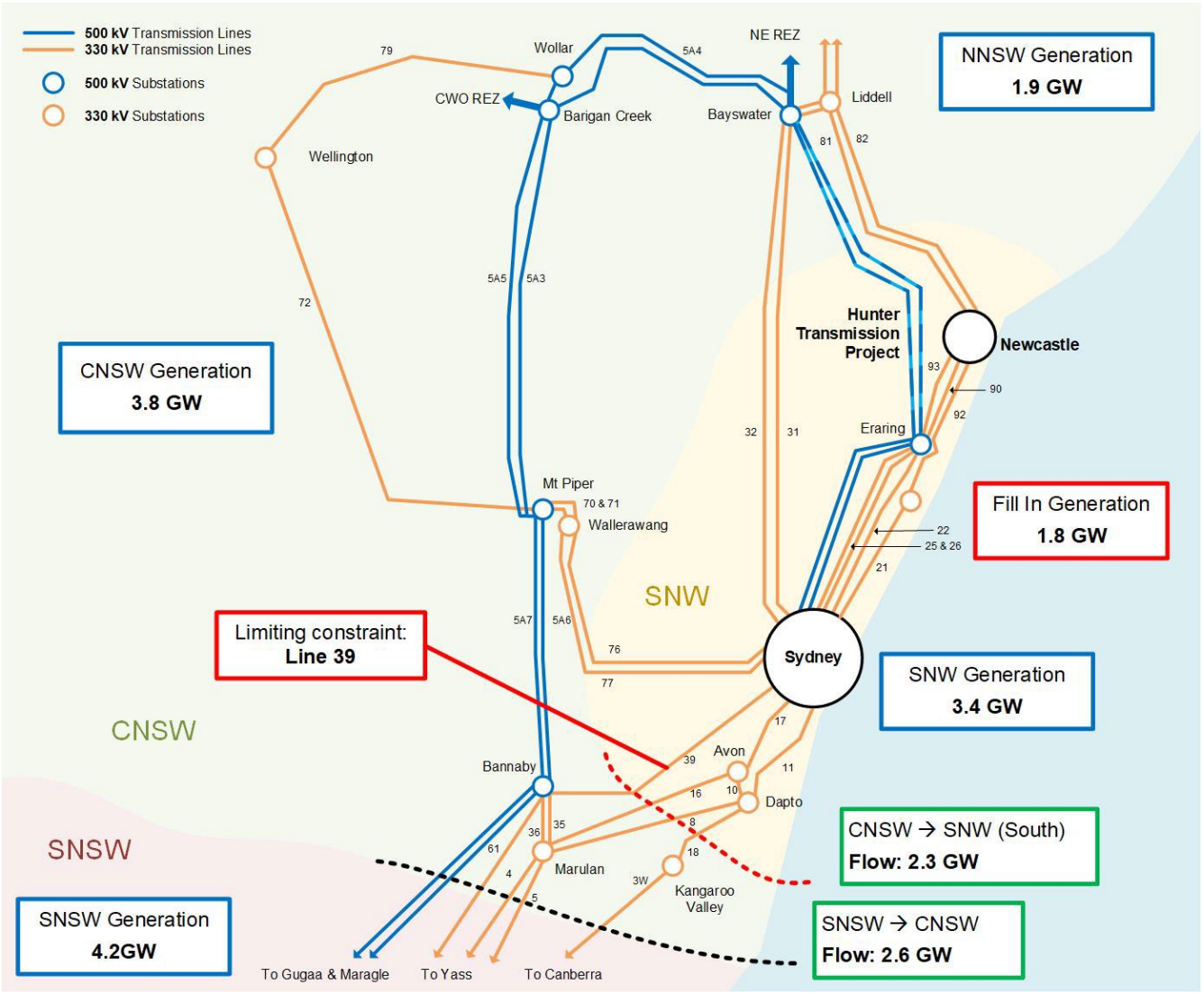
The base case demonstrates peak summer demand conditions in 2031/32 without any contingencies. In this scenario, total operational demand for NSW is 15.1GW, with 11.8GW of load in the SNW sub-region. It is assumed that all available northern generation is dispatched.

This scenario is represented in Figure 3. Transgrid observes a generation shortfall of 1.8GW in SNW that cannot be met by southern generation due to network constraints south of SNW. This is modelled via the fill-in generator within SNW, which indicates that 1.8GW of additional generation is required in this scenario to meet demand, not considering any requirement to maintain system reserves.

At the same time, less than 60% of the generation available for dispatch in SNSW is utilised, leaving over 3GW of unused capacity. This is due to constraints from CNSW to SNW (South), which constrains flows to 2.3GW. In this scenario, line 39 reaches its maximum normal line rating.

[5] Based on CWO nameplate capacity of 4.5GW and NE+HCC nameplate capacity of 4GW by 2031/32.

Figure 3: NSW Transmission Network – Base Case



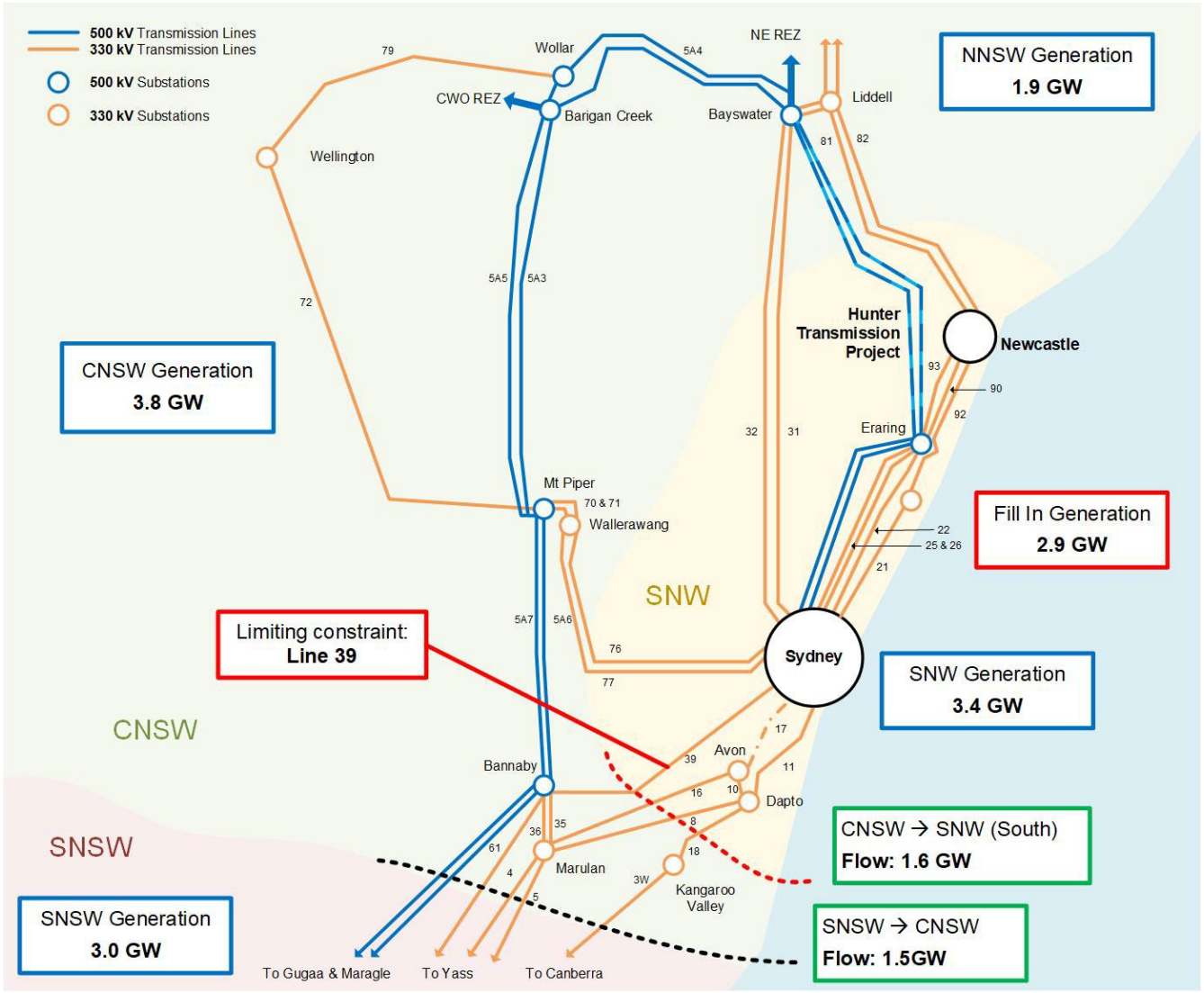
Scenario 2: Requirement to resecure the network following an n-1 contingency

This scenario models system impacts of resecuring the network following a credible n-1 contingency event on 330kV line 17 from Avon to Macarthur, which serves as a critical link connecting Wollongong to Sydney. An outage of line 17 was selected as this is the worst-case contingency scenario for supply to the SNW sub-region, meaning this line is the most relevant line for assessing the impacts of a contingency event under network operating standards. Immediately following this contingency, line 39 overloads to its short-term contingency rating, requiring generation south of Bannaby to be re-dispatched to resecure the network.

This study, illustrated in Figure 4, shows the resulting network after the network operator has resecured the network for the next credible contingency. Due to the loss of a line, the capacity for transfers from CNSW to SNW (South) is lower than in the base case, requiring 2.9GW of fill-in generation.

After the network is resecured, only 40% of generation available in SNSW is dispatched, with more than 4GW of available generation unable to access SNW.

Figure 41: NSW Transmission Network – Resecure following an n-1 contingency on line 17



Scenario 3: Accelerated load growth in Western Sydney

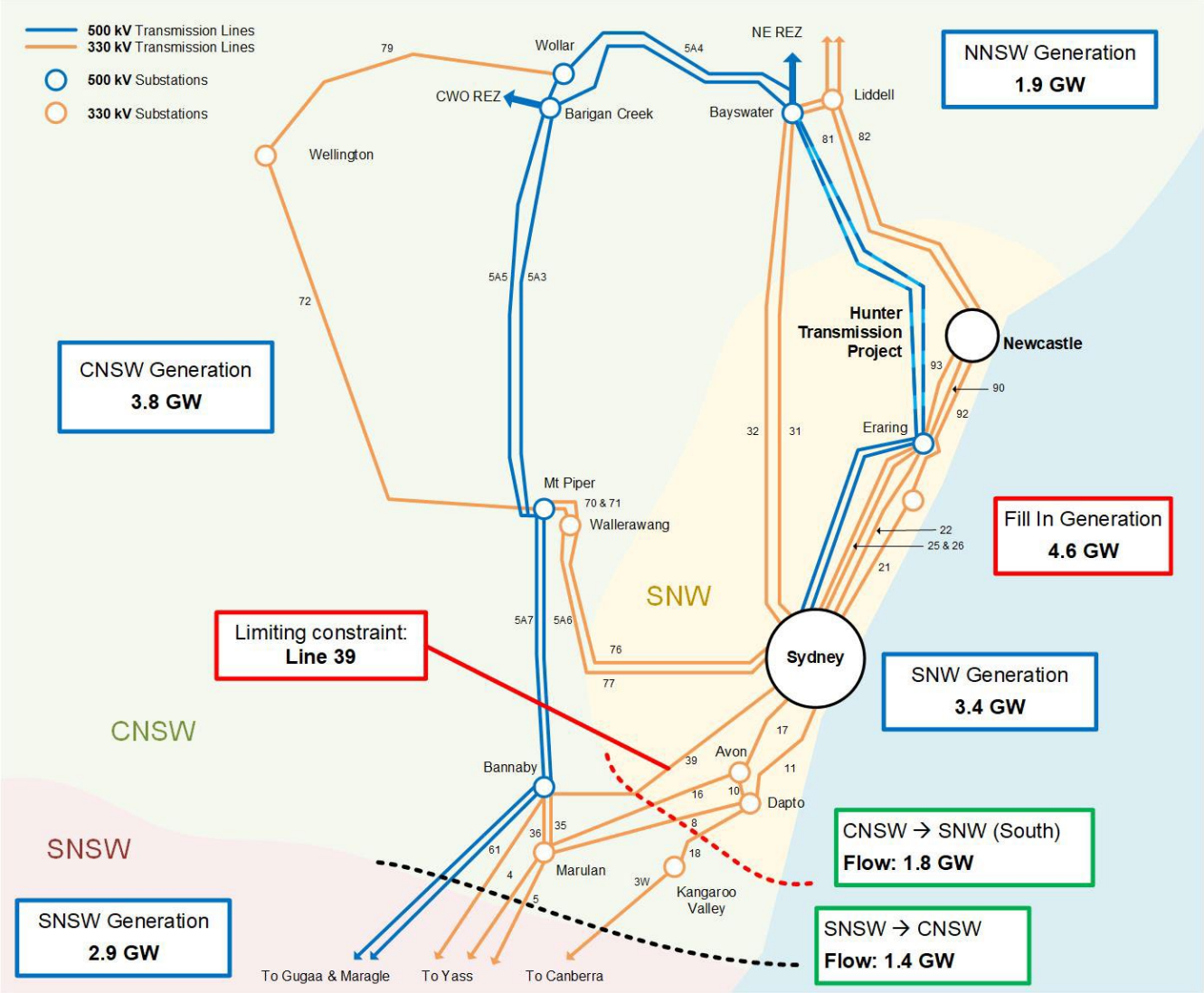
This scenario assumes that there is an additional 1.5GW of load growth concentrated in Western Sydney. This additional load increases operational demand to 16.6GW in NSW, with 13.3GW in SNW. This scenario is grounded in recent observations of substantial, out-of-trend load growth in Western Sydney. The incremental load growth assumes a subset of recent enquiries for new load connections in Western Sydney are developed by the early-2030s.

This scenario is represented in Figure 5. As load in Western Sydney increases, it amplifies southern constraints and exacerbates the generation shortfall in SNW. The addition of 1.5GW of load in Western Sydney increases the required fill-in generation in SNW by more than two and a half times from the base case, from 1.7GW to 4.6GW.

In this scenario, generation from SNSW is limited to 3GW, or around 40% of the available capacity, leaving 4.5GW of southern generation capacity un-dispatched. The line flow from CNSW to SNW (South) is now limited to 1.8GW due to a constraint on line 39 between Bannaby and Western Sydney.

This case shows how load growth in Western Sydney draws more power through the CNSW to SNW (South) cutset, particularly across line 39, rather than utilising the western and northern 500kV networks. When line 39 is constrained, it impacts all southern generation flows from through SNSW to CNSW.

Figure 5: NSW Transmission Network – Additional load growth in Western Sydney



Transgrid appreciates and acknowledges work undertaken in the Draft 2024 ISP to model the CNSW to SNW (North) and CNSW to SNW (South) constraints. However, Transgrid notes that the interaction between load growth in Western Sydney and constraints from CNSW to SNW are a significant contributor to anticipated future network constraints. We welcome the opportunity to continue working with AEMO via the joint planning process to align positions on representing the CNSW to SNW (South) transfer limits during periods of high demand in SNW.

Recommendation 1

Recognise in the Final 2024 ISP that new infrastructure is required to increase transfer capacity via the southern section of the Sydney Ring. This is needed to support load growth, particularly in Western Sydney and the Illawarra, and to address future constraints on generation in southern NSW.

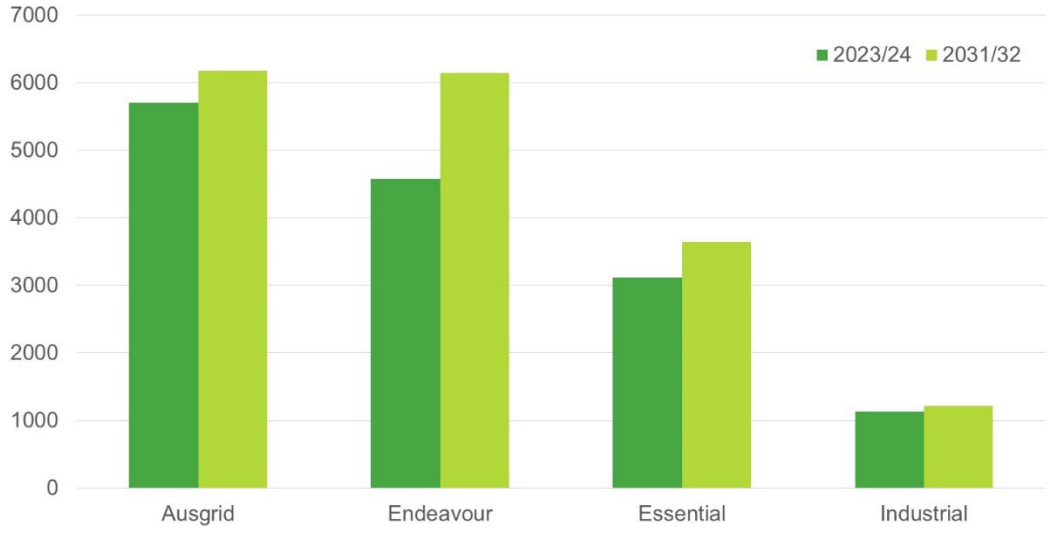
2.2. Western Sydney load growth increases the need for southern transfer capacity

Transgrid's system planning studies of network congestion in the early-2030s highlight how load growth in Western Sydney increases the need for southern transfer capacity into SNW. This finding is significant as loads in Western Sydney has been growing disproportionately faster than in other areas.

Western Sydney is a priority growth area for the NSW Government. Forecasts have suggested that between 2016 and 2031, the population will increase by approximately 43%, compared to 29% in Greater Sydney[6]. In addition to underlying population growth, commercial and industrial loads are expected to grow rapidly with the development of the Western Sydney Aerotropolis, the Western Sydney Employment Area, and extension of North-West and South-West Rail Corridors. Furthermore, there is a desire for these future precincts to be socially responsible, meaning electricity, being the quickest and cheapest source of green energy due to connection of new renewable energy zones, is seen as the key energy input.

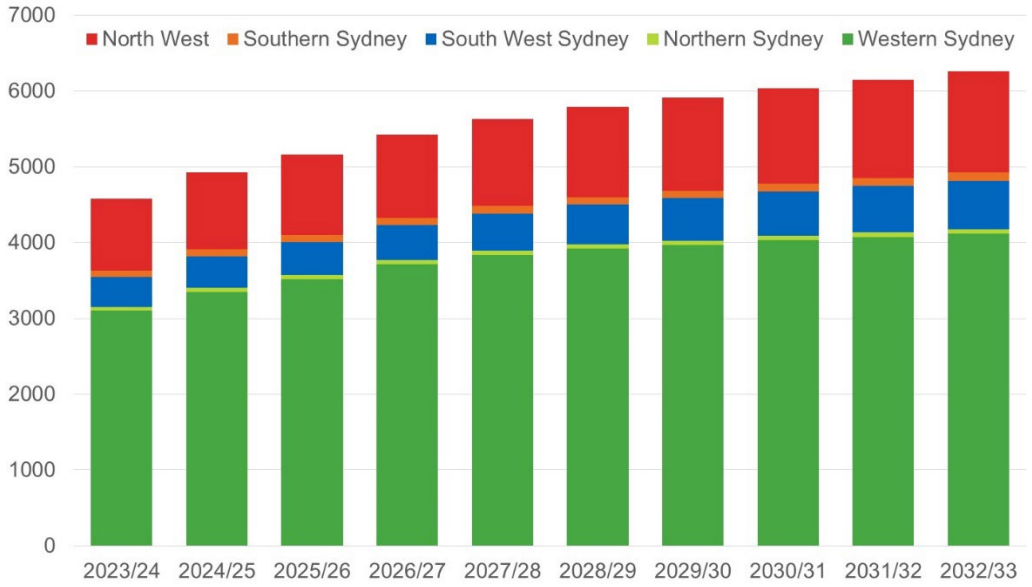
The view that peak demand growth will be concentrated in Western Sydney is supported by peak demand forecasts of bulk supply points, which are published by the distribution networks. Endeavour Energy, which primarily serves the southern and western metropolitan areas of Sydney, expects more rapid growth than the other NSW distribution networks. Figure 6 shows aggregated peak demand forecasts at bulk supply points for each distribution network in 2023-24 and 2031-32. Based on these figures, Endeavour would account for around 60% of total peak demand growth in NSW. Around two thirds of growth within the Endeavour network is attributed to Western Sydney, as shown in Figure 7.

Figure 62: Aggregate bulk supply point maximum demand forecasts (MW) and growth (%) from distribution networks[7]



[6] Transport for NSW Travel Zone Projections 2022.
[7] Transgrid Transmission Annual Planning Report 2023 - Bulk Supply Point forecasts.

Figure 7: Endeavour Energy Summer Peak Demand Bulk Supply Point Forecasts (MW)[7]



In addition to predicted growth, applications and enquiries received directly from customers or discussed in joint planning activities with distribution networks provide a leading indicator that loads in Western Sydney and the Illawarra may grow more rapidly than previously forecast. Transgrid's system planning studies are based on a peak NSW load of 15.1GW, which was chosen to align with Transgrid's 50% POE high case in 2031/32. Scenario 3, which examines the effect of an additional 1.5GW of peak demand in Western Sydney, is based on exploring the impacts of this more rapid growth.

A key driver is demand for data centres in Western Sydney, which are underpinned by growing data use and favourable development characteristics of the Western Sydney area. Data centres typically require several hundred megawatts of electricity per site, so the impact of multiple new developments would be material. In addition, decarbonisation efforts by small mid-size commercial users in Western Sydney may cumulatively drive a substantiative increase in electricity loads. In the Illawarra, the potential for the development of low emissions manufacturing at an industrial scale could also lead to a material increase in electricity consumption.

Recommendation 2

Review demand growth forecasts, with a particular focus on expected load growth in major industrial centres such as Western Sydney and the Illawarra. This recommendation reflects early indications that growth in these regions may be significantly higher than is reflected in current forecasts.

2.3. New transfer capacity south of SNW is critical to unlock southern generation

Transgrid's system studies highlight how southern network constraints into SNW can restrict the amount of generation and capacity that can reach major load centres from SNSW. By 2032, generation constrained under the conditions considered in these system studies could include critical deep storage capacity from the expanded Snowy Hydro scheme, renewable energy resources and storage capacity from the South

West REZ, and transfer capacity from South Australia and Victoria via Project EnergyConnect and VNI West, respectively. Unlocking these sources of generation has the potential to deliver material benefits for the NSW power system and both price and reliability benefits for consumers.

By allowing more existing generation to access major load centres, unlocking network constraints can defer the need for localised firming capacity

Each of the system studies considered requires some level of fill-in generation – that is, generation that would be required in addition to what was assumed to be available in the system. This generation would be delivered to avoid a demand response in each of the scenarios examined. In each case, the amount of fill-in generation required could have been substantially met from existing generation if all available capacity in SNSW were able to be dispatched to the SNW load centre.

In addition to capacity, electricity supplies in SNSW have characteristics that could deliver additional value for the NSW power system:

- The expanded Snowy Hydro scheme provides dispatchable capacity, long duration storage, and system strength benefits.
- South-West REZ is intended to host 2.5GW, including a high proportion of wind generation projects utilising the expected high-quality wind resources that are less closely correlated with resources at sites in northern and central NSW.
- In addition to supporting access to the Snowy Hydro capacity, the completion of the HumeLink project will connect interstate capacity from Project EnergyConnect and VNI West into Bannaby. Completing the 500kV backbone between Bannaby and Sydney may result in lower prices for consumers by enabling generation to be dispatched more efficiently.

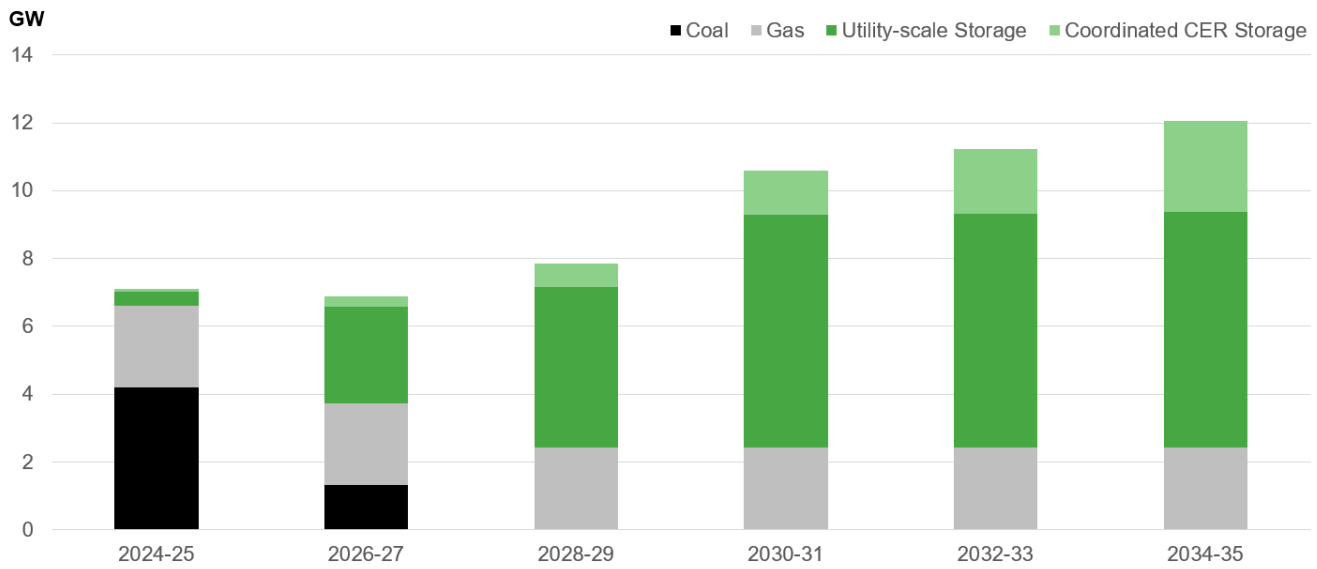
Unlocking southern generation mitigates risks linked to the energy transition, including project timing

The nature of the energy transition introduces sources of uncertainty to power system planning, including the timely delivery of large infrastructure projects. In NSW, multiple major infrastructure projects are underway to meet this need for new generation and capacity. These include over 14GW of capacity across five REZs, an expansion of Snowy Hydro, new gas-fired generation from Kurri Kurri and Tallawarra B, and the VNI West and Project EnergyConnect interconnectors.

Delays on major projects, either from project-specific issues or systemic problems like supply chains, would make it increasingly difficult to maintain power system security and reliability through the transition. The potential for coal generators to retire earlier than expected, either due to economic decisions or failures of aging equipment, increases this risk. Recent system events in Victoria on 13 February 2024 are salient reminders of the fragility of the system in these circumstances.

At the same time, the future power system will rely much more on the dispatch of various types of batteries as a critical source of capacity. Figure 8 shows how the mix of dispatchable capacity in SNW transitions from over 90% synchronous gas and coal generation in 2025 to less than 20% a decade later, following the retirements of the Eraring and Vales Point power stations. The gap is filled by utility-scale batteries or dispatchable consumer energy resources (CER).

Figure 8: Forecast dispatchable capacity in the Sydney, Newcastle, Wollongong sub-region[8]



It is uncertain how these battery storage facilities will be operated in future market conditions. For example, it is not clear if batteries will be fully charged at peak times (issue of perfect hindsight) or whether dispatchable CER will achieve the required level of consumer buy-in, being untested at mass-market scale in Australia. These factors mean it is uncertain how much of the rated battery capacity will be available to be called on in real-time market conditions, at times of peak demand. A shortage of capacity within SNW would increase its reliance on transfer capacity from outside the sub-region.

There is a clear need for network planning to balance risk management against the total system cost of the transition. Yet, the additional capacity and diversity of resources made available through the southern section of the Sydney Ring are also highly valuable as a form of insurance in this uncertain environment.

Improved access to southern generation would support network operations in the future energy system

As the NSW power system evolves, load in SNW will increasingly be met by generation from outside the sub-region. This will be driven by the change in the mix of capacity illustrated in Figure 8, but also the concentration of new renewable energy developments in areas more distant from load centres. Between 2024 and 2032, it is expected that 4.2GW of coal fired generation will retire in the SNW sub-region, and a further 2.7GW will retire outside SNW. This will be replaced by an additional 11.4GW of wind capacity and 7.1GW of utility-scale solar[9], substantially located outside SNW.

A network with less dispatchable synchronous capacity, more reliance on battery storage, and generation resources much further from load centres will present challenges for system operators. For example, relying on fewer, higher-capacity lines means a single contingency event may require significantly more intervention to redispatch generation and resecure the network. Also, the geographical co-location of some

[8] Draft 2024 ISP results workbook – Step Change (ODP11), AEMO; Draft 2024 ISP, Appendix 7.
Note: This figure is based on utility-scale storage projections from the Draft ISP results workbook, with capacity allocated to SNW based on the share of NSW battery capacity in Sydney West and Newcastle from Appendix 7.
[9] Draft 2024 ISP results workbook – Step Change (ODP11).

lines (i.e., the use of double-circuit lines) may increase the risk of a dual contingency, for example, as the result of a bushfire or lightning strike.

In other jurisdictions, planning standards reflect the additional challenges of securing critical demand centres. For example, US NERC and Great Britain have imposed higher planning standards to ensure a reliable and secure supply to key load centres, and Great Britain makes explicit consideration and inclusion for contingency events involving the fault outage of a double circuit in planning standards.

While changes to standards may need to be considered in future, reinforcement of Sydney Ring (South) would mitigate potential risk through providing operators with more generation and transfer capacity to secure the critical SNW area.

3. Transgrid has identified viable options to reduce southern network constraints

3.1. Additional transmission expansion options proposed for inclusion in the Final 2024 ISP

Transgrid's system planning studies identify a need for more southern transfer capacity to meet SNW demand by the early-2030s. Transgrid recommends that the ISP recognise the need for new infrastructure to expand transfer capacity of southern section of the Sydney Ring, which would trigger a detailed evaluation of potential project options including a cost-benefit assessment through the regulatory investment test (RIT–T) process.

Transgrid is currently evaluating project options that could increase transfer capacity on the CNSW to SNW (South) flow path, considering feasibility, expected capacity and estimated costs. In AEMO's *2023 Transmission Expansion Options Report*, three potential options were identified that would increase the southern transfer capacity from CNSW to SNW:

- CNSW to SNW *Option* 2: Building Sydney Ring (South) but not developing the northern section (HTP). The southern section would include new 500 kV double-circuit lines from Bannaby to a new substation in South Creek, and related infrastructure. The cost of this option was estimated as $1,550m[10] and it was expected to deliver 4,500MW of additional network capacity.
- CNSW to SNW *Option 2b*: Rebuilding line 39 from Bannaby to Sydney West as double-circuit line and augmenting related substations, but not developing HTP. The cost of this option was estimated as $553m and it was expected to deliver 1,200MW of additional network capacity.
- CNSW to SNW *Option 3*: Building Sydney Ring (South) in addition to HTP. The cost of this option, including developing HTP, was estimated as $2,038m and it was expected to deliver 8,600MW of additional network capacity.

The Draft 2024 ISP discusses *Options 2* and *Option 2b* as alternatives to developing HTP, but does not include *Option 3*, which would expand both northern and southern transfer capacity. HTP was identified as an actionable project in the 2022 ISP and is proceeding as an actionable NSW project, with anticipated completion in 2027-28. Transgrid supports the need to develop HTP and recognises its critical role in accessing capacity from the Central West Orana and New England REZs, and from Queensland.

[10] All cost estimates are in dollars as per 2023.

Considering this, Transgrid recommends that AEMO ensure that the following additional option is made available to the ISP model:

- CNSW to SNW *Option 3b* (including *Option 1* and *Option 2b)*: Rebuilding line 39 from Bannaby to Sydney West as double-circuit line and augmenting related substations, in addition to developing HTP.

Transgrid is developing a further option for southern augmentation (*Option 3c*) to assess in conjunction with HTP, which considers a combination of minor augmentations and/or power flow control devices. Due to the complexity of the CNSW to SNW cutset, investigation into the scope, feasibility, expected capacity and estimated cost of this option is ongoing, and will be refined with AEMO through ongoing joint planning for the Final 2024 ISP.

It is expected that *Option 3c* will have a lower cost, shorter lead time and reduced capacity compared to alternatives, enabling it to be deployed sooner. However, due to its limited capacity, it will not deliver the full scope of benefit. As such, Transgrid recommends that AEMO consider *Option 3c* as both an alternative, and as a possible interim solution in addition to *Option 3.* While *Option 3* provides a strategic long term solution, *Option 3c* enables access to constrained southern generation sooner within the decade and mitigates against delays to other projects or risks of early coal closures, and providing potential price and reliability benefits for consumers.

3.2. Preliminary evaluation of network solutions to meet SNW transfer capacity needs

Transgrid has considered the benefits of developing Sydney Ring (South) in addition to developing HTP by repeating the system planning cases explored in Section 2.3 with the southern section of the Sydney Ring expanded to include a new double circuit 500kV line. This effectively gives a comparison between outcomes for *Option 1* from the *2023 Transmission Expansion Options Report,* being delivery of the HTP only, and *Option 3*, being the delivery of both the HTP, and the Syndey Ring (South) double circuit 500kV line between Bannaby and Sydney.

The results from these revised studies are summarised in Table 1. This table encompasses various measures of network stress previously identified, including:

- Additional fill-in generation or demand response required within SNW.
- The amount of generation dispatched from SNSW, expressed as both total generation and a percentage of available generation capacity.
- The status of constraints on line 39 (from Bannaby to Sydney West)
- Total flows on the SNSW to CNSW and CNSW to SNW (South) cutsets.

Table 1: Adding Sydney Ring south removes forecast network constraints in 2032

Measure of network stress	Scenario 1: Base case		Scenario 2: Resecure following an n-1 contingency		Scenario 3: Additional load in Western Sydney	
	Sydney Ring north only	Sydney Ring south & north	Sydney Ring north only	Sydney Ring south & north	Sydney Ring north only	Sydney Ring south & north
Supply from fill-in generation & demand response (GW)	1.8	-	2.9	-	4.6	1.5
Generation dispatch from SNSW (GW)	4.2	6.1	3.0	6.1	2.9	6.1
Share of generation capacity dispatched from SNSW	57%	83%	41%	83%	40%	83%
Line 39 status	Constrained	Normal	Constrained	Normal	Constrained	Normal
SNSW to CNSW flow (GW)	2.6	4.3	1.5	4.3	1.4	4.3
CNSW to SNW (South) flow (GW)	2.3	4.5	1.6	4.4	1.8	4.6

Red sections of the table indicate major stresses within the network, orange indicates moderate levels of stress and green indicates the network is operating within normal parameters. Table 1 demonstrates how implementation of both the northern and southern sections of Sydney Ring substantially eliminate network constraints on flows into the SNW sub-region.

Recognising the need for new infrastructure to increase southern transfer capacity in the ISP would trigger a detailed evaluation of potential project options through the RIT-T process. Transgrid recognises the importance of this process to deliver required network solutions at the least cost to consumers. The RIT-T assessment would include a cost-benefits assessment of all potential solutions, including non-network solutions like developing new dispatchable capacity.

While the RIT-T process would include a more comprehensive analysis, Transgrid has undertaken an initial comparison of the alternative network solutions presented in which is presented in Table 2. This analysis highlights how potential network solutions compare favourably with non-network alternatives. The network solutions considered have a lower cost per unit of capacity added into the SWN sub-region, the longest asset lives, are not constrained by output duration during a peak event and produce no direct carbon emissions.

This analysis anticipates the need to demonstrate the value of transmission upgrades relative to alternative non-network solutions. It indicatively highlights the relative attractiveness of the southern network augmentation options, both in terms of the expected cost and other characteristics of the solution.

Table 2: Comparison of transmission network expansion with alternative capacity solutions[11]

Type	Example project type	Project cost estimate ($m)	Additional capacity estimate (MW)	Capacity cost estimate ($000/MW)	Asset life (years)	Capacity Duration	Site availability	Delivery (years)	Scope 1 emissions
Transmission (CNSW to SNW options)	Sydney Ring, Northern & Southern Ring (Option 3)[12]	2,038	8,600	240	40+	NA	Few viable options	7+	No
	Augmentation of Bannaby to Sydney West *(Option 2b)*[12]	553	1,200	440	40+	NA	Few viable options	7+	No
	Power flow control solution	TBC	TBC	TBC	20-30	NA	Few viable options	3-5 years	No
Gas-fired generation	Hunter Power Project (Kurri Kurri)	950	660	1,440	~30	Subject to gas supply	Few viable options	7+	Yes
Utility-scale battery in SNW	Waratah Super Battery	1000	850	1,200	10-20	2-4 hours	Few viable options	2-4	No
Utility-scale battery outside SNW and REZ	Liddell BESS	750	500	1,500	10-20	2-4 hours	Medium	2-4	No
Utility-scale battery in REZ	Muswellbrook BESS	157	150	1,000	10-20	2-4 hours	Good	2-4	No

[11] Sources: AEMO Draft ISP, Appendix 5, December 2023; Snowy Hydro News, Spring 2023; EnergyCo, Waratah Super Battery; Australia New Zealand Infrastructure Pipeline, Liddell Battery, December 2023; Muswellbrook BESS Environmental Impact Statement, Firm Power, August 2022.

[12] AEMO 2023 Transmission Expansion Options Report (TEOR) Options for Central NSW to SNW. Costs and capacity estimates are directly from the TEOR.

3.3. Developing Sydney Ring (South) requires immediate action

The analysis presented in Table 2 shows that transmission-based options are an attractive solution to capacity constraints on the southern section of the Sydney Ring, particularly in terms of the low expected cost per unit of capacity. Yet, the 'Site availability' and 'Delivery' columns of the table also show two key constraints; the required delivery timeline for major transmission infrastructure, and the need to determine and access a viable easement corridor following consultation with local communities and landowners.

Development must commence without delay to deliver Sydney Ring (South) before 2033

Delivery timelines for major transmission projects can be more than seven years. Allowing appropriate development time is particularly important to allow Transgrid to work with landowners, the community, regulatory authorities and governments to find solutions to balance local impacts, consumer costs, time constraints and critical supply reliability. This delivery window means that developing Sydney Ring (South) by the early-2030s requires that project development should commence without delay following the release of the 2024 ISP.

Including Sydney Ring (South) as an actionable project in the Final 2024 ISP would enable it to be in service between 2031 and 2033. This would increase transfer capacity into SNW through the critical period in the early 2030s modelled in Transgrid's system planning studies.

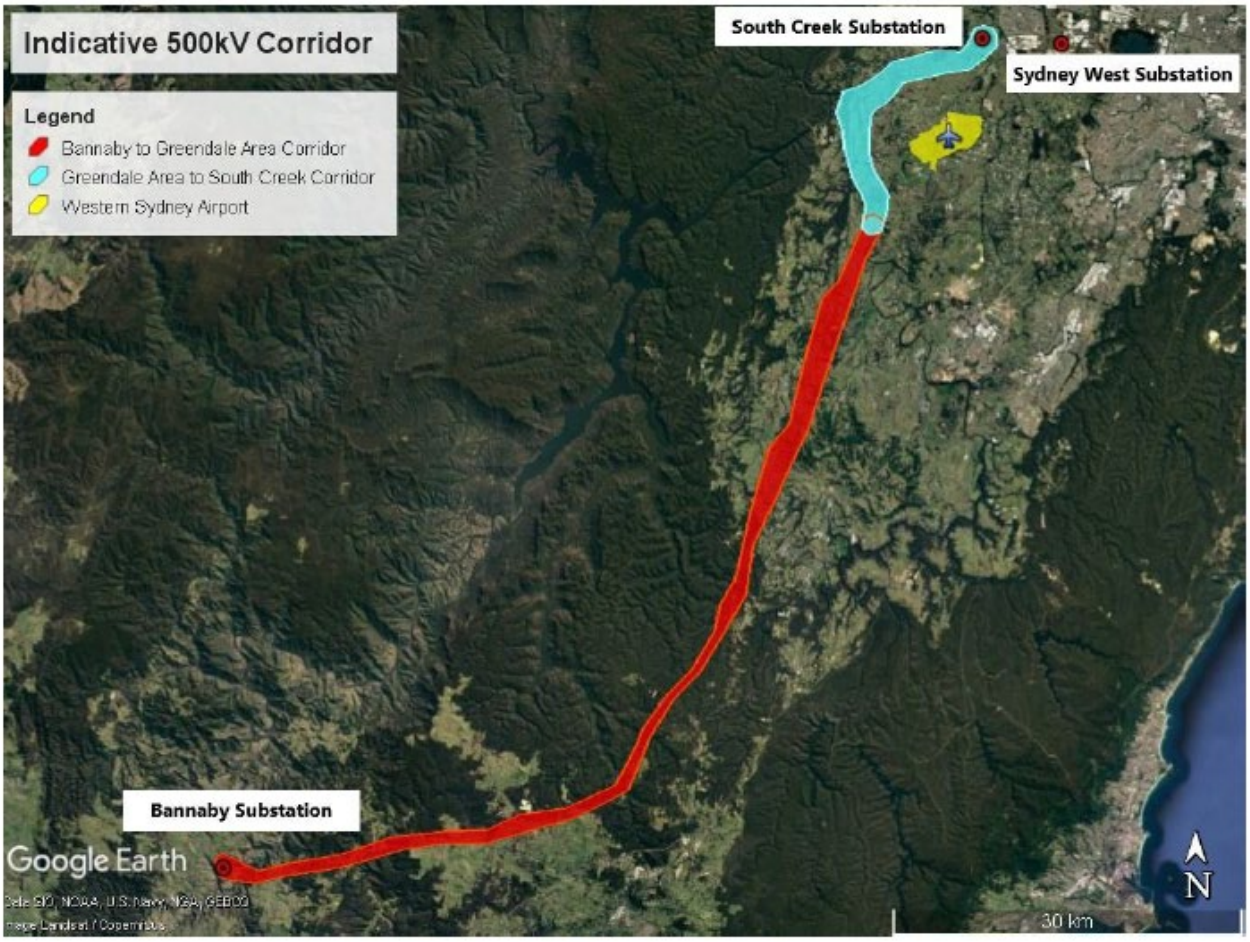
The 2031 to 2033 window is a critical period for the NSW power system. Based on the Draft 2024 ISP, all coal-fired generation except Mt Piper will have retired, including both remaining power stations within the SNW sub-region (Eraring and Vales Point). Major new sources of generation and capacity will enter the market in the late–2020s, including Snowy 2.0 in 2028, but may not be able to access major load at critical times without Sydney Ring (South). In parallel, REZs will be rapidly expanding, which will add significant new generation and capacity but also means this is the period where potential project delays would have the greatest impact.

On the demand side, delivering additional network capacity by 2031 to 2033 would provide greater certainty to large industrial users making major investment decisions in decarbonisation projects within the coming years. It would also support development in the Western Sydney priority growth precinct following the opening of the new airport in 2026 and support commercial and population growth within Western Sydney. A decision to defer recognition of the need for additional transfer capacity in the southern section of the Sydney Ring to the 2026 ISP would postpone this delivery window to 2033 to 2035 and forgo the opportunity to support the power system through this critical transition period.

Delivering Sydney Ring (South) requires access to a critical development corridor

Securing access to critical transmission easements is a key aspect of delivery timing for the double circuit 500kV option for the Sydney Ring (South). As part of Preparatory Activities for the 2024 ISP, Transgrid undertook desktop analysis to identify and assess a transmission line corridor for this option. This assessment considered a range of criteria, including environment, property and stakeholder perspectives, and informed cost estimates. This assessment identified a viable route to deliver Sydney Ring (South), which is shown in Figure 9.

Figure 9: Indicative 500kV double circuit corridor for Sydney Ring (South)



The proposed 500kV double circuit corridor leverages the established corridor for the 330kV line 39, from Bannaby Substation to near Greendale. This corridor of approximately 90km is shown as the red line in Figure 9. From the Greendale area to the new South Creek Substation, the corridor is strategically diverted to navigate around the Western Sydney Airport. This section of the line, approximately 24 km in length, is shown in teal.

Securing easements for the designated teal corridor from near Greendale to South Creek will be crucial to developing Sydney Ring (South). This section of the corridor is located within the Westen Sydney growth area, and land use pressures in this region have been progressively increasing, as evidenced by rising land values and a substantial increase in rezoning across the four impacted Local Government Areas.

Delaying the development of Sydney Ring (South) introduces the risk that the preferred development corridor for the 500kV double circuit solution becomes no longer viable in its current form. A two-year delay to the 2026 ISP would coincide with the opening of Western Sydney Airport. The associated land use changes are expected to materially increase the cost of securing easements as land progressively moves to higher value uses. It may also significantly increase social licence costs of development, partly due to rising land values but also because ongoing subdivisions increase the number of landowners impacted. If this were to occur, the delay could eliminate what Transgrid considers the most strategically viable long-term solution for augmenting southern transfer capacity into SNW.

Transgrid recognises that the 500kV double circuit loop is one of several options to expand transfer capacity into the southern section of the Sydney Ring. However, recognition of the need to augment the Southern segment of the Sydney Ring in the 2024 ISP would allow for a more detailed assessment of potential options while the 500kV double circuit option remains viable.

Recommendation 3

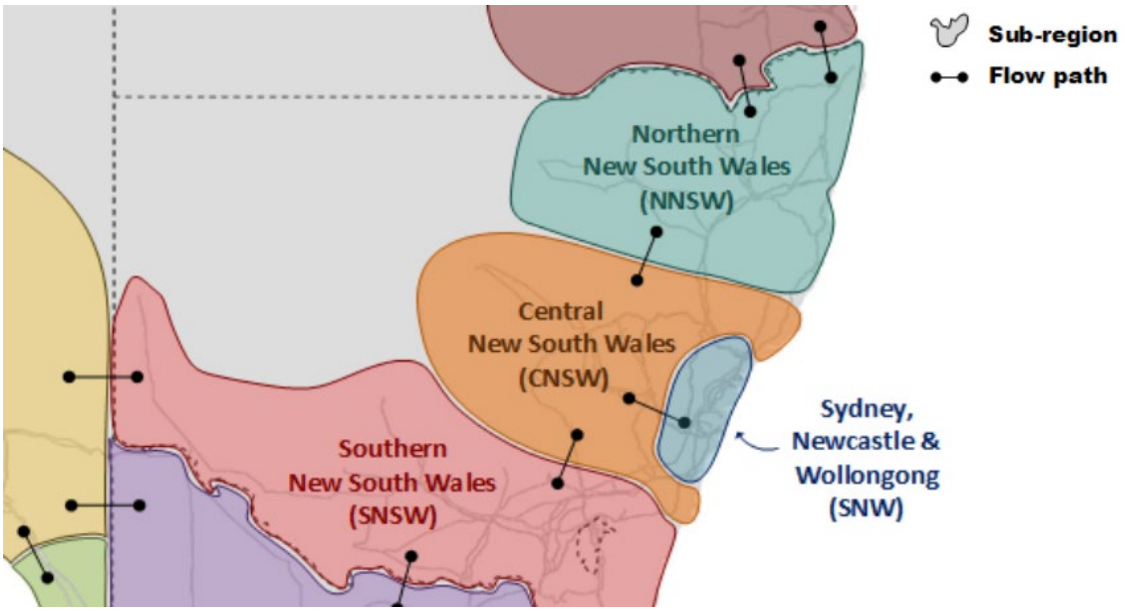
Consider additional transmission expansion options as potential solutions to increase transfer capacity in the southern section of the Sydney Ring and recognise the time-sensitive development constraints for the new transmission line options affecting the proposed corridor into Western Sydney.

4. Opportunities to improve representation of network constraints

4.1. Improve the representation of network constraints in the ISP

The ISP and associated modelling resources published by AEMO play a critical role in guiding market participants to make decisions that best meet the needs of consumers. The 2024 ISP is underpinned by detailed modelling of the NEM, which represents the five NEM regions as a set of 12 sub-regions, connected by a small number of potential flow paths. The NSW region is represented as a set of four sub-regions as shown in Figure 10.

Figure 10: AEMO modelling representation of four sub-regions in NSW[13]



Transgrid welcomes efforts AEMO has made to model flow path transmission constraints in its capacity expansion planning models, including the use of northern and southern constraints to limit the flows of generation into SNW from CNSW. However, flows between CNSW and SNW are possibly the most complex sub-regional boundary in the ISP model, with the single flow path representing 14 existing transmission lines. Representing a complex set of real-world transmission pathways through a single flow path is inherently challenging, particularly as line constraints may be sensitive to assumptions such as other transmission augmentations, generation developments or load growth. Constraints may also change significantly under dynamic network conditions.

Transgrid recommends that system planning models and approaches should align with real world observations of the network and the expectations of system operators. This includes developing constraint equations that reflect contribution coefficients from generators and loads.

As the jurisdictional transmission planning body for NSW and ACT, Transgrid conducts comprehensive planning studies to identify more specific network needs and drivers, including details of potential network

[13] Draft 2024 ISP Inputs and Assumptions workbook.

investments. These studies underpin Transgrid's view that new southern transfer capacity into the SNW sub-region is needed by the early-2030s.

Transgrid recognises the significant benefit in continuing to work collaboratively with AEMO to explore these issues and potential solutions through network studies and would welcome the opportunity to engage in an enhanced joint planning approach prior to the release of the Final ISP.

Recommendation 4

Align system planning models and approaches with real world observations of the network, and the expectations of system operators. This includes reviewing how the ISP models power flows into SNW from central, southern and northern NSW, particularly under high demand conditions, and developing constraint equations that reflect contribution coefficients from generators and loads.