2025 Infrastructure Investment Objectives Report

August 2025

Important notice

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VERSION CONTROL

Version	Release date	Changes
1.0	11 August 2025	n/a

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ACKNOWLEDGEMENT OF COUNTRY

ASL recognises the Traditional Custodians of Country throughout Australia and acknowledges that, wherever we work, we do so on Aboriginal and Torres Strait Islander lands.

We pay respect to the world's oldest continuing culture and First Nations peoples' deep and continuing connection to Country; and hope that our work can benefit both people and Country.

We acknowledge the ongoing challenges and opportunities in First Nations reconciliation and are committed to implementing our Reflect Reconciliation Action Plan (RAP).

Artwork credit: The 'Journey of unity: AEMO's Reconciliation Path' was created by Wiradjuri artist Lani Balzan.

Message from the CEO

The NSW energy transition has reached a critical juncture. We are moving from planning to delivery – from ambition to action – with infrastructure now being built across the state.

Construction is underway in the Central-West Orana Renewable Energy Zone (REZ), marking a significant milestone in the delivery of the NSW Electricity Infrastructure Roadmap (the Roadmap). In this REZ alone, over 7 gigawatts (GW) of access rights have been awarded, signalling strong industry commitment to moving more projects into construction.

The Hunter-Central Coast REZ is close behind, and generation projects under long-term energy service agreements are breaking ground across NSW. Together, we have secured 76% of the generation capacity required to meet NSW's 2030 targets. A robust long-duration storage market is also emerging, with 0.8 GW / 6.4 GWh of batteries and 0.8 GW / 12 GWh of pumped hydro now contracted, making good progress against the state's target.

As the Consumer Trustee, our mandate is to act in the long-term financial interests of NSW electricity customers. That principle is at the heart of this report.

That is why the Infrastructure Investment Objectives report sets out an ambitious development pathway for NSW. We are calling for 16 GW of new generation by 2030 and more beyond that to 2040. This is a stretch target that will require a step-change in how quickly and efficiently projects progress through the pipeline, and in how we, as the Consumer Trustee, use our tenders to incentivise faster delivery of high-quality projects that deliver enduring value for NSW electricity customers.

The ambitious development pathway has been chosen because it delivers the greatest consumer value – an estimated $6.8 billion in benefits over the next 20 years (in present value terms) compared to a scenario that is limited by historical build rates in the medium term. These benefits come from higher volumes of new generation that will drive down wholesale prices, more than offsetting the costs of faster, larger-scale deployment through the Roadmap. This isn't without its challenges. But the value is real. The opportunity is clear and we believe the benefits are well worth striving for.

As we shift into delivery, we face headwinds. Large-scale infrastructure delivery is challenging in any context – and at the unprecedented scale and pace we now require, coordinating roads, ports, supply chains and local approvals while maintaining community support will stretch our collective capacity. Transmission delays are emerging, underscoring the need to maintain momentum while actively de-risking the pathway ahead.

To our generation and storage proponents: your role in this next phase is critical. We encourage you to innovate and bring forward projects that can accelerate delivery, provide resilience in the system, strengthen community trust, and maximise value for consumers – not just deliver the lowest tender bid. We call on network proponents to advance augmentation proposals that can unlock hosting capacity efficiently, reducing costs and accelerating connection for new projects.

The projects that will define this transition are those that move swiftly and responsibly, have local and First Nations support, manage supply chain and transition risks, accelerate delivery, and ultimately, unlock the benefits of a clean, reliable and affordable energy future for NSW. These are the projects that will be considered in the long-term financial interests of consumers under the Roadmap.

We are at a defining moment. Let's seize it, together, and deliver the infrastructure NSW needs to transition to a net zero energy system that benefits all.

Nevenka Codevelle
Chief Executive Officer, ASL

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Executive summary

The Infrastructure Investment Objectives (IIO) report is the central planning document underpinning the NSW Electricity Infrastructure Roadmap (the Roadmap). It outlines the investment required to ensure a secure, reliable, sustainable energy system that is in the long-term financial interests of NSW electricity customers.

The report is governed by legislative requirements, including biennial updates and minimum infrastructure investment objectives (minimum objectives) under the *Electricity Infrastructure Investment Act 2020* (NSW) (EII Act). These requirements ensure that the Roadmap can respond to changing technologies and technology costs, evolving drivers of electricity demand, global supply chain pressures, and changes in policy settings.

The energy transition ahead is significant. Replacing the state's ageing coal-fired generators with clean, reliable energy sources that are in the long-term financial interests of NSW customers is a once-in-a-generation infrastructure challenge. Getting it right is essential to support jobs, investment and quality of life in NSW.

As the Consumer Trustee, ASL plays a central role in enabling the transition by translating system needs into investment opportunities. The role of the Consumer Trustee is to provide clear investment signals that give industry confidence over the long term.

This report builds on the 2023 IIO report and responds to several important areas of change and uncertainty in the NSW energy market landscape, including:

- the risk of earlier than anticipated retirement of coal-fired power stations
- demand forecast variability, particularly in connection with the projected increased demand from data centres and consumer energy resources (CER)
- ongoing supply chain challenges
- delays to the delivery of network infrastructure projects.

The transition is underway

NSW is on track to complete the first stage of this transition, with the total capacity of already constructed or secured generation infrastructure representing an estimated 76% of the 2030 minimum objective for generation.

The commitments signalled through the allocation of long-term energy service agreements (LTESAs), Capacity Investment Scheme (CIS) agreements and access rights suggest the building blocks are in place to meet the 2030 generation and storage minimum objectives but progressing these projects through to completion will take a coordinated effort by proponents, government and industry.

CIS tenders, which have been crucial to this progress, replaced the Roadmap generation tenders from April 2024, and will continue until the NSW CIS allocation of 7.1 gigawatts (GW) is met.

The Central-West Orana Renewable Energy Zone (REZ) has commenced construction to deliver transmission to support 7.1 GW of projects that have received access rights. The Hunter-Central Coast REZ will follow with capacity to support 1 GW in new generation and storage.

Setting a clear intent through the development pathway

Through comprehensive electricity market modelling and an understanding of the current pipeline, ASL has determined that an ambitious infrastructure build best serves the long-term financial interests of NSW electricity customers. In short: more generation and sooner.

The *Ambition* scenario modelled for this IIO report forms the basis for the development pathway. While also incorporating long-duration storage and firming infrastructure, the generation element of the development pathway targets 16 GW of new generation by 2030, significantly above the 12 GW minimum objective.

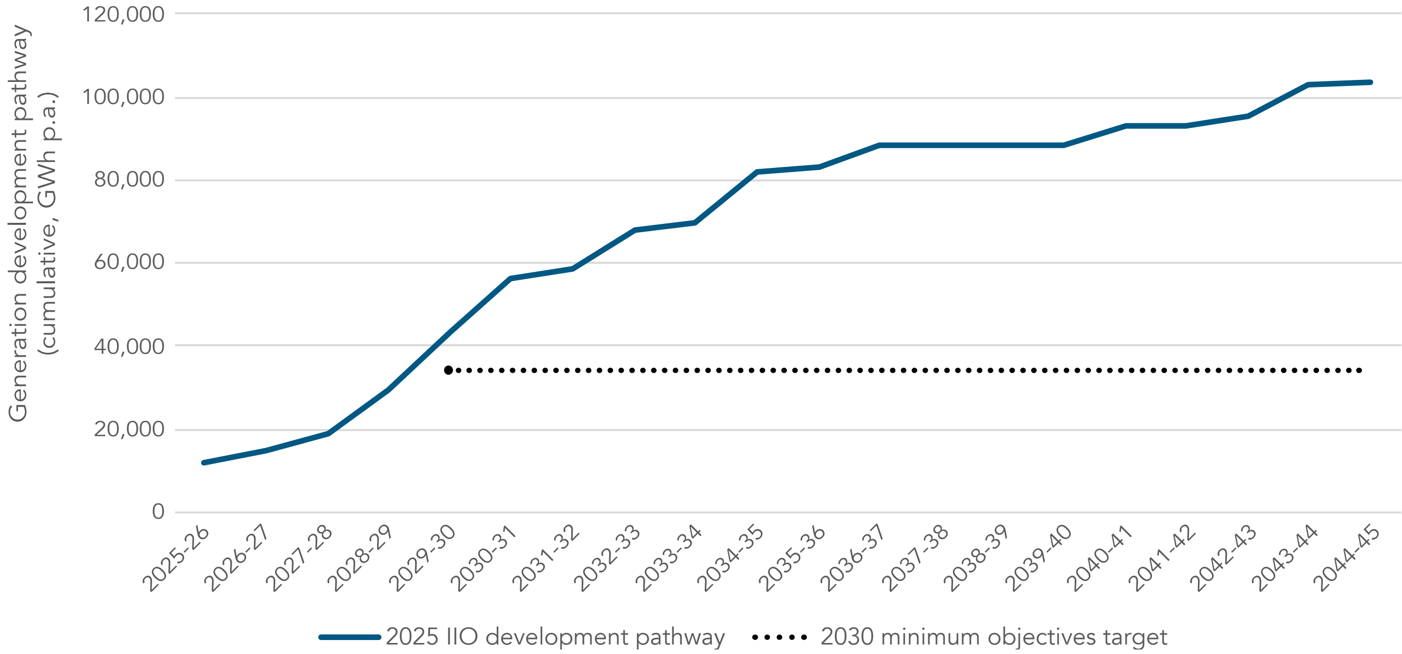
The development pathway and the 10-year tender plan are very ambitious and will require a step change in how both proponents and the broader industry accelerate development, including ASL in the way it uses its LTESA tenders to incentivise fast-tracking of quality projects.

This is a challenging target, higher than those contained in previous IIO reports and historical investment rates in NSW and the National Electricity Market (NEM). It will require an unprecedented level of support and coordination to reduce lead times and fast-track the commissioning of new capacity.

The next five years are crucial for infrastructure investment to replace retiring coal-fired power stations on schedule, maintain reliability and provide for the long-term financial interests of NSW electricity customers.

The *Ambition* scenario can deliver up to $6.8 billion in benefits to NSW electricity customers (over the next 20 years in present value terms) compared to an alternative modelled *Supply Chain Constrained* scenario where infrastructure delivery is limited to historically observed rates.

Figure 1: Generation element of the development pathway



Adding to our evidence base through the NSW Generation Investment Outlook

In developing the 2025 IIO report, ASL undertook an initiative to understand how the practical and commercial realities facing generation project proponents are impacting the time taken to progress through the development pipeline and ultimately the ability to deliver on system needs.

This initiative, named the NSW Generation Investment Outlook, assesses the number of projects in the development pipeline in NSW and their likely progress through development phases, including approvals, construction and commissioning.

It has informed the development pathway and generation 10-year tender plan and finds there is enough capacity in the pipeline to meet the minimum objectives. However, it will require ASL, and the industry more broadly, to support relatively early-stage projects, through deep and coordinated effort, to continue deploying initiatives that accelerate development timeframes.

Recommencement of LTESA generation tenders

Once the NSW allocation under the CIS is awarded, the NSW LTESA generation tenders will recommence to incentivise further investment towards the ambitious development pathway.

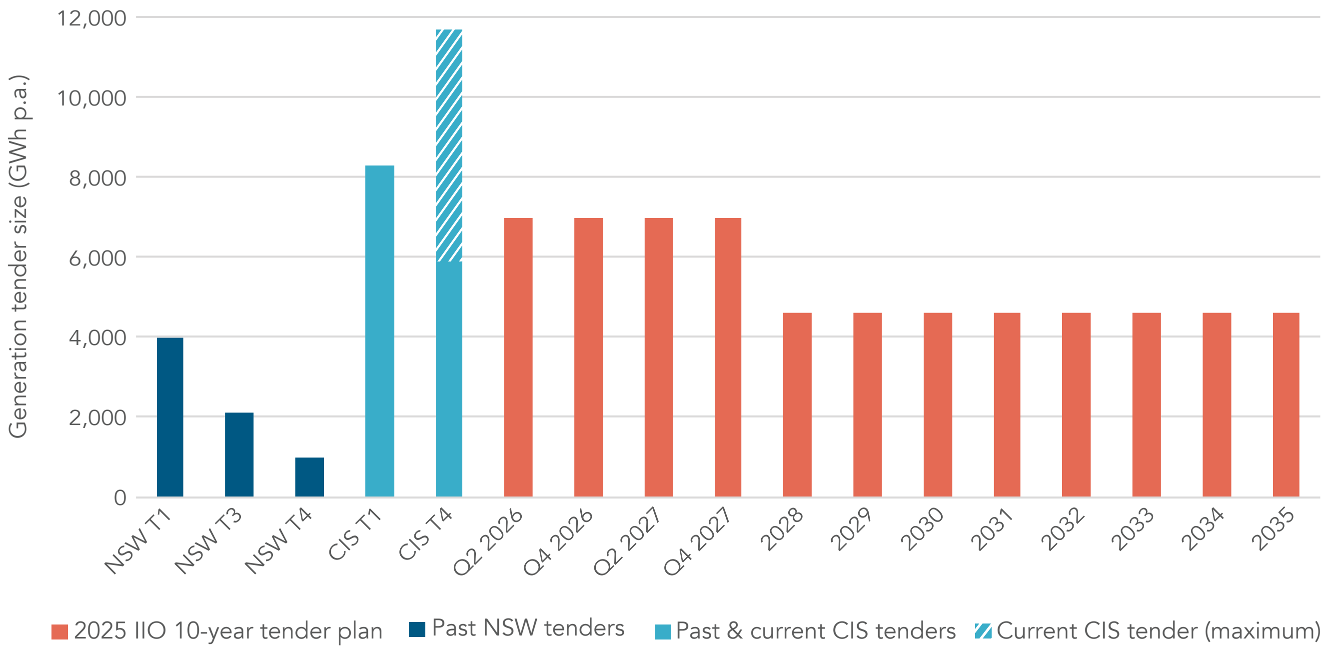
The next LTESA generation tender is planned for Q2 2026 and will seek 7,000 gigawatt hours (GWh) per annum (p.a.) of generation. This will be followed by three additional 7,000 GWh tenders across 2026 and 2027, and annual tenders of 4,600 GWh p.a. from 2028 to 2035.

ASL encourages high-quality projects, including those that:

- have community support
- are backed by proponents with a strong track record, and
- are well-located in terms of congestion risks.

These projects are encouraged to come forward and bid on LTESA tenders in a way that facilitates acceleration towards an earlier delivery date, including securing project finance. The generation tender plan is designed to give effect to the ambitious development pathway and requires significant investment in the near term to meet both minimum and overall infrastructure investment objectives.

Figure 2: Generation infrastructure 10-year tender plan



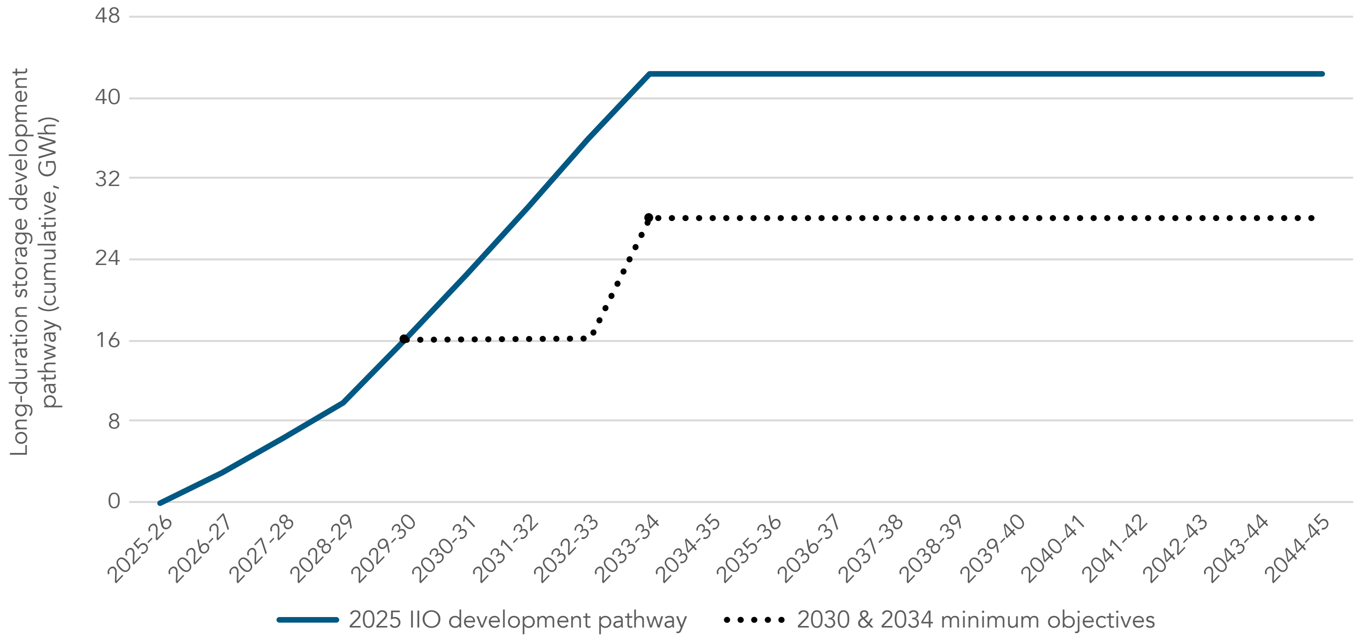
Note: CIS Tender 4 is live at the time of publishing this report and is indicated by a range reflecting possible outcomes between the minimum and maximum allocations to NSW.

Ambition in long-duration storage infrastructure is also required

The new minimum objective for long-duration storage infrastructure, introduced in legislation in 2024, requires the construction of 28 GWh by 2034, an additional 12 GWh beyond the existing 2030 minimum objective of 2 GW / 16 GWh.

The long-duration storage element of the development pathway, formulated to work alongside the generation and firming elements of the development pathway is based on the *Ambition* scenario. This significantly exceeds minimum targets, aiming to secure 42 GWh of long-duration storage by 2034.

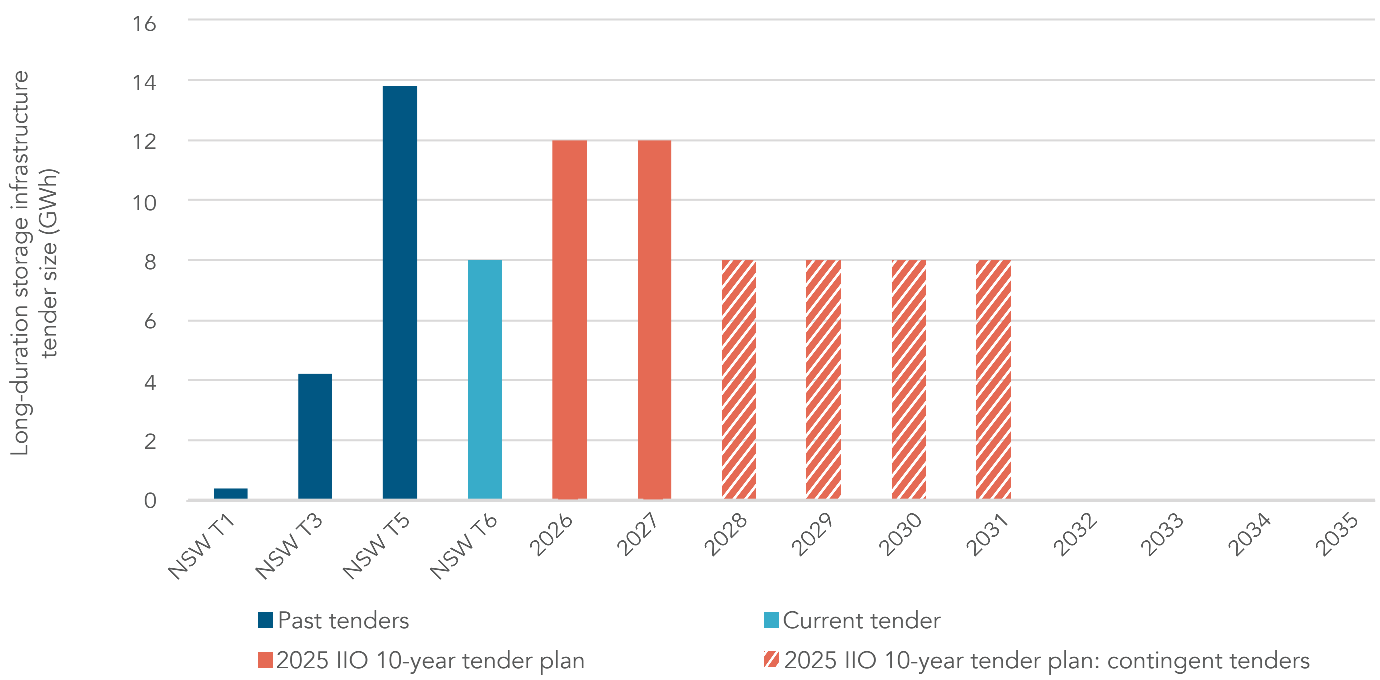
Figure 3: Long-duration storage element of the development pathway



Tenders for long-duration storage infrastructure will build on previous tenders, which have contracted 40% of the required capacity under the 2030 minimum objective, and 66% of the required capacity under the 2034 minimum objective.

Projects that can be rapidly developed are encouraged to contribute to the remaining 1.2 GW / 9.6 GWh needed to meet the 2030 minimum objective. The tender plan is also intentionally front-ended to accommodate larger projects with longer lead times, and these technologies should continue to come forward where they can support the 2034 minimum objective.

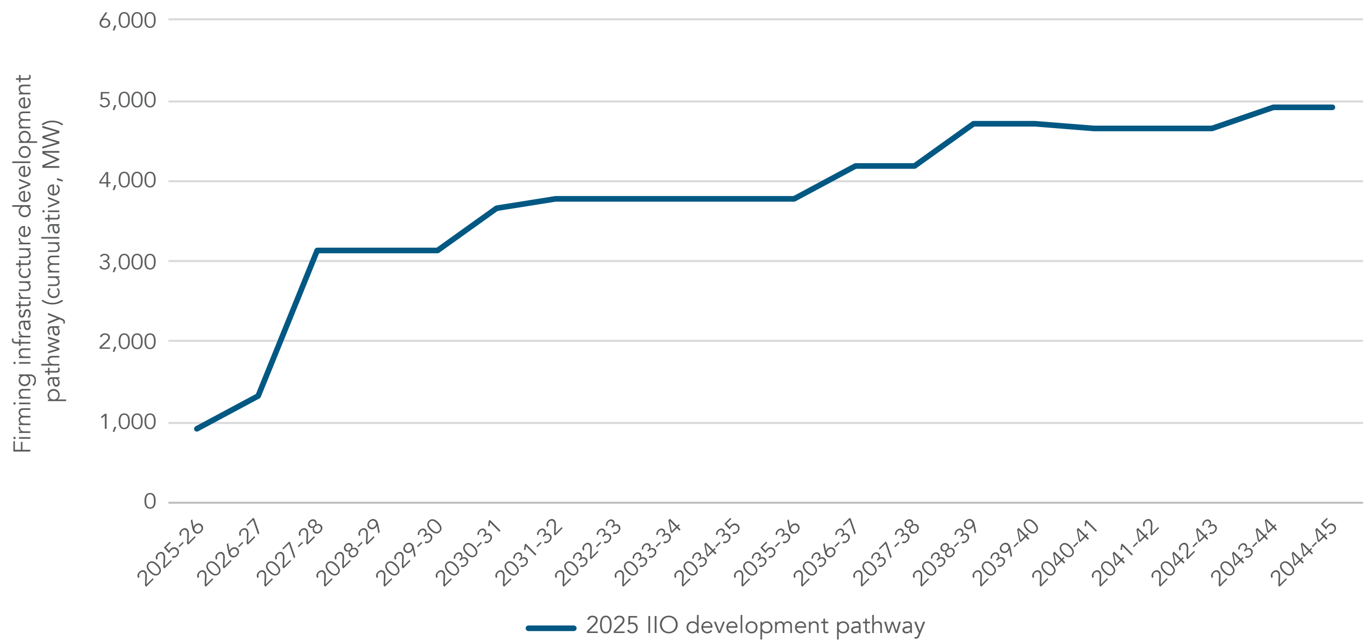
Figure 4: Long-duration storage infrastructure 10-year tender plan



Firming infrastructure is critical

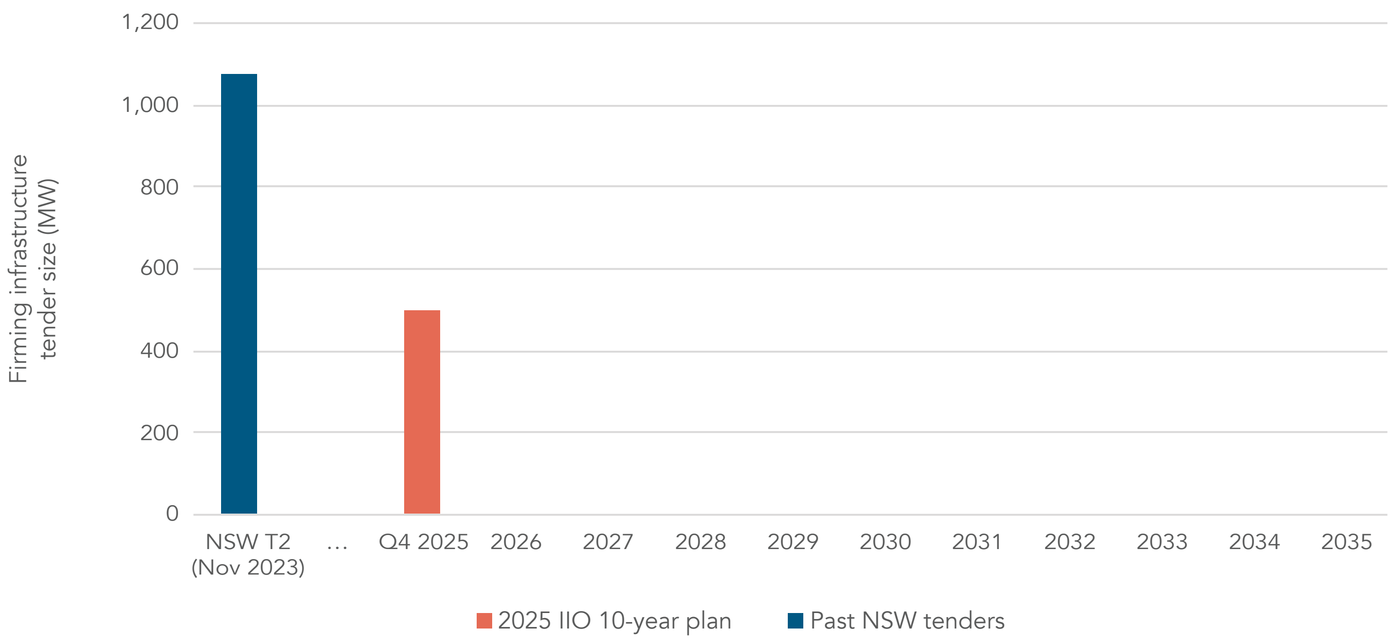
The firming element of the development pathway also aligns with the *Ambition* scenario, which includes volumes of dispatchable capacity (largely batteries) incentivised under the Australian Government's CIS. Using the *Ambition* scenario is consistent with the generation and long-duration storage infrastructure elements of the development pathway.

Figure 5: Firming infrastructure element of the development pathway



This IIO report also responds to a firming direction provided by the NSW Minister for Energy (Minister) to ASL as the Consumer Trustee on 2 July 2025. The firming direction requires ASL to tender for 500 megawatts (MW) to address risks of a capacity shortfall in 2027-28. The firming element of the development pathway also identifies that additional firming is likely required from 2031 (which would require a further firming direction for ASL to incentivise that investment).

Figure 6: Firming infrastructure 10-year tender plan



Note: As part of NSW Tender 2, the Australian Government supported up to an additional 550 MW of firming infrastructure through the CIS.

IIO report as a tool for network authorisation

ASL, as the Consumer Trustee, is responsible for authorising the network infrastructure proposed by the Infrastructure Planner (EnergyCo). The *Electricity Infrastructure Investment Regulation 2021* (NSW) (EII Regulation) was amended in 2024 to enable the IIO report to be used as a primary input into network authorisation decisions, delivering a streamlined and accelerated authorisation process.

This iteration of the IIO report is the first to provide for this capability. Accordingly, this report establishes a benchmark cost test designed to identify network options that represent high value and low costs compared to those that were selected in the model.

The benchmark annual cost (set at $10,000/GWh of available generation p.a. for this report) is based on annualised network costs and the generation enabled by a network option and seeks to provide further guidance to the industry while ensuring the long-term financial interests of NSW electricity customers are maintained.

Network projects within REZs that meet this benchmark annual cost, have a capital cost below $300 million, and can be delivered by 2031, can now be considered for ASL's streamlined authorisation process. ASL encourages NSW network service providers to work with developers and EnergyCo to identify these options in the period between 2025 and 2027.

Furthermore, the report also demonstrates that projects connecting outside a REZ can be successfully connected through the augmentation of the shared network and/or the use of extended connection assets. ASL strongly encourages generation proponents to work closely with local network service providers to scope and accurately cost any beneficial upgrades, even where these costs were previously considered unfeasible.

1. Introduction

- The IIO report considers the evolution of NSW's energy transition and determines an optimal pathway for development.
  - It responds to changes to future demand in the network, the timing of coal-fired power stations retiring and the opportunity to recommence the LTESA tenders following the Australian Government's CIS.
- It contains a comprehensive plan to achieve the infrastructure investment objectives and maximise value to NSW electricity customers.
- The report is underpinned by energy market modelling and ASL's new NSW Generation Investment Outlook, which assesses the current and future state of the project pipeline to estimate the capacity available to tender in any given year.
- The development pathway is ambitious, but this is required to set NSW up for success. If we aim too low, while reliability requirements can be met, it means customers risk missing out on benefits because of investment not coming forward at the required rate.
- The development pathway and tender plans provide a framework to signal system requirements and provide support for investment through LTESAs.

1.1 Purpose of the report

As the state's coal-fired generators reach the end of their lifespan, the NSW Electricity Infrastructure Roadmap (Roadmap) is delivering the transition to a clean electricity system while maintaining reliability.

The Infrastructure Investment Objectives (IIO) report, prepared by ASL as the Consumer Trustee, is published approximately every two years and sets out a 20-year development pathway that best meets NSW's legislated objectives for energy infrastructure.

The development pathway and the 10-year tender plan it informs provide energy infrastructure investors with certainty around the progress of tenders for long-term energy service agreements (LTESAs) for generation and long-duration storage infrastructure.

In July 2025, ASL received a direction from the NSW Minister for Energy (Minister) to conduct an additional competitive tender for firming infrastructure. The firming direction followed the identification of an energy security target breach in 2027-28 by the Energy Security Target Monitor.[1] This IIO report also provides ASL's response to the firming direction and a plan to conduct a firming tender.

As the Consumer Trustee, ASL acts in the long-term financial interests of NSW consumers by ensuring that the benefits of energy infrastructure investment exceed the costs to consumers. This principle guides critical decisions about the size and timing of competitive tenders for LTESAs, as well as decisions regarding Renewable Energy Zone (REZ) network infrastructure.

1 See NSW Climate and Energy Action's website, 2024 Energy Security Target Monitor report.

The defining features of the IIO report are summarised in Figure 7 below.

Figure 7: Defining features of the IIO report

Provides stakeholders with certainty

The 20-year development pathway provides certainty to industry, consumers, and the community on required levels of investment to transition the NSW electricity system to one that is affordable, clean and reliable.

Promotes real outcomes

ASL conducts tenders on the basis of the IIO report to support the construction of infrastructure to deliver outcomes for consumers. The IIO report is a call for investors to come forward with projects to deliver the development pathway.

Focuses on the long-term interests of consumers

The 10-year tender plan is designed specifically to give effect to the development pathway, ensuring that energy system needs are optimised while also safeguarding the long-term financial interests of NSW electricity customers.

NSW's energy sector is transforming rapidly, with frequent market developments and announcements reshaping the landscape. The IIO report addresses this dynamic environment by providing guidance and building investor confidence.

In 2025, the IIO report recognises the benefits to NSW consumers that will be realised if the ambitious development pathway is achieved. ASL aims to support proponents of network, generation and long-duration storage projects that can deliver on this ambition through both tender and network authorisation functions.

1.2 The infrastructure investment objectives

The infrastructure investment objectives considered in this report are set out in the EII Act. The objectives include both:

- **minimum objectives** for the construction of specified amounts of generation by the end of 2029 and long-duration storage infrastructure by the end of 2029 and 2033, and
- **overall objectives** to construct additional generation, long-duration storage, and firming infrastructure to minimise costs to NSW electricity customers and meet the NSW energy security target and reliability standard. These apply across the 20-year period of the IIO report.

These objectives are summarised in Figure 8 below.

Figure 8: Infrastructure investment objectives and eligible infrastructure

Definitions		Minimum objectives	Overall objectives		
			Minimise costs for NSW electricity customers	Meet reliability standard	Meet the energy security target
Generation	Generation from a renewable energy source ≥ 30 MW	At least the same amount as 12 GW (~33,600 GWh p.a.)* constructed by the end of 2029	✓	N/A	N/A
Long-duration storage	Storage able to be dispatched at registered capacity for ≥ 8 hours, and scheduled by AEMO in the central dispatch process under the NER	28 GWh constructed by the end of 2023 (including 2 GW and 16 GWh constructed by the end of 2029)	N/A	✓	N/A
Firming	Firm capacity scheduled by AEMO in the central dispatch process under the NER	None	N/A	✓	✓

*ASL, *2021 Infrastructure Investment Objectives report*, December 2021, section 2.2.1.

The development pathway and 10-year tender plan outlined in this report must achieve infrastructure investment objectives.[2] The objectives also act as a guiding framework for all infrastructure investment decisions made by the Consumer Trustee under the EII Act.

1.3 Interaction with other planning documents

The IIO report forms part of a broader planning framework with links to other key planning documents, as summarised in Figure 9 below. Clarity and transparency around the different roles, scope and timing of national and NSW planning reports help stakeholders engage effectively and make informed decisions about the energy transition.

2 The 2025 IIO report sets out one development pathway for three types of infrastructure – that is, generation infrastructure, long-duration storage infrastructure and firming infrastructure. For the purposes of this report, ASL refers to the development pathway as containing three elements: a generation element, a long-duration storage element and a firming element. The 2025 IIO report also sets out a plan for the competitive tenders that the Consumer Trustee will conduct during the following 10 years. This plan includes a generation tender plan, a long-duration storage tender plan and, in response the firming direction received in July 2025, a firming infrastructure tender plan.

Figure 9: The IIO report and the broader planning landscape

Document	Integrated System Plan (ISP)	Electricity Statement of Opportunities (ESOO)	Energy Security Target Monitor (ESTM) report	Infrastructure Investment Objectives (IIO) report	Network Infrastructure Strategy (NIS)
Entity	AEMO	AEMO	NSW Government	ASL	EnergyCo
Focus	NEM	NEM	NSW	NSW	NSW
Purpose	· NEM power system transition roadmap: a clear plan for essential infrastructure to meet future energy needs. · Outlines the optimal development path for generation, storage and network investments to achieve net zero emissions by 2050, in line with state and Australian Government energy and climate targets.	· A 10-year outlook that provides technical and market data to inform decision-making for market participants, investors, governments and other jurisdictional bodies. · Includes reliability forecasts and assessments to identify any potential reliability gaps in the NEM, helping stakeholders plan and prepare for future energy needs.	· Assesses whether forecast firm capacity in NSW is sufficient to meet the energy security target for the next 10 years. · Sets the target capacity required to meet forecast NSW maximum consumer demand in summer, including a reserve for the unexpected loss of the two largest generating units in NSW.	· Central planning document that guides NSW's energy transformation under the Electricity Infrastructure Roadmap. · Sets out the least-cost 20-year pathway for meeting NSW's legislated targets for renewable energy infrastructure, alongside a 10-year plan for conducting tenders for long-term energy service agreements.	· Strategy for the practical coordination of NSW network infrastructure to connect new generation, firming and storage in NSW's five Renewable Energy Zones, and meet the EII Act objectives. · Proposes network infrastructure options for delivering 14 GW of capacity by 2033, as per the EII Act.
Forecast period	Out to 2050	10 years	10 years	20 years	20 years

As shown in Figure 9, the IIO report draws on key Australian Energy Market Operator (AEMO) publications, including the Integrated System Plan (ISP)[3] and the Electricity Statement of Opportunities (ESOO),[4] as well as the Energy Security Target Monitor report.[5] These interactions drive coordination across planning frameworks, while maintaining focus on delivering outcomes for NSW electricity customers:

- **IIO report and the ISP:** The IIO report serves as both an input to and uses base assumptions from AEMO's ISP. Together, the ISP and IIO reports create a complementary planning framework, where the ISP provides a National Electricity Market (NEM)-wide optimisation, while the IIO report focuses specifically on the interests of NSW customers. The IIO report utilises key ISP inputs, including scenarios, cost assumptions, and transmission planning outcomes, and applies these through a NSW-specific lens. This ensures the development pathway aligns with broader NEM developments while delivering on the needs of NSW electricity customers.
- **IIO report and the ESOO:** The IIO report directly incorporates and responds to reliability gaps identified in AEMO's ESOO. The 2024 ESOO identified deficiencies in meeting the reliability standard in NSW in the near term (from 2027 to 2028) following the advised retirement of Eraring Power Station. Where other coal-fired power stations retire earlier than expected and this is not accompanied by new infrastructure investment, the state may face similar shortfalls in reliable energy supply, which could undermine the ambitious transition to renewables. The development pathway is designed to deliver sufficient new infrastructure to meet these reliability challenges, including through competitive tender processes. The importance of delivering new infrastructure ahead of the retirement of existing generation cannot be overstated.
- **IIO report and the Energy Security Target Monitor report:** The Energy Security Target Monitor report identifies forecast breaches of the energy security target and monitors the adequacy of firming capacity, while the IIO report provides the strategic response through the development pathway and 10-year tender plan. The 2025 IIO report's development pathway, which includes the NSW Government's firming direction, specifically responds to the October 2024 Energy Security Target Monitor report's identification of breaches in 2027-28 and 2033-34. The long-duration storage and firming infrastructure development pathway along with tender plans work together to deliver the new infrastructure needed to meet NSW's energy security target over the medium to long term.

1.4 Developments since previous report

The energy transition landscape is evolving rapidly. This IIO report reflects the current environment and incorporates significant developments that have emerged since the previous report published in December 2023. These developments and their implications for the IIO report are outlined below.

1.4.1 Progress of the energy transition in NSW

NSW continues to advance its energy transition as market conditions and the energy system evolve rapidly. Since December 2023, significant developments have reshaped the state's renewable energy environment, reflecting both progress and emerging challenges.

Construction has commenced on the Central-West Orana REZ, marking a significant milestone in NSW's renewable energy infrastructure development. The Hunter-Central Coast REZ has been authorised and is expected to progress rapidly, given its predominantly brownfield nature. The successful tender for access rights in the South West REZ, along with the application process for access rights under the Central-West Orana REZ access scheme have further demonstrated market confidence in NSW's renewable energy zones and provided certainty to infrastructure investors in those regions.

However, transmission challenges highlight the complex nature of large-scale infrastructure delivery under current supply chain constraints. The need for further upgrades to existing transmission and distribution networks to unlock additional hosting capacity beyond that already identified in REZs has become an even greater priority in mitigating the risks associated with the transition.

The extension of Eraring Power Station's operation, despite its previous scheduled closure date of 2025, highlighted the prevailing uncertainty around the retirement of coal-fired power stations. According to AEMO's ISP, the retirement of some generation would need to occur earlier than the expected closure year nominated by power station owners to meet policy targets. Coal-fired power stations are also subject to technical and commercial considerations which adds uncertainty as to whether they could be extended past currently scheduled closure dates if replacement investment does not happen quickly enough.

Demand forecasts also remain uncertain, particularly considering the potential growth of data centres and consumer

3 See AEMO's website, Integrated System Plan.
4 See AEMO's website, NEM Electricity Statement of Opportunities.
5 See NSW Climate and Energy Action's website, Energy Security Target Monitor reports.

energy resources (CER). Greater demand for data centres will increase requirements for firmed renewable generation, making it more challenging to meet infrastructure investment objectives. The expansion of CER, with lower-than-expected levels of coordination, could also increase the amount of generation and firming infrastructure required to be provided by the market.

It is in this context that this IIO report establishes a clear course of action as market conditions and energy system changes influence the path forward. The development pathway and 10-year tender plan outline an ambitious investment program for NSW, recognising that the addition of more capacity in the immediate term is crucial to securing NSW's clean, affordable, and reliable energy future.

1.4.2 Capacity investment scheme

Since publication of the 2023 IIO report, the Australian Government introduced the Capacity Investment Scheme (CIS), a significant national policy initiative designed to accelerate investment in renewable energy generation and clean dispatchable capacity, such as battery storage. By providing long-term revenue underwriting, the scheme reduces financial risk for investors, ensuring more renewable energy projects are built.

The goal of the CIS is to add 32 gigawatts (GW) of capacity by 2030 which includes 23 GW of renewable generation and 9 GW of dispatchable storage. This will support the transition to a cleaner, more reliable electricity grid and meet the 82% renewable electricity target.

NSW has been allocated a maximum of 7.4 GW of generation capacity under the CIS. This volume of generation projects is being procured through tenders conducted for the Australian Government (rather than for the NSW Government under the Roadmap).

The CIS tenders have been crucial in accelerating project development and market participation across the NEM. Since April 2024, ASL as the Consumer Trustee, has paused NSW LTESA tenders under the Roadmap while CIS tenders run in NSW, as this is in the long-term financial interests of NSW electricity customers.[6] This approach is expected to continue until the maximum NSW CIS allocation of 7.1 GW is reached, anticipated by late 2025 or early 2026 at the latest.[7]

The generation LTESA 10-year tender plan has been designed to carefully anticipate and accommodate NSW's full CIS allocation. NSW generation LTESA tenders will recommence in Q2 2026 to allow the CIS allocation to take place and then continue to support the healthy pipeline of projects in NSW with LTESAs aligned with the requirements of the ambitious development pathway.

1.4.3 Changes in relevant legislation

The legislation underpinning the publication of the IIO report and its application has changed since the publication of the 2023 IIO report, with implications for this report and future editions.

- **December 2023:** The EII Act was amended to provide ASL with greater flexibility to align IIO report publication with the ISP timeline and to respond to rapidly changing market conditions, rather than being constrained to strict two-year cycles. The amendment requires the Consumer Trustee to publish the IIO report approximately every two years. It previously referred to every two years.[8] The interaction between the IIO report and ISP is discussed further in section 1.5 and Appendix A1.
- **July 2024:** The EII Regulation was amended to support an expedited authorisation process for REZ network infrastructure projects, where the Consumer Trustee can assess whether a project is in the long-term financial interests of NSW electricity customers based on the IIO report instead of undertaking a separate cost-benefit analysis (CBA) at the time of authorisation.[9] Given that project-specific authorisation CBA can take several months to complete, this amendment is intended to result in a more efficient and timely authorisation process. The new approach to REZ network infrastructure project authorisations is discussed further in section 5.3.
- **November 2024:** A new 2034 minimum objective for long-duration storage was included in the EII Act to provide the Consumer Trustee with clear planning parameters for long-duration storage development beyond 2030. The new additional minimum objective requires the construction of 28 gigawatt hours (GWh) of long-duration storage by 31 December 2033 – an additional 12 GWh by 2034, beyond the existing 2030 objective of 16 GWh.[10] The long-duration storage element of the development pathway is discussed in section 4.2.

6 ASL, Important update for Q2 2024 NSW generation infrastructure tender, published on 22 April 2024.

7 See DCCEEW's website, Renewables Energy Transformation Agreement allocations by jurisdiction.

8 EII Act, section 45(2)(b).

9 EII Regulation, clause 19B(3).

10 EII Act, sections 44(1)(c) and 44(3A).

1.5 Preparing this IIO report

Charting an adaptive course

The 2025 IIO report is the fourth in the series and builds upon the strong foundations of previous reports, remaining adaptive to a changing environment.

The use of scenarios and sensitivities enables the testing of likely futures and allows for the selection of a development pathway that accounts for future uncertainty and is in the long-term financial interests of NSW electricity customers. It then sets a tender plan to give effect to the development pathway.

The tender plan also charts a clear and certain course despite a changing environment. It balances the need to set tender sizes and frequency that reflect system requirements while ensuring the plan is practical for the market to respond to and achieve. To this end, ASL have used a similar approach taken in previous IIO reports, which is to:

- Conduct electricity market modelling using the most recent ISP *Step Change* scenario as a base, with updates to capture the latest available information at time modelling commenced.
- Consider and construct plausible scenarios from that base to test conditions most relevant to NSW.
  - For the 2025 IIO report, it was considered most pertinent to test the outcomes in a *Supply Chain Constrained* scenario and to also test a sensitivity to a situation in which there are no coal-fired power stations operating in NSW by 2034.
- Decide on a development pathway that becomes *the* development pathway for the three infrastructure types.
  - For the 2025 IIO report, ASL considered the *Ambition* development pathway would best provide for the long-term financial interests of NSW electricity customers for all three infrastructure elements of the development pathway (generation, long-duration storage and firming).
- Set tender plans to give effect to the development pathway.
  - In the case of generation and long-duration storage, the tender plan is developed as part of the IIO report. For 2025, a firming direction was received from the Minister in time for it to be included in the main 2025 IIO report rather than requiring a separate stand-alone report, as in 2023. The firming tender plan reflects the Minister's direction and is in addition to firming requirements set in the firming element of the development pathway.

ASL evaluates the development pathway against key outcomes which contribute towards the objectives under the EII Act, including the objective to improve affordability, reliability, security and sustainability of the NSW electricity supply. The findings from this analysis are presented throughout the report, along with additional considerations that may inform ASL's future decision-making.

Exploring the supply chain constraint

In the electricity market modelling results, the *Ambition* scenario predictably resulted in more infrastructure than the *Supply Chain Constrained* scenario, due to the limitation applied to the *Supply Chain Constrained* scenario to build rates of 4 GW p.a. across the NEM to 2030.[11]

ASL is optimistic that this build limit can be exceeded through the maturing of the Australian renewable generation industry, policy and regulatory developments and an increasingly coordinated effort to reach this important goal. This is why we have established the development pathway and tender plan in accordance with the *Ambition* scenario.

The high-level process used in the modelling undertaken to support the IIO report is outlined in section 1.5.1, with the detailed approach set out in Appendix A1.

However, even if the tenders successfully secure generation, firming and long-duration storage infrastructure, consistent with the *Ambition* scenario, there are a range of other factors outside ASL's direct control that will ultimately determine whether the *Ambition* scenario can be achieved.

To help ASL better understand the risks associated with achieving the *Ambition* development pathway, we have developed the NSW Generation Investment Outlook, which outlines the current development pipeline and estimates the rate at which projects may progress through the pipeline to full operation, based on three outlooks: pessimistic, middle, and optimistic.

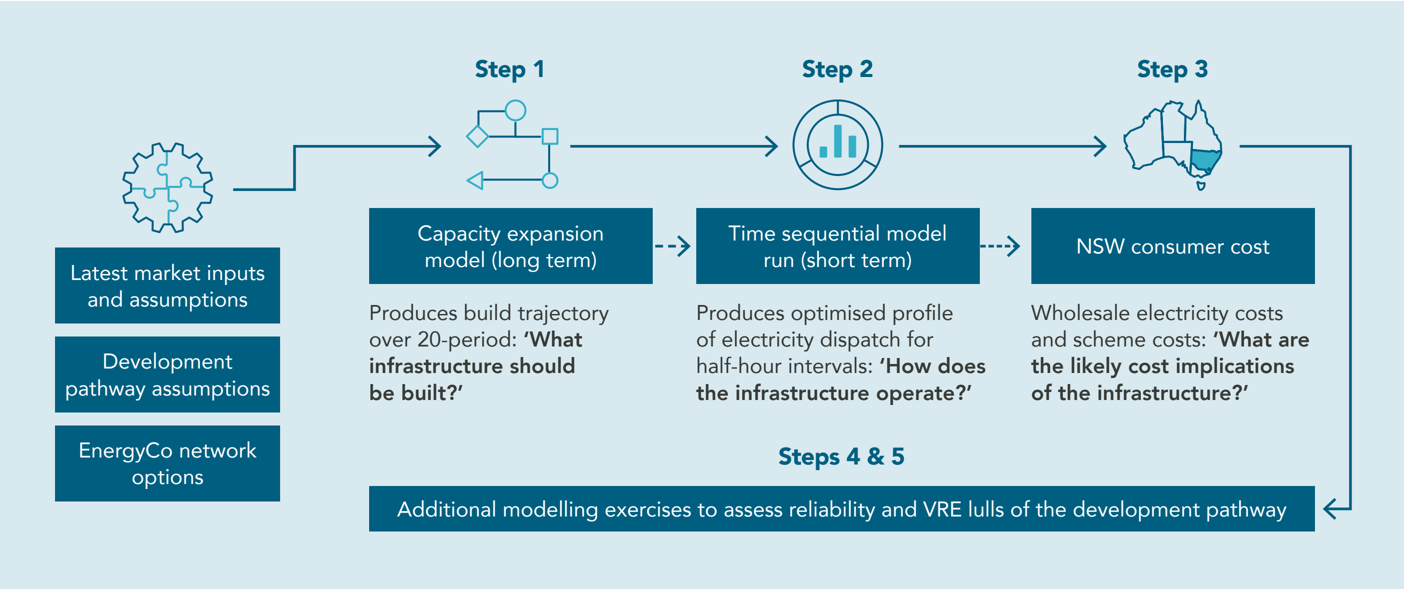
11 The 4 GW constraint is set equal to the previous maximum historical annual build in the NEM over the last 10 years, achieved across 2020 and 2021. The recent 2024-25 financial year achieved 4.4 GW of total new build, a new record for annual build across the NEM over the last 10 years. This constraint applies NEM-wide annually to new entrant generation (excluding lithium battery storage), at 4 GW p.a. to 2029-30. Following 2029-30, the limit is increased by 2 GW per year until 2034-35 and then removed.

An overview of ASL's NSW Generation Investment Outlook report is provided in section 1.5.4.

1.5.1 Modelling approach

An electricity market modelling exercise was scoped, designed and funded by ASL and undertaken by AEMO. The electricity market modelling exercise informs the development pathway in this IIO report. The key steps involved in the modelling are in Figure 10.

Figure 10: Overview of IIO report modelling steps



The market modelling for this report commenced in late 2024 and broadly aligns with the 2024 ISP methodology, with important variations to ensure all regulatory requirements associated with the IIO report are met. It includes key interactions between various models and analytical processes and contains the following elements:

- **Latest market inputs and assumptions** over a 20-year horizon from 2025-26 to 2044-45 to produce a consumer least-cost trajectory for the development of new infrastructure.
- **Capacity expansion modelling**, which determines the long-term outcomes for generation, long-duration storage, firming and network expansion in each scenario, informing the development pathway and alternative infrastructure plans.
- **Time-sequential modelling**, which produces forecast wholesale prices and is used to validate the capacity expansion for each scenario by producing optimised profiles of electricity dispatch for half-hour intervals.
- **NSW customer costs**, which involve estimating the costs associated with the supply of wholesale energy services.
- **Reliability and variable renewable energy (VRE) lulls assessments** to ensure the overall infrastructure investment objectives are met and the development pathway is designed in a way that makes it resilient to solar and wind droughts.

1.5.2 Scenarios

In setting the 2025 development pathway, ASL has considered two key scenarios and a sensitivity, illustrated in Figure 11 below.

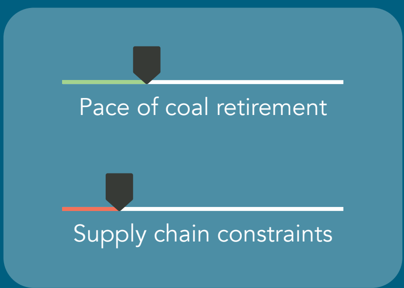
Figure 11: 2025 IIO report scenarios and sensitivity

Scenarios

Ambition

- Broadly aligned with the 2024 ISP *Step Change* scenario.
- Assumes historical supply chain constraints are removed and that the project pipeline can support a materially faster rate of delivery than recent years.
- Identifies the pace of infrastructure deployment needed to minimise cost, while accounting for near-term build and integration constraints.

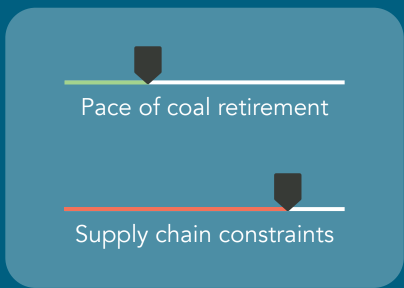
This scenario defines the electricity infrastructure required in NSW to achieve the minimum and overall objectives.



Supply Chain Constrained

- Based on the 2025 IIO report's *Ambition* scenario.
- Incorporates a supply chain constraint and limits the construction of new infrastructure across the NEM to 4 GW until 2029-30. After that, the limit increases by 2 GW per year until 2034-35, when the constraint is removed.

This constraint reflects the practical challenges of delivering a large-scale, NEM-wide infrastructure program. It captures the pressure this build-out places on commodity availability, manufacturing capacity, and skilled labour resources.

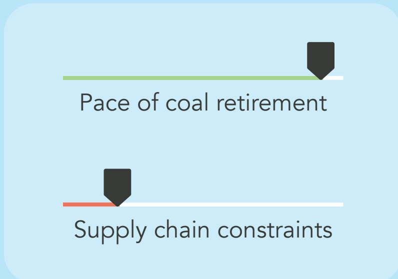


Sensitivity

No NSW Coal by 2034

- Based on the 2025 IIO report's *Ambition* scenario.
- Accelerates the retirement of ~1.4 GW of coal capacity from 2036-37 to 2033-34.

This earlier coal retirement aligns with considerations made by the NSW Government in its Long Duration Storage Review position paper, released in October 2024.



Note: The diagrams presented above are for illustrative purposes only. When the slider is to the right it indicates a faster pace of coal retirement or more supply chain constraints.

The *Ambition* scenario represents the optimal scale and speed of development in an environment where, besides very near-term build limits on projects that are already under construction, the industry is assumed to be able to rapidly deploy projects based on learning effects and the removal of delivery obstacles. It also assumes that coal-fired power stations retire according to the 2024 ISP *Step Change* schedule, which is faster than the current announced retirement dates. This pathway was then tested to understand the impact when these assumptions do not play out as anticipated.

The *Ambition* scenario is based on AEMO's 2024 ISP *Step Change* scenario – AEMO's 'most likely' scenario – which is focused on achieving a scale of energy transformation that supports Australia's contribution to limiting global temperature rise to <2°C, compared to pre-industrial levels, and compatible with <1.5°C depending on actions taken in other sectors. The *Step Change* scenario received the most consistent level of support and was considered the most likely 2024 ISP scenario by most participant groups.[12]

Specifically, ASL has examined the risk and the optimal response under the following circumstances:

- Where supply chain constraints significantly delay commissioning of new renewable energy capacity (reflected in the *Supply Chain Constrained* scenario); and
- Where coal-fired power stations retire even earlier than under the 2024 ISP *Step Change* schedule (reflected in the *No NSW Coal by 2034* sensitivity).

1.5.3 Key modelling inputs

The modelling underlying the IIO report adopts:

- the forecast and insights provided in the 2024 Inputs, Assumptions and Scenarios Report (IASR) and 2024 ISP for the *Step Change* scenario
- the NSW REZ network infrastructure project options, including size, timing and costs, provided by EnergyCo to ASL
- ASL's internal analysis, such as technology-specific weighted average costs of capital (WACC), near-term build limits and the supply chain constraints
- the latest available AEMO's Generation Information and NSW tender information at the commencement of modelling.

Where possible, ASL seeks to capture the latest available, relevant information in the IIO report. Consequently, some of the 2024 ISP *Step Change* assumptions were altered. This includes the extension of the Eraring Power Station's operation to 2027, which was not included in the scenario modelling underpinning the 2024 ISP, and limiting generation build in REZs to align with announced access schemes for the South West and the Central-West Orana REZs. Further alterations and the complete set of assumptions used in the modelling for this report are in Appendix A1.4.

EnergyCo's recent announcement of the Hunter Transmission Project's updated delivery date to late-2029 was not incorporated into modelling underpinning the development pathway presented in this report. This project is a critical network infrastructure project designed to increase the transfer capacity from the regions into NSW's major load centres and enable the supply of high-value renewable electricity from projects in the Central-West Orana and New England REZs.

The updated forecast delivery date provided by EnergyCo includes a contingency to reflect the risks associated with delivering major infrastructure projects. EnergyCo and Transgrid are committed to delivering this critical infrastructure project as soon as possible.

The impact of the updated delivery date of the Hunter Transmission Project on risks to NSW's reliability of supply is expected to be explored in the upcoming 2025 ESOO. ASL will continue to work with the NSW Government and EnergyCo to identify and implement necessary mitigation measures. The impact of this updated information on elements of the 2025 IIO report is further discussed in Chapters 3 and 4 and Appendices A1 and A2.

Other updated information from events or publications after the modelling commenced, and not directly incorporated into the modelling, but referred to in this report can be found in Table 14 in Appendix A1.

In July 2025, AEMO released its 2025 Input, Assumptions and Scenarios Report (IASR) as part of preparations for the 2026 ISP. This update is a critical step in ensuring that the ISP reflects the most current data, policy settings and stakeholder feedback. The IASR highlights the pace of decarbonisation across the economy, including emissions reductions both within and beyond the energy sector.[13]

There will also be updates to the 2026 ISP to reflect changes to demand, project costs and the inclusion of distribution opportunities to facilitate the operation of forecasted uptake of CER and other distributed resources.

12 AEMO, 2024 ISP Delphi Panel, November 2023. AEMO gathered expert opinions via a Delphi Panel to assess the likelihood of each 2024 ISP scenario. The Panel identified *Step Change* as the most likely scenario for the 2024 ISP.

13 AEMO, 2025 Inputs, Assumptions and Scenarios Report, 31 July 2025.

1.5.4 NSW Generation Investment Outlook

The NSW Generation Investment Outlook is a new initiative that examines historical data concerning the time taken by projects to progress through development, across various phases such as approvals, construction and commissioning, to estimate development lead times and attrition rates for new generation infrastructure. It uses this data to forecast the future state of the pipeline based on the existing project cohort.

This dataset and forecast have been used to inform the validity of the generation 10-year tender plan and the development pathway.

Box 1: Forecasting project development in the NSW Generation Investment Outlook report

- A snapshot of the current cohort of generation projects in NSW was developed, with each assigned to a progress category: conceptual, pre-development, development, construction and commissioning, and full output.
- The historical cohort was analysed to determine average lead time and attrition rates per progress category and by generation type.
- Lead time and attrition rates were then used to forecast the development of the project cohort over the next 10 years.
- Based on the analysis in Figure 18, projects from the forecast cohort were assessed for LTESA eligibility, and an eligibility ratio for each proposed tender was determined by comparing the forecast eligible projects and the proposed tender size.
- The dataset that underpins the NSW Generation Investment Outlook is expected to expand over time through additional information from tenders and the contract management function undertaken by the Scheme Financial Vehicle. This will provide better visibility into the NSW generation project pipeline and tender participation levels.

Whilst not determinative, the forecast of projects expected to reach full energisation indicates how NSW electricity infrastructure could track the ambitious development pathway. The data shows that, while there is a sufficient volume of projects expected to reach full energisation, this is sensitive to lead times and will require (at the very least) historical performance to hold into the future.

The likely levels of participation and competition in a tender can be derived from the eligibility ratio. Competition in tenders is essential for uncovering high-quality projects that serve the long-term financial interests of NSW electricity customers.

The snapshot shows a large number of projects now in pre-development, and these projects progress according to the Generation Investment Outlook. A steady rate of annual generic new entrants was used as an assumption to ensure the pipeline regenerates, reflective of historical rates. This assumption, like others, will be updated in future iterations if new information becomes available.

The analysis demonstrates a stable bank of new LTESA-eligible projects into the future. The challenge is to ensure that barriers to progress are sufficiently reduced to allow these projects to participate in tenders, reach final investment decisions and move to construction and commissioning. This will take a coordinated approach from industry, government and all stakeholders.

2. Tracking progress and contributions from tenders

- Strong progress has been made towards the 2030 minimum objectives; however, continued effort is required.
  - Constructed and secured generation infrastructure represents approximately 76% of the 2030 minimum target.
  - Secured long-duration storage infrastructure accounts for an estimated 40% of the 2030 and 66% of the 2034 minimum targets.
- While there has been a significant amount of generation and long-duration storage locked in, a strong focus will need to be maintained to ensure that the necessary infrastructure is built on time.

2.1 Tracking progress towards achieving the minimum objectives

Generation infrastructure

Table 1 outlines that, as of July 2025, 28% of the 2030 minimum objective is already constructed and 76% is likely to be constructed by 2030, when the following projects are taken into account:

- projects classified as committed in AEMO's Generation Information
- all LTESA holders
- access rights holders with a development approval and an expected commercial operations date before 2030
- all remaining CIS agreement (CISA) holders not already accounted for in the above categories.

Collectively, these are considered as 'secured' towards the 2030 minimum objectives.

Table 1: Generation infrastructure progress towards 2030 minimum objectives

Generation infrastructure	Capacity (GWh p.a.)	Progress to date
2030 minimum target[14]	**33,600**	**-**
- Constructed[a]	9,566	28%
- Constructed + committed[b]	13,959	42%
- Constructed + committed + LTESA holder	15,983	48%
- **Constructed + committed + LTESA holder + access right holder[c] + CISA holder[d]**	**25,444**	**76%**

[a] Projects classified as 'existing' in AEMO's Generation Information page are categorised as 'constructed'.
[b] Projects classified as 'committed' in AEMO's Generation Information page are categorised as 'committed'.
[c] Central-West Orana and South West REZ access rights holders, which are expected to be operational before 2030 and have a development approval are included.
[d] CISA holders that are not already accounted for as a committed project or an access right holder, that have a development approval are included.

14 Target date is 31 December 2029.

Long-duration storage infrastructure

For long-duration storage, projects expected to contribute towards the minimum objectives include long-duration storage LTESA holders. In total, these are expected to contribute an overall 40% (6.4 GWh) to the 2030 minimum objective of 16 GWh and 66% (18.4 GWh) towards the 2034 minimum objective of 28 GWh.[15]

2.2 Status of overall objectives

2.2.1 The reliability standard

The planned generation and storage projects, combined with additional firming infrastructure, will ensure NSW maintains a reliable electricity supply as older coal-fired power stations retire.

AEMO's 2024 ESOO *Committed and Anticipated Investments* sensitivity identified a reliability gap in 2027-28, following the planned retirement of the Eraring Power Station in August 2027.[16] The additional capacity and network infrastructure outlined in this IIO report will improve reliability outcomes, reducing expected unserved energy below the reliability standard.

The 2024 ESOO also identified reliability challenges from 2031-32 onwards, with risk increasing by 2033-34 as Bayswater and Vales Point Power Stations are assumed to retire. The critical milestone of achieving 28 GWh of long-duration storage by December 2033, combined with over 3 GW of planned firming infrastructure, is expected to address these challenges and maintain the reliability standard over the 10-year assessment horizon.

Appendix A2.1 provides further comparison of reliability outcomes between the 2024 ESOO and the 2025 IIO report.

2.2.2 The energy security target

Planned generation and storage capacity, combined with firming infrastructure, will ensure the development pathway will meet NSW's energy security target as coal-fired power stations continue to retire.

In September 2024, the EII Regulation was amended to require the Energy Security Target Monitor to include 'anticipated' projects in addition to 'existing or committed' infrastructure, and to consider a wider variety of factors when assessing firm capacity. These changes recognise that short-duration storage projects and interconnectors will not be dispatched or be available at times of maximum demand under certain conditions.

Having regard to these changes, the 2024 Energy Security Target Monitor identified potential breaches of the energy security target (488 megawatts (MW)) in 2027-28 when the Eraring Power Station retires, and again in 2033-34 after both the Vales Point and Bayswater Power Stations have retired.

In July 2025, ASL received a firming direction from the Minister. The direction outlines risks identified in the 2024 Energy Security Target Monitor report for 2027-28, including uncertainties related to coal supply availability, industrial demand projections, and existing generator retirements. It identifies the need for 500 MW of firming capacity to address these risks, targeting 2027-28.

While the development pathway can achieve the energy security target each year, even without additional direction, the additional capacity of the firming direction can reduce risks related to uncertain assumptions not captured in the underlying 2025 IIO report modelling. The firming direction, therefore, aims to ensure a sufficient buffer is available if planned developments are delayed or fail to occur.

The development pathway outlined in this report ensures that the energy security target is achieved over the 10-year assessment horizon through the development of additional generation, storage, firming and network infrastructure. Future Energy Security Target Monitor reports will be evaluated to understand the impacts associated with more recent developments, such as the Hunter Transmission Project's updated delivery date.

Appendix A2.2 provides more details on progress in meeting the energy security target.

15 ASL, Long-duration storage market briefing note, 27 February 2025.

16 The reliability risks are then forecast to reduce in 2028-29 with the modelled inclusion of Snowy 2.0, Maryvale Battery Energy Storage System (BESS), Liddell BESS, Silver City Energy Storage and New England Solar Farm BESS.

2.3 The contribution of tenders since the previous report

ASL publishes the outcomes of tenders undertaken since the previous IIO report. These results demonstrate how the LTESA and access rights tenders are supporting NSW's renewable energy development objectives.

2.3.1 Outcomes of LTESA tenders

ASL conducts LTESA tenders as part of its core role as Consumer Trustee. These agreements support renewable energy projects and aim to deliver more affordable, reliable, secure and sustainable electricity to NSW customers while meeting the infrastructure investment objectives set out in the EII Act.

The tender process encourages competition and projects that offer the best long-term value for NSW electricity customers, helping to achieve the state's infrastructure goals.

Since the publication of the 2023 IIO report, ASL has announced the results of two LTESA tenders:

- **LTESA Tender 4 for generation:** Projects in Tender 4 represented a combined capacity of more than 300 MW (~ 980 GWh) of generation and 372 megawatt hours (MWh) of storage.
- **LTESA Tender 5 for long-duration storage:** Projects in Tender 5 represented a combined capacity of more than 1 GW, providing 13.79 GWh of long-duration storage.

Table 2 provides more detail on tender participation.

Table 2: LTESA tender participation

Tender round	LTESA Tender 4	LTESA Tender 5
Infrastructure type	Generation	Long-duration storage
Total bids	7	5
Proponents	7	5
Capacity bid into tender	1,579 MW	2,100 MW
Proportion of capacity bid to indicative tender size	137%	103%
Eligible bids	7	5
Ineligible bids	Nil	Nil
LTESAs recommended	2	3
LTESAs entered into	2	3

Source: ASL.

Table 3 and Table 4 below present an overview of the projects awarded in the LTESA Tenders 4 and 5, detailing their respective technology type, capacity and location.

Table 3: LTESA Tender 4 projects

Project name	Company	Infrastructure / technology type	Capacity (MW)	Storage capacity (MWh)	Location / REZ
Flyers Creek Wind Farm	Iberdrola	generation wind	140	-	Orange
Maryvale Solar and Energy Storage System	Gentari Renewables Australia	generation solar / battery	172	372	Dubbo (Central-West Orana REZ)

Source: ASL.

Table 4: LTESA Tender 5 projects

Project name	Company	Infrastructure / technology type	Capacity (MW)	Storage capacity (MWh)	Location / REZ
Phoenix Pumped Hydro Energy Storage	ACEN	long-duration storage pumped hydro	800	11,990	Lake Burrendong (Central-West Orana REZ)
Stoney Creek Battery Energy Storage System	Enervest Utility	long-duration storage BESS	125	1,000	Narrabri
Griffith Battery Energy Storage System	Eku Energy Projects	long-duration storage BESS	100	800	Yoogali

Source: ASL.

2.3.2 Outcomes of CIS tenders

In December 2024, the CIS Tender 1 NEM generation awarded 6.4 GW of generation capacity and 3.6 GWh of storage capacity to various projects across the NEM. Of this total, 3.1 GW of generation and 104 MWh of storage were allocated to projects in NSW.[17]

The Australian Government has engaged AEMO and ASL to support the roll-out of the CIS as tender delivery partner.

2.3.3 Outcomes of access rights tenders

Generation and storage projects that wish to connect to network infrastructure which is subject to an access scheme may need to apply for an access right – either through an application process or a competitive tender. ASL, in its role as the Consumer Trustee, will conduct these competitive tenders if requested by the Infrastructure Planner.

Access schemes authorise or prohibit access to, and use of, specified network infrastructure in a REZ by network operators and the operators of generation and storage infrastructure. They are a cornerstone of the NSW Government's strategy to coordinate and incentivise renewable energy and storage investments in REZs, and to meet the objectives of the Roadmap and the EII Act.

Since the publication of the 2023 IIO report, access rights have been allocated under two access schemes:

- South West REZ via Tender 5 run by ASL as the NSW Consumer Trustee, awarding 3.56 GW of generation capacity and 700 MW of storage capacity.[18, 19]
- Initial tranche of access rights for the Central-West Orana REZ, via an application process run by EnergyCo, awarding 5.5 GW of generation capacity and 2.2 GW of storage capacity.[20]

17 See DCCEEW's website, Closed CIS tenders. These figures exclude Junction Rivers project.

18 See ASL's website, Tenders, for the outcomes of access rights tenders.

19 Currently, none of the projects holding South West REZ access rights have been granted an LTESA.

20 Three projects were also successful in CIS Tender 1.

2.3.4 Location of LTESA and CISA projects in NSW

The map below highlights projects in NSW that have been awarded a LTESA or CISA in tenders to date.

Figure 12: Map of current LTESA and CISA holders in NSW

Note:

1) As part of NSW Tender 2, the Australian Government supported up to an additional 550 MW of firming infrastructure through the CIS.
2) The map does not include the Junction Rivers project. Although successful in CIS Tender 1 (December 2024), the project was not allocated South West REZ access rights by EnergyCo (April 2025). Windlab has since announced it considers the project a medium-term opportunity, subject to future transmission upgrades and broader REZ planning.

3. Generation infrastructure

- The development pathway aims to deliver generation capacity significantly greater than both the 2030 minimum objective and development pathways contained in previous IIO reports.
- The development pathway is based on the modelled *Ambition* scenario (16.5 GW by 2030) projected to provide up to $6.8 billion of benefits to NSW customers compared to a more conservative trajectory as modelled under the *Supply Chain Constrained* scenario.
- The *Supply Chain Constrained* scenario may still arise if current and emerging constraints to infrastructure delivery are not addressed but will still allow for the Roadmap minimum and overall objectives to be met, including meeting the reliability standard and energy security target.
- LTESA tenders for generation infrastructure are scheduled to recommence in Q2 2026, following the exhaustion of the NSW allocation under the Australian Government's CIS tenders.
- From Q2 2026, ASL will conduct six-monthly LTESA tenders for generation infrastructure seeking 7,000 GWh p.a (approximately 2.5 GW) in each of the four tenders for the following two years, followed by tenders amounting to 4,600 GWh p.a (approximately 1.6 GW) each year from 2028.

3.1 Generation infrastructure development pathway

The development pathway set out in this report signals ASL's intention to increase the scale and speed of the NSW infrastructure build in line with the steep near-term trajectory of new generation required to minimise costs to NSW consumers as existing coal-fired power stations retire.

Delivering against these ambitious targets will require a step change in the rate at which generation projects progress through the development pipeline. ASL will play a role in this acceleration, seeking to incentivise accelerated development via generation LTESA tenders.

Overview of the generation development pathway

The development pathway delivers over 42,000 GWh of generation annually by 2030 (from 16.5 GW of capacity). This approach significantly exceeds the minimum objective of 33,600 GWh p.a. by 2030.[21] The additional capacity is justified by substantial consumer savings, compared to less ambitious alternatives.

According to the modelling presented in Chapter 6 of this report, if delivery challenges are addressed and the proposed development pathway is met, the total cost to NSW electricity customers is projected to be $6.8 billion lower compared to the less ambitious scenario constrained by supply chain limitations.

Addressing initial bottlenecks

Over the short term, lead times for new projects and NSW-specific build constraints create a bottleneck that restricts the pace of new capacity additions in the first two to three years, regardless of whether an ambitious or conservative approach to generation build is pursued.

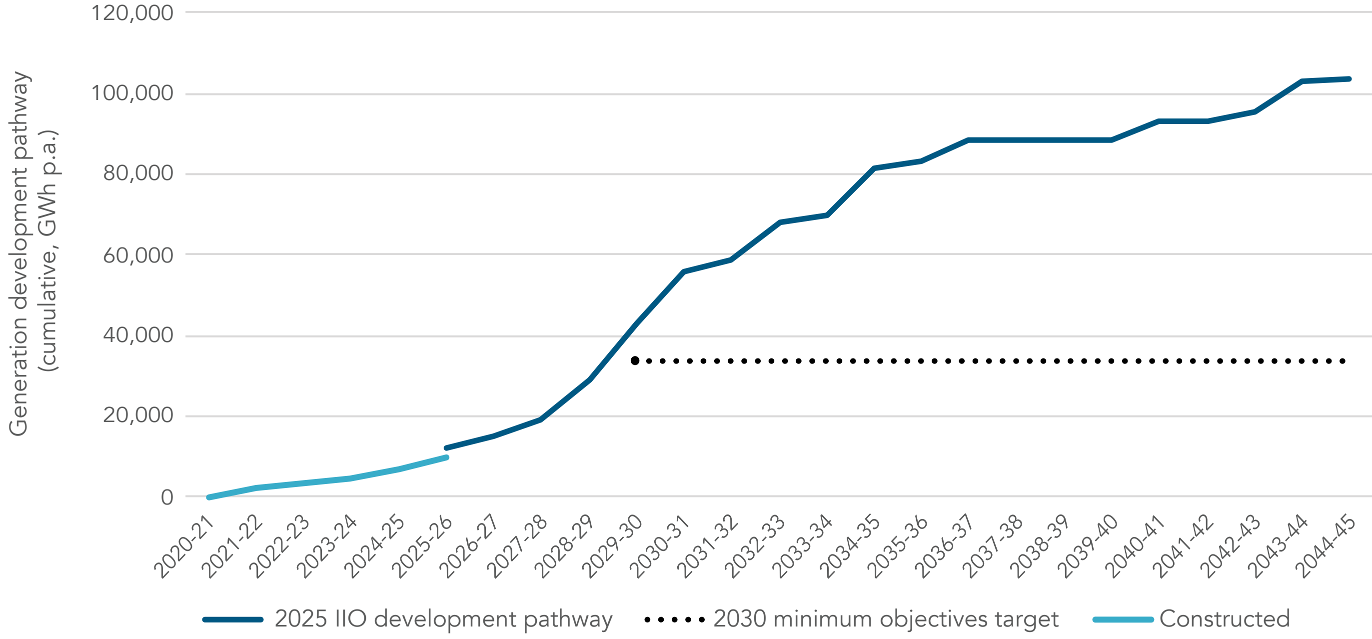
Figure 13 shows the impact of these challenges on the development pathway, whereby the initial modelled years reflect a constrained pipeline rather than an optimised outcome. The development pathway is also presented alongside historical progress to date, illustrating that the pace of new capacity additions is not inconsistent with recent observed trends. While the development pathway appears slow initially, this does not reflect the urgent need for additional capacity, as demonstrated by the subsequent years of the development pathway and the tender plan (section 3.2).

21 The EII Act expresses the minimum objective for the construction of generation infrastructure in volumetric terms, being infrastructure that generates at least the same amount of electricity in a year as 12 GW of generation capacity. The NSW Consumer Trustee, with AEMO, has determined this volumetric requirement to be approximately 33,600 GWh of electricity per year, based on assumptions of technology capacity mix and capacity factor estimates. The renewable technologies' capacity mix was taken from the *Step Change* scenario in AEMO's 2020 ISP, at the earliest period in which new build of renewable generation in NSW (post-November 2019) reaches 12 GW of capacity. The capacity factors assumed for each technology within each NSW REZ are in line with AEMO's 2020 ISP. The capacity mix and capacity factors are multiplied and summed to gain the final energy target in GWh per year.

Through the latter part of this decade and the early years of the next, investment under the development pathway remains at record levels, in line with increasing electricity demand and the retirement of coal-fired power stations. By 2030, a foundation of generation infrastructure will be in place, contributing over 42,000 GWh of annual generation capacity to the NSW electricity system.

Beyond the mid-2030s, growth in renewable energy generation moderates as the system matures, though uncertainty remains about long-term generation needs and the optimal technology mix.

Figure 13: Generation element of the development pathway



Note: Constructed refers to GWh at the start of the financial year, whereas the development pathway refers to GWh averaged across the financial year.

A conservative alternative pathway

An alternative pathway was considered to understand the impacts of an approach that anticipates more significant constraints to the infrastructure supply chain.

Modelling demonstrates that while the minimum and overall objectives (including the reliability standard and energy security target) would still be met under this *Supply Chain Constrained* scenario, it would come at a greater cost to consumers and would generate an additional 9 million tonnes of CO_2 emissions over the modelled period.

As the energy transition progresses, various factors can influence the delivery of the development pathway, many of which are beyond ASL's control. These include both economy-wide constraints on capital, workforce and materials, as well as site-specific issues such as land availability, social licence and development approvals.

To address these risks, ASL is collaborating with Roadmap partners to identify and mitigate potential impediments to projects bringing new capacity to market.

Additionally, ASL will continue to provide support to project development through the LTESA product awarded via the tender process.

High-quality projects, including those that have community support, are backed by proponents with a strong track record and are well-located in terms of congestion risks. They are encouraged to come forward and bid in LTESA tenders in a way that provides for acceleration towards an earlier delivery date and project bankability.

Impact of Hunter Transmission Project's updated delivery timing

The recent announcement of the Hunter Transmission Project's updated delivery timing to late-2029 was not included in the modelling underpinning the development pathway. This project is expected to unlock electricity supply from the Central-West Orana and New England REZs, as well as other parts of the NSW electricity system, and allow it to be imported to the major load centres.

Prior to the delivery of the Hunter Transmission Project, a significant portion of new renewable generation in NSW is expected to come online but may experience greater curtailment[22] and be more limited in delivering output to the major load centres.

ASL has set an ambitious development pathway and is expecting projects intending to participate in future tenders to consider any expected curtailment impacts from this updated information as part of their competitive bid.

Installed capacity technology mix

The modelled technology mix in the *Ambition* scenario provides valuable insights into how different technologies may contribute to meeting the infrastructure investment objectives.

Both wind and large-scale solar are expected to reach approximately 10 GW of installed capacity each in NSW by 2030. From 2030 to 2035, wind capacity doubles to approximately 20 GW, while large-scale solar grows to approximately 13 GW. This expansion occurs as coal-fired power stations retire in NSW.

In line with outcomes in the 2023 IIO report, modelling typically favours wind projects over solar projects within the generation element of the development pathway. This is driven by wind generation's ability to put downward pressure on wholesale electricity prices, owing to its diverse profiles and complementarity with demand. Wind projects often require additional network infrastructure to access locations of high resource potential.

In comparison, large-scale solar availability profiles are less favourably aligned with operational demand, are less diverse and directly compete with rooftop solar which continues to proliferate across the network. Solar hybrid projects, which are becoming increasingly prevalent in the development pipeline, have the potential to increase the value of solar projects to consumers, offering cost-effective generation and the flexibility to locate within REZs and throughout the broader network.

The value of solar hybrids has been demonstrated in recent tender outcomes. This includes the Maryvale Solar and Energy Storage System, a successful project from NSW Tender 4, and the CIS Tender 1, where solar hybrids accounted for more than 1 GW of the 6.4 GW of contracted capacity. In contrast, no hybrid projects participated in the first Roadmap LTESA tender, which was completed less than two years beforehand.

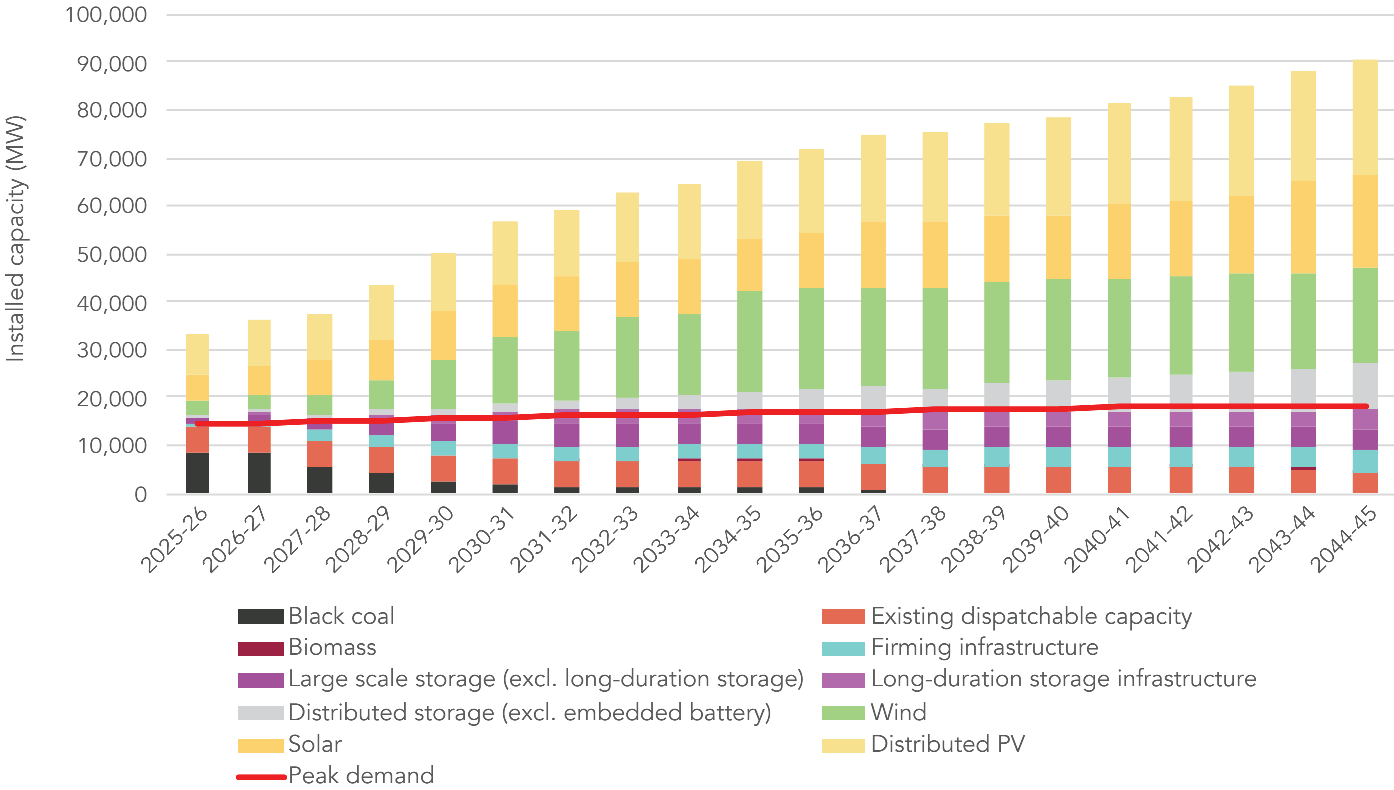
Longer term, when supply chain constraints are assumed to be largely relieved, modelling indicates that high-quality wind projects are favoured. Solar nonetheless continues to play a crucial role in the future energy mix through the emerging large-scale solar hybrid market and an ambitious assumed uptake of distributed rooftop systems, as shown in Figure 14.[23]

In practice, the projects that are delivered will likely vary from the modelled outcomes, depending on the project pipeline, outcomes of LTESA tenders (which are technology neutral), as well as the rate of broader technological change and learning.

22 AEMO, 2025 Enhanced Locational Information Report, 9 July 2025, figures 38 and 39.

23 As outlined in section 4.2, the long-duration storage development pathway between 2030 and 2034 is depicted as being smooth and not capturing step changes associated with large bulky projects identified in the *Ambition* scenario modelling. Further detail is provided in section 4.2.

Figure 14: Forecast installed capacity in NSW aligned with development pathway

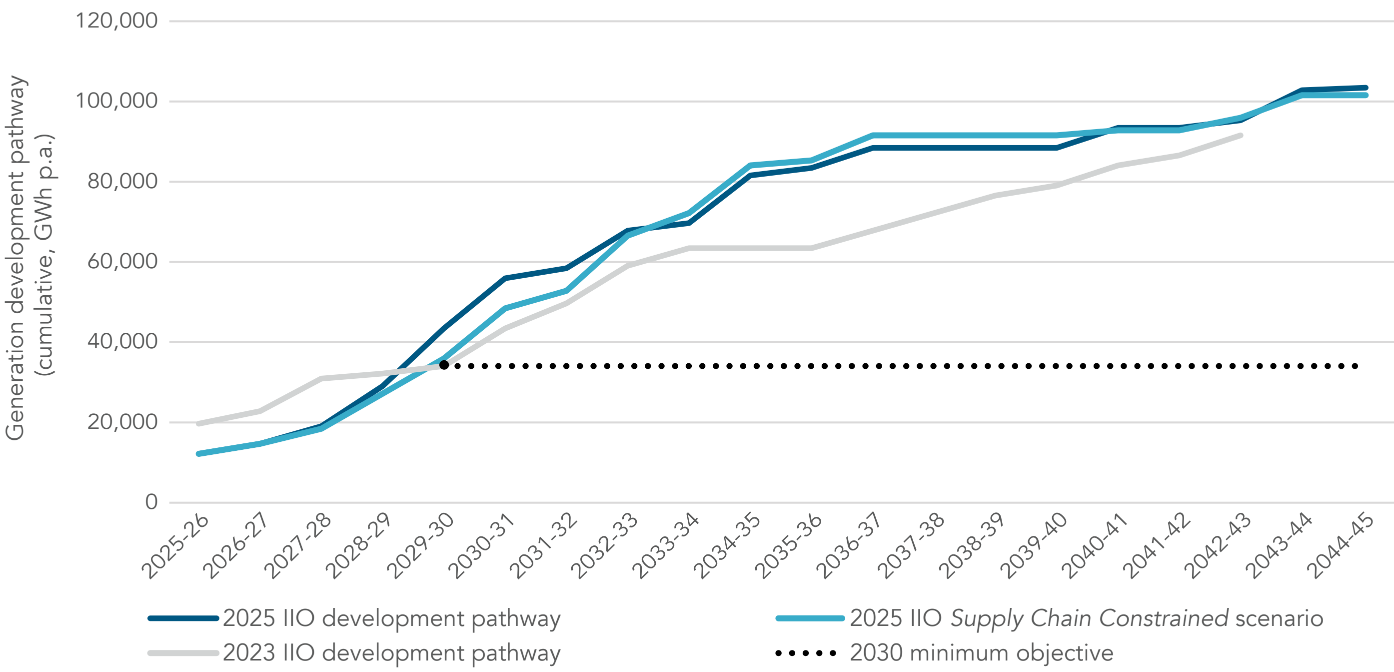


Generation comparison to the 2023 IIO report

The 2025 development pathway in Figure 15 shows a more constrained trajectory through to 2029 compared to the development pathway set in the 2023 IIO report. This reflects the reality of project delivery challenges, where delays to committed and anticipated projects, combined with updated timelines for NSW REZ infrastructure, create a conservative near-term outlook.

Updated demand projections and coal-fired power stations retirement timing assumptions since the 2023 IIO report mean more generation capacity will ultimately be required, leading to the development pathway accelerating and exceeding 2023 projections by 2030. ASL will leverage the competitive tender process to challenge modelling assumptions in the near-term and will support faster delivery timeframes for generation where feasible.

Figure 15: Comparison of the generation element of the development pathways (2025 vs 2023 IIO report)



Generation development pathway emissions

The development pathway delivers environmental benefits in the form of reduced carbon emissions, approximately 9 million tonnes of CO_2-e lower than the *Supply Chain Constrained* scenario from 2025-26 to 2044-45.

After the final coal-fired power station exits the NSW system (assumed to occur in the late 2030s), emissions from the NSW electricity sector are modelled to account for 1.4 million tonnes of CO_2-e thereafter, a reduction of approximately 97% when compared to the first modelled year.

The NSW Generation Investment Outlook and the development pathway for generation

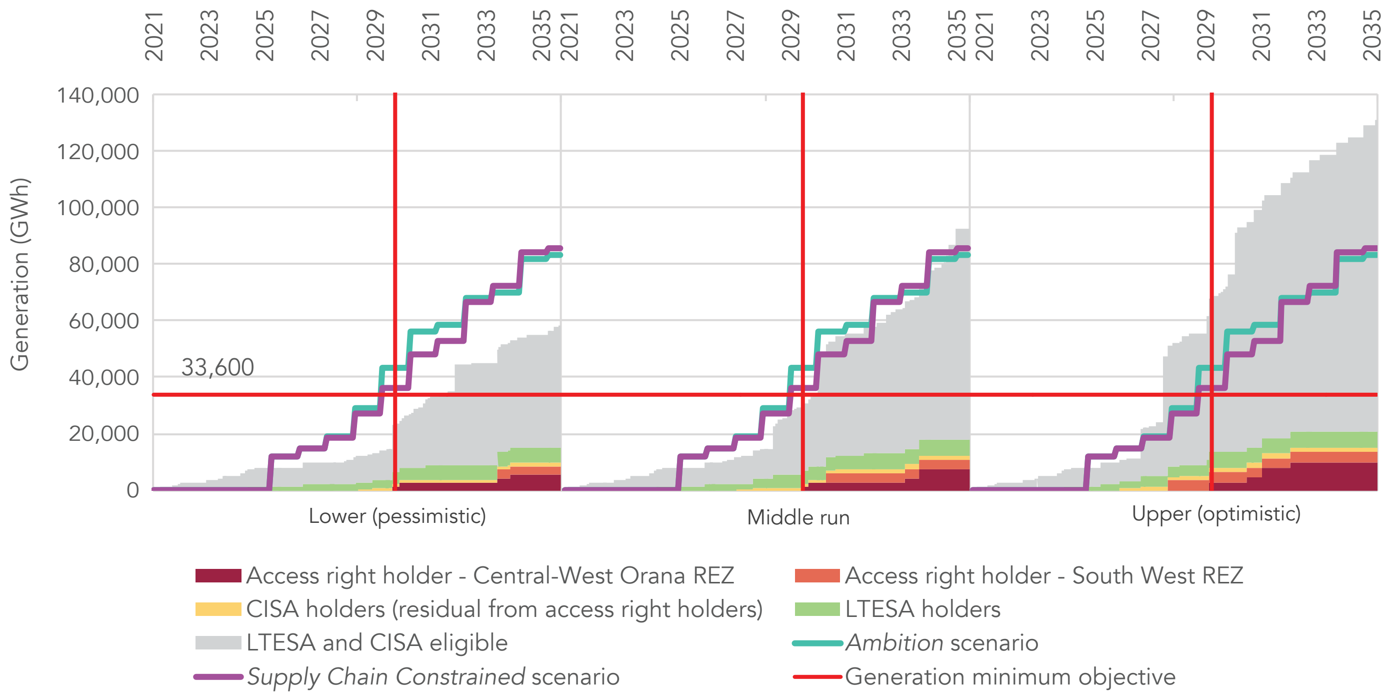
Achievement of the ambitious development pathway depends upon the ability of generation projects to move through the development pipeline faster than historical rates.

The NSW Generation Investment Outlook provides a forecast of projects likely to reach full output over the period to 2035, under a pessimistic, middle and optimistic outlook.

As shown in Figure 16, under the optimistic outlook, enough projects reach full output to meet the development pathway. However, under the middle outlook, there is only sufficient capacity to fulfil the requirements of the *Supply Chain Constrained* scenario.

The pessimistic outlook shows a more challenging picture, under which neither the *Supply Chain Constrained* scenario nor the ambitious development pathway are achieved. This demonstrates that to meet the development pathway, there will need to be a high degree of prioritisation and focus to remove barriers and accelerate investment.

Figure 16: NSW Generation Investment Outlook forecast of projects to full operation



3.2 Generation tender plan

The generation tender plan is set to give effect to the development pathway and is driven by steep investment required between now and the early 2030s. LTESA tenders are expected to re-commence in Q2 2026, allowing time for participants to prepare competitive bids following the publication of this report and the exhaustion of the CIS NSW allocation.

The Australian Government's CIS has replaced Roadmap generation tenders since April 2024. NSW has a maximum allocation of 7.1 GW under this scheme and once the Australian Government meets this target, the CIS will no longer seek bids from NSW generation projects.

The generation tender plan balances the need to give effect to the development pathway and provide for competitive tenders, noting the flexibility to under or over-award in the tender process. It recognises the significant investment trajectory required in the near term and, for the first time, accounts for potential attrition estimated at around 10%, given that not every project awarded an LTESA will necessarily go on to achieve full output.

The tender plan consists of four 7,000 GWh p.a. (approximately 2.5 GW) tenders across two years, followed by tenders amounting to 4,600 GWh p.a. (approximately 1.6 GW) each year from 2028. The timing and indicative sizing for competitive tenders for generation infrastructure over the next 10-year period is shown in Figure 17.

Figure 17: Generation infrastructure 10-year tender plan

Note: CIS T4 is live at the time of publishing this report and is indicated by a range reflecting possible outcomes between the minimum and maximum allocations to NSW.

To achieve the ambitious development pathway and accompanying tender plan, ASL is encouraging participation and competitive bidding in future tenders from high quality projects to fast track development timeframes and ensure projects' financial viability.

While value for money will remain the primary consideration for tenders, high quality projects located in areas that are relatively unconstrained, have community support and demonstrate an ability to manage supply chain risks are more likely to be supported.

NSW Generation Investment Outlook competition analysis

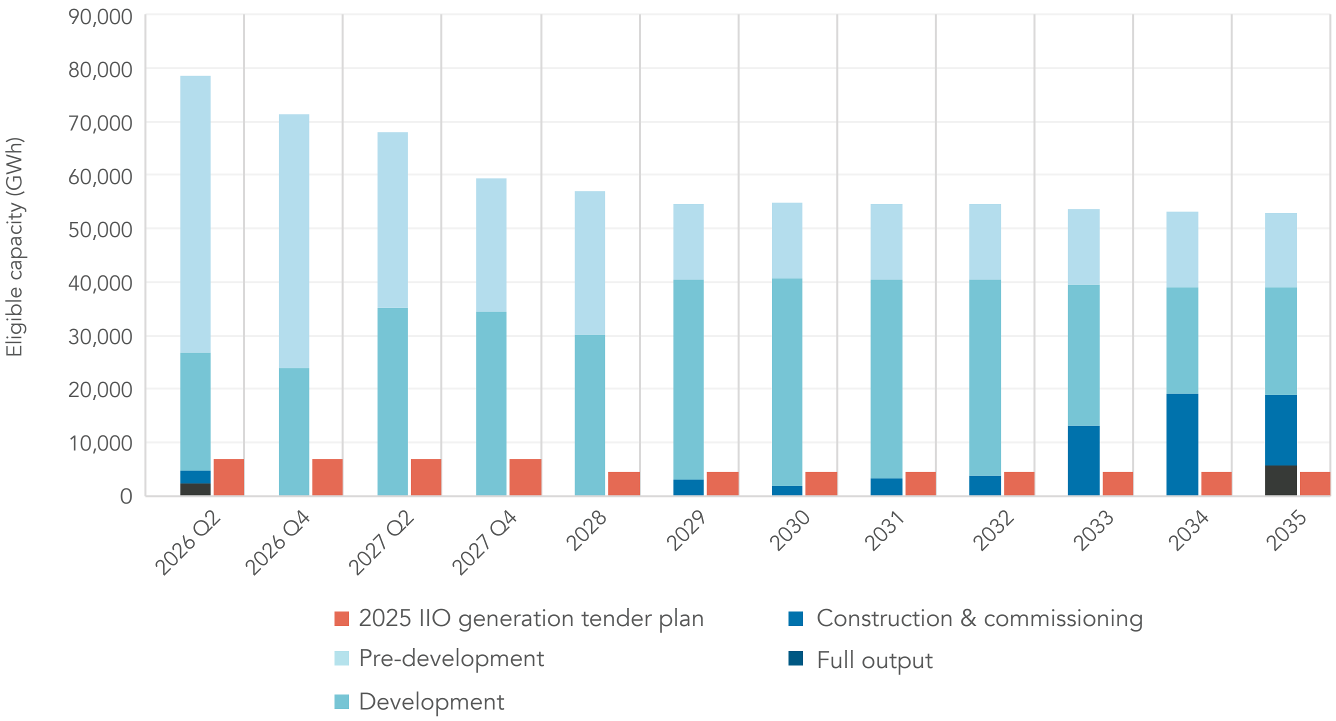
The NSW Generation Investment Outlook analysis indicates that sufficient market competition exists for planned LTESA tenders, though tender sizing may need to be managed to maintain competitive tension whilst taking into account delivery risks associated with projects at earlier development stages.

It validates competition levels by comparing the total capacity of eligible projects to the tender size. Under central assumptions, eligible projects are forecast to exceed tender requirements by a factor of ten, meaning that approximately 30% market participation will achieve desired competition levels of three times the tender target.

Eligible projects may feature at earlier development stages, compared to previous tender rounds. This puts further emphasis on the need for a cross-government and cross-industry coordinated approach to remove barriers so projects can progress more smoothly through approval stages and to help ensure that the transmission build is on schedule.

Figure 18 compares the 2025 generation tender plan to the amount of estimated capacity eligible to bid for a LTESA at each tender.

Figure 18: LTESA-eligible projects across the 2025 generation 10-year tender plan



4. Long-duration storage and firming infrastructure

- The development pathway requires accelerated and additional long-duration storage infrastructure beyond that previously identified in the 2023 IIO report. The long-duration storage element of the development pathway exceeds the new 2034 minimum objective of 28 GWh by 50%, requiring over 42 GWh of long-duration storage infrastructure by 2034.
- In the short term to 2030, an additional 1.2 GW / 9.6 GWh of long-duration storage is required to be secured quickly to combine with the 0.8 GW / 6.4 GWh already secured via LTESAs. Beyond 2030, a further 14 GWh of long-duration storage infrastructure is required to meet the development pathway requirements in 2034, in addition to capacity secured through previously awarded LTESAs.
- Two large upcoming tenders for long-duration storage (12 GWh each) are planned over the next two years to ensure there is sufficient capacity secured to meet the development pathway.
- The Minister has directed ASL to conduct a competitive tender for firming infrastructure by Q4 2025, targeting 500 MW with a delivery date of 2027-28. This is reflected in the firming development pathway. An additional 650 MW of firming capacity is required to meet the development pathway by the early 2030s, but the Minister has not, at this stage, provided any further direction for tenders targeting this capacity.
- The need for firming and long-duration storage infrastructure is interrelated, with both providing for mitigation of reliability risks. Where the firming infrastructure identified within the development pathway is delayed or not able to be delivered by the market, additional long-duration storage infrastructure may be required. ASL will continue to monitor system and market updates in planning for these infrastructure types over time.

4.1 Overview of long-duration storage and firming pathways

The 2025 development pathway includes a long-duration storage element and a firming element, designed to work together with the generation pathway to meet the reliability standard and the energy security target.

NSW faces reliability risks as the four remaining NSW coal-fired power stations approach retirement, with three scheduled to exit over the next decade. To facilitate an orderly transition, the development pathway seeks to incentivise timely replacement capacity in the form of firming and long-duration storage infrastructure that complement the generation element.

The right mix of generation, firming and long-duration storage infrastructure is a complex interplay that depends on the rate of deployment of renewable generation, baseload coal-fired power stations retirement and transmission network development connecting renewable generation in the regions to load centres.

The firming infrastructure represents an essential complement to renewable generation and storage, providing the responsive capacity needed to maintain grid stability as the electricity system transforms. The firming element of the development pathway is designed to work with the long-duration storage and generation infrastructure elements to deliver comprehensive energy security for NSW.

Therefore, these elements are sequenced to complement the generation element, coal-fired power station retirement, and network development assumptions, ensuring a degree of conservatism if coal-fired power stations retire earlier than expected or network development is somewhat delayed.

Further, to ensure the development pathway is both reliable and resilient to extreme events, ASL undertakes additional testing to examine how the pathways perform under challenging conditions.

These include:

- a reliability assessment, which examines whether the development pathway meets the reliability standard,
- a test against the NSW energy security target, and
- a VRE lulls assessment, which tests the pathway's resilience during extended periods of low wind and solar generation by considering extreme weather scenarios.

This year ASL also conducted a *No NSW Coal by 2034* sensitivity to test the resilience of the development pathway to earlier than expected coal-fired power station retirement.

As outlined in sections 4.2 and 4.3, modelling underpinning the development pathway indicates that a balanced mix of energy sources is required, including gas, pumped hydro, short-duration batteries and long-duration storage.

4.2 Long-duration storage development pathway

The long-duration storage element of the development pathway is based on the results of the *Ambition* scenario, which calls for 42.4 GWh of long-duration storage by 2034 – 50% higher than the 2034 minimum objective of 28 GWh. By significantly surpassing the minimum objective by 2034, the development pathway ensures greater resilience to reliability risks, which are uncertain in the same timeframe.

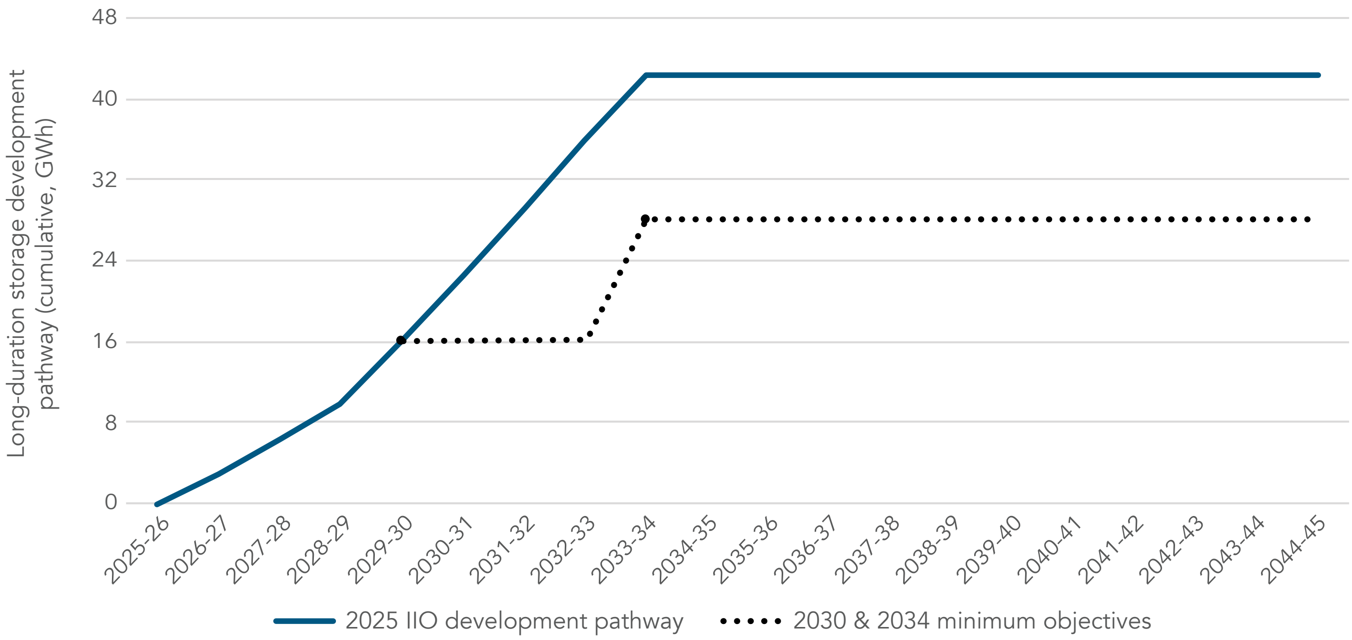
Furthermore, this development pathway sends a strong signal for long-duration storage projects that are required beyond the 2030 and 2034 long-duration storage minimum objectives.

Figure 19 illustrates the long-duration storage development pathway, which incorporates the following:

- All long-duration storage projects announced through the LTESA tender processes (Tenders 1, 3 and 5).
- An additional 9.6 GWh (1.2 GW) of long-duration storage, required to be developed quickly to meet the minimum 2030 objective of 2 GW and 16 GWh.
- Additional long-duration storage to surpass the minimum 2034 objective of 28 GWh, achieving 42.4 GWh in total by 2034, which was found to be in the long-term financial interests of NSW electricity customers.

The development pathway is presented in GWh terms, reflecting the basis of the new 2034 minimum objective, and providing flexibility to achieve long-duration storage needs with storage duration of eight hours or more.

Figure 19: Long-duration storage element of the development pathway



The additional 1.2 GW / 9.6 GWh of long-duration storage needed to achieve the 2030 minimum objective of 16 GWh will help support reliability following the scheduled retirement of the Eraring Power Station in mid-2027. Given the limited timeframe leading up to 2030, it is important to prioritise technologies that can be implemented quickly.

The additional 14 GWh of long-duration storage infrastructure required by 2034 under the development pathway, in addition to capacity secured through previously awarded LTESAs, provides flexibility for projects that have longer lead-times to contribute to the development pathway. Modelling underpinning the development pathway assumes this additional infrastructure is delivered by 48-hour pumped hydro. The development pathway may be delivered by lower duration technologies, depending on outcomes of the tender process.

While the pathway trajectory between 2030 and 2034 is depicted as smooth, in practice actual project sizes may deliver stepped changes in progress. To this end, the tender plan is intentionally front ended to accommodate larger projects with longer lead times. Ultimately, the actual trajectory will be driven by projects that arise through market interest and tender outcomes.

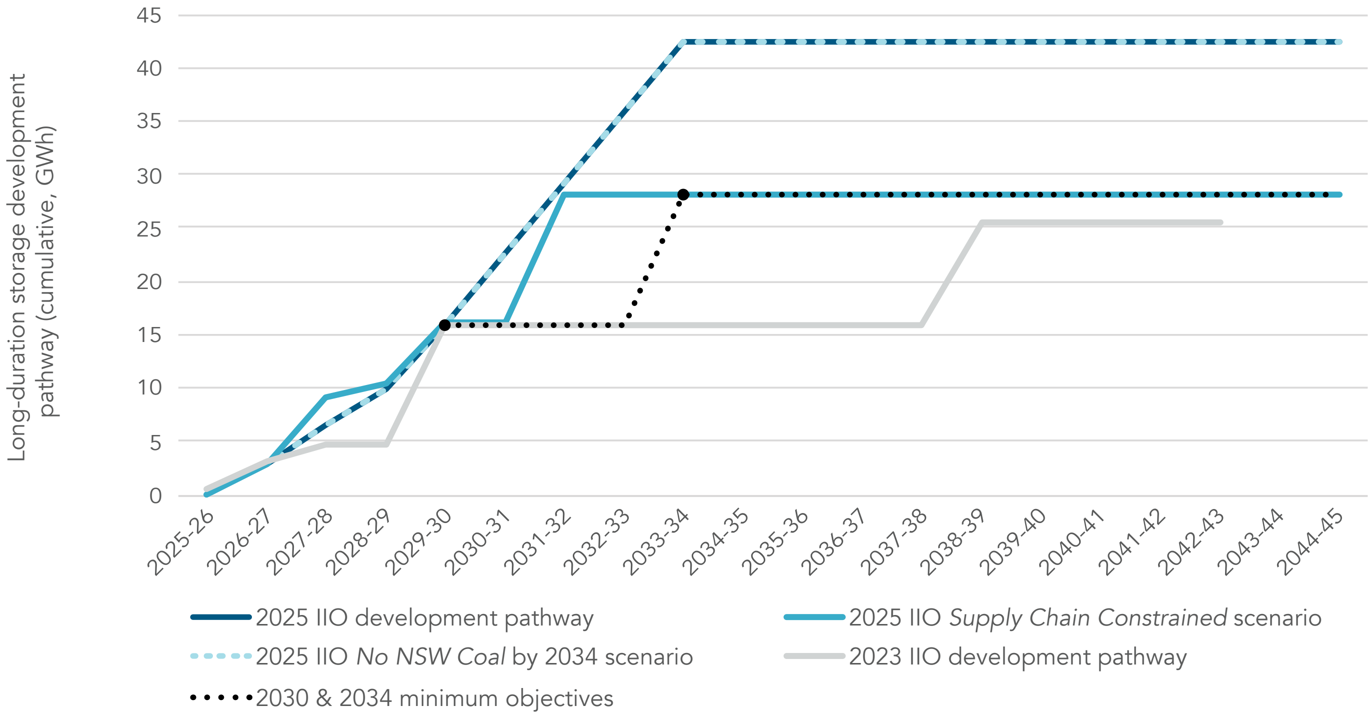
The development pathway, which runs until 2044-45, does not require any additional long-duration storage beyond 2034. This assumes the entry of Snowy 2.0 in 2028-29 and that additional firming infrastructure is delivered by that time, in line with the firming element of the development pathway shown below.

The long-duration element of the development pathway is resilient to early coal-fired power stations closure risks. As illustrated in Figure 20, sensitivity analysis demonstrates that the long-duration storage element of the development pathway is consistent with the outcome of the *No NSW Coal by 2034* sensitivity.

Long-duration storage comparison to the 2023 IIO report

The long-duration storage element of the development pathway differs significantly from the 2023 IIO report. As shown in Figure 20, after 2030 substantially more long-duration storage is needed under the 2025 development pathway, relative to the 2023 IIO development pathway. Several factors are driving these needs, including higher electricity demand, earlier assumed coal-fired power stations retirement, and the new 2034 minimum target.

Figure 20: Comparison of the long-duration storage element of the development pathways (2025 vs 2023 IIO report)



4.3 Firming infrastructure development pathway

The firming infrastructure pathway is outlined in Figure 21 and is underpinned by modelling outcomes of the *Ambition* scenario, consistent with the generation and long-duration storage infrastructure elements of the development pathway.

This modelling incorporates a mixture of short-duration storage and gas peaking plants which give rise to the overall firming pathway, emphasising an increasing need for firm, dispatchable capacity capable of also generating bulk energy, particularly after 2030.

The firming element of the development pathway comprises the following:

- Expected entry of projects that have already received an LTESA in NSW Tender 2, and dispatchable projects that are classified as committed or anticipated by AEMO.[24]
- 1.3 GW / 5.2 GWh of CIS dispatchable capacity, in line with the minimum NSW allocation of the CIS dispatchable targets, assumed to be delivered by 2030.[25]
- Modelled firming capacity required beyond 2030, with 530 MW identified as early as 2031, increasing to over 1.8 GW by 2045. Modelling assumes that much of this additional firming capacity is delivered through gas peaking generation, reflecting the need for both dispatchability and bulk generation ability. Where gas, or alternative fuel-based generation cannot be delivered, higher amounts of short- and long-duration storage, coupled with additional generation, may be required.
- An additional (not modelled) 500 MW of firming by 2027-28, in line with the Minister's firming direction.[26]

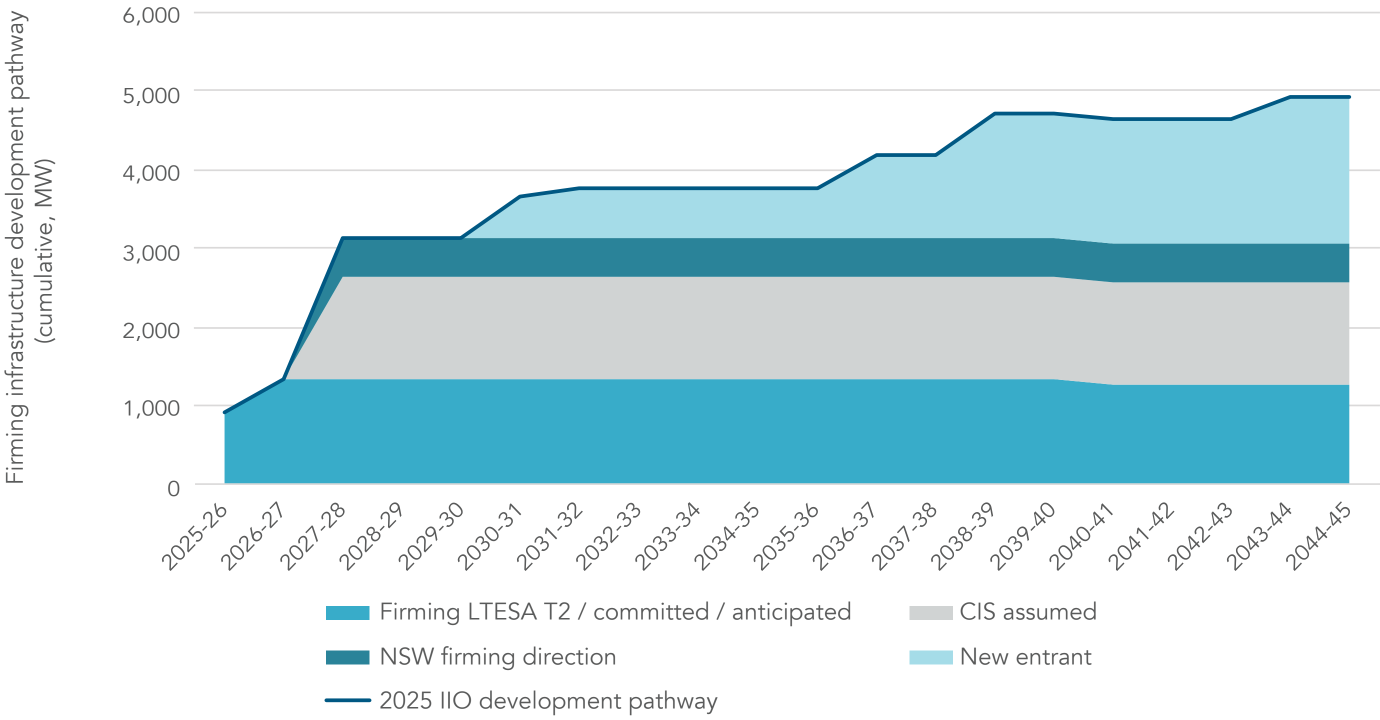
The firming direction focuses on risks related to uncertainty in assumptions underlying the 2025 IIO report modelling, including coal availability challenges, industrial load forecasts and the potential for earlier than anticipated coal-fired power stations retirement. Since it targets an additional reliability risk not already captured in modelling, this firming direction is treated as additional to the modelled firming element of the development pathway.

Further, the nature of the identified risk in the firming direction requires near-term solutions that cannot be addressed with longer lead-time options such as new gas generation or network augmentations. This differs from the modelling underpinning the firming element of the development pathway, which identified a need in the early 2030s for additional dispatchable capacity capable of providing bulk generation, assumed to be delivered via gas.

The early 2030s modelled capacity and the additional capacity in the firming direction serve different system needs and target different reliability risks, which is why reducing the forecast additional requirement by the firming direction amount was not considered in the modelling.

Since the direction is focused on very near-term risks, the volume and required technical characteristics of additional firming infrastructure in the 2030s will be revisited in future reports.

Figure 21: Firming infrastructure element of the development pathway



24 AEMO, Generation Information, October 2024.

25 The Australian Government is negotiating bilateral Renewable Energy Transformation Agreements (RETAs) with states and territories. Through RETAs, the Australian Government has agreed minimum capacity allocations under the CIS. See DCCEEW's website, Renewables Energy Transformation Agreement allocations by jurisdiction.

26 While the development pathway reflects the Minister's direction which specifies 500 MW of firm capacity, ASL may update the indicative tender size in line with advice received from the Energy Security Target Monitor on the forecast energy security target shortfall as more information becomes available. Any updates will be communicated in launching the firming tender.

Resilience of the firming infrastructure development pathway

As shown in Figure 22, the firming infrastructure trajectory under the *Supply Chain Constrained* scenario is higher than the 2025 IIO development pathway from the early 2030s, driven by higher modelled volumes of short-duration storage.

In the *Supply Chain Constrained* scenario, the expansion of generation infrastructure is highly constrained, leading to higher wholesale prices and reliability challenges. These challenges are, however, somewhat mitigated by increased short-duration storage volumes in NSW. Both the *Ambition* and *Supply Chain Constrained* scenarios include the additional firming infrastructure provided for under the firming direction, providing additional resilience to reliability risks.

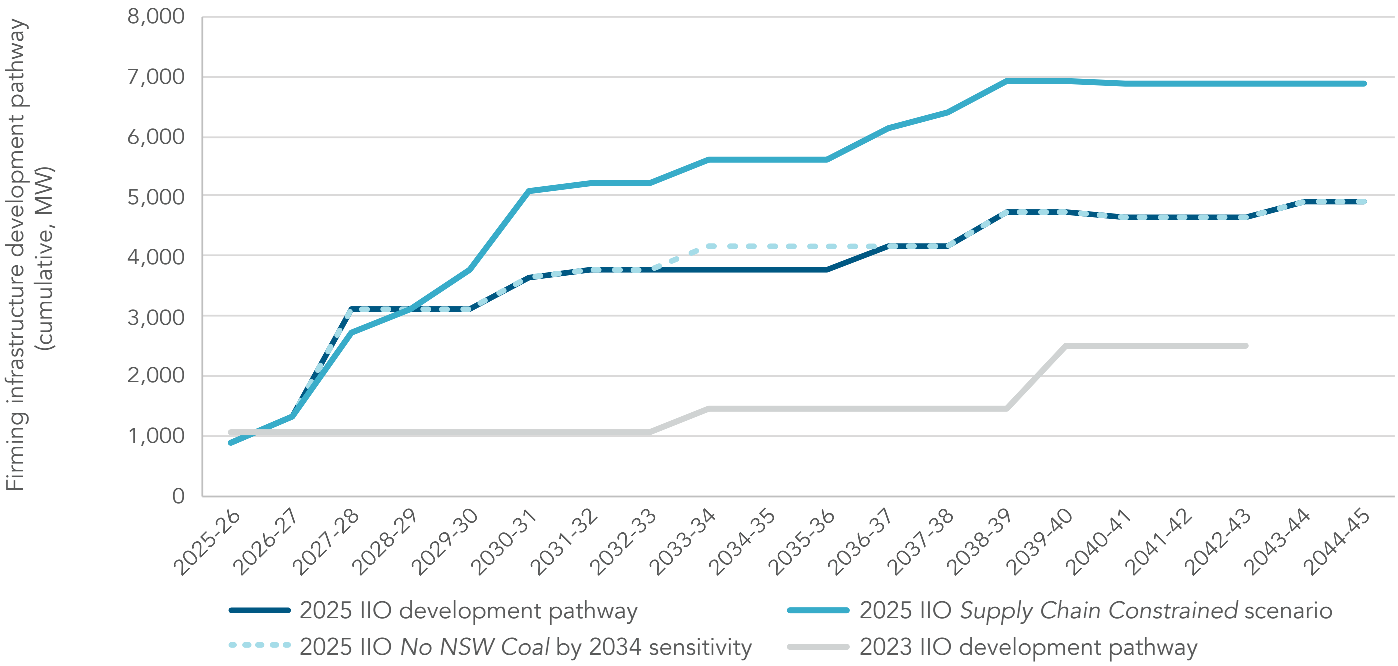
The outcomes of long-duration storage and firming infrastructure trajectories across the *Supply Chain Constrained* and *Ambition* scenarios (illustrated in Figure 20 and Figure 22 respectively) demonstrate the interrelated nature of these infrastructure types. While the firming element of the development pathway is lower than modelled outcomes in the *Supply Chain Constrained* scenario, any risks to the delivery of the long-duration storage pathway could be further mitigated with firming infrastructure.

The *No NSW Coal by 2034* sensitivity further highlights the impact of uncertain market conditions on the need for firming infrastructure. Where coal-fired power station retirement occurs earlier than anticipated, additional firming infrastructure is expected to be required earlier. ASL will continue to monitor evolving system and market conditions as well as risks to the delivery of the development pathway to inform future planning.

Firming comparison to the 2023 IIO report

As shown in Figure 22, substantially more firming capacity is needed under the 2025 development pathway relative to the 2023 IIO report development pathway, due to the inclusion of the CIS dispatchable target, as well as increased demand projections and earlier coal retirements.

Figure 22: Comparison of the firming infrastructure element of the development pathways (2025 vs 2023 IIO report)



4.4 Meeting policy objectives with long-duration storage and firming infrastructure

4.4.1 Reliability

ASL has conducted comprehensive analysis to examine whether the long-duration storage and firming infrastructure elements of the development pathway meet the reliability standard and the energy security target. The outcomes of this work have directly informed the total capacity, duration and timing of new infrastructure included in the development pathway. The key outcomes of this analysis are as follows:

- The detailed reliability assessment focuses on the *Supply Chain Constrained* scenario and demonstrates that under this scenario, NSW meets the relevant reliability standard in each forecast year of the 10-year assessment window. The *Ambition* scenario, underpinning the development pathway, has higher resilience to reliability risks than the *Supply Chain Constrained* scenario, and thus is also expected to meet the reliability standard.
- The assessment of the energy security target shows that it will not be breached for the development pathway or for the *Supply Chain Constrained* scenario. While there is some tightness in 2028-29, the development pathway incorporates sufficient capacity to meet the forecast NSW maximum electricity demand in summer, with sufficient reserve to cover for the unexpected loss of the two largest generating units in the state, as required by the energy security target.

In undertaking this analysis, ASL has adopted a similar approach to that applied in the 2024 ESOO[27] and the Energy Security Target Monitor reports. Detailed analysis is provided in Appendix A2, demonstrating how the development pathway will maintain reliability during the transition.

Box 2: Implications of Hunter Transmission Project's updated delivery timing

The transmission network in the Sydney, Newcastle and Wollongong (SNW) area was originally designed to connect large coal-fired power stations in the Hunter region, including the Eraring and Vales Point power stations, to supply the SNW load centres. When these coal-fired power stations retire, the network has insufficient capability to supply SNW load centres from generators located outside of the Hunter region. The Hunter Transmission Project increases the transfer capacity into the SNW load centres.

In the longer-term, the Hunter Transmission Project will enable the supply of high-value renewable electricity from projects in the Central-West Orana and New England REZs to pass via Bayswater, putting downward pressure on prices.

Modelling informing the 2025 IIO report has assumed that the Hunter Transmission Project would be delivered in mid-2028. Since that modelling was completed, EnergyCo has provided an updated forecast delivery date which includes an appropriate level of contingency to reflect the risks associated with delivering major infrastructure projects. This updated date, as outlined in AEMO's 2025 Electricity Network Options Report,[28] is estimated as late-2029.

Recognising the critical importance of this project, EnergyCo is working with Transgrid and the broader NSW Government to identify opportunities to deliver this critical infrastructure project as soon as possible. EnergyCo and Transgrid executed a Commitment Deed in late 2024 for the progression of the Hunter Transmission Project and are currently in the midst of a competitive tender process to appoint development and construction contractors to deliver the works.

The updated delivery time of the Hunter Transmission Project leaves a gap between when Eraring is currently scheduled to retire in August 2027, and when it comes online. Without mitigants, this may pose risks in relation to the reliability of supply and the ability of new renewable generation to be well-utilised and reach load centres during this gap.

As such, the 2025 IIO report may underestimate the reliability risks between 2028-29 and 2029-30 where the Hunter Transmission Project is delivered later than assumed. The upcoming 2025 ESOO will explore the implications of this updated information on the reliability outcomes for NSW. ASL will continue to work with the NSW Government and EnergyCo to identify and implement necessary measures, while continuing to target the development pathway set out in this report.

27 AEMO, 2024 Electricity Statement of Opportunities, August 2024.

28 AEMO, 2025 Electricity Network Options Report, 31 July 2025.

4.4.2 VRE lulls

In addition to meeting the reliability standard and the energy security target, the development pathway maintains resilience to VRE lulls (multi-day events where availability from wind and solar generation across the entire NEM is sustained below the fifth percentile of recently observed history). As VRE capacity increases in NSW, the electricity system is becoming increasingly dependent on the weather. It is therefore critical the development pathway is resilient to VRE lulls.

This analysis (which also explored the impact of climate change on VRE lulls) forecast that across the remainder of the century, the average frequency and duration of compound VRE lulls should remain consistent with observed history. Across the next decade, VRE lulls are expected to have a duration of 4 days (the 1-in-2-year events) to 12 days (the 1-in-50-year events).

The development pathway maintains resilience to VRE lulls across this range of durations. This resilience is driven by the increased diversity of VRE, which minimises the magnitude of VRE lulls, the expansion of transmission within NSW and with neighbouring regions, which enables the sharing of generation, and the increased capacity of storage and firming infrastructure to meet NSW demand during low VRE periods. Detailed analysis is provided in Appendix A3.

4.5 Long-duration storage infrastructure tender plan

The long-duration storage tender plan sets out the scale and broad technology mix that will be needed to make the development pathway a reality. LTESA Tender 6 is currently underway, targeting 1 GW (at least 8 GWh) of projects that can be operational by 2034. Results are expected in late 2025 or early 2026.

Long-duration storage tenders will continue until at least 2027 to ensure that the Roadmap's targets are met. In 2026 and 2027, tenders will each seek 12 GWh of long-duration storage capacity, as illustrated in Figure 23.

The long-duration storage tender plan is designed to allow sufficient time to provide for all technology types, including batteries, pumped hydro and compressed air, to apply for LTESAs.

It is intentionally front-ended to allow larger projects with longer lead times to bring their capacity to market in time to meet the 2034 target, while also accommodating projects with shorter lead times which can contribute to meeting the 2030 target (subject to outcomes of the current tender). ASL may conduct up to a further four consistently sized contingent tenders of 8 GWh each until the development pathway's 2034 targets for long-duration storage are met.

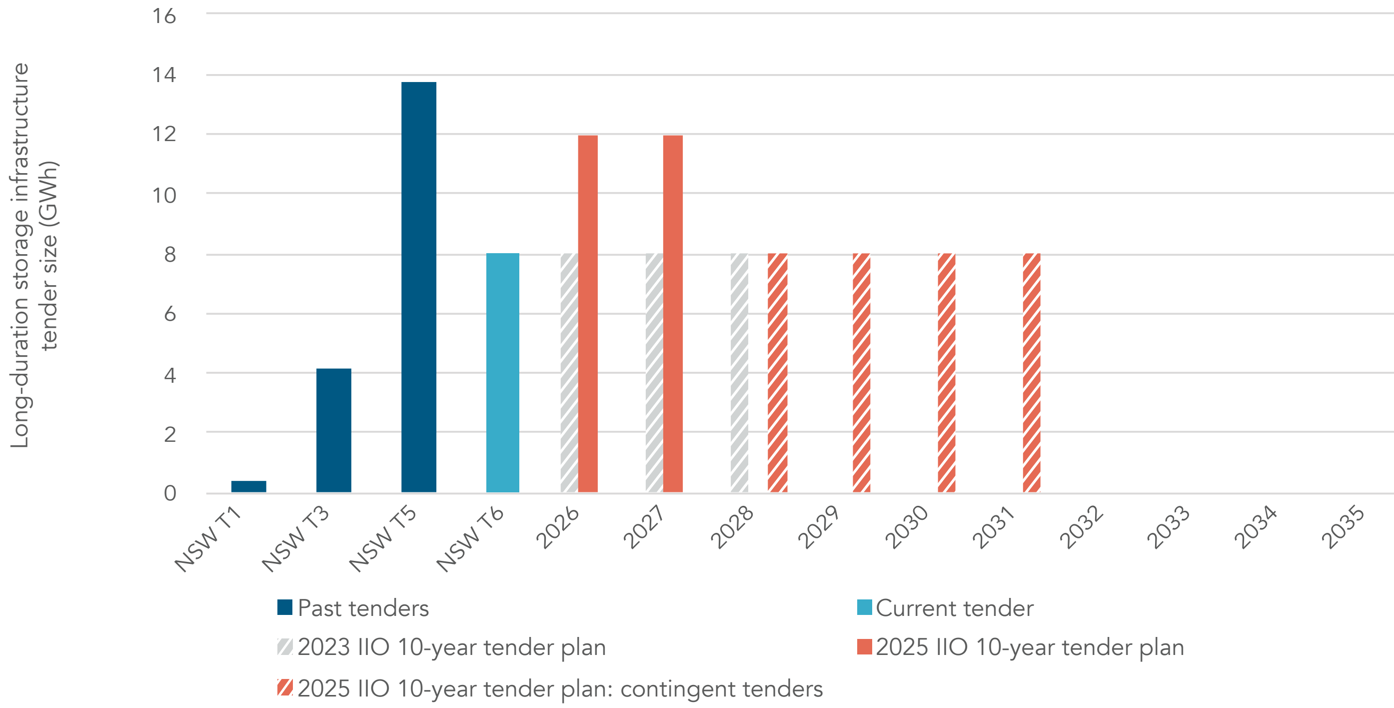
In a similar manner to the approach taken with the generation tender plan, ASL has considered potential attrition rates in formulating the long-duration storage tender plan. This accounts for development risks carried by projects, including those that are awarded an LTESA, helping to de-risk the development pathway.

As with all its tenders, ASL maintains the ability to under- or over-award within each tender, based on consideration of the long-term financial interests of NSW electricity customers and the overall objectives of the Roadmap.

After 2034, the development pathway does not indicate further need for long-duration storage infrastructure. However, where the firming infrastructure development pathway is not met or reliability gaps emerge post-2034, then there may be additional requirements for long-duration storage. Future IIO reports will address this.

Figure 23 shows the timing and sizing for competitive tenders for long-duration storage infrastructure over the next 10 years. This plan is now presented in volumetric (GWh) terms, consistent with the format of the 2034 minimum objective.

Figure 23: Long-duration storage infrastructure 10-year tender plan



4.6 Firming infrastructure tender plan

In July 2025, ASL received a direction from the Minister to conduct a competitive tender for LTESAs for firming infrastructure.[29] The firming direction followed the identification of an energy security target breach in 2027-28 where anticipated and planned developments are delayed or do not eventuate. Inclusion of the firming direction in this report meets the statutory requirement under section 45(3) of the EII Act for an IIO report to be prepared as soon as practicable after being directed by the Minister.

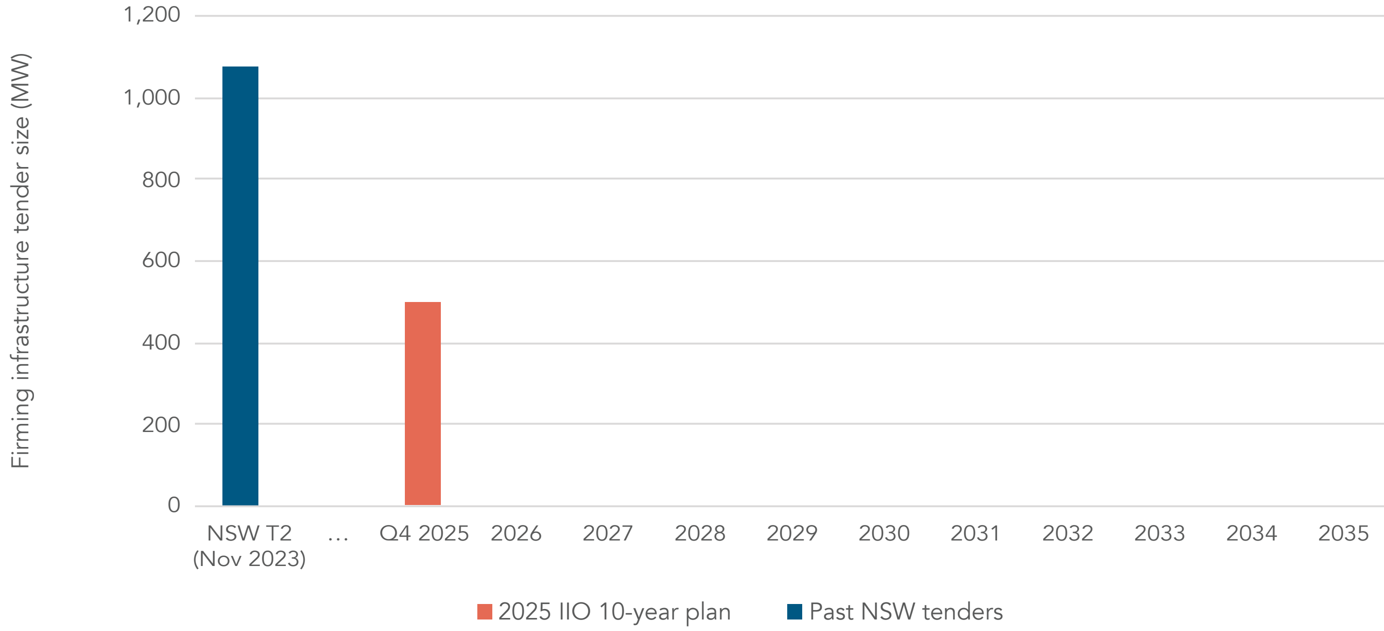
The Minister has directed ASL to conduct a competitive tender for firming infrastructure for 500 MW of firm capacity, prioritising firming infrastructure located in the Sydney-Newcastle-Wollongong sub-region. The firming direction focuses on risks related to uncertain assumptions not captured in the underlying 2025 IIO report modelling, such as coal availability challenges, new generation and storage committed by 2027-28, industrial load forecasts and earlier than anticipated coal-fired power stations closure. ASL expects to be advised by the Energy Security Target Monitor on the forecast energy security target shortfall and these uncertainties as more information becomes available.

As such, ASL maintains flexibility to adjust the indicative tender size prior to the tender round commencing, after considering the latest available information, including advice from the Energy Security Target Monitor, initial results from the LTESA Tender 6 (long-duration storage), and any other market updates. ASL confirms tender size prior to a competitive tender process commencing, while retaining flexibility to adjust tender size in response to market feedback during the tender process.

29 EII Act, section 47(2).

Figure 24 outlines the 10-year tender plan, which captures the firming direction.

Figure 24: Firming infrastructure 10-year tender plan



Note: As part of NSW Tender 2, the Australian Government supported up to an additional 550 MW of firming infrastructure through the CIS.

This tender plan does not include additional future firming needs as presented in the development pathway. ASL, as the Consumer Trustee, can only initiate tenders for firming infrastructure if directed by the Minister. In this case, the firming direction targets needs within the 2027-28 period. Further firming directions from the Minister would be required for ASL to run tenders for later identified needs, including additional firming capacity identified in the development pathway beyond 2030, or any such needs associated with risks not captured in modelling underpinning the development pathway.[30]

30 The potential reliability risks associated with the updated delivery timing of the Hunter Transmission Project are discussed in sections 4.6 and Appendix A2. If a competitive tender for firming infrastructure was identified as an effective mitigation approach, ASL would require another Ministerial direction to initiate this.

5. Network infrastructure to support the pathways

- The delivery of new network infrastructure, both within REZs and to support REZs through the transmission backbone, underpins the development pathway and the infrastructure investment objectives more broadly.
- ASL, as the Consumer Trustee, is responsible for authorising network infrastructure in REZs proposed by the Infrastructure Planner (EnergyCo). The EII Regulation was amended in 2024 to enable the IIO report to be used as a primary input into network authorisation decisions, and this iteration of the report is the first to provide for this capability.
- This report introduces a new benchmark annual cost test and associated criteria to support streamlined authorisation of high value, low-cost network upgrade options that can deliver new generation by 2031 – but which were not modelled for this report. This benchmark will also provide guidance to EnergyCo and network service providers as to what projects are potentially viable for consideration for authorisation under the EII Act.
- The estimated total capital cost of the network projects supported under the Roadmap is $15.6 billion in present value terms.

5.1 Approach

ASL has considered how the existing network, and augmentations to the existing network, might best support delivery of the 2025 development pathway.

In doing this, ASL has optimised new network infrastructure development for each of the scenarios in this report, focusing on the timing of major NSW REZ network augmentations. Smaller network augmentations on existing networks are also considered.[31]

Network infrastructure options that are selected in the development pathway in the 2025 IIO report can be considered in the long-term financial interests of NSW electricity customers as the lowest cost way to meet the infrastructure investment objectives. As such, these network infrastructure options are more likely to deliver benefits to customers.

5.2 Network infrastructure requirements

New network infrastructure is required both within and outside of NSW REZs to enable generation in areas of high resource potential and to alleviate downstream constraints.

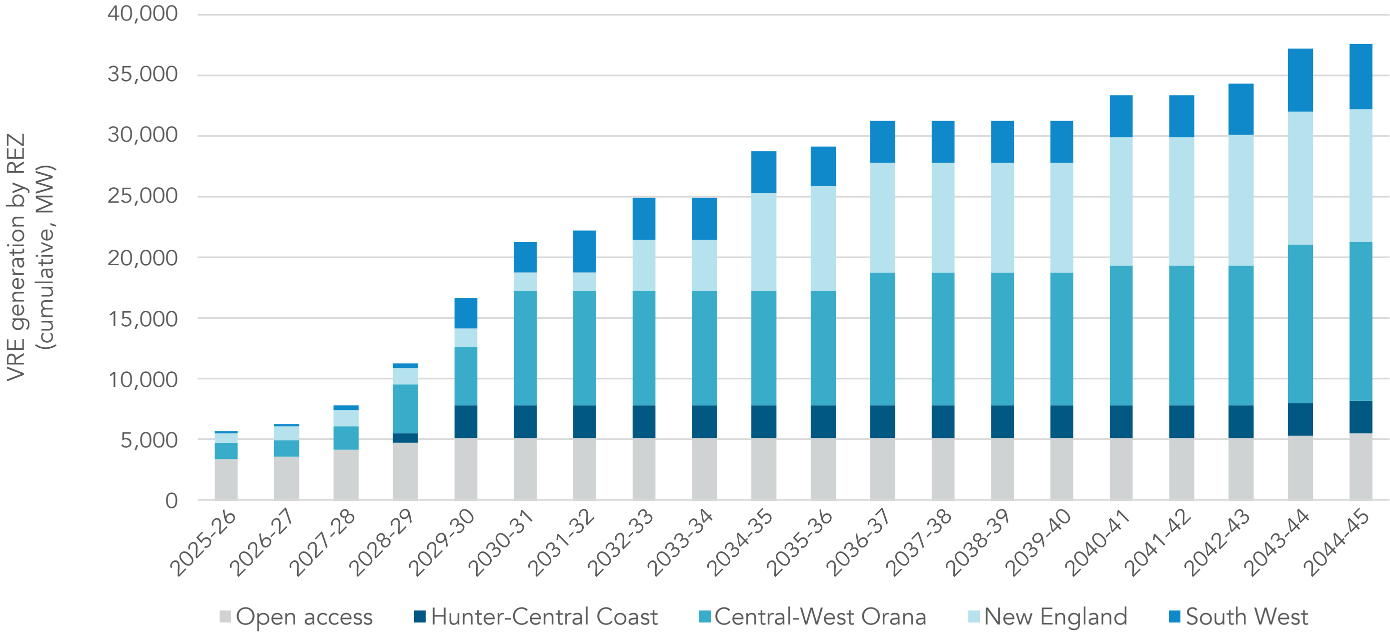
Based on EnergyCo's inputs, the estimated total capital costs (excluding construction, finance and contingency costs) of the network projects supported under the Roadmap (including all the REZ network infrastructure projects and priority transmission infrastructure projects) amount to $15.6 billion in present value terms.[32]

Details of the 'in REZ' and 'out of REZ' projects required to underpin the development pathway are set out in sections 5.2.1 to 5.2.5. A summary of all modelled REZs and their VRE build is provided below in Figure 25.

31 EnergyCo provides ASL with network infrastructure options which ASL then evaluates for cost and ability to improve network capacity in REZs and/or downstream areas. ASL also assesses how this network capacity enables higher quality renewable generation in NSW. In December 2024, EnergyCo submitted over 50 candidate network infrastructure options for ASL's consideration as part of the 2025 IIO report.

32 The present value reflects the entry timing of modelled network projects. The costs include elements captured in AEMO's Transmission Cost Database along with (where relevant) Infrastructure Planner and network operator development costs, biodiversity costs and brownfield costs.

Figure 25: VRE generation underpinning the development pathway by REZ



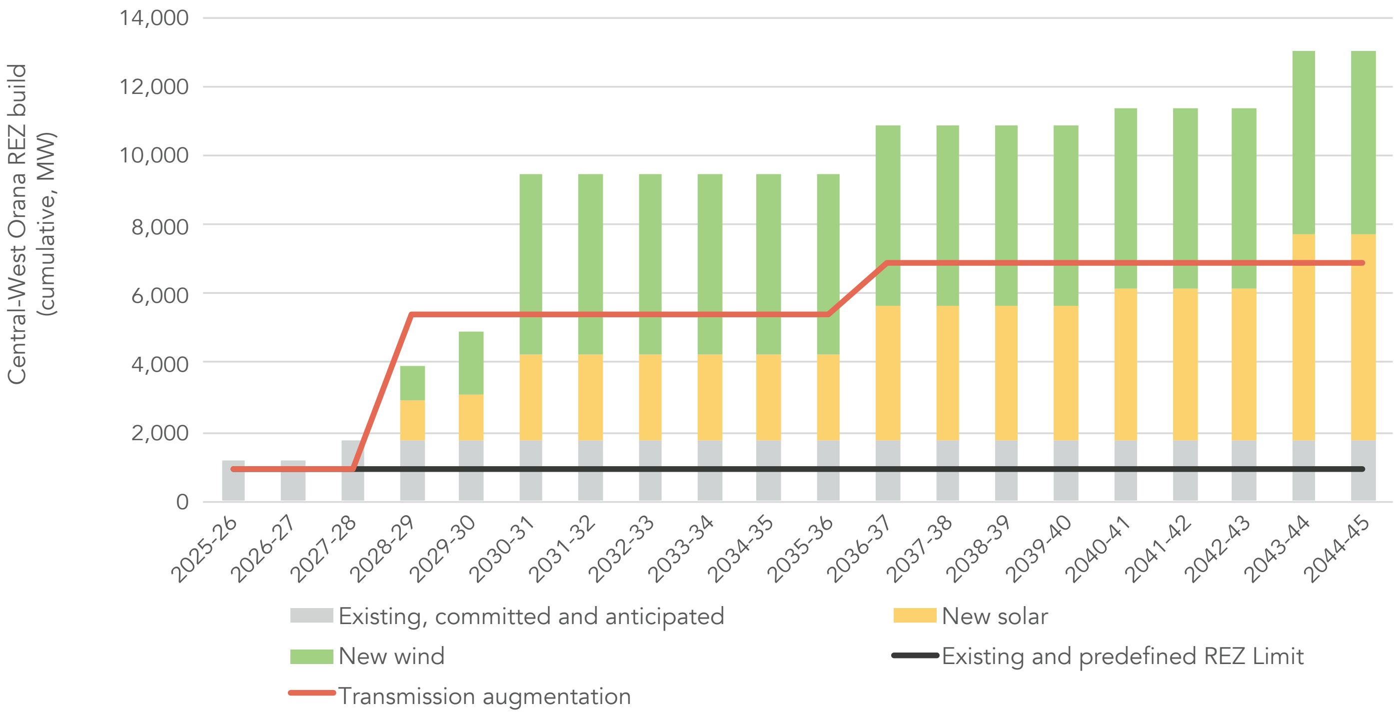
Note: Includes existing, committed, anticipated and new entrant generation.

5.2.1 Central-West Orana REZ

The Central-West Orana REZ is a major source of new generation assumed in the development pathway.[33] This is underpinned by two significant network investments:

- Central-West Orana option 1 is the REZ network infrastructure project that has already been authorised by ASL and is now entering the construction period with a delivery date of 2028-29. This option will support ten renewable energy and storage projects that have been granted access rights.
- The second option to increase the hosting capacity of Central-West Orana REZ is forecast to be required in around 2036-37, increasing the REZ network transfer capacity to approximately 6 GW and providing it with the ability to host approximately 13 GW of generation infrastructure (Figure 26).

Figure 26: Central-West Orana REZ network and generation capacity under the development pathway



Note: Modelling underpinning the development pathway does not capture latest information on the Central-West Orana REZ access rights.

33 ASL acknowledges that some access rights projects are hybrids and that future generation in the Central-West Orana REZ could also include storage.

Dubbo Portion 1, which aims to increase hosting capacity in Essential Energy's network, was determined to be necessary under the *Supply Chain Constrained* scenario to host wind generation projects, but not under the *Ambition* scenario.

This is because the *Supply Chain Constrained* scenario seeks out wind projects which maximise generation per GW of constructed capacity to meet the supply chain constraint pre-2030, even if this involves a relatively higher-cost network upgrade.

Under the *Ambition* scenario, lower cost solar projects that do not require network upgrades are selected, delivering a more balanced variable renewable energy mix.

Work remains ongoing between Essential Energy, EnergyCo and AEMO to jointly plan this network option.

Table 5: 2025 IIO report modelled projects in the Central-West-Orana REZ

REZ project	Description	Modelled timing
Central-West Orana option 1	New 500 kV and 330 kV transmission lines from the existing network at Wollar to Merotherie, with an extension to Elong Elong to enable the delivery of 4.5 GW of additional network capacity.	2028-29
Central-West Orana option 2	Infrastructure to support an increase to the operating voltage from 330 kV to 500 kV between Merotherie and Elong Elong. This will support an additional 1.5 GW of network capacity.	2036-37
Dubbo Portion 1	Essential Energy network augmentations to provide energy hubs at Forest Glen and Geurie. Supporting local line work modifications and upgrades.	2026-27 (selected in *Supply Chain Constrained* scenario only)

Note: Options 1 and 2 were modelled in conjunction with the 2024 ISP network topology and network augmentations in its Optimal Development Pathway which includes the Hunter Transmission Project entering in 2028-29 and the Sydney Ring South represented by Option 2D. The Hunter Transmission Project has since had an updated delivery timing of late-2029.

5.2.2 South West REZ

In the South West REZ, committed network capacity is being delivered through National Electricity Rules (NER) pathways, including Project EnergyConnect, HumeLink and VNI West which, based on AEMO's 2024 ISP, and are expected to provide 2.5 GW of network transfer capacity for the South West REZ.

At the time modelling commenced for this report, these options were expected to be delivered by 2030. However, a delay to VNI West has subsequently been announced, with the project's revised completion date now set for late 2030. This project is expected to be required to enable the efficient utilisation of the South West REZ access rights projects, including the 3.56 GW of generation capacity.

Following the publication of AEMO's 2024 ISP, ASL understands that EnergyCo, with input from Transgrid, has conducted analysis demonstrating that an additional transformer at Dinawan is required in addition to Project EnergyConnect, HumeLink and VNI West (all progressing through NER pathways) to enable the full 2.5 GW of network transfer capacity in the South West REZ in 2029-30.

Under the 2025 IIO report scenarios, this additional transformer was *assumed* to be delivered in conjunction with VNI West in 2029-30, unlocking 2.5 GW of network transfer capacity.

Delivering 2.5 GW of network transfer capacity in the South West REZ is required to ensure the South West REZ generation projects underpinning the development pathway can deliver benefits to NSW electricity customers.

Noting the announced delay to VNI West since modelling for this report commenced, network options that can facilitate and/or support the achievement of this network transfer capacity for the South West REZ may be seen to be in the long-term financial interests of NSW electricity customers where:

- They can accelerate the South West REZ by increasing its network transfer capacity compared to expected delivery timelines of necessary network projects delivered under NER, and
- They are required in addition to the necessary network projects delivered under NER to achieve the 2.5 GW network transfer capacity, and
- Their cost does not exceed the expected benefits to NSW electricity customers from the generation enabled in the South West REZ.

Beyond this, one additional network augmentation has been selected in modelling underpinning the development pathway in the South West REZ to support additional generation capacity separate to the maximum aggregate capacity cap under the access scheme on the access rights network. This expansion is achieved through a new network augmentation connecting Darlington Point and Dinawan, which is selected in 2042-43 across both scenarios, including the development pathway, and the *No NSW Coal by 2034* sensitivity (Figure 27).

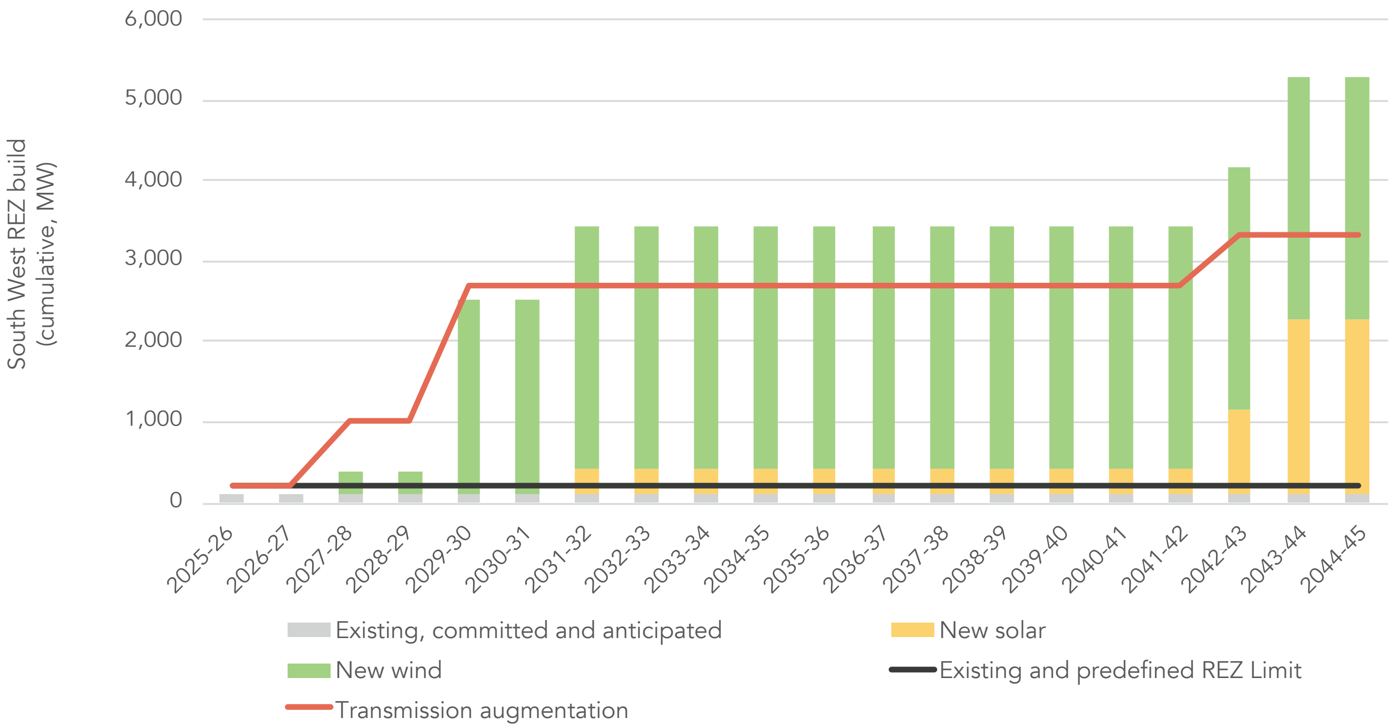
It is possible for this project to be brought forward if generation expansion in the South West REZ is identified to be required sooner than the 2040s, for example where the quality of generation projects is higher than assumed in modelling, including the wind resource profiles.

Based on the IIO report modelling selecting this option in both scenarios and the sensitivity, this project may be in the long-term financial interests of NSW electricity customers. Further investigations may be required as to whether these interests would be best served by an accelerated delivery schedule for the project using updated information on resource potential.

Table 6: 2025 IIO report modelled projects in the South West REZ

REZ project	Description	Modelled timing
South West Darlington Point to Dinawan	Transgrid construction of a new 330 kV transmission line from Darlington Point to Dinawan and associated substation augmentation works.	2042-43

Figure 27: South West REZ network and generation capacity under the development pathway



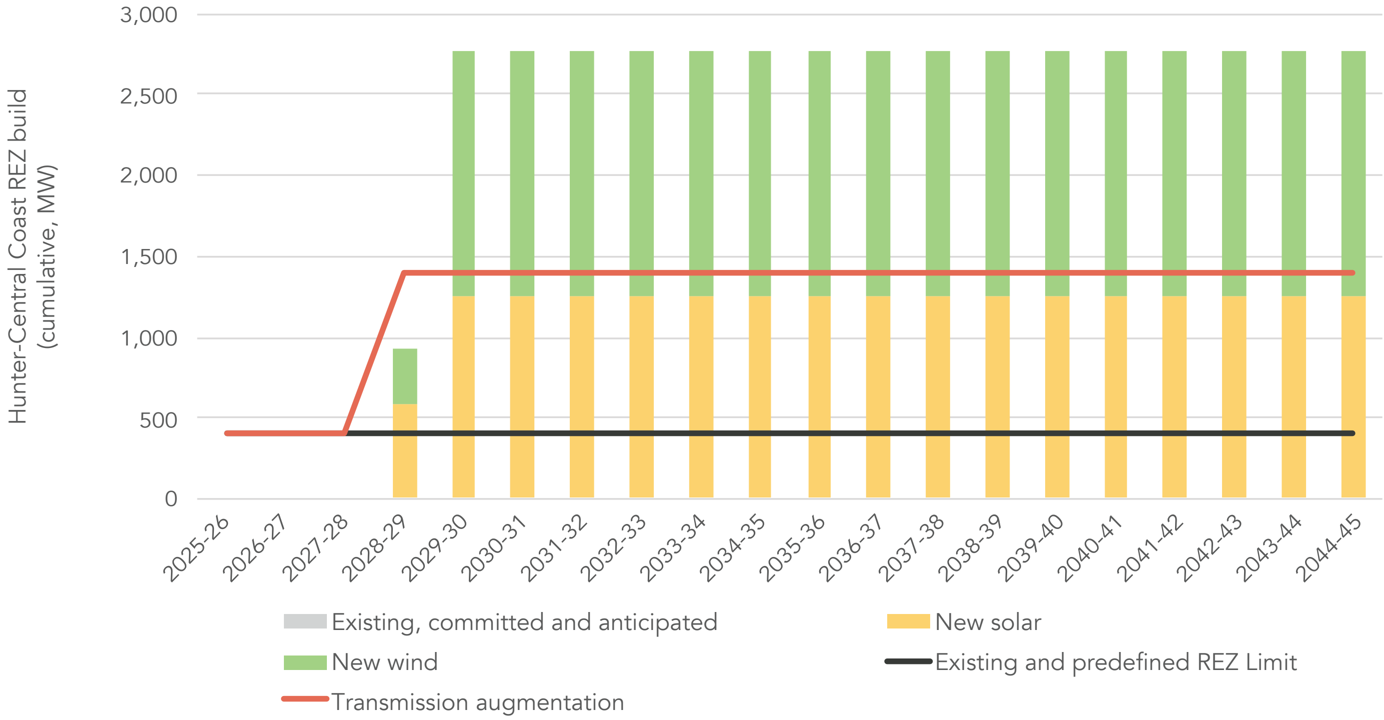
5.2.3 Hunter-Central Coast REZ

The Hunter-Central Coast REZ is an important source of new generation development in the lead-up to 2030. This requires the delivery of one distribution network augmentation, the Hunter-Central Coast Option 1 (Table 7), which has been authorised by ASL and is scheduled to be delivered by 2028-29.[34] Once this option is built, the REZ is expected to host approximately 2,800 MW of generation (Figure 28).

Table 7: 2025 IIO report modelled projects in the Hunter-Central Coast REZ

REZ project	Description	Modelled timing
Hunter-Central Coast option 1	Upgrades to the existing Ausgrid transmission and sub-transmission network, with works in Muswellbrook, Singleton and Kurri, including a new 132kV line between Singleton and Kurri and a new 132 kV Antiene sub-transmission switching station. This will support an additional 1 GW of network capacity.	2028-29

Figure 28: Hunter-Central Coast REZ network and generation capacity under the development pathway



Note: Modelling underpinning the development pathway may not capture latest information on the Hunter-Central Coast REZ generator project pipeline.

34 The Hunter-Central Coast Option 1 was authorised by the Consumer Trustee in April 2025 and is awaiting a revenue determination from the Australian Energy Regulator.

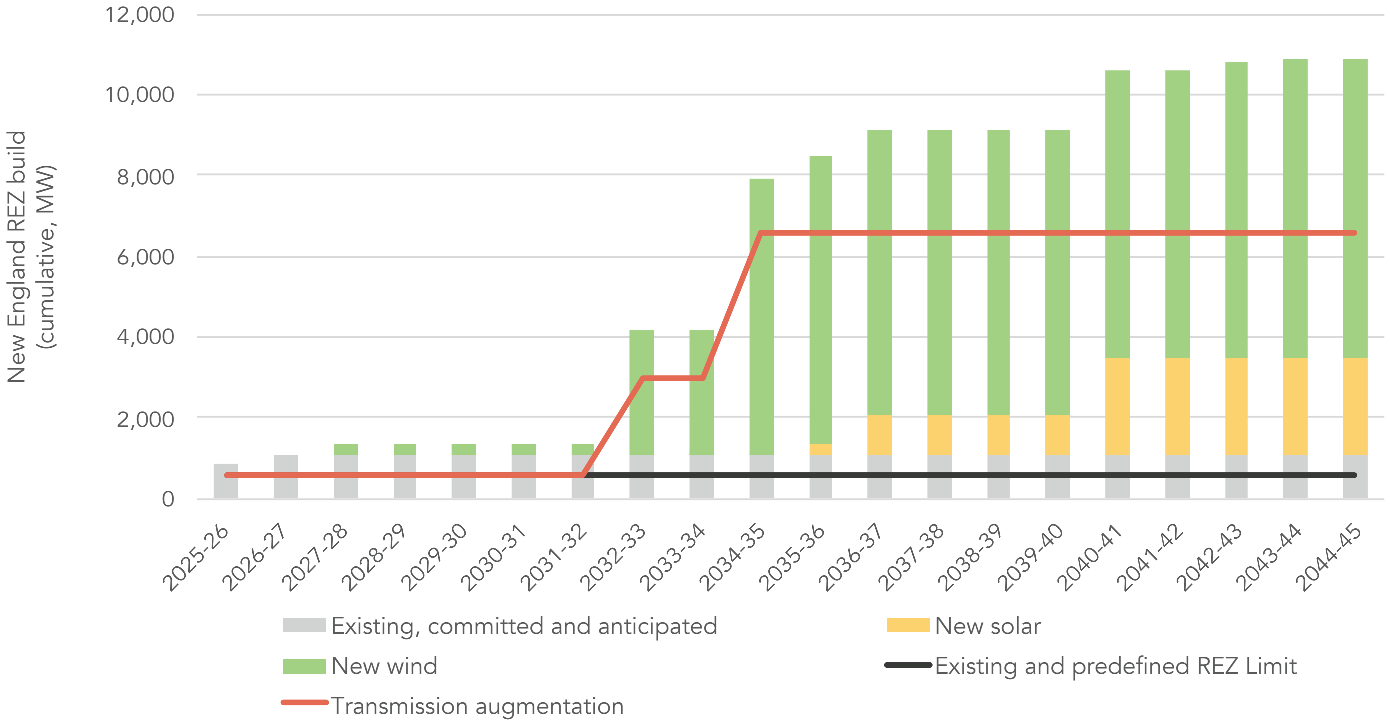
5.2.4 New England REZ

Along with the Central-West Orana REZ, the New England REZ is a significant provider of new generation capacity in NSW in the 2030s. Under the development pathway, two new stages of New England are selected for construction in the IIO report modelling. These two network augmentations are: New England Option 1A, which enters service in 2032-33, and New England Option 2A, arriving two years later in 2034-35 (Table 8). These augmentations deliver 2.4 GW and 3.6 GW of additional network transfer capacity respectively and are modelled to host around 9 GW of generation by the late 2030s (Figure 29).

Table 8: 2025 IIO report modelled projects in the New England REZ

REZ project	Description	Modelled timing
New England option 1A	This option includes construction of a new 500 kV transmission line from Bayswater to a new Central Hub via Central South. It cuts into the existing Tamworth to Armidale Line at the new Central hub, with new 330 kV lines from Central Hub to create Northern and Eastern Hubs, as well as creating a connection to the Central South Hub. It also includes utilisation of phase shifting transformers. This option delivers additional network capacity of 2.4 GW.	2032-33
New England option 2A	Building on New England Option 1A, this enables an additional 3.6 GW of network capacity through operating lines at higher voltage and installing or expanding associated infrastructure. It also includes a new 500 kV line built from Central Hub to Bayswater. The North Hub is cut into the existing Armidale to Sapphire line. Includes utilisation of phase shifting transformers.	2034-35

Figure 29: New England REZ network and generation capacity under the development pathway



5.2.5 Other relevant network infrastructure projects

In addition to the REZ network projects considered above, further network projects are either currently under construction or planned. This includes projects listed as actionable or future projects in AEMO's 2024 ISP (being delivered through NER pathways) as well as priority transmission infrastructure projects captured under the EII Act.

These projects remain pivotal to NSW's energy transition and were included in the 2025 IIO report modelling with assumed entry as per their optimal date in the 2024 ISP *Step Change* scenario. Subsequently announced updates to delivery timing for transmission infrastructure, including the Hunter Transmission Project and VNI West, pose risks to the full utilisation of new renewable generation and its ability to reach load centres. This may result in greater curtailment of variable renewable energy generation and less downwards pressure on wholesale prices while these projects are being completed.

A summary of these projects is set out in Table 9 below.

Table 9: Future transmission projects underpinning the development pathway

REZ project	Description	Modelled timing	Regulatory status
Hunter Transmission Project	A 500 kV transmission upgrade to reinforce supply to Sydney, Newcastle and Wollongong load centres.	2028-29[35]	Priority Transmission Infrastructure Project under the EII Act
Waratah Super Battery	New battery with system integrity protection scheme and associated minor network augmentation, to improve transfer limit between Central NSW and Sydney-Newcastle-Wollongong.	2025-26	Priority Transmission Infrastructure Project under the EII Act
Project Energy Connect	A new 330 kV double-circuit interconnector between South Australia and New South Wales.	2027-28	ISP Committed/ Anticipated Project. Regulatory approval gained from the AER in May 2021
Sydney Ring South (Option 2D)	New 330 kV switching station in the Greater Western Sydney region allowing more generation to be transferred to Sydney from Southern NSW. This option also improves power flow sharing between the northern and southern segments of Central NSW and Sydney-Newcastle-Wollongong flow paths.	2029-30	ISP Actionable Project
HumeLink	A 500 kV transmission upgrade connecting Project EnergyConnect and the Snowy 2.0.	2029-30	ISP Actionable Project
VNI West	A new high capacity 500 kV double-circuit line to connect Western Renewables Link (from Bulgana) with Project EnergyConnect and HumeLink (at Dinawan) via a new substation near Kerang.	2029-30[36]	ISP Actionable Project
QNI Connect	Adds capacity between southern Queensland and New England REZ, following development of the New England REZ network infrastructure project.	2034-35	ISP Actionable Project

Source: AEMO, 2024 ISP, Appendix 5 Network Investments, June 2024 and EnergyCo. Modelled timing for ISP Actionable projects based on ISP optimal timing *Step Change* scenario.

35 The delivery timing of Hunter Transmission Project has been updated to late-2029 in AEMO's 2025 Electricity Network Options Report.

36 The Transmission Company Victoria announced that the VNI West project has been delayed, with completion now expected for late 2030. See Transmission Company Victoria's website, media release, 30 June 2025.

5.3 A new approach to high-value, low-cost network upgrades

Under the EII Act, ASL as the Consumer Trustee independently assesses and authorises REZ network infrastructure projects following a recommendation from the Infrastructure Planner. In exercising its authorisation function, the Consumer Trustee is required to act independently and in the long-term financial interests of NSW electricity customers. The Consumer Trustee must also exercise its function in a way that is consistent with the objects of the EII Act.

On 1 July 2024, an amendment to the EII Regulation took effect to enable ASL to give the IIO report primary consideration when deciding whether authorising a recommended REZ network infrastructure project is in the long-term financial interests of NSW electricity customers (see Appendix A4). Further details of the amendment are set out in Box 3.

Box 3: Amendments to the authorisation process for REZ network infrastructure projects

The relevant changes to the EII Regulation noted in section 5.3 only impact the "long-term financial interests" aspect of the authorisation process and enable ASL to determine that a separate CBA is not required. It remains the responsibility of EnergyCo, in exercising its statutory function as the Infrastructure Planner, to assess and make recommendations to the Consumer Trustee about REZ network infrastructure projects.

ASL, as the Consumer Trustee, must then consider the Infrastructure Planner's recommendations and decide whether the recommended project should be authorised consistent with its statutory requirements.

While reliance on the IIO report facilitates a more streamlined authorisation process, ASL maintains its statutory discretion to independently assess the recommended project as part of the Consumer Trustee's authorisation decision.

To support this new approach, the 2025 IIO report includes a benchmark annual cost test (benchmark) and associated thresholds to identify additional network options that have a high-value and low-cost relative to network projects modelled in the 2025 IIO report.

Projects that meet the benchmark and associated thresholds are likely to have a greater net benefit than those network projects that were selected in the IIO report modelling and are therefore more likely to be considered in the long-term financial interests of NSW electricity customers.

If EnergyCo identifies and recommends projects that meet the benchmark and associated thresholds, this approach enables a more streamlined authorisation process by allowing ASL to rely on the IIO report in its analysis of the long-term financial interests of NSW electricity customers.

For projects that do not meet the thresholds, the benchmark can still be used as a relevant comparison because, while such projects are not eligible for the streamlined authorisation process, they are more likely to have net benefits to NSW electricity customers.

There are three elements to the approach:

1. **Benchmark annual cost test for REZ network infrastructure projects:** ASL has applied a benchmark annual cost of $10,000 / GWh of available generation enabled p.a. in real terms (2025 dollars). See Appendix A4.4 for more details on how the benchmark has been derived.
2. **Delivery date threshold:** The project must be able to be delivered by the end of calendar year 2031 to enable additional renewable generation in the near future.
3. **Capital cost threshold:** The project must have a capital cost of less than $300 million in real terms (2025 dollars).

The benchmark will apply until the 2027 IIO report, when modelling for the least-cost pathway to meet the infrastructure investment objectives is updated using latest network augmentation costings. Projects will be eligible for streamlined authorisation using the benchmark until the cumulative GWh of generation enabled by authorised projects exceeds the largest assumed REZ network infrastructure project in the 2025 IIO report modelling in 2031. Where this cumulative amount is exceeded, eligible network projects recommended to ASL will be considered for authorisation assessment via CBA.

The benchmark is based on annualised network costs and is expressed in terms of GWh available (i.e. not accounting for technical or economic constraints, or time-of-day value) rather than other measures such as GW of network transfer capacity, generation capacity or generation delivered. This enables a like-for-like comparison with the 2025 IIO report modelling and reflects that the value to NSW electricity customers of a REZ network infrastructure project depends upon the amount of generation it can enable.

Importantly, the value of the available generation – for example, forecast capacity factors and network constraints – will be assessed separately as part of the recommendation and authorisation process based on up-to-date information (such as latest information on network constraints).

REZ network infrastructure projects with the following characteristics are more likely to meet the benchmark and associated thresholds:

- The development and capital costs of the project are reasonable and proportionate, taking into account AEMO's latest Transmission Cost Database information.
- The project can be delivered as early as possible and at least by the end of calendar year 2031.
- The project is in a part of the network that is relatively unconstrained in delivering electricity to load centres and/or the project will alleviate constraints, including downstream constraints (including by reference to AEMO's most recently published Enhanced Locational Information Report).
- The project primarily enables medium to high quality wind resources which are geographically diverse when compared to existing and committed wind generation projects.
- The project may also include options for solar and solar hybrids to connect (in addition to wind generation projects).

To promote competition and reduce risk to NSW electricity customers, ASL recommends that the cost of a network infrastructure project assessed against the benchmark under this threshold should exclude dedicated network infrastructure that is dependent on a specific individual generator proceeding – for example, connection assets or shared network upgrades to accommodate single generators.

As explained in section 5.4, the costs of dedicated network infrastructure should be factored into the LTESA bids of the relevant generation proponents as generator-specific network upgrades.

5.4 Generator specific network upgrades

In addition to the network infrastructure discussed above, the development pathway creates opportunities for generation to connect to the existing network via open access. In these areas, the existing transmission network has available hosting capacity that can accommodate new generation projects.

The modelling underpinning the IIO report demonstrates that projects connecting outside a REZ can connect successfully, utilising existing network capacity effectively.

ASL recognises that some projects in these areas may require augmentation of the shared network and/or extended connection assets. To facilitate successful project development, ASL strongly encourages generation proponents to work closely with the local network service provider to scope and accurately cost any beneficial upgrades, even where these costs were previously thought to be unfeasible.

ASL is committed to enabling all viable generation projects to participate competitively in the LTESA process. Where projects demonstrate strong value propositions, ASL provides clear pathways for incorporating generator-specific network upgrade costs within tender bids to support bankability requirements. Good value projects are likely to:

- be deliverable by 2030 or earlier where feasible
- be located in areas that are relatively unconstrained
- have community support, and
- be backed by proponents which have a strong track record of delivery and/or demonstrate that delivery risks will be managed via engaged supply chains.

This approach ensures that high-value generation projects across all connection scenarios can participate meaningfully in the LTESA process while maintaining system reliability and delivering consumer value.

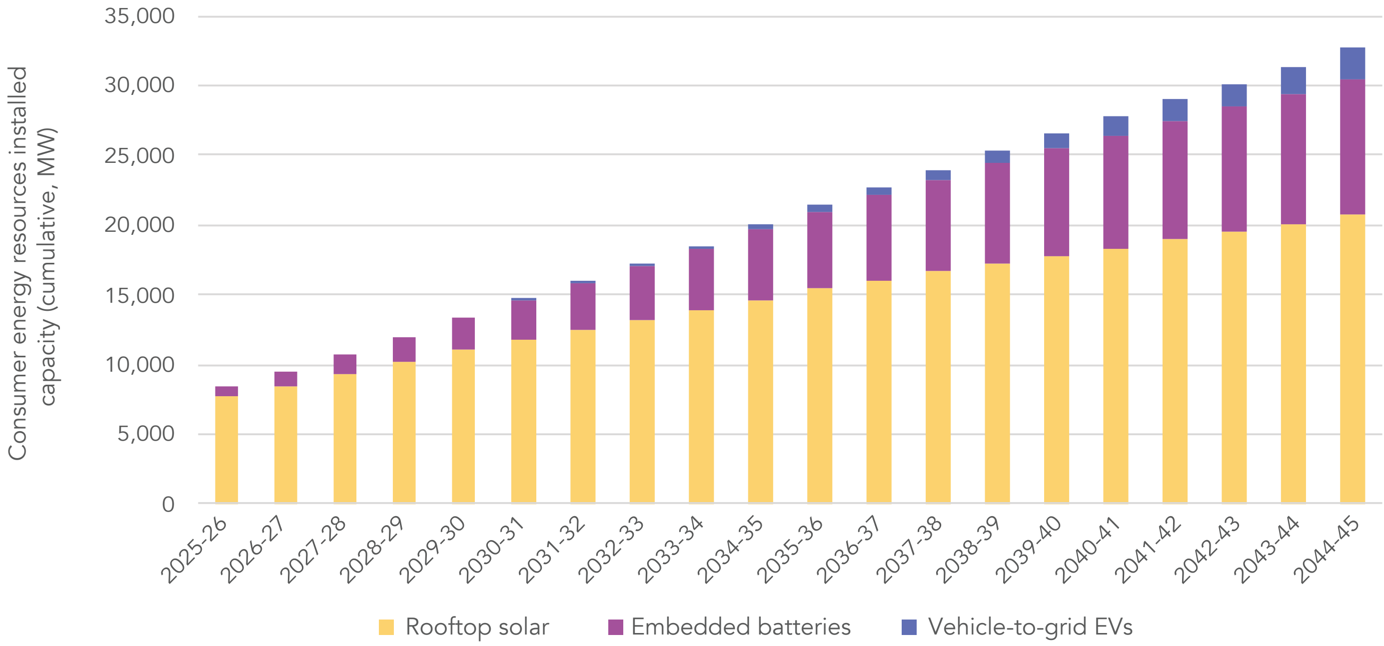
5.5 Network upgrades for consumer energy resources

CER is likely to play a crucial role in the energy transition. AEMO's 2024 ISP CER forecasts, adopted for the 2025 IIO report, show significant growth in uptake (Figure 30).

By 2050, CER is forecast to provide for almost half of the capacity in the NEM and about a fifth of energy consumption. By 2034 in AEMO's *Step Change* scenario, over half of the detached homes in the NEM are assumed to have rooftop solar. Residential and commercial batteries in the NEM also grow significantly over this period to account for approximately 12 GW of installed capacity.

Updated assumptions from the 2025 IASR continue to show strong rooftop solar growth, while the uptake of behind-the-meter batteries in the NEM has been revised down compared to the 2023 IASR.

Figure 30: Forecast of consumer energy resources uptake in NSW



In many cases, upgrades to distribution networks may be required to support this level of CER.

Under the EII Act, generation infrastructure must have a capacity of at least 30 MW to be eligible to count towards the IIOs.[37] For this reason, network infrastructure that supports smaller scale generation and storage is not the focus of the 2025 IIO report.

However, ASL recognises that network investment to support the continuing roll out and orchestration of CER is essential to achieving the development pathway. If the CER forecasts are not achieved, then the infrastructure volume underpinning the development pathway will need to increase to compensate.

The Roadmap is exploring ways to more broadly support CER roll out including potential opportunities for innovation within the Illawarra REZ (Box 4). As part of the 2026 ISP, AEMO is exploring the need for investment in distribution networks to support CER uptake. The NSW Government is also investigating opportunities for CER and has released a Consumer Energy Strategy.[38]

Box 4: Consumer energy resources in the Illawarra REZ

The increasing prominence of CER is highlighted by two recent developments: AEMO's ongoing work to capture distribution network opportunities in the 2026 ISP (with a focus on opportunities to facilitate the aggregate operation of CER and other distributed resources such as community and neighbourhood batteries); and the emergence of the Illawarra region as NSW's first urban REZ through innovative network and battery solutions.

The Illawarra REZ is not only about large-scale opportunities. There is significant potential for neighbourhood and community batteries to unlock commercial and industrial roof space for solar and provide benefits for all parts of the community, including those who may not have access to their own roof spaces.

This REZ presents a powerful opportunity to deliver real community benefits – reskilling the existing talent in this industrial hub, supporting training pathways and unlocking long-term economic strength through cleaner, smarter infrastructure.

By repurposing the existing infrastructure and integrating solutions like neighbourhood batteries, environmental impacts can be minimised and energy solutions that truly work for the region can be delivered.

37 EII Act, section 43(1)a.

38 See NSW Climate and Energy Action's website, Consumer Energy Strategy.

6. Costs of the pathway for NSW electricity customers

- ASL delivers value for NSW electricity customers by setting a development pathway that minimises costs and informs the 10-year tender plan. In preparing the development pathway, ASL has prepared a forecast of the costs of providing wholesale energy services based on the modelled scenarios over a 20-year horizon.
- Given the uncertainty involved with forecasting the variables concerned across long time periods, modelling for this report concentrates on comparing the relative costs to the consumer across scenarios.
- The anticipated cost of Roadmap delivery is on par with 2023 expectations.
  - The estimated total cost of wholesale electricity supply to NSW customers to 2045 is $110 billion in present value terms (2025 dollars). The consumer cost forecast is largely similar to the 2023 IIO report, with increases to the estimated costs of network infrastructure.
- The *Ambition* scenario offers superior value to NSW electricity consumers.
  - Compared to the *Supply Chain Constrained* scenario, the cost to consumers under the *Ambition* scenario is $6.8 billion less in present value terms, across the next 20 years, driven by lower forecast wholesale costs from accelerated delivery of new generation.

6.1 Approach to forecasting costs

Given the variables inherent in modelling, it is not possible to accurately forecast precise market conditions and resulting wholesale electricity costs or scheme costs over a 20-year period. Rather, cost forecasts are prepared and compared across scenarios, allowing decision-making to be informed by an understanding of the relative cost impacts of different development trajectories. These costs do not represent all cost components that appear on an electricity customer's bill and instead seek to quantify those cost elements included in the 2025 IIO report, as outlined in further detail below.

ASL's cost forecasts are prepared utilising a methodology similar to the 2023 IIO report whereby cost estimates for the supply of wholesale energy services to NSW electricity customers consider both wholesale electricity costs, and 'scheme costs', which are costs associated with the Roadmap. Scheme costs are categorised by the EII Act as follows:

- **scheme LTESA costs:** costs associated with payments made by the Scheme Financial Vehicle under existing and planned LTESAs to generation, long-duration storage and firming infrastructure projects
- **scheme network costs:** costs of network infrastructure delivered under the EII Act
- **scheme administration costs:** costs for administration associated with Roadmap entities including the Consumer Trustee, Financial Trustee, Infrastructure Planner, Scheme Financial Vehicle and regulators (the Australian Energy Regulator (AER) and the Independent Pricing and Regulatory Tribunal).

These different cost components, which are included in ASL's forecast, are defined in Table 10. Since the 2023 IIO report, ASL has updated the methodology for calculating LTESA payments for the following reasons:

- **To more accurately reflect the nature of the LTESA as an option product,** whereby projects receive LTESA payments funded by consumers via the scheme in years where they are unprofitable, but not in years where they are profitable. Updates have also been made to reflect that LTESA projects do not typically rely on the LTESA to recover the entirety of their costs.[39]
- **To exclude assumed CIS-supported projects**, considering the expected volume of NSW projects and the financial support they will receive through the Australian Government's CIS. This was not applicable in previous IIO reports as the CIS was not in operation.

39 LTESA scheme costs are assumed to recover up to 60% and 80% for generation and long-duration storage/firming costs respectively. This updated estimate is a refinement to the 2023 IIO report which included full cost recovery.

Further, this report presents consumer costs in present value terms using a 5% discount rate (unless stated otherwise). This rate aligns with NSW Treasury Guidelines and ensures consistency with the approach taken by ASL when deciding whether to authorise a REZ network infrastructure project using a CBA.

Table 10: Cost components included in forecast of costs for provision of wholesale energy services to NSW customers

Cost type	Definition	Cost recovery mechanism
Wholesale electricity costs	The wholesale electricity purchase costs to NSW customers (assuming that spot prices reflect contract prices). This is calculated by multiplying the forecast load-weighted average of NSW spot prices by NSW region operational demand.	Via retailers
Scheme LTESA costs[40]	**Generation LTESA costs** – A proxy for the total net cost paid by the Scheme Financial Vehicle[41] under LTESAs for generation projects. This has been calculated as the difference between a project's costs and revenues, reflecting the 'missing money' required for projects to break even. For a project's costs, it is assumed that up to 60% of project capital and running costs are recovered through the LTESA. For a project's revenues, both wholesale revenues and Large-Scale Generation Certificate (LGC)[42] revenues are considered. This approach is deliberately simplified and does not reflect the way ASL expects proponents to bid for and exercise the LTESA options. By design the LTESA provides flexibility for projects to maximise revenues and ASL's competitive tender process encourages proponents to provide competitive financial value LTESA bids. [43]	Via distribution network service providers under the EII Act contribution determination process[44]
	Long-duration storage and firming LTESA costs – A proxy for the total net cost paid by the Scheme Financial Vehicle under LTESAs for long-duration storage projects. This has been calculated using the same general approach outlined above for generation LTESAs. For long-duration storage projects, assumptions are made on projects' portion of cost recovery through the LTESA, and on additional revenue streams to wholesale revenues not explicitly captured in modelling.[45]	
Scheme network costs	A proxy for total network costs funded by the Scheme Financial Vehicle for new REZ network infrastructure projects or priority transmission infrastructure projects (as defined under the EII Act). Capital cost assumptions for modelled network projects are provided by EnergyCo and are class 5b estimates. Costs are annualised over their economic lifetime[46] using a 4.5%[47] rate of return. Only annual costs incurred over the 20-year time horizon are included in the consumer cost forecast. This approach makes simplified assumptions as to how these costs are recovered from customers over time. It excludes construction finance and considerations of depreciation.	Via distribution network service providers under the EII Act contribution determination process[48]

40 See ASL, 2023 Draft IIO report, pp. 35-37 for an illustration of Scheme LTESA costs.

41 The Scheme Financial Vehicle is established under the EII Act to fund key activities of the Roadmap and collects contributions from NSW distribution network service providers.

42 For generation-eligible LTESA projects, revenue earnt from LGCs was considered, based on assumptions sourced from Aurora Energy Research.

43 See ASL's website, LTESA, to learn more about the LTESA product.

44 EII Act, Part 7.

45 For long-duration storage and firming LTESA-eligible projects, multiple additional revenue streams were considered in addition to wholesale market revenues, including participation in Frequency Control Ancillary Services markets. These were considered to be outside of the core electricity market modelling and were applied as simplified and bundled revenue uplifts.

46 Assumed to be 50 years in line with AEMO's assumptions in the ISP.

47 Based on information provided by EnergyCo.

48 EII Act, Part 7. Participants in an access scheme may also contribute to network costs in REZs.

Cost type	Definition	Cost recovery mechanism
Scheme administration costs	A proxy for the total administration expenses of the Roadmap.[49] For the purposes of this report, forecast administration expenses as contained in the AER's *NSW Electricity Infrastructure Fund 2025–26 contribution determination*[50] are used as an estimate for future administration expenses.	Via distribution network service providers under the EII Act contribution determination process[51]

The Roadmap passes on scheme costs via the distribution component on a customer's bill and are intended to be offset by reductions in wholesale costs. That is, without the Roadmap, there would be no scheme costs but wholesale costs would rise (at a greater rate than the fall in scheme costs).[52]

The approach taken by ASL to estimating scheme costs in this report differs from the contribution determination which is completed by the AER.[53] The AER's contribution determination process is an annual determination conducted over a three-year time horizon and is based on a detailed build-up of revenues and expenditures as well as considering the liquidity requirements of the Scheme Financial Vehicle.

The purpose of this process is to determine the amount required to be recovered from distribution network service providers in order to allow the Scheme Financial Vehicle to make payments as required under the EII Act.

6.2 Forecast costs for the supply of wholesale energy services

ASL's analysis shows that the present value of total costs (in real terms 2025 dollars)[54] for the supply of wholesale energy services to NSW electricity customers is $110 billion over the 20-year horizon to 2045. An annual breakdown of forecast wholesale and scheme costs, in real terms, is set out in Figure 31.

Historical actual wholesale costs to NSW customers in 2024-25 are incorporated for reference against the forecast trajectory. Wholesale costs are forecast to reduce when compared to recent historical observations, in line with significant additional capacity assumed to enter the system. This includes the delivery of approximately 1.4 GW of committed and anticipated battery projects, the Hunter Power Station (Kurri Kurri) and over 2 GW of solar and wind projects in NSW, as well as additional capacity in other regions.

Notably, the forecast reduction in wholesale costs in the initial three years, as compared to recent historical observations, is primarily driven by consistent input assumptions across modelled scenarios. In these scenarios, new infrastructure build is limited by the development pipeline. As such, this initial cost reduction is not attributed to the ambitious development pathway outcomes around 2030.

Total wholesale costs to NSW customers increase in line with assumed generator retirements and higher electricity demand over time.[55] In general, higher wholesale costs are associated with generator retirements and/or higher demand, while lower wholesale costs are associated with new investment in generation and/or network capacity. These costs reflect the modelled wholesale price outcomes which arise where the development pathway is delivered. As noted above, modelling relies on highly uncertain assumptions, such as assumed bidding behaviour of both new and existing generators.

The historical 2024-25 and current 2025-26 years are presented with the actual contribution determination figures published by the AER to reflect Roadmap scheme costs. From 2026-27, forecast LTESA scheme costs reflect a combination of increasing volumes of LTESA projects and the impacts of modelled wholesale prices on their assumed revenues.

49 This includes costs incurred by the Consumer Trustee, Financial Trustee and regulators in exercising their functions under the EII Act, s55(b). The Infrastructure Planner may also recover administration costs through alternative pathways, such as on the basis of access scheme declarations or approval under section 66(4) of the EII Act.

50 AER, NSW Electricity Infrastructure Fund – Contribution determination 2025-26, 19 February 2025.

51 EII Act, Part 7.

52 NSW Government, NSW Electricity Infrastructure Roadmap benefits modelling outcome report, May 2024.

53 See AER's website, NSW contribution determination guideline, for further information on the approach.

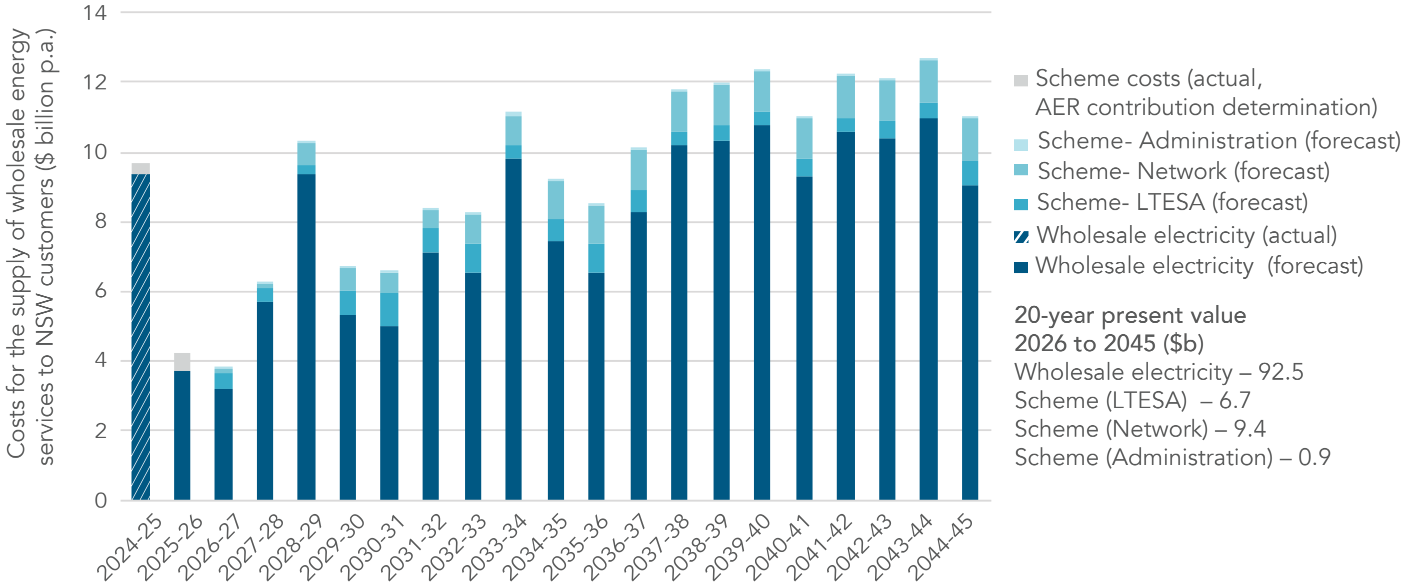
54 The present value of the cost forecast is in real terms (2025 dollars), calculated by discounting costs to the first modelling year (2025-26) at a real discount rate of 5%.

55 Costs in Figure 31 are presented on a total NSW consumption basis. While these appear to increase over the modelled horizon, this is partially reflective of increased electricity demand projections.

As outlined in Table 10, scheme network costs reflect the assumed annualised costs of modelled REZ network infrastructure projects and priority transmission infrastructure projects, increasing over time as additional network is delivered. Scheme administration costs make only a small contribution to the overall estimated costs and are assumed constant across the forecast.

Notably, the costs presented in this report are distinct in nature from those forecast in other publications which report on system costs, such as AEMO's 2024 ISP.[56] Rather, these costs focus on modelled wholesale electricity market dynamics, prices and associated revenues of certain NSW projects, as well as annualised costs of certain NSW network projects.

Figure 31: Forecast of annual costs for the supply of energy services to NSW electricity customers



There have been a range of updates since the 2023 IIO report, including the dollar basis and discount rate applied. Table 11 presents the 2023 IIO report costs against the 2025 IIO report costs on both a 10- and 20-year present value basis. When compared on a like-for-like basis, the wholesale, LTESA scheme and administration scheme costs are similar between the two publications. Network costs have increased since the previous report, reflecting observed increases in the cost of delivering new network projects in the NEM.

Table 11: Comparison of 2023 and 2025 IIO report cost forecasts (real 2025 dollars, 5% discount rate)

Cost forecast	2025 IIO report *Ambition scenario*	2025 IIO report *Supply Chain Constrained scenario*	2023 IIO report *Central scenario*
20-year present value	$109.6 billion	$116.4 billion	-
10-year present value	$56.1 billion	$63.7 billion	$57.9 billion*

Note: *Conversion made for comparison purposes. 2023 IIO report value was $49.6 billion (real 2022 dollars, 7% discount rate).

56 AEMO's ISP reports on the net present value of capital costs for new network augmentations and utility-scale generation and storage across the NEM.

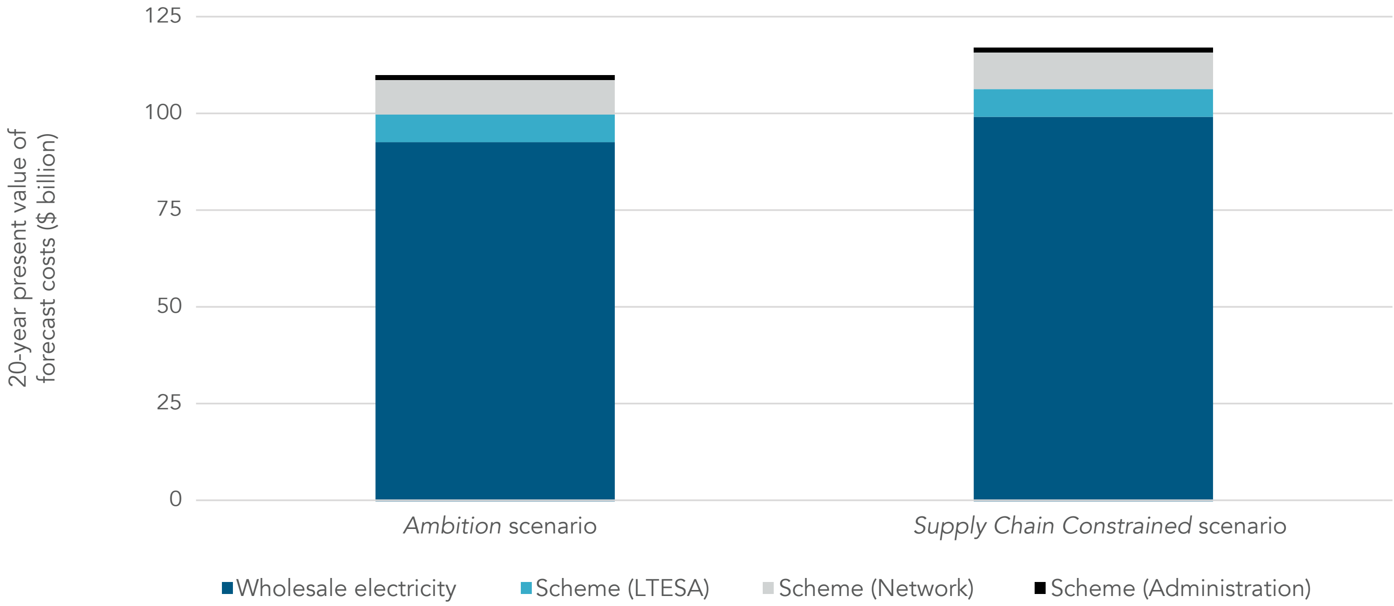
Comparing costs between scenarios

The infrastructure trajectory and cost forecast of each scenario represent least-cost outcomes. Figure 32 shows the consumer cost comparison between the *Ambition* and *Supply Chain Constrained* scenarios, demonstrating that *Ambition* has lower overall consumer costs by $6.8 billion in present value terms across the next 20 years.

This is predominantly driven by *Ambition's* lower wholesale costs, realised through higher volumes of new build renewable generation, with these benefits outweighing the increased associated scheme LTESA costs. This is most pronounced before the early 2030s, in line with the assumed supply chain constraint which limits annual build in the NEM to 4-8 GW per year in this scenario.

Beyond 2032-33, when the supply chain constraint no longer binds, the two wholesale cost trajectories converge and deliver similar consumer cost outcomes.

Figure 32: 20-year present value of forecast costs by scenario ($ billion)



Taken together, the customer cost outcomes across both scenarios demonstrate the importance of timely coordinated infrastructure delivery and the benefits that can be obtained by addressing supply chain challenges and delivering more projects at an accelerated rate.

A1. Modelling methodology

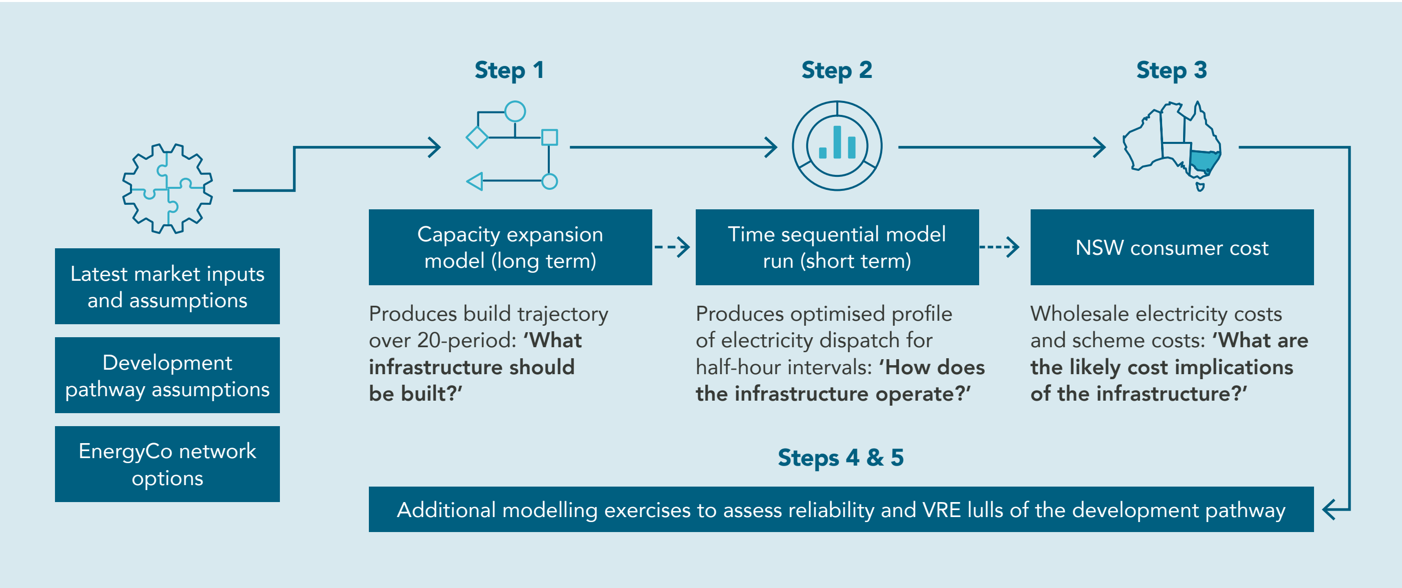
This section describes the modelling methodology used by ASL in preparing the development pathway contained in this 2025 IIO report, including the objectives and the range of inputs and assumptions. ASL uses electricity market modelling, commissioned and funded by ASL and undertaken by AEMO, to inform the development pathway.

The market modelling for this report commenced in late 2024 and involves considering a range of forecast inputs and assumptions over a 20-year period to produce an optimal (customer least-cost) trajectory for the development of new infrastructure (including generation, storage, firming and network infrastructure).

A1.1 Modelling steps

An overview of ASL's end-to-end modelling approach is set out in Figure 33 below.

Figure 33: Overview of IIO report modelling steps



- **Latest market inputs and assumptions:** Inputs and assumptions are mostly aligned with AEMO's 2024 IASR for the *Step Change* scenario. Some deviations are used when capturing latest information or where these are more appropriate for the purposes of the 2025 IIO report, such as the forecasting of consumer costs. Updates are sourced from EnergyCo (such as latest NSW REZ network information), AEMO (the most recent Generation Information page at the time of modelling) and ASL's own internal work (such as technology-specific WACC assumptions, assumed near-term build limitations and supply chain constraint assumptions).
- **Step 1:** This step builds a trajectory for infrastructure development over a 20-year period, answering the question 'what infrastructure should be built?'. The capacity expansion modelling considers both demand-side inputs (including operational demand and CER uptake) and supply-side inputs (including existing and committed generation, retirement dates and new infrastructure costs). The selection of NSW REZ network infrastructure projects and their timing, alongside the selection of generation, storage and firming infrastructure, is co-optimised in this step to minimise costs. The outcome is the least-cost capacity expansion trajectory.
- **Step 2:** This step creates an optimised profile of electricity dispatch for half-hour intervals, answering the question 'how does the infrastructure operate?'. The modelling uses the infrastructure trajectory from step 1 to simulate the operation of the NEM. The results predict real-time electricity generation, consumption and pricing that would occur in the market over the modelling horizon. In this time-sequential modelling step, we ran 480 iterations for each forecast year and scenario including:
  - 12 weather reference years (2011 to 2022)
  - 20 outage patterns (each with a unique and randomised set of generator outages across the NEM)
  - 2 demand profiles (reflecting POE10 and POE50 maximum demand).[57]

57 Probability of exceedance (POE) measures the percentage likelihood of exceeding the maximum demand by the number specified.

- **Step 3:** This step considers wholesale electricity costs and scheme costs, answering the question 'what are the likely cost implications of the infrastructure?'. The step conducts consumer cost calculations using outputs from steps 1 and 2 to estimate the costs of supplying wholesale energy services to NSW electricity customers. This involves considering wholesale electricity costs and 'scheme costs' (that is, costs associated with payments made under LTESAs to generation, long-duration storage and firming infrastructure projects, and costs of network infrastructure delivered under the EII Act). This ensures the overall objective of building additional generation, long-duration storage and firming infrastructure minimises costs to NSW electricity customers.
- **Steps 4 and 5:** These two steps are undertaken to test the reliability and resilience of the development pathway.
  - **Reliability assessment:** This assessment is completed over a 10-year modelling horizon and broadly aligns with standard practices adopted by AEMO for its ESOO. It is designed to ensure sufficient infrastructure is built to achieve the overall objective of meeting the reliability standard and interim reliability measure.
  - **VRE lulls assessment:** This assessment re-simulates the development pathway in time-sequential modelling with additional extreme VRE lull events. ASL assesses the resilience of the development pathway to such events by analysing metrics including the sufficiency of generation to meet NSW demand and the impact on NSW wholesale prices.

A1.2 Modelling purpose and infrastructure requirements

The model underpinning the development pathway is designed to minimise overall system cost while meeting key infrastructure investment, reliability and energy security requirements. Specifically, the modelling process seeks to:

- Meet the legislated infrastructure investment objectives, including:
  - A minimum of 33,600 GWh p.a. of available VRE generation infrastructure having construction completed by the end of 2029.
  - A minimum of 28 GWh of long-duration storage capacity constructed by the end of 2033, including 2 GW and 16 GWh constructed by the end of 2029.
- Meet the reliability standard and energy security target in New South Wales.

The model allows for the entry of generation and long-duration storage infrastructure that is additional to the minimum requirements, both prior to and after achieving the minimum objectives, if it minimises costs for NSW electricity customers or is required to maintain reliability.

The objective of the modelling is to produce least-cost outcomes to NSW electricity customers. Practically, it is challenging through linear programming, which is the foundation of the majority of energy market modelling software, to optimise system planning in a way that minimises end-costs to consumers in the capacity expansion model (step 1 of Figure 33). These mathematical limitations mean capacity expansion plans minimise overall system costs with consumer cost minimisation being validated through time sequential modelling and the calculation of consumer costs (steps 2 and 3 of Figure 33).

Over the last three years, ASL has tested various modelling approaches to more closely align with consumer cost-minimising infrastructure planning. Previous tests have indicated that higher wind-to-solar ratios of new generation infrastructure and earlier network delivery can lead to lower forecast consumer costs, all else being constant. However, these approaches are case-specific and not broadly applicable.

Step 1 of the modelling exercise uses system least-cost optimisation and therefore provides a simplified view of consumer cost minimisation outcomes. This is then further explored in step 2, which attempts to replicate the operational behaviour of the NEM through the NEM dispatch engine.

Step 3 of the IIO report modelling process focuses on consumer costs (rather than the system and wholesale costs) derived from the electricity market modelling of steps 1 and 2. This is then used to inform costs associated with the development pathway.

A1.3 NSW network assumptions

The NSW REZ network infrastructure project options available to the model are provided by EnergyCo, including their cost, added network capacity and earliest entry timing for four Roadmap REZs:

- Central-West Orana
- New England
- Hunter-Central Coast
- South West.

In addition to this, and in an update from previous IIO reports, some options reflecting upgrades to the existing transmission and distribution network have been provided as options for the model to consider. Results describing the role of network options in modelling underpinning the development pathway are discussed in Chapter 5 of this report.

A1.4 Modelling assumptions

The build trajectories for the two scenarios and one sensitivity outlined in this report are driven by a range of assumptions. Assumptions used in the modelling cover a broad range of variables and include:

- existing and planned supply
- forecast demand
- policy settings
- fuel costs
- the transmission network configuration
- the expected costs and attributes of new candidate infrastructure.

Generally, ASL seeks to align with AEMO's most recent assumptions, which in this instance are drawn primarily from AEMO's 2023 IASR and 2024 ISP. However, ASL may update these assumptions to reflect the best available information known at a certain point in time or as needed to address the specific objectives of the IIO report.

The key assumptions used in the modelling for this report are set out in section A1.4.1.

A1.4.1 Overarching assumptions

A summary of key assumptions across the two scenarios and one sensitivity modelled for this report are included in Table 12. Where possible, ASL looks to align with AEMO's ISP assumptions and as such many assumptions are taken from the 2024 ISP. Some important modelling assumptions differ to the approach taken in the 2024 ISP. These generally occur because of the timing of the reports as well as the different purposes of the two reports.
An explanation of diversions where relevant are outlined in the below table.

Table 12: Key modelling assumptions and diversions from the 2024 ISP

Assumption	ASL approach	AEMO approach for 2024 ISP	Justification where diversion occurs
Australian Government renewable policy	Exclusion of the Powering Australia Plan to achieve 82% VRE share by 2030.[58] Inclusion of the corresponding dispatchable capacity targets.	Inclusion of the Powering Australia Plan renewable energy and dispatchable capacity targets.	Ensuring the development pathway reflects the least-cost pathway to NSW customers in meeting the IIOs requires the removal of additional targets which could influence the development pathway.
State-based renewable policies	All state-based policy targets were included in this modelling exercise while ensuring technology lead times were met.	All state-based policy targets modelled.	Some adjustments were made where lead time assumptions no longer enable policy targets to be met at the time of modelling for the 2025 IIO report (over a year after the 2024 ISP).
Demand	Demand assumptions (including CER) are aligned to the 2024 ISP *Step Change* scenario.	Demand assumptions (including CER) are outlined in the 2023 IASR.	N/A
Coal-fired power stations' retirement timings	Aligned with 2024 ISP *Step Change* scenario outcomes whilst capturing the announced extension of the Eraring Power Station to August 2027.	Output of the 2024 ISP.	Utilises latest available information.
Network Investment	2024 ISP Optimal Development Path options and their timings are assumed inputs. NSW REZ network infrastructure projects are optimised in the IIO report modelling.	Network options considered in modelling are outlined in AEMO's 2023 IASR.	Utilising latest information from EnergyCo.
Assumed capacity	AEMO Generation Information (October 2024) plus additional NSW Tender 5 LTESA projects.	Existing, committed and anticipated projects are assumed as per AEMO February 2024 Generation Information.	Utilises latest available information at modelling commencement.

58 While the renewable energy component of the Powering Australia Plan 2030 target was excluded from modelling in this report, the outcomes of the *Ambition* scenario are consistent with the 82% renewables by 2030 target for the NEM.

Assumption	ASL approach	AEMO approach for 2024 ISP	Justification where diversion occurs
Technology-specific build limits	Beyond lead time assumptions, NSW build limits are applied to generic new[59] wind and solar build options. Limits are informed by projects in the NSW development pipeline which have development approval and equate to ~1.5 GW total new VRE limit by 2026-27 and ~3.9 GW total new VRE limit by 2027-28.	No build limits are applied beyond lead time assumptions.	Reflects practical challenges associated with the pipeline of short-term build, in line with NSW project development pipeline.
REZ VRE build	Both Central-West Orana and South West access rights projects are assumed in the modelling. REZ access schemes are captured by not allowing further generation expansion beyond the maximum aggregate capacities (Central-West Orana 7.7 GW, and South West 3.98 GW) unless there is further network investment.	No consideration beyond REZ land limits.	Captures latest available information and reflects REZ access schemes in place.
Build costs	Aligned with *Step Change* Scenario assumptions in the 2023 IASR.	Aligned to assumptions in the 2023 IASR.	N/A
Coal and gas fuel cost	Aligned with *Step Change* scenario forecasts in 2023 IASR.	Aligned with forecasts in 2023 IASR.	N/A
Generation, storage and transmission WACCs (pre-tax real terms)	Technology-specific WACCs which range from 7 – 8.5% (pre-tax real terms) for generation and storage projects and 4.5% for transmission projects.[60]	Technology-agnostic WACC of 7% (pre-tax real terms).	Variations in cost of capital are important to reflect for the accuracy of customer costs, considering ASL's obligation to consider the long-term financial interests of NSW electricity customers.
Discount rate	5%, in line with NSW Treasury Guidelines.	7%, as per assumptions in the 2023 IASR.	5% ensures consistency with the approach taken when authorising a REZ network infrastructure project using a CBA.

59 New projects exclude those projects listed as existing, committed or anticipated in AEMO's Generation Information from October 2024.

60 CEPA, WACC assumptions, 13 November 2023. Report prepared for ASL.

The *Supply Chain Constrained* scenario and *No NSW Coal by 2034* sensitivity used in this report seek to alter a set of specific variables to further help understand key aspects of the energy transition. The *Supply Chain Constrained* scenario imposes a supply chain constraint onto the *Ambition* scenario consistent with previous IIO reports.

The supply chain constraint seeks to capture practical challenges associated with a large NEM-wide infrastructure program and the demands that this places on commodity, manufacturing and labour needs associated with these large infrastructure builds.

The 4 GW constraint is set equal to the previous maximum historical annual build in the NEM over the last 10 years, achieved across 2020 and 2021. The recent 2024-25 financial year achieved 4.4 GW of total new build, a new record for annual build across the NEM over the last 10 years. This constraint is a NEM-wide annual new entrant generation (excluding lithium battery storage) limit of 4 GW[61] to 2029-30. Following 2029-30, the limit is increased by 2 GW per year until 2034-35 at which point it is then removed.

The *No NSW Coal by 2034* sensitivity diverges from the *Ambition* scenario by bringing forward the closure of coal-fired power stations. This sensitivity aligns with considerations made by the NSW Government in its Long Duration Storage Review position paper,[62] released in October 2024, which resulted in the additional minimum objective of 28 GWh of long-duration storage by 2034. In setting this new target, the NSW government took on stakeholder feedback that it should align with the closure of two of the state's remaining coal-fired power stations.

A1.5 Modelling limitations

The rapidly changing nature of the electricity market as it transitions means that information can quickly become outdated. The electricity market modelling underpinning the development pathway involves considering a range of forecast inputs and assumptions.

Given the multitude of variables, it is impossible to accurately forecast precise market conditions over a 20-year period. Rather, the forecasts are a proxy for how the market operates. ASL acknowledges simplifications are needed which lack the detail and nuances that can materialise in actual operations of the market. For example, market participants are assumed to have more foresight and rational decision-making than may actually be the case.

Table 13 summarises key limitations in the modelling underpinning the development pathway which arise from new information which was not captured in the modelling.

61 Excludes committed, anticipated and LTESA projects. Lithium battery storage excluded to reflect the rapid growth being observed in this industry.

62 See NSW Climate and Energy Action's website, Position Paper: Long Duration Storage Review.

Table 13: Modelling limitations resulting from updated assumptions

Update	Observations
Updated delivery timing of Hunter Transmission Project	As outlined in AEMO's 2025 Electricity Network Options Report, the latest timing estimate for the Hunter Transmission Project is in late-2029. Modelling underpinning the development pathway assumed the Hunter Transmission Project can be delivered in mid-2028. This update could influence reliability and consumer cost outcomes and was not considered in the 2025 IIO report.
Announcements of changes to generator operation and closure dates from November 2024 onwards	Modelling for this report commenced in November 2024 and utilises AEMO's October 2024 Generation Information as its primary basis. Subsequent announcements including new projects, such as further additions to the depth of the Eraring Big Battery and a number of solar, wind and battery projects being discontinued, have not been captured. Uncertainty remains around coal retirement timings and changes to dates will impact outcomes. The *No NSW Coal by 2034* sensitivity has sought to understand the impact of earlier closures.
Technology build costs	Build costs continue to fluctuate in the market with the 2025 IASR showing wind technology moderately increasing in cost since the 2024 ISP. Various battery technologies and large-scale solar are experiencing declining costs.
CIS tender outcomes	Modelling did not explicitly capture CIS tender 1 outcomes. Subsequent CIS tenders underway are still live at the time of the release of this report.
Updated network options and costs	Modelling for this report utilises the 2024 ISP network topology. REZ network options were provided by EnergyCo in December 2024. Any changes to options since then, such as a delay of VNI West to late 2030 along with outcomes from AEMO's 2025 Electricity Network Options Report, have not been included.
Updates to demand since the 2024 ISP	Modelling for this report utilised the 2024 ISP *Step Change* scenario's demand projections. The 2024 ESOO, which was released in August 2024, provided updated demand forecasts for its central scenario. These updated forecasts for operational sent out demand are approximately 10% lower by the end of the first decade modelled, and up to 15% lower in NSW than the 2024 ISP assumptions by the end of the 20-year modelling horizon. The pace, scale and orchestration of CER investments has also been revised down since the 2024 ISP. Uncertainties in demand could lead to changes in the composition of the NSW energy system from that forecast in this report. ASL will continue to monitor changes to forecasts, and these will be reflected in future IIO reports.
Further updates from the 2025 IASR	Modelling for this report concluded prior to the release of the 2025 IASR in July 2025. Updates to a range of assumptions since the 2024 ISP in addition to those already mentioned above, have not been captured. This includes an update to the network topology and inclusion of the new South Cobar REZ in NSW, and increased lead times for gas, wind and pumped hydro technologies.

A2. Reliability and energy security target assessment

The development pathway outlined in the 2025 IIO report indicates the infrastructure required to achieve the infrastructure investment objectives. These objectives encompass the construction of long-duration storage infrastructure to meet the reliability standard, as well as firming infrastructure to meet both the energy security target and the reliability standard.

The reliability and the energy security target assessments included in this report span a 10-year period from 2025-26 to 2034-35. The reliability assessment broadly aligns with the methodology applied for the 2024 ESOO, while the energy security target assessment follows an approach similar to that applied for the ESTM report. Both assessments seek to identify opportunities to invest in new assets to maintain a reliable supply of electricity in NSW.

The assessment of both reliability measures demonstrate that the development pathway meets the outlined objectives. However, there are risks associated with project delivery delays that could impact the achievement of these objectives.

A2.1 Reliability assessment

The 2025 IIO report underscores the importance of timely investments in generation, long-duration storage and firming infrastructure to ensure reliability for NSW electricity customers.

The EII Act mandates the preparation of the IIO report to identify infrastructure required to ensure the reliability and security of electricity supply. The applicable reliability standard is the interim reliability measure of 0.0006% expected unserved energy until June 2028. From July 2028, the standard reverts to the NEM reliability standard of 0.002% unserved energy as set out in the NER.

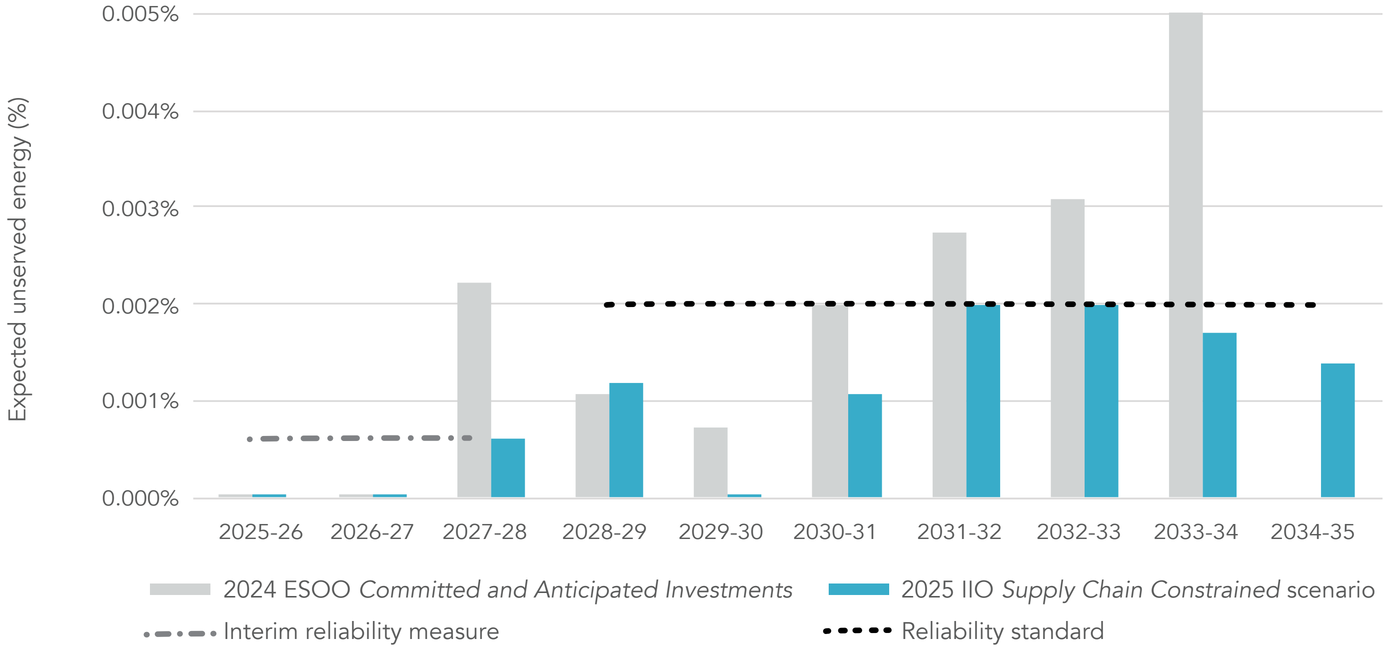
In assessing reliability outcomes under the development pathway, the 2025 IIO report adopts a modelling approach consistent with AEMO's 2024 ESOO. This includes the use of the time-sequential model to assess reliability performance across a range of plausible demand, generation availability and weather conditions.

Reliability outcomes are expressed in terms of unserved energy, which represents energy that cannot be supplied under certain circumstances. Where forecast unserved energy exceeds the applicable standard, a reliability gap is identified.

The 2025 IIO report has quantified the additional capacity required to reduce expected unserved energy below the reliability standard and interim reliability measure, aligning with ESOO practices. Additional capacity identified through this analysis has been incorporated into the development pathway presented in this report.

ASL's reliability assessment shows that the *Supply Chain Constrained* scenario can maintain reliability levels over the 10-year period under base case assumptions, as illustrated in Figure 34.

Figure 34: NSW expected unserved energy, 2025 IIO *Supply Chain Constrained* scenario and 2024 ESOO *Committed and Anticipated Investments* sensitivity (%)



Comparing the 2024 ESOO and the 2025 IIO report is crucial in understanding the reliability risks faced by the NSW electricity sector. The 2024 ESOO *Committed and Anticipated Investments* sensitivity focuses on reliability risks when commissioning delays eventuate in the absence of new investments. Meanwhile, the 2025 IIO *Supply Chain Constrained* scenario assumes that NSW policy objectives are met with generation, firming, long-duration storage and network investments implemented without delays. This distinction highlights the importance of timely and effective investment in mitigating potential reliability issues.

In NSW, indicative reliability forecasts show that:

- The *Committed and Anticipated Investments* sensitivity identified a reliability gap in 2027-28, following the advised retirement of the Eraring Power Station in August 2027. However, additional new wind generation and storage capacity outlined in the *Supply Chain Constrained* scenario improves reliability outcomes, reducing expected unserved energy marginally below the interim reliability measure.
- The 2024 ESOO reliability outcomes improve from 2028-29 to 2030-31, reflecting the assumed entry of Snowy 2.0, Maryvale BESS, Liddell BESS, Silver City Energy storage and New England Solar Farm BESS, additional to the inclusion of HumeLink transmission project. Across the same period, the *Supply Chain Constrained* scenario includes consideration of new wind capacity and access rights projects, further reducing reliability risks.
- The *Committed and Anticipated Investments* sensitivity identifies reliability challenges from 2031-32 onwards, with risks increasing as the Bayswater and Vales Point Power Stations reach retirement. In contrast, the *Supply Chain Constrained* scenario's critical milestone of achieving and exceeding 28 GWh of long-duration storage by December 2033, combined with planned firming infrastructure, addresses those challenges and maintains reliability risks within the standard.

The *Ambition* scenario, which underpins the development pathway, is expected to exhibit greater resilience than the *Supply Chain Constrained* scenario. This is primarily due to the absence of annual build constraints in *Ambition*, enabling more flexible and timely delivery of new generation and storage capacity. As the *Supply Chain Constrained* scenario satisfies the reliability standard, ASL considers that the *Ambition* scenario – and by extension the development pathway – also meets the standard, providing confidence in the reliability outcomes under this scenario.

More broadly, a key shift in the 2025 IIO report's reliability risk profile emerges over the outlook period. NSW transitions from a summer-peaking to a winter-peaking reliability profile, consistent with the NEM-wide trend identified in the 2024 ISP.

While summer risks are forecast to peak in 2027-28 due to high cooling demand and reduced solar output in hot evenings, the dominant risk transitions to winter in 2031-32 driven by higher demand for electrified heating loads coinciding with reduced solar output. This seasonal trend indicates existing hydro power stations and deep storage units such as Snowy 2.0 play a role in shifting energy on a seasonal basis to provide strategic energy reserves.

This analysis did not consider the recent update to expected delivery timing of the Hunter Transmission Project from mid-2028 to late-2029.

A2.2 Energy security target assessment

The energy security target sets the target of firm capacity required to meet NSW's maximum customer demand, with a reserve margin to account for the unexpected loss of the state's two largest generating units. ASL has completed an assessment of the development pathway against the energy security target[63] using a process which is aligned with the methodology outlined in the October 2024 ESTM report.[64]

The results presented below utilise assumptions consistent with the modelling underpinning the scenarios of this report. This includes the 2024 ISP *Step Change* demand profile which at the end of the assessed 10-year period has maximum demand figures which are approximately 10% higher than the 2024 ESOO demand, which the 2024 ESTM report is based on.

Consistent with the reliability assessment, this analysis did not consider the recent announcement of the Hunter Transmission Project's updated delivery timing.

A2.2.1 Testing the *Ambition* scenario

While the 2024 ESTM report showed breaches occurring in 2027-28 and 2033-34, the *Ambition* scenario underpinning the development pathway (with its demand assumptions, coal-fired power station retirements and build of new entrant projects) can meet the energy security target over the assessed 10-year period. The 2028-29 financial year is the tightest year with a surplus of 421 MW.

The recent firming direction from the Minister adds 500 MW of firming infrastructure by 2027-28, incorporated into the firming element of the development pathway, helping offset a range of risk factors:

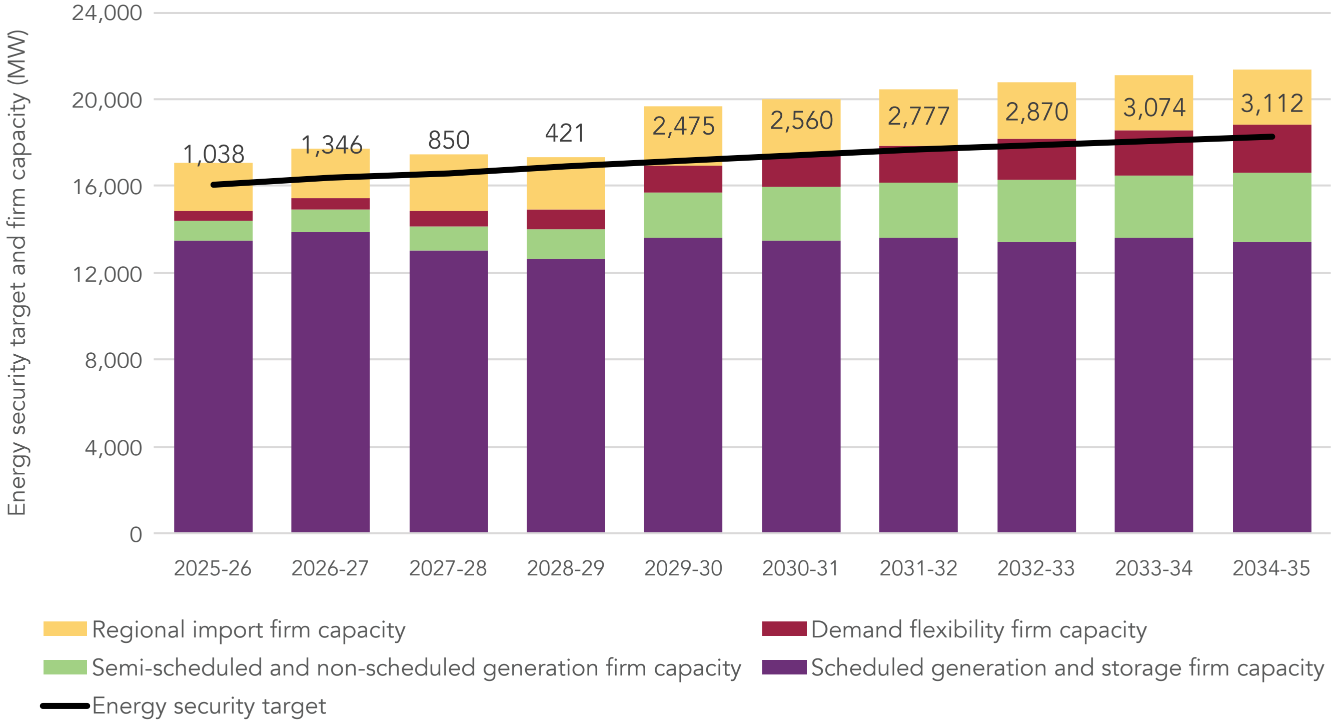
- The timing of coal retirements and the need for a timely and coordinated delivery of VRE, long-duration storage and firming. In the development pathway, the closure of the Vales Point Power Station occurs five years earlier compared to the 2024 ESTM report and is no longer available in 2028-29.
- The importance of network build and an ability to move electricity generation to major load centres. In the development pathway, HumeLink enters in 2029-30 which is 2 years later than the 2024 ESTM report assumption.
- Ongoing changes to electricity demand including behind-the-meter generation. The development pathway utilises the 2024 ISP demand while the ESTM adopts the 2024 ESOO demand profile. In 2028-29, the 2024 ISP maximum demand used for the energy security target is approximately 500 MW higher than the 2024 ESOO demand for the corresponding year.

These factors present uncertainties that ASL will continue to monitor. From 2029-30 and beyond, the development pathway delivers larger energy security target surpluses in the order of 2.5 – 3 GW each year. The surpluses identified in 2033-34 and 2034-35 are sufficient enough to accommodate earlier coal closures like those contemplated in the *No NSW Coal by 2034* sensitivity.

63 The energy security target sets the target electricity generation capacity required to meet forecast NSW maximum consumer demand in summer, with a reserve to account for the unexpected loss of the state's two largest generating units. It is calculated in accordance with the EII Act.

64 See NSW Energy and Climate Action's website, 2024 Energy Security Target Monitor report, prepared by AEMO.

Figure 35: Energy security target assessment of the development pathway



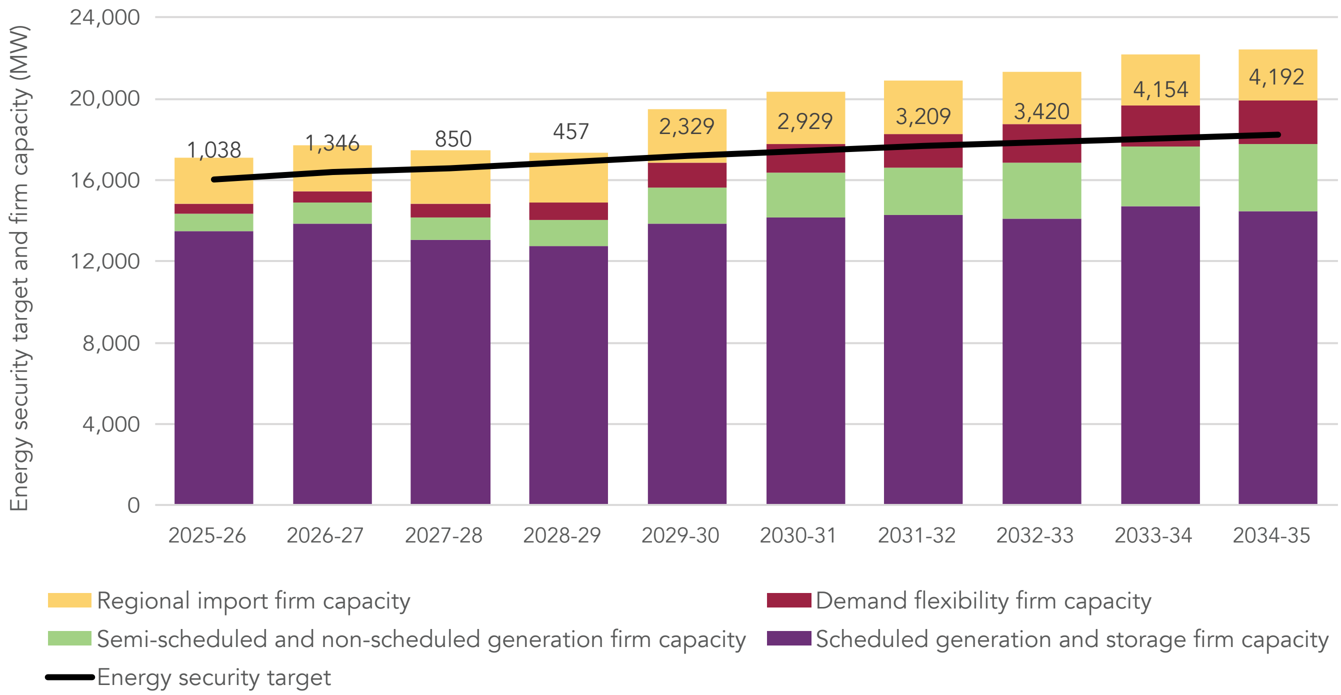
A2.2.2 Testing the *Supply Chain Constrained* scenario

Like the *Ambition* scenario, the *Supply Chain Constrained* scenario meets the energy security target with no breaches identified over the assessment period. While there are different build trajectories by technology and location under the two scenarios, the first three modelled years produce consistent surplus results.

Similarly to the *Ambition* scenario, 2028-29 is the tightest year providing a surplus of 457 MW. Following this year, higher surpluses are identified across the remainder of the assessment period.

ASL will continue to observe market developments and findings in subsequent ESTM reports to keep abreast of any emerging risks which may need to be incorporated into tender considerations.

Figure 36: Energy security target assessment of *Supply Chain Constrained* scenario



A3. Resilience to variable renewable energy lulls

A3.1 Overview

As the capacity of VRE increases, the NSW electricity system becomes increasingly dependent on the weather. Additionally, Australia's weather systems are changing with climate change. Understanding the possible realms of future climate conditions and the operability of the electricity system during adverse weather is critical to ensuring the resilience of the development pathway.

VRE lulls are defined in this analysis as multi-day events where availability from wind and solar generation across the NEM is sustained below the fifth percentile of recently observed weather history.

In Part 1 of this analysis the definition is applied to weather data (wind speed and solar irradiance) and in Part 2 of this analysis the definition is applied to generation data (dependent on both weather data and the capacity mix of wind and solar generators across the NEM).

Across the next decade, NEM-wide compound wind and solar VRE lulls are projected to have a duration of 4 days (the 1-in-2-year events) to 12 days (the 1-in-50-year events). These are projected to decrease in duration over time as both the climate changes and the diversity of VRE increases.

Part 1: Impact of climate change on VRE lulls

The VRE lulls analysis utilises long-term climate projections calibrated to historical weather data. This allows the analysis to capture the potential impact of climate change, and to use a large sample of possible weather patterns to create a probability distribution of extreme VRE lulls events.

The results show that throughout the remainder of the century there is:

- **a projected decrease** in the average frequency and duration of **solar lulls**, particularly in the second half of the century, and
- no projected change in the average frequency and duration of wind and compound solar and wind lulls.

Part 2: Resilience of the development pathway to VRE lulls

The VRE lulls assessment indicates that the development pathway maintains resilience to various severities of VRE lulls across the next decade. Across the 15 cases simulated, the modelled VRE lull led to higher NSW wholesale prices and greater reliance on hydro and gas resources compared to cases with typical weather conditions. There was a very small amount of NSW unserved energy observed in one case, but at an amount well below the reliability standard.

The resilience of the development pathway to VRE lulls is driven by the:

- increased technological and geographical **diversity of VRE**, to minimise the duration and depth of VRE lulls,
- expansion of the **electricity network** within NSW and with neighbouring regions to enable the sharing of generation, and
- expansion of **storage** and **firming** infrastructure to meet NSW demand during periods of very low VRE.

The continuous development of climate and electricity market modelling will assist in ensuring future development pathways remain resilient to VRE lulls in the longer-term.

A3.2 Results

A3.2.1 Part 1: Impact of climate change on VRE lulls

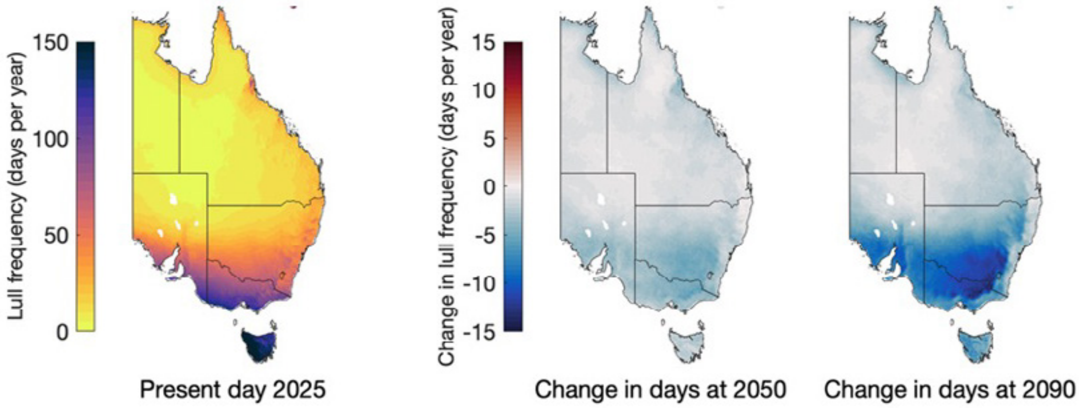
Part 1 of the analysis investigates the impact of climate change on weather across the NEM. This includes wind speeds and solar irradiation projections, in particular the average annual frequency and duration of VRE lulls. The analysis also explores temperature projections which impact electricity demand, and rainfall projections which impact hydro power stations.

Projected changes to wind speed and solar irradiation

The southern area of Australia receives less direct sunlight than the northern area, particularly during winter, due to the lower angle of the sun and the increased cloud coverage. This results in significantly more solar lull days in southern Australia, for which solar irradiation falls below the fifth percentile of recently observed history.

The climate projections show an increase in sunny days and a decrease in cloudy days across Australia, such that the frequency of solar lull days is projected to decrease in 2050 and 2090, particularly in the southern area of Australia, as shown in Figure 37.

Figure 37: Average frequency of local solar lulls



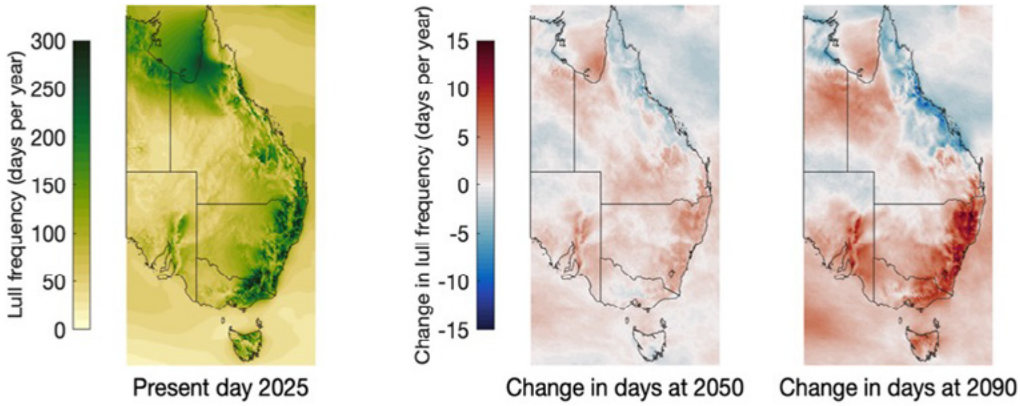
Note: Solar irradiation is Surface Downwelling Solar Radiation from the Regional Climate Model (RCM) ensemble. Projections are the average across two climate warming scenarios. Each of the 2025, 2050 and 2090 datasets are an average across a centred 20-year rolling window (for example, 2050 is the average across 2041 to 2060). A solar lull day occurs when daily solar irradiation falls below the fifth percentile of the 2000 to 2023 historical period, which is 109 watts per metre squared (W/m²).

Source: Risk Frontiers.

Wind speeds across Australia are influenced by a combination of factors including latitude, proximity to the coast and local topography. Areas with wind speeds below the fifth percentile of recently observed history are typically near mountainous areas. The change in topography creates localised wind patterns, and the leeward side typically experiences turbulence and reduced wind speeds.[65]

The climate model shows there is a projected change in wind speeds across Australia. The number of days where wind speeds fall below the fifth percentile is projected to generally increase in the southern area of Australia and decrease in part of the northern area of Australia, as shown in Figure 38.

Figure 38: Average frequency of local wind lulls



Note: Wind speeds at 150 metres above ground level from the RCM ensemble. A wind lull day occurs when daily wind speed falls below the fifth percentile of the 2000 to 2023 historical period, which is 5.17 metres per second (m/s). Otherwise, the basis of this chart is in line with Figure 37 above.

Source: Risk Frontiers.

Weather patterns during VRE lulls

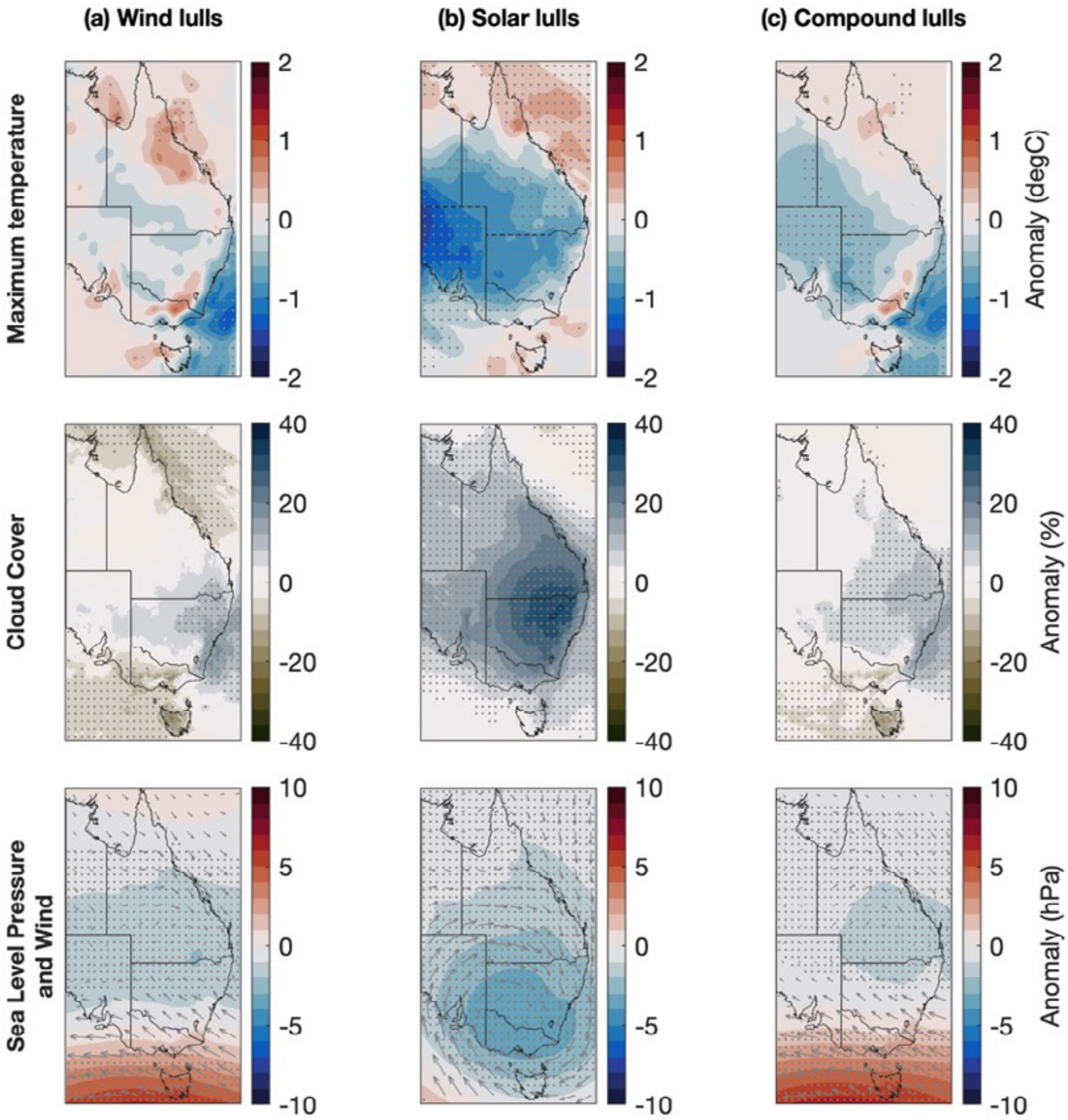
The VRE lull events which are likely to be the most challenging for the electricity system are compound lulls (both wind and solar at low output) that are widespread across the regions underpinning the entire NEM. To analyse NEM-wide VRE lulls, the daily wind speed and solar irradiation output from 30 key REZs across the NEM are averaged. See section A3.3.1 for more detail on the approach.

Fortunately, the weather patterns responsible for solar lulls are typically different to those responsible for wind lulls. Still days are typically sunny whilst windy days are typically cloudy. However, there are weather events which can cause widespread compound wind and solar lulls.

The synoptic weather charts in Figure 39 show the typical weather conditions which occur during different types of VRE lulls. These charts show average daily anomalies (the difference between the lull event and the long-term monthly average) of temperature, cloud cover and atmospheric circulation.

65 Note that this analysis focuses on the number of days with *low* wind speeds, which may have different trends to average wind speeds. Mountainous areas can also have higher wind speeds.

Figure 39: Typical weather patterns during VRE lulls



Note: Synoptic composites of daily weather anomalies (difference between the lull event and the long-term monthly average) during a) wind lulls, b) solar lulls and c) compound lulls for daily maximum temperature, cloud cover and atmospheric circulation represented by sea level pressure and 150 metre wind speeds. Composites are the average of daily anomalies for lull events occurring in May, June and July from 2000 to 2023. The stippling (the dots within the chart) denotes areas where the lull conditions are statistically different to the mean, whilst other areas may be different to the mean by chance (t test, p<0.01).

Source: Risk Frontiers.

Wind lulls tend to occur when a high-pressure system is to the south of Australia and when there is weakening or reversal of westerly airflow over the east of Australia. This situation can occur during blocking high events.[66] There also tends to be some increased cloud cover over the southeastern seaboard.

Solar lulls are associated with a low-pressure system over the southeast of Australia and clockwise cyclonic wind circulation. This situation can occur during general low-pressure systems and can be more persistent during cut-off low events.[67] During solar lulls, cloud cover is increased over most of the NEM and daytime maximum temperatures are lower than average over much of South Australia and inland NSW, Victoria and Queensland.

Compound lulls are associated with a low-pressure system over Queensland together with a high-pressure system to the south of Australia. This situation can occur during cut-off low or northwest cloudband[68] events, especially if they occur with a blocking high to the south. During compound lulls, daytime maximum temperatures are lower than average over inland Australia and cloud cover is increased over most of NSW and Queensland.

66 Blocking highs are strong high-pressure systems which have formed further south than usual and remain near stationary for an extended period. These highs effectively block the west to east progression of weather systems across Australia.

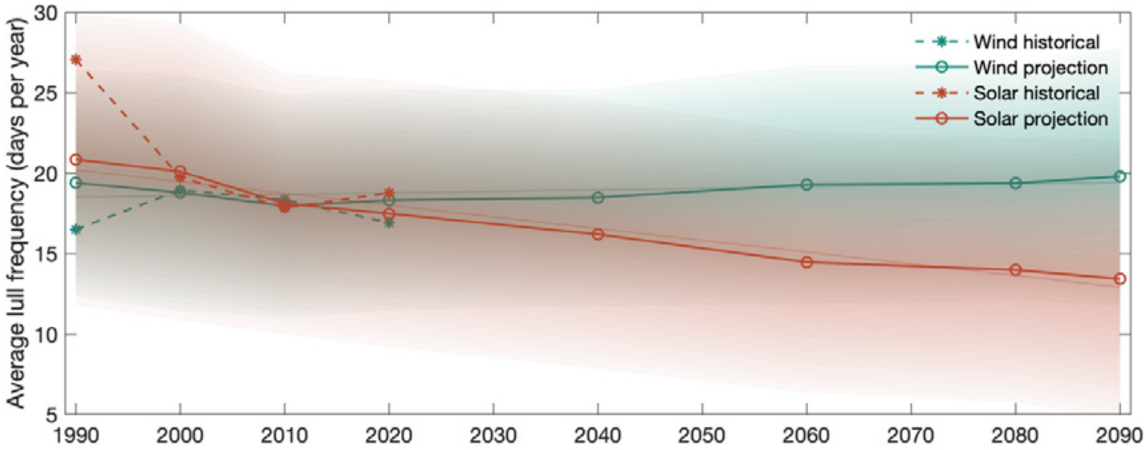
67 Cut-off lows are low pressure systems which have broken away from the main belt of low pressure which lies to the south of Australia.

68 Northwest cloudbands are an extensive layer of cloud which can stretch from northwest to southeast Australia.

Projected changes to VRE lulls

Across the remainder of the century, the climate model shows the average frequency of solar lulls is projected to decrease, whilst the average frequency of wind lulls is projected to remain relatively consistent with recently observed history, as shown in Figure 40. The climate model shows the average frequency of compound lulls is also projected to remain relatively consistent with observed history, as shown in Figure 41.

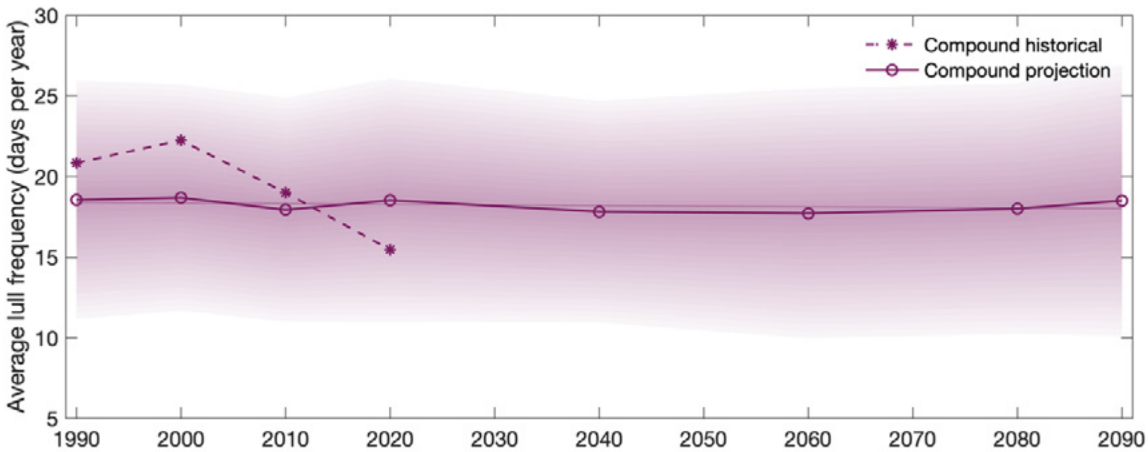
Figure 40: Average frequency of widespread solar and wind lulls



Note: Wind and solar lull days are defined as days where the 3-day rolling mean of daily wind speed or solar irradiation across the NEM is below the fifth percentile based on observed history from 2000 to 2023. Projections are the average across two climate warming scenarios. Each of the projections are an average across a centred 20-year rolling window (for example, 2060 is the average across 2051 to 2070). Wind speed and solar irradiation is averaged across 30 key REZs across the NEM to develop a NEM-wide output. Solid lines represent model forecast, dotted lines represent observed history, and thin lines represent model trendline. Shading represents one standard deviation in wind and solar lull frequency.

Source: Risk Frontiers.

Figure 41: Average frequency of widespread compound lulls

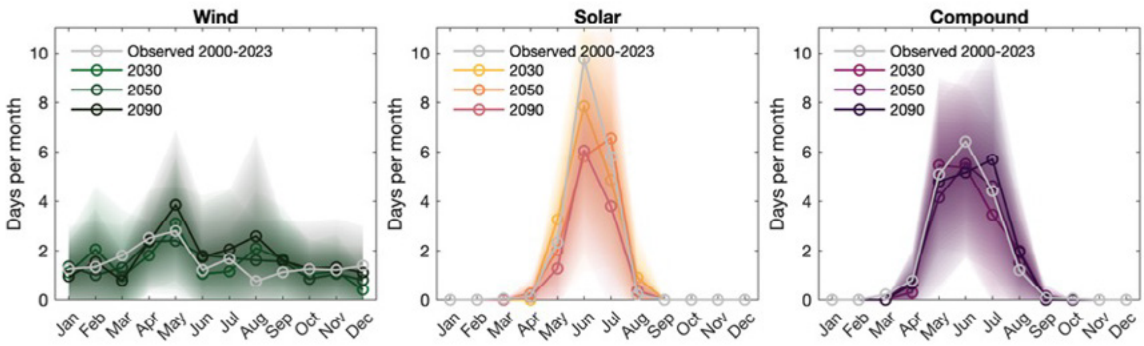


Note: Compound lulls are based on a dataset which averages the percentiles of wind speeds and solar irradiance and renormalises the distribution. Otherwise, the basis of this chart is in line with Figure 40 above.

Source: Risk Frontiers.

The projected frequency of wind, solar and compound lulls by month is shown in Figure 42. Wind lulls can occur throughout the year but are most common in April and May. Solar and compound lulls are more frequent during the winter months of May to July when days are shortest and cloud coverage is highest. The seasonality of the projected lulls is relatively consistent with observed history.

Figure 42: Average frequency of widespread VRE lulls by month

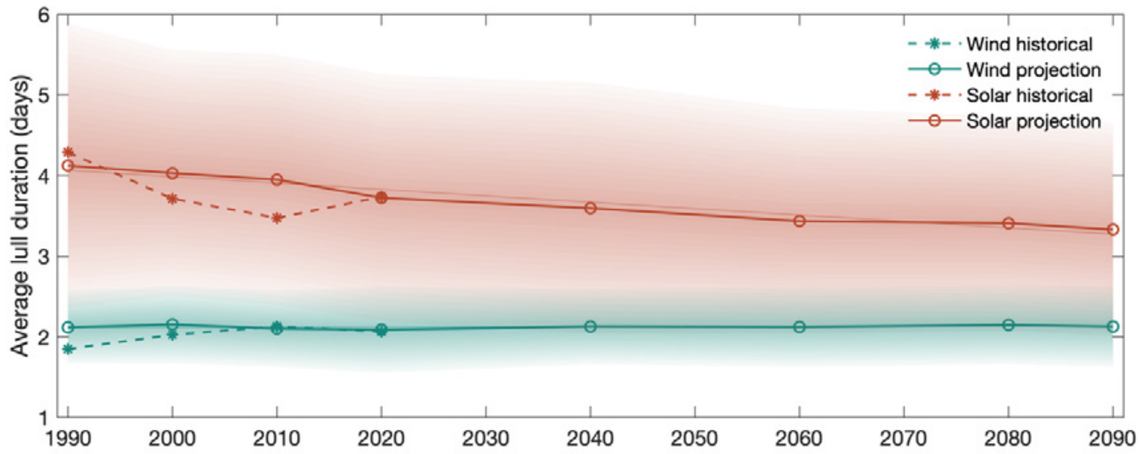


Note: Shading represents one standard deviation in wind, solar and compound lull frequency.

Source: Risk Frontiers.

The climate forecasts show the trends in average lull duration are similar to those of lull frequency. The average duration of solar lulls is projected to decrease, whilst the average duration of wind lulls is projected to remain relatively consistent with observed history, as shown in Figure 43. The average duration of compound lulls is projected to remain relatively consistent with observed history, as shown in Figure 44.

Figure 43: Average duration of widespread solar and winds lulls

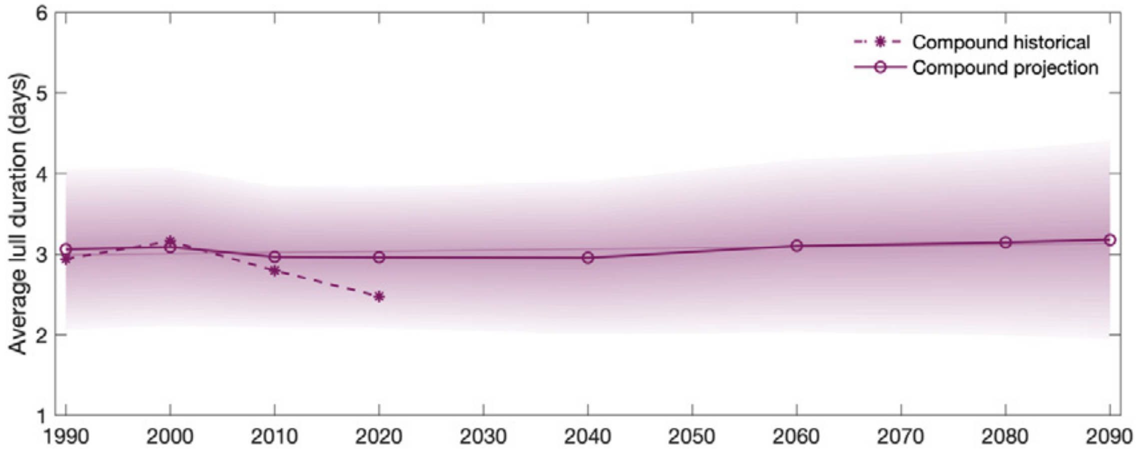


Note: The basis of this chart is in line with Figure 40.

Source: Risk Frontiers.

Solar lulls have a higher average duration than wind lulls because they are concentrated in autumn and winter months rather than all-year round.

Figure 44: Average duration of widespread compound lulls



Note: The basis of this chart is in line with Figure 40.

Source: Risk Frontiers.

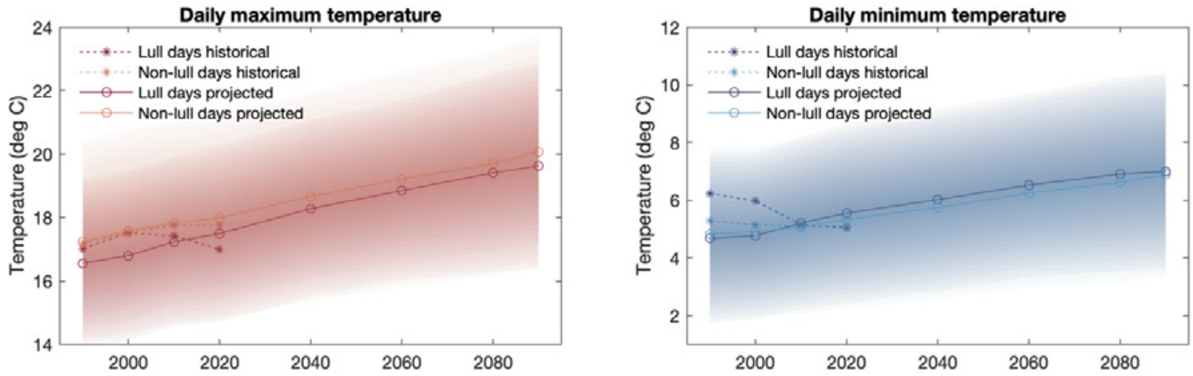
Additional analysis conducted by Risk Frontiers can be found on ASL's website, including correlation between VRE lulls and Australia's three major climate drivers, El Nino Southern Oscillation, the Indian Ocean Dipole and the Southern Annular Mode.

Projected changes to temperature

Historical and projected temperatures during VRE lulls are examined due to their historically observed and expected future impact on electricity demand. The daily maximum and minimum temperature during lull events are examined for historical observations and climate forecasts during the months of May, June and July. The months when compound VRE lulls are most frequent are also the months when temperatures are lowest.

The climate forecasts in Figure 45 show an increase to both the NSW average daily maximum (daytime) and minimum (overnight) temperatures over time due to climate warming. Both historical observations and climate projections show that the daily maximum temperature tends to be lower during lull days compared to non-lull days. Conversely, the daily minimum temperature is higher during lull days compared to non-lull days.

Figure 45: Daily maximum and minimum NSW temperature between compound lull and non-lull days



Note: Analysis restricted to May, June & July as these months are most impacted by VRE lulls.

Source: Risk Frontiers.

During compound lull events there is an increase in cloud cover. During the day, increased cloud cover reduces incoming solar irradiation and causes colder temperatures. Overnight, increased cloud cover traps outgoing solar irradiation and causes warmer temperatures.

There is a relationship between temperature and electricity demand,[69] primarily due to the use of heating during winter and cooling during summer. For each one-degree reduction in NSW maximum temperature during winter, demand can increase by between 3% and 7%.[70] Temperatures also impact the technical capabilities of electricity infrastructure, including transmission line ratings and generator maximum output limits.

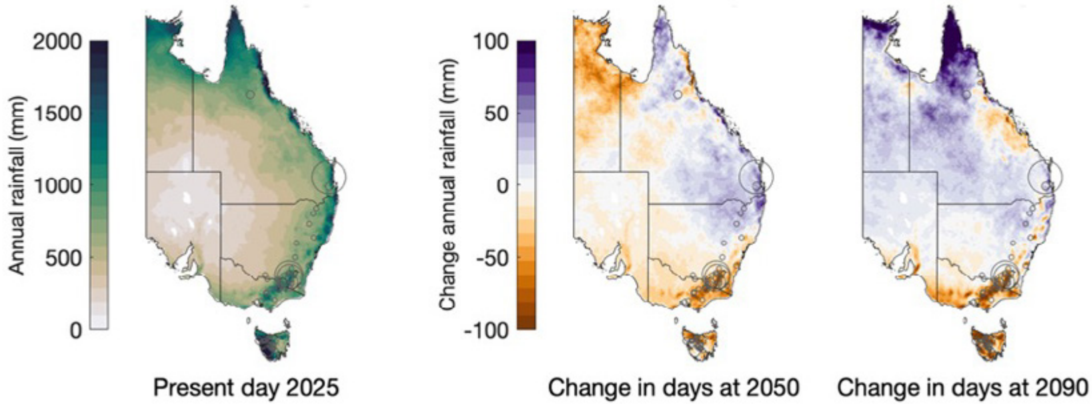
69 AEMO, 2020 Electricity Demand Forecasting Methodology Information Paper, p. 7, August 2020.

70 AEMO, Temperature Forecast Analysis for Summer 2020-21, p. 8, June 2021.

Projected changes to rainfall

Projected rainfall is examined due to its impact on the operation of hydro power stations. Projections for total annual rainfall indicate an increase in some areas and a decrease in other areas. Figure 46 shows areas in the Snowy region and Tasmania are projected to experience a decrease in annual rainfall, which is where the majority of the NEM's hydro power stations are located.

Figure 46: Annual rainfall forecast



Note: Projections are the average across two climate warming scenarios. Each of the 2025, 2050 and 2090 datasets are an average across a centred 20-year rolling window (for example, 2050 is the average across 2041 to 2060). Existing, committed and anticipated hydro power stations across the NEM are shown as circles, where circle size is scaled relative to capacity.

Source: Risk Frontiers.

These findings broadly align with the Electricity Sector Climate Information[71] project which also reported decreased rainfall across the Snowy and Tasmania regions.

This has implications on the ability of hydro power stations to provide generation during VRE lull events. Conservative rainfall assumptions have been made for the resilience assessment, which are further explained in section A3.3.1 Methodology. These findings also support the need for improved short-term forecasting of VRE lulls and appropriate water reservoir management throughout the year.

A3.2.2 Part 2: Resilience of the development pathway to VRE lulls

Part 2 of the analysis investigates the resilience of the development pathway to NEM-wide compound VRE lulls observed in the climate projections. For this analysis, the *Supply Chain Constrained* scenario has been simulated against a range of VRE lulls. To enable this, wind speed and solar irradiation data is converted to generation data for wind and solar farms across the NEM (see section A3.3.1 Methodology for more detail on the approach).

The resilience assessment makes assumptions on the demand and the operability of dispatchable generators such as gas, hydro and batteries during the VRE lulls (see section A3.3.2 Limitations for more detail on limitations of the assessment which will inform future evolution of the assessment).

71 The Electricity Sector Climate Information project was a collaboration between the Commonwealth Scientific and Industrial Research Organisation (CSIRO), the Bureau of Meteorology and AEMO from 2019 to 2021 which delivered improved climate and weather information.

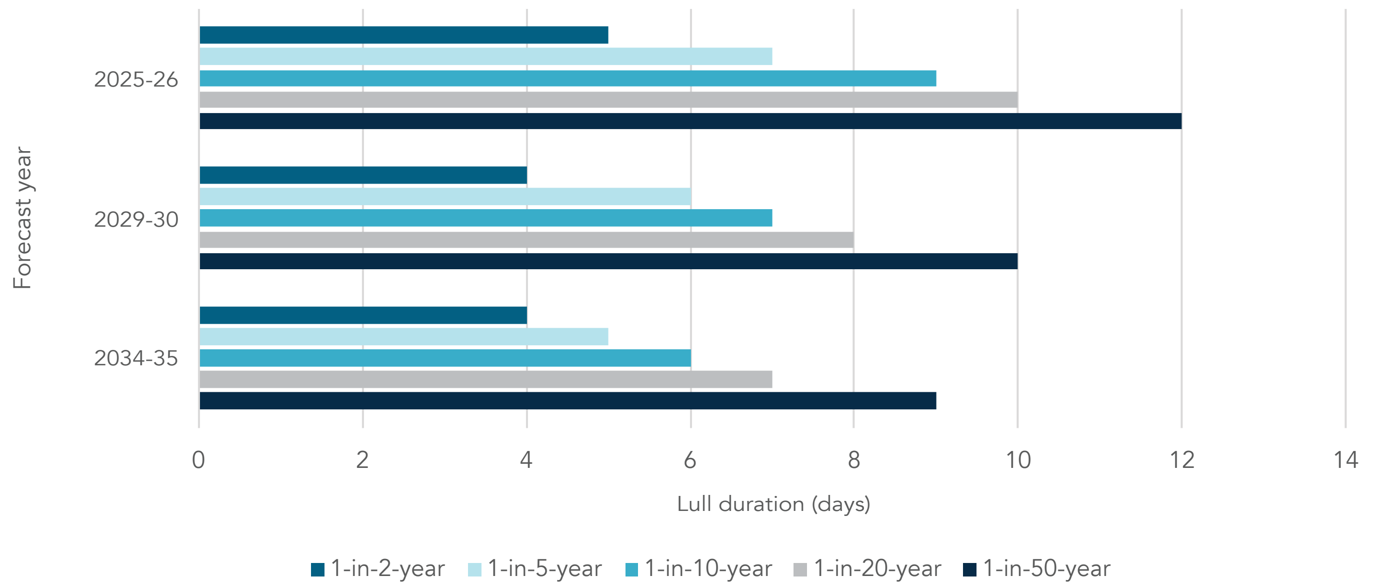
Increasing diversity of VRE

There are 15 VRE lulls which are selected with consideration of both the climate projections and the forecast capacity mix of VRE. The VRE lulls selected include a range of durations, from 4-days long to 12-days long. The lowest duration VRE lulls are expected to occur every 1-in-2-years, whilst the longest VRE lulls are expected to occur every 1-in-50-years. Five durations are selected for three forecast years over the next decade, including 2025-26, 2029-30 and 2034-35. Across the three forecast years, the duration of the VRE lulls is forecast to reduce, as shown in Figure 47.

For Part 2 of the analysis, the VRE lulls are a product of both the weather projections and the capacity mix of VRE (that is, the size and location of wind and solar farms across the NEM). Whilst there are projected changes to the climate (solar lulls are projected to decrease in average duration), it is the increase in VRE diversity over time which is the primary driver of the reduction in VRE lull duration.

From 2025-26 to 2034-35, the forecast generation expansion includes increased levels of wind and solar generation into NSW REZs, such as the Central-West Orana REZ, Hunter Central Coast REZ, South West REZ and New England REZ. The increase in technological and geographical diversity of VRE reduces the likelihood that NEM-wide VRE output is sustained at low output for many days. The diversity of VRE infrastructure is itself a form of resilience to VRE lulls.

Figure 47: Duration of VRE lulls



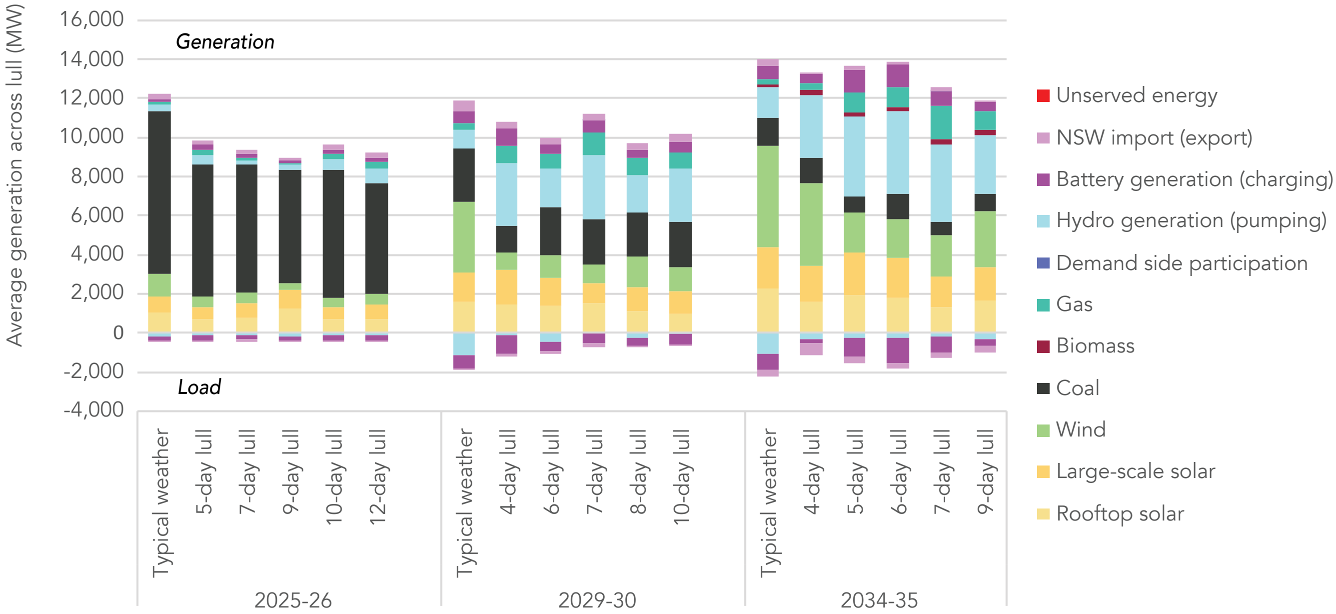
However, as the capacity of VRE increases across the NEM, the magnitude of each VRE lull increases. From 2025-26 to 2034-35, VRE capacity across the NEM is forecast to increase from 50 GW to 130 GW (including rooftop solar). The energy deficit during a VRE lull therefore increases in later forecast years.

As explored in the remainder of this section, the resilience of the development pathway to VRE lulls depends on factors including the duration and depth of the VRE lulls, and also whether the VRE lull occurs during a higher demand period and the capability of dispatchable capacity to fill the energy deficits.

Modelling the VRE lulls against the development pathway

The selected VRE lull cases were simulated in time-sequential modelling, commonly referred to as short-term modelling. The average generation across the lull event from each technology type is shown in Figure 48.

Figure 48: Average generation across the lull event by technology in NSW



Note: The total of each column represents underlying NSW demand which needs to be met by various sources of NSW generation. Average NSW demand increases in later years and varies across lull cases as they fall in different months. Columns below the x-axis represent additional NSW demand, which includes exported energy, battery charging and hydro pumping.

There is still wind and solar output during the VRE lulls. By definition, the NEM-wide capacity factor of VRE is sustained below 19% across all lull cases (the fifth percentile based on recently observed weather history). The NEM-wide capacity factor falls as low 13% when averaged across the lull duration, and as low as 6% when averaged across a single day. In the 2034-35 VRE lulls cases, VRE still contributes to about half of NSW demand.

The contribution from coal-fired power station reduces over time as they are assumed to gradually retire in NSW. Other technology types – particularly hydro, gas, battery and imported energy – provide the additional generation required to meet NSW demand. There are also small contributions from biomass and demand side participation. New network infrastructure, including greater interconnection, facilitates greater balancing of diverse resources across the NEM, further increasing resilience.

Across the 15 VRE lull cases, there is a small amount of unserved energy observed in one case, as shown in Figure 49. The 10-day lull in 2025-26 incurred unserved energy equivalent to 0.000006% of NSW demand, which falls below the relevant reliability standard.[72]

72 The interim reliability measure is 0.0006% and applies up until June 2028, after which the reliability standard of 0.002% applies.

Figure 49: Increase to annual NSW unserved energy for each lull case compared to typical weather conditions

Forecast year	Lull duration	Unserved energy
2025-26	5-day lull	0%
	7-day lull	0%
	9-day lull	0%
	10-day lull	0.000006%
	12-day lull	0%
2029-30	4-day lull	0%
	6-day lull	0%
	7-day lull	0%
	8-day lull	0%
	10-day lull	0%
2034-35	4-day lull	0%
	5-day lull	0%
	6-day lull	0%
	7-day lull	0%
	9-day lull	0%

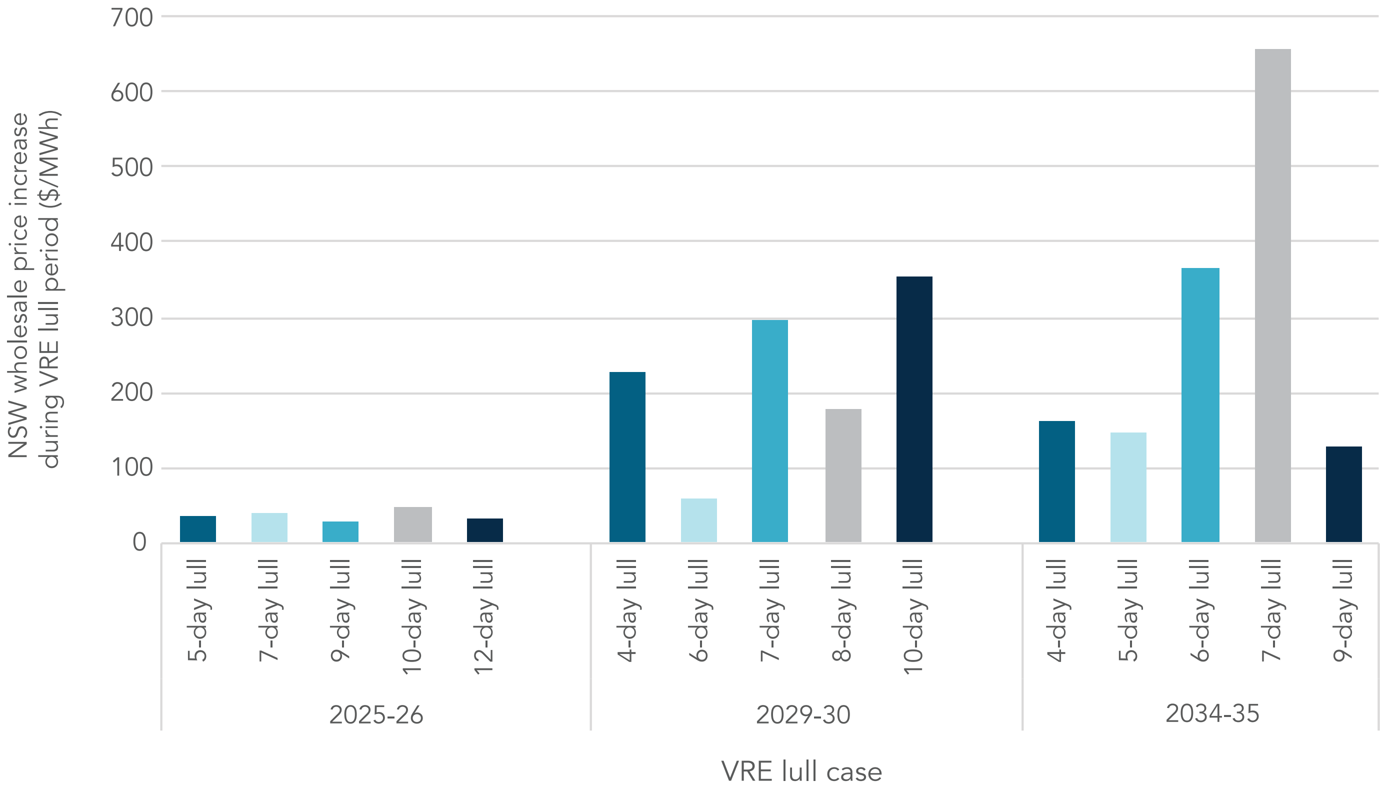
■ No unserved energy ■ Unserved energy below the relevant reliability standard ■ Unserved energy above the relevant reliability standard

The unserved energy outcomes differ between this VRE lulls assessment, and the reliability assessment presented in Appendix A2.1 due to the differences in purpose and approach between the two exercises.[73]

73 The reliability assessment simulates a full set of weather, demand and generator outage conditions to specifically assess the likelihood of NSW unserved energy. In contrast, the VRE lulls assessment simulates only a select range of NEM-wide VRE lulls and assesses the resilience (broader than unserved energy) of the NSW system. The reliability assessment in section A2.1 demonstrates higher unserved energy in 2034-35, indicating that it included more challenging periods for NSW than the VRE lulls assessment.

Across the 15 VRE lull cases, NSW wholesale prices are higher during the lull cases when compared to typical weather conditions, as shown in Figure 50.

Figure 50: Increase to NSW wholesale price during VRE lull period compared to typical weather conditions



There are a few VRE lull cases which result in a NSW wholesale price increase over $300 / MWh relative to typical weather conditions. Whilst this is a material outcome, there have been several instances in the last two years where the average NSW wholesale price has increased by $300 / MWh from week-to-week.

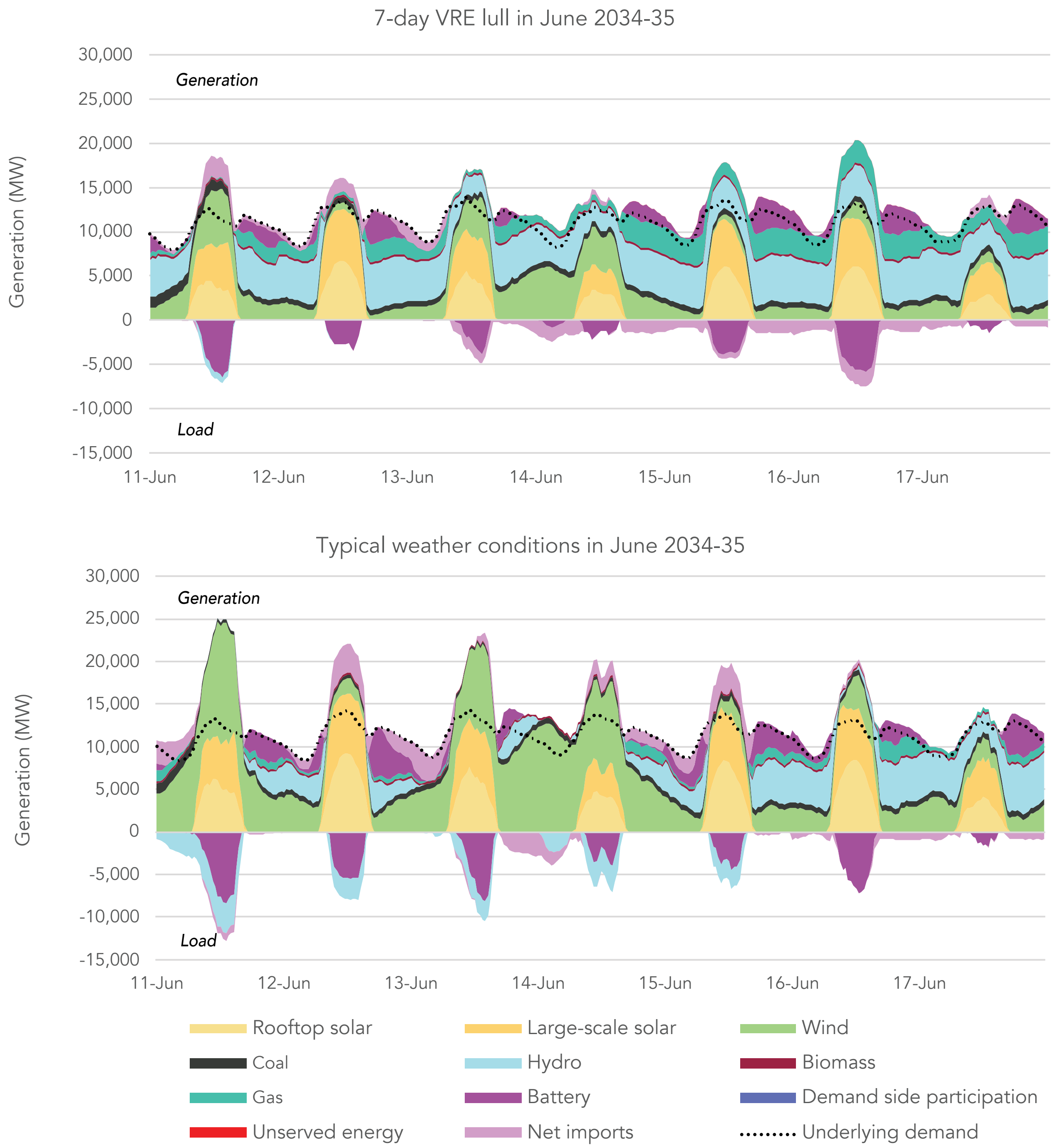
The impact on NSW wholesale prices during the VRE lull events generally increases with the length of the lulls, with some exceptions. The 7-day lull in 2034-35 had the largest impact on NSW wholesale prices, despite there being a longer 9-day lull also assessed. There are three primary reasons for this:

1. It is not only the duration of the lull but also the depth of the lull which impacts the NSW electricity system. VRE lulls are defined in this analysis based on duration below a threshold. The 7-day lull in 2034-35 has particularly low VRE on the fifth, sixth and seventh day (see Figure 51).
2. Electricity demand levels during the lull, in addition to VRE availability, materially impact the NSW electricity system. The 7-day lull in 2034-35 happens to fall in June, which has higher demand in NSW than the 9-day lull in 2034-35 which happens to fall in April.
3. The VRE lulls are defined on a NEM-wide basis and the conditions in NSW compared to other regions in the NEM may have been slightly more or less favourable in each lull.

Deep dive on the 7-day lull in June 2034-35

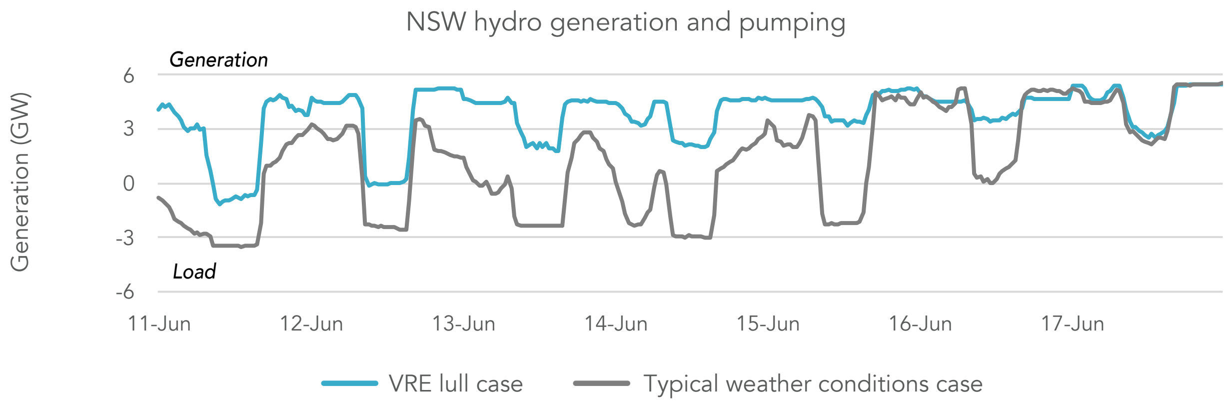
The 7-day lull during 2034-35 is presented and analysed in more detail. This is the VRE lull case which led to the highest increase in the NSW wholesale price. Figure 51 shows NSW dispatch across the 7-day lull period and across a corresponding 7-day period with typical weather conditions.

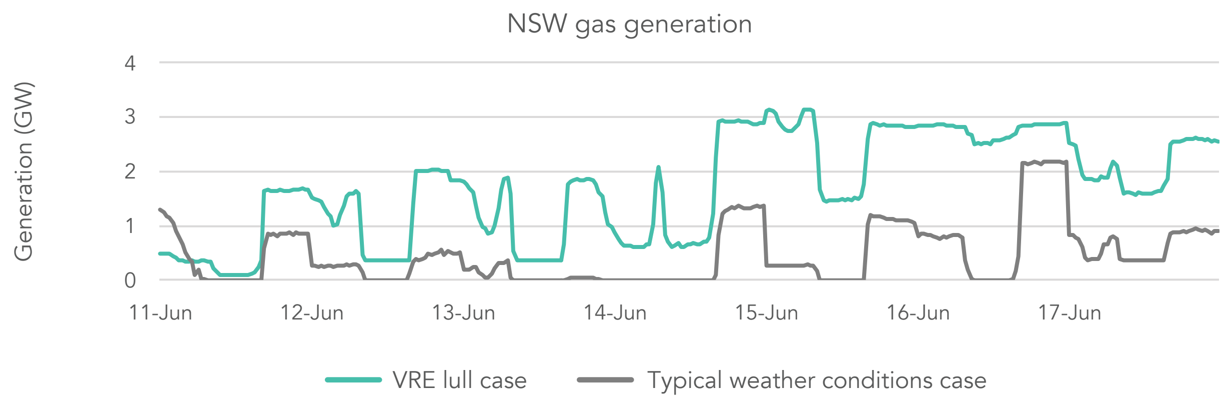
Figure 51: NSW dispatch during the 7-day VRE lull in June 2034-35 compared to typical weather conditions

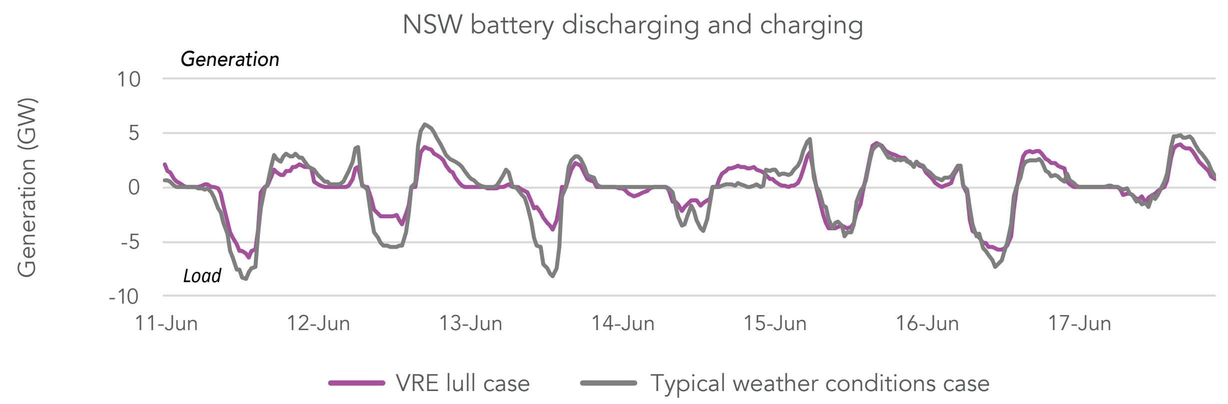


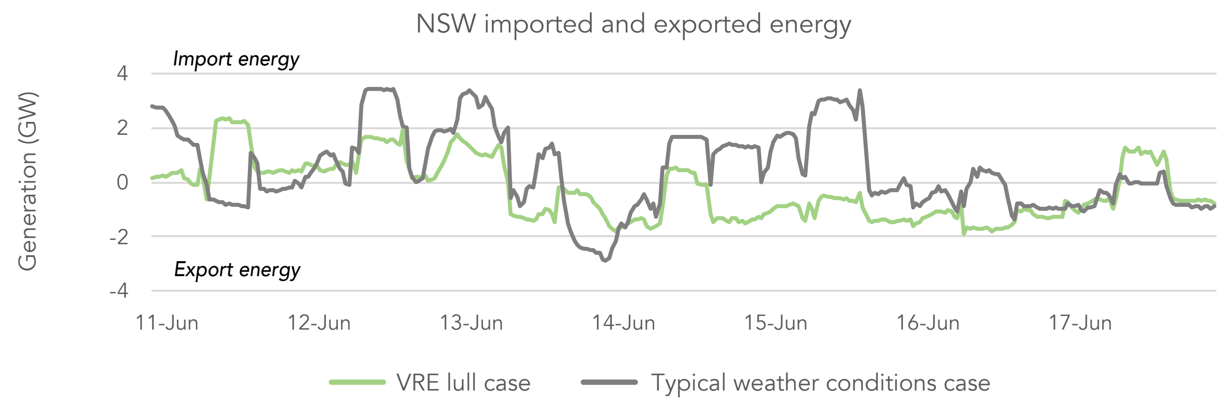
Across the 7-day period, the lull experiences significantly less VRE availability than the typical weather conditions case, with a NSW VRE capacity factor of 11% and 20% respectively across the period. VRE is primarily replaced by hydro, gas, battery and imported energy.

Figure 52: Comparison of NSW generation during the 7-day lull in 2034-35 case and typical weather conditions case across key technologies









Hydro generation plays an increased role during the VRE lull, particularly towards the end of the lull. There is minimal pumping during the lull, which contrasts with the daytime pumping which occurs in the typical weather conditions case. In the VRE lull case, the reservoir storage levels of the hydro and pumped hydro power stations drop by approximately 10% across the VRE lull period.

This small decrease in the level of storage, despite the high level of hydro generation, reflects the large volume of hydro storage available in NSW. The storage is mostly provided by existing hydro power stations but also partly by the development of new long-duration storage in NSW which reaches 42 GWh by 2033-34.

Gas generation also plays an increased role during the VRE lull, particularly towards the end of the lull. There is 530 MW of new gas in NSW assumed prior to this 2034-35 case. The modelled level of gas output may exceed the current capability of the gas system in NSW, indicating that reliance on onsite secondary fuels may be necessary to maintain resilience under the modelled assumptions.

Battery cycling occurs during the VRE lull to enable shifting of energy from the middle of the day to morning and evening demand peaks. There is slightly less cycling in the lull case compared with the typical weather conditions case, due to there being fewer low-priced periods for batteries to charge.

NSW both imports and exports energy during the VRE lull. Energy is imported when NSW has less VRE generation available than other regions, and energy is exported when NSW has more VRE generation available than other regions. Network interconnection is assumed to increase between NSW and Victoria (VNI West) and Queensland (QNI Connect) by 2034-35 which enables greater sharing of electricity between regions.

Resilience of the development pathway to VRE lulls

The analysis indicates that the development pathway maintains resilience to various severities of VRE lulls captured in the climate projections. The VRE lull cases resulted in a material increase to NSW wholesale prices. However, there was minimal unserved energy observed in the VRE lull cases and there was no breach of the reliability standard. This resilience is supported by three main drivers:

1. **Increase in VRE diversity over time:** Even during the VRE lulls, there is a material contribution from VRE, which does not fall below a NEM-wide capacity factor of 13% when averaged across the lull period. As wind and solar generation expand into new REZs across NSW and the NEM, the duration of days with sustained low VRE decreases.
2. **Increase in network capacity over time:** This allows NSW to import energy from neighbouring regions when NSW VRE is particularly low. The VRE lulls simulated have generally low VRE conditions across the NEM, and so there are also instances when NSW exports energy to neighbouring regions during a lull. This is enabled by the assumed expansion of interconnection to Victoria (VNI West) and Queensland (QNI Connect). Delivering energy to the Sydney-Newcastle-Wollongong load centre also relies on new network expansion within NSW, particularly the Waratah Super Battery, Hunter Transmission Project and HumeLink.
3. **Increase in storage and firming infrastructure over time:** There are expected to be instances where instantaneous output from VRE across the NEM is close to zero, and hence a need for sufficient dispatchable capacity (firming or storage) to meet demand. However, across the timescale of multiple days, the minimum contribution from VRE quickly increases. Long-duration storage is particularly valuable in how it stores surplus VRE to then utilise this energy during the 4 to 12-day VRE lulls modelled.

This analysis relies on many assumptions in projecting VRE lulls and simulating the dispatch of supply and demand in response to the modelled VRE lulls. These assumptions are uncertain and may overstate the resilience of the development pathway indicated by the analysis.

In particular, the demand likely to occur during the VRE lulls may be underestimated, and the ability of gas and hydro power stations to operate at high levels of output for prolonged periods may be overestimated. There are also impacts of climate change on the electricity system which have not been explored in this analysis, such as the potential impact of increasing bushfires and storms on transmission infrastructure.

Limitations are further explored in section A3.3.2.

The VRE lulls were simulated against the *Supply Chain Constrained* scenario, as this scenario has a tighter supply and demand balance compared to the *Ambition* scenario and is therefore a stricter test. ASL considers that the development pathway, underpinned by the *Ambition* scenario, is likely to have higher resilience to VRE lulls.

A3.3 Approach

The EII Regulation provides that an IIO report must contain an assessment of the resilience of the NSW electricity system in relation to lulls in VRE sources, as it relates to the development pathway, including by reference to climate modelling.[74]

This is ASL's third iteration of the VRE lulls resilience analysis, following the 2022 and 2023 IIO reports. For the first time, this analysis is considering long-term climate model projections rather than historical weather data. This provides two advantages:

1. the ability to capture the potential impact of climate change
2. the ability to project a larger sample of possible weather patterns, and therefore more accurately understand the probability distribution of extreme VRE lulls under the current climate.

The climate model utilised 280 projected sample weather years for each forecast year.

This work also draws from existing research which has investigated present day climatology of VRE lulls[75] and utilises recent advancements in Australian weather and climate data.

A3.3.1 Methodology

Climate data sources

This analysis utilises the latest generation of historical weather observations and regional climate model (RCM) weather projections.

The historical analysis uses the Bureau of Meteorology Atmospheric Regional Reanalysis for Australia – Convective Scale Version 2 (BARRA-C2). This is a high-resolution (4 km) downscaled reanalysis dataset over Australia which covers the period of 1979 to present.

The forecast analysis uses the Bureau of Meteorology Atmospheric Regional Projections for Australia – Regional (BARPA-R). This is a moderate-resolution (17 km) regional climate projection dataset over Australia which covers the period of 1979 to 2100 (both a backcast and a forecast).

The BARPA ensemble consists of seven global climate models and two climate warming scenarios, a 'best case' scenario with warming of approximately 1.7 degrees (SSP1-26) and a 'worst case' scenario with warming of approximately 3.9 degrees (SSP3-70) above pre-industrial levels (1850-1900).

The wind data is wind speeds at 150 metres above ground level, and the solar data is Surface Downwelling Shortwave Radiation (SDSR). Air temperature, cloud cover and mean sea level pressure are also used for this analysis. All datasets have a daily time resolution.

Definition of a VRE lull

VRE lulls are defined as multi-day events where the 3-day rolling mean of wind and solar output across the NEM is sustained below the fifth percentile. This threshold is based on observed weather history from 2000 to 2023.

For Part 1 of this analysis, which explores the impact of climate change on VRE lulls, this definition is applied to weather data. Daily wind speed and solar irradiance data is averaged for 30 key REZs across the NEM. The NEM-wide wind and solar fifth percentile threshold is 5.17 m/s and 109.16 W/m^2 respectively, as shown in Figure 53.

To analyse compound wind and solar lulls, the wind speed and solar irradiance percentiles are averaged to produce a compound lull index, whereby VRE lull days occur when this index falls below the fifth percentile. An illustrative example of the identification of lulls is provided in Figure 54. This analysis deliberately excludes the overlay of the projected generation capacity mix, to isolate the impact of climate change on VRE lulls, given the capacity mix is forecast to change over time.

74 EII Regulation, clause 24(2)(e).

75 NSW Government, Lulls in variable renewable energy resources, February 2023.
Richardson et al, Climate influence on compound solar and wind droughts in Australia, November 2023.

Figure 53: The fifth percentile threshold applied to weather data

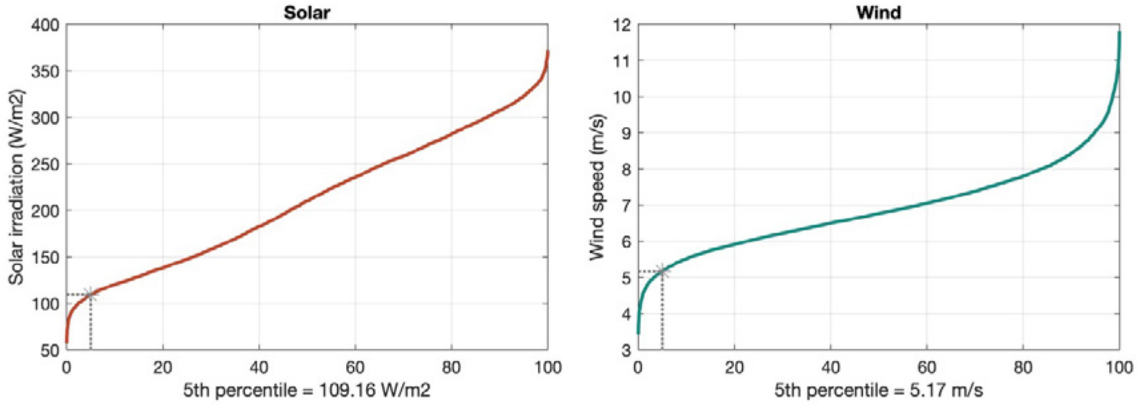
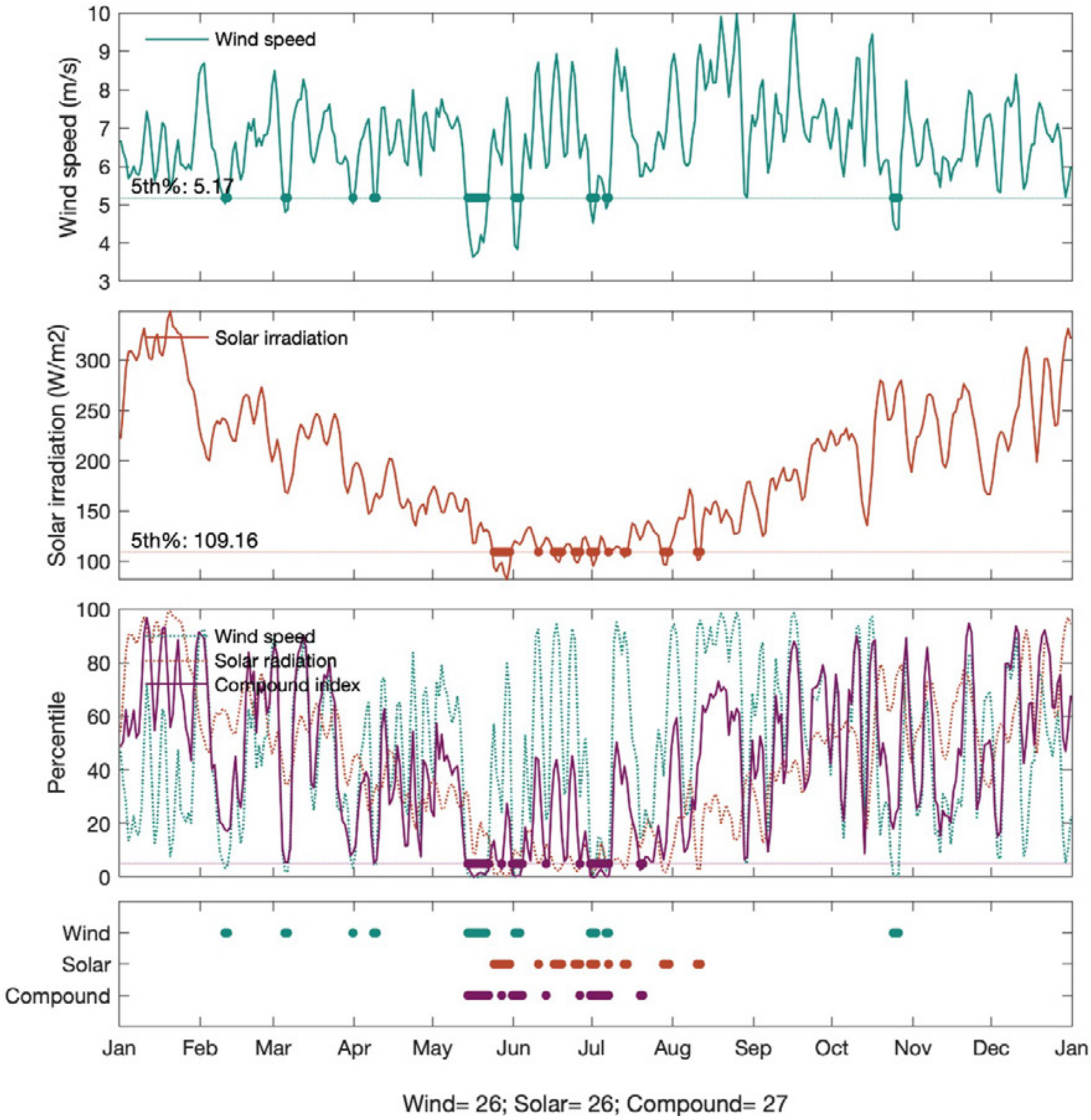


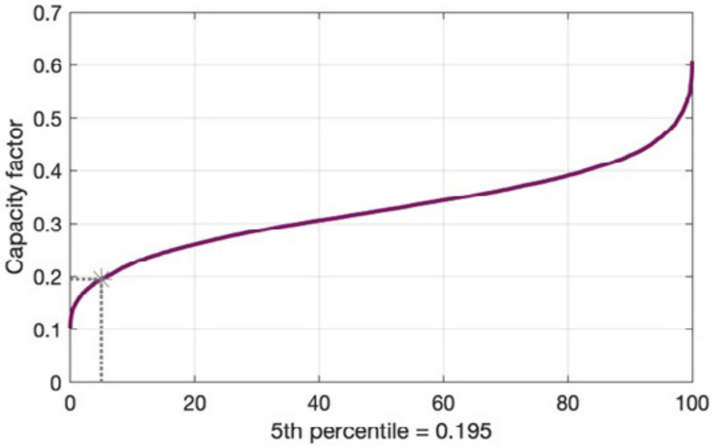
Figure 54: Illustrative example of the identification of wind, solar and compound lulls



The annual frequency and average duration of lulls is highly dependent on the chosen fifth percentile threshold. It is the projected change in these metrics over time which this analysis seeks to understand.

For Part 2 of this analysis, which explores the resilience of the development pathway to VRE lulls, the definition is applied to NEM generation data. Daily wind speed and solar irradiance data for each REZ is converted to normalised generator output. To set the fifth percentile threshold, the data is aggregated to a NEM-wide output by weighting each REZ based on the current 2024-25 capacity mix. The NEM-wide fifth percentile threshold is a generation availability capacity factor of 19%, as shown in Figure 55.

Figure 55: The fifth percentile threshold applied to generation data



Definition of resilience

Resilience is defined as the ability of the NSW electricity system to limit the severity and duration of system degradation following an extreme VRE lull event.[76]

Resilience includes the ability of the system to operate reliably. This analysis has explored the ability of the system to minimise unserved energy during VRE lulls, and explores the implications associated with increased reliance on generation sourced from hydro, battery, gas and imported generation from other regions.

The reliability standard requires that at least 99.998% of forecast demand be met each year.[77] This is informed by the value customers place on reliability, striking a balance between reliability and affordability.[78]

Resilience is broader and less deterministic than meeting the reliability standard. This analysis has also explored the impact of VRE lulls on NSW wholesale prices of electricity.

76 AEMO, 2020 ISP Appendix 8: Resilience and Climate Change, p. 6, July 2020.

77 The interim reliability measure increases this to 99.9994% temporarily until 2028.

78 See AEMC's website, Reliability, for an explanation on the reliability standard.

Part 1: Impact of climate change on VRE lulls

This analysis has two parts – the impact of climate change on VRE lulls and the resilience of the development pathway to VRE lulls. The methodology is outlined below.

- **Step 1 – Bias-correct the projected data to the historical data.** Regional Climate Models (RCMs) usually contain small biases which require correction before being used for risk assessments. The BARPA RCM data was bias corrected to the BARRA reanalysis data. This was done using interpolation and Quantile Mapping of Extremes techniques across the overlapping period 1979 to present. Bias correcting the 17 km resolution RCM data with the 4 km reanalysis data results in 4 km bias-corrected RCM data.
- **Step 2 – Aggregate the REZ-level data to NEM-wide data.** The weather data is aggregated to NEM-wide output so that widespread VRE lulls can be analysed. The 4 km cells within a REZ were averaged to produce a REZ-level output. The REZ-level output was then equally averaged across 30 key REZs across the NEM.[79] The key REZs were deliberately weighted equally so the impact of climate change on VRE lulls could be analysed whilst controlling for the changing capacity expansion plan.
- **Step 3 – Apply rolling averages to the data.** VRE lulls can include days where output from VRE increases temporarily. To account for this, the 3-day rolling average wind and solar resource availability is calculated so that these VRE lull events can be identified.
- **Step 4 – Apply rolling windows to the data.** To account for the natural year-to-year variation in weather projections (such as those caused by El Nino Southern Oscillation), a 20-year rolling window centred on the projected year is applied. For example, the 20 weather forecast years between 2041 and 2060 are considered reflective of the 2050 forecast year. This results in a total of 280 weather sample years for each forecast year – 7 global climate models, 2 climate warming scenarios and a 20-year rolling window.
- **Step 5 – Identify VRE lulls.** VRE lulls are identified as one or more consecutive days whereby NEM-wide 3-day rolling output of VRE output falls below the fifth percentile of wind speeds and solar irradiance based on observed history. Wind and solar lulls are identified separately, as well as compound VRE lulls.

Part 2: Resilience of the development pathway to VRE lulls

- **Step 6 – Transform the weather data to available generation data.** The already calibrated REZ-level weather data from Step 2 is converted to generator data (normalised generator output from 0 to 1). This is done via quantile mapping of weather data with AEMO's resource trace data for each REZ across the overlapping period of 2011 to 2024 financial year ending, as these are the years that AEMO's resource trace data span.
- **Step 7 – Aggregate the REZ-level data to NEM-wide data.** The generator data is aggregated to NEM-wide output by weighting REZs by capacity mix forecast in the *Supply Chain Constrained* scenario. This captures the forecast output for VRE across the NEM.
- **Step 8 – Select VRE lulls.** VRE lulls are identified as one or more consecutive days whereby the NEM-wide 3-day rolling average of VRE capacity factor falls below the fifth percentile based on observed history. The maximum VRE lull duration from each of the 280 sample weather years is obtained. There are 15 VRE lulls selected across three forecast years (2025-26, 2029-30 and 2034-35), each of five increasing durations (from 4 days to 12 days), which correspond with decreasing average return intervals (1-in-2-year events to 1-in-50-year events).
- **Step 9 – Simulate the VRE lulls in time sequential modelling.** Synthetic weather years are created by embedding each of the 15 selected lulls into the 2019 reference weather year.[80] Demand is held constant as per the 2019 reference year during the lull event. Annual rainfall is assumed to decrease over the time horizon in line with AEMO's 2024 ISP, broadly aligned with the rainfall forecast provided in Figure 46. The *Supply Chain Constrained* scenario is simulated in time sequential modelling.[81] Resilience is then assessed by analysing dispatch outcomes during the VRE lull events, including unserved energy, reliance on other sources of energy (primarily hydro, gas, battery and NSW imported energy) and impact on NSW wholesale price outcomes.

79 The 30 REZs included those with more than 500 MW of forecast wind and/or solar capacity by 2045 across any of the 2025 IIO scenarios *(Ambition* and *Supply Chain Constrained)* and two of the 2024 ISP scenarios *(Progressive Change* and *Step Change)*.

80 The 2019 reference year is selected to host the identified VRE lulls due to its typical VRE conditions and conservative level of rainfall. Rainfall in this reference year is below average for both the Snowy and Tasmania regions relative to the 2011 and 2022 reference years.

81 It is assumed the development pathway (which is based on the *Ambition* scenario) is equally if not more resilient to VRE lulls than the *Supply Chain Constrained* scenario.

A3.3.2 Limitations

This analysis relies on many assumptions in representing the characteristics of VRE lulls and in simulating the dispatch of the NEM during the VRE lulls. These assumptions each have varying degrees of uncertainty and may overestimate the resilience of the development pathway indicated by the analysis.

General limitations in climate and electricity market modelling which underpin the analysis include:

- **Uncertainty in climate projections:** climate projections contain a moderate level of uncertainty. Year-to-year weather outcomes are highly uncertain given they are influenced by natural climate drivers which climate models cannot yet simulate accurately, such as the El Nino Southern Oscillation. Nonetheless, climate models can produce a large distribution of plausible future outcomes, from which long-term average trends can be distilled reasonably well. For this exercise, the RCM was calibrated to observed historical data. A 20-year rolling window was utilised to remove year-to-year variability from the long-term trends. See additional analysis conducted by Risk Frontiers on ASL's website, which includes an uncertainty range for the climate trends provided in this analysis.
- **Perfect foresight in dispatch modelling:** the time sequential modelling, also known as short-term modelling, is used in this analysis to simulate the dispatch of the capacity expansion plan at a half-hourly time resolution. One limitation is perfect foresight, which is the ability of generators to optimise their operation with the knowledge of when the VRE lull will occur. This is evident in how during the VRE lull simulations, hydro, pumped hydro and battery typically had high reservoir levels at the beginning of the VRE lull period.

Limitations associated with the methodology which underpin the analysis include:

- **Demand during the VRE lulls:** the demand assumed during the VRE lull periods does not necessarily reflect likely demand during a VRE lull. The demand during the VRE lulls reflects AEMO's 2024 ISP *Step Change* demand forecast, at the probability of exceedance level of 10% (POE10). Most of the VRE lulls occurred during the months of June, when demand is typically highest. However, there is a relationship between demand and VRE lulls shown in Figure 45 which was not directly applied for the simulations. Where demand is higher than modelled during a VRE lull, the resilience of the development pathway may be overestimated.
- **Continuous gas generation during the VRE lulls:** gas capacity is assumed to be able to run at maximum capacity for prolonged periods across the VRE lull events. There is a NEM-wide daily gas consumption soft constraint[82] which typically binds during the extreme VRE lull cases, beyond which it is assumed secondary fuels enable continued generation. Where this is not possible, the resilience of the development pathway may be overestimated.
- **Continuous hydro generation during the VRE lulls:** hydro capacity is assumed to be able to run at maximum capacity for prolonged periods across the VRE lull events. There may be limitations to sustained hydro generation in avoiding downstream flooding, which has not been captured. Where assumed hydro output is overestimated, the resilience of the development pathway may be overestimated.
- **Simplified representation of the NEM:** a subregional representation of the NEM was used in the time sequential modelling which does not include detailed network constraints.

82 AEMO, 2024 ISP Appendix 2: Generation and storage development opportunities, p. 16, June 2024.

A4. Authorisation of existing network upgrades

A4.1 Regulatory requirements

Under the EII Act, the Consumer Trustee has the function of authorising REZ network infrastructure projects following a recommendation from the Infrastructure Planner.[83]

In exercising its authorisation functions, the Consumer Trustee is required to act independently and in the long-term financial interests of NSW electricity customers and consistently with the objects of the EII Act.[84]

In addition, the EII Regulation[85] provides that, in determining whether it is satisfied that a recommended REZ network infrastructure project is in the long-term financial interests of NSW electricity customers, the Consumer Trustee must:

- undertake a cost-benefit analysis (CBA) of the project in accordance with the requirements set out in the EII Regulation and give primary consideration to the CBA; or
- give primary consideration to the most recent IIO report as at the time of the Infrastructure Planner's recommendations.

A4.2 Principles for using the IIO report for authorisation purposes

ASL has developed the following approach to determine which source it will give primary consideration to in undertaking its analysis of the long-term financial interests of NSW electricity customers:

- The IIO report will be given primary consideration when doing so is considered to be fit-for-purpose to make an authorisation decision using the principles set out below:
  - Whether the most recent IIO report demonstrates that the project has benefits under conservative scenarios.
  - Whether there have been material changes in the electricity market since the most recent IIO report, with particular consideration generally to be given to the currency of assumptions relating to network options (in terms of capacity and cost), demand and changes to policy objectives.
  - Whether the contents of the most recent IIO report allow for a sufficiently robust assessment of the long-term financial interests of NSW electricity customers.
- Where the IIO report is not considered to be fit-for-purpose, ASL will undertake a CBA.

These principles and the approach to authorisation using the IIO report do not alter EnergyCo's obligation to submit a recommendation that includes all required information, including the proposed network option(s) and network operator.

A4.3 Scenario selection

As noted in Appendix A1, ASL modelled two scenarios and a sensitivity to test a range of different futures. The speed of the energy transition is tested through accelerating coal retirements in NSW, while the technology mix and ability to meet minimum objectives is tested through implementing supply chain constraints and build limits on the build out of generation infrastructure.

Collectively these assumptions capture a range of possible upside and downside outcomes for different network projects. The fact that the model chooses the same selection of network projects (with one variation) indicates that construction of these network projects is likely to be 'low regrets' for NSW electricity customers.

83 EII Act, section 31.

84 EII Act, sections 3(3) and 60(3).

85 EII Regulation, clause 19B(3).

A4.4 Benchmark cost methodology

The 2025 IIO report includes a $10,000 per gigawatt hour per annum (GWh p.a.) benchmark annual cost test, and associated thresholds, to enable the streamlined authorisation of REZ network projects with those attributes.

This benchmark considers modelling underpinning the 2025 IIO report and represents the modelled relationship between network investment and generation enabled within NSW.

ASL calculated the $10,000/GWh benchmark amount by dividing the annualised network option costs in dollars by the GWh p.a. available from new generation infrastructure within NSW, where:

- The annualised cost of the network options includes network options that were selected in the *Supply Chain Constrained* scenario, excluding the costs of the Central-West Orana and Hunter Central Coast REZ authorised network options.
- The annual GWh amount of new generation in NSW captures available renewable generation enabled from network options selected in modelling, as well as from modelled open access in 2031 in the *Supply Chain Constrained* scenario. It excludes generation enabled by already authorised REZ network options.

ASL considers the present value of the annual $/GWh p.a. outcomes to capture the long-term value of network investment underpinned by the annual modelling outcomes. In deriving the benchmark value, ASL has:

- Used the *Supply Chain Constrained* scenario as it describes a world where any additional generation that could be enabled early is highly valuable.
- Excluded existing and committed generation and network projects. The calculation also excludes network projects enabling long-duration storage or firming infrastructure.
- Used costs in real 2025 dollars and in equivalent terms to modelled cost assumptions for network options.

ASL will work with EnergyCo and network service providers to clarify the approach as needed.

A5. Regulatory requirements

A5.1 Requirements under the EII Act and EII Regulations

The EII Act and the EII Regulation require that specific items be included in the IIO report prepared by the Consumer Trustee, as well as matters that must be taken into account when preparing its report.

A summary of the relevant requirements, and where they are addressed in this report, is set out in Table 14.

Table 14: IIO report regulatory requirements

EII Act section reference	Description	Report reference
Section 45(1) The Consumer Trustee is to prepare a report about the infrastructure investment objectives that contains:		
(a)	the development pathway for the infrastructure to which this Part applies that is required to be constructed over the following 20 years to achieve the infrastructure investment objectives	Sections 3.1, 4.1, 4.2, 4.3
(b)	a plan for the competitive tenders that the Consumer Trustee will conduct during the following 10 years to give effect to the development pathway, including when tenders will be conducted and the classes of LTESA for which a tender will be conducted	Sections 3.2, 4.5, 4.6
(c)	other matters prescribed by the regulations	See below
Section 45(3)	The Consumer Trustee is also to prepare a report as soon as practicable after being directed by the Minister under section 47(2) to conduct a competitive tender for LTESAs for firming infrastructure.	This report, in particular section 4.6
Section 45(6)	The Consumer Trustee is to exercise its functions under this Part on the basis of the reports prepared under this section.	This report.
EII Regulation clause reference	**Description**	**Report reference**
Clause 24(1) An infrastructure investment objectives report must contain the following:		
(a)	how the infrastructure required under the development pathway specified in the report will assist in achieving the infrastructure investment objectives	Sections 3.1, 4.2, 4.3, 4.4, Appendix A2
(b)	information about the expected timing, staging and sequencing of the construction of: (i) the infrastructure required under the development pathway, and (ii) REZ network infrastructure projects that may be required	Sections 3.1, 4.2, 4.3, 5.2
(c)	a comparative assessment of the merits of constructing long-duration storage infrastructure that exceeds the minimum objective specified in section 44(3)(b) of the EII Act and firming infrastructure to meet the reliability standard	Sections 3.1, 4.2, 4.4, Appendix A2
(d)	a forecast of wholesale electricity costs and costs for NSW electricity customers that are due to contributions required to be paid by distribution network service providers under section 58 of the EII Act	Section 6.2
(e)	details of the current, planned and expected construction and operation of infrastructure for the supply of electricity in NSW and the national electricity market	Chapters 2, 3, 4, 5
(f)	an analysis, including the methodology, of the risks to NSW electricity customers of early or delayed investment in relevant infrastructure	Chapter 3, 4, Appendix A1

(g)	an estimate of the amount of electricity in gigawatt hours that is equivalent to the gigawatts of capacity required under the minimum objectives specified in section 44(3) of the EII Act, using information in the 2020 Integrated System Plan published by AEMO under the National Electricity Rules	Section 3.1
Clause 24(2) **An infrastructure investment objectives report, other than the first report prepared under the Act, section 45(2)(a), must also contain the following:**		
(a)	a description of the changes since the previous report to (i) the development pathway, and (ii) the plan for competitive tenders under the Act, section 45(1)(b)	Sections 3.1, 4.2, 4.3
(b)	the outcomes of tenders carried out since the previous report, including (i) the number of persons who made a bid in each tender, including the number of eligible and ineligible bids according to the rules made under the Act, section 47(5), and (ii) the number of LTESAs recommended by the Consumer Trustee after each tender, and (iii) the number of LTESAs entered into.	Section 2.3
(c)	details of the infrastructure constructed, or proposed to be constructed, under LTESAs entered into, or agreed to be entered into, since the previous report	Section 2.3
(d)	an assessment of the progress in achieving the minimum objectives specified in the Act, section 44(3)	Section 2.1
(e)	an assessment of the resilience of the NSW electricity system in relation to lulls in variable renewable energy sources, as it relates to the development pathway in the report, including by reference to climate modelling	Section 4.4, Appendix A3
Clause 25(1) **The Consumer Trustee must take the following into account in preparing an infrastructure investment objectives report:**		
(a)	any target breaches identified in the most recent energy security target monitor report	Section 2.2 and Appendix A2
(b)	the forecast of unserved energy from the most recent statement of opportunities published by AEMO under the National Electricity Rules	Section 2.2 and Appendix A2
(c)	the most recent Integrated System Plan published by AEMO under the National Electricity Rules	Sections 1.3, 1.5, Chapter 5, Appendix A1, Appendix A2
(d)	the market conditions, including supply chains and labour and capital constraints	Sections 1.4, 1.5, 2.3, 3.1, 4.2, 4.3, Appendix A1
(e)	the payments required to be made by the scheme financial vehicle under existing and planned LTESAs	Sections 6.1, 6.2
(f)	how the development pathway in the report will contribute to the object under section 3(1)(a) of the EII Act	Chapters 3, 4, 6, Appendix A2, Appendix A3
(g)	the resilience of the NSW electricity system in relation to lulls in variable renewable energy sources, including by reference to climate modelling	Appendix A3
Clause 25(3) **When preparing the development pathway, the Consumer Trustee must:**		
(a)	take into account several scenarios for the construction of generation, long-duration storage and firming infrastructure in NSW	Sections 1.5.2, 3.1, 4.2, 4.3, Appendix A1
(b)	analyse the resilience of the outcomes for each scenario, including in relation to (i) the reliability of supply and (ii) the financial exposure risks to NSW electricity customers	Sections 4.4 and 6.2, Appendix A2

Abbreviations and definitions

Term	Definition
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
ASL	AusEnergy Services Limited
BESS	battery energy storage system
CBA	cost-benefit analysis
CER	consumer energy resources
CIS	Capacity Investment Scheme
CISA	CIS agreement
CO2-e	carbon dioxide equivalent
Consumer Trustee	ASL appointed as the Consumer Trustee under the EII Act
development pathway	infrastructure required to be constructed over the following 20 years
EII Act	*Electricity Infrastructure Investment Act 2020* (NSW)
EII Regulations	*Electricity Infrastructure Investment Regulation 2021* (NSW)
EnergyCo	Energy Corporation of NSW
ESOO	Electricity Statement of Opportunities
ESTM report	Energy Security Target Monitor report
firming direction	A direction by the Minister under section 47(2) of the EII Act to conduct a competitive tender for LTESAs for firming infrastructure
IASR	Inputs, Assumptions and Scenarios Report
IIO report	Infrastructure Investment Objectives report
ISP	Integrated System Plan
LTESA	long-term energy services agreement
minimum objectives	minimum infrastructure investment objectives established by section 44(3) of the EII Act
Minister	NSW Minister for Energy
NEM	National Electricity Market
NER	National Electricity Rules
NIS	Network Infrastructure Strategy
the Roadmap	NSW Electricity Infrastructure Roadmap
overall objectives	overall infrastructure investment objectives established by section 44(2) of the EII Act
QNI	Queensland to NSW Interconnector
REZs	renewable energy zones
VNI	Victoria to NSW Interconnector
VRE	variable renewable energy
WACC	weighted average cost of capital

Figures and tables

Figures

Tables