AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

2024 ISP Consultation Summary Report

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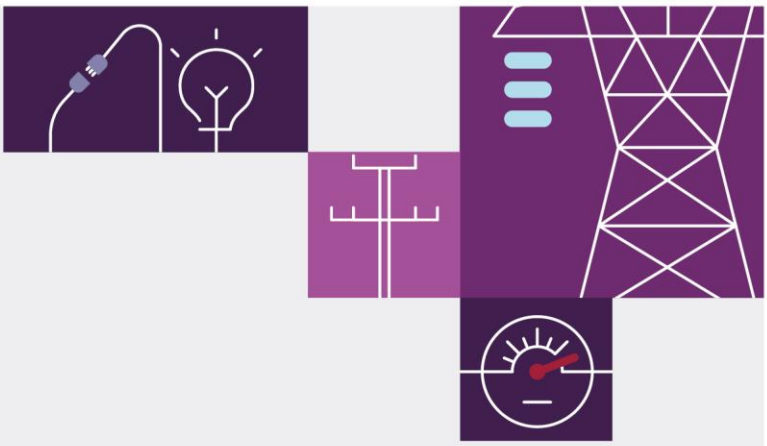

Important notice

Purpose

AEMO has prepared this document to provide information about the Draft 2024 Integrated System Plan (ISP) consultation pursuant to National Electricity Rules (NER) 5.22.14(c) and Section 2.5 of the Forecasting Best Practice Guidelines. This publication is generally based on information available to AEMO as at 1 May 2024 unless otherwise indicated.

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Version control

Version	Release date	Changes
1.0	26/06/2024	Initial release

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Executive summary

AEMO's *Integrated System Plan* (ISP) is a roadmap for the transition of the National Electricity Market (NEM) power system. Drawing on extensive stakeholder engagement, the ISP's optimal development path (ODP) sets out the needed generation, storage and network investments to transition to net zero by 2050 through current policy settings and deliver significant net market benefits for consumers.

AEMO appreciates the considerable time stakeholders devoted across the past two years to engage with ISP planning, including consultation on the Draft 2024 ISP, and looks forward to future engagement.

AEMO thanks stakeholders for their submissions

Engagement to inform the development of the 2024 ISP was carried out regularly over almost two years from September 2022 to May 2024, with multiple opportunities for stakeholder input. AEMO has considered 104 formal submissions to the Draft 2024 ISP, as well as four submissions to the *Addendum to the Draft 2024 Integrated System Plan*. Stakeholders acknowledged the difficulty and complexity of understanding and mitigating risks associated with the development of the Draft 2024 ISP, and there were suggestions for improvement. Table 1 lists the 11 key themes of the feedback, as well as frequency of mentions and the main cohort providing comments.

Table 1 Summary of key themes

Theme	Frequency*	Main cohort
Detailed planning on the role of **consumer energy resources (CER) and distribution networks** is strongly supported, with concerns raised about the proposed level of coordination and whether it can be achieved.	37 stakeholders	Individuals and consultants
The ISP **modelling approach** should optimise demand-side investments, undertake more tests against different possible weather outcomes, introduce a 'do-nothing' scenario, and include a value of greenhouse gas emission reduction.	32 stakeholders	Individuals and consultants
Consideration of alternative treatment of **generation and storage technologies** is desired by some stakeholders, including nuclear generation, and pumped hydro.	30 stakeholders	Individuals and consultants
Securing **social licence** for the energy transition is a challenge that presents risk to the implementation of the ISP, and requires broader consultation.	27 stakeholders	Industry
Risks to the delivery of the ODP need to be modelled in more depth and ODP project timings reviewed if necessary.	25 stakeholders	Industry
Concerns about feasibility and viability of the proposed expanded **role of gas-powered generation** in the ISP, as well as questions about whether other solutions ought to have been identified.	21 stakeholders	Industry
Mixed views were given on the status of several **actionable ISP projects**, in particular advocating for the inclusion of South Australian developments (Mid North and South East South Australia), and New South Wales developments (Sydney Ring South) in the ODP.	18 stakeholders	Consumer and community advocates; Industry
Stakeholders had a number of queries about the **demand forecast** applied in the 2024 ISP, particularly about whether the electric vehicle uptake is too ambitious, and about whether sufficient future large industrial loads have been included.	16 stakeholders	Industry
Communication in the ISP should be clear and comprehensive.	15 stakeholders	Consumer and community advocates
Forecast **hydrogen** workforce needs and load flexibility assumptions should be revised and modelled in more detail.	13 stakeholders	Industry
The **2026 ISP** scope needs to expand to model distributional effects and the role of demand-side energy resources.	5 stakeholders	Various

*Frequency of stakeholder mentions is approximate. Not all stakeholders who commented on a topic will be mentioned in the body of the report.

Stakeholder feedback has been incorporated in inputs and modelling for the 2024 ISP

AEMO reviewed the written and verbal feedback from submissions, and has made the following key changes to the inputs and modelling process of the final 2024 ISP:

- **Greater recognition of the role of consumer resources and distribution networks,** including adding 'distribution networks' in the ISP tagline about where renewable resources are connected. In so doing, the ISP explicitly recognises CER as a significant resource in the transition and the contribution it makes, while also calling out more explicitly the input assumptions regarding orchestration and alternative costs if this does not occur to the level assumed.
- **Additional renewable energy and emissions reduction policies have been included**, with all scenarios now including updated targets for New South Wales and Queensland, the Federal Government's expanded Capacity Investment Scheme, and the application of Energy Ministers' value of greenhouse gas emissions reduction.
- **Updates to transmission projects,** including updated timing for several committed and anticipated transmission projects, and new smaller options for Sydney Ring South and Mid North South Australia REZ Expansion.
- **490 MW of additional generation and 3.7 GW / 10.8 GWh of storage have progressed** sufficiently to be considered committed or anticipated, and so are included in the ISP in all futures.
- **Sensitivity analysis exploring the impact of reduced CER coordination**, finding that $4.1 billion of additional grid-scale investment would be needed without effective coordination of consumer batteries.
- **Analysis considering the capability of gas infrastructure** to back up renewable supply during long periods of dark and still weather, estimating $230 million for fuel and fuel storage - potentially including hydrogen, green gases and other liquid fuels.
- **Net market benefits of transmission investment have increased to $22 billion.** Benefits due to avoided costs grew from $17 billion in the Draft 2024 ISP to $18.5 billion, and a further new benefit of $3.3 billion was calculated due to the application of the Energy Ministers' value of greenhouse gas emissions reduction.
- **Five transmission projects have progressed to actionable status, in addition to the two projects identified as actionable in the Draft 2024 ISP** – Sydney Ring South, Mid North South Australia REZ Expansion, Waddamana to Palmerston Transfer Capability Upgrade, Hunter-Central Coast REZ Network Infrastructure project and QNI Connect. The first two have become actionable due to the identification of smaller options, the third has been brought forward slightly, the fourth was identified after closer investigations through joint planning, and the fifth needs to start earlier to allow for more coordinated and effective community consultation.

AEMO is required under the National Electricity Rules (NER) to initiate consultation on non-network options following the identification of newly actionable projects not included in the Draft ISP. As such, AEMO calls for nomination of non-network options for Sydney Ring South, the Mid North South Australia REZ Expansion, the Waddamana to Palmerston Transfer Capability upgrade, and QNI Connect.[1]

[1] AEMO. *Current and closed consultations*, at https://aemo.com.au/consultations/current-and-closed-consultations.

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1 ISP consultation overview

Consultation and dialogue with stakeholders are critical to AEMO's role as the National Transmission Planner for the National Electricity Market (NEM), helping improve and refine the plans that support investment decisions required to transition the energy system, and serve the long-term interests of consumers.

This document outlines how AEMO has taken stakeholder feedback into account in developing the 2024 ISP.

- **Section 1** provides an overview of the consultation framework for the 2024 ISP.
- **Section 2** lists the stakeholders who made a submission to the Draft 2024 ISP, and includes a brief summary of key themes.
- **Section 3** provides detailed feedback from stakeholders and AEMO's response on material issues for the Draft 2024 ISP (including responses to the *Addendum to the 2023 Inputs, Assumptions and Scenarios Report* (IASR) and the Addendum to the Draft 2024 ISP), and a log of input and modelling changes between the draft and final ISP.

More detail on each of the stakeholder engagement opportunities in the 2024 ISP development process can be found in Section 1.1, and a full overview of the ISP process in Section 1.2.

1.1 Consultation on the development of the 2024 ISP

Engagement to inform the development of the 2024 ISP was carried out regularly between September 2022 and May 2024, with multiple opportunities for stakeholder input. AEMO's definition of stakeholders includes consumers and advocates, industry, market bodies, government, and other interested stakeholders such as environmental groups, academics, and energy industry consultants.

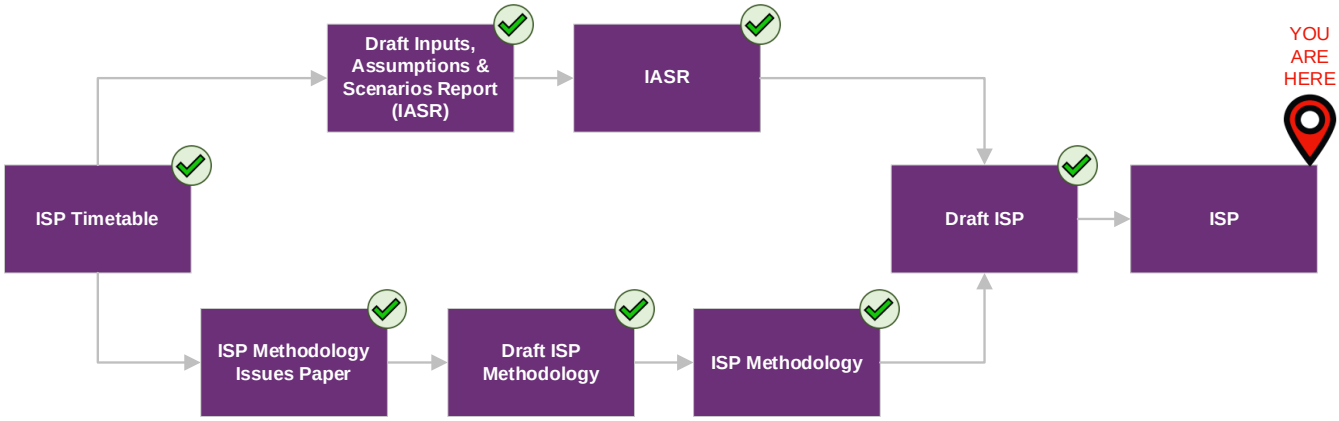
AEMO develops and publishes the ISP at least every two years. As shown in Figure 1, the ISP process includes the concurrent development of the *ISP Methodology* and the *Inputs Assumptions and Scenarios Report* (IASR) (which also includes the *Transmission Expansion Options Report*). AEMO also consults on addendums to the IASR and the Draft ISP, if required in response to transparency reviews by the Australian Energy Regulator (AER).

The consultation process for the 2024 ISP has incorporated the following major engagements, with more information on the engagement process to develop the final 2024 ISP available in Appendix 1[2] to the 2024 ISP.

- Consultation on the 2023 IASR, including the *Transmission Expansion Options Report* and Addendum to the 2023 IASR (Section 1.1.1).
- Consultation on the *ISP Methodology* (Section 1.1.2).
- Consultation on the Draft 2024 ISP, including the Addendum to the Draft 2024 ISP (Section 1.1.3).

[2] AEMO. 2024 ISP *Appendix 1. Stakeholder Engagement.* See https://aemo.com.au/consultations/current-and-closed-consultations/draft-2024-isp-consultation.

Figure 1 Parallel ISP consultations



1.1.1 Consultation on the *Inputs, Assumptions and Scenarios Report*

The IASR provides scenarios, inputs and assumptions used to deliver AEMO's range of planning and forecasting publications. AEMO prepared the 2023 IASR[3] and accompanying Inputs, Assumptions and Scenarios Workbook containing the key scenario data following stakeholder consultation, as required by the NER in accordance with the AER's *Forecasting Best Practice Guidelines*.

AEMO completed its consultation on the IASR in July 2023, taking into consideration feedback provided on the Draft 2023 IASR published in December 2022, as well as from several stakeholder workshops and webinars. The 2023 IASR was used to develop the 2024 ISP.

The *Transmission Expansion Options Report* aims to improve the accuracy and transparency of transmission expansion options used for the ISP, and supplements the IASR. AEMO initiated consultation on the 2023 *Transmission Expansion Options Report*[4] in May 2023, and feedback received from stakeholder workshops, webinars, and written submissions was used to inform the 2024 ISP.

The AER published its transparency review of the 2023 IASR in August 2023. The Addendum to the 2023 IASR[5] provides further explanation in response to issues highlighted by the AER, which were consulted on as part of the Draft 2024 ISP consultation process.

1.1.2 Consultation on the *ISP Methodology*

Under the NER, AEMO is required to develop, consult on and publish the *ISP Methodology*[6], which sets out how AEMO undertakes the modelling used to determine potential development paths in the ISP, and the cost-benefit analysis approach that tests these candidate development paths (CDP) to determine an ODP. AEMO commenced a consultation on updates to the *ISP Methodology* in March 2023. Formal stakeholder consultation included

[3] AEMO. 2023 IASR, at https://aemo.com.au/en/energy-systems/major-publications/integrated-system-plan-isp/2024-integrated-system-plan-isp/current-inputs-assumptions-and-scenarios.

[4] AEMO. 2023 *Transmission Expansion Options Report*, at https://aemo.com.au/consultations/current-and-closed-consultations/2023-transmission-expansion-options-report-consultation.

[5] AEMO. Addendum to the 2023 IASR, at https://aemo.com.au/-/media/files/major-publications/isp/2023/addendum-to-2023-inputs-assumptions-and-scenarios-report.pdf?la=en.

[6] AEMO. *ISP Methodology*, at https://aemo.com.au/consultations/current-and-closed-consultations/consultation-on-updates-to-the-isp-methodology.

workshops, meetings and briefings as required, as well as a written submission consultation process which concluded in May 2023.

1.1.3 Consultation on the Draft 2024 ISP

In December 2023, AEMO published the Draft 2024 ISP[7]and initiated a formal written submission consultation process that concluded in February 2024. Concurrently, in January 2024, the AER published its Transparency Review of AEMO's Draft 2024 ISP. The Addendum to the Draft 2024 ISP addresses the matters raised in the AER's transparency review by providing additional information on how AEMO derived key inputs and assumptions and how they contributed to Draft 2024 ISP outcomes.

Across five months of consultation, AEMO engaged with stakeholders via two webinars and two consumer advocate sessions, as well as via the written submission consultation process on the *Draft 2024 ISP* and its *Addendum*. This report responds to key themes raised in written submissions and consumer advocate sessions.

1.2 The ISP process

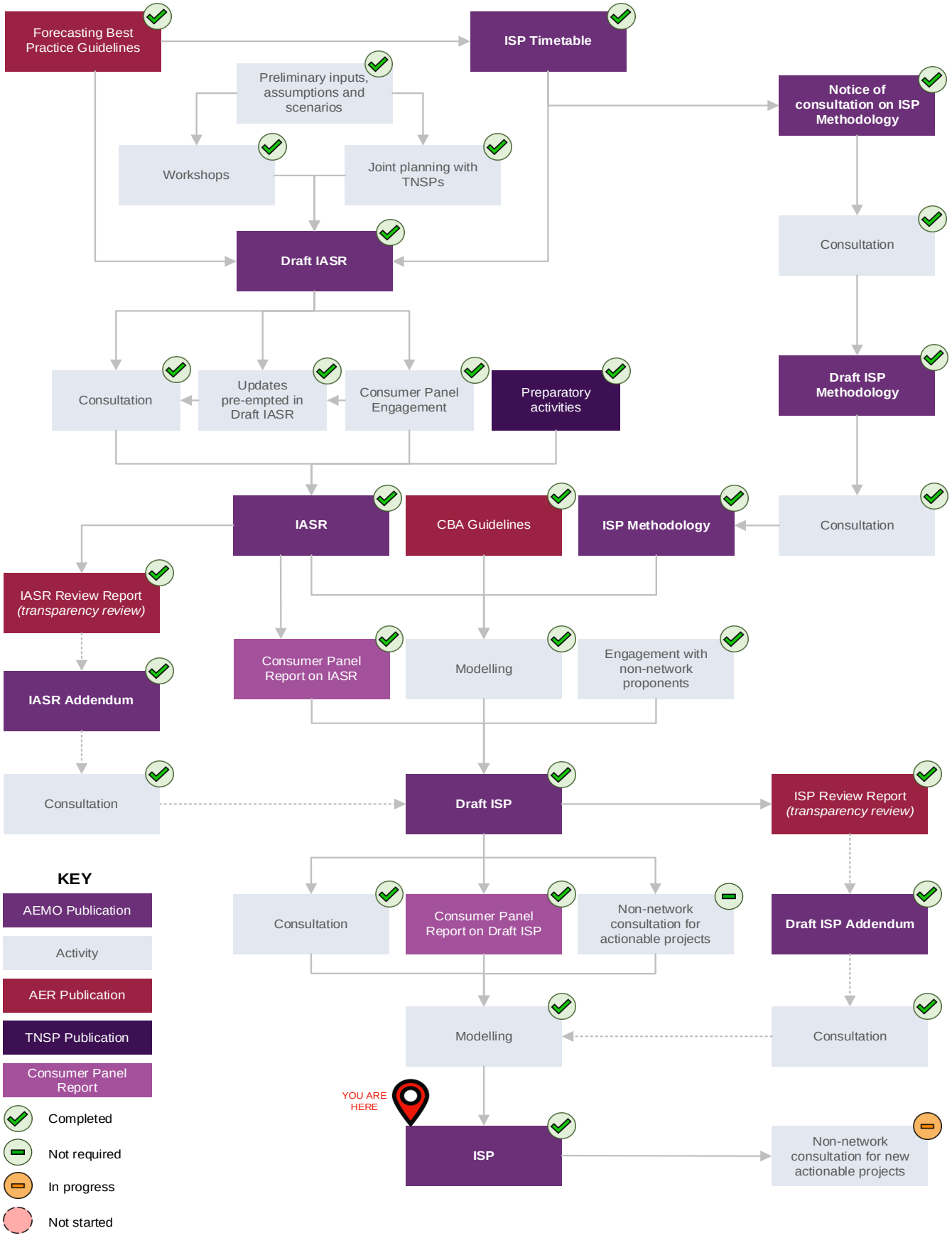
The ISP framework in the NER[8] and associated AER guidelines apply to the development of the 2024 ISP, including the AER's *Forecasting Best Practice Guidelines* and *Cost Benefit Analysis Guidelines*, and consideration of AER transparency reviews and ISP Consumer Panel reports.

Within this framework, and in consultation with stakeholders, AEMO designs and conducts the process to develop the ISP. Figure 2 below provides a visual representation of this process, including both the elements of the regulatory framework (in purple, red and light purple boxes) and the activities undertaken by AEMO and stakeholders (in light grey boxes). Figure 2 also identifies those steps that are complete.

[7] AEMO. Draft 2024 ISP, at https://aemo.com.au/consultations/current-and-closed-consultations/draft-2024-isp-consultation.

[8] As per NER rule 5.22.

Figure 2 The ISP process



2 Submissions and key themes

This section identifies stakeholders who submitted to the formal consultation on the Draft 2024 ISP and its Addendum, as well as the Addendum to the 2023 IASR (Section 2.1), and provides a summary of feedback received across 11 key themes (Section 2.2).

2.1 List of stakeholders who provided formal feedback to the Draft ISP

AEMO received 104 formal submissions on the Draft 2024 ISP, including six verbal submissions from consumer advocates. Four submissions were also received to the Draft 2024 ISP Addendum, and a further four submissions to the Addendum to the 2023 IASR. These 112 submissions are listed in Table 2 below.

Table 2 List of stakeholders who provided formal feedback to the Draft ISP

Submissions to the Draft 2024 ISP		
Australian Conservation Foundation (ACF)	Endeavour Energy	mc^2 Energy
Australian Energy Council (AEC)	EnergyAustralia	Member for Wagga Wagga
AGIG	Energy Decarb	Michael French
AGL	Energy Estate	Michael Kottek*
Alan Pears	Energy Flex^	Neara
Alinta Energy	Energy Grid Alliance (EGA)	Nexa Advisory (Nexa)
AMP Energy	Ergon and Energex	Origin Energy (Origin)
Andrew Fletcher and Huyen Nguyen (Fletcher and Nguyen)	Etrog Consulting^	Paul Schulz
Anthony Donnellon	Electrical Trades Union (ETU)	Public Interest Advocacy Centre (PIAC)
APA	Electric Vehicle Council (EVC)	Queensland Conservation Council (QCC)
Australian Pipelines and Gas Association (APGA)	Fortescue	Queensland Energy Users Network^ (QEUN)
Australian Solar Thermal Research Institute and Australian Solar Thermal Energy Association (ASTRI and AUSTELA)	Geoffrey Houston	Ready Energy^
Academy of Technological Sciences and Engineering (ATSE)	Hydro Tasmania	Re-alliance^
Ausgrid	Hydrostor	Riverina Sustainable Food Alliance
Australian Hydrogen Council (AHC)	Ian Stevens	Roderick Sinclair
Australian Workers Union (AWU)	Iberdrola	Rondo
Barrie Hill	Institute for Energy Economics Financial Analysis (IEEFA)	South Australian Chamber of Mines and Energy (SACOME)
BlueScope	James Taylor et al.	South Australian Council of Social Service (SACOSS)
Clean Energy Council (CEC)	Kelvin Lillingstone-Hall	Save the Mary River Coordinating Group (STMRCG)
Clean Energy Investor Group (CEIG)	Isaac Mattoo*	South East Queensland Community Alliance (SEQCA)
Centre for Independent Studies (CIS)	ISP Consumer Panel	Smart Wires

Submissions to the Draft 2024 ISP		
Charles Esson	ITEZZE	Snowy Hydro
Cherylle Stone	Jack Horig*	Star of the South (SOTS)
Climateworks Centre (Climateworks)	John Moore	Stojan Karlusic*
CMX Energy (CMX)	John Wallace	Stride Renewables (Stride)
Daniel Black	Josh Leyshon*	Sunshine Hydro
David Bowen	Joy Thomas^	TasNetworks
David Brunt and Denis Feeney	Lewis Arnold*	Tesla
David Close	Lighter Footprints Energy Transition Group (Lighter Footprints)	Transgrid
David Mulholland*	Lindsay Campbell	Victorian Farmers Federation (VFF)
Declan Kuch	Lost River Australia	Volt Power*
Delta	MarinusLink	WestWind
ElectraNet	Mark Duffett*	WWF Australia (WWF)
ElectraNet Consumer Advisory Panel (ElectraNet's CAP)	Martin Kamener	Zenith Applied Sciences (Zenith)
Electric Power Consulting (EPC)	Mary River Catchment Coordinating Committee (MRCCC)	
Submissions which included feedback on the Addendum to the 2023 IASR		
IEEFA	ISP Consumer Panel	STMRCG
QCC		
Submissions to the Addendum to the Draft 2024 ISP		
Climateworks	Hydrostor	STMRCG
Tesla		

* Due to the similar content and nature of material raised, these submissions are collectively referred to as Campaign Group A.
^ Verbal submissions from consumer advocates were published in one document labelled 'Consumer Advocates' under the consultation submissions tab at https://aemo.com.au/energy-systems/major-publications/integrated-system-plan-isp/2024-integrated-system-plan-isp.

AEMO's 2024 ISP consultation webpage[9] contains all published papers and reports, written submissions, webinar recordings, and other consultation documents and reference material (other than material identified as confidential). Certain submissions were not published due to confidentiality or compliance with consultation guidelines[10].

[9] At https://aemo.com.au/consultations/current-and-closed-consultations/draft-2024-isp-consultation.

[10] Consistent with NER 5.22.14(c)(4) and confidentiality obligations set out in section 54 of the National Electricity Law. AEMO also assesses the publication of any information marked as confidential by referring to AEMO's Consultation Submission Guidelines, at https://aemo.com.au/-/media/files/stakeholder_consultation/working_groups/industry_meeting_schedule/aemo-consultation-submission-guidelines---march-2023.pdf?la=en&hash=DB5BAA8CC5A29297C205B91640A97518.

2.2 Summary of key themes

Table 3 below shows a heat map indicating the quantity of stakeholders comments, by cohort, for each of the key feedback themes identified by AEMO across the full set of submissions. Darker purple indicates more comments, lighter purple indicates fewer comments, and white areas indicate no comments.

Table 3 Heat map of key themes

Key themes	Industry (generators, retailers, developers, networks and associations)	Individuals and consultants	Consumer and community advocates	Environmental and climate groups	Academics
CER & distribution networks					
Modelling approach					
Generation & storage developments					
Social licence					
Delivery risks					
Role of gas					
Actionable projects					
Demand forecast					
Communication					
Hydrogen					
2026 ISP					

Section 3 of this document summarises stakeholder feedback and recommendations, and provides AEMO's response to each of the key themes. Table 4 below summarises Section 3, providing an overview of stakeholder feedback by theme and listing stakeholders who provided feedback on the theme in their submission. The order of themes corresponds to the order in Section 3, and does not include AEMO's response to the feedback.

Table 4 Key themes from submissions to the Draft ISP

Theme	Summary	Stakeholders
Role of gas	• Stakeholders were generally concerned with the feasibility of operating gas as proposed in the Draft ISP under current policy settings, and asked for more evidence and communication to support gas expansion, including an additional sensitivity assessing the role of gas. • Several submissions recommended assessment of the economic viability of gas developments and in general a higher price for the supply of gas. • Other submissions wanted to see the final ISP forecast a greater role for GPG including consideration of renewable gas.	CEC, Stride, David Close, Marinus Link, Lighter Footprints Energy Transition Group, Energy Australia, ETU, Alinta Energy, Sunshine Hydro, PIAC, Hydrostor, IEEFA, Nexa Advisory, Alan Pears, APGA, Tesla, AGIG, Fortescue

Theme	Summary	Stakeholders
Delivery risks	• Several submissions called for a sensitivity that models combined "delivery risks" including supply chain constraints, cost pressures, social licence and shortages of skilled labour. • Some stakeholders felt project timings in the ODP could be reviewed to manage the risks associated with delayed transmission investment. • Several stakeholders requested the publication of electricity sector workforce projections with the 2024 ISP.	ISP Consumer Panel, ElectraNet's CAP, CIS, Sunshine Hydro, ETU, Nexa Advisory, mc^2 Energy, QCC, CEC, AEC, Alinta Energy, Delta Electricity, Energy Australia, Origin Energy, Volt Energy, Energy Grid Alliance, Marinus Link, QEUN, WestWind Energy Development, ATSE, AMP Energy, CMX Energy
Actionable projects	• Many stakeholders argued for projects to be included in the ODP, in particular the Mid-North and South East South Australia expansions, and Sydney Ring South. An increasing amount of new renewable generation connection and future large industrial loads, power system reliability and benefits to energy consumers were the themes raised most often. • One stakeholder raised concerns about the position in the Draft 2024 ISP that HumeLink continues to be an actionable ISP project, and the ISP Consumer Panel asked for further explanation for why Stage 2 of Project Marinus ought to retain its actionable status. • Several transmission network service providers suggested updated inputs for inclusion in the final 2024 ISP modelling. • Other stakeholders asked AEMO to consider the impact of concessional finance on the optimal timing of actionable projects.	ElectraNet, ElectraNet's CAP, SACOME, Rondo Energy, SACOSS, ISP Consumer Panel, Marinus Link, Hydro Tasmania, Transgrid, Blue Scope, Snowy Hydro, CIS, Campaign Group A, TasNetworks, CEIG, VFF
Modelling approach	• Stakeholders recommended that demand-side interventions should be co-optimised with supply in the ISP model where possible. • Some stakeholders argued that the ISP does not model 'whole-of-system' costs unless CER costs and distribution network investments are included. • There was concern that perfect foresight assumptions in the ISP will lead to an over-reliance on short-duration storage to meet system needs, and called for more testing of alternate weather patterns. • Submissions proposed additional scenarios and sensitivities, including a "do-nothing" scenario similar to the 2022 ISP's Slow Change.	ISP Consumer Panel, CIS, EPC, John Wallace, Campaign Group A, Origin Energy, Marinus Link, Energy Australia, Ergon and Energex, Ian Stevens, CEIG, Snowy Hydro, WWF Australia, ACF, Paul Schulz, IEEFA, ACF, Stride, James Taylor et al., PIAC, Rondo Energy, Hydro Tasmania, Lighter Footprints, Smart Wires, mc^2 Energy, CEC
CER and distribution networks	• Several submissions noted that the significant level of CER coordination assumed in the ISP scenarios will be challenging without innovation, reform and acquiring social licence, and requested the ISP propose ways to achieve this. • Stakeholders wanted to see the ISP consider the role of distribution networks, recommending the inclusion of detailed planning of CER, energy efficiency, and sub-transmission requirements.	ISP Consumer Panel, AGL, Ausgrid, Endeavour Energy, Ergon and Energex, Energy Decarb, Hydrostor, Hydro Tasmania, Martin Kamener, Nexa Advisory, Rondo Energy, IEEFA, PIAC, EPC, Blue Scope, ElectraNet's CAP, Marinus Link, CIS, Tesla, Etrog Consulting, Alan Pears, SEQCA
Demand forecast	• Stakeholders were concerned that the ISP forecast uptake of electric vehicles was too high, without supporting subsidies and accelerated charging infrastructure roll-out. Others noted that EV charging profiles biased towards peak demand periods could trigger over-investment in network build-out. • Several submissions wanted to see the ISP further consider the contribution of potential future large industrial loads on the demand forecast, citing gigawatt-capacity connections in South Australia and New South Wales in particular. • Some submissions noted an increase in demand and consumption forecasts from the 2022 ISP, though the scenario settings for *Step Change* have not significantly changed.	CEC, EVC, IEEFA, Ausgrid, Endeavour Energy, CIS, Origin Energy, Hydro Tasmania, Energy Grid Alliance, ETU, SACOME, ElectraNet, Transgrid, ElectraNet's CAP, Blue Scope
Social licence	• Stakeholders agreed that securing social licence for new projects was a challenge and risk for the ISP and in general more can be done to better plan for and address it. • Many submissions proposed ways to facilitate social licence discussions and progress solutions through collaboration with community, industry and First Nations groups. • Several stakeholders suggested changes and enhancement to ISP sensitivity analysis for considering the impacts of social licence.	APA Group, ETU, CEC, Origin Energy, Star of the South, IEEFA, ISP Consumer Panel, AEC, AGL, Member for Wagga Wagga, Declan Kuch, WWF, VFF, Re-Alliance, ATSE, Energy Grid Alliance, WestWind

Theme	Summary	Stakeholders
Communication	• Many stakeholders requested greater clarity or information on certain topics, or for AEMO to consider how the coverage of certain topics in the ISP might be perceived by different stakeholder groups. • Requests for additional emphasis on certain topics included clarifying the role of the ISP, its scope and limitations, and where possible identifying policy gaps and their risk to the transition. Additionally, stakeholders wanted to see the role of consumers emphasised in the ISP and its tagline, and expansion on what "affordability" means.	AEC, ISP Consumer Panel, QEUN, PIAC, Iberdrola, David Close, Paul Schulz, SEQCA, James Taylor et al.
Generation and storage development	• Several stakeholders proposed alternative treatment of generation and storage technologies, including nuclear, pumped hydro, offshore wind, concentrated solar thermal, and compressed air storage. • There was a call for AEMO to further consider offshore wind in NSW and Tasmania in de-risking disorderly coal closure. • Some stakeholders requested changes to the application of GenCost results in the 2024 ISP.	CIS, James Taylor et al., Roderick Sinclair, Campaign Group A, ETU, Star of the South, Cherylle Stone, QCC, WestWind Energy Development, Lost River Australia, ISP Consumer Panel, ASTRI & AUSTELA, Rondo Energy, Hydrostor, PIAC
Hydrogen	• Stakeholders asked for more detail on hydrogen modelling assumptions and encouraged AEMO to consider modelling in more detail. Others also recommended that AEMO explore the impact of the hydrogen load flexibility assumption. • It was noted that national hydrogen workforce needs and policies may be underestimated if only 50% of hydrogen projects are assumed to be NEM-connected. • Some submissions considered that the ISP underestimated the forecast level of export growth and encouraged AEMO to consider modelling greater uptake.	Marinus Link, Fletcher and Nguyen, Hydro Tasmania, Origin Energy, AGIG, CEC, AHC, Fortescue, Sunshine Hydro, Rondo Energy, Energy Estate
2026 ISP	• A number of stakeholders made recommendations for the 2026 ISP. Comments were received on themes including the role of demand-side energy resources, consumer risk preferences and how discount rates are applied.	ISP Consumer Panel, IEEFA, Climateworks, Iberdrola, Fortescue, Neara, Transgrid

2.3 2024 ISP Consumer Panel recommendations on the Draft ISP

The 2024 ISP Consumer Panel provided its report on the Draft 2024 ISP to AEMO in February 2024[11]. The Panel identified six major recurring themes ('Transmission' plan vs 'whole of system' plan, constrained ODP, hard choices, affordability, the role of gas, and the 'how?')[12] and made numerous recommendations which are summarised in Table 5 along with AEMO's responses. In addition, the ISP Consumer Panel feedback is discussed as part of the detailed feedback in Section 3, along with comments from other stakeholders on the same themes.

Table 5 Recommendations in the 2024 ISP Consumer Panel's report on the Draft 2024 ISP

Theme	Recommendation	AEMO response
Overall framing[13]	The ISP Consumer Panel recommend that the ISP should be framed as a transmission plan rather than a whole of system plan, as demand side options are not optimised as an output of the ISP modelling process. The Consumer Panel considers that this matter should be reflected in the tagline used to summarise parts of the ISP (that is, AEMO's variations on the statement that "with coal retiring, renewable energy connected with transmission, firmed with storage and backed up by gas-powered generation is the lowest cost way to supply electricity to homes and businesses throughout Australia's transition to a net zero economy."). The ISP Consumer Panel suggests an alternate tagline. The ISP is required to include government energy and climate policies across all scenarios and in the ODP if they meet thresholds specified in the National Electricity Rules. The ISP Consumer Panel is concerned that this "constrains the transparency of results for consumers", and that "the more that policy expansion continues, the less the result will be an Optimal Development Plan from a consumer perspective."	AEMO acknowledges that the ISP model currently optimises for supply side developments, while taking demand side behaviours in the electricity system as an input. The ISP takes a scenario-based approach to planning. Each ISP scenario contains a demand side development outlook consistent with the parameters of the scenario and the ISP model determines the supply side investments. AEMO recognises the contribution of demand side developments and has updated the main finding tagline to reflect this by including reference to renewable energy connected by distribution networks as well as transmission. In addition, supporting documentation for the ISP (such as the Addendum to the Draft 2024 ISP) provides greater detail about the forecasting approach taken for demand side options. AEMO agrees that further efforts to co-optimise supply side and demand side developments is valuable and AEMO is exploring this as per the Energy and Climate Change Ministerial Council (ECMC) recommendations for incorporation into the 2026 ISP. AEMO agrees that the inclusion of government policies and targets in the ISP modelling do influence the suite of developments which are identified as an output of the model. AEMO considers that it is appropriate to include committed government policy in the ISP, consistent with the National Electricity Rules, to ensure that the ODP remains within the bounds of the policies underway for delivery by the Australian state and federal governments.

[11] The ISP Consumer Panel included feedback on the Addendum to the 2023 IASR in its report on the Draft 2024 ISP.

[12] The role of gas theme is discussed in Section 4.1 and not listed in Table 5. The hard choices theme nominated by the ISP Consumer Panel does not include any recommendations for ISP and has also been omitted from Table 5.

[13] Overall framing addresses the 'Transmission' plan vs 'whole of system' plan, and constrained ODP themes.

Theme	Recommendation	AEMO response
		AEMO has not sought to evaluate the impact of each policy or target in isolation through the ISP, as this is not the role of the ISP and would introduce further complexity and uncertainty into the modelling process. It is true that transparency of results for consumers is very important, and AEMO has sought to include as much detail as possible about the inclusion of government policies, such as through the addition of content in the Addendum to the Draft 2024 ISP.
Affordability	The ISP should not make any judgements about affordability as allocating responsibility for funding the ODP is outside the scope of the ISP, and the ISP does not publish forecasts of retail prices. AEMO should provide more clarity about whether it considers that its approach to measuring consumer affordability is valid, and develop measures of the distributional impacts of the ISP.	AEMO agrees that energy affordability for consumers is extremely important. Although allocating funding responsibilities for the ODP sits outside the ISP's remit, AEMO considers some commentary on affordability to be valid as the ODP is selected to deliver the highest net market benefits while also ensuring secure and reliable electricity supply and emissions reduction. AEMO considers this approach to be consistent with the National Electricity Objective to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers "with respect to price". As discussed in Appendix 6, all else being equal, the least-cost development paths under each of AEMO's three scenarios provide net market benefits across the ISP planning horizon when compared with the counterfactual. That is, the counterfactual would result in higher long-term energy costs, leading to worse affordability for consumers.
Actionable projects	Clarify the status of Project Marinus Stage 2 as an actionable project given that the optimal delivery is in the 2030s and in some scenarios is beyond the nominated project proponent date. AEMO should provide further justification to support Project Marinus Stage 2 as an actionable project and demonstrate compliance with the AER's Cost Benefit Analysis Guidelines to balance the risk of overinvestment against underinvestment.	AEMO has provided additional explanation of the case for Project Marinus Stage 2 in section 4.3.2 below, and in Appendix 6 Cost Benefit Analysis of the final 2024 ISP. AEMO continues to find that Project Marinus is an actionable ISP project – both Stage 1 and Stage 2 – with a CDP including Stage 2 being identified as the path with the greatest weighted net market benefits, as well as one of the most resilient development paths, and delivering the highest-ranked weighted net market benefits across the majority of sensitivity analyses undertaken. AEMO considers that the selection of the ODP for the final 2024 ISP is consistent with the AER's Cost Benefit Analysis Guidelines as they relate to the requirement for AEMO to consider consumer risk preferences. AEMO considers that the identified net market benefits from Project Marinus (Stages 1 and 2) strikes the right balance of risk to consumers. Under-investment in this project could mean that consumers do not receive the benefits of the project, namely access to low-cost renewable generation and security of supply.
Delivery risks[14]	Include a sensitivity on project timing relating to a delay in planning and environmental approvals for electricity infrastructure.	AEMO has conducted a combined risk sensitivity in the final 2024 ISP and supply chain constrained sensitivity in the Draft 2024 ISP. These sensitivities include delays to transmission and generation developments and though not specifically intended to reflect approval delays, these sensitivities do by proxy demonstrate the impact of delay. AEMO

[14] AEMO considers this to be the 'how?' theme and is discussed further in section 4.2

Theme	Recommendation	AEMO response
	The ISP should advocate for mechanisms, policies and practices that will help deliver the ODP. AEMO should consider more commentary on policy responses to mitigate the risks discussed in Chapter 8 of the ISP regarding policy and market settings.	has also based the delay to lead time of generation developments on real world project outcomes, which allows some capture of recent approval times. AEMO therefore has not conducted additional sensitivities to test the delays due to planning and environmental approvals. AEMO recognises the importance of mechanisms, policies and practices for delivering the ODP and has highlighted the risks facing the energy transition in this area in the 2024 ISP. AEMO will continue to work with governments, network organisations, developers, and other industry participants to support the timely progression of the work needed to deliver the energy transition.
CER & distribution network	AEMO and the ISP Consumer Panel to consider implications of the Energy Security Board findings in February 2024 on the role of CER in the transformation of the NEM, as part of finalising the 2024 ISP[15].	AEMO has considered insights from the Energy Security Board report. As the report makes recommendations rather than final determinations or rules, AEMO has not incorporated modelling changes into the final ISP as a result of the report, but has been informed by the report where relevant, for example in revisions to Appendix 8. AEMO will continue to progress reform in this area with the Energy Security Board (now known as the Energy Advisory Panel) and other market institutions through separate reform processes.
Communication	The final 2024 ISP should discuss the following points in further detail: • information to customers about the cost challenges, as well as 'common good' benefits of the ISP and related transition costs • application of the AER's Cost Benefit Analysis Guidelines and its limitations in a consumer summary • the risk of forecast errors in the executive summary and in Appendix 6 • the downside impact of connection to international material and equipment markets more explicitly • judgement applied to balancing reliability and affordability, particularly recognising that reliability standards are set exogenously • discussion of sensitivity results • method for determining the social licence sensitivity parameters	AEMO has considered these recommendations for the final 2024 ISP as follows: • included additional material about keeping costs as low as possible, net benefits, and common good with regard to the benefits of CER orchestration in the 2024 ISP Overview. • decided not to include further information about forecast errors in the ISP reporting, as a forecast is uncertain by nature and AEMO considers that this is understood by the readership • included an additional note in the 2024 ISP regarding the impact of connection to international material and equipment markets • did not include additional information about judgement applied to balance reliability and affordability, as Appendix 4 System Operability already provides several sections about adjustments made to ensure that the ODP complies with the reliability standard, and Appendix 6 Cost Benefit Analysis provides extensive information about the cost benefit analysis informing the ODP selection • retained the existing approach to explain the detail of sensitivity analysis results in Appendix 6 Cost Benefit Analysis to ensure that this economic analysis is fully explained with an appropriate level of detail

[15] Energy Security Board (now known as the Energy Advisory Panel). February 2024. *Consumer energy resources and the transformation of the NEM report*. At https://www.energy.gov.au/energy-and-climate-change-ministerial-council/energy-ministers-publications/consumer-energy-resources-and-transformation-of-nem.

Theme	Recommendation	AEMO response
		• included additional information about the method used to determine the social licence sensitivity parameters.
GenCost	The ISP Consumer Panel encourages AEMO to seriously consider using the draft CSIRO 2023-24 GenCost results in the final ISP modelling, rather than continuing to use the final 2022-23 GenCost results. We await other submissions' views on this matter.	AEMO has reviewed the draft 2023-24 GenCost results (which were still under consultation when the ISP modelling was being undertaken) and retained the 2022-23 GenCost results, as the updated GenCost values were not considered to be material enough to impact the ODP. In addition, one other stakeholder submission touched on this matter, from **Stride**, relating to the technical and economic life of pumped hydro and hydro generation installations (addressed separately in Section 4.12).
System security & reliability	AEMO provide greater clarity about their approach to how all categories of system security costs are calculated and why they are included/not included, and the large cost accuracy range for synchronous condensers costs.	AEMO has provided more information on this matter in the Addendum to the Draft 2024 ISP, in response to the AER transparency review.
Improvements for the 2026 ISP	• Co-design further development to consumer risk preferences with the 2026 ISP Consumer Panel for application to future ISPs. • Enhance recording and reporting of third party CER and distribution network involvement on the electricity market • Energy Ministers should develop a national CER orchestration strategy to be implemented as part of the development of the 2026 ISP, while AEMO should seek to better quantify impact of effective orchestration and measures, and the risks if this is not successful, to enable improvements in policy and forecasting. • AEMO investigate using different discount rates for regulated and unregulated assets in assessing the net market benefits, given that investors differ in their cost of capital for these assets. Also consider consumer discount rates in the context of consumers' decisions on behind the meter investments. • Establish an increased cost as well as schedule delay for the supply chain sensitivity. • Develop measures of the distributional impact of the ISP. • Explore the options for reporting on potential levels of future curtailment and spilling to maximise use of generation. • A more comprehensive approach to analysing the hydrogen cost assumptions and how they may influence the scenario variables. • Incorporate gas supply and pipeline augmentation requirements to meet long term GPG gas requirements from the GSOO and develop a Gas Costs Database (akin to the Transmission Cost Database) to inform the 2026 ISP modelling. • System security issues should be examined more closely as part of the Methodology review in the 2026 ISP.	AEMO has recorded these suggestions in Section 4.11, alongside suggestions for the 2026 ISP provided by other stakeholders in response to the Draft 2024 ISP. The scope of improvements and inclusions in the 2026 ISP will be considered separately, including through consultation on review of AEMO's ISP Methodology, consultation on the 2025 IASR, and consultation on the Draft 2026 ISP.

Theme	Recommendation	AEMO response
	• Commence wide-ranging consultation on the ISP scenarios earlier in the 2026 ISP process including industry and consumer stakeholders, as well as the 2026 ISP Panel to assess possible improvements to the Delphi process. • Develop a strategy to document engagement with First Nations communities and include this record in future ISP documentation, to effectively recognise the interests and concerns of First Nations communities. • Conduct a thorough review of the 'unknown risk' factor in the 2026 ISP Transmission Cost Database (TCD) based on more up to date data.	

3 Changes between the draft and final ISP

This section details changes between the draft and final 2024 ISP, made in response to stakeholder feedback or to new market, policy and power system observations.

Changes to policy and emissions reduction

The final 2024 ISP has been updated to incorporate additional renewable energy and emissions reduction policies, with all scenarios now including updated emissions reduction targets for New South Wales and Queensland for 2035, the Federal Government's expanded Capacity Investment Scheme, and the application of Australia's Energy Ministers' value of greenhouse gas emissions reduction.

Changes to gas infrastructure

In response to stakeholder feedback, AEMO has incorporated revisions to the modelling of gas infrastructure across all scenarios. Changes included: assumptions that when capacity limitations of the east coast gas system to deliver adequate gas are breached, GPG is assumed to switch to liquid fuel supply in *Progressive Change* and *Step Change*; additional capital costs applied for GPG in all southern states to reflect the need for liquid fuel storage for *Progressive Change* and *Step Change*; and in all scenarios a limitation of approximately 1 GW of GPG per year (to reflect a reasonable market response with imperfect foresight of low VRE conditions).

Changes to transmission network investments

The following changes to transmission network investments have been made in the final ISP, following the application of updated inputs and assumptions relating to transmission projects and as a result of other modelling updates noted in this section and in the ISP documentation.

In addition to the changes noted below, a number of updates to project options, cost updates and project proponent delivery dates have been made through joint planning and have been recorded in the 2024 ISP Inputs, Assumptions and Scenarios Workbook.

Committed and anticipated projects

Latest committed and anticipated project statuses are included. There are delays to in-service dates for the Far North Queensland REZ, Central West Orana REZ Network Infrastructure Project, and Project EnergyConnect, due to rains, contracting and construction matters, and approval timelines. AEMO understands that delivery of all these projects is continuing at pace, consistent with the adjusted timelines.

Newly actionable projects

Five projects have moved to actionable status in the final 2024 ISP:

- **Hunter-Central Coast REZ Network Infrastructure Project** will support the expected increase in renewable energy in the Hunter and Central Coast regions of New South Wales through upgrades to existing infrastructure.

- **Sydney Ring South** will increase the power system's capability to supply the Sydney, Newcastle and Wollongong load centres from the south, with assessment now including a smaller and lower-cost option prepared by Transgrid.
- **Mid North South Australia REZ Expansion** will support the expected increase in renewable generation north of Adelaide, ensure adequate supply for large industrial loads, and alleviate network congestion, with assessment now including a smaller and lower-cost option prepared by ElectraNet.
- **Waddamana to Palmerston transfer capability upgrade** will support the expected increase in renewable generation near the Waddamana region in Tasmania, now modelled with an updated delivery date as advised by TasNetworks.
- **Queensland – New South Wales Interconnector (QNI) Connect** will support efficient sharing of new renewable generation between NEM regions, and will provide firming support between NEM regions, with assessment now including an updated project lead time from Transgrid to reflect timelines for inter-network testing and stakeholder consultation.

Future ISP projects

The list of **future ISP projects** in the *Step Change* scenario is similar to the Draft 2024 ISP, with some shifts – both earlier and later – observed for optimal timing of projects in the 2040s.

Changes to REZ analysis and presentation, and network planning inputs and assumptions

The final ISP includes the following revisions:

- Boundaries for Southern Ocean (formerly Portland Coast) and North Tasmania Coast offshore REZs updated to align with proposed and declared areas published by the Federal Government.
- Southern Ocean offshore REZ (V8) fixed and floating wind resource limits have been updated to reflect offshore wind developments announced by the Commonwealth in March 2024.
- North West Tasmania Coast (T4) and North East Tasmania Coast (T5) REZ input parameters have been updated to reflect the proposed Bass Strait, Northern Tasmania offshore REZ.
- Queensland: Corrected the modelling of the South West Queensland (SWQLD1) REZ transmission limit across seasonal ratings to reflect latest advice and align with the 2023 IASR Assumptions Workbook.
- South Australia: The Mid-North SA (MN1) group constraint limit was reduced based on advice from ElectraNet.
- Victoria: The South West Victoria (SWV1) group constraint has been revised to reflect the Mortlake turn-in project supporting 1,100 MW of transfer capacity (average additional generation output during peak summer periods), which was previously modelled as 1,500 MW (under optimal network conditions).

Updates to supply forecasts

Energy supply forecasts in the final ISP have been updated to include updated generation information from the *Generation Information* February 2024 release[16] to capture additional committed and anticipated projects.

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

As the announcement of a two-year extension of the retirement date for Eraring Power Station was only announced in May 2024, it has not been included across all scenarios. Instead, AEMO has prepared and published sensitivity analysis to explore the implications of this announcement.

The final ISP includes additional sensitivity analysis to demonstrate:

- The value of the forecast coordination of CER;
- The impact on the ODP if additional industrial demand in addition to the growth forecast in the Step Change scenario connects to key growth areas, particularly northern South Australia and Sydney, Newcastle and Wollongong;
- The impact on the ODP of updated assumptions regarding the electrification pace of the transport industry;
- The impact on the ODP if supply chains are constrained, slowing the capability to commission generation, storage and transmission developments;
- The impact on the ODP if hydrogen production was less flexible than assumed in the scenario analysis; and
- The impact on the ODP if weather variance is different to the core sequence of weather applied in the scenario analysis.

4 Detailed feedback

AEMO identified over 500 individual points of feedback across 104 submissions to the Draft 2024 ISP. This section provides a summary of material issues raised in stakeholder submissions, and AEMO's response to each issue, sorted into 11 broad categories.

4.1 Role of gas

Summary of material issues raised in submissions

Some stakeholders raised concerns with the feasibility and viability of expanding gas-powered generation (GPG) as proposed in the Draft 2024 ISP. These concerns focus on the economic viability of new GPG and the ability of existing gas infrastructure to deliver adequate fuel to operate GPG during periods of particularly high utilisation. Stakeholders called for more discussion on the business case to support further GPG expansion and further analysis on the additional costs associated with delivering adequate fuel for GPG operation during peak gas demand periods.

Stakeholders also questioned the economic viability for the GPG developments given that the low-capacity factors of GPG to provide back-up does not align with its typical commercial basis and existing use case (**CEC, EnergyAustralia, ATSE**). Stakeholders (**AGIG** and **APGA)** expressed concern that investments in GPG expansion with high intermittency would not happen without policy change. **APGA** noted that in the absence of government incentives, existing GPG may be reluctant to remain in the market and new investments in GPG may not be sufficient to develop the capacity required from 2033.

Another issue raised by stakeholders was the increased risk of inadequate gas supply to GPG (**Alinta, David Close, Delta, EnergyAustralia, Hydrostor, Marinus Link**). Stakeholders noted that despite low forecast utilisations, high intermittent demand peaks for GPG – which may also coincide with gas heating demands during winter – can't be met without substantial investments in pipeline infrastructure, gas storage and gas fields. Stakeholders highlighted peak day shortfalls forecasts from the 2024 Gas Statement of Opportunities (GSOO) and noted the cost of securing a reliable supply of gas for GPG needs to be reflected in the cost of GPG expansion and dispatch.

Some stakeholders (**ETU, Hydrostor**) questioned the social licence for GPG and suggested that GPG and gas infrastructure be included in the social licence sensitivity analysis.

Several submissions recommended further analysis on a higher cost for GPG expansion to reflect the uncertainties noted above. **Marinus Link** suggested including a cost premium for GPG to enable reliable access to forecast gas supply, **Lighter Footprints** suggested that GPG bid in closer to the market cap price rather than short-run marginal cost and **IEEFA** also suggested a 'high gas price' sensitivity.

Some stakeholders (**CEC, Lighter Footprints, ETU, IEEFA, Nexa Advisory, Alan Pears, Sunshine Hydro**) questioned the need for forecast GPG expansion, and called for more clarity and transparency on the expanded role anticipated for gas. The **CEC** requested an exploration on all assumptions underpinning the increase in GPG capacity between the 2022 ISP and Draft 2024 ISP, and **EnergyAustralia** requested plant level analysis for an example GPG project and time series dispatch weighted price curves.

Stakeholders noted that GPG expansions in the ODP may have displaced the need for medium and long duration storage and recommended further analysis to understand the relationship between the technologies (**CEC, Lighter Footprints**, **Hydrostor, CEIG, ACF, Sunshine Hydro**).

The impact of emissions from GPG was also raised, with the **QCC** suggesting that the expansion of gas is not compatible with Australia's emissions reduction goals, or that it is delivering affordable energy.

Stride and **CEC** suggested further analysis and a discussion on the impact of varying renewable droughts on GPG build-out, and argued that pumped hydro may be a more effective, net-zero solution.

Other submissions suggested a greater role for GPG to facilitate the energy transition by allowing coal generation to retire earlier. **APGA** and **APA** were concerned GPG consumption is underestimated in the ISP, which could lead to inadequate gas supply contracting, and recommended AEMO incorporate multi-sector energy modelling to improve these outcomes. **APGA** suggested AEMO consider the contribution of current facilities, such as Victoria's Iona Underground Gas Storage Facility, to avoid overinvestment in new infrastructure.

AGIG wanted to see a broader range of pathways for gas usage, proposing renewable gas as an alternative to electrification, to potentially deliver the ODP with lower costs and lower emissions. **Fortescue** also encouraged AEMO to begin considering the least cost way to build the required infrastructure to enable use of renewable gases like hydrogen.

AEMO's consideration and response

Feasibility and viability of expanding GPG

AEMO acknowledges the valuable feedback provided by stakeholders about feasibility and viability of expanding gas in the NEM. AEMO recognises that forecast capacity factors for GPG are low, but are consistent with recently observed capacity factors at some existing gas peaking facilities. Gas peaking stations are generally designed to run at low capacity factors during relatively infrequent periods when the supply/demand balance is particularly tight. AEMO acknowledges that the need for higher levels of flexible gas capacity and utilisation will challenge existing gas supply infrastructure. The need for investment does not guarantee that investment will flow, and market and policy settings will need to evolve to enable the overall investments required through the transition, including for gas investments.

AEMO acknowledges the Draft 2024 ISP did not consider the additional costs associated with delivering fuel to GPG during peak periods and gas infrastructure limitations. AEMO has undertaken further analysis to explore limitations on gas infrastructure and resultant higher fuel costs for GPG, and has adapted its modelling inputs and included greater detail on this issue in the final 2024 ISP (See: 2024 ISP, Appendix 2, and Appendix 4). The additional analysis highlighted that the east coast gas system may have insufficient pipeline and storage capacity to deliver all the gas projected to be required for GPGs during some particularly severe and longer-lasting renewable energy droughts, particularly when coal fired power stations have retired.

To ensure the system remains resilient to unpredictable renewable drought events AEMO has explored modelling options to ensure daily gas infrastructure delivery limitations will not affect the ability of GPG to generate. AEMO found these delivery limitations are more likely to be reached during winter in the southern states when gas demand for GPG coincides with high gas demand for heating. New GPG are assumed to be developed with flexible operations being key to the design, including dual fuel capability and on-site storage for liquid fuel to

provide fuel reserves during gas supply contingency events. In its revised analysis, AEMO acknowledges the additional capital costs associated with installing on-site liquid fuel storages, and has updated the timing of generation developments to ensure sufficient flexible, dispatchable GPG is built for the system to remain reliable. This approach acknowledges that renewable drought events can occur at any stage and are particularly impactful to power system reliability following coal fired retirements.

Specifically, the following changes have been made to AEMO's modelling approach and incorporated in in the 2024 ISP results:

1. When the capacity limitations of the east coast gas system to deliver adequate gas are breached, GPGs are assumed to switch to liquid fuel supply in *Progressive Change* and *Step Change*. This is modelled using maximum daily delivery limits from the 2024 Gas Statement of Opportunities and applying a liquid fuel cost premium when these limits are breached.
2. Additional capital costs of $47,500 per megawatt (MW) have been applied for GPG in all southern states (all NEM regions excluding Queensland) for *Progressive Change* and *Step Change*. This reflects the capital costs for on-site liquid fuel storage and associated infrastructure with sufficient capacity for 14 hours continuous operation on diesel fuel[17].
3. In all scenarios, a limitation of approximately 1 GW of GPG build per year has been applied over the long-term to ensure GPG is built progressively while other dispatchable capacity is retiring, rather than perfectly timed to when modelled weather conditions necessitate the capacity, given that weather events can occur at any time during the outlook period.

In performing the ISP, AEMO considered alternative pathways that excluded GPG expansion. In such a future, significantly more medium duration storage and renewable energy generation was required to substitute for flexible gas, leading to higher overall electricity system costs.

AEMO has concluded that fitting GPG with sufficient on-site storage for liquid fuels, and purchasing sufficient fuel to deliver energy under a long-duration variable renewable energy (VRE) drought is the most economically efficient pathway in comparison to alternatives which include a combination of wind, solar and long-duration storage technologies. More information can be found in the 2024 ISP (See: 2024 ISP, Appendix 2 and Appendix 4). AEMO will expand its consideration of gas market conditions in the 2026 ISP, consistent with Australia's energy ministers' March 2024 response to the review of the ISP[18].

Concern about the need for the forecast GPG expansion

AEMO notes stakeholders' concerns on this matter. Following the further analysis explained above, AEMO considers that the modelled outcomes for GPG expansion in the 2024 ISP are robust. AEMO has consulted on the inputs, assumptions and scenarios applied in this ISP, including the parameters for GPG, batteries and pumped hydro, and has applied the *ISP Methodology* to identify the resulting GPG forecast. The ODP results are consistent with government emissions reduction policies and targets, with the application of the AER's Cost Benefit Analysis Guidelines, and with the power system reliability needs that must be met in the ISP.

[17] See GHD Advisory 'Power station and associated costs' (pg. 17 – Fixed fuel costs), available at https://www.erawa.com.au/cproot/23060/2/-BRCP.2023---Power-Station-and-Associated-Costs-Report---GHD-Advisory---Dec-2022.PDF.

[18] See https://www.energy.gov.au/sites/default/files/2024-04/ecmc-response-to-isp-review.pdf.

Other issues raised

On the suggestion to include GPG and gas infrastructure in the social licence sensitivity analysis, AEMO decided not to re-assess the social licence sensitivity for the final 2024 ISP (See: Appendix 8).

On the request to consider the contribution of current gas facilities, AEMO confirms that current facilities such as the Iona Underground Gas Storage Facility are included in the ISP modelling and recognise the importance that these provide to ensure sufficient flexibility for maintaining gas system supply adequacy to all gas consumers.

4.2 Delivery risks

Summary of material issues raised in submissions

Stakeholders raised concerns about the ability of industry to deliver the ODP, particularly over the coming decade, and requested further analysis and discussion.

The sensitivity analyses on constrained supply chains and reduced social licence were well received but stakeholders (**AEC, Alinta Energy, Delta Electricity, Energy Australia, Origin Energy, ISP Consumer Panel**) recommended further analysis on a sensitivity that models combined "delivery risks" including supply chain constraints, cost pressures, social licence and shortages of skilled labour. Suggestions for additional sensitivities included a sensitivity on the impact of delay in planning and environmental approvals (**ISP Consumer Panel)**, and on the impact of disruptions in technological advancements (**Energy Grid Alliance**).

A number of submissions (**ISP Consumer Panel**, **Nexa**, **Sunshine Hydro, ETU, Iberdola, AEC, AGL**) called for the ISP to clearly identify any policy gaps or where existing policy presented barriers to delivering the ODP.

Some submissions (**Nexa, mc² Energy, Delta, ACF, CEIG**) stated that implications of early and disorderly coal closures on the ODP should be made clearer, including the impact on large industrial load operation. **Nexa** and **APA** also recommended AEMO emphasise the impact of transmission delays more clearly and **Energy Australia** recommended expanding on the costs of not achieving targets in terms of higher emissions and foregone market benefits.

The **ETU** and **QCC** communicated the important role of the ISP in highlighting energy sector workforce needs to policymakers and industry, and encouraged greater consideration of the workforce transition as part of the energy transition. The **CEC** and **Energy Australia** called for the inclusion of detailed workforce projections as was done for the 2022 ISP.

Submissions from investors asked for better communication of the need for streamlined approval processes on renewable energy projects (**WestWind Energy Development**) and for clear market mechanisms and investment plans for development of firming technologies (**ATSE**).

CEIG and **EnergyAustralia** noted that large variations in the build rate of generation capacity expansion per year could hinder investor confidence and challenge supply chains. A 'smoothing' constraint or build limit would be more realistic.

AEMO's consideration and response

AEMO agrees that there are risks to the delivery of the ODP and to the energy transition. As explored in the 2024 ISP report, AEMO considers that market and policy settings are not yet ready for coal's retirement, and that social licence and supply chains are not secured for project delivery.

AEMO acknowledges stakeholders' concerns about the risks to delivery of the ODP and the implications of early coal retirement, and notes that the ISP results forecast coal generators' retirement in advance of their announced schedules. Given that the ODP already identifies transmission investment where practical to meet power system needs, and policy is actively encouraging replacement renewable generation and storage assets to meet demand (including industrial load operation), AEMO considers that at present the ISP already sufficiently considers the implications of early coal retirements. In addition, the final 2024 ISP provides analysis of the May 2024 announcement by the New South Wales Government and Origin Energy about the agreement to extend the operating life of the Eraring Power Station (See: Appendix 6).

AEMO has included stakeholders' recommendation to model the impact of combined delivery risks by running the *Constrained Supply Chains* sensitivity with updated input parameters. The parameter changes include: a slower lifting of modelled supply chain pressures on generation and storage by slowly lifting the assumed build limit out to 2034-35 rather than stopping the limit at 2029-30; assuming a three-year delay to transmission projects rather than a two-year delay; and applying increased capital costs for generation and transmission projects until 2034-35. Full results of the updated *Constrained Supply Chains* sensitivity are in Appendix 6.

AEMO has not modelled new sensitivities to consider the impact of delay to environmental and planning approvals, or disruption to technological advancements, as it considers the revised *Constrained Supply Chains* sensitivity provides sufficient consideration of compounding delivery risks. AEMO has, however, included acknowledgement of the impact of delay to environmental and planning approvals in the 2024 ISP report.

While AEMO understands the suggestion to include a 'smoothing' constraint on the build rate of generation capacity, AEMO is bound to have consideration towards government policy under the NER, and so for the ISP modelling AEMO has complied with the build trajectory announced in the Commonwealth Government's expanded Capacity Investment Scheme.

AEMO has considered feedback on the role of the ISP in emphasising energy workforce needs and has partnered again with the Institute for Sustainable Futures and the RACE Energy cooperative research centre to provide a forecast of workforce projections for the 2024 ISP. NEM-wide results by technology are available as a chart in the 2024 ISP and the ISP Chart Data. Full details of electricity sector workforce projections will be published alongside the ISP in quarter 3 of 2024.

In response to stakeholders' request for emphasis on the need for improved generator and storage connection approval processes, AEMO notes the Streamlined Connections Process[19] workstream AEMO is progressing under the Connections Reform Initiative.

[19] AEMO. Streamlined Connections Process, at https://aemo.com.au/en/initiatives/trials-and-initiatives/streamlined-connections-process.

4.3 Actionable projects

4.3.1 Mid-North South Australia REZ Expansion (and other South Australia matters)

Summary of material issues raised in submissions

A number of submissions (**ElectraNet, ElectraNet's CAP, AMP Energy, CMX, SACOME, SACOSS**) suggested that ElectraNet's Mid-North (North and South options)[20] and South East South Australian transmission network expansion projects should be made actionable in the 2024 ISP. **ElectraNet** and **SACOME** noted that CDPs in the Draft 2024 ISP including these transmission developments delivered very similar net market benefits to the ODP, and so suggested that the projects should be considered as actionable.

ElectraNet considered that the ISP underestimated the amount of large industrial load growth in South Australia and expected an additional 1,000 MW of load to connect by the early 2030s in the north of the state. **ElectraNet** considered these projects to be well advanced despite not meeting the threshold requirements for industrial load projects[21] and recommended they should be incorporated into the final 2024 ISP. **AMP Energy** and **CMX** also noted industrial investment interest in South Australia and recommended increased transmission capacity to support large-scale green hydrogen and green ammonia projects.

Stakeholders noted that the NER require that the ISP balance the risks to consumers arising from uncertainty. **ElectraNet's CAP** and **SACOME** consider that the risk to South Australian electricity consumers as a result of later investment in transmission is greater than the risk of early investment, particularly in the context of increasing electricity demand by industrial consumers, although they did note some caveats to this assertion.

AEMO and ElectraNet undertook extensive joint planning throughout late 2023 and early 2024 to consider ElectraNet's proposed transmission augmentations and the power system analysis undertaken to inform the ISP modelling and results. In their submission on the Draft 2024 ISP, **ElectraNet** provided the following information:

- **Updated transfer limit between Davenport and north of Adelaide** (known as the mid-north SA (MN1) group constraint). **ElectraNet** provided a change request to reduce the modelled limit from 2,400 MW to 2,000 MW, consistent with power system analysis completed by AEMO. The updated limit reflects observed network congestion in the area under typical operating conditions, and the current status of existing network equipment and runback schemes.
- **Additional options for Mid North South Australia REZ Expansion. ElectraNet** considered whether alternative transmission network options could be prepared to augment the transmission corridor between Davenport and north of Adelaide, and provided two additional options. These options were lower-cost and smaller than those considered for the Draft 2024 ISP, and AEMO incorporated these as additional inputs for the final 2024 ISP.

[20] These transmission augmentation options relate to expansion of the transmission corridor between Davenport and north of Adelaide. In AEMO's ISP documentation, these are referred to as the 'MN1-SA mid-north group constraint' and the 'NSA1 northern group constraint'. These expansion options are relevant for the Mid North South Australia REZ Expansion project in the ISP.

[21] AEMO applies several criteria outlined in its Electricity Demand Forecasting Methodology, with anticipated or prospective industrial loads only included if it has relevant environmental approvals, network connection approvals and that it has either reached financial close or has commenced construction. See Section 2.1 in https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/nem_esoo/2023/forecasting-approach_electricity-demand-forecasting-methodology_final.pdf.

- **Additional information about expected new generation in the South East South Australia REZ. ElectraNet** re-affirmed their view that an urgent expansion of the network in South East South Australia is needed to accommodate forecast generation. Although AEMO did request preparatory activities from ElectraNet in the 2022 ISP, which were provided (the South East South Australia REZ Expansion preparatory activities), in the Draft 2024 ISP this project was not identified as needed within an actionable timeframe. In its submission, **ElectraNet** re-iterated its concern and suggested re-arrangement of how the expansion option is considered in the ISP model by applying it as an expansion of the flow path between South East and Central South Australia, rather than as an expansion of the South East REZ.

Stakeholders also raised concern that, without future transmission development, South Australian consumers would be relying on other states for the timely delivery of new renewable energy projects.

Stakeholders noted that the South Australian 100% net renewable energy target has not been included in the ISP. The **SACOSS** encouraged AEMO to reconsider the inclusion of jurisdictional policies and targets outside of South Australia, with a view that they adversely impact the equity, affordability, and net market benefits of the ODP for South Australian consumers.

AEMO's consideration and response

AEMO has responded to stakeholder feedback on South Australian transmission network projects and load forecasts by incorporating the updated transmission network inputs and assumptions provided by ElectraNet, and by undertaking sensitivity analysis to consider the potential impact of increased industrial load in South Australia. AEMO and ElectraNet have undertaken extensive joint planning, including information sharing and power system analysis, to inform the final 2024 ISP modelling and results.

AEMO acknowledges that the Draft 2024 ISP found the net market benefits between the draft ISP's ODP (CDP11) and a development path with an actionable Mid North South Australia REZ Expansion (CDP13) could be viewed as marginal. AEMO has closely considered each individual South Australia project as part of its revised modelling for the final 2024 ISP. For further details of the CDPs and the final ODP, see Appendix 6.

In the final 2024 ISP, AEMO has found the Mid-North South Australia REZ Expansion project to be actionable, with the ISP candidate option being one of the smaller options provided as new inputs by ElectraNet in their submission on the Draft 2024 ISP. This change in status is a result of the reduced transfer limit for the 'MN1 group constraint' discussed above, and the availability of a smaller, lower-cost option to meet the need to connect renewable generation and meet demand in Adelaide. For further details, see Appendix 5 and Appendix 6.

AEMO analysis confirmed that if there was substantive new industrial load in the north of South Australia then there would be a need to further expand the transmission network, depending on the type and size of renewable generation nearby. As no additional load commitments were identified between the draft and final ISPs, AEMO has not modified the load forecasts applied across the three ISP scenarios. Instead, AEMO consulted with **ElectraNet** and the South Australian Government to prepare sensitivity analysis to consider the impact of additional industrial load in South Australia (See: *Additional Load* sensitivity, Appendix 6). The sensitivity analysis finds that further expansion of the 'MN1 limit' would deliver increased net market benefits, in addition to those identified for the ISP candidate option in the Mid North South Australia REZ Expansion actionable ISP project. Full details for the sensitivity analysis are available in Appendix 6.

AEMO will consult, as required under the Forecasting Best Practice Guidelines, on the continued appropriateness of its Electricity Demand Forecasting Methodology ahead of the 2025 Electricity Statement of Opportunities and 2026 ISP, including the suitability of including anticipated and prospective industrial load.

Regarding expansion of the South East South Australia REZ, AEMO undertook extensive power system analysis and consultation with ElectraNet, and has not identified this as an actionable project. AEMO notes that although over 1,000 MW of wind generation capacity is installed in the REZ in the ISP forecast, this generation may simultaneously supply both toward Victoria and toward Adelaide without exceeding network limits (or otherwise be economically spilled). AEMO investigated ElectraNet's proposal, but ultimately found that the existing modelling approach was fit for purpose, and that an adjustment would not have changed the outcome.

AEMO considers inclusion of policies in the ISP by assessing them against criteria specified in the NER. AEMO has not modified its treatment of the South Australian 100% net renewable energy target in the final ISP modelling (discussed in more detail in Section 4.12), nor the treatment of policies in other jurisdictions unless changes have occurred which meet the threshold for policy inclusion in the ISP (which was the case for 2035 emissions reduction targets in Queensland and New South Wales, updated Capacity Investment Scheme targets, and the treatment of a value of emissions reduction as advised by Australian energy ministers).

4.3.2 Project Marinus

Summary of material issues raised in submissions

The **ISP Consumer Panel** asked AEMO to clarify why Marinus Link Cable 2 (under Project Marinus Stage 2) is classified as actionable for the 2024 ISP, given that the identified optimal timing in the Draft 2024 ISP is in the 2030s for only one scenario (*Green Energy Exports).* The **ISP Consumer Panel** asked how this is consistent with the requirement that the AER's Cost Benefit Analysis Guidelines must recognise the risks to consumers relating to premature investment.

Marinus Link encouraged AEMO to include the impact of concessional finance on the optimal timing of Project Marinus. **Hydro Tasmania** was concerned that the optimal timing of Marinus Link Stage 2 in the *Step Change* scenario is 2047-48, and noted that targets such as the Tasmanian Renewable Hydrogen Action Plan which relied on an earlier delivery date may be adversely impacted by a delivery date in the 2040s. **Hydro Tasmania** suggested AEMO consider the impact (and the confidence) of the assumptions that are causing delays in interconnection timing in some scenarios.

AEMO's consideration and response

AEMO has carefully considered whether Project Marinus Stage 2 ought to remain actionable in this final 2024 ISP. AEMO has confirmed in the final 2024 ISP that all of Project Marinus (Stages 1 and 2) remains as an actionable ISP project, and that this project will not be 'staged' in the regulatory sense. This is primarily because, consistent with the AER's Cost Benefit Analysis Guidelines and AEMO's *ISP Methodology*, the CDP with the highest weighted net market benefits includes an actionable Project Marinus Stage 2. AEMO is satisfied with this conclusion, noting that:

- Based on the analysis outlined in Appendix 6 to the 2024 ISP, delivering Project Marinus Stage 2 within its actionable window, rather than never, delivers significant relative market benefits of $434 million. Therefore, it is clear that Stage 2 is needed at some point in time, although the optimal timing is not as clear-cut.

- Analysis of the benefits of the actioning Stage 2 suggests the decision to action Stage 2 now, rather than delaying that decision, is finely balanced. AEMO considered whether Project Marinus was more appropriately identified as a staged project for the purposes of the ISP framework. When considering this, AEMO noted that including Project Marinus Stage 2 as an actionable project, maximises weighted net market benefits.
- AEMO also noted that the project proponents intend to stage the delivery of the project, as reflected in the different earliest in service dates (EISDs) for each stage included in this analysis. Based on the proposed timing of Stage 2, the 2026 ISP will reassess the actionability of Project Marinus Stage 2 in the same way that the 2024 ISP has reassessed the actionability of all projects that are not yet considered anticipated or committed projects. Prior completion of the feedback loop, including confirmation that a project or project stage is aligned with the ODP in the 2024 ISP, does not exclude that project or stage from being reassessed in a subsequent ISP if the project has not yet achieved anticipated or committed status.
- Finally, in the Draft 2022 ISP consultation, AEMO sought stakeholder feedback specifically on whether Project Marinus should be treated as a single or staged actionable ISP project. AEMO considers that reversing the decision to treat it as a single project should only occur if there is a clear benefit for consumers of such a decision.

On this basis, the 2024 ISP identifies Project Marinus a single actionable project without staging for the purposes of the ISP framework. Making the whole of Project Marinus actionable now allows for continued investigation of cost optimisation and tender negotiation by the project proponents and allows for early works to proceed. AEMO considers that these are no-regrets activities, given that Stage 2 is needed across all scenarios at some point on the ISP planning horizon.

In response to Hydro Tasmania's identification of an earlier Project Marinus date as being important for the delivery of the Tasmanian Renewable Hydrogen Action Plan, AEMO notes that this policy has not yet met the threshold for inclusion in AEMO's planning and forecasting scenarios.

4.3.3 Sydney Ring South

Summary of material issues raised in submissions

Transgrid submitted that there is an immediate need to consider reinforcement options for both the northern and southern segments of the Sydney Ring. **Transgrid** stated that the southern ring is needed to bring supply from the south of the region under certain dispatch conditions, to support increasing load within the Sydney, Newcastle and Wollongong load centre of New South Wales, and to support power system security and reliability. **Blue Scope** also called for the accelerated investigation of Sydney Ring southern options.

Following extensive joint planning between AEMO and **Transgrid** over late 2023 and early 2024, **Transgrid** provided some information in its submission to the Draft 2024 ISP about a new Sydney Ring South transmission network option that had been identified and initially scoped, including the use of modular power flow controllers and the establishment of a new switching station in the Greater Western Sydney area. This option is smaller and lower-cost than other options considered for the Draft 2024 ISP. **Transgrid** then provided additional information about the new option, as well as adjustments to another existing option, in an addendum to its preparatory

activities for reinforcing Sydney, Newcastle and Wollongong supply, which had originally been provided after the 2022 ISP[22].

Snowy Hydro commented that both HumeLink and Sydney Ring South projects are needed to bring supply to the Sydney, Newcastle and Wollongong load centre and to provide reliability benefits.

Smart Wires recommended using modular power flow controllers to increase the capability of the transmission network into south-western Sydney as a part of a Sydney Ring supply project.

AEMO's consideration and response

AEMO included the new Sydney Ring South option provided by Transgrid in the final 2024 ISP modelling, and evaluated it alongside the existing options to reinforce the southern transmission corridor for supply to Sydney, Newcastle and Wollongong. AEMO has now identified the Sydney Ring South project as an actionable ISP project, with a scope including Greater Western Sydney modular power flow controllers and switching station option being the ISP candidate option.

Including the new option in the ISP model required adjustment to the constraint representing the network limitation on the southern transmission corridor supplying the Sydney, Newcastle and Wollongong sub-region from the Central New South Wales sub-region, in order to adequately consider the contribution of central NSW generators to congestion at times of particular generator dispatch patterns. This adjustment had the effect of representing the potential impact of this new option of the system.

AEMO acknowledges stakeholders' feedback that increased load, particularly industrial load, within the Sydney, Newcastle and Wollongong load centre would likely indicate an increased need for both HumeLink and the Sydney Ring South project in some form. As noted in the submissions, this demand may arise from a rapid expansion in data centre demand in Sydney, additional growth in demand around the new Western Sydney Airport, increased electrification of industrial processes, or a combination of the above.

AEMO has undertaken an *Additional Load* sensitivity that incorporated additional demand to cater for the uncertainty in demand drivers above the core scenarios (See: Appendix 6). This *Additional Load* sensitivity found that both the Greater Western Sydney switching station and modular power flow controllers option, as well as an option to uprate Line 39 from Sydney to Bannaby, would deliver increased net market benefits in the event of additional industrial load connecting.

4.3.4 HumeLink

Summary of material issues raised in submissions

The **CIS** requested clarification on the actionable status for HumeLink given the increase in project cost since the 2022 ISP and suggested that the net market benefits are preserved in the Draft 2024 ISP due to an increase in the quantity of avoided generation capacity, rather than inflationary pressures on generation costs. The **CIS** questioned the sensitivity of the ISP model to installed generation capacity and hence generation capital to the sequence of weather years.

[22] Transgrid. *Preparatory activities report: Transgrid: Reinforcing Sydney, Newcastle and Wollongong Supply – March 2024 Addendum*, March 2024. At https://aemo.com.au/consultations/current-and-closed-consultations/draft-2024-isp-consultation.

The **CIS** suggested that comparing CDP3 and CDP5 in the Draft 2024 ISP (which differ only on whether HumeLink is delivered within its actionable window) is misleading because Victoria – New South Wales Interconnector West (VNI West) is also delayed by five years when HumeLink is delayed. The **CIS** questioned the value of this comparison given there is no way of attributing how much of the change is due to HumeLink's timing shifting by three years or VNI West's shifting by five years.

The **CIS** also noted that Transgrid's Contingent Project Application for HumeLink was being progressed with an in-service date of 2026-27 despite the Draft 2024 ISP identifying an optimal delivery date of 2029-30 in the *Step Change* scenario. The **CIS** considered that an earlier delivery date for HumeLink would erode its net market benefits by increasing net transmission costs and requested evidence to support delivering HumeLink in 2026-27. The **CIS** and **Campaign Group A** recommended that AEMO model HumeLink at the date proposed in Transgrid's feedback loop request, rather than applying a six-year actionable window for the project.

The **CIS** considered AEMO's confirmation in December 2023 that HumeLink (and VNI West) satisfied the requirements of the feedback loop was not in accordance with the Rules because the feedback loop confirmation was based on Draft 2024 ISP outcomes, by way of ISP update, and the ISP update was not subject to consultation.

AEMO's consideration and response

Clarification on the actionable status of HumeLink

AEMO has followed the AER's Cost Benefit Analysis Guidelines and AEMO's *ISP Methodology* and found HumeLink to be actionable in both the draft and final 2024 ISP, as the optimal timing of HumeLink was within its actionable window. The actionable window for HumeLink is six years because this project has been actionable in previous ISPs, and regulatory approval processes as well as certain early works are already underway. Reverting the status of previously actionable projects would reset these processes and serve to greatly increase the project lead time, The *ISP Methodology* provides for increasing the actionable window length for projects previously found to be actionable, in order to recognise the progress made on the project and the subsequent delays should the project be stopped and then re-started later.

The cost of alternatives to HumeLink have gone up for many reasons, including supply chain constraints and cost pressures across the sector.

AEMO acknowledges the impact of weather patterns on modelling outcomes and that some years result in a lower capacity factor for renewable generation. As per the *ISP Methodology*, AEMO tests numerous alternative weather sequences in the ISP capacity outlook model and selected a "typical" sequence in terms of outcomes such as transmission and generation development to ensure the sequence chosen is not resulting in an outlier outcome. Improving the robustness of outcomes to weather sequences is an active area of development and is discussed further in the response to Section 4.4 (Modelling Approach) below.

AEMO maintains that comparing the Draft 2024 ISP's CDP3 to CDP5 is valid for assessing the benefits for HumeLink. The project scopes for Project EnergyConnect, HumeLink and VNI West are inter-related – the three projects, if delivered as currently designed, will meet in the Dinawan, Wagga Wagga and Gugga areas. These projects will require integration works and careful sequencing to make sure that projects are connected efficiently. The comparison of CDPs for the Draft 2024 ISP applied the currently-designed project sequencing, with HumeLink establishing a 500 kV substation at Gugga, and VNI West accessing that voltage uplift afterwards.

Should the project scoping and sequencing change as these projects are designed in detail and progress through regulatory gateways, then adjustments would be required.

Comparing CDP3 to CDP5 in the Draft 2024 ISP showed that delivery of HumeLink beyond its optimal timing would impact the timing of VNI West. CDP5 demonstrated that HumeLink being delayed beyond its actionable window would cause the optimal timing for VNI West to shift to the end of its actionable window. All changes in net market benefits between these two CDPs are therefore caused by a delay to HumeLink.

In December 2023, AEMO confirmed via an ISP feedback loop notice, that the latest cost, timing and scope of HumeLink remained aligned with the latest ISP.[23] AEMO decided not to lock in Transgrid's latest timing for HumeLink in the 2024 ISP because the project is not yet anticipated or committed, and locking in its timing would conflict with requirements set out in the ISP Methodology and the AER's Cost Benefit Analysis Guidelines. The ISP has a regulatory function to determine which transmission projects are actionable and should progress, but neither the ISP nor the ISP Feedback Loop has a function to determine the precise time that a given project must be delivered. The ultimate timing and delivery of a project after it has been declared as actionable, and as it progresses through the regulatory approval process, will depend on the delivery matters considered by the project proponent – such as supply chain matters, bulk procurement activities where relevant, optimisation of workforce and labour planning.

Meeting the requirements of the feedback loop

In December 2023, AEMO provided feedback loop confirmation that HumeLink (and VNI West) addresses the relevant identified need and aligns with the ODP referred to in the most recent ISP. The 2024 ISP re-confirms the actionable status of HumeLink.

HumeLink (and VNI West) were first identified as actionable ISP projects in the 2020 ISP and have been subject to extensive consultation over multiple ISPs. In order to assess feedback loops based on the latest inputs, assumptions and scenarios, AEMO consulted with the AER to develop a workable process to update the 2022 ISP in a timely way. A timely ISP update allowed feedback loops to be assessed based on Draft 2024 ISP outcomes.

Importantly, a project that receives feedback loop confirmation is not "locked in". The 2024 ISP has re-tested the actionability of all projects identified as actionable in the Draft 2024 which have not yet reached anticipated or committed status, or received AER contingent project approval for all project stages. When considering project actionability, AEMO has carefully considered all submissions received in response to the Draft 2024 ISP. Therefore, AEMO disagrees that the feedback loop is the final and only opportunity to confirm the actionability of projects, and notes that the 2026 ISP will again test the actionability of any projects that are not yet anticipated or committed.

4.3.5 Other network augmentation projects

Summary of material issues raised in submissions

TasNetworks advised in its submission to the Draft 2024 ISP that the lead time for the Waddamana to Palmerston Transfer Capability Upgrade would be at the upper end of the three- to five-year 'short' project lead time range,

[23] AEMO. *ISP Feedback Loop Notice – HumeLink*, at https://aemo.com.au/-/media/files/major-publications/isp/2023/integrated-system-plan-feedback-loop-notice---humelink.pdf.

rather than at the lower end as was modelled by AEMO for the Draft 2024 ISP. **TasNetworks** stated that this longer lead time was needed to allow for appropriate time to undertake regulatory review and approval processes, and to assess and negotiate easements for transmission lines where needed.

Transgrid advised in its submission to the Draft 2024 ISP that the earliest feasible delivery date for delivery of QNI Connect has extended, and subsequently provided details in an addendum to its preparatory activities for QNI Connect, which had originally been provided after the 2022 ISP[24]. Transgrid advised that the earliest delivery date has moved from 2030-31, to April 2032 for completion of construction and March 2033 for completion of inter-network testing. This extended project lead time has been adjusted to reflect lessons learnt from community engagement and environmental approval schedule impacts on other projects such as HumeLink, Project EnergyConnect and VNI West, and to allow enough time for appropriate engagement and assessment given the overlap between the New England REZ project and the proposed corridor for QNI Connect. In addition, this extended delivery reflects the experience gained from the ongoing inter-network testing and commissioning of the QNI Minor augmentations.

VFF argued that current actionable projects in Victoria should be revised to 'future' status, rather than actionable, as these projects have lost social licence and are incompatible with existing land use[25]. **APA** recommended that future Victorian ISP projects should be actionable, noting binding constraints in the 2023 *Electricity Statement of Opportunities* (ESOO). **Smart Wires** recommended modular power flow controllers could provide additional benefits by managing power flows on the lines between Bulgana and Ballarat, particularly when combined with VNI West. **EnergyAustralia** requested clarification on how VNI West can be delivered earlier with additional support.

AEMO's consideration and response

AEMO noted the feedback from TasNetworks and Transgrid about project lead times, undertook joint planning to understand the nature of the changes, and decided to include the updated values as inputs for the final 2024 ISP modelling. Both Waddamana to Palmerston transfer capability upgrade and QNI Connect have been identified as actionable ISP projects in the 2024 ISP (See: 2024 ISP, Appendix 5 and Appendix 6).

AEMO considers that new actionable projects must start sooner to allow for the critical engagement associated with the initial investigation of these projects. There is a clear need for earlier engagement with communities hosting infrastructure to allow for more coordinated and effective consultation.

AEMO recognises the importance of social impact, community sentiment and benefits related to the energy transition. Obtaining and granting social licence is not a specified process and will vary from location to location and project to project. AEMO considers that engagement with communities, landholders and other relevant stakeholders for transmission augmentation projects is undertaken by the relevant project proponent. A crucial aspect of seeking social licence is that all parties understand that there are many unanswered questions, and social licence starts with identifying the possibilities, concerns and opportunities of any potential projects on and for all parties. In regard to the actionable projects in Victoria, AEMO continues to find that these projects are actionable, and acknowledges that this engagement process is ongoing.

[24] Transgrid. *Preparatory activities report: Transgrid: Queensland – New South Wales (QNI) Connect– March 2024 Addendum*, March 2024. At https://aemo.com.au/consultations/current-and-closed-consultations/draft-2024-isp-consultation.

[25] The VFF feedback was also noted for the Western Renewables Link project, which is an anticipated project in the ISP.

4.4 Modelling approach

Summary of material issues raised in submissions

Many stakeholders commented on elements of the ISP modelling approach. This section summarises common issues raised by a number of different stakeholders, including treatment of demand-side investments, perfect foresight in the model, accounting for and valuing greenhouse gas emissions, and the *Slow Change* scenario. Where some specific matters were commented on by fewer stakeholders, they may be found in Section 4.12.

Stakeholders (**PIAC, ACF, IEEFA, Climateworks, QCC, Alan Pears, Ausgrid, Endeavour Energy, CIS**) generally noted that demand-side investments such as CER, demand response, and energy efficiency have been treated as inputs to modelling and recommended that these should be co-optimised against transmission and large-scale generation and storage to support the claim that the ODP is the lowest-cost pathway to supply electricity throughout Australia's transition to a net zero economy.

A number of stakeholders (**CIS, Campaign Group A, EPC, EnergyAustralia**) called for those demand-side modelling inputs to be costed and included in the total system costs in the ISP modelling. **CIS** also recommended that the cost of subsidies expected to keep coal and gas economically viable should be included in the total system cost. The **ISP Consumer Panel** asked for greater clarity on system security cost calculations and synchronous condenser cost accuracy range.

A number of stakeholders noted the impact of perfect foresight on modelling outcomes across different time horizons. **CIS** and **Campaign Group A** noted that perfect foresight across the modelling horizon results in generation and storage capacity being overfit to the specific sequence of weather years which are selected at the start of the modelling process. **Origin Energy, Marinus Link** and **Energy Australia** noted that perfect foresight may be overstating the ability of shorter duration batteries to meet system needs in the ISP.

Ergon and Energex, EPC, Ian Stevens, CIS and **Campaign Group A** encouraged AEMO to plan for a greater range of potential weather events to make the ISP model more robust against unpredictability. **CEIG** and **Snowy Hydro** suggested a historical weather profile of 30-50 years, arguing that 10 rolling reference years is not long enough to capture solar and wind droughts.

A number of stakeholders considered that the ISP should quantify the value of emissions reduction (**PIAC, CEIG, Alan Pears, Transgrid**). **Stride** asked for clarification about the amount of emissions from GPG in the year 2039-40 under the ODP in the Draft 2024 ISP. The **CIS** and **James Taylor et al.** sought clarification on the reported NEM emissions associated with the ODP and encouraged AEMO to acknowledge and account for Scope 3 emissions in its modelling, in particular emissions associated with offshore manufacturing of energy infrastructure.

The **CIS** and **Campaign Group A** suggested that the absence of a 'do nothing' scenario is a significant omission and that without one, the true cost of the energy transition cannot be assessed. **Zenith** suggested that there is greater than zero chance that renewable energy and emissions targets are not met, and questioned if the ODP would be resilient to this scenario. The **CIS** argued that the 2022 ISP's *Slow Change* scenario served as a "do nothing" scenario and that reasons stated by AEMO for its removal are false. **EnergyAustralia** noted the *Slow Change* scenario would be a useful bookend.

AEMO's consideration and response

Demand-side investments are included but not co-optimised

AEMO acknowledges that demand-side investments are currently an exogenous modelling input and not co-optimised against transmission and large-scale generation investments in the ISP. AEMO uses a scenario-based approach to modelling, and applies three different CER forecasts in the ISP which are tailored to each of AEMO's current forecasting and planning scenarios[26].

All demand-side investments such as CER, as well as any associated upgrades to distribution networks to support their integration, are assumed to be implicitly present in the counterfactual. The distribution network elements are non-differential costs for the purposes of the ISP, which do not contribute to net market benefits or count toward choosing the ODP. As detailed in the Addendum to the Draft 2024 ISP, the direct cost of CER investments to consumers was considered in the development of the CER uptake forecasts, including having regard to the anticipated payback of devices for consumers and how that may be affected by tariff settings and additional revenue that may be offered to virtual power plant customers[27].

Consideration of trading off supply-side investments with demand-side investment is an active area of consideration by AEMO and will be pursued in some form for the 2026 ISP as part of the implementation of the recommendations enhancement of the ISP agreed by Australia's Energy Ministers following the Federal Government's review of the ISP[28].

Some compensations are made for perfect foresight distortions

AEMO acknowledges the impact of perfect foresight on modelling outcomes over both the short- and long-term horizons. AEMO accepts that perfect foresight over the long-term horizon results in pre-emptive expansion for the underlying weather sequence used to drive the model, and that in reality the weather cannot be known in advance. As per the *ISP Methodology*, AEMO tests numerous alternative weather sequences in the ISP capacity outlook model and selects a "typical" sequence in terms of outcomes such as transmission and generation development to ensure the sequence chosen is not resulting in an outlier outcome.

AEMO considers this to be a reasonable approach given the intractability of determining an ODP based off all possible sequences of weather years. However, to further ensure the reliability of the ODP against weather sequences, a constraint for the annual expansion of gas capacity has been adopted in all ISP scenarios for the final 2024 ISP, and in addition AEMO undertook a sensitivity using persistent low renewable energy conditions (an *Alternative weather sequence* sensitivity) (See: Appendix 2 and Appendix 6). In this sensitivity, the ODP continues to deliver positive net market benefits.

AEMO also considers that based on a study of meteorological data conducted in the 2022 ISP[29], the previous 10 years of weather is a representative sample for the past 40 years, in terms of average wind speeds. AEMO expects to continue to expand its capability to extend weather patterns in future forecasting and planning

[26] Further details about the approach taken to forecast CER uptake in the 2023 IASR, as applied in the 2024 ISP, is provided in the Addendum to the Draft 2024 ISP, at https://aemo.com.au/en/consultations/current-and-closed-consultations/draft-2024-isp-addendum-consultation.

[27] Further details about the approach taken to forecast CER uptake in the 2023 IASR, as applied in the 2024 ISP, is provided in the Addendum to the Draft 2024 ISP, at https://aemo.com.au/en/consultations/current-and-closed-consultations/draft-2024-isp-addendum-consultation.

[28] See https://www.energy.gov.au/sites/default/files/2024-04/ecmc-response-to-isp-review.pdf.

[29] See page 15 at https://aemo.com.au/-/media/files/major-publications/isp/2022/2022-documents/a4-system-operability.pdf?la=en.

publications, as identified in AEMO's 2023 Forecasting Improvement Plan. AEMO notes that the 2024 ISP is modelled with reference to 13 years of historical data.

Regarding the impact of perfect foresight on storages over the short term, AEMO proposed three different options in the early-2023 consultation[30] on updates to the *ISP Methodology*. Stakeholder feedback overwhelmingly did not favour these modelling changes[31]. As noted in the concluding consultation summary report, AEMO will review imperfect foresight considerations for storages in operability modelling to assess power system reliability.

Emissions are accounted for consistent with the *ISP Methodology*

Consistent with the *ISP Methodology* and 2023 IASR, the scenarios in the ISP contain NEM carbon budgets which are derived from a national carbon budget. AEMO acknowledges the scope 3 emissions involved in offshore manufacturing but maintains that the appropriate accounting for offshore emissions is within the carbon budget of the country of origin.

In response to **Stride's** inquiry, AEMO does not agree with calculated emissions provided in the submission. The heat rate for a new entrant flexible gas generator is approximately 11GJ/MWh, and the emissions factor of the same generator is 581kg/MWh CO_2-e. If the gas fleet burned 117,000 TJ of gas to produce electricity as outlined in the submission, at a heat rate of 11GJ/MWh, and with an emissions factor of 581kg/MWh CO_2-e then the estimated emissions would be equal to approximately 6 MT (or 117,000,000 GJ / 11 GJ/MWh * 581 kg/MWh = 6.2 MTCO2), rather than the almost 19 MT estimated by Stride.

On 28 February 2024, Australia's Energy Ministers released a statement about the interim methodology for calculating the value of greenhouse gas emissions reduction. As outlined in the 2024 ISP, and consistent with the *ISP Methodology*, AEMO has now included a value of emissions reductions (VER) in the final 2024 ISP results, by applying this as a cost in the calculation of a CDP's net market benefits when determining the ODP. This treatment is consistent with AEMO's obligation to have regard to the emissions reduction element in the National Electricity Objective added on 21 November 2023.

The *Slow Change* scenario is no longer relevant

AEMO consulted on scenarios in the 2023 IASR and removed the *Slow Change* scenario, consistent with stakeholder feedback. In the 2023 scenarios webinar held on 13 July 2022, when stakeholders were polled on the relevance of the *Slow Change* scenario, 44% voted that it was no longer relevant, 41% that it was relevant, and 15% were neutral. Evidently, the majority of stakeholders considered that the *Slow Change* scenario was no longer relevant, while numerous stakeholders commented that the *Slow Change* scenario was relevant only as a benchmark, bookend or sensitivity and did not view it as likely. The *Slow Change* scenario in the 2022 ISP was only weighted at 4% and had commensurate impact on the weighted net market benefits.

AEMO acknowledges a *Slow Change* scenario has a non-zero likelihood, but does not consider it to be fit-for-purpose in the 2024 ISP. The purpose of the ISP is not to calculate the cost of the energy transition or government

[30] See https://aemo.com.au/en/consultations/current-and-closed-consultations/consultation-on-updates-to-the-isp-methodology.

[31] AEMO. *Consultation summary report – Update to the ISP Methodology*, June 2023. At https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2023/isp-methodology-2023/consultation-summary-report---update-to-the-isp-methodology.pdf?la=en.

policy on emission targets. AEMO also recognises that applying no federal government policy targets would be inconsistent with the ISP framework and NER requirements to consider public policies when producing the ISP.

4.5 CER and distribution networks

Summary of material issues raised in submissions

Although supportive of the role that CER will play in the NEM, many submissions (**ISP Consumer Panel, AGL, Ausgrid, Endeavour Energy, Ergon and Energex, Energy Decarb, Hydrostor, Hydro Tasmania, Martin Kamener, Nexa, Rondo Energy, QEUN**) noted that the significant level of coordination of the high CER uptake forecasted in the ISP will be challenging without innovation, reform and acquiring social licence. Stakeholders requested more detail in the ISP on how this coordination will be achieved. **Tesla** reiterated the need for incentives for residential energy storage uptake and coordination.

Stakeholders (**IEEFA, PIAC, Energy Decarb, EPC, QCC, ACF, Re-Alliance**) proposed the ISP also consider the role of distribution networks to host generation and storage, with submissions recommending the inclusion of detailed planning of CER, energy efficiency, and distribution network requirements. **Ergon and Energex** noted the ISP tagline statement[32] does not mention the distribution network. Submissions (**Ausgrid, Blue Scope, Ergon and Energex, Endeavour Energy, QCC**) suggested AEMO consider REZs in the distribution network, and the regulatory changes that would be required to enable them. **PIAC** also suggested AEMO further consider opportunities for CER demand flexibility, and to do so, model behind-the-meter generation as energy exported to the grid, and separately, energy used by other consumers.

Marinus Link and **Hydro Tasmania** recommended the removal of the assumed 50% rebate on residential batteries from the CER forecasts to be applied in the final 2024 ISP (relating to the Green Energy Markets (GEM) forecast used, not the CSIRO forecast), since the inclusion of such a rebate is inconsistent with the policy inclusion criteria of the ISP under the NER, and was not adopted by CSIRO in its GenCost modelling. In contrast, **SEQCA** and **IEEFA** remarked that the forecast uptake of CER is slower than what is currently occurring. The **ETU** noted assumptions around CER and smart appliances despite there being no government policy to support them and the **CIS** called for the ISP to model scenarios without government subsidies for CER[33].

Ausgrid, Etrog and Ready Energy encouraged AEMO to consider how much the ISP relies on CER, and in particular consider including more community batteries than behind-the-meter resources and storage. **IEEFA** and **SEQCA** supported the development of a high-CER scenario to assess the potential benefits and implications of increased CER penetration.

EnergyAustralia requested analysis on the contribution of CER in managing extreme maximum and minimum demand events. **IEEFA** recommended making the assumptions used by CSIRO and Green Energy Markets around the uptake of dynamic operating envelopes transparent.

[32] As noted in the Draft 2024 ISP, "Renewable energy connected by transmission, firmed with storage and backed up by gas-fired generation is the lowest cost way to supply electricity to homes and businesses throughout Australia's transition to a net zero economy."

[33] The CIS and other stakeholders provided additional feedback about the treatment of costs for CER. This feedback, and AEMO's response, is covered in Section 3.4.

AEMO's consideration and response

CER coordination requires innovation and reform

AEMO recognises that CER coordination, particularly at scale, is an emerging solution in the energy sector, and will require integration across technology, consumers and regulation. While uncertainty exists as to how large-scale orchestration is best achieved, AEMO notes that virtual power plant (VPP) offers[34] currently in the market support the prospect of ongoing competition and innovation, and trials such as Project Edge[35] provide key insights on how a vibrant marketplace for VPP may be supported. Before the delivery of the Draft 2024 ISP, with the benefit of stakeholder feedback, AEMO's 2023 IASR adopted scenario-based forecasts of CER (and hence CER orchestration), reflecting uncertainty on the scale of CER uptake and orchestration.

AEMO agrees with stakeholders that it will be important to consider the trajectory for CER coordination in the NEM, and the innovation, reform and social licence required for effective coordination. For the final 2024 ISP, AEMO undertook additional modelling to consider the value of CER coordination, in the *Reduced CER coordination* sensitivity (See: Appendix 6). AEMO considers this analysis to be an important guide for the benefit of achieving CER coordination, with the sensitivity results showing that the total system costs paid by consumers would increase by $4.1 billion with no further coordination of consumer batteries than exists currently. This would be due to higher levels of medium and long duration utility storages being required to compensate for the lack of coordinated embedded storage devices.

Role of distribution networks to support utility-scale and consumer-scale renewable and storage uptake

AEMO agrees that distribution networks play an important role in hosting renewable energy generation and storage, both at the utility scale and at the consumer level. AEMO has added more acknowledgement of this role in the 2024 ISP report, including adding a reference to distribution networks in the ISP tagline. AEMO will expand its consideration of distribution networks in the 2026 ISP to consider how distribution network investments and programs may impact CER and distributed resources development, and therefore the ODP (consistent with Australia's energy ministers' March 2024 response to the review of the ISP[36]).

Residential battery uptake forecast approach

AEMO notes **Marinus Link** and **Hydro Tasmania**'s concern about GEM's anticipation of extended initiatives that support continued investments in the CER forecast. However, AEMO considers that the adjustments in the GEM forecast are consistent with a scenario-based approach to forecasting, with the approach applied for *Step Change* and *Green Energy Exports* aligned with scenario narratives that support a high consumer role in the energy transition. Queensland's Battery Booster program is one such initiative that reasonably aligns to the approach taken in the highest CER forecast, while other jurisdictions have various supportive policies. In addition, the CER forecasts applied in the ISP are a blend of the GEM and CSIRO forecasts, as explained in the Addendum to the Draft 2024 ISP.

[34] See https://www.solarquotes.com.au/battery-storage/vpp-comparison/.

[35] See https://aemo.com.au/en/initiatives/major-programs/nem-distributed-energy-resources-der-program/der-demonstrations/project-edge.

[36] See https://www.energy.gov.au/sites/default/files/2024-04/ecmc-response-to-isp-review.pdf.

Other issues raised

AEMO has not re-modelled the ISP scenarios with no government support for CER, as the ISP includes a range of government policy assumptions where thresholds in the NER are met.

It is true that resources such as community batteries will have a role to play in the future of the NEM. The ISP already includes forecasts for utility-scale storage that could be delivered through a range of mechanisms, and AEMO will expand its consideration of distributed resources in the 2026 ISP consistent with Australia's energy ministers' March 2024 response to the review of the ISP[37].

While AEMO notes the interest in further analysis from both **EnergyAustralia** and **IEEFA**, unfortunately this has not been possible for the 2024 ISP. AEMO hopes to work with stakeholders on the kind of analysis that would be useful to be provided in future ISPs.

AEMO has not prepared an additional high-CER uptake forecast, as the *Green Energy Exports* scenario is considered to be the bookend for ISP purposes. AEMO will adjust its forecasts over time as required, through annual consultation on the IASR.

4.6 Demand forecast

Summary of material issues raised in submissions

Stakeholders recommended further consideration of various issues impacting the demand and energy forecasts applied in the ISP.

Stakeholders (**CEC**, **EVC**) raised concern that the ISP forecast uptake of electric vehicles (EVs) was too high, and that EV uptake will not match the rapid trajectory of rooftop photovoltaic (PV) uptake. **Ausgrid** also found the EV forecast to be optimistic without accelerated charging infrastructure roll-out, and suggested future ISPs could consider forecasting the infrastructure required to support EV uptake. Some stakeholders (**EVC, SEQCA**) considered that EV contribution to evening peak demands was overstated due to pessimistic assumptions of convenience charging rates, while **Charles Esson** considered that EVs should not contribute to maximum demand at all. **IEEFA** and **MarinusLink** suggested the ISP incorporate more recent projections in EV forecasts.

Additionally, **EVC** and **Endeavour Energy** encouraged revision of the Draft ISP projected EV charging profiles, stating concern that biasing expected EV charging times towards peak demand periods would lead to potentially unnecessary further network investment. **EVC** suggested EV charging load could also be partially offset by vehicle-to-grid (V2G) participation and suggested reflecting this in the final 2024 ISP.

Several submissions called for greater consideration of the contribution of future large industrial loads on the demand forecast.

- **ElectraNet** and **SACOME** identified 12 large industrial loads seeking to connect in South Australia by the early 2030s which are not captured in the ISP demand forecast.
- **Ausgrid**, **Endeavour Energy** and **Transgrid** noted the strong growth in load for new and existing data centres, with **Endeavour Energy** citing 2023 data centre load applications totalling 2.6 gigawatts (GW) and an

[37] See https://www.energy.gov.au/sites/default/files/2024-04/ecmc-response-to-isp-review.pdf.

additional 2.7 GW in enquiries. **Transgrid** stated it has also observed connection interest for new industrial/manufacturing facilities.

- As a large industrial consumer, **Blue Scope** stated concern that the Draft 2024 ISP underestimated its electrification needs, asserting that half of the New South Wales business electrification forecast would be required for just the first stage plans of its Port Kembla Steelworks operations.

Origin Energy recommended inclusion of a low demand sensitivity as proxy to assess the impact of large industrial loads having lower-than-predicted growth or if hydrogen targets are missed.

Other submissions, stakeholders (**Origin Energy**, **Hydro Tasmania**) noted a significant increase in the demand forecast of the Draft 2024 ISP compared to the 2022 ISP *Step Change* scenario. **Energy Grid Alliance** encouraged greater consideration of the advantages of demand-side management in reducing peak demand. **Origin Energy** and **Ausgrid** recommended AEMO clarify the underlying reasons for increased consumption forecasts, given that the scenario settings for *Step Change* have not significantly changed. **Hydro Tasmania** said that supporting a total consumption growth beyond 2 terawatt hours (TWh) in Tasmania is likely to require an earlier build of Project Marinus Stage 2 as well as additional network investment. The **ETU** expressed concern that the assumptions affecting the demand forecast around hydrogen production and smart home management were not supported by policy.

AEMO's consideration and response

EV uptake forecasts and charging profiles

AEMO has considered the feedback provided from stakeholders about EV uptake projections, including through looking at changes to vehicle types included in scope for the Fuel Efficiency Scheme (which were not legislated at time of EV forecasting for the 2023 IASR) and updated underlying transport statistics[38].

AEMO's assessment is that amendments to the forecasts, were they to be incorporated, would not be substantively impactful on the ISP results over the 20-year horizon. As such AEMO has decided to incorporate this feedback (and other feedback) in future forecasts to be consulted on through the 2025 IASR process. AEMO has also prepared a *Low EV sensitivity* for the final 2024 ISP to evaluate the robustness of the ISP outcomes (See: Appendix 6).

AEMO also considered stakeholders' feedback on EV charging profiles and their impact on peak demand, in light of the available research. AEMO notes some limitations on the applicability of various EV charging research to forecasting work – for example, not all research attempts or achieves a representative spread of vehicle users and vehicles, and some research does not cover a full year of seasonal usage. AEMO considers the data source used by CSIRO in supporting the development of the 2023 IASR forecasts – the Ergon Network and Energex Network SmartCharge research[39] - to be appropriate for continued application in the forecasts used in the 2024 ISP.

[38] See https://www.bitre.gov.au/publications/2023/australian-infrastructure-and-transport-statistics-yearbook-2023.

[39] See https://www.energex.com.au/__data/assets/pdf_file/0008/1096496/EV-SmartCharge-Queensland-Insights-Report.pdf.

Industrial demand and consumption forecasts

AEMO forecasts growth in industrial consumption in accordance with the *Electricity Demand Forecasting Methodology*[40], which outlines specific criteria for the inclusion of new loads and the process for surveying existing large industrial load customers. AEMO is aware of the potential impact of data centres and has monitored consumption from existing data centres over recent years. AEMO will consult as required under the AER's Forecasting Best Practice Guidelines on the continued appropriateness of the current approach, ahead of the 2025 Electricity Statement of Opportunities and 2026 ISP, including the suitability of the existing approach to including anticipated and prospective industrial load.

AEMO also identifies prospective projects through the annual *Standing Information Requests*[41] sent to transmission and distribution network service providers, and direct surveys to major industrial load proponents in the NEM. The ISP consultation submissions and direct engagement with network service providers identified further additional prospective industrial and data centre loads, and AEMO has included an *Additional Load* sensitivity that explores the potential influence of expanded industrial load growth (See: Appendix 6).

AEMO has investigated stakeholders' concerns that the Draft 2024 ISP underestimated New South Wales business electrification. AEMO notes that this load appears to relate to the adoption of direct reduction of iron (DRI) technology and additional electricity required for green steel manufacturing, ultimately using hydrogen. The ISP captures this load under 'hydrogen' in the *Green Energy Exports* scenario, and has further considered the appropriate hydrogen load allocation across ISP subregions in the final 2024 ISP (See Section 4.10).

Other issues raised

AEMO notes other issues raised by stakeholders relating to the demand forecast applied for the 2024 ISP, but also notes that the consultation for the forecasts applied for the ISP is through the annual IASR process. AEMO welcomes further advice and evidence ahead of or within the consultation process for the 2025 IASR, which will be applied for the 2026 ISP modelling.

4.7 Social licence

Summary of material issues raised in submissions

Several submissions (**APA Group, ETU, CEC**, **Origin Energy, Star of the South**) commented on the social licence sensitivity modelling, and in particular wanted to see greater consideration of specific technologies, including offshore wind. The **ETU** and **APA Group** suggested sensitivity modelling could consider reduced social licence for GPG and batteries, Native Title, undergrounding of transmission, and non-REZ based generation. **IEEFA** suggested assessing the impacts of reduced social licence for CER, and non-renewable developments such as new gas and gas infrastructure, and coal plant life extensions.

The **ISP Consumer Panel** asked for more transparency on how social licence sensitivity parameters were selected.

[40] Available at https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-approach/forecasting-and-planning-guidelines.

[41] For further information see https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-reliability/standing-information-requests.

The **AEC** suggested modelling the rollout of transmission as a binary issue, to highlight increased costs to consumers if social licence is not acquired for committed and anticipated projects. **AGL** proposed that modelling should assess time delays longer than two years for renewable generation projects, consistent with the approach applied to transmission projects. The **Member for Wagga Wagga** supported the inclusion of a sensitivity modelling community impact with consideration of their willingness to accept change.

The **ETU** and the **CEC** called for more diverse social licence consultation, recommending input from worker representatives be included, and that representatives from a renewable energy generator proponent and the CEC be added to the Advisory Council on Social Licence. Regarding acquiring social licence for CER coordination, **Declan Kuch** encouraged AEMO to incorporate social science expertise in consultation, in addition to technical and economic expertise.

Many stakeholders wanted the ISP to identify current policy barriers to resolving social licence issues and call for improvements. **WWF** wanted to see the final ISP explicitly recognise and address how tensions between renewable energy development and biodiversity protection can erode social licence and emphasise the need for governments to prioritise strategic planning in REZs.

ATSE recommended AEMO target REZ development in locations where generation and transmission can provide positive social impact to local communities and integrate new energy generation with local industries to help articulate the benefits to local communities. **Energy Grid Alliance** encouraged AEMO to identify and propose solutions to mitigate the disproportionate impact of energy plans on disadvantaged communities. **WestWind** requested more information on improving community engagement practices.

AEMO's consideration and response

AEMO acknowledges the breadth of stakeholder interest and feedback on the topic of social licence and thanks stakeholders for their contributions in an area of continuing learning and uplift for AEMO.

Recognising the focus, ongoing and substantive work underway by industry and governments to advance matters of social licence and community engagement in the sector, AEMO has expanded on examples of recent community sentiment research and good practice guidelines in Appendix 8 to provide a broader view of emerging issues and responses.

On social licence sensitivity modelling, while AEMO agrees with many of stakeholders' suggestions, AEMO did not re-model this sensitivity for the final 2024 ISP. AEMO considered that re-modelling the sensitivity to apply the updates included in the 2024 ISP would not have resulted in substantively different insights or outcomes for the final ISP. AEMO has responded to ISP Consumer Panel feedback seeking more information on sensitivity parameters in Appendix 8.

AEMO acknowledges the valuable feedback received on the nuanced social, cultural, environmental and broader impacts and benefits of renewable and transmission projects for local landholders, communities, industries and economies. AEMO will consider how these aspects could inform its 2026 ISP planning and modelling in line with broader recommendations being progressed by the Federal Government following its review of the ISP.

Finally, AEMO appreciates the interest of stakeholders in ensuring appropriate representation of consumer and community voices in its ISP planning. AEMO will continue to seek insights from a diverse range of consumer and

environmental, social and governance (ESG) experts in its future planning, including in the 2026 ISP consistent with Australia's Energy Ministers' March 2024 response to the review of the ISP[42]

4.8 Communication

Summary of material issues raised in submissions

Stakeholders made recommendations for how the outcomes and purpose of the ISP are communicated, specifically around transparency, clarity and emphasis of messaging.

Some stakeholders raised concern that the purpose of the ISP is unclear and recommended its purpose, inputs, scope and limitations be communicated very explicitly to avoid misinterpretation (**AEC, Zenith, ISP Consumer Panel**). Stakeholders also asked for AEMO to do more public engagement in accessible language and to explain the net market benefits in more accessible language (**Re-Alliance, EnergyAustralia, Etrog, ACF**). **Re-Alliance** welcomed more public engagement from AEMO, particularly regional outreach, to address misinformation about the ISP.

Some stakeholders (**CIS**, **PIAC, Zenith, ISP Consumer Panel**) considered that the main tagline of the Draft 2024 ISP[43] is open to misinterpretation, and that it could more clearly acknowledge the ISP's assumptions, methodologies, and exclusions. Some stakeholders were generally concerned that the tagline did not acknowledge the role of distribution networks and CER which are a significant feature of the ODP.

The inclusion of government policies and targets and their impact on the ODP was a key issue where stakeholders requested further discussion. The **ISP Consumer Panel** asked AEMO to clarify how AER guidelines are applied, their limitations, and the role of input policy assumptions. Some stakeholders (**QEUN, CIS, PIAC**) requested analysis on the government targets and policy so that their costs and benefits could be evaluated.

Some stakeholders (**Alinta, AEC, Iberdrola, Nexa**) requested that the ISP should clearly identify any gaps or misalignment between policy targets and existing mechanisms. **Iberdrola** recommended that the ISP identify any shortfall where market intervention beyond existing policy is required to meet government targets. **David Close** wanted more transparency on the assumptions in the ODP, including acknowledging volatility in demand for GPG.

EnergyAustralia, **Marinus Link** and **Zenith** noted that the focus of the Draft 2024 ISP was on the *Step Change* scenario, which was only identified as 1% more likely than the *Progressive Change* scenario by the Delphi Panel[44]. Given the closeness, further discussion on *Progressive Change* was recommended, including how headline results from *Step Change* may be different. **ACF** noted that scenario likelihoods from the Delphi Panel are only indicative.

Stakeholders (**ACF, AWU, WWF, PIAC, CEIG, Climateworks**) also wanted further discussion on the scenario settings, particularly the degree of global temperature rise that informed the emissions budget applied in the ISP and the broader economic implications of each scenario eventuating. Some stakeholders (**ACF, Nexa, IEEFA, CEIG**) called for the *Rapid Decarbonisation* sensitivity (*Step Change* scenario with an emissions budget consistent

[42] See https://www.energy.gov.au/sites/default/files/2024-04/ecmc-response-to-isp-review.pdf.

[43] As noted in the Draft 2024 ISP, "Renewable energy connected by transmission, firmed with storage and backed up by gas-fired generation is the lowest cost way to supply electricity to homes and businesses throughout Australia's transition to a net zero economy."

[44] AEMO. *2024 ISP Delphi Panel - overview*, November 2023. At https://aemo.com.au/en/energy-systems/major-publications/integrated-system-plan-isp/2024-integrated-system-plan-isp/current-inputs-assumptions-and-scenarios.

with limiting global temperature rise to 1.5°) to be elevated (e.g. to a scenario) and discussed further. **Nexa** and **Climateworks** encouraged planning for the NEM to operate without any fossil fuel generation including non-renewable gas.

Several stakeholders (**ISP Consumer Panel, Paul Schulz**) wanted the ISP to explicitly address the role of consumers in supporting the energy transition and include more details on challenges, common good benefits, and related transition costs. The **ISP Consumer Panel** also recommended that the ISP tagline statement include the role that consumers will play in achieving net zero emissions targets.

Several submissions (**ISP Consumer Panel, QEUN**) wanted to know what the term 'affordability' means in the ISP, how it is balanced with reliability, and whether the ISP can be both affordable and deliverable. **PIAC** recommended the ISP make clear that reliability is a planning standard that must be met in the ISP, not something that is completely open to AEMO's application of judgement when balanced against affordability. A number of submissions (**ACF, Alan Pears, EnergyAustralia, ETU, QEUN, SOTS, SACOSS**) called for further discussion and analysis of price impacts to inform assessments on the economic case for generation and storage outcomes in the ODP and assessments of equitability and affordability.

Hydrostor, PIAC, Stride and **CEC** noted that GPG was alternatively described as providing back-up and firming and suggested that these terms be clarified and used consistently.

AEMO received requests for further details, discussion and clarification on a range of topics including:

- Releasing more details of the counterfactual development path (**EnergyAustralia**).
- Additional discussion and details of the sensitivity studies (**Nexa, ISP Consumer Panel**).
- Setting out the rationale behind the different inputs and assumptions (**Origin**).
- Additional detail on the drivers behind firming outcomes (**Origin**).
- Higher granularity datasets for generation results with regional breakdowns (**IEEFA, EnergyAustralia**).
- Further details on the assumptions around future consumption forecasts and drivers (**Ausgrid**).
- Greater transparency regarding costs and underlying assumptions (**SEQCA**).
- Further details on how demand response is incorporated into the model (**AGL**).
- Explaining the three types of consumers and their different needs more simply (**ISP Consumer Panel**).
- Providing simple comparisons of the ODP for each scenario in the main report (**ACF**).
- Providing more clarity around the drivers of coal exits (**IEEFA**).

AEMO's consideration and assessment

AEMO thanks stakeholders for their suggestions on how outcomes are communicated in the ISP, and how the ISP is communicated in general.

Further clarity on the purpose of the ISP

AEMO delivers the ISP consistent with the purposes set out in the NER. AEMO understands that industry and stakeholders rely on the ISP for purposes beyond those set out explicitly in the NER, and that the material covered in the full ISP documentation has been enhanced over time to provide further detail and analysis.

AEMO considers that the ISP is appropriately described as a roadmap for the energy transition which outlines generation, storage and transmission infrastructure needs. The ISP is not designed to re-evaluate government policies or to re-evaluate generation, storage or transmission projects that are already underway for delivery. The ISP does identify risks to the delivery of the ODP, to support consultation and engagement with interested stakeholders.

AEMO has taken stakeholders' feedback that the inputs, assumptions and outputs of the ISP process could be more plainly explained. The 2024 ISP report now includes a section dedicated to inputs and outputs (See: 2024 ISP, Section 3) and a new figure providing a diagrammatic view of the process, including clarity on which inputs and assumptions AEMO consults on before preparing the ISP (See: 2024 ISP, Figure 12).

AEMO has also adjusted the ISP tagline for the 2024 ISP to call out the role of distribution networks in the energy transition. As discussed in Section 4.5, CER will play an important part in the energy transition, and distribution networks will support and enable that role. AEMO has not made further changes to the tagline simply due to the vast number of inputs and assumptions that apply to the ISP modelling process – rather, the tagline is used when a shorthand is required to summarise elements of the ISP. Further detail on all inputs, assumptions, exclusions and methods is provided across the suite of ISP and IASR documentation.

AEMO will continue to seek opportunities to provide clarity and explain the ISP more plainly in the future.

Scenario weightings and settings

AEMO acknowledges that the assigned likelihoods of *Progressive Change* and *Step Change* scenarios are close and that long-term generation, storage and transmission outcomes (including the pace of coal retirement) vary across scenarios. For the headline statements presented in the 2024 ISP main report, AEMO has decided to retain its existing approach of primarily referring to *Step Change* results. AEMO does consider that this provides greater ease of reading. However, AEMO has continued to publish a suite of results for all three scenarios across the supporting appendices and data workbooks that are published with the ISP. Ultimately, the results of the ODP do take in to account all three scenarios, consistent with the assigned likelihoods.

The settings for each of the scenarios, including the specific temperature rise target, are developed, and consulted during preparation of the IASR. The ISP does provide an overview of these settings in Section 3.3. AEMO acknowledges that further discussion of scenario settings would provide additional context, but AEMO considers that the IASR is the appropriate report for discussing scenario settings in detail.

AEMO acknowledges that some stakeholders would prefer all scenarios to be consistent with limiting temperature rise to 1.5°, noting the Paris Agreement. The scenarios for the ISP have been developed and consulted on through the 2023 IASR and AEMO has not altered these for the 2024 ISP. AEMO has conducted and discussed the *Rapid Decarbonisation* sensitivity which applies a 1.5°-aligned emissions budget to the *Step Change* scenario.

ISP treatment of affordability

AEMO agrees that energy affordability for consumers is important. AEMO selects the ODP to deliver the highest net market benefits while also ensuring secure and reliable electricity supply and emissions reduction, and AEMO considers this approach to be consistent with the National Electricity Objective (NEO). This approach to affordability as it relates to the ISP is outlined in Section 3.2 of the 2024 ISP.

As discussed in Appendix 6, all else being equal, the least-cost development paths under each of AEMO's three scenarios provide net market benefits across the ISP planning horizon when compared with the counterfactual (where no transmission is built). That is, without new transmission, consumers would pay more for electricity.

AEMO agrees with **PIAC** that the reliability standard must be met in the ISP, as well as other power system reliability and security needs. AEMO hopes that the additional new figure showing high-level inputs and outputs to the ISP clarifies this point. AEMO has retained some description of balancing between reliability and affordability in the ISP, to explain the potential consideration of consumer risk preferences and explore some aspects of reliability, but agrees with **PIAC** that meeting the reliability standard cannot be traded-off with other aspects of the ISP.

AEMO has not provided additional discussion or analysis of price impacts in the ISP. This has not been AEMO's practice for the ISP in the past and such an approach can involve market sensitivities. AEMO is not currently intending to prepare this analysis for publication from the ISP, although it remains open to views on the need for this through future ISP consultation processes.

AEMO has responded to the other matters raised on this topic by the **ISP Consumer Panel** in Section 2.3.

Use of the terms 'firming' and 'back-up' in the ISP

In general, 'firming' is used much more frequently in the ISP than 'back-up'. Firming refers to the capability of some technologies to be continually in operation to support and provide smoothing for variable renewable generation. AEMO uses the term 'back-up' when referring to the ability of a technology, such as flexible gas, to be available to provide standby capacity, or strategic reserves. In this sense, variable renewable generation is firmed by storage, and flexible gas provides back-up during less frequent periods of low renewable energy – particularly when storages have been exhausted.

AEMO has reduced the number of potentially overlapping references to these terms in the ISP, but has continued to use the terms as the distinction is considered to be important.

Requests for further details

AEMO has considered requests for additional details and has included these where appropriate and possible. AEMO notes that the ISP is underpinned by the 2023 IASR and the *ISP Methodology,* and that further details are available in those documents. AEMO has considered including further information from these documents in the 2024 ISP and has opted not to duplicate that information across multiple publications.

4.9 Generation and storage development

Summary of material issues raised in submissions

Stakeholders commented on the expansion of different generation and storage technologies and generally requested further information and analysis to support the developments in the ODP.

A number of stakeholders (**Barrie Hill, Anthony Donnellon, Michael French, Geoffrey Houston, David Brunt and Denis Feeney, James Taylor et al., Roderick Sinclair, CIS, Campaign Group A**) called for both conventional nuclear reactors and small modular reactors to be included as generation options in the ISP as they

may provide additional net market benefits to the ODP. **Lighter Footprints** also called on AEMO to clarify why nuclear power should not be considered in the ISP.

The **ETU, AWU and Star of the South** encouraged AEMO to reconsider the benefits of offshore wind in de-risking disorderly coal closure, including in New South Wales and Tasmania. **Cherylle Stone** supported more onshore wind capacity than offshore, arguing that proximity to load centres and existing transmissions corridors can be leveraged, whereas **SEQCA** recommended the budget for utility-scale wind needed to be better justified.

The **ISP Consumer Panel** and **Etrog** proposed that AEMO incorporate the draft CSIRO 2023-24 GenCost results[45] in the final 2024 ISP. **IEEFA** requested further information of the mapping of GenCost scenarios to ISP scenarios, raising a concern that a change in mapping between the 2022 ISP and the Draft 2024 ISP has significantly altered the battery cost trajectories applied in the ISP, resulting in more expensive batteries.

ASTRI and AUSTELA raised concern that that the dispatch and operation of concentrated solar thermal generation is not accurate in the IASR or ISP, and argued that it should be considered as a viable firming technology similar to pumped hydro, batteries and gas. **Rondo Energy** suggested AEMO include consideration of thermal storage and **Hydrostor** requested compressed air storage be included as it is a mature technology.

Some stakeholders (**Hydrostor, ATSE**) recommended that the ISP should remain technology-neutral and avoid picking technology "winners and losers". Stakeholders (**CEIG, EnergyAustralia**) wanted to understand the commercial implications of generation and storage developments in the ODP including further analysis on the sensitivity of forecasts for specific technologies to cost changes. **Marinus Link** encouraged a sensitivity of battery cost assumptions and **Energy Australia** suggested that medium and deep storage could be valued with a 'take-one-out' assessment. **CEIG** noted that a 20% economic spill for renewable generation is not commercially viable, and **EnergyAustralia** requested analysis on prices at times of dispatch to assess the revenue impacts of spill.

Hydro Tasmania considered there are important market benefits from pumped hydro plant in Tasmania larger and earlier than what appears in the ODP**. CEC** and **Stride** noted that Aurecon's Technical Parameters report to AEMO assumes a technical life of 80-100 years for pumped hydro, however the Draft 2024 ISP assumes a 50-year technical life. **Stride** recommended exploring longer duration (up to 192-hour) pumped hydro storage options, stating that limiting options to 48-hours undervalues PHES potential.

Tesla noted that only 0.8 GW of shallow duration storage capacity is developed between 2026 and 2028 and that this appears to be inconsistent with the Federal Government's Capacity Investment Scheme. **Tesla** suggested a smoother expansion of storage capacity would be more likely. **Hydrostor** noted the capacity of medium duration storage in 2050 is 3.48 GW and suggested this may not align with the New South Wales target of 2 GW long duration storage and Victoria's 6.3 GW target.

Hydrostor also recommended that AEMO reconsider its threshold for categorising long duration storage, recommending the limit be changed to eight hours and above rather than 12 hours and above. **Hydrostor** is concerned that the current thresholds resent a risk of sending the wrong signals to proponents, potentially leading to more development at the lower end of the current medium duration storage category (between four and eight hours) when longer duration storages might have been more effective.

[45] CSIRO released the draft 2023-24 GenCost report in December 2023 for consultation, at https://www.csiro.au/en/research/technology-space/energy/gencost.

AEMO's consideration and response

Nuclear generation is not modelled

The ISP is bound by the NER to have regard to government policy, and current policy prohibits the approval, licensing, construction, or operation of a nuclear power plant[46]. As such, AEMO has not modelled nuclear generation as an option for the 2024 ISP.

Additionally, the latest CSIRO GenCost data[47] indicates that nuclear as a technology is more expensive than renewable alternatives and would require at least 15-20 years to be deployed.

Both on and offshore wind will play an important role

The ISP projects the optimal mix of generation and storage, including utility-scale wind, based on capital and operating costs from GenCost. Early investment favours utility-scale wind, which is typically stronger in the winter months and generates energy overnight, complementing the strong existing and forecast distributed solar. Although onshore wind is lower cost than offshore wind, assuming it can be sited properly and connected efficiently to the grid, offshore turbines capture stronger, more consistent wind.

AEMO included offshore wind as a technology option in the Draft 2024 ISP available for development in offshore wind zones across the NEM, however uptake was limited given the lower cost of onshore wind. As per the NER requirement that AEMO has regard to government policy, AEMO has incorporated the Victorian Government's offshore wind energy targets in the ISP. AEMO notes that while other NEM states have released policy statements for offshore wind, these plans have not reached the same level of formal policy development to justify further analysis at this stage.

Application of GenCost results in the 2024 ISP

Generation and storage inputs to the ISP model are based on the GenCost report developed each year between CSIRO and AEMO. The draft CSIRO 2023-24 GenCost figures were reviewed and were not found to be significantly different to the 2022-23 GenCost results which have undergone full consultation. As such, AEMO continued to use the 2022-23 results for the final 2024 ISP.

Regarding the issue raised by **IEEFA** on the battery cost forecast implications from mapping the 2022-23 GenCost scenarios to the 2023 IASR scenarios which are then applied for the 2024 ISP, AEMO does agree with **IEEFA** that there is a difference in battery cost trajectories as they have been applied for the 2024 ISP compared to the 2022 ISP for the *Step Change* scenario. However, the mapping process takes an entire GenCost scenario and applies it to an entire ISP scenario, rather than picking different technology trajectories to bring across. AEMO consulted on the mapping applied for the 2024 ISP through the preparation of the 2023 IASR, with discussion of this mapping exercise raised for consultation in Section 3.5.3 of the Draft 2023 IASR[48].

[46] *Environment Protection and Biodiversity Conservation Act 1999* and *Australian Radiation Protection and Nuclear Safety Act 1998*.

[47] CSIRO. GenCost 2023-24 Report, at https://www.csiro.au/en/research/technology-space/energy/Energy-data-modelling/GenCost.

[48] AEMO. *Draft 2023 Inputs, Assumptions and Scenarios Report,* December 2022, pages 93-96. At https://aemo.com.au/consultations/current-and-closed-consultations/2023-inputs-assumptions-and-scenarios-consultation.

AEMO has applied the consulted-on GenCost trajectories and scenario mapping for the 2024 ISP. AEMO and CSIRO will continue to consult on future cost trajectories, scenarios and mapping of scenarios in future publications.

ISP outcomes for concentrated solar thermal and compressed air

AEMO seeks to adopt a technology-agnostic approach in modelling the ISP generation and storage mix. As the optimisation is designed to find a least-cost solution, higher-cost technologies such as concentrated solar thermal may have limited deployment in the ISP results. AEMO notes that compressed air storage (A-CAES) was not integrated into the GenCost projection methodology and as such future costs were not available to include in the ISP model, as was the case for pumped hydro of longer than 48-hour duration.

AEMO recognises the impact of economic spill and curtailment on the commercial viability of renewable generation projects, and reiterates the need for market reform to ensure sufficient incentives for investors to develop an optimal level of capacity.

Other issues raised

AEMO agrees with stakeholders that long-duration storage technologies are, and will continue to be, very important in the NEM, and that a broad range of technologies are either available or may be available in the future to meet these needs. AEMO is open to considering feedback on re-categorisation of storage category thresholds as part of consultation on the 2025 IASR – the results of which will apply to the 2026 ISP and a range of other AEMO forecasting and planning publications.

In the 2024 ISP modelling, an economic life of 40 years is used to calculate the annual annuity and applicable period for pumped hydro costs. The technical life is used to determine the retirement date of plant. Regarding **Stride**'s feedback, an increase of technical life to 80-100 years is not expected to change economic outcomes in the ISP because the technical life is beyond the modelling horizon. Furthermore, Aurecon has noted that the electrical package is designed for around 40 years while civil infrastructure is designed for 100 years. As such, AEMO has not adjusted the treatment of pumped hydro project life in the final 2024 ISP.

AEMO has confirmed that the storage forecasts in the final ISP are consistent with the Federal Government's Capacity Investment Scheme, with some potential mismatches in early years if projects are not yet committed or anticipated, but are expected to occur before the ISP modelling treatment of project lead time would permit a new project to be built.

4.10 Hydrogen

Summary of material issues raised in submissions

Stakeholders asked for more detail on hydrogen modelling assumptions and encouraged AEMO to consider modelling in more detail. **Origin Energy** and **Marinus Link** noted a lack of clarity as to how the model incorporated electrolyser flexibility, derivation of hydrogen production values and how regional hydrogen load growth was modelled, particularly given the substantially higher hydrogen load growth in Tasmania and South Australia. **Lost River Australia** questioned the absence of hydrogen export in New South Wales in the *Step Change* scenario.

Fletcher and Nguyen called for further analysis on hydrogen in general, including models and data inputs for coupling of industrial decarbonisation load, demand traces split between industry and transport, costs for firming variable hydrogen supply, and benefits of integrating green ammonia value chain demand response. **Fletcher and Nguyen** considered that the ISP input models that provide hydrogen demand and electrolyser capex projections lacked the time-sequential detail to undertake an accurate assessment of the cost competitiveness of firmed green hydrogen.

Fletcher and Nguyen further considered that most hydrogen use cases identified by **Climateworks** and **CSIRO** require a constant supply of hydrogen and there is no evidence base supporting the monthly balancing assumption without a significant volume of storage. **Fletcher and Nguyen** recommended sensitivities including one with no domestic hydrogen load and one with daily balancing for the final 2024 ISP.

Marinus Link and **Hydro Tasmania** also noted that hydrogen facilities are currently considering hydrogen storage duration significantly shorter than what is assumed in the Draft 2024 ISP, and as such recommended that AEMO explore the impact of the hydrogen load flexibility assumption, including modelling runs where much lower flexibility is assumed, to inform selection and timing of transmission in the ODP. **Origin Energy** also encouraged more detail on how electrolyser flexibility forecasts were derived.

AGIG encouraged AEMO to consider the ability of hydrogen production to support the grid at times of minimum demand. **AGIG** also suggested that the ISP model hydrogen production in REZs and consider gas distribution networks as a way to transport hydrogen to demand centres, reducing the need for some transmission investment.

The **CEC** and the **AHC** noted that the Draft 2024 ISP scenarios assume that only 50% of hydrogen projects will be NEM-connected, and expressed concern that national sector workforce needs and policies may be underestimated. The **CEC** and **AHC** also encouraged the inclusion of additional headroom for hydrogen exports in the *Step Change* scenario, taking into consideration policies like Hydrogen Headstart and the proposed National Hydrogen Strategy, which may lead to some export-oriented green hydrogen derivatives in place by 2030. **Fortescue** suggested a scenario between *Step Change* and *Green Energy Exports* may more accurately capture the forecast level of export growth. **Sunshine Hydro** also found that Draft 2024 ISP understated the value that hydrogen production will bring to the NEM.

AEMO received additional comments on hydrogen:

- **Rondo Energy** presented a countering viewpoint, suggesting AEMO consider electrification and other technologies over hydrogen due to potential risks around economic viability.
- **Fortescue** encouraged AEMO to emphasise the role of electrolysis technologies in supporting stable network operation in the final ISP.
- **Energy Estate** requested AEMO consider including Port of Abbot Point (Queensland) as a hydrogen production and ammonia conversion site connected to Strathmore in ISP planning.

AEMO's consideration and response

Stakeholders asked AEMO to provide more detail on hydrogen modelling assumptions. Detailed information on modelling methods can be found in the *ISP Methodology*[49], with additional information in the Electricity Demand Forecasting Methodology[50]. AEMO relies on CSIRO's HyResource program as a source of data on committed hydrogen supply projects, and develops assumptions based on industry research and consultations with governments on related legislation. AEMO acknowledges the complex and emerging nature of hydrogen and intends to consult on enhancements and further detail to the demand forecasting and ISP methodologies in 2024 and 2025.

Regional hydrogen load growth for domestic demand is calculated through multi-sector modelling and is then used as an input to the ISP, with electrolysers assumed to be located in the ISP model at the sub-regional reference nodes. However, hydrogen targets for exports and steel is an input to the ISP at NEM level, as consulted on through the IASR process. Sub-regional allocation of the hydrogen load is optimised by the ISP model, based on the modelled cost of electricity supply and distance to the nearest port (where electrolysers are assumed to be located for export purposes).

Regarding hydrogen exports in *Step Change*, the makeup of the projects to be funded by Hydrogen Headstart is not yet known, and will likely be a mix of domestic and export applications. The 2025 IASR will include an update relating to this program, assuming further information is available in time.

The value that hydrogen production brings to the NEM is usually considered in relation to the flexibility of electrolysers and their ability to shift load away from peak times, and supporting minimum loads by operating during these periods. AEMO has taken stakeholders' feedback on board and has prepared a dedicated *Low hydrogen flexibility* sensitivity for the final 2024 ISP (See: Appendix 6). AEMO recognises that assuming maximum flexibility would have consequences for available hydrogen supply for domestic hydrogen consumers – these impacts are explored in the sensitivity.

AEMO has noted the **CEC** and **AHC** request regarding workforce needs outside of NEM-connected projects. Further information on this will be provided in the supporting *Electricity Sector Workforce Projections* material to be published alongside the 2024 ISP within quarter three of 2024, through partnership with the Institute for Sustainable Futures and RACE for 2030.

The 2025 IASR, for the 2026 ISP and other publications, will further consider feedback on hydrogen, and will include updated multi-sector modelling to explore the relative merits of hydrogen, biomethane and electrification (and other considerations).

4.11 Recommendations for the 2026 ISP

Summary of material issues raised in submissions

The **ISP Consumer Panel** made a number of recommendations for the 2026 ISP, which are detailed in Section 2.3. Several other submissions provided recommendations for the 2026 ISP, including:

[49] See Section 2.5 on page 52.

[50] See Section 2.2, at https://www.aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/nem_esoo/2023/forecasting-approach_electricity-demand-forecasting-methodology_final.pdf?la=en.

- Consider more detailed analysis on consumer risk preferences (**IEEFA**)
- Expand analysis of the role of demand-side energy resources (**IEEFA, Climateworks**)
- Focus more on modelling of green fuels (**Iberdrola**)
- Modelling of green ammonia (**Fletcher and Nguyen**)
- Consider a faster progression towards and increasing level of green exports (**Fortescue**)
- Incorporate recent technological advances in the ISP modelling to optimise generation siting (**Neara**)
- Reconsider how discount rates are incorporated into the modelling and affect net market benefits. (**Alan Pears**)
- Consider options for a major inland NSW REZ (**Transgrid**)
- Consider creating the demand equivalent of a renewable energy zone (**Bluescope**).

AEMO's consideration and response

AEMO thanks stakeholders for their suggestions for the 2026 ISP. A number of these suggestions are being actively considered in the early stages of the 2025 IASR. The scope for the 2026 ISP will be considered through a separate process.

4.12 Additional items of specific feedback

Feedback received	AEMO response
ElectraNet raised inclusion of the South Australian Government's target of 100% net renewable energy generation by 2030, as reflected in the AEMC's emissions target statement.	Under the NER[51], AEMO must consider the South Australian Government's target of 100% renewable energy by 2030 since it is listed in the AEMC's emissions targets statement[52]. AEMO did not have sufficient information on the target's mechanisms in order to model the target. The South Australian Government has since announced the bringing forward of this target to 2027.
CEIG proposed that the impact of the 'Rewiring the Nation' concessional finance should be reflected in the ISP. Marinus Link also noted that it would be useful to understand the impact of concessional financing.	As noted in the 2023 IASR, AEMO has not incorporated the impact of concessional finance in the draft or final 2024 ISP. This decision was made because the terms of concessional finance loans are generally not firm until after a project is committed.
Bluescope suggested that the locational accuracy of the demand forecasts in the ISP is insufficient to plan transmission for concentrated loads.	AEMO acknowledges that sub-regional demand traces lack the granularity to capture specific locations of growth. However, the transmission limits are developed based on detailed power system models that consider more granular network limitations. AEMO will consider whether improvements to sub-regional definitions are needed to address any material deficiencies in the 2026 ISP.
STMRCG, MRCCC and QEUN questioned the inclusion of Borumba Pumped Hydro Energy Storage (PHES) in the modelling given that it has no federal environmental approvals for the preliminary or main works. It was also noted that Borumba PHES should be in the Wide Bay REZ and not in Banana REZ.	AEMO receives advice confidentially regarding generation project commitment criteria that a project has met, or is on the way to meeting, to be declared as anticipated. Additionally, under the NER, the ISP may consider state policies that are supported by existing or pending legislation, including the Queensland Government's commitment to Borumba PHES for firming capability. More information on the commitment criteria is within the *Generation Information* data releases, and the treatment of committed and anticipated projects can be found in the *ISP Methodology*. AEMO has corrected the allocation of Borumba PHES to Wide Bay REZ in the 2024 ISP Inputs, Assumptions and Scenarios Workbook[53].
mc² Energy questioned whether Snowy 2.0 will be able to meet the energy storage capacity nominated by Snowy Hydro, and suggested that at least 203 GL of water to flow from Tantangara to Talbingo would be required, which would exceed the active storage of Talbingo (155 GL).	AEMO has not further investigated the discussion provided by the stakeholder about available flows or duration of Snowy 2.0 – AEMO has applied advice from Snowy Hydro about the capability of the plant. Separately, AEMO notes that the Draft 2024 ISP erroneously reported 376 GWh as the capacity for Snowy 2.0 in charts in the main report. This had no impact on modelling outcomes, and AEMO has corrected this reporting for the final 2024 ISP, with reporting energy storage capacity for Snowy 2.0 as 350 GWh consistent with the capacity stated by Snowy Hydro[54].
ACF recommended the expansion to the Commonwealth Government's Capacity Investment Scheme be included in the modelling.	AEMO has included the expanded Capacity Investment Scheme across all scenarios in the final ISP modelling.
Lighter Footprints and APA asked whether high voltage direct current (HVDC) linkages between major REZs and load centres are considered in AEMO's analysis.	AEMO considers a range of augmentation options for REZs, including HVDC options, in the 2023 *Transmission Expansion Options Report*[55].
Lost River Australia suggested joining the NEM with the Wholesale Electricity Market (WEM) by connection between Kalgoorlie, Western Australia to Ceduna, South Australia.	AEMO has not investigated the costs or benefits of connecting the NEM with other power systems (such as the SWIS or NT systems). The scope of the 2024 ISP is limited to the NEM, and as such a cross-continent connection is not within the remit of the ISP.

[51] AEMC. NER Chapter 5, clause 5.22.3(b) at https://energy-rules.aemc.gov.au/ner/347/37933.

[52] AEMC. Emissions targets statement under the National Energy Laws, at https://www.aemc.gov.au/sites/default/files/2024-01/Emissions%20Targets%20Statement%201%20February.pdf.

[53] At https://aemo.com.au/consultations/current-and-closed-consultations/draft-2024-isp-consultation.

[54] Snowy Hydro. Snowy 2.0, at https://www.snowyhydro.com.au/snowy-20/about/#:~:text=Snowy%202.0%20will%20provide%20an,to%20the%20National%20Electricity%20Market.

[55] At https://aemo.com.au/-/media/files/major-publications/isp/2023/2023-transmission-expansion-options-report.pdf?la=en.

Feedback received	AEMO response
Stride requested clarification on the value for gas capacity factors and emissions.	AEMO has expanded on capacity factors of gas peaking facilities in Section 4.1 of this report, and some additional gas information is also available in Appendix 2 and Appendix 4.
STMRCG and the MRCCC were concerned that methane emissions that would occur over the life of Borumba PHES have not been considered.	AEMO acknowledges that there are emissions associated with pumped hydro and there is ongoing research in this area. AEMO notes in the 2023 IASR[56] that Scope 1 emissions intensity for existing generators are an input to the ISP model based on data from the Clean Energy Regulator. As a point of comparison, the emission intensity (CO_2-e / MWh) of the nearby Wivenhoe Pumped Hydro was 600 times less than that of a typical black coal generator in 2022-23.
Origin requested clarification on how generation profiles are derived for projects located at new sites. The methodology, which states that the modelling incorporates generation traces entirely derived from meteorological data, does not fully explain how the information is derived, including the assumptions used such as the wind/solar resource mapping data that underpins the projections.	AEMO's method for developing VRE traces is described in Section 4.3 of the ESOO and Reliability Forecast Methodology Document and Section 3.6.2 of the 2023 IASR.
Sunshine Hydro noted that GPG is not defined in the Glossary of the ISP but is fleetingly defined as gas-powered generation in the document without the nuance of whether this gas can be non-fossil fuel sources.	AEMO notes that Executive Summary of the 2024 ISP main report provides a figure footnote defining 'flexible gas' as gas-powered generation and potential hydrogen capacity. Gas as a fuel may include natural gas, as well as blends of renewable gases such as biomethane and/or hydrogen (depending on the technical capability of relevant gas infrastructure and renewable gas availability). Full details about gas type assumptions are made clear where needed in the appendices to the ISP, and in other documentation such as the IASR.
EnergyAustralia recommended AEMO identify 'tipping points' where sensitivities produce situations of zero or negative net market benefits such as the amount of increase to transmission costs. Break even points for specific actionable projects should be identified, that is, the value at which project costs result in no or negative net market benefits.	AEMO acknowledges that identifying the points at which sensitivities and actionable projects no longer yield net market benefits would be useful, and may consider this in the development of future projects where needed. There are considerations relating to modelling complexity and market sensitivity that affect whether or not this kind of assessment can be completed and published.
EnergyAustralia noted that the Constrained Supply Chains sensitivity suggests that adding two years of lead time for transmission and limiting construction of wind and solar generation to 4 GW per year to 2030 would increase weighted net market benefits by around $2 billion relative to AEMO's core scenarios and requested clarification.	AEMO notes that the Constrained Supply Chain sensitivity is applied to both the counterfactual and the ODP. This tests the ODP's net market benefits under conditions where supply chains are constrained, rather than costing the direct impact of such constraints.
Alan Pears noted that the energy efficiency and electrification sensitivities had small impacts on the weighted net market benefits.	AEMO acknowledges the benefits of energy efficiency and electrification. AEMO notes that sensitivities considering these variables apply to both the counterfactual and ODP. Therefore the sensitivity does not cost the impact of energy efficiency or electrification but tests the ODP net market benefits under different conditions.
AEC and CIS recommended that reliability and security modelling results should be calculated every year rather than at five-year intervals. CIS also noted the ISP should model reliability to the same level as the ESOO.	AEMO tests intervening years where needed, but does not always publish results for each year due to modelling complexity and the timeframes that must be met for preparing the ISP. AEMO does test that the reliability standard is met in the ISP's ODP, but does not undertake the same detailed simulations as the ESOO due to modelling complexity and the timeframes that must be met for preparing the ISP.
Transgrid, Iberdola, Nexa Advisory and AGL recommended further analysis of system services beyond what is contemplated in the ISP including identification of locationally specific technical and physical requirements.	As noted in the Addendum to the Draft 2024 ISP, AEMO is considering future ISP enhancements for treatment of system security services. These enhancements could include iteration (between market modelling and power system analysis) and power system analysis, to represent system security investment options. This could allow the ISP to provide more complete information on the expected total system costs. AEMO will consider how to enhance its analysis of system security for the 2026 ISP, consistent with Australia's energy ministers' March 2024

[56] Page 88, at https://aemo.com.au/-/media/files/major-publications/isp/2023/2023-inputs-assumptions-and-scenarios-report.pdf.

Feedback received	AEMO response
	response to the review of the ISP[57]. AEMO will welcome stakeholder views on these matters through the 2026 ISP consultation process.
EnergyAustralia requested clarity on REZ curtailment noting that the solar capacity in N5 South West NSW appears to exceed the network capacity.	The approach to modelling network limits is detailed further in the *ISP Methodology*. The transmission network limit is the maximum amount of power that can flow through the limiting element before a thermal or stability constraint is violated, it is not the maximum installation capacity or hosting capacity. In the case of N5 REZ, the transmission network limit is 2,715 MW in 2030, meaning that generation from the 3,300 MW of installed solar capacity may be limited. Some additional generation may go toward charging the co-located battery. That there is no transmission curtailment may mean generation is economically curtailed before reaching the network limit.
Stakeholders (QCC, WWF, John Moore) expressed concern for the environmental impact of the ODP and recommended that the tension between reducing emissions and protecting biodiversity be explicitly recognised. Avoiding sensitive areas of biodiversity in the early stages of planning was also encouraged.	AEMO recognises that local communities are concerned with a range of community, social, cultural, environmental and economic values. Community acceptance of projects may be affected by potential impacts to local biodiversity and biosecurity, among many other factors. In the ISP, the design of REZs do consider biodiversity when estimating the available generating resource limits. These estimates are appropriate for the ISP forecasts. As a REZ progresses, the consideration of environmental impacts is further refined, with specific projects ultimately having to gain jurisdictional environmental approvals.
Lindsay Campbell proposed a flow path augmentation option for Northern New South Wales to Southern Queensland between Tenterfield 132 kV substation and Stanthorpe 110 kV substation	AEMO has not modelled this augmentation option in the 2024 ISP. AEMO considers that there is insufficient network capacity on the existing network surrounding Tenterfield and Stanthorpe to transfer a major, bulk capacity of electricity through the area. AEMO notes TransGrid's Queensland – New South Wales Interconnector (QNI) Minor upgrade completed in June 2022, which was done to more efficiently share lower-cost generation between Queensland and New South Wales and help reduce electricity bills for customers.
CIS found that the take one out at a time (TOOT) analysis for determining benefits of individual projects is not fit for purpose, finding that the sum of individual project benefits is greater than the total benefits for the CDP. CIS claimed that the discrepancy arises from a misunderstanding of how network effects can distort the perceived values of individual components within a system. **CIS is concerned about how this method has been applied for consideration of HumeLink and VNI West, as well as Sydney Ring. CIS considers that the individual TOOT analyses prevents the ISP from considering the net market benefits from a development path without this system of projects and Snowy Hydro 2.0.**	AEMO considers the TOOT analysis to be a valuable method for assessing the net market benefits of individual actionable projects. The TOOT analysis is intended to provide an indication of the positive net market benefits of individual projects. AEMO acknowledges that the sum of individual TOOT net market benefits sum to greater than the total net market of the ODP. This is not unexpected and reflects the value that one project adds to others (like valuing individual links in a chain). As an example, Gladstone Grid Reinforcement is a pre-requisite for SuperGrid South, so it is impossible to perform TOOT analysis for Gladstone Grid South without also removing SuperGrid South. AEMO acknowledges the relationship between HumeLink and VNI West and could have performed TOOT analysis on these combined projects. Given the relationship was not assessed in previous ISPs, AEMO considers it prudent and transparent to assess the merits of each project in isolation, in line with previous assessments. AEMO considers it unlikely that two projects that deliver weighted net market benefits in isolation would add a net market cost when combined, and tests this explicitly through the development paths (which represents combinations of projects). The ISP does not test Snowy Hydro 2.0 as this is a committed project.
CIS submitted that AEMO should not treat committed and anticipated projects as sunk costs by including them in all development paths, scenarios and sensitivities until they have gone through the regulatory investment test for transmission (RIT-T) process, regardless of whether they are declared by states as priority projects.	AEMO notes that some transmission projects will not progress through the RIT-T framework but through a jurisdictional framework. AEMO considers that it is appropriate for these projects to be included as committed or anticipated projects once they have reached threshold requirements. The ISP is not a vehicle for evaluating government policy or historical investment decisions. This approach is considered best practice, is required by the AER's Cost Benefit Analysis Guidelines and is aligned with Infrastructure Australia's Guide to Economic Appraisal.

[57] See https://www.energy.gov.au/sites/default/files/2024-04/ecmc-response-to-isp-review.pdf.

Feedback received	AEMO response
CIS questioned whether AEMO has breached the NER by passing responsibility for approving projects to state governments instead of issuing an ISP update to re-consider an actionable projects if there is no credible option for an actionable ISP project that satisfies the RIT-T.	AEMO considers that it has not breached the NER by actioning projects under jurisdictional frameworks. Jurisdictional frameworks include mechanisms that assess the efficiency of proposed network investments, and the 2024 ISP has independently tested the individual contributions that jurisdictional projects make to the net market benefits delivered by the ODP using TOOT analysis. For instances where a project is actioned under a jurisdictional framework, the decision to do so is made to avoid duplication between the ISP framework and the jurisdictional framework.
CIS expressed concern that solar panel, wind turbine and battery disposal and recycling costs are not included, and asked for clarification as to how costs incurred beyond the end of the ISP modelling horizon are considered.	In the 2023 Inputs and Assumptions Workbook, AEMO includes the retirement costs for solar and wind, based on the 2018 GHD report. These costs cover decommissioning, demolition, site rehabilitation and any on-going monitoring required, but do not include recycling[58]. A number of technologies (battery storage, biomass, solar thermal, offshore wind) do not have a retirement cost estimate due to insufficient data available at the time of the 2018 GHD report. AEMO will endeavour to update generator retirement costs as new information becomes available. In regard to the ISP modelling horizon, AEMO applies an annuity approach for all build costs, including retirement costs where data is available, associated with transmission, generation, and storage over the planning horizon. AEMO acknowledges that the net present value (NPV) of annualised costs could be lower than the NPV of the full build cost if the planning horizon is shorter than the economic life of a project, however annual benefits would also be under-estimated if limited to the planning horizon. This implies an assumption that annual benefits beyond the planning horizon are greater than or equal to annualised costs, which AEMO considers to be reasonable based on previous modelling experience and the expectation that the NEM will continue to progressively transition from fossil fuels to renewable generation.
CIS recommended that a figure of at least 3% for total annual expenditure on transmission assets over their lifecycle be adopted to more accurately account for both opex and capex.	AEMO notes that this recommendation was raised in the consultation on the 2023 *Transmission Expansion Options Report*. AEMO has not changed the decision to maintain the 1% p.a value as per the reasons given in the 2023 *Transmission Expansion Options Report* consultation summary report.
CIS observed potential flaws in the exploratory modelling of the VRE drought analysis including: • **Hydro generation exceeds capacity.** • **Medium and shallow storage exceeds capacity.** • **Queensland export to New South Wales exceeds capacity.** • **Continuous demand side participation (DSP) exceeds limits.**	AEMO does not find any parameters to have exceeded limits but acknowledges that more clarity was required for presenting these results. Hydro generation includes both hydro capacity and pumped hydro capacity. Deep, medium and shallow storages report the state of charge, which is the percentage of total stored energy, not the storage capacity in GWh. Queensland's export capacity in winter is the sum of QNI and the HVDC link at Terranora (totalling 1.37 GW). QNI Connect option 2 upgrades Queensland's export capability by 1.7 GW for a total of 3.07 GW. Therefore, the capacity of QNI is not exceeded. Regarding operation of DSP, AEMO has applied values consulted on through the 2023 IASR process. AEMO remains open to consultation on alternative values in future IASRs.
CIS suggested that as the uprating of Snowy 2.0 was not included in the 2023 IASR it should not be part of the ISP analysis.	The uprating of Snowy 2.0 from 2,040 MW to 2,200 MW was published in September 2023 NEM Generation Information. AEMO noted in the IASR that generator and storage data is updated quarterly, and that material updates may be applied in ISP modelling. AEMO considers that these updates are compliant with the AER's guidelines, and that it is reasonable to include this updated information in the 2024 ISP.
James Taylor et al. claimed that a fundamental flaw in the Draft 2024 ISP is the assumption that sufficient variable and intermittent VRE will always be available, if only transmission interconnectors are built to move it to wherever shortages exist.	AEMO does not assume that wind and solar generation is always available. AEMO acknowledges that VRE is variable. A half-hourly breakdown of the resource availability for wind and solar generation is available in the supporting material of the ISP, reflecting the intermittency that is captured within AEMO's modelling.

[58] GHD. 2018. AEMO costs and technical parameter review, at https://aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/Inputs-Assumptions-Methodologies/2019/9110715-REP-A-Cost-and-Technical-Parameter-Review---Rev-4-Final.pdf.

Feedback received	AEMO response
James Taylor et al. commented that Draft 2024 ISP shows no evidence of the rigorous system engineering required for high reliability system development, including taking into account worst-case conditions and reserve supply margins and that by 2030 the NEM has a generation shortfall of 18 GW. **James Taylor et al. also noted that the accuracy of a top level whole-of-system power budget is not as high as a simulation containing detailed models of all facilities.**	AEMO considers that the ISP is a rigorous and transparent modelling effort providing a roadmap for the efficient development of the power system that achieves power system needs. The ISP is underpinned by an integrated approach to energy market modelling, combined with relevant power system analysis as detailed in the *ISP Methodology*. AEMO considers that a top-down grid power budget is not the preferred technique for assessing power system needs. AEMO observes that the maximum demand used in the suggested analysis provided by the stakeholder appears to have been overestimated. The 10% probability of exceedance (POE) demand is the level for which there is only a 10% chance that the year's peak demand exceeds this value (rather than the level of demand that is exceeded for 10% of the year). It is expected that a 10% POE demand is exceeded once only every 10 years, and is calculated for each NEM region. As maximum demand across the NEM regions is generally non-coincident, this figure cannot be summated to give a NEM-wide 10% POE maximum demand as suggested in this submission. The ODP, informed by AEMO's time sequential simulation containing detailed models of all facilities, has been developed to meet the reliability standard and caters to a credible demand forecast with reserve levels built in as described in the *ISP Methodology* (p42).
James Taylor et al. commented that the Draft 2024 ISP is missing data on costs for a range of network elements and values the NEM transition at $3.146 trillion.	AEMO includes a detailed cost breakdown of transmission network elements in the 2023 Transmission Expansion Options Report and its associated documentation, and includes all cost assumptions for generation and storage in the 2023 IASR and its workbook. AEMO clarifies that the net present value of annualised capital costs in the Draft ISP was $121 billion. As a net present value, this already represents the sum of costs over the modelling horizon, discounted into real dollars. The suggested value in excess of $3 trillion appears to be calculated by multiplying the net present value of $121 billion by the 26 years to 2050.
EPC used modelling software developed in-house to test the performance of the ODP for a week in summer and winter 2050. EPC found that demand was met in summer but that the reliability standard was breached in winter with significant unserved energy.	AEMO has reviewed the information presented in the EPC submission and notes that although EPC modelling appears to have used actual historical data, the NEM daily peaks presented by the EPC for testing the ODP appear to have been scaled to regularly exceed the summated non-coincident 10% POE regional maximum demands. AEMO considers this to be an overestimate of NEM peak demand due to diversity. AEMO considers that this underlying difference will drive the further differences from the ODP provided in the stakeholder's submission.

4.13 Additional feedback on the Addendum to the Draft 2024 ISP

Summary of material issues raised in submissions

In response to the Addendum to the Draft 2024 ISP, some stakeholders (**STMRCG, Hydrostor**) re-iterated the feedback they had provided on the Draft ISP:

- **Climateworks** shared insights from its own research into areas raised by the AER in its transparency review of the ISP.
- **Tesla** suggested the system strength costs should be re-calculated based on a technology mix of grid-forming inverters and synchronous condensers.

AEMO's consideration and response

AEMO thanks all stakeholders for their feedback on the Addendum to the Draft 2024 ISP.

Regarding **Climateworks**' submission, it is AEMO's consideration that the proposed recommendations do not directly inform a change to any input or assumption that can be brought into the ISP modelling.

AEMO has sought to address **Hydrostor**'s feedback in Sections 4.1 and 4.9, and **STMRCG**'s concerns in Section 4.12.

In response to **Tesla**'s submission, AEMO notes that synchronous condensers are a mature technology that are used as a proxy for system strength costs in the ISP. If alternative solutions such as grid-forming inverters provide system strength, then the cost of providing system strength may reduce below AEMO's estimates.

4.14 Additional feedback on the Addendum to the 2023 IASR

Summary of material issues raised in submissions

AEMO received feedback in relation to the Addendum to the 2023 IASR from the **ISP Consumer Panel** in their recommendations to the Draft ISP, which was to conduct a thorough review of the 'unknown risk' factor in the 2026 ISP Transmission Cost Database (TCD) based on more up to date data.

IEEFA recommended AEMO revise the coal price assumptions in the 2023 IASR as they appear to be materially lower than actual prices.

QCC suggested that social licence for offshore wind has been eroded and recommended AEMO consider the impact of this in the social licence sensitivity.

STMRCG considered that the inclusion of Borumba pumped hydro energy storage (PHES) as anticipated despite not yet having environmental approvals project erodes trust in the ISP and its processes.

AEMO's consideration and response

AEMO thanks stakeholders for feedback on Addendum to the 2023 IASR.

AEMO has separately noted in its 2023 *Transmission Expansion Options Report* consultation summary that the 'unknown risk' factor will be reviewed as part of the next review of AEMO's Transmission Cost Database, through preparation of the 2025 *Transmission Expansion Options Report*.

Regarding **IEEFA**'s observation on actual coal prices, as per the 2023 IASR[59], AEMO included the New South Wales and Queensland Governments' agreements to implement temporary coal price caps as part of the Federal Government's Energy Price Relief Plan, which was applied to coal generators exposed to export pricing dynamics. Those generators not considered exposed to the export markets use coal price forecasts from 2021, which AEMO recognises may differ to 2024 coal prices.

AEMO acknowledges the **QCC**'s concerns about low social licence for offshore wind, and remains open to undertaking further analysis as the industry matures in Australia.

Regarding **STMRCG's** feedback on Borumba PHES, AEMO notes that it receives advice confidentially regarding generation project commitment criteria that a project has met, or is on the way to meeting, to be declared as anticipated. Additionally, under the NER, the ISP may consider state policies that are supported by existing or pending legislation, including the Queensland Government's commitment to Borumba PHES for firming capability. More information on the commitment criteria is within the *Generation Information* data releases, and the treatment of committed and anticipated projects can be found in the *ISP Methodology*.

[59] Page 117, at https://aemo.com.au/-/media/files/major-publications/isp/2023/2023-inputs-assumptions-and-scenarios-report.pdf?la=en.

Glossary

This glossary has been prepared as a quick guide to help readers understand some of the terms used in the ISP. Words and phrases defined in the National Electricity Rules (NER) have the meaning given to them in the NER. This glossary is not a substitute for consulting the NER, the AER's Cost Benefit Analysis Guidelines, or AEMO's *ISP Methodology*.

Term	Acronym	Explanation
Actionable ISP project	-	Actionable ISP projects optimise benefits for consumers if progressed before the next ISP. A transmission project (or non-network option) identified as part of the ODP and having a delivery date within an actionable window. For newly actionable ISP projects, the actionable window is two years, meaning it is within the window if the project is needed within two years of its earliest in-service date. The window is longer for projects that have previously been actionable. Project proponents are required to begin newly actionable ISP projects with the release of a final ISP, including commencing a RIT-T.
Actionable New South Wales project and actionable Queensland project	-	A transmission project (or non-network option) that optimises benefits for consumers if progressed before the next ISP, is identified as part of the ODP, and is supported by or committed to in New South Wales Government or Queensland Government policy and/or prospective or current legislation.
Anticipated project	-	A generation, storage or transmission project that is in the process of meeting at least three of the five commitment criteria (planning, construction, land, contracts, finance), in accordance with the AER's Cost Benefit Analysis Guidelines. Anticipated projects are included in all ISP scenarios.
Candidate development path	CDP	A collection of development paths which share a set of potential actionable projects. Within the collection, potential future ISP projects are allowed to vary across scenarios between the development paths. Candidate development paths have been shortlisted for selection as the ODP and are evaluated in detail to determine the ODP, in accordance with the ISP Methodology.
Capacity	-	The maximum rating of a generating or storage unit (or set of generating units), or transmission line, typically expressed in megawatts (MW). For example, a solar farm may have a nominal capacity of 400 MW.
Committed project	-	A generation, storage or transmission project that has fully met all five commitment criteria (planning, construction, land, contracts, finance), in accordance with the AER's Cost Benefit Analysis Guidelines. Committed projects are included in all ISP scenarios.
Consumer energy resources	CER	Generation or storage assets owned by consumers and installed behind-the-meter. These can include rooftop solar, batteries and electric vehicles. CER may include demand flexibility.
Consumption	-	The electrical energy used over a period of time (for example a day or year). This quantity is typically expressed in megawatt-hours (MWh) or its multiples. Various definitions for consumption apply, depending on where it is measured. For example, underlying consumption means consumption being supplied by both CER and the electricity grid.
Cost-benefit analysis	CBA	A comparison of the quantified costs and benefits of a particular project (or suite of projects) in monetary terms. For the ISP, a cost-benefit analysis is conducted in accordance with the AER's Cost Benefit Analysis Guidelines.
Counterfactual development path	-	The counterfactual development path represents a future without major transmission augmentation. AEMO compares candidate development paths against the counterfactual to calculate the economic benefits of transmission.
Demand	-	The amount of electrical power consumed at a point in time. This quantity is typically expressed in megawatts (MW) or its multiples. Various definitions for demand, depending on where it is measured. For example, underlying demand means demand supplied by both CER and the electricity grid.
Demand-side participation	DSP	The capability of consumers to reduce their demand during periods of high wholesale electricity prices or when reliability issues emerge. This can occur through voluntarily reducing demand, or generating electricity.

Term	Acronym	Explanation
Development path	DP	A set of projects (actionable projects, future projects and ISP development opportunities) in an ISP that together address power system needs.
Dispatchable capacity	-	The total amount of generation that can be turned on or off, without being dependent on the weather. Dispatchable capacity is required to provide firming during periods of low variable renewable energy output in the NEM.
Distributed solar / distributed PV	-	Solar photovoltaic (PV) generation assets that are not centrally controlled by AEMO dispatch. Examples include residential and business rooftop PV as well as larger commercial or industrial "non-scheduled" PV systems.
Firming	-	Grid-connected assets that can provide dispatchable capacity when variable renewable energy generation is limited by weather, for example storage (pumped-hydro and batteries) and gas-powered generation.
Future ISP project	-	A transmission project (or non-network option) that addresses an identified need in the ISP, that is part of the ODP, and is forecast to be actionable in the future.
Identified need	-	The objective a TNSP seeks to achieve by investing in the network in accordance with the NER or an ISP. In the context of the ISP, the identified need is the reason an investment in the network is required, and may be met by either a network or a non-network option.
ISP development opportunity	-	A development identified in the ISP that does not relate to a transmission project (or non-network option) and may include generation, storage, demand-side participation, or other developments such as distribution network projects.
Net market benefits	-	The present value of total market benefits associated with a project (or a group of projects), less its total cost, calculated in accordance with the AER's Cost Benefit Analysis Guidelines.
Non-network option	-	A means by which an identified need can be fully or partly addressed, that is not a network option. A network option means a solution such as transmission lines or substations which are undertaken by a Network Service Provider using regulated expenditure.
Optimal development path	ODP	The development path identified in the ISP as optimal and robust to future states of the world. The ODP contains actionable projects, future ISP projects and ISP development opportunities, and optimises costs and benefits of various options across a range of future ISP scenarios.
Regulatory Investment Test for Transmission	RIT-T	The RIT-T is a cost benefit analysis test that TNSPs must apply to prescribed regulated investments in their network. The purpose of the RIT-T is to identify the credible network or non-network options to address the identified network need that maximise net market benefits to the NEM. RIT-Ts are required for some but not all transmission investments.
Reliable (power system)	-	The ability of the power system to supply adequate power to satisfy consumer demand, allowing for credible generation and transmission network contingencies.
Renewable energy	-	For the purposes of the ISP, the following technologies are referred to under the grouping of renewable energy: "solar, wind, biomass, hydro, and hydrogen turbines". Variable renewable energy is a subset of this group, explained below.
Renewable energy zone	REZ	An area identified in the ISP as high-quality resource areas where clusters of large-scale renewable energy projects can be developed using economies of scale.
Renewable drought	-	A prolonged period of very low levels of variable renewable output, typically associated with dark and still conditions that limit production from both solar and wind generators.
Scenario	-	A possible future of how the NEM may develop to meet a set of conditions that influence consumer demand, economic activity, decarbonisation, and other parameters. For the 2024 ISP, AEMO has considered three scenarios: *Progressive Change*, *Step Change* and *Green Energy Exports*.
Secure (power system)	-	The system is secure if it is operating within defined technical limits and is able to be returned to within those limits after a major power system element is disconnected (such as a generator or a major transmission network element).
Sensitivity analysis	-	Analysis undertaken to determine how modelling outcomes change if an input assumption (or a collection of related input assumptions) is changed.
Spilled energy	-	Energy from variable renewable energy resources that could be generated but is unable to be delivered. Transmission curtailment results in spilled energy when generation is

Term	Acronym	Explanation
		constrained due to operational limits, and economic spill occurs when generation reduces output due to market price.
Transmission network service provider	TNSP	A business responsible for owning, controlling or operating a transmission network.
Utility-scale or utility		For the purposes of the ISP, 'utility-scale' and 'utility' refers to technologies connected to the high-voltage power system rather than behind the meter at a business or residence.
Value of greenhouse gas emissions reduction	VER	The VER estimates the value (dollar per tonne) of avoided greenhouse gas emissions. The VER is calculated consistent with the method agreed to by Australia's Energy Ministers in February 2024.
Virtual power plant	VPP	An aggregation of resources coordinated to deliver services for power system operations and electricity markets. For the ISP, VPPs enable coordinated control of CER, including batteries and electric vehicles.
Variable renewable energy	VRE	Renewable resources whose generation output can vary greatly in short time periods due to changing weather conditions, such as solar and wind.