AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

2022 ISP Consultation Summary Report

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Published in conjunction with the 2022 Integrated System Plan (ISP)

Important notice

Purpose

AEMO publishes this 2022 ISP Consultation Summary Report pursuant to National Electricity Rules (NER) 5.22.14(c) and the Forecasting Best Practice Guidelines. This publication is generally based on information available to AEMO as at 19 May 2022 unless otherwise indicated.

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Version control

Version	Release date	Changes
1.0	30/6/2022	Initial release.

AEMO acknowledges the Traditional Owners of country throughout Australia and recognises their continuing connection to land, waters and culture. We pay respect to Elders past and present.

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1 Introduction

Consultation and dialogue with all NEM stakeholders is critical to AEMO's role as the National Transmission Planner for the NEM, helping improve and refine scenario development, forecasting, decision-making and assessment processes.

For the 2022 *Integrated System Plan* (ISP), consultation commenced in September 2020, about 10 months before publication of the *2021 Inputs, Assumptions and Scenarios Report (IASR)* and the *ISP Methodology* on 30 July 2021, and has continued through to publication of the final 2022 ISP.

This document outlines how AEMO has taken stakeholder feedback into account in developing the 2022 ISP.

- **Section 1** provides an overview of the consultation framework for the 2022 ISP.
- **Section 2** lists stakeholders who made a submission to the Draft 2022 ISP, and include a brief summary of key themes.
- **Section 3** outlines key changes between the draft and final 2022 ISP.
- **Section 4** details AEMO's response to feedback on material issues.

1.1 Consultation on the development of the 2022 ISP

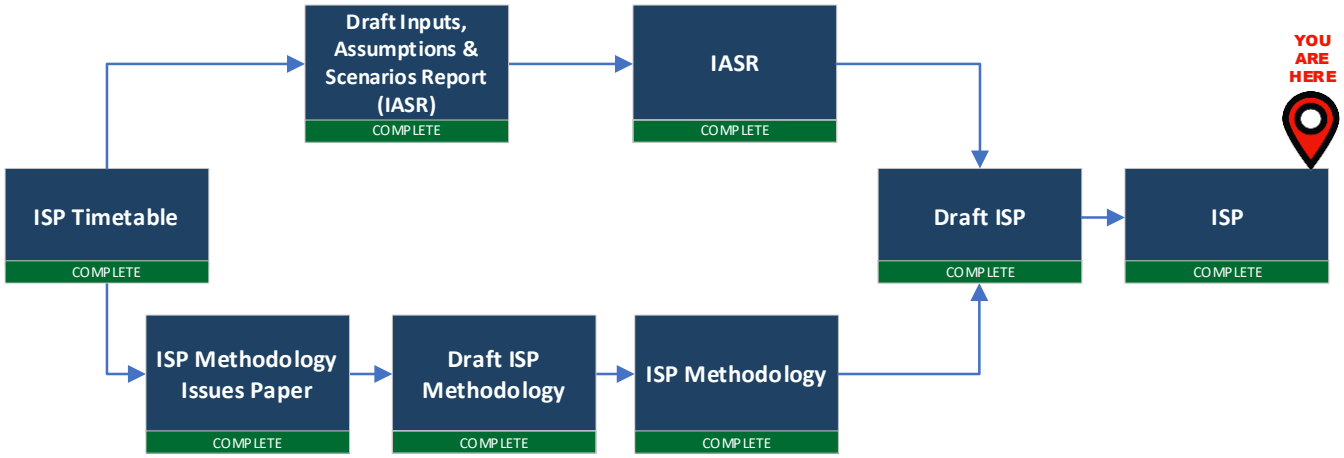
Consultation with consumers, market participants and all other stakeholders is a foundational element of all AEMO's activities. Throughout the development of the 2022 ISP, AEMO has sought to offer all interested stakeholders the opportunity to understand the process and contribute to the final outcomes.

AEMO develops and publishes the ISP at least every two years. As shown in Figure 1, the 2022 ISP is informed by the concurrent development of the *ISP Methodology* and the IASR.

The consultation process has contained the following major elements:

- Consultation on the IASR.
- Consultation on the *ISP Methodology*.
- Consultation on the Draft ISP.

Figure 1 Parallel ISP consultations



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

AEMO followed the requirements of the Australian Energy Regulator's (AER's) *Forecasting Best Practice Guidelines* and *Cost Benefit Analysis Guidelines* in developing the 2021 IASR and the *ISP Methodology*. This included providing a transparent process, supporting and working with stakeholders in their understanding of AEMO's analysis, methodologies and data, and providing additional information to complement the formal documentation.

AEMO completed its consultation on the IASR in July 2021, taking into consideration feedback provided on the Draft 2021 IASR published in December 2020, as well as from several stakeholder workshops and webinars. The 2021 IASR[1] was used to develop the 2022 ISP.

1.1.2 Consultation on the *ISP Methodology*

AEMO commenced a consultation on the *ISP Methodology*[2] on 1 February 2021, and includes the cost benefit analysis and modelling methodology for the 2022 ISP.

There were two rounds of formal stakeholder consultation, with workshops, meetings and briefings as required, and the process concluded on 30 July 2021.

1.1.3 Consultation on the Draft ISP

On 10 December 2021, AEMO published the Draft 2022 ISP[3]. AEMO's consultation included public forums, workshops, individual meetings and a written consultation. This report responds to material feedback in written submissions.

[1] AEMO. 2021 IASR, at https://aemo.com.au/consultations/current-and-closed-consultations/2021-planning-and-forecasting-consultation-on-inputs-assumptions-and-scenarios.

[2] AEMO. *ISP Methodology*, at https://aemo.com.au/consultations/current-and-closed-consultations/isp-methodology.

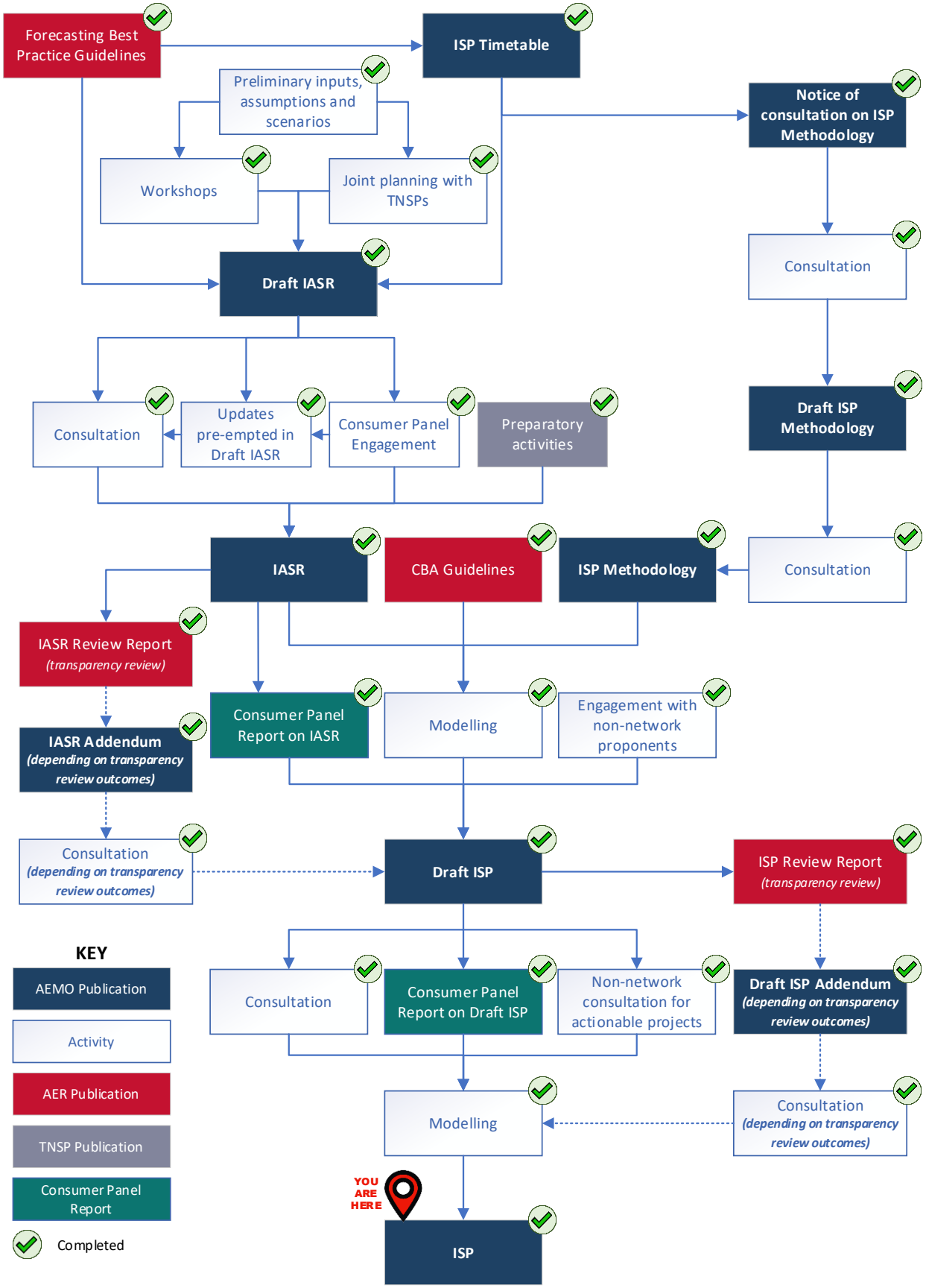
[3] AEMO. Draft 2022 ISP, at https://aemo.com.au/consultations/current-and-closed-consultations/2022-draft-isp-consultation.

1.2 The ISP process

The ISP framework and associated AER guidelines apply to the development of the 2022 ISP. The regulatory framework includes obligations set out in the National Electricity Rules (NER), the AER's *Forecasting Best Practice Guidelines* and *Cost Benefit Analysis Guidelines*, AER transparency reviews, and the 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 blue, red and green boxes) and the activities undertaken by AEMO and stakeholders (in white boxes). Figure 2 also identifies those steps that are complete.

Figure 2 The ISP process



2 Submissions and key themes

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

AEMO received written submissions from 78 stakeholders on the Draft 2022 ISP and its Addendum. These submissions are listed in Table 1 below. AEMO provided energy consumer advocates with the opportunity to provide verbal submissions to the Draft ISP, which AEMO published alongside written submissions.

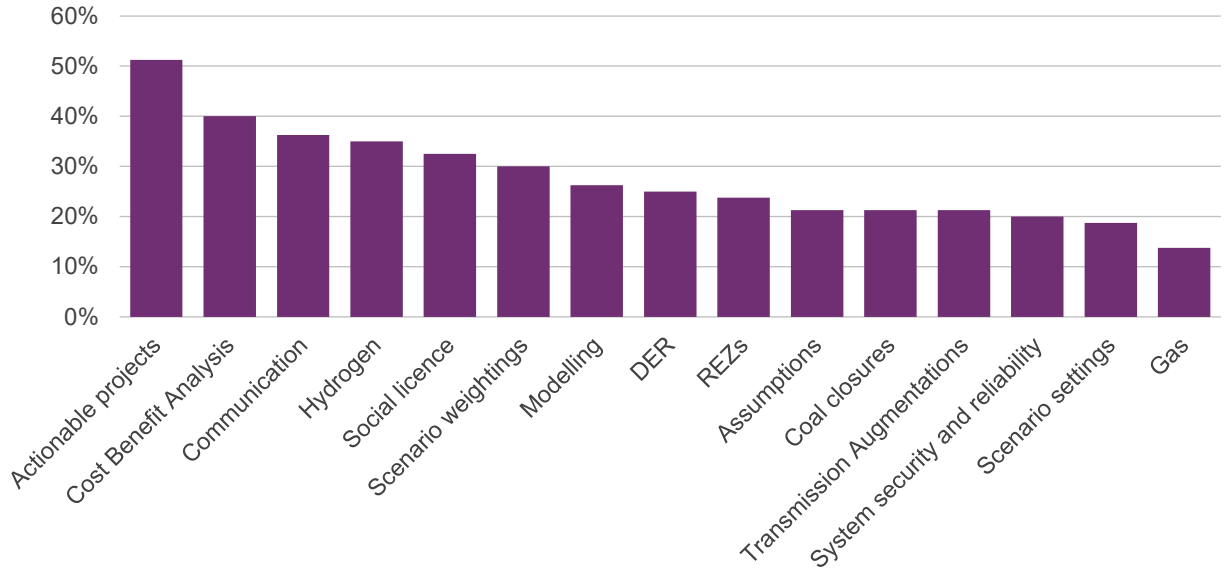
Table 1 List of stakeholders who provided formal feedback to the Draft ISP

SUBMISSIONS TO DRAFT 2022 ISP		
AGL	Energy Networks Australia (ENA)	Powerlake
ANLEC R&D	EnergyAustralia (EA)	Powerlink Queensland (Powerlink)
APA Group	Engineers Australia	Protect the West Group
ATCO	Environment Victoria	Public Interest Advocacy Centre (PIAC)
AusNet Services	Flotation Energy	Queensland Conservation Council (QCC)
Australian Conservation Foundation (ACF)	Fortescue Future Industries (FFI)	RE-Alliance
Australian Energy Infrastructure Commissioner (AEIC)	GE Renewable Energy (GE RE)	Regulation Economics
Australian Hydrogen Council (AHC)	Grampians New Energy Taskforce (G-NET)	Robert Honeywill
Australian Pipelines and Gas Association (APGA)	Greenpeace Australia Pacific	Robert Monteath
Australian Resources Development Limited (ARD)	Hepburn Shire Council (Hepburn)	Sligar and Associates
Australian Sugar Milling Council (ASMC)	Hydro Tasmania	Smart Wires
Beyond Zero Emissions (BZE)	Iberdrola	Snowy Hydro (Snowy)
Bob Brown Foundation (BBF)	Independent Engineers and Scientists (IE&S)	South Australian Council of Social Service (SACOSS)
Clean Energy Council (CEC)	Institute for Energy Economics and Financial Analysis (IEEFA)	South Australian Department of Energy and Mines (SA DEM)
Clean Energy Investor Group (CEIG)	ISP Consumer Panel	Star of the South (SS)
Climate Council of Australia (CC)	Jemena	Tasmanian Department of Premier and Cabinet (TPC)
ClimateWorks Australia	Lee Kingma	TasNetworks
CopperString 2.0	Macroeconomics Advisory (MA)	Tesla
Delta Electricity (Delta)	MGA Thermal	Tilt Renewables (Tilt)
ElectraNet	Moyne Shire Council (Moyne)	Transgrid
Electric Power Consulting (EPC)	Neoen	Uniting Communities (UC)
Electric Vehicle Council (EVC)	Network of Illawarra Consumers of Energy (NICE)	Victoria Energy Policy Centre (VEPC)
Electrical Trades Union (ETU)	Northern Grampians Shire Council	Walcha Energy (Walcha)
Energetic Communities (EC)	Origin Energy (Origin)	Wimmera Development Association (WDA)
Energy Users Association of Australia (EUAA)	Pacific Hydro Australia (Pacific)	World Wildlife Fund (WWF)
SUBMISSIONS TO ISP ADDENDUM		
AGL	Hydro Tasmania	Snowy Hydro (Snowy)

2.2 Summary of key themes

Figure 3 below shows the topics about which stakeholders commented and the relative volume of feedback on each topic.

Figure 3 Topics of interest



Section 4 of this document summarises stakeholder comments in each of these 15 categories and provides AEMO's response to these topics. Table 2 below summarises Section 4, providing an overview of stakeholder comments and listing submitters against each. Table 2 lists topics in the order in which they are expanded on in the subsequent section and does not include AEMO's response in each case.

Table 2 Key topics from submissions to the Draft ISP

Topic	Description	Submitters
Actionable projects	• Many stakeholders commented on specific projects in the Draft Optimal Development Path (ODP), especially the staged delivery of HumeLink and Victoria – New South Wales Interconnector (VNI) West. Marinus Link also received specific comments. The risk of increasing capital costs, benefits of the projects to energy consumers and optimal timings were the topics raised most often. • Some stakeholders also advocated for a general acceleration of all transmission development, to support reductions in carbon emissions as quickly as possible.	ISP Consumer Panel, Transgrid, TasNetworks, Powerlink, Jemena, Origin, Delta, Snowy, Tilt, Walcha, CEC, ENA, Tas DPC, CEIG, Hepburn, WDA, AEIC, Climate Works, Smart Wires, BBF, VEPC, WWF, IE&S, QCC, RE-Alliance, NICE, Lee Kingma
Consumer risk preferences	• Stakeholders commented that AEMO should do more to understand consumer risk preferences between the draft and final ISP. The ISP Consumer Panel suggested that this engagement focus on how the risks of over- and under-investment can be managed within the ISP, especially in relation to staged actionable transmission projects. • PIAC, ECA, and EUAA expressed the view that the Draft ODP appropriately balanced the risk of over and under-investment.	ISP Consumer Panel, ECA, SACOSS, EWOSA, PIAC, EUAA, QEUN

Topic	Description	Submitters
	• PIAC, ECA, EUAA and QEUN told AEMO that consumer risk preferences can only be effectively gleaned through direct surveying or other analysis or engagement with bill payers. This is because consumer risk preferences vary from person to person, and while consumer advocates may advocate for consumer interests, they cannot accurately quantify their risk preferences.	
Benefits, challenges and risks of new transmission projects generally	• Stakeholders commented on the need to consider the potential price impacts of new transmission projects, including distributional effects. • Jemena and Origin raised the need to consider the risk of assumed project delivery costs and timelines, and the impact of a cost increase or delay. • Several stakeholders (CEC, VEPC, WWF, Tilt) argued that the public benefit of emissions reduction should be included in cost-benefit calculations. • Other benefits identified by stakeholders included those related to employment, both direct and indirect. • Stakeholders commented on the potential growth of offshore wind and the need to analyse the impact of such a development on the ODP.	ISP Consumer Panel, CEIG, SACOSS, SA DEM, TasNetworks, Jemena, Neoen, Hydro Tas, Origin, Delta, Tilt, CEC, WWF, ETA, EC, NICE, SS, Flotation, RE-Alliance
Scenario weightings	• Many stakeholders commented on the scenario weightings used in the Draft ISP. While there was no consensus about the appropriateness of the weightings, there was a notable level of agreement that Step Change is the most likely scenario. • AGL and Delta submitted that *Step Change* is not the most likely scenario, as it does not reflect current policy commitments. • Some stakeholders commented on the Delphi Panel scenario weighting process, including factors that may have impacted how participants answered the question.	ISP Consumer Panel, AGL, Delta, Jemena, APGA, Hydro Tas, Iberdrola, Tilt, CEIG, FFI, NICE, ECA, EC, Climate Works, BZE, ACF, QCC, Greenpeace, ARDL
Coal closures: outcomes and approach	• Delta expressed concerns about AEMO's approach to modelling the future level of coal-fired generation in the NEM, including outcomes regarding timing of coal retirements and the level of plant flexibility. • EA noted that the ISP assumes perfect foresight of coal retirements and the replacement thereof with new capacity. EA believes further work between AEMO and stakeholders is needed, given the level of uncertainty that exists about both topics. EA also suggested AEMO should be clearer about why retirements are projected to occur. • CEC and Walcha energy commented on the risk of earlier than expected coal closures.	Delta, EA, Powerlink, MA, CEC, Walcha
Social licence	• Stakeholders agreed that securing social licence for new projects was a challenge and risk for the ISP and that there is a need to better plan for and work to address these challenges. • Many submitters offered suggestions about how social licence discussions and solutions could be explored and progressed through collaboration with community and First Nations groups. • Some stakeholders called for AEMO to take a leadership role in managing social licence conversations.	ISP Consumer Panel, SS, Ausnet, CEC, CEIG, EC, RE-Alliance, SACOSS, EFF, AEIC, BZE, Moyne, WDA, ACF, Walcha, Moyne
DER and distribution network impacts	• Several stakeholders took the view that AEMO's projection for growth in distributed energy resources (DER), especially battery storage, are too high. • Other submissions argued for consideration of a future with higher levels of DER and low overall consumption, or further growth in microgrids. • ECA submitted that DER should not be an ISP input, but rather viewed as a development option for the system, alongside new transmission investments.	Snowy, HydroTas, GE, EA, Powerlink, ENA, EVC, CEC, FFI, IE&S, NICE, UC, EPC, Engineers Aus, ECA, ACOSS
Renewable Energy Zones (REZs)	• Stakeholders raised the need to further examine the impact of REZs on Marginal Loss Factors (MLFs). • Sligar and Associates suggested that locating REZs further west would allow solar supply to continue further into the east coast peak consumption time. • Origin submitted that forecast growth in wind generation in the New England REZ was unlikely to be feasible. • Stakeholders supported AEMO's proposal for the development of REZ Design Reports, with further recommendations about specific changes to the REZ Design Report process and highlighting specific regional matters.	Powerlink, ENA, SA DEM, Sligar, ElectraNet, Origin, Moyne, WDA, QCC, Northern Grampians, AusNet, RE-Alliance, ASMC, Delta, NICE, Walcha
Hydrogen	• ENA and QEUN raised concern that consumers should not fund transmission infrastructure for hydrogen export.	ISP Consumer Panel, ENA, Origin, APGA, AHC, FFI,

Topic	Description	Submitters
	• Origin and APGA submitted the use of hydrogen pipelines could complement electrical transmission infrastructure. • Stakeholders made comments in relation to the impact of electrolysers on the network.	Greenpeace, CEC, VEPC, SA DEM, ATCO, ClimateWorks, BZE, R Honeywill
Role of gas	• APA Group, Jemena and APGA raised concerns about the fact the ISP forecasts a future in which gas network infrastructure is not used. Stakeholders submitted that the gas network can offer cost effective energy transport and storage solutions. • EA and other stakeholders noted the technical and cost challenges of the level of electrification forecast in the ISP. • EA, Iberdrola and APA commented on the economics of gas generation, in both the coming years and across the ISP time horizon to 2050. • Other stakeholders argued that gas-fired generation did not have a viable part to play in the future energy system.	APA Group, Jemena, EA, APGA, Iberdrola, Tesla, Hydro Tas, CEC, ETU
Modelling approach and development outcomes	• EA and Tesla submitted that the ability of battery energy storage systems to provide grid support services should be included in ISP analysis. • Several stakeholders commented on the outcomes for newer energy technologies, such as deeper storage/thermal energy storage. • EA and Origin both called for further consideration of assumptions about possible VRE curtailment.	EA, Tesla, MA, MGA, EPC, Origin, IE&S, ANLEC R&D, Snowy, R. Monteath, ACOSS
Security and reliability	• Stakeholders including Delta raised concerns about the use of non-synchronous technologies to maintain system security, or commented on the use of advanced inverters for grid forming. • Engineers Australia and other stakeholders emphasised the need to keep the grid secure. • Other stakeholders suggested there was a need for more information on – and consideration of – how system security is maintained after the retirement of the coal fleet.	Delta, APGA, ARDL, Engineers Aus, Origin, EA, Tesla, EPC
Communications	• 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 increases in overall cost and caution against overemphasis of certain aspects of any scenario.	ISP Consumer Panel, EC, Jemena, Engineers Aus, MA, EA, AGL, CopperString 2.0, SACOSS, Iberdrola
2024 ISP	• A number of stakeholders made recommendations for the 2024 ISP. Comments were received on topics including the use of a Delphi Panel to allocate scenario weightings, adjustments to emissions budgets and consideration of biomass technologies.	ISP Consumer Panel, APGA, Iberdrola, ASMC
Data and model release	• Stakeholders requested additional data including: Half-hourly demand profiles, daily profiles of individual plant, financial data, reliability of supply and performance of storage, and additional data about carbon budgets and sources of decarbonisation.	Delta, EA, EPC, Powerlink, IEEFA
ISP Addendum	• AGL questioned the ISP's use of a least-cost approach to coal generation closures, and disagreed with the allocation of relatively high weights to scenarios that have sub-economic outcomes in the short term. • Hydro Tasmania argued that a just-in-time approach to the delivery of new transmission infrastructure created additional risks for consumers. • Snowy reiterated that the cost of applying decision rules to transmission projects outweighed any benefits provided by consumer protection, and that AEMO needed to better define what constitutes dispatchable capacity.	AGL, Hydro Tas, Snowy

2.3 2022 ISP Consumer Panel recommendations on the Draft ISP

The 2022 ISP Consumer Panel submitted its report on the Draft ISP to AEMO on 10 February 2022.[4] Comments made by the Consumer Panel in that report are discussed amongst the detailed feedback in Section 4, along with comments from other stakeholders about the same topics.

Table 3, below, provides the Panel's recommendations and outline's AEMO's response, including current status. The ID, headline and description are taken directly from the Panel's report. Note that recommendations in the Panel's report on the final 2021 IASR[5] were labelled A to D and the below recommendations continue the same identification convention.

Table 3 Recommendations in the 2022 ISP Consumer Panel's report on the Draft 2022 ISP and AEMO's response

ID	Headline	Description	AEMO response and current status
E: Develop processes to understand consumer risk preferences and use those preferences to inform how risks are managed in the ISP			
E1	Acknowledge First Nations	The Panel acknowledges the many First Nations that host Australia's electricity grids and pay respect to Elders past, present and emerging. We are conscious of the landscape-scale impacts of the energy transition and wish to emphasise the importance of engaging further with traditional owners as the grid seeks to expand. In recognition of this we encourage AEMO to include overlaid maps of the Transmission Networks and Renewable Energy Zones with the AIATSIS Map of Indigenous Australia in the Final ISP as one step on a longer walk.	The Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) enforces strict copyright over its map. AEMO has instead included a map that overlays Renewable Energy Zones on a different map of First Nations (published by the National Native Title Tribunal). AEMO has also added an acknowledgement of country to its report template.
E2	Transparently explain the key risks and judgements involved in the ISP	AEMO should clearly explain in the ISP the key risks to consumers of under or over-investment, how those risks are impacted under different candidate development paths (CDPs), how AEMO has exercised its judgement that the Optimal Development Path (ODP) best manages those risks and why AEMO considers those decisions to be consistent with consumers' risk preferences.	AEMO seeks to be as transparent as possible in our reporting. The final ISP has provided these explanations primarily in the 2022 ISP report, with additional detail available within the accompanying appendices.
E3	Undertake targeted engagement to understand consumer risk preferences	AEMO should undertake targeted engagement with consumer stakeholders on their risk preferences in relation to ISP investments. This engagement should focus on specific tangible issues where AEMO needs to exercise judgement in how the risks to consumers of under or overinvestment are managed, particularly where different CDPs have similar net market benefits but different impacts on the risks to consumers arising from uncertainty.	AEMO undertook a targeted engagement process across March and April 2022. PIAC, ECA, QEUN and EUAA participated in two key workshops. Participants were broadly supportive of how the Draft ISP manages risk for consumers. It was not possible to agree on detailed risk preferences, but participants recommended that AEMO conduct specific research directly with bill payers as part of the 2024 ISP. More information on this engagement and outcomes is provided in Appendix 1 of the 2022 ISP.

[4] See https://aemo.com.au/-/media/files/major-publications/isp/2022/isp-consumer-panel-report-on-draft-2022-isp.pdf.

[5] See https://aemo.com.au/-/media/files/major-publications/isp/2021/isp-consumer-panel-report-on-2021-iasr.pdf.

ID	Headline	Description	AEMO response and current status
E4	Use consumer preferences to inform how risk is managed	AEMO's decisions on the ODP and the ISP's risk management toolkit (e.g. option value, early works, preparatory activities, REZ Design reports) should be informed by the outcomes of AEMO's engagement with consumers on risk preferences. AEMO should transparently explain how it has taken these risk preferences into account.	Appendix 1 of the 2022 ISP explains how AEMO has considered the outcomes of the above consultation in selecting the final ODP.
E5	Understand differences between government and consumer risk preferences	AEMO should consult with governments to understand their risk preferences in relation to under and over-investment and the timing of potential actionable projects. Where governments' risk preferences diverge from consumers' risk preferences, AEMO and governments should consider the appropriate role of government funding to reduce the risks borne by consumers	As part of future ISP processes, AEMO will continue to work with all Governments to ensure that the ISP continues to meet the needs of consumers, the energy sector, industry and Government. This includes incorporating any changes to policies and programs that may occur. Such policies would be reviewed for the scheduled 2023 IASR, and feed into the 2024 ISP, or any earlier ISP update.
E6	Explain distributional impacts	Consistent with the AER's CBA Guidelines, the ISP should explain the key distributional impacts of the ODP. These impacts should not drive decisions on the ODP, but are useful to inform stakeholders form their risk preferences and develop ways of expressing them. For the 2022 Final ISP, AEMO should include analysis of the impacts on different types of customers, including by state/territory, by customer size and type (e.g. residential, small business and large customers), intergenerational impacts and the incidence of costs and benefits between electricity consumers and Hydrogen exporters.	For a selection of CDPs, AEMO has presented information on indicative distributional effects for NEM consumers. As considerations on wealth transfer and equity issues are not included in the cost benefit analysis (CBA) framework, distributional effects are presented for information purposes only. AEMO has assessed distributional effects for a selection of CDPs under *Step Change* and *Progressive Change*.
F: Provide more information and engage with consumers on staging decisions for VNI West and HumeLink for the 2022 Final ISP			
F1	Focus on how consumer preferences can inform staging decisions for VNI West and HumeLink	Given time constraints, AEMO should focus on how consumer risk preferences can inform its decisions on the optimal timing and staging of VNI West and HumeLink. AEMO states that its decision to make VNI West and HumeLink actionable with staging 'best align with consumer risk preferences', but there is no evidence AEMO has consulted with consumers on their preferences. AEMO should undertake a targeted consultation process with consumers to understand their risk preferences and how they can inform the decisions on these two projects for the 2022 Final ISP.	AEMO engaged specifically on this issue as part of the targeted engagement outlined above, and detailed in Appendix 1 of the 2022 ISP.
F2	Provide more detailed explanations of the scope and costs of early works	We support the concept of early works and its use for VNI West and HumeLink, but more detailed explanations of the scope of the works and more comprehensive cost estimates are needed to be confident that the scope of these works is appropriate and they deliver value to consumers.	AEMO has included further information on the scope and cost of early works for HumeLink – based on Transgrid's Contingent Project Application (CPA). Further details on the scoping of early works for VNI West will be made available through the Regulatory Investment Test for Transmission (RIT-T) or CPA. AEMO will consider whether the cost of the early works is consistent with that assumed in the ISP, to confirm the first stages pass the Feedback Loop.

ID	Headline	Description	AEMO response and current status
F3	Develop more specific decision rules	The decision rules for proceeding to stage 2 of VNI West and HumeLink should be clearer and more specific. In particular, the decision rules should enable consumers to have a clear understanding of the level of residual risk they are bearing after the early works expenditure.	After considering stakeholder feedback, AEMO now considers that decision rules should only apply when they can be very clearly defined. The removal of the decision rules defined in the Draft 2022 ISP do not reduce consumer protections against over-investment as these projects remain as staged projects, with the Feedback Loop providing equivalent protection to the circumstances defined in the Draft ISP decision rules.
F4	Implications of feedback loop decisions	AEMO's January 2022 'feedback loop' decision for HumeLink early works appears to mean the approach to early works for HumeLink is now locked-in with no scope for AEMO to make changes based on stakeholder feedback to the Draft ISP. AEMO should clearly explain in the Final 2022 ISP the implications of this decision, and the timeline for the various decision points relevant to all projects potentially involving early works. In future ISP processes, AEMO should undertake thorough consultation on these types of issues prior to publication of the Draft ISP or an ISP Update.	AEMO has explained the next regulatory steps for each project in section 6 of the 2022 ISP.
G: Other recommendations for the 2024 ISP process			
G1	Delphi Panel process	AEMO should consider how the Delphi Panel process for determining scenario weights can be improved to better reflect consumer risk preferences and consult closely with the Consumer Panel and other stakeholders on that process.	AEMO will engage with the 2024 ISP Consumer Panel, and the broader stakeholder cohort, on the process determining scenario weights in the next ISP.
G2	Use of scenario weights in selecting the ODP	Recognising that any decision on scenario weights is subjective, AEMO should use a broader range of possible scenario weights and sensitivities to test the robustness of the ODP.	AEMO will consider this recommendation as part of the development of the 2024 ISP, including through engagement with the 2024 Consumer Panel.
G3	Hydrogen Superpower scenario	AEMO should not place significant weight on the Hydrogen Superpower scenario until AEMO has undertaken further consultation on risk preferences and AEMO and stakeholders are more confident in the robustness of this scenario's inputs, assumptions and likelihood.	AEMO has identified in the Draft 2022 Forecasting Assumptions Update that the Hydrogen Superpower scenario may need adjustment to the scale of hydrogen development in order to increase the likelihood of that future scenario. The 2024 ISP Consumer Panel will become involved in this process as soon as it appointed.
G4	Social licence	Managing social licence is a key risk to the delivery of the ISP's ODP. AEMO should put more emphasis on this issue – and take a leadership role amongst the many stakeholders that will need to be involved – as it plans the development of the 2024 ISP. The Transmission Cost Database should be extended to explicitly include analysis of likely social licence costs.	The Draft ISP identifies social licence as the greatest challenge facing the development of key major projects identified in the ISP. AEMO is working with governments and other stakeholders on progressing coordinated efforts in this key area. See section 7.3 of the 2022 ISP for more information.
G5	Supply chain risks	Supply chain risks related to delivering multiple projects at the same time have the potential to be a material risk to the delivery of the ISP's ODP. AEMO should consider how to better assess this risk as part of the development of the 2024 ISP. The Transmission Cost Database should be extended to explicitly include analysis of likely supply chain risks.	AEMO will consider this issue as part of the 2023 IASR.

ID	Headline	Description	AEMO response and current status
G6	Build a community of practice around the ISP for consumer stakeholders	The complexity of the ISP development process can make it difficult for consumers to understand and engage in it, and this impacts the ability to build consumer confidence in the findings. AEMO should identify and implement learning and development opportunities to build a community of practice amongst consumer stakeholders who wish to engage in the ISP development process or use information from the ISP to inform other process.	AEMO agrees with the intent of this recommendation and is actively seeking to build a community of practice through the AEMO Consumer Forum and regular offerings of bespoke ISP sessions to consumer advocates.

3 Changes between the Draft and final ISP

This section details changes between the Draft and final 2022 ISP, made in response to stakeholder feedback or to new market and system observations.

In addition to the modelling changes listed below, stakeholder feedback has led to additional sensitivity analysis on a range of additional input changes, such as discount rates and storage development. The impact of potential new government policy has also been added, for example the development of significant offshore wind developments driven by the Victorian Government's offshore wind directions paper[6]. Finally, updated inputs – including updated generator retirement dates – have been captured in targeted analysis of key development paths.

Changes to actionable and future ISP projects

The following changes to actionable and future ISP projects have been made in the final ISP:

- **HumeLink and VNI West decision rules have been removed**. The draft decision rules were qualitative because they were drafted to cater for an array of potential circumstances that might affect the projects' optimal timing. However, because these projects remain staged in the ISP and will have staged Contingent Project Applications, the ISP Feedback Loop will provide the same level of consumer protection without a need for decision rules. AEMO considers that decision rules are best used where a clear trigger can be identified to progress from one stage to the next.
- **Sydney Ring** and the **New England REZ Transmission Link** remain as actionable projects, and will progress via the NSW Infrastructure Roadmap (*Electricity Infrastructure Investment Act 2020*) rather than as actionable ISP projects, in line with NSW Government announcements[7,8]. These projects remain as part of the ODP and are identified as "actionable NSW projects".
- **Marinus Link** delivery timing was advised to be two years later than what was modelled in the Draft ISP (and footnoted in the Draft ISP), with updated cost estimates from the proponent (an increase of approximately 8%). The updated timeline recognises COVID-related delays and the need for additional inter-network testing (such as staged commissioning and capacity release).
- **Preparatory activities** have been declared for several future ISP projects including QNI Connect and REZ upgrades in South East South Australia, Mid-North South Australia, Darling Downs and South West Victoria.
- **For north Queensland,** updated modelling of network losses has weakened the signal for investment in generation and transmission.

Changes to REZ analysis and presentation

The final ISP includes the following additional elements (Appendix 3 has more information):

- **Two new candidate offshore wind zones (OWZs)** – Portland Coast and South East SA Coast.

[6] Victorian Government. *Victorian Offshore Wind Policy Directions Paper*, at https://www.energy.vic.gov.au/renewable-energy/offshore-wind.

[7] New South Wales Government. *New England Renewable Energy Zone declaration*, at https://www.energy.nsw.gov.au/renewables/renewable-energy-zones/new-england-renewable-energy-zone-declaration.

[8] The Sydney Ring project will be progressed under the *Electricity Infrastructure Investment Act 2020* (NSW). For more information, refer to the letter from the New South Wales Minister for Energy at https://aemo.com.au/consultations/current-and-closed-consultations/2022-draft-isp-consultation.

- **Reporting on MLF robustness** factors in REZ scorecards.
- A new map which overlays the REZs on the **National Native Title Tribunal Indigenous Estates map**.

Changes to network planning inputs and assumptions

Following feedback from transmission network service providers (TNSPs), AEMO has made **minor updates to a series of network parameters**:

- **Updated REZ expansion costs and capacities**:
  - **New South Wales**: The REZ hosting capacity for N5 was increased following the delivery of Project EnergyConnect (PEC), HumeLink and KerangLink network augmentations in service. The increase in capacity reflects capacity provided with PEC with Dinawan to Wagga Wagga double circuit line being built at 500 kilovolts (kV).
  - **Queensland:** Modelling of the NQ2 group constraint was improved by capturing a new tranche 2 cost to accurately reflect the additional cost required for different staged augmentations. MLF penalty factors were introduced for north QLD REZs – This was implemented to capture the forecast declined in MLF with large projections of VRE in North Queensland – see section 4.8.1.
  - **South Australia**: The costs modelled for South East SA REZ (S1) were updated with a second tranche, since the cost varies significantly between stage 1 and stage 2 of this REZ – see Section 4.8.2.
  - **Tasmania**: The REZ hosting capacities for North West Tasmania REZ (T2) and Central Highlands REZ (T3) following the Marinus Link augmentation were updated. AEMO also expanded the indicative expansion cost applied to the Central Highlands REZ to include a tranche 2 cost to accurately reflect the additional cost required of different staged augmentations – see Section 4.8.2.
  - **Offshore**: Modelling of Hunter Coast OWZ was improved by updating the transmission limit and corresponding indicative expansion costs to better reflect the network limits to transfer power between this OWZ and the Sydney load centre.
- **Updated transfer limits for flow path augmentations**:
  - **New South Wales:** The New South Wales Government announced 700 MW Waratah Super Battery[9] and accompanying System Integrity Protection Scheme (SIPS) are now listed explicitly as potential options to provide a staged delivery of the Sydney Ring project.
  - **Queensland**: The northerly direction transfer limit gain was changed from 300 MW to 0 MW for the stage 1 development of SQ-CNQ flow path, as advised by Powerlink through joint planning. The development of a mid-point substation on the Calvale – Halys 275 kV double circuit line increases capacity in the southerly direction, but the northerly direction transfer limit is not impacted by this option.
  - **Victoria to New South Wales**: The VNI SIPS allows South Morang – Dederang – Murray 330 kV lines to operate at their 5-minute thermal rating increasing the transfer limits from Southern New South Wales to Victoria during summer peak demand. The decrease in transfer capacity between Southern New South Wales and Victoria has been updated under summer peak demand conditions to reflect the conclusion of the Victoria SIPS arrangement.

[9] See https://www.nsw.gov.au/news/waratah-super-battery-eoi.

- **Updated network expansion modelling for supplying Hydrogen Ports in Queensland:**
  - **Fitzroy REZ** (Q6) was updated to include a network limit of 3,000 MW to reflect changes in power flow direction associated with significant hydrogen demand in the CNQ sub-region.
  - **Banana REZ** (Q9) has been revised in the *Hydrogen Superpower* scenario by locating the REZ in Central Queensland as opposed to Southern Queensland (as modelled in all other scenarios). The need to model the REZ in Central Queensland under the Hydrogen Superpower scenario is due to the location of hydrogen demand in the CNQ region under this scenario.

See the updated Inputs and Assumptions workbook[10] for more information.

Updates to supply forecasts

Energy supply forecasts in the final ISP have been updated to include:

- **Updated generation information** from the Generation Information February 2022 release[11] to capture additional committed and anticipated projects.
- Announcements regarding timing of **generator retirements** (Eraring, Bayswater and Loy Yang A).
- Enhancements to the determination of electrolyser capacity development in *Hydrogen Superpower,* which produces a more cost-effective solution with lower levels of storage development towards the end of the modelling horizon.

The impact of these changes on generation and storage development is outlined in Appendix 2, and the impact on the cost benefit analysis is provided in Section A6.3 of Appendix 6.

The final ISP also includes additional sensitivity analysis to explore **offshore wind impacts**, lower uptake and level of coordination of **distributed storage,** and **low discount rates**.

Non-Network options submission assessments

In the Draft ISP, AEMO called for submissions on non-network options for two new actionable ISP projects:

- New England REZ Transmission Link[12], and
- Reinforcing Sydney, Newcastle and Wollongong Supply[13].

As part of the joint planning process, AEMO and Transgrid, as the relevant jurisdictional planning body, have provided an **assessment of the non-network submissions** received. The outcome of these assessments has been published on the relevant consultation web pages.

Following publication of the Draft 2022 ISP, AEMO was advised that these projects will progress under the *Electricity Infrastructure Investment Act* (NSW) rather than through the ISP framework. EnergyCo NSW, as the Infrastructure Planner, will assess and recommend solutions to deliver this infrastructure. These provisions now replace the requirement on Transgrid to undertake a Regulatory Investment Test for Transmission (RIT-T). As

[10] See https://aemo.com.au/consultations/current-and-closed-consultations/2022-draft-isp-consultation.

[11] See https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-planning-data/generation-information.

[12] See https://aemo.com.au/consultations/current-and-closed-consultations/2022-isp-consultation-non-network-options-new-england-rez-link.

[13] See https://aemo.com.au/consultations/current-and-closed-consultations/2022-isp-consultation-non-network-options-supply-sydney-newcastle-wollongong.

such, AEMO will provide this preliminary assessment and the details of the non-network proposals to EnergyCo NSW for further consideration.

System Security modelling

To reflect the most likely scenario, AEMO has reassessed all the **system security modelling** in Appendix 7 **to reflect the outcomes of the *Step Change* scenario** rather than the Progressive Change scenario.

Climate resilience modelling

Based on feedback to the Draft ISP, AEMO has expanded the analysis on climate risks, including the impact of weather variance and exposure to long 'dark and still' weather events (referred to as "dunkelflaute") by:

- Assessing the benefit of route diversity and resilience to climate risks under extreme weather events and non-credible contingencies.
- Considering the impact of imperfect foresight during dunkelflaute events.
- Considering the benefit of geographical diversity and increased interconnection during localised dunkelflaute events.

Modelling distributional effects and risks to consumers

Consistent with AEMO's previous commitments and stakeholder feedback to the Draft ISP, AEMO has:

- **Estimated distributional effects to NEM consumers** for a selection of CDPs.
- **Considered risk asymmetry to consumers** of delaying transmission, focusing primarily on HumeLink.

4 Detailed feedback

AEMO identified 481 individual points in the 78 submissions received to the Draft 2022 ISP and Draft 2022 ISP Addendum combined. This section provides a summary of stakeholder submissions, and AEMO's consideration of those submissions, across 16 categories. These are the topics that AEMO reasonably considers to be material to the final ISP outcomes.

As outlined in sections 4.11 and 4.17, many submissions commented on aspects of the inputs, assumptions and scenarios and ISP Methodology. AEMO completed consultation on the 2021 IASR[14] and *ISP Methodology*[15] in July 2021, including the publication of consultation summary reports.

4.1 Actionable Projects

4.1.1 HumeLink

Summary of material issues raised in submissions

The ISP Consumer Panel noted that, in its opinion, the approach to early works for HumeLink is now locked in with no scope for AEMO to make changes based on stakeholder feedback to the Draft ISP. It was the Panel's view that AEMO should clearly explain in the final 2022 ISP the implications of this decision, and the timeline for the various decision points relevant to all projects potentially involving early works.

Transgrid put forward a number of arguments against the classification of HumeLink as a staged project, which it considers increases costs, increases the risk of delays, and has a detrimental impact for consumer and community outcomes. Transgrid pointed to challenges with the procurement process, production slots for steel, towers, and contractors, and also said that it would be very difficult to simply shift the project back two years if the optimal timing changed.

Accepting however that project stating was AEMO's recommendation in the Draft ISP, Transgrid's view was that the staged CPA process for HumeLink provides a future checkpoint for AEMO to confirm through an ISP Feedback Loop that the project is still beneficial, and that the decision rules proposed introduce unneeded rigidity. Snowy Hydro put forward similar arguments and said that not progressing with HumeLink (and VNI West) results in greater uncertainty for investors.

In contrast, the VEPC put forward several arguments against HumeLink and the assessment of its costs and benefits. These are detailed in Section 4.17.

Lee Kingma put forward a view that HumeLink should be staged physically, through the construction of the 1C option (from the HumeLink RIT-T[16]) with a later optional construction of the balance of the 3C option. Lee Kingma also suggested that the project is not justified given the uncertainties and risks of over-investment.

[14] See https://aemo.com.au/consultations/current-and-closed-consultations/2021-planning-and-forecasting-consultation-on-inputs-assumptions-and-scenarios.

[15] See https://aemo.com.au/en/consultations/current-and-closed-consultations/isp-methodology.

[16] See https://www.transgrid.com.au/projects-innovation/humelink.

AEMO's consideration and assessment

AEMO agrees with stakeholder views that the draft decision rules for HumeLink would not add any additional consumer protections. The draft decision rule for HumeLink was qualitative because it was drafted to cater for an array of potential circumstances that might affect the project's optimal timing. However, with the project retaining a staged development approach in the 2022 ISP, the ISP Feedback Loop will provide the same level of consumer protection without the need for decision rules. AEMO considers that decision rules are best used where a clear trigger can be identified to progress from one stage to the next. AEMO has therefore removed decision rules for HumeLink.

As with any large infrastructure project, the decision to proceed should be reviewed if project costs change. Regardless of decision rules, funding for the implementation of HumeLink will remain subject to the ISP Feedback Loop (AEMO tests whether the project remains aligned with the latest ISP) and the Contingent Project Application process (the AER reviews whether the project costs are prudent and efficient).

In regard to the timing of the project, the cost benefit analysis (CBA) in the Draft 2022 ISP found that the risk of a potential two-year slippage of the commissioning schedule of HumeLink, delays in storage development, or faster coal retirements would result in increased benefits associated with declaring the project as a staged, actionable project. AEMO has expanded on its analysis of these risks in the final ISP and taken these into account in the determination of the ODP. Similarly, AEMO has noted other implementation challenges for HumeLink, including impacts on investor certainty, in the final ISP.

The network options for the ISP were developed through a transparent public consultation with a broad range of energy stakeholders during the development of the 2021 IASR, prior to the commencement of the Draft ISP. For HumeLink, AEMO modelled an increase in transfer capability from Southern New South Wales to Central New South Wales using the preferred option determined through the RIT-T process. AEMO is unable to include additional options or staging for HumeLink because the RIT-T was completed in December 2021. AEMO will consult on network options again in the development of the next ISP.

4.1.2 VNI West

Summary of material issues raised in submissions

The ISP Consumer Panel and Tilt Renewables supported the inclusion of VNI West as a staged project, however the Consumer Panel's view was that more details on the scope of what is included in early works was needed.

Several stakeholders considered that the Draft ISP undersold the benefits of VNI West, particularly Snowy Hydro, which questioned how the analysis reflected the role of VNI West in providing Victoria access to Snowy 2.0, whether the role of utility-scale storage had been ignored, and how Marinus Link can be preferred over VNI West given correlation of VRE resources and transmission access risk.

Both the ENA and CEC considered that the proposed timeline for VNI West would be too late, and an earlier delivery timeframe was needed.

Other stakeholders raised concerns with VNI West, with the VEPC suggesting that it would provide limited value through access to Snowy 2.0, and RE Alliance, Hepburn Shire Council, Wimmera Developments all noting concerns over the process and route selection.

AEMO's consideration and assessment

AEMO's capacity outlook models seek to develop sufficient dispatchable capacity to maintain reliability and meet consumer energy needs at the lowest possible cost. The inclusion and timing of potentially actionable ISP projects such as VNI West affects these considerations, such that in those development paths where VNI West is delivered later, additional resources may need to be developed to reflect continued limitations on flows between Victoria and New South Wales. This therefore would consider the reduced access to Snowy 2.0 if VNI West is delayed. AEMO acknowledges there are other considerations that are not necessarily reflected in the core assumptions, and these are considered, either in sensitivity analysis, or more qualitatively, in determining the ODP.

Earlier delivery dates do need to consider the potential for risks of overinvestment reflected in scenarios where an early delivery date is not beneficial. AEMO notes, however, that the earliest possible delivery date for VNI West is 2030-31, as advised by the project's proponents – AEMO (Victorian Planner) and Transgrid. The classification of VNI West as an actionable ISP project in the ODP allows for that delivery timeline to be met.

The determination of the ODP balances the risks of overinvestment (where these are reflected in the scenarios) against the risks and consequences of underinvestment, which may include reduced resilience or greater expenditure on alternative resources.

The draft decision rule for VNI West was qualitative because it was drafted to cater for an array of potential circumstances that might affect the project's optimal timing. With the project retaining a staged development approach in the 2022 ISP, the ISP Feedback Loop will provide the same level of consumer protection that was sought in the Draft ISP without a need for decision rules. AEMO considers that decision rules are best used where a clear trigger can be identified to progress from one stage to the next. AEMO has therefore removed decision rules for VNI West.

AEMO appreciates feedback on the details provided for the scope of early works. The RIT-T or Contingent Project Application will include further information on the scope of early works. AEMO will then need to consider whether the cost of the early works is consistent with that assumed in the ISP, to confirm the first stage passes the ISP Feedback Loop.

4.1.3 Marinus Link

Summary of material issues raised in submissions

Hydro Tasmania and TasNetworks both recommended that AEMO should retain the classification of Marinus Link as a single actionable ISP project, noting that any change could have a material impact on costs and commissioning timeline. GE RE's view was that AEMO could submit a rule change request relating to interconnector cost recovery to help facilitate the delivery of Marinus Link. On the other hand, Delta Electricity recommended that the project should be delivered in two stages such that the second stage could be more efficiently implemented, reducing the risk of overinvestment.

The Bob Brown Foundation and the VEPC put forward numerous arguments against the inclusion of Marinus Link as an actionable project and the quantification of market benefits.

AEMO's consideration and assessment

AEMO's modelling for the final ISP confirms that Marinus Link should retain its status as a single actionable project, particularly given the later delivery timeline than assumed in the Draft ISP has increased the potential costs of the project being deferred.

In terms of the classification of both cables as a single project, the ISP modelling finds that the timely delivery of the second cable is beneficial in all scenarios. AEMO therefore considers that the costs involved in a staged regulatory process outweigh any benefits, of which none are evident given the scenarios considered in the ISP. The Marinus Link PACR reached a similar finding with the second cable between two and three years after the first cable.

AEMO acknowledges the view that it could submit a rule change request, but is aware that the Commonwealth and Tasmanian government have already agreed to work together to submit a rule change on this topic.[17]

4.1.4 All ISP projects

Summary of material issues raised in submissions

In addition to the feedback on specific projects detailed above, some stakeholders (CEC, WWF, Tilt) supported commencing early works on all potential actionable projects, and CEC and WWF also supported early works for all future ISP projects. The CEIG suggested that staging should be removed given the urgency of the strategic, actionable ISP projects.

Snowy Hydro put forward its view that it is difficult to accept that the accuracy of ISP models is sufficient to nail down transmission timings to a single year, noting susceptibility to factors such as droughts and climate volatility.

The issue of potential supply chain risks and the impact on transmission projects was raised across many submissions. Some argued this supports continuing to progress strategic projects (TasNetworks), or more generally that these limitations should be a consideration in the timing of projects (Powerlink). Others pointed to this risk being considered more generally both as a risk and in early planning (ISP Consumer Panel, EA, ETU, Origin, AEIC, Iberdrola). The ISP Consumer Panel considered that the risk of supply chain limitations increasing costs is not managed to a degree that would satisfy the risk appetite of most consumers. The CEC suggested that AEMO should adopt the CEC employment factors and produce employment demands for each of the scenarios, similar to an approach successfully applied by Transgrid in its *Energy Vision* report.[18] CEC noted this methodology would allow constraints to be applied to the increase and decrease in employment demand as a means of smoothing the profile of employment over time.

Another key issue raised in submissions from a range of stakeholders related to the presence of decision rules in the ODP. Origin, EA and the ISP Consumer Panel requested that more clarity be provided on their implementation, whereas Snowy Hydro, Neoen, and the CEC argued that the decision rules create uncertainty without sufficient benefit from timeline optionality.

[17] Tasmanian Government. *Tasmania's historic agreement to deliver Marinus Link and Battery of the Nation*, at https://www.premier.tas.gov.au/site_resources_2015/additional_releases/tasmanias_historic_agreement_to_deliver_marinus_link_and_battery_of_the_nation.

[18] Transgrid. *Energy Vision*, at https://www.transgrid.com.au/about-us/network/network-planning/energy-vision.

AEMO's consideration and assessment

AEMO considers that staging is still an important consideration which can help reduce the risk of overinvestment, but that the potential costs of staging need to be considered (even if the consequences of staging on project costs are challenging to quantify). AEMO acknowledges Snowy Hydro's view on the accuracy of project timings and has considered the risks of schedule slippage in selecting the ODP.

The issue of supply chain limitations has also been further discussed in the final ISP. AEMO has partnered with Infrastructure Australia and the Institute for Sustainable Futures to assess and understand the labour and material requirements for the transmission and generation projects identified in the ISP. The *Market Capacity for Electricity Infrastructure* project[19] develops and publishes electricity sector workforce projections by technology, occupation and location to correspond with ISP scenarios. It allows stakeholders to understand the employment implications of alternative scenarios and give governments and the electricity industry an awareness of the workforce development needs for future development paths – see Section 7 of the 2022 ISP.

HumeLink and VNI West decision rules have been removed. The draft decision rules were qualitative because they were drafted to cater for an array of potential circumstances that might affect the projects' optimal timing. The ISP Feedback Loop will provide the same level of consumer protection without a need for decision rules. AEMO considers that decision rules are best used where a clear trigger can be identified to progress from one stage to the next.

4.2 Consumer risk preferences

Summary of material issues raised in submissions

Both ECA and the ISP Consumer Panel noted that there is a lack of evidence and reasoning behind the assumptions of consumer risk preference used in the Draft ISP. SACOSS and the ISP Consumer Panel said it is difficult or impossible to gauge the risk preferences of consumers without further engagement via a broader consultation, and the ISP Consumer Panel believed engagement needs to focus on tangible ways in how risks of over- and under-investment are managed. EWOSA observed that some consumers do not feel well placed or have the capacity to manage risks.

The ISP Consumer Panel's view was that where government risk preferences differ from those of consumers, AEMO and governments should consider the roles of government funding.

AEMO's consideration and assessment

AEMO undertook a targeted engagement process with consumer advocates in March-April 2022 to better understand consumer risk preferences. Representatives of ECA, EUAA, PIAC, QEUN and Renew participated in two workshops with AEMO, to explore the range of risks that potentially stem from either over- or under-investment in the shared transmission network.

In the session, representatives of ECA, PIAC and EUAA stated that in their view, the Draft ODP appropriately balanced the risk of over- and under-investment, assuming the capital cost of actionable transmission projects does not increase above current estimates. Participants also told AEMO that the specific risk preferences of consumers could only be learned via direct engagement with individual bill payers, rather than via consumer

[19] Infrastructure Australia. *Market capacity for electricity infrastructure,* at https://www.infrastructureaustralia.gov.au/market-capacity-electricity-infrastructure.

advocates. PIAC, EUAA and QEUN commended the AER's survey process as part of its work to determine the value of customer reliability (VCR) as a robust approach to understanding energy consumer preferences.

The targeted engagement on consumer risk preferences was very helpful in building an understanding of the wide spectrum of consumers and their risk preferences. Through this process, AEMO formed the following views:

1. **The 2022 ISP broadly aligns with consumer risk preferences** – the Draft ISP appropriately balanced the risk of over- and under-investment. Given that the final ISP maintains the same level of consumer protection, and finds the cost of providing consumer protection is now more economic than calculated in the Draft ISP, the 2022 ISP therefore also appropriately balances the risk of over- and under-investment.

   The protections provided by the ISP Feedback Loop are important in balancing these risks.

2. **Quantification of consumer risk preferences can be improved** – while consumer advocates are clearly skilled in advocating on behalf of their respective consumers, any true quantification of consumer risk preferences requires direct engagement or assessment of consumer behaviour. The suggestions from consumer advocates to apply consumer surveying or an assessment of consumer behaviour may improve the approach to quantifying consumer risk preferences in the 2024 ISP.

A full summary of the comments from participants in these workshops is provided in Section 2.6 of Appendix 1 to the 2022 ISP.

4.3 Consideration of challenges, risks, and other benefits of transmission augmentations

4.3.1 Distributional effects

Summary of material issues raised in submissions

Several stakeholders (CEIG, SACOSS, SA DEM, ENA and TasNetworks) commented on the need to consider the potential price impacts of transmission, and other stakeholders (CEIG, SACOSS, SA DEM, TasNetworks) supported the inclusion of distributional effects. Two stakeholders went further, with Neoen arguing that despite its subjectivity, a price-driven approach should be used to identify what projects deliver value to consumers in the short term, and the CEIG arguing that short-term consumer benefits should be considered in the application of professional judgement in the determination of the ODP. On the other hand, the ISP Consumer Panel cautioned that distributional effects should not drive decisions on the ODP, but noted that they are useful to inform stakeholders' risk preferences.

Hydro Tasmania accepted AEMO's rationale for not including competition benefits but considered that acknowledging the impact of transmission projects on competition could still be included, even if in a qualitative fashion.

AEMO's consideration and assessment

AEMO agrees with stakeholders that it is important for the ISP to provide a perspective on the potential impact of transmission projects on the total delivered cost of energy, in particular as a means of informing considerations of stakeholder risk preferences. AEMO also notes, however, as indicated by the ISP Consumer Panel, that the AER's Guidelines prohibit distributional effects from influencing AEMO's choice of the ODP.

AEMO's view is that although the evaluation of distributional effects presented in the 2022 ISP does not itself influence the choice of the ODP, AEMO has used the outcomes on retail prices to understand the potential asymmetry between late and early transmission development. In future ISPs, it may also inform AEMO's processes to further quantify consumer risk preferences, and consumers' willingness to invest in transmission projects to mitigate these risks.

AEMO acknowledges the feedback from Hydro Tasmania, and has commented in the 2022 ISP on the potential competition impacts of transmission augmentation, but also notes that competition impacts are highly uncertain given factors such as changing market conditions, generator ownership, contracting positions.

4.3.2 Transmission benefits and retirements

Summary of material issues raised in submissions

NICE commented that most of the benefits of transmission augmentations occur towards the end of the modelling horizon. Several stakeholders (including Jemena and Origin) raised the need to consider the risks associated with assumed transmission costs and timelines.

Delta proposed that a risk-averse approach should be included, which could include consideration of a risk of a HumeLink delay. The SA DEM opinion was that announcement of Eraring's accelerated retirement underlined the need to adopt a least regrets approach towards system planning.

AEMO's consideration and assessment

In response to the feedback from NICE, it is true that in general transmission project benefits have been observed to increase over the modelling horizon. However, through the testing of CDPs, AEMO's approach explicitly compares the costs and benefits of acting on a project now or deferring action to a later point in time, and therefore a project needs to deliver weighted benefits greater than the costs of early development to justify its status as an actionable project, also considering various risks that consumers may face, demonstrated by modelled sensitivities and additional analysis.

AEMO acknowledges that the risks of cost increases and timeline slippage are important considerations. In relation to cost increases, AEMO notes that the ISP must be published at least every two years, and projects must be validated through the ISP Feedback Loop process prior to a funding request. AEMO also notes that the benefits of transmission projects are frequently to avoid generation and storage capital and fuel costs, both of which also suffer from some of the same supply chain and social licence risks. Considering these risks only for transmission investments increases the potential risk of underinvestment.

With respect to timeline slippages or delays, AEMO has tested this risk thoroughly for HumeLink, for example, as shown in Section 4.1.1. This analysis shows that the materialisation of this risk increases the benefits of the project as an actionable project. In general, the risk of project slippage increases the benefits of all projects being actionable, as project benefits do tend to increase throughout the project life, and having sufficient timeline flexibility to accommodate a schedule slippage will minimise regret.

AEMO's approach of considering both a weighted net market benefits and a least-worst weighted regret, supported by sensitivity analysis, is consistent with the SA DEM's recommendation of a least regrets approach to system planning.

4.3.3 Broader benefits

Summary of material issues raised in submissions

A number of submissions (CEC, VEPC, Tilt, WWF) put forward the view that the ISP should take into consideration broader public benefits such as those relating to emissions reduction.

The ETU considered that the ISP continues to be constrained by a narrow least-cost framework, which ignores broader economic and societal impacts such as the transition cost for REZs located away from existing power stations, and employment impacts more generally. GE and Energetic Communities also supported the inclusion of workforce/employment implications and challenges with a 'just transition' in the consideration of benefits.

CEIG supported the use of an insurance weighting when selecting the ODP, given the rate of change in recent years, and that under-investment is a greater risk than over-investment. This was supported by Walcha Energy, which noted that there is too much emphasis on optimal timings, as well as the CEC, which urged AEMO to continue to account for risk asymmetry.

AEMO's consideration and assessment

AEMO notes that the CBA Guidelines specify a suite of allowable classes of market benefits. For the 2022 ISP, AEMO's analysis quantifies only these benefits. Currently the AEMC is also conducting the Transmission Planning and Investment Review (TPIR), the purpose of which is to explore options to support the timely and efficient delivery of major transmission projects, and AEMO is supporting and engaging in this process. The inclusion of wider economic benefits and additional classes of market benefits may provide a clearer transition plan for the economy to meet net zero emissions goals, such as emissions outcomes. AEMO's approach of applying carbon budgets does provide some improved consideration of emissions outcomes.

With respect to other benefits, the CBA Guidelines require AEMO to exclude any market benefits which cannot be measured as a benefit to generators, distribution network service providers (DNSPs), TNSPs and consumers of electricity. AEMO suggested in its response to the TPIR consultation paper[20] that the AEMC should consider additional classes of market benefits for the ISP, but the draft report[21] for Stage 2 of the review has made it clear that this will not be considered as part of the review.

With regards to the feedback on insurance benefits and the consideration of risk asymmetry in determining project timings, AEMO has taken this into account in the final ISP in its consideration of potential risks and benefits which have informed AEMO's decision in selecting the ODP.

4.3.4 Sensitivities and stress events

Summary of material issues raised in submissions

The consideration of offshore wind was raised in a number of submissions. NICE's view was that there is potential for transmission investments to be deferred in the event that offshore wind is developed, noting the Victorian Government's offshore wind directions paper, and therefore supported sensitivities that explore the impact of

[20] AEMO's response to the Transmission Planning and Investment Review consultation paper, at https://www.aemc.gov.au/sites/default/files/documents/aemo_8.pdf.

[21] AEMC. *Transmission Planning and Investment – Stage 2 Draft Report*, at https://www.aemc.gov.au/sites/default/files/2022-06/stage_2_draft_report_-_transmission_planning_and_investment_review.pdf.

offshore wind on the ISP projects. An investigation of offshore wind more generally was also put forward by Star of the South, Flotation Energy, RE-Alliance and CEC.

The ETU recommended revising resource assumptions based on information available from Blue Economic CRC report and information provided by Star of the South. RE-Alliance encouraged AEMO to investigate offshore wind projects more closely in the final 2022 ISP in light of the number of project proposals and the dramatic cost reduction demonstrated to date by the offshore wind industry in the UK and Asia. BZE noted that current REZ scorecards have little or no detail on OWZs, with three out of four wind zones showing no projected offshore wind across all four scenarios out to 2050. BZE recommended full integration of offshore wind into AEMO's scenario planning, noting that now offshore wind legislation is passed, projects that have been on hold are now moving forward. BZE said the impact of these projects on the NEM must be considered.

Several submissions (SA DEM, ANLEC R&D, EA, ENA, Ausnet) supported a greater consideration of extreme weather events and analysis of resilience to climate events such as renewable energy droughts. EA noted the potential deficiency in only testing historical reference years, suggesting the use of synthetic reference years, and more general explorations of the impact of perfect foresight, including limiting the foresight available to long-term storages to foresee and optimise energy management ahead of unexpected renewable energy droughts.

Snowy Hydro considered that the ISP does not include meaningful considerations of stress events such as correlated generation and transmission outages. The ECA raised the view that the ODP is not tested against demand side risks (with respect to scale and timing) related to electrification and energy efficiency. Demand uncertainties were also raised as a risk by the ISP Consumer Panel, which pointed to DER coordination as an example. The Protect-the-West Group was more concerned about the risk of over-investment that may arise due to the increasing energy consumption evident in the forecasts.

AEMO's consideration and assessment

With regards to the inclusion of offshore wind, AEMO included offshore wind as a technology option available for development in the Draft ISP, however uptake was limited, with higher uptake in those development plans which had restricted transmission development.

In consideration of the continued interest in offshore wind, cost reductions identified in the Draft 2021-22 GenCost projection, and the Victorian Government's offshore wind directions paper, AEMO has included a sensitivity in the final ISP which tests the impact of the potential policy and more rapid cost reductions for offshore wind, focusing on the potential impact on actionable transmission projects.

AEMO thanks EA for their feedback on the use of historical weather years and perfect foresight and will continue to consider how best to improve these aspects of the modelling in future ISPs through methods that go beyond current case studies. Improving renewable generation and demand traces was also identified as a key area of focus in AEMO's 2022 Forecasting Improvement Plan[22]. Similarly, AEMO will continue to look to develop the assessment framework to explore the impact of the risks of transmission outages, as raised by Snowy Hydro.

In the final ISP, AEMO has also examined several additional case studies to identify potential increases in power system resilience provided by ISP projects in the event of extreme weather events driving asset outages. These case studies (see Appendix 4) demonstrate the resilience improvement with transmission investment.

[22] See AEMO, Forecast Accuracy Report, November 2021, Section 8.2.4 at https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/accuracy-report/forecast-accuracy-report-2021.pdf.

In relation to demand-side risks and the concerns raised by the Protect-the-West Group on the risks of overinvestment, AEMO's *Slow Change* scenario does test the impact of lower demands and slower demand growth due to reduced electrification, lesser population and economic growth, potential industrial load closures and (temporary) growth in distributed PV investment. As demonstrated in the 2022 ISP, *Slow Change* continues to deliver an overall net market benefit from the ODP.

In response to the ISP Consumer Panel's feedback on the risks associated with DER coordination, in addition to other feedback outlined in Section 4.7, AEMO has included a sensitivity which tests the impact of a lower level of DER coordination in the *Step Change* scenario and has found that it does not materially impact the relative costs and benefits between CDPs.

4.4 Scenario weightings and settings

Summary of material issues raised in submissions

The topic of scenario weightings was raised in many submissions, without a clear consensus on whether the weightings reflected a reasonable representation of future uncertainty.

With regards to the Delphi Process, Delta Electricity questioned whether the process had given sufficient attention to security challenges, while NICE wondered whether the process might have been inherently biased by the announcement that the Australian Government would take a commitment to net zero carbon emissions by 2050 to the Glasgow Conference of the Parties, which just preceded the second Delphi Panel. AGL suggested that the outcomes of the Delphi Process should be followed by a sense check of whether the outcomes are factually supported, while ECA and the ISP CP wanted to explore how different scenario weightings may impact the CBA. Delta suggested that the Delphi Process should be subject to an independent review process.

However, many stakeholders supported the scenario weightings, agreeing with *Step Change* as the most likely scenario (Tas DPC, Jemena, SA DEM, Hydro Tasmania, Iberdrola, APGA). Tilt, Energetic Communities, BZE, ACF, Climate Council, Greenpeace, QCC, FFI and CEIG believed that scenarios should be further weighted towards stronger decarbonisation, either through increasing ambition within the scenarios, increasing weight towards the *Hydrogen Superpower* scenario (or adding *Strong Electrification* as a scenario), or adding an additional high ambition scenario. Iberdrola recommended the removal of the *Slow Change* scenario.

In contrast, AGL and Delta Electricity consider that *Step Change* is not the most likely scenario given it is not reflective of current policy commitments or economic rationale, noting the inclusion of a carbon budget and the various challenges in meeting the scenario objectives in the short term. ARD suggested a coal-fired scenario should be added.

The ISP CP considered that AEMO should not place any significant weight on the *Hydrogen Superpower* scenario until AEMO has undertaken further consultation on consumer risk preferences and AEMO and stakeholders are more confident in the robustness of this scenario's inputs, assumptions and likelihood. APA supported the *Hydrogen Superpower* scenario.

Further comments on DER and the role of gas in the scenarios are covered separately in Section 4.7 and Section 4.10 respectively.

AEMO's consideration and assessment

AEMO's use of the Delphi Panel was informed by strong feedback throughout the IASR Consultation that scenario weightings should be heavily based on stakeholder engagement and feedback. Throughout that process AEMO provided information on the key drivers of each scenario. This information was provided to a broad range of stakeholders who provided the inputs used in determining the weightings applied in the Draft ISP. AEMO will continue to engage with the next ISP Consumer Panel and others on how this process can be refined in future ISPs.

In response to the feedback on *Step Change* as the most likely scenario, AEMO acknowledges that there is a broad spectrum of views on the likely speed of decarbonisation, and that the *Step Change* scenario does require drivers, including policy, which is not yet in effect or specified. However, AEMO also notes that previous "Central" scenarios that assumed only current policies have consistently underestimated the speed of the energy transition, including coal retirements and VRE development.

As part of future ISP processes, AEMO will continue to work with all governments to ensure the ISP continues to meet the needs of consumers, the energy sector, industry and government. This includes incorporating any changes to policies and programs that may occur. Such policies would be reviewed for the scheduled 2023 IASR, and feed into the 2024 ISP, or any earlier ISP update.

With respect to the use of the *Hydrogen Superpower* scenario, AEMO agrees that the inputs related to potential hydrogen uptake are particularly uncertain, although notes the scale of interest in the technology.

AEMO notes that the Draft ISP tested the replacement of the *Hydrogen Superpower* scenario with an alternative sensitivity (*Strong Electrification*) which removed the hydrogen elements of the scenario, but retained the faster rate of decarbonisation, and this had negligible effect on the CDP rankings. AEMO notes there has been consistent feedback from many stakeholders that *Step Change* may still understate the speed of decarbonisation. This risk is reflected through the inclusion of this scenario (which is balanced by the potential for slower decarbonisation as expressed by the *Progressive Change* and *Slow Change* scenarios).

4.5 Coal closure outcomes and approach

Summary of material issues raised in submissions

Delta was critical of the approach and outcomes used in determining coal retirements, noting the limitations of the approach and that the approach needed further examination, pointing to the AER's transparency review. Delta also suggested insufficient attention had been paid to coal flexibility, the role of the hedge market, and similar topics. Macroeconomics Advisory also raised coal flexibility as an issue that needs to be addressed in regard to coal closures.

The CEC welcomed the identification of early coal exits as a critical risk, and Walcha Energy agreed that the ISP should continue to consider the implications of earlier than expected coal exits.

EA noted that scenarios show accelerated coal exits and that AEMO's modelling assumes replacement capacity is delivered with perfect foresight, which has implications for market reform. Given this, deep dives into the economic drivers of closures and new investments could inform the policy debate. EA considered that releasing information on projected reliability performance could help inform this debate.

Powerlink suggested the final ISP should provide more analysis on the robustness of coal retirements to changes in the anticipated closure of other coal-fired plants.

EA also stated that AEMO should be clearer in communicating the reasons for the projected retirement schedules, and questioned whether there has been sufficient consideration of curtailed distributed PV and its impact on coal operations.

AEMO's consideration and assessment

As demonstrated by the latest announcements by AGL and Origin Energy regarding accelerated retirement of the Eraring, Loy Yang A and Bayswater power stations, the assumption that all coal generation will continue to operate until currently nominated closure years is unlikely, and it is therefore necessary to identify the risk of early coal withdrawals.

In its Addendum to the Draft 2022 ISP, AEMO provided detailed explanation on how it derived the assumptions and inputs regarding the profitability of coal plants and how this contributed to the modelled coal plant retirements across each scenario.

In response to the feedback from Delta, AEMO acknowledges that the timing of thermal generation retirements is challenging to predict due to the complex nature of these decisions, which are influenced by a multitude of factors including commercially sensitive information not known to AEMO, including revenue streams from outside the wholesale energy market. AEMO reiterates that its projection forecast is just one possible path for coal withdrawals, applying two clear methodologies[23] described in the ISP Methodology (and re-iterated in the Draft 2022 ISP Addendum). Approach 1 (revenue sufficiency analysis) cannot include all possible revenue streams, and Approach 2 (least-cost optimisation with a carbon budget) was the key driver or retirements in most scenarios.

AEMO recognised the importance of considering coal flexibility and engaged directly with market participants to understand how coal flexibility might be achieved in preparing the Draft 2022 ISP. In the Draft 2022 ISP, AEMO considered seasonal mothballing and the potential impact on retirement decisions in the time-sequential modelling in *Progressive Change* up to 2030. This modelling showed that while seasonal mothballing led to higher revenue, in no case did seasonal mothballing change long-run profitability outcomes sufficiently to affect the timing of retirements in accordance with Approach 1.

Market participant discussions also suggested that intra-day flexible operation, also known as two-shifting, could be challenging to pursue for aging coal power stations. Two-shifting may have reliability implications which are not well known or understood (particularly for brown coal generators), and would increase wear-and-tear costs. Based on this feedback, ISP modelling assumed that coal might achieve greater flexibly via increased intra-day ramping (but still within assumed technical limits).

Curtailment of distributed PV could impact coal operation; the ISP modelling assumes that distribution systems are developed to enable surplus local energy generation to be exported back to the grid, and has not explicitly factored curtailment.

AEMO agrees with EA on the importance of timely generation investments to replace coal capacity. AEMO acknowledges that market reforms and the right investments signals are required to efficiently support the transition. Timing of retirements is highly uncertain and AEMO's modelling considers this risk via scenario

[23] As outlined in Section 2.4.1 of the *ISP Methodology*, at https://aemo.com.au/-/media/files/major-publications/isp/2021/2021-isp-methodology.pdf.

analysis; a number of sensitivities have been performed to ensure that the optimal development path is robust enough to cater for risk of expected closures matched by delays in delivering replacement capacity.

See AEMO's Addendum to the Draft 2022 ISP[24] for a more in-depth discussion of coal retirement assumptions and methodology.

4.6 Social licence

Summary of material issues raised in submissions

Submissions from CEC and CEIG welcomed the recognition of social licence considerations in the Draft ISP and noted the significant need to continue to improve consideration of social licence in planning. Many submissions provided recommendations on how considerations of social licence could be improved through greater collaboration with community advisory groups, traditional landholders and owners, and communities, and advised that local communities should be involved in developing genuine benefit-sharing solutions. Some stakeholders suggested AEMO should take a leadership role in managing social licence conversations (RE-Alliance, Energetic Communities, ISP CP, SACOSS, WWF, AEIC, BZE, Moyne Shire Council, WDA, ACF, Walcha).

The ISP Consumer Panel suggested that AEMO overlay REZs over the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) map of Indigenous Australia[25].

AusNet considered that the ISP's economic analysis has limitations from a social licence perspective in not considering some important broader issues beyond power system and economic modelling. Star of the South noted that social licence challenges are not properly reflected in the timeframes, nor are they reflected realistically in the cost assumptions.

Walcha noted that landowners will coordinate their objections against additional transmission line development. They recommended building a large augmentation to obtain the capacity required at the onset rather than through progressive expansions of transmission corridors.

NICE considered that offshore wind is less subject to community objections than land-based wind generation, noting the locations of OWZs are relatively close to major transmission infrastructure that is already losing some of its connected coal generators.

The ISP Consumer Panel considered that the challenges of securing social licence for so many projects is a material uncertainty. Complex trade-offs (for example, increased costs from landholder agreements versus increased certainty that a project can be built in an optimal timeframe) are being made on behalf of consumers by default. Star of the South also noted the potential implication of social licence on transmission developments and suggested that social licence risks should be tested through a sensitivity.

Star of the South and ACF suggested that greater weighting should be given to projects near existing energy jobs so local communities and workers can be supported.

[24] At https://aemo.com.au/-/media/files/major-publications/isp/2022/addendum/addendum-to-the-draft-2022-isp.pdf.

[25] AIATSIS. *Map of Indigenous Australia*, at https://aiatsis.gov.au/explore/map-indigenous-australia.

AEMO's consideration and assessment

In response to the request by the ISP Consumer Panel, AEMO has included, in Appendix 3 of the final ISP, the National Native Title Tribunal Indigenous Estates map of Indigenous Australia with the REZs overlaid on this map.

AEMO welcomes the feedback received from numerous stakeholders in relation to social licence. AEMO acknowledges the significant need to improve social licence in planning, and recognises it is an issue that affects transmission, generation and storage developments. VRE developments will tend to be concentrated or clustered in particular areas within the REZ where the network access and/or land use is most suitable. AEMO recognises that with these REZ development opportunities there needs to be a key focus on building social licence and acting collaboratively.

While AEMO agrees that there are benefits in locating REZs near existing energy jobs, this is outside the scope of benefits that AEMO can include in the ISP, as per the AER's CBA Guidelines. AEMO considers that state governments are best placed to align REZ planning with jobs and regional growth through policy and other state-based schemes.

In response to NICE's view that offshore wind is less subject to community objection than land-based wind generation, AEMO considers offshore wind to have great potential due to resource quality, possible lower social licence hurdles, and proximity to strong transmission, however it is not currently projected to play a large role without government support unless land use considerations (including social licence) limit onshore development.

4.6.1 Existing land use and biodiversity

Summary of material issues raised in submissions

Concerns over the development of REZs affecting agricultural land have been raised in submissions.

- Bob Brown Foundation requested more information about the plans for the South Western Victoria REZ over concerns the development of this REZ will affect agricultural output in the area.
- The ASMC raised concerns that the location of Queensland REZ candidate regions cover almost all of the 390,000 hectares of the current Queensland cane land, and noted concerns relate to the temptation of parties to cut costs building renewable energy projects and transmission infrastructures on cane land given its low lying and flat topography. The ASMC is looking for stronger protection in the REZ policy and legislative frameworks and/or government directives to ensure renewable energy and sugar-related activities can occur in tandem.
- RE-Alliance proposed using REZ design reports to screen out projects that require excessive land use as well avoiding prime agricultural land. RE-Alliance considered existing land use and bio-diversity should be significantly expanded in the final 2022 ISP.
- QCC also noted conflict with environment values in areas of high wind resources in Far North Queensland with growing concerns over environmental issues and land use conflict in Fitzroy and Darling downs. It recommended greater considerations be given to siting of REZ and transmission lines in relation to environmentally sensitive ecosystems and high value land uses.

AEMO's consideration and assessment

AEMO acknowledges the Bob Brown Foundation request for additional information for South West Victoria REZ, and notes that the development of this REZ will depend on the location of new generation connections. AEMO

has requested AEMO (Victoria Planner) to conduct preparatory activities for South West Victoria REZ Expansion. Preparatory activities will provide more details for stakeholders and more detailed inputs for the 2024 ISP – see Section 7.2.1 of the 2022 ISP for more information.

In regard to land use, AEMO has allocated resource limits in each REZ initially based on a DNV-GL[26] estimate which considers typical wind and solar land area requirements, and an assumption of land available in each REZ. The availability is determined by existing land use (for example agriculture) and environmental and cultural considerations (such as National Parks) as well as the quality of wind and solar resources. For wind, the resource limits are based on 20% of the lead area being utilised for wind generation, considering competing land and social limitations. For solar, the assumption is that only 0.25% of the approximate land area of the REZ will be available for solar generation due to the larger impact on land dual-use. Land use considerations have therefore been included at a high level in the REZ assessments to inform the selection process.

Detailed assessments of the impacts of new infrastructure and the most effective mitigation measures of community impacts are, however, expected to be addressed as part of the existing planning and delivery processes, which best position project developers to understand local benefits and impacts and directly engage with communities.

4.7 DER and distribution network impacts

Summary of material issues raised in submissions

A frequent theme across several submissions (Snowy Hydro, GE, CEC, EA, Powerlink, ENA, EA, IE&S, Hydro Tasmania, and FFI) was that the ISP's projections of DER were too high, particularly the uptake of distributed storage. The level of co-ordination and uptake was also questioned, given the required policy reforms, social licence issues, and the issues associated with managing the interface between transmission and distribution networks, with some stakeholders considering that further investigation may be needed. Similarly, the EVC believed that the levels of Vehicle to Grid (V2G) were too optimistic, and the level of convenience charging was likely overstated given the benefits of shifting charging away from peak times.

On the other hand, NICE considered that the scenarios fail to consider a future with higher levels of DER and that as a result no projects should be considered as actionable. It also suggested a scenario with higher levels of DER coupled with lower overall consumption. Uniting Communities suggested a similar "gone local" scenario which also includes more stand-along power systems.

The ECA questioned the ISP using DER as an input, and instead recommended an approach that considers DER as development options alongside utility-scale solutions. Energetic Communities argued for the consideration of microgrids.

Other submissions (EA, Engineers Australia) argued that the ISP should consider the impact of DER uptake on costs in the distribution network, which could help inform debate around decarbonisation pathways. EPC considered that the cost of DER should be considered in the assessment of the net present value (NPV) of development paths, in addition to the impact on distribution networks, as well as other costs such as retail and metering.

[26] Multi-Criteria-Scoring-for-Identification-of-REZs DNV-GL, 2018, at https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/ ISP/2018/Multi-Criteria-Scoring-for-Identification-of-REZs.pdf.

ACOSS and NICE suggested that the level of system resilience provided by DER needs to be an ISP consideration and may be an alternative to transmission augmentation.

AEMO's consideration and assessment

In response to the feedback on the level of distributed storage uptake and level of coordination, AEMO has included an additional sensitivity in the final ISP which tests the impact of reduced DER coordination, by applying the level of uptake and coordination from the *Progressive Change* scenario in the *Step Change* scenario. Sensitivity analysis was already a consideration within the Draft ISP modelling. AEMO will continue to engage with stakeholders on the level of uptake for distributed PV, distributed storage and electric vehicles (EVs), including the behaviour of these DER technologies in the development of the 2023 IASR which will inform the 2024 ISP.

In response to NICE, AEMO notes that the scenarios already take into account very high levels of DER in which the majority of dwellings have rooftop PV and battery storage, and where the majority of vehicles are EVs. AEMO also included a sensitivity which looked at a higher uptake of distributed PV specifically, and also notes the feedback from other stakeholders on the potential overestimation of distributed storage in the current forecasts.

AEMO acknowledges that there are interactions between DER uptake and impacts on the transmission system and large-scale VRE development, however given the very different factors affecting these ends of the spectrum it remains very difficult to formulate a single model that takes into account the potential competition and interactions, and considers that the uncertainty on DER uptake remains best tested through the use of scenarios. AEMO will continue to explore improvements in this area in the future.

AEMO also acknowledges that the level of DER integration may materially impact the needs and costs associated with the distribution system. However, the level of DER remains constant across development paths within scenarios and therefore does not influence the CBA which compares alternative development paths for scenarios consistently. DER does vary between scenarios, however this does not influence the net market benefits of the ODP. Scenarios differ by many aspects which affect overall costs (for example, different levels of industrial loads, energy efficiency expenditure, and different levels of investment in gas connections) and therefore direct comparison between scenarios would not include many of these factors, not just distribution network costs. The same argument applies to why the potential resilience provided by DER is not relevant to the determination of the ODP in the ISP, but is relevant in informing the scenario settings in exploring a range of possible DER uptake.

4.8 Renewable Energy Zones

4.8.1 Marginal Loss Factors (MLF)

Summary of material issues raised in submissions

Powerlink, ENA and the SA DEM supported further work on the impacts of MLFs on REZs.

Powerlink raised concerns over declining MLFs due to large development of generation in far north Queensland. Powerlink noted that AEMO's modelling proposal to include an MLF risk rating metric for REZs falls short of addressing a shortcoming that is likely to impact the ODP and/or urgency for REZ design reports. Powerlink Queensland proposed that the final 2022 ISP extend the sole focus on inter-regional interconnectors to account for the marginal losses on intra-regional connectors.

AEMO's assessment and consideration

AEMO welcomes support for further work on the impacts of MLFs on REZs from Powerlink Queensland, ENA and SA DEM.

AEMO acknowledges that a risk rating metric is valuable but would not fully address Powerlink's concerns of addressing VRE build in REZs with poor MLFs. Further detailed analysis conducted by AEMO for the final ISP supports Powerlink's findings that the MLFs in these regions may fall significantly with large VRE build. AEMO has subsequently considered the influence of MLFs on VRE projections in North Queensland through sensitivity analysis for the final 2022 ISP, and adjusted the ISP Development Opportunities for affected REZs accordingly. AEMO intends for the MLF process to be further enhanced and extended across the NEM for inclusion in the 2024 ISP.

4.8.2 Input and assumptions changes

Summary of material issues raised in submissions

AEMO received suggested revisions to inputs and assumptions in relation to REZs.

ElectraNet proposed changes in relation to two REZs:

- **Mid-North REZ –** ElectraNet proposed including a low-cost staged development, reconfiguring the 132 kV network, that could be considered prior to the much larger Mid North SA transmission development captured in AEMO's *Transmission Cost Report*[27].
- **South East SA REZ** – ElectraNet recommended that AEMO include a new double circuit 275 kV twin conductor transmission line between Tailem Bend and the South East substation as the scope for a stage 2 development of this REZ. ElectraNet also proposed removing the limit of the 100 megawatts (MW) solar potential in South East SA REZ, as it considers that there is no strong basis for this limitation. ElectraNet supported AEMO's examination of South East SA REZ as a quality REZ for both solar and wind, and suggested it be considered for an offshore wind REZ given developer interest.

TasNetworks identified a discrepancy in the capacity available to expand VRE connections in the Central Highlands REZ and the North West Tasmania REZ after Marinus Link stage 1 and 2. It noted that this discrepancy has resulted in a higher forecast of wind in the Central Highland REZ, above what the transmission network can transfer through this zone.

AEMO's assessment and consideration

AEMO undertook extensive consultation on the inputs, assumptions, and scenarios in the lead up to the Draft 2022 ISP. AEMO will continue to work closely through joint planning with TNSPs to refine inputs and assumption for the 2024 ISP.

In response to feedback provided by ElectraNet with regards to the Mid-North REZ, AEMO has not implemented this recommended change in the modelling for the 2022 ISP. AEMO has requested as part of the 2022 ISP that preparatory activities for Mid-North REZ expansion be completed to better inform the 2024 ISP. AEMO will engage with ElectraNet to determine if any additional augmentation options for the Mid-North REZ should be included for the 2024 ISP.

[27] At https://aemo.com.au/-/media/files/major-publications/isp/2021/transmission-cost-report.pdf.

In response to feedback provided by ElectraNet with regards to South East SA REZ, AEMO:

- Agrees that a stage 2 development for South East SA REZ is required that reflects the additional cost of this development. AEMO has implemented this change in the Inputs and Assumptions Workbook as well as through modelling for the 2022 ISP.
- Notes, in response to increasing the solar potential limit in the South East SA REZ recommended by ElectraNet, that South East SA REZ does not project any solar development in the *Step Change, Slow Change* and *Progressive Change* scenarios. Lifting the solar limit would not change the outcome if the existing limit is not utilised. The *Hydrogen Superpower* scenario does project solar development in the early to mid-2040s. AEMO will explore this solar limit further as part of the 2024 ISP.
- Supports ElectraNet's view of considering the South East SA REZ for offshore wind development, and has defined this as an OWZ for South East SA in the final 2022 ISP. Appendix 3 contains more details of this OWZ as well as modelling outcomes.
- Welcomes feedback from TasNetworks on the discrepancy in the capacity available to expand VRE connections in the Central Highlands and North West Tasmania REZ. After conducting detailed assessments and through further joint planning with TasNetworks, AEMO has updated the VRE capacities for these two REZs in the Inputs and Assumptions Workbook and modelling to align with TasNetworks' feedback.

4.8.3 Interactive REZ map

Summary of feedback

Origin asked AEMO to consider providing a detailed interactive REZ map including exact boundaries, overlaid with existing and proposed transmission network to assist project proponents in making investment decisions.

AEMO's assessment and consideration

AEMO understands that an interactive map could assist proponents in making investment decisions. AEMO is currently undertaking a review of the AEMO interactive map. As a result, this map will not be updated as part of the 2022 ISP. However, AEMO does publish the REZ polygons on the 2020-21 consultation on Inputs, Assumptions and Scenarios Consultation page[28]. Please note that the GPS data for these REZs are approximate in nature, derived by replicating the REZ illustration at Figure 1 of the 2022 Draft ISP Appendix 3. AEMO does not publish any GPS data for existing network, because the power system infrastructure is not owned by AEMO.

4.8.4 Utilising resources further west

Summary of feedback

Sligar and Associates recognised the limitations of solar only being available for limited periods every day. It noted that developing resources further west will expand the window of solar generation availability towards the daily peak (in the evening on the east coast). This will reduce the necessary rate of rise in firming capacity associated with the use of solar generation. This can be established by expanding westward from Olympic Dam

[28] Indicative REZ boundaries 2021 – GIS, at datahttps://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/isp/2021/indicative-rez-boundaries-2021---gis-data.kmz?la=en.

or Broken Hill followed by links from Sydney Ring to Broken Hill, Olympic Dam and westward. This could be facilitated by identifying and valuing the location of solar installations sites.

AEMO's assessment and consideration

AEMO agrees that considering solar resources further west will expand the window of solar generation availability towards daily peak. Extending resources further west will also require significant transmission infrastructure to securely transfer power to the load centres. AEMO's 2022 ISP modelling approach does capture this benefit, and the resulting costs, in determining whether REZ developments should proceed.

4.8.5 Lead time of generator connections

Summary of feedback

Origin noted that 3.4 gigawatts (GW) of wind capacity is forecast in New England REZ to be commissioned, under the *Step Change* scenario, in a single year (2027-28). Origin considers this outcome unlikely given the lead time involved in commissioning and connecting projects.

AEMO's assessment and consideration

AEMO acknowledges that significant co-ordination will be required to connect 3.4 GW of wind in one REZ in a single year. The process will need to be carefully managed to achieve this outcome. The advantage of connecting VRE in REZs is that through the co-ordination of transmission and generation, some of the technical challenges can be collaboratively addressed during the REZ design phase. This could ensure the network is designed with adequate system strength as part of the project to reduce challenges faced during the connection process.

In terms of the connection process, AEMO and the CEC have established a Connections Reform Initiative to address delays and increasing complexity of connection to the NEM. In December 2021, AEMO and the CEC published the Connections Reform Roadmap[29], as a result of industry-wide collaboration, seeking to improve the process for new renewable energy, energy storage and hybrid projects connecting to the NEM. Implementation on the reforms has been initiated, including reviewing selected minimum access standards, exploring options to advance batteries behind existing connection points, and a revised approach to updating AEMO's Guidelines.

4.8.6 REZ design reports

Summary of feedback

AEMO received a number of individual stakeholder comments regarding REZ design reports:

- A number of stakeholders supported AEMO's proposal for REZ design reports stipulated in the Draft 2022 ISP (Walcha, Delta, Origin, NCIE, Re-Alliance), with some noting that these reports will provide useful information to support investment decisions.
- Walcha considered that the REZ design reports should not be limited to the staging and capacity targets in the ISP.

[29] AEMO & CEC. *Connections Reform Roadmap*, at https://aemo.com.au/-/media/files/stakeholder_consultation/working_groups/other_meetings/connections-reform-initiative/roadmap.pdf.

- ENA suggested that AEMO ensure the REZ design parameters are aligned to and supported by the jurisdiction before triggering the REZ design reports.
- Queensland Conservation Council supported the preparation of REZ design reports for Darling Downs, Far North Queensland and Fitzroy, but noted that these have not yet been formally declared as REZs. It urged AEMO to require REZ design reports with timeframes for delivery to keep Queensland renewable energy development on track.
- NICE recommended including OWZs for REZ design reports.
- Moyne Shire Council asked to be engaged with on any REZ design report in South West Victoria. It noted REZ planning should consider strategic land use and prevent clustering of development.
- Wimmera Development Association supported the preliminary view which proposed that REZ design reports will be required for Murray River and South West Victoria. Wimmera Development Association and Northern Grampian Shire Council would like to see REZ design reports for Western Victoria REZ together with an overarching integration plan between proposed REZ design reports.
- Northern Grampian Shire Council noted that through development of REZ design reports, AEMO may delegate areas of responsibility to AusNet, which comes with a risk of fracturing the engagement/consultation process and needs to be actively managed.
- AusNet noted that REZ planning frameworks such as REZ design reports or the New South Wales REZ network authorisation process can de-risk the planning and delivery of REZ infrastructure. It also noted the need to consider the inter-REZ interactions such as opportunities that identify augmentation options that optimise benefits across zones.
- RE-Alliance noted that REZ design reports have not been flagged for the three New South Wales REZs (Central West-Orana, New England and South West NSW REZs). It noted its strong support for the New South Wales Government Electricity Infrastructure Roadmap, but considered that the development of new regulatory and planning processes is taking some time. RE-Alliance noted that for three critical actionable network investments, AEMO said that these projects could proceed under the alternate planning arrangements under the New South Wales Government's Electricity Infrastructure Roadmap. RE-Alliance considered these arrangements to be unclear. RE-Alliance urged AEMO to work closely with the New South Wales Government to deliver certainty and appropriate consultation processes as soon as possible.

AEMO's assessment and consideration

AEMO welcomes stakeholder support for REZ design reports. There are no REZ design reports being triggered in this 2022 ISP, as REZ frameworks are still being defined in some jurisdictions. See Section 7.2.2 of the 2022 ISP for more information.

AEMO notes in response to feedback from ENA and NICE that AEMO will work closely with state governments ensuring compliance with the obligations set out in clause 5.24 of the NER. AEMO will only trigger REZ design reports with state government support, for REZs that require coordination of both generation and transmission infrastructure within 12 years, and are reasonably considered by AEMO to have the support of the Minister for the relevant jurisdiction.

In response to feedback provided by Walcha, AEMO is required to specify the minimum generation capacity, in megawatts, that is projected to be developed in the REZ with the forecast date or dates by which tranches of generation capacity may be developed[30].

In response to feedback provided by RE-Alliance, AEMO has worked closely and will continue to work closely with the New South Wales Government on its Electricity Infrastructure Investment roadmap.

4.9 Hydrogen

Summary of feedback

Many of the submissions that referenced hydrogen related to scenarios and assumptions – these will be captured and considered in development of the 2023 IASR, which will commence later in 2022.

ENA raised the concern that consumers should not be funding transmission infrastructure for hydrogen export, and suggested AEMO split out the network costs between domestic and export hydrogen production.

Origin Energy, AHC and APGA noted that the use of hydrogen pipelines instead of electrical transmission lines could provide an alternative solution for transporting energy, and Origin noted this may mitigate social licence challenges in the future. Origin also noted the potential role of hydrogen in energy storage, with possible storage durations of up to eight hours. AHC noted that the exclusion of off-grid electrolysers in the ISP analysis is likely to compound social licence challenges due to increased competition for land and water within REZs. AHC also noted that for locations with strong VRE potential but limited access to transmission, the REZ scorecards should be expanded. In such cases, the existing network capability is largely irrelevant but a metric relating to access to transport routes, pipelines and ports may be more appropriate.

Regarding the potential impact of electrolysers on infrastructure investment in the NEM, FFI suggested that if gigawatt-scale electrolyser facilities enter the frequency control ancillary services (FCAS) market, this may impact the revenues available to other short-term storage technologies such as utility-scale batteries. FFI also noted that development of gigawatt-scale load centres for hydrogen generation would have a large impact on transmission planning to support the grid, and that AEMO should incorporate potential plans for such facilities as early as possible in the ISP.

Greenpeace stated that AEMO must evaluate the environmental and social impacts of rapid large-scale development of hydrogen production including the impact on water scarcity and local ecosystems.

Comments on scenarios included:

- CEC and Greenpeace questioned the efficiency of converting gas networks to 100% hydrogen.
- CEC and AHC suggested a degree of hydrogen exports should be included in other scenarios.
- VEPC said AEMO should consider removing the *Hydrogen Superpower* scenario, as the default position will likely be for hydrogen users to 'self-supply' with off-grid power.
- FFI said the *Hydrogen Superpower* scenario will become increasingly likely, with some large projects well underway by the time of the 2024 ISP.

[30] NER clause 5.24.1(4)(i)(B) and NER clause 5.24.1(4)(i)(C)

- BZE said residential electrification should be higher in the *Hydrogen Superpower* scenario, as blending of hydrogen into gas networks is too expensive, and industrial electrification should be higher in *Hydrogen Superpower*.

Submitters also commented on inputs, assumptions and methodology in relation to hydrogen forecasting. Comments on inputs included:

- Some stakeholders indicated that the assumed cost of electrolysers should be lower.
- SA DEM identified several ports in South Australia as potential hydrogen production and export sites.

Comments on hydrogen assumptions were:

- ATCO said that hydrogen assumptions should consider the difference between hydrogen that is exported or used domestically, and break down assumed demand into key uses to better define future demand.
- Some stakeholders (Origin, ClimateWorks) said AEMO should consider scenarios with high VRE capacity to allow surplus electricity to produce hydrogen at times of over-supply, while AHC said AEMO should assume greater flexibility and lower cost of electrolysers as the scale of uptake grows.

Comments on hydrogen modelling methodology were:

- AHC said modelling should explicitly account for the cross-sector, system-wide costs of any fuel-switching.
- AHC suggested the model should include the potential for off-grid REZs to produce hydrogen onsite and transport via pipelines.
- AHC noted that a strong solar or wind resource which does not have immediate access to electricity transmission infrastructure may be more suitable for hydrogen production which can then be transported via roads or at larger scale via pipelines.

AEMO's assessment and consideration

In response to ENA's request for splitting out network costs, AEMO's modelling outputs do not provide the split of network costs between domestic and export hydrogen production, and the ISP does not recommend alternative cost-recovery methods in the event a hydrogen industry emerges. The ISP reports on total system costs and the net market benefits of investments to all consumers.

AEMO acknowledges the feedback on the use of hydrogen pipelines as a form of energy storage, and as an alternative to transmission lines, along with AHC's comment on compounded social licence challenges when considering off-grid electrolysers as well as on-grid. The current ISP model does not contain this functionality, but it will be considered for inclusion in future ISPs.

AEMO agrees with the feedback from FFI, and that it is important to continue to consider potential electrolyser developments in transmission planning. The 2022 ISP's inclusion of the *Hydrogen Superpower* scenario, and future refinement of the scenario, will enable greater visibility of hydrogen's influence on future power system needs. These impacts may become clearer as specific projects progress and the level of uncertainty in hydrogen uptake reduces over time.

In response to Greenpeace's feedback, the ISP is limited in its consideration of market benefit classes defined by the AER, and wider environmental and social impacts of hydrogen uptake are not included in the cost benefit analysis framework.

Comments on scenarios, inputs and assumptions will be considered in development of the 2023 IASR, which will commence later in 2022.

4.10 Role of gas

Summary of feedback

The submissions from APA Group, Jemena, and the APGA Group raised concerns about the lack of consideration for the use of gas infrastructure in the ISP. These submissions also put forward the view that using pipelines may in some instances be more cost-effective for energy transport and storage than transmission lines and battery/pumped storage, and this was particularly raised in the context of hydrogen (noted above). Jemena proposed that there are greater benefits to society from using gas infrastructure in a more fulsome way.

APA, EA and Jemena also noted the challenges and potential costs of the level of electrification assumed in the ISP, including fuel-switching of appliances currently using gas. EA noted that scenarios are not intended to highlight the merits of pathways and cannot simply be compared on a total system cost basis.

Several submissions referenced the forecast role for gas generation. Jemena and EA noted the challenges of operating gas generation in the context of electrification in the *Step Change* scenario. EA and Iberdrola questioned whether there are economic signals to justify the way in which these generators operate and considered that further analysis may help to inform whether the current gas system can support this implied use.

APA Group noted its view that the economics of gas generation make it ideal as a backstop for VRE. Tesla, Hydro Tasmania, ETU, and CEC, on the other hand, were opposed to the forecast role of gas generation, noting uncertainty on gas prices and the dual use of gas (direct and for generation).

Jemena suggested the inclusion of a renewable gas target, and consideration of a no-gas scenario to demonstrate the value of gas.

AEMO's assessment and consideration

AEMO acknowledges the feedback from APA, Jemena and the APGA on consideration of gas infrastructure as an alternative to transmission in the ISP. AEMO will consider this feedback in development of the 2023 IASR, which will commence later in 2022.

AEMO also notes the feedback on the potential costs of electrification, and agrees with EA that comparing different scenarios does not highlight the merit of the pathways, because many of the costs and potential benefits of alternatives between scenarios are not considered in the system cost. The total system costs presented are not intended to be compared across scenarios.

AEMO agrees with those submissions noting the potential challenges with gas system funding in futures with volatile gas-fired generation and reducing gas consumption given the level of electrification assumed in the scenarios. Without new arrangements, the potential gas network price implications may be material and inhibitive. This may need to be explored more fully in future ISPs. However, these assumptions are not material to the key recommendations of the 2022 ISP in relation to actionable transmission developments.

Regarding the use of gas fired generation more generally, AEMO's modelling indicates that gas generation will play a crucial role as coal-fired generation retires, complementing storage to provide a firm and flexible resource in periods of peak demand, particularly during long 'dark and still' weather periods. It will help cover for planned

maintenance of existing generation and transmission, and provide essential power system services to maintain grid security and stability. This critical role will persist to 2050, so retiring peaking plants may need to be replaced.

4.11 Modelling approach and development outcomes

Summary of feedback

Submitters commented on the general modelling approach and specific outcomes presented in the Draft ISP. Section 4.17 provides responses to a number of specific matters raised in submissions.

More generally, concerns were raised about the lack of consideration of FCAS (Tesla, EA), and other potential benefits of batteries and hybrid batteries which should be considered by assuming a cost reduction (for example, grid-forming batteries could reduce the need for synchronous condensers).

A number of submissions referred to the role of firming and deep storage in the ISP. Macroeconomics Advisory put forward a view that the ISP undervalues medium and deep storage, as well as dispatchable generation. MGA Thermal requested that the emerging and critical role of thermal energy storage be recognised. ANLEC R&D questioned the approach of the ISP to future market design, noting that minimising costs cannot be achieved if those technologies that deliver a lowest cost system (such as nuclear, and coal with carbon capture and storage [CCS]) are excluded. EPC recommended putting a random variability factor in VRE output, and maintaining a reasonable safety margin between generation and load at all times.

Origin and EA both commented on the level of VRE curtailment. Origin considered that the level of VRE development relative to transmission development could be unrealistic, and questioned whether there is a disconnect between modelling outcomes and what is reasonably practical, noting New England VRE projection by 2028-29 of 6 GW with a network capacity of 3.1 GW. EA recommended further insights into the operations of REZs, likely revenue shortfalls associated by economic curtailment and how storage plays a role, and said that AEMO should also consider the potential for load to locate within a REZ.

AEMO's assessment and consideration

AEMO acknowledges that the ISP does not model FCAS markets, but considers the approach is fit-for-purpose. From a net market benefit perspective, the system cost of providing FCAS is very low because there will be an abundance of resources that are capable of providing FCAS and a relatively shallow market for their services. AEMO will not discount the cost of resources that can provide FCAS because that approach would constitute a wealth transfer.

In regard to system strength, AEMO's approach for estimating costs includes technologies that are commercial or have been demonstrated at a large scale. For this reason, synchronous condensers are used as a proxy for estimating system strength costs. While AEMO expects that alternative technologies, such as grid-forming inverters, are likely to improve system strength in future, their performance and costs are still developing. This provides a robust approach to assessing the need for future network investment, as alternative technologies would only be considered when more optimal than the proxy.

In response to the range of feedback provided on the level of firming capacity and the depth of storage, AEMO's models ensure that the capacity developed is capable of meeting the 10% probability of exceedance (POE) peak demand, when considered across multiple weather reference years. The development plans are verified in time-sequential half-hourly modelling across weather reference years which includes stochastic outage modelling

to confirm that the reliability standard is able to be met. The need for firm capacity does reduce slightly as transmission augmentations assist in sharing resources, and with increased geographical and technological diversity of VRE resources. This is explored in more detail in Appendix 4 of the final ISP (section A4.2.4).

In response to feedback on the level of VRE curtailment, AEMO's modelling recognises curtailment or spill is forecast to occur when there is higher VRE generation available (particularly during daylight hours), and that more seasonal storage or transmission may not be least cost. AEMO also notes that much of the curtailment is at a system level due to an excess of supply of VRE, rather than at an individual REZ level as a result of a transmission constraint.

4.12 System security and reliability

Summary of feedback

Several submissions raised concerns with the use of non-synchronous technologies to maintain system security. Delta Electricity requested AEMO consider a risk-averse approach, being to delay the ISP until after the Engineering Framework has confirmed it is feasible to operate the power system with high levels of non-synchronous generation, and that risks to power system security requirements should be acknowledged with regards to their impact on the ODP.

The APGA noted its concern that the ISP relies heavily on advanced inverters with grid-forming capabilities, and recommended an alternative be considered where these technologies cannot be relied on, with more emphasis being placed on existing options. The need to ensure the grid is secure was also emphasised by ARD and Engineers Australia.

Others requested further detail on how system security is maintained after the retirement of coal generation. From Origin Energy, this included setting out power system requirements, and what level of synchronous generation the grid is capable of hosting given these requirements. EA recommended the ISP provide guidance on whether the ODP would be materially affected if a requirement for synchronous operation was continued. The SA DEM also requested the ISP provide guidance on what technologies may be needed to keep the system secure.

Tesla recommended more consistency in the view of grid-forming inverters across the 2022 ISP and parallel engineering and system security publications supporting advanced inverters providing system stability services. Tesla asked AEMO to highlight the role that grid-forming battery storage will need to play, including the full suite of services that will be provided including system strength, frequency, inertia and voltage stability.

Powerlink suggested the final ISP should consider the adequacy of the ISP investments and other investments in operational conditions including 100% instantaneous penetration of renewables by 2025.

EPC shared that its own modelling suggested lower levels of reliability, higher carbon emissions and higher wind curtailment compared to the ISP, and that more storage would be needed. Similarly, IE&S considered that the system forecast in the ISP is incapable of meeting the reliability standard.

AEMO's assessment and consideration

AEMO recognises the scale of long-term challenges in maintaining power system security as the NEM evolves. At present, thermal power stations are providing most of the system services in the NEM, and these services will need to be delivered through other means after the synchronous generation closes.

The ISP focuses on describing the power system security needs and their timing, rather than specifying technology which could meet the identified need. AEMO remains open to different technologies, existing and future, that might evolve during the outlook period that could provide system security services.

AEMO's approach for estimating costs includes technologies that are commercial or have been demonstrated at a large scale. For this reason, AEMO considers the cost of synchronous condensers as a proxy cost for potential system strength remediation solutions. However, as technology evolves AEMO will explore alternative cost-effective options. In response to Tesla, AEMO acknowledges the potential services that advance inverters with grid-forming capabilities can play once demonstrated at necessary scale.

In response to Powerlink, with regards to 100% instantaneous penetration of renewables by 2025, AEMO is in the process of scoping this assessment, which is likely to include the *2022 System Security Assessments* (system strength, inertia and NSCAS). AEMO also understands that some TNSPs are undertaking their own detailed assessments, and AEMO will continue to explore this further through joint planning and discussion with AEMO's Engineering Framework team.

In response to EPC and IE&S, AEMO's reliability and carbon emissions are based on consulted upon inputs including power station forced outage rates and emissions factors. AEMO's modelling methodologies and published materials (including the ISP models) enable external validation of the modelled outcomes.

4.13 Communication

Summary of feedback

Many of the submissions made requests and recommendations for how the outcomes and process of the ISP are communicated.

A number of participants recommended great clarity in communication, for example:

- Taking into account how descriptions of REZ infrastructure may be perceived by affected communities (Energetic Communities).
- More detail on risks of over-or under-investment, how those risks are impacted under different CDPs, how AEMO has exercised its judgment in the choice of ODP, and how the choice is consistent with consumer risk preferences (ISP Consumer Panel).
- Being mindful of how the ISP influences national conversations around the energy transition and the need for insurance firming technologies (Jemena).
- The limitation of perfect foresight (Hydro Tasmania).
- More clarity on what drives the major projects in the ODP (Engineers Australia, Macroeconomics Advisory).

Stakeholders made requests for additional emphasis on certain matters, including:

- On the increase in overall total system costs compared to the 2020 ISP (EA).
- Caution against specific details in certain scenarios being overemphasised (AGL).
- Reiterating reliability requirements (EA).
- That the ISP should not hinder investment in considerations outside the scope of the ISP (CopperString 2.0).
- What the ODP means for retail bills/wholesale prices more generally (Origin, EPC, SACOSS).

- That the ISP should include system Levelised Cost of Energy (LCOE) analysis (IE&S), and whole-of-life analysis of emissions.
- More details provided on challenging weeks (Iberdrola).

AEMO's assessment and consideration

AEMO thanks stakeholders for their suggestions on how outcomes are communicated in the ISP. AEMO has attempted to address many of these requests and suggestions in the final ISP, particularly:

- The reasoning behind the selection of the ODP and the costs and benefits associated with the status of key actionable projects have been articulated more clearly.
- With regards to the communication of perfect foresight and the insurance value of firming technologies, these considerations have been made clearer, particularly in describing potential risks.
- AEMO has sought to expand the discussion on a number of topics including the impact on retail bills, challenging weeks and the cause of potential reliability risks.
- AEMO has not attempted to include a system LCOE analysis, and notes that CSIRO conducts an LCOE analysis as part of its GenCost publication.
- AEMO notes the feedback from AGL on balancing the information and not over-emphasising certain scenarios. AEMO's communication focuses on projections of the development opportunities needed in the most likely scenario, but recognises that other outcomes exist within the scenario collection, and across a broader range of futures across many dimensions.
- AEMO has made note of the significant increase in system costs compared to the 2020 ISP, and the reasons for this increase, in Appendix 6.

4.14 Recommendations for the 2024 ISP

Summary of feedback

Several submissions provided recommendations for the 2024 ISP, including:

- Greater consideration of the role of hydrogen and renewable gases in all scenarios (APGA).
- Adjustments to the use of the Delphi panel for scenario weightings (ISP Consumer Panel).
- Considering adjusting the role of offsets in emissions budgets (Iberdrola).
- Increasing the consideration of the potential role of biomass technologies (ASMC).
- Identifying and implementing learning and development opportunities to build a community of practice amongst consumer stakeholders who wish to engage in the ISP development process or use information from the ISP to inform other process (ISP Consumer Panel).
- Extending the transmission cost database to explicitly include analysis of likely social licence costs and supply chain risks (ISP Consumer Panel).

AEMO's assessment and consideration

AEMO thanks stakeholders for their suggestions for the 2024 ISP. A number of these suggestions are being actively considered in the early stages of the 2023 IASR. Similarly, the suggestions on process are being considered in formulating the engagement plan for the 2024 ISP.

4.15 Data and model release

Summary of feedback

Stakeholders generally supported the level of transparency AEMO provides on inputs, models and outputs to enable stakeholders to further their own analysis. A number of requests were made for the release of additional data, across a number of dimensions (Delta, EA, Powerlink, IEEFA, EPC).

AEMO's assessment and consideration

AEMO publishes a significant volume of material, including the capacity outlook model that may be used to replicate parts of the ISP. AEMO's level of published data granularity is limited to a reasonable data size, and focuses on material directly relevant to the determination of the ODP, including the details regarding ISP development opportunities. AEMO encourages stakeholders to seek their own advice if attempting to apply the ISP modelling data to decision-making for other purposes.

Significant modelling detail is also available in the 2021 IASR and the accompanying consultant reports (for example, the CSIRO/ClimateWorks Australia report on multi-sectoral modelling provides context and details of the method for deriving the NEM's carbon budgets, applied in the ISP models).

AEMO also publishes a significant volume of half-hourly trace data on demand and renewable resources across the REZs. This includes new details since the Draft ISP's publication on the calculation of firmness of VRE.

AEMO agrees that the publication of the primary capacity outlook model is important for transparency and to give stakeholders the ability to conduct their own analysis to support and enhance the findings of the ISP.

4.16 Additional feedback from ISP Addendum

Summary of feedback

In its submission to the ISP Addendum, AGL referenced AEMO's description of a least-cost approach to coal retirements in the *Slow Change*, *Step Change* and *Hydrogen Superpower* scenarios. AGL stated that because this approach does not adequately consider short-term revenue outcomes, these scenarios result in more rapid coal closures and more rapid buildout of sub-economic transmission and generation projects than what is supported by existing market structures and policies. As such, AGL considered that the scenario weights were inappropriate considering the lack of policy direction to achieve the long-term benefits forecast in each scenario. AGL also recommended AEMO more clearly articulate how inputs such as emissions trajectories would need to be supported by the market in the absence of government policy drivers.

Hydro Tasmania noted the discussion on the trade-offs between optimal timing and economies of scale, and put forward its view that the "just in time" approach to investments is increasingly difficult given the rate of industry

transition, and that this may create additional risk for consumers. Hydro Tasmania also noted its support for revenue adequacy considerations in forecasting coal closures.

Snowy Hydro's feedback was that AEMO's ISP Addendum only demonstrated the significant deficiencies that remain unanswered. Snowy Hydro reiterated its feedback on the Draft ISP that the costs of the imposition of decision rules outweighed their benefits. In Snowy Hydro's view, the information provided in the ISP Addendum showed that AEMO is ignoring the realities associated with project delivery. Snowy Hydro was critical of the level of dispatchable capacity that the ISP Addendum implied could defer the need for transmission projects, and questioned how the timing of VNI West aligns with state-based renewable energy targets. Snowy Hydro also questioned whether flexibility is being adequately considered, noting considerations such as sustained periods where long duration storage is needed.

AEMO's assessment and consideration

In response to AGL's feedback on the *Step Change* scenario, these matters are discussed more extensively in Section 4.4 of this report.

AEMO notes the importance of Hydro Tasmania's comments on the "just in time" approach given the speed and uncertainty in the transition of the energy sector, and has considered this in determining and justifying the ODP via the CBA and sensitivity analysis on insurance and option value.

In relation to Snowy Hydro's feedback, AEMO's position is outlined in Section 4.1, in relation to both decision rules and VNI West. Furthermore, AEMO considers that ISP modelling takes into account many types of flexibility, and notes the role of storage at a variety of depths, and gas generation, to meet the needs of consumers across all time periods. Appendix 4 of the ISP provides detailed assessments of the operability of the NEM.

4.17 Additional items of specific feedback

Feedback received	AEMO Response
VEPC argues against HumeLink, stating that the cost of Snowy 2.0 should be included in AEMO's assessment, and also raised concern with the assumed operation of Snowy (e.g. that Tumut 3 should be fully loaded before using Snowy 2.0).	With regards to the feedback from VEPC, AEMO's considers that: • Snowy 2.0 is a committed project that has commenced construction and therefore is not appropriate to be taken into account in assessing the costs and benefits of HumeLink. • AEMO does not assume that Tumut 3 is "fully loaded" before using Snowy 2.0. The operation of the combined Snowy scheme is always optimised subject to constraints in the transmission network and on the management of the flow of water between the various storages. The inclusion of Snowy 2.0 and/or HumeLink impacts on how water would be optimally used to minimise system costs.
The **BBF** and **VEPC** put forward a number of concerns regarding the assessment of Marinus Link, including: • Questioning the assumptions for Basslink operation when Marinus Link is in operation. • Whether the reliability of transmission was considered. • The inclusion of the cost of TRET, the cost of Tasmanian renewable investment and considerations of Victorian self-sufficiency. • The cost of storage in Victoria relative to the cost of Marinus Link. • Whether the profitability of Basslink was taken into account.	In response to the feedback from the Bob Brown Foundation and the VEPC, AEMO has the following comments: • It would be inappropriate to assume Basslink is fully loaded before Marinus Link can be used – the two lines would operate co-optimally. • Transmission outages are not considered; were these to be added, it may increase the resilience benefits of Marinus Link given the potential outages and impacts during Basslink outage. • The TRET is a legislated policy and meets the criteria outlined in the public policy clause (NER 5.22.3(b)). AEMO also conducted sensitivity analysis on removing the TRET, and reported that Marinus Link would still proceed without the policy (with up to four years delay from the original EISD only, in *Progressive Change*). See Section 6.4 of the Draft ISP. • Marinus Link delivers a multi-faceted benefit beyond simply storage. • The profitability of Basslink is not taken into account; profitability of an MNSP is not an objective assessed in minimising costs to consumers.

Feedback received	AEMO Response
Origin notes that the actionable ISP project for New England REZ increases capacity by 3.1 GW with an expected cost of $1.9 billion, equivalent to $0.62 million/MW which is inconsistent with the transmission cost database which lists expansion options for New England REZ ranging between $1.08 and $1.76 million/MW. They note that it would be useful to understand what is driving the difference between the original options and the now preferred option recommending AEMO examine its transmission cost assumptions for further inconsistencies.	In response to feedback from Origin, AEMO notes that the transmission network augmentation for this REZ is represented in two sections of the Transmission Cost Reports, in flow path augmentations and REZ augmentations. Under options to expand this flow path, the Transmission Cost Report includes options 1 to 10 under Central New South Wales (CNSW) to Northern New South Wales (NNSW) flow path which also increases the capacity to this REZ. The costs of the flow path augmentations range from $0.56/MW to $1.09/MW. The ISP further refined CNSW-NNSW option 6 (flow path) through analysis to include option 6A and option 6B. In addition to the 10 flow path augmentation options, there are also 5 options to develop this REZ under REZ augmentations listed in the Transmission Cost Report ranging from $0.56/MW and $1.76/MW. The recommended actionable ISP project, CNSW – NNSW Option 6A, from the Draft ISP for New England REZ builds on the flow path augmentation for CNSW – NNSW option 6 listed in the transmission cost report. More information is also provided in the updated inputs and assumptions workbook.
Walcha Energy recommended for New England REZ: • Completing a 330 kV network expansion for New England REZ concurrently with the 500 kV actionable project New England REZ transmission link proposed in the Draft ISP. They note that it can be delivered quicker than the 500 kV option and, with many generator connections expected to connect on the 330 kV network, that it makes no sense to delay the grid reinforcement. • A proposed sequence of development between Armidale and the Hunter Valley/Newcastle area: Stage 1 includes the development a high capacity 330 kV double circuit line connecting Armidale – Uralla hub – Dungowan hub – Liddell and rebuilding a Liddell – Newcastle 330 kV line as a double circuit. Stage 2 includes the development of 500 kV lines between Bayswater, Uralla and Norther New England REZ. Stage 3 includes 500 kV lines between Uralla and Richmond Vale. • Considering terminating the 500 kV lines, for the future New England REZ Extension, at Richmond Vale rather than at Bayswater. This may be more efficient considering the expected load growth in the Newcastle area.	AEMO welcomes the detailed feedback received from Walcha in relation to the development of New England REZ. The ISP has identified the 500 kV network as the optimal path to develop this REZ. Generator connection, community engagement and consultation are underway by EnergyCo which will help inform the timing and the detailed design of the New England REZ. With respect to the termination of the 500 kV network for New England REZ extension, AEMO notes that this is a future ISP project which is conceptual and is expected to evolve from one ISP to the next. We welcome the feedback to consider an alternative termination point than Bayswater. AEMO will further explore this through future ISPs.
Walcha Energy considers that both the north and the south sections of the NSW 500 kV loop should proceed concurrently, targeting completion of the northern loop in July 2027 and the southern loop by 2028. They also call for the 2022 ISP to initiate further development of the 330 kV network in New South Wales within the 500 kV ring including immediate action to reinforce the Armidale – Tomago – Newcastle 330 kV network.	In response to Walcha with regards to Sydney 500 kV ring, the 2022 ISP has not determined a need to close both the southern and northern loop concurrently.
Powerlink recommended that the ISP note the potential for further augmentation to Gladstone.	The ISP includes new commentary on this matter in Appendix 5.
The **QCC** noted the lack of actionable projects in Queensland.	In response to the QCC, AEMO has not found any projects that are requiring immediate action to be classified as an actionable project, but do note there is development required from FY2029. This includes Darling Downs REZ and Gladstone Grid . In addition, AEMO has identified two new preparatory activities required to be completed for use in the 2024 ISP. In subsequent ISPs it is possible that these investments will become actionable projects.
RE-Alliance considers that AEMO's approach of using existing corridors should be reconsidered, as over time the corridor may become densely populated and less suitable for transmission projects.	AEMO acknowledges RE-Alliance feedback that existing corridors may become densely populated overtime, noting that obtaining the necessary easements can become more challenging over time. AEMO considers options to expand the network that considers new, diverse routes and routes along existing corridors. Early procurement of strategic corridors could assist to reduce these risks.

Feedback received	AEMO Response
Smart Wires welcomed the inclusion of power flow controllers in the ISP Methodology and were pleased that AEMO is considering the potential benefits of MPFC solutions on both new and existing transmission assets.	AEMO acknowledges that power flow controllers can increase network capacity and have considered them in a range of network augmentations. AEMO expects that TNSPs will consider the merits of different power flow control technologies in more detail through the RIT-T process.
IE&S recommended that considerations of national security be included in the CBA, and the **Bob Brown Foundation** recommended the inclusion of biodiversity as a consideration.	AEMO appreciates the suggestion of expanded considerations for the cost benefit assessment. The CBA Guidelines currently limit the assessment to exclude any market benefit which cannot be measured as a benefit to generators, DNSPs, TNSPs and consumers of electricity. In determining the ODP, AEMO has taken into consideration the potential risk of schedule slippages and early coal retirements, and has noted challenges associated with supply chain and social licence that will need to be addressed to deliver this new infrastructure.
Powerlink recommended that the Borumba Dam project should be included in the final ISP.	AEMO has conducted sensitivity analysis to examine the impact of the development of Queensland storage on the ODP. AEMO has noted that this is not sufficient to change the selection of actionable projects. AEMO has also noted that deep storage is vital to manage seasonal and long-duration variations in renewable resource availability, and that early investment in deep storage across the NEM will enable improved resilience to earlier coal closures or project commissioning delays.
Origin questioned why the generation outcomes do not align with the NSW IIO report.	With regards to alignment with the IIO report, the ISP modelling has aligned with the IIO report's recommended development path in terms of the speed of VRE and storage investment as a minimum requirement, but can accelerate beyond that depending on the drivers in each scenario. Some differences are present due to the additional committed and anticipated generation assumed in the ISP.
The **VEPC** believes that the ISP's approach to NPV understates costs relative to benefits.	AEMO's approach first annualises payments over the economic life of each asset from the moment they are incurred, in a given development path. Critically this is done for not only transmission but also generation, and this approach allows the evaluation of projects with different asset lifetimes on the same basis. Net market benefits are calculated by subtracting the annual cost of a development path from the (higher) annual cost of a counterfactual with no transmission, so net market benefits are avoided costs. These net market benefits can then be discounted back to 2021 to arrive at a single NPV figure for the net market benefits of a given development path. The submission argues that such an approach distorts the calculation of net present value because expenditure is discounted more relative to income (given how expenditure occurs before revenues). The fundamental difference with the ISP approach is that net market benefits are avoided costs otherwise incurred in a counterfactual at any given year, not later. Costs and benefits (avoided costs) of a development path are then treated equally if incurred on a particular year.
The **Australian Sugar Milling Council** raised concerns with the absence of co-generation in the sugar industry, which can help manage intermittency.	With regards to biomass, existing biomass generators are modelled, however for the 2022 ISP the technology was not an active development option, and the additional co-generation potential was not identified. AEMO will continue to explore what are the most relevant biomass technologies for inclusion in future ISP and GenCost processes, also noting the multiple uses of biomass, both for co-generation or as feedstock to produce biofuels, including biogas. AEMO welcomes data submissions on generation potential to inform the 2023 IASR.
Snowy Hydro questioned the decline in firming capacity until 2034, and that the ISP has erroneously focused on energy rather than capacity, and has not considered the probability distribution of NEM peak demand.	In response to Snowy Hydro, the ISP does not focus on either energy or capacity in isolation, but ensures resources are developed to meet both energy and capacity-related requirements at least cost. AEMO acknowledges that the capacity outlook models do assume perfect foresight, however the time-sequential models used to confirm reliability have far less foresight (only extending for a period of 1-2 days at a lower resolution). For future ISPs, AEMO will continue to explore how the impact of imperfect foresight could be considered in the capacity outlook model. Similarly, considerations of VRE variability beyond that reflected in historical reference years is also being considered as a further improvement.