AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

ISP Methodology – Consultation Summary Report

July 2021

Consultation Summary Report

For the Integrated System Plan (ISP)

Important notice

PURPOSE

AEMO publishes the Consultation Summary Report – ISP Methodology pursuant to National Electricity Rules (NER) 5.22.8(d). This report includes key information and context for the methodology used in AEMO's ISP.

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VERSION CONTROL

Version	Release date	Changes
1.0	30/7/2021	Initial Release

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1. Introduction

The *Integrated System Plan* (ISP) is a whole-of-system plan that provides an integrated roadmap for the efficient development of the National Electricity Market (NEM) over at least the next 20 years.

AEMO considers that leveraging expertise from across the industry is pivotal to the development of a robust plan that supports the long-term interests of energy consumers. AEMO is committed to facilitating a stakeholder engagement process that ensures a collaborative approach to developing the 2022 ISP.

In the development of the *ISP Methodology*, AEMO has also addressed the binding elements of the Australian Energy Regulator's (AER's) Forecasting Best Practice Guidelines and the Cost Benefit Analysis Guidelines (CBA Guidelines). This included:

- Providing a transparent process.
- Supporting and working with stakeholders in their understanding of AEMO's methodologies.
- Providing additional information to complement the formal documentation.

Purpose of the ISP Methodology

AEMO has published the *ISP Methodology*, which accompanies this consultation summary report and sets out the methodologies for:

- **Modelling** – the methodologies for the capacity outlook models, time-sequential model, and engineering assessment.
- **Cost benefit analysis** (CBA) – an overview of AEMO's approach to applying the steps outlined in Section 3.3 of the AER's CBA Guidelines. This section also:
  - Differentiates between scenarios and sensitivities and outlines how each is treated differently in helping inform the determination of the Optimal Development Path (ODP).
  - Discusses the approach to take-one-out-at-a-time (TOOT) analysis, which will form part of the approach to undertaking CBA.
  - Outlines how AEMO will determine weights for scenarios

The combination of the processes described above leads to the determination of the ODP that optimises benefits to consumers and has a positive net benefit in the most likely scenario.

Consultation Process

An initial Issues Paper was the first part of this process in February 2021. Following written submissions and a workshop hosted on 1 April 2021, AEMO published the *Draft ISP Methodology* on 30 April 2021. AEMO then hosted a webinar on 17 June 2021 to workshop recommendations in the written submissions. This document summarises submissions to the *Draft ISP Methodology* and outlines changes AEMO has made to incorporate feedback into the final *ISP Methodology* (see Figure 1 for more information).

Figure 1 Timeline for ISP Methodology process

Next steps

AEMO will use the attached *ISP Methodology* in developing the 2022 ISP. AEMO is required to update the *ISP Methodology* at least every four years. If AEMO considers the *ISP Methodology* to no longer be best practice, or if a material change requires an earlier review, AEMO may update and consult on changes to the *ISP Methodology* outside the four-yearly process in accordance with the AER's Forecasting Best Practice Guidelines.

1.1 Broader ISP processes and consultation

2022 ISP publications to date

The *ISP Methodology* is a major publication in the process to develop the ISP. It complements the *Inputs, Assumptions and Scenarios Report* (IASR), which finalises inputs, assumptions and scenarios for the ISP. AEMO has published:

- The **2022 ISP Timetable** in October 2020, providing a high-level overview of the key milestones related to the 2022 ISP, and allowing stakeholders to understand and engage in the ISP consultation process.
- The **Draft IASR** in December 2020, proposing the scenarios to be used, as well as detailing current inputs and assumptions in relation to a variety of considerations for use in the 2022 ISP, including the approach for updating current assumptions for use in the proposed scenarios. Before the Draft IASR was published, multiple stakeholder engagements had taken place to inform the content, including workshops and webinars.
- The ***ISP Methodology Issues Paper*** in February 2021, which provided an overview of existing methodologies (used in the 2020 ISP), and information on where these are discussed elsewhere (if applicable), in addition to areas where AEMO is looking to enhance existing methodologies (used in the 2020 ISP) or introduce new methodologies to keep pace with emerging industry developments or align with the CBA.
- The ***Draft ISP Methodology*** in April 2021, which provides AEMO's position on submissions to the *ISP Methodology* Issues Paper and seeks feedback on the *Draft ISP Methodology*. This was also informed by stakeholder feedback at the *ISP Methodology* workshop on 1 April 2021.
- The ***Draft 2021 Transmission Cost Report*** in May 2021, which forms part of the IASR and sets out AEMO's proposed approach to transmission cost estimation for the 2022 ISP. This includes a cost estimating tool, and a summary of the design, capacity, and cost estimate for candidate transmission projects in the 2022 ISP. Before the *Draft 2021 Transmission Cost Report* was published, multiple stakeholder engagements had taken place to inform the content, including workshops and webinars.
- The ***2021 IASR***, supplemented by the ***2021 Transmission Cost Report*** and a consultation summary report that outlines how stakeholder feedback informed the final inputs, assumptions, and scenarios.

The publication of the *ISP Methodology* marks the end of consultation on ISP modelling methods that utilise the inputs and assumptions in the IASR. These methods, and proposed refinements and improvements, are not reliant on individual assumptions or the scenario definitions.

2022 ISP ongoing consultations

Figure 2 below shows the status of the main ISP consultations. Before developing and consulting on the Draft 2022 ISP, AEMO is required to:

- **Consult on inputs, assumptions and scenarios** – AEMO received submissions from 47 stakeholders on the Draft IASR. Following a submission webinar in March 2021, a series of Forecasting Reference Group (FRG) meetings, and a separate consultation on transmission costs, AEMO released the 2021 IASR on 30 July 2021.
- **Consult on the *ISP Methodology*** – after the *ISP Methodology Issues Paper* was published in February 2021, publication of the *Draft ISP Methodology* marked the second major milestone for the development of an ISP methodology. AEMO released the final *ISP Methodology*, which accompanies this report, on 30 July 2021.

Figure 2 Parallel ISP consultations

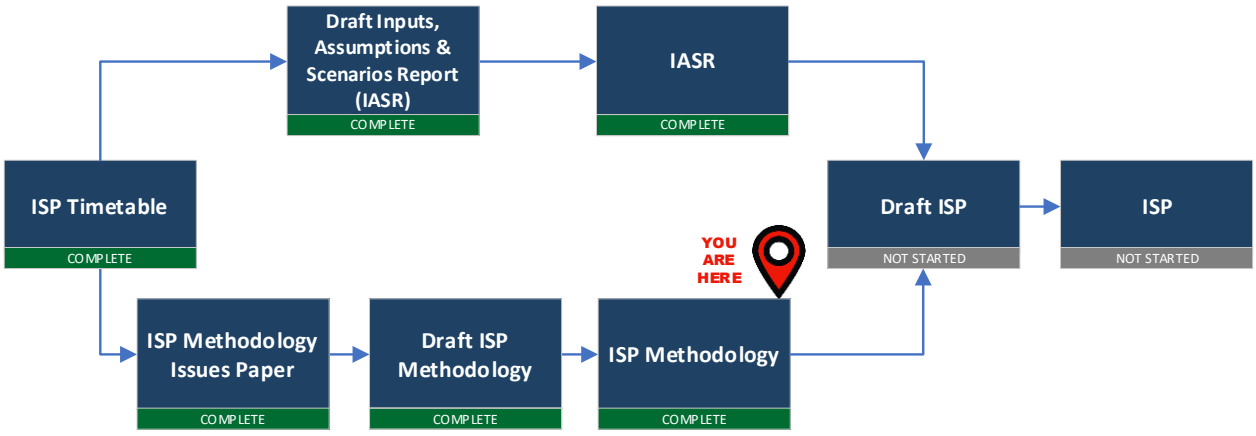
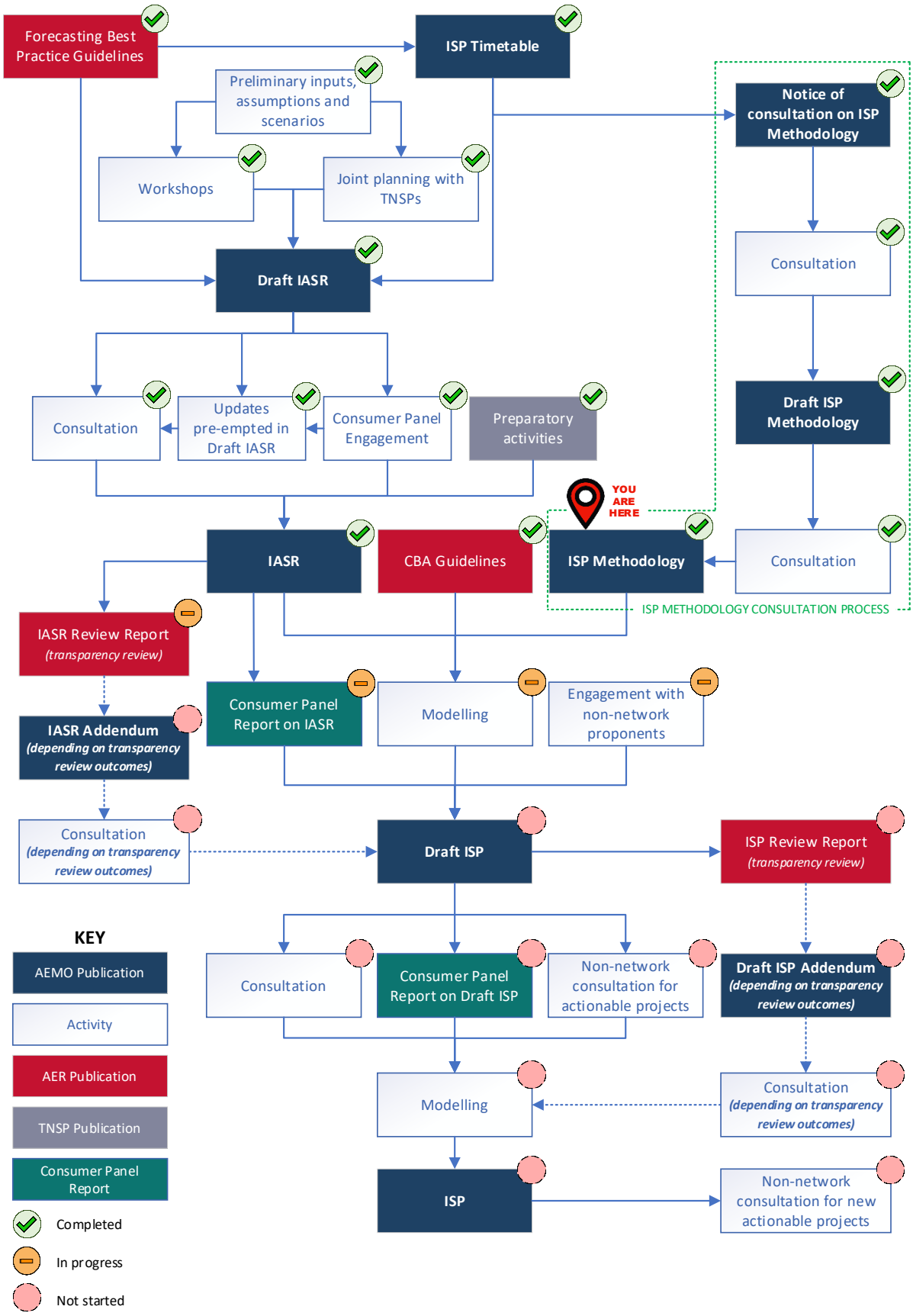


Figure 3 below shows the ISP process as a whole, noting current progress on all elements. The *ISP Methodology* consultation process is also highlighted within the overall process.

Figure 3 Navigating the ISP process



Supplementary materials

Table 1 below outlines related methodologies and information that will be used in preparing the 2022 ISP. Stakeholders are invited to refer to these documents for further background and context.

Table 1 Related methodologies and procedures

Document	Description	Location
2020-21 Planning and Forecasting Consultation on Inputs, Assumptions and Scenarios	AEMO has recently completed consulting on the scenarios, inputs and assumptions proposed for use in AEMO's 2021-22 forecasting and planning activities, including the 2022 ISP	https://aemo.com.au/consultations/current-and-closed-consultations/2021-planning-and-forecasting-consultation-on-inputs-assumptions-and-scenarios
Electricity Demand Forecasting Methodology Consultation	AEMO has completed a consultation on its *Electricity Demand Forecasting Methodology* under section 2.1 of the AER's Forecasting Best Practice Guidelines. The Methodology forms part of AEMO's Forecasting Approach.	https://aemo.com.au/en/consultations/current-and-closed-consultations/electricity-demand-forecasting-methodology
2021 GSOO Gas Supply Adequacy Methodology	The *Gas Statement of Opportunities* (GSOO) provides AEMO's forecast of annual gas consumption and maximum gas demand, and reports on the adequacy of eastern and south-eastern Australian gas markets to supply forecast demand over a 20-year outlook period. This document describes the methodology and assumptions used to assess supply adequacy for the 2021 GSOO.	https://aemo.com.au/en/energy-systems/gas/gas-forecasting-and-planning/gas-statement-of-opportunities-gsoo
ESOO and Reliability Forecast Methodology Document	The *Electricity Statement of Opportunities* (ESOO) provides AEMO's forecast of electricity supply adequacy to meet the demands of an evolving consumer demand over a 10-year outlook period. This methodology explains the key supply inputs and methodologies involved in determining the expected unserved energy (USE) outcomes, for the ESOO and reliability forecast. It also explains how the forecast reliability gap and forecast reliability gap period are determined. This methodology provides relevant components that are shared with the ISP, outlined in the *ISP Methodology*.	https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-reliability/nem-electricity-statement-of-opportunities-esoo
Engineering Framework	The *Engineering Framework* provides a map to help stakeholders stay informed of the changing technical needs of the power system, the work underway to meet these changing needs, how the different pieces fit together, and how they can engage on topics of interest.	https://aemo.com.au/en/initiatives/major-programs/engineering-framework

2. Summary of changes – *ISP Methodology*

This section summarises the key developments and changes in methodology since the *Draft ISP Methodology*. AEMO has also published a 'tracked changes' version of the final *ISP Methodology* showing all revisions.

Inclusion of offshore wind zones

Several submissions recommended that AEMO include more offshore wind resources both within and outside existing REZs.

In response, AEMO has updated the definition of REZs in section 2.3.4 to include a sub-category of offshore wind zones (OWZs). These OWZs are treated in a very similar way to onshore REZs, with minor adjustments to the approach to reflect the particular nature of offshore wind projects.

The location of OWZs include Illawarra Coast, Hunter Coast, and North West Tasmania Coast. AEMO has also modified the boundary of the Gippsland REZ to reflect connection interest and avoid overlapping the adjacent OWZ.

Added "sea" (in addition to land) on project commitment criteria questions

AEMO received feedback that sea areas were not included in the project commitment criteria questions. In response, AEMO has updated the project commitment criteria questions in Table 2 to reflect 'land or sea' developments.

Added approach to sensitivity testing using a higher discount rate.

AEMO received several written submissions and feedback during the *Draft ISP Methodology* webinar[1] on the appropriateness of the discount rate applied to ISP projects. Concerns related to the assumption that annual benefits, which are uncertain in nature, are greater than or equal to annualised costs beyond the 2050 planning horizon, which could result in stranded asset risk should this prove false. Some stakeholders suggested that AEMO should consider applying higher discount rates to transmission projects as this would result in more cost being recouped within the planning horizon.

As outlined in the 2021 IASR, AEMO engaged independent expert opinion on the appropriate discount rate to apply to generation and transmission assets, as well as a range of discount rates. Like other key variables, AEMO will apply sensitivity analysis on this range to ensure the robustness of the ODP. The importance of this sensitivity testing has also been outlined in Section 5.2 of the *ISP Methodology*. More information is available in the 2021 IASR. Applying a higher discount rate to transmission than to generation and storage investments was not recommended by the independent expert (as detailed in Synergies Economic Consulting's report[2]).

[1] AEMO, Draft ISP Methodology webinar, available at https://aemo.com.au/-/media/files/major-publications/isp/2022/isp-methodology-webinar.mp4?la=en&hash=77EF3C9D0EEF34BC2C46BB72B1B1155A.

[2] Synergies Economic Consulting, Discount rates for use in cost benefit analysis of AEMO's 2022 ISP, available at https://aemo.com.au/en/energy-systems/major-publications/integrated-system-plan-isp/2022-integrated-system-plan-isp/current-inputs-assumptions-and-scenarios.

Clarification of non-network consultation

AEMO received several submissions stressing that non-network solutions should be given more consideration as viable alternates compared to network augmentations.

AEMO agrees that a robust consideration of non-network solutions in addition to network alternatives is required, and notes that non-network options were consulted on via the Draft IASR and in the *Draft 2021 Transmission Cost Report*. In response to this feedback, AEMO has added text in Section 2.3.3 to clarify that AEMO will consult further on non-network options for all actionable ISP projects to ensure they are considered appropriately[3].

Removed hydro reservoir information

AEMO has previously documented asumptions detailing the approach to individual hydro schemes in the Market Modelling Methodology Paper. The assumptions were documented in the *Draft ISP Methodology* but have now been moved to the *2021 IASR*[4].

Removed boxes that referenced stakeholder feedback

The 'consideration of stakeholder feedback' boxes present in the *Draft ISP Methodology* have been removed in the final version. AEMO has also released a separate 'tracked changes' version of the final *ISP Methodology*. These changes are in line with suggestions made by EnergyAustralia.

Hydrogen production

AEMO has continued to refine its approach to how hydrogen production is modelled, particularly regarding the treatment of the new export industries modelled in the Hydrogen Superpower scenario. The export of hydrogen is assumed to be first converted into ammonia, with the ammonia facility operating as a constant load throughout the year. The electrolysers are also assumed to have some constant level of electricity demand.

In response to stakeholder feedback, export-focused electrolysers are considered more likely to be larger, and the balance of plant will represent a smaller proportion of the total site demand. This is supported by observations of the largest presently operating Proton Exchange Membrane (PEM) electrolyser, Energiepark Mainz[5]. Therefore the fixed load component of export electrolysers has reduced to 2% (electrolysers used for domestic purposes will continue to use an assumption of 4.5%).

Through the multi-sectoral modelling, the growth of a green steel industry is also considered. These new facilities will be co-located with the hydrogen export facilities that are identified as most cost-effective. The green steel includes a direct electricity demand (from the electric arc furnace) and a hydrogen demand.

Finally, while it is recognised that there may be a strong variability in seasonal demand for domestic hydrogen, it is assumed that this will be managed through large underground storages. Consequently, hydrogen production will not be considered to have a seasonal profile.

These assumptions are reflected in the *2021 IASR* (see Section 3.3.14).

[3] AEMO will consult on non-network options for all actionable projects in the Draft ISP or final ISP in accordance with 5.22.12 and 5.22.14(c)(1) of the NER.

[4] At https://www.aemo.com.au/energy-systems/major-publications/integrated-system-plan-isp/2022-integrated-system-plan-isp/current-inputs-assumptions-and-scenarios.

[5] Kopp, M., Coleman, D., Stiller, C., Scheffer, K., Aichinger, J., Scheppat, B. et al. (2017), "Energiepark Mainz: Technical and economic analysis of the worldwide largest Power-to-Gas plant with PEM electrolysis", International Journal of Hydrogen Energy, Vol. 42, Issue 52.

3. Summary of feedback

3.1 Submissions

AEMO received feedback from 17 stakeholders during the consultation on the *Draft ISP Methodology*; these stakeholders are listed in Table 2. The submissions are available on AEMO's website. AEMO also undertook a series of one-on-one engagements. A verbal feedback session was held with consumer advocates, who provided feedback that was considered by AEMO in the same way as all other written submissions. AEMO would like to thank all who provided feedback throughout this process.

Submissions covered a broad range of topics, providing AEMO with a valuable perspective on stakeholders' collective view of the *Draft ISP Methodology*. While there was comprehensive coverage of topics, there were also common themes, as shown in Table 3 (in Section 3.2).

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

Stakeholder	Form of submission
AGL	Written
Australian Industry Group (AI Group)	Consumer advocate feedback session
Electrical Trades Union (ETU)	Written
Energy and Water Ombudsman South Australia (EWOSA)	Consumer advocate feedback session
EnergyAustralia (EA)	Written
Etrog Consulting (Etrog)	Consumer advocate feedback session
ISP Consumer Panel (Consumer Panel)	Written and consumer advocate feedback session
Major Energy Users (MEU)	Written and consumer advocate feedback session
Maritime Union of Australia (MUA)	Written
Mark Henley / Uniting Communities	Consumer advocate feedback session
Monash University	Written
Origin Energy (Origin)	Written
Powerlink Queensland (Powerlink)	Written
Public Interest Advocacy Centre (PIAC)	Written
Queensland Farmers Federation (QFF)	Consumer advocate feedback session
Total Environment Centre (TEC)	Consumer advocate feedback session
Victorian Bioenergy Network (VBN)	Written

3.2 Summary of key themes

AEMO received feedback from stakeholders on a wide range of key areas from the *Draft ISP Methodology*, which have been categorised in the left of Figure 4 based on which section of the Methodology they fall within. The capacity outlook modelling section received the highest number of responses, and is further refined into the themes presented in the right of Figure 4.

Figure 4 Topics of interest

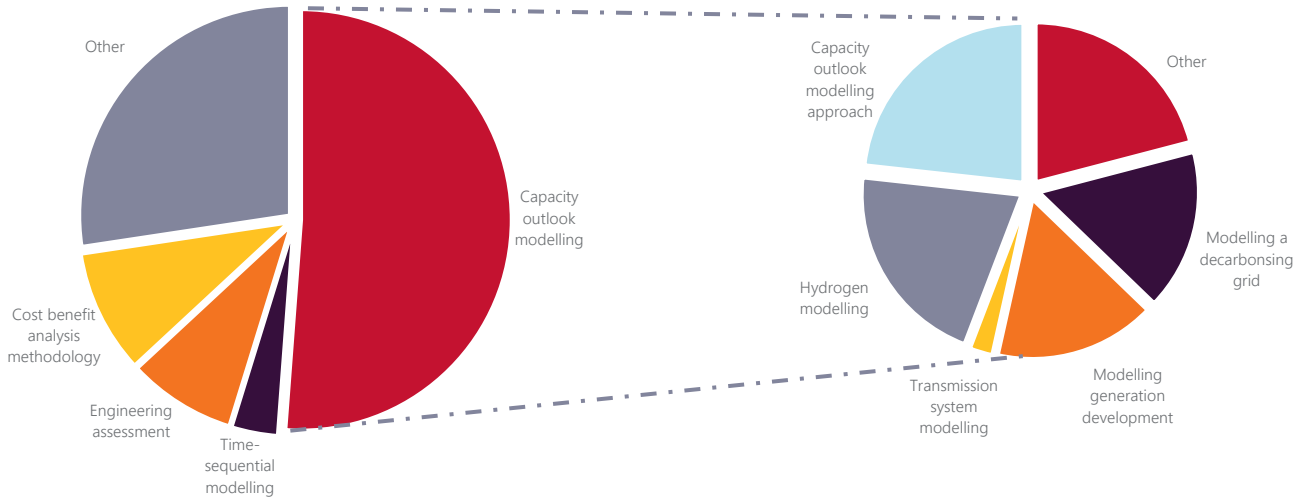


Table 3 provides an overview of the themes that emerged from the submissions seen in Figure 4. Section 4 provides detailed discussion of the feedback received, and AEMO's responses.

Table 3 Key themes from submissions to the *Draft ISP Methodology*

Theme	Description	Submitter(s)
Hydrogen modelling	The uncertainty regarding uptake of hydrogen warrants caution in modelling by AEMO.	ISP Consumer Panel, PIAC, MEU
	AEMO should consult on the location and network connection type (private network or transmission network) of hydrogen electrolysers for modelling assumptions.	MEU, EWOSA, PIAC
	AEMO should consider a wider range of services that hydrogen may provide.	AI Group
	AEMO should consider development of variable renewable generation, in particular wind generation, to supply local hydrogen loads and offset network development.	MUA, ETU
Modelling a decarbonising grid	AEMO should consider the modelling of earlier than anticipated generator retirements.	AGL, PIAC
	AEMO should undertake further consultation on emission trajectories and the related electrification of loads.	EA, VBN
Modelling generation development	AEMO should carefully consider the inclusion of anticipated projects or plans (be they government or private), and sensitivities should be conducted where investments are highly dependent on such assumptions.	Powerlink, PIAC, ETROG

Theme	Description	Submitter(s)
	Further consideration of biomass for electricity and heat production should be made in the ISP. The potential for offsets and derived biofuels furthers this cause.	VBN, EA
Capacity outlook modelling approach	Forecast photovoltaics (PV) rates should take into account recent installation rates and also factor in the export constraints levied on rooftop solar in South Australia and the Energy Security Board's consideration for similar arrangements elsewhere.	Powerlink, Origin
	AEMO should consider ways to better model gas including the impact of carbon tax on gas prices and how better to co-optimise and coordinate in modelling.	ISP Consumer Panel, VBN
	AEMO should provide further consideration and clarification of who pays with respect to system strength remediation.	AGL, MEU
	Offshore wind should be modelled as a possible candidate generation source for more REZs than just Gippsland and included in the counterfactual scenario.	MUA, ETU
	The ISP should more rigorously consider non-network solutions including applications to edge of grid customers.	MEU, Uniting Communities, ETROG
Transmission system modelling	The ISP should recognise that delivering multiple major projects side by side will increase delivery costs.	MEU
Wider societal costs and benefits	The costs and benefits assessed in the ISP modelling should be expanded to include: • Transition costs for affected communities with respect to new REZs being developed more than 50 km from existing coal powered generator stations. • Employment, education and health benefits should be modelled. • Emission reduction benefits.	MUA, ETU, AI Group
Annuity approach	There is a stranded assest risk for projects modelled in the ISP due to the assumption that benefits balance annualised costs beyond the modelling horizon.	ISP Consumer Panel, MEU
	The discount rate determined for ISP modelling may not be appropriate as it is based on network investments whose lives can extend beyond the planning horizon. This requires assumptions being made for uncertain benefits beyond the modelling horizon.	ISP Consumer Panel, MEU
The Delphi technique	General support for the use of the Delphi technique to determine scenario weights.	ISP Consumer Panel, PIAC
	Importance of including consumer representatives from different types of consumers in the panel.	ISP Consumer Panel, PIAC
	Hydrogen modelling should be referred to Delphi panel.	ISP Consumer Panel
Sub-regional model	The structure of the sub-regional model was generally supported.	Powerlink, EA
Other recommendations	A 'tracked changes' version of the final *ISP Methodology* should be published to assist stakeholders in identifying what has changed.	EA

3.3 Themes from the *ISP Methodology* webinar

An open stakeholder webinar was held on 17 June 2021 regarding the *Draft ISP Methodology*. Attendance was above 28 attendees throughout the event and peaked at 41 attendees. The recording of the webinar is available on AEMO's website[6].

The webinar was developed based on the common themes arising from stakeholder submissions and was advertised to stakeholders as comprising:

- Scenario weights.
- Hydrogen in the ISP.
- Annuity approach.
- Types of benefits and costs.
- Other improvements.
- General support of methodology.

An hour of open discussion was provided in the webinar to allow due process for stakeholder comment and questions with regard to the themes presented. Attendees did not vocalise any issue with AEMO's characterisation of the range of feedback received in written submissions or the verbal feedback session.

Six stakeholders submitted written questions through the web-based forum and each question was addressed in the open discussion. The key areas of additional comment in the webinar included:

- The assumption that benefits are greater than or equal to costs beyond the 2050 planning horizon in the annuity approach and the perception that this may increase risk of stranded assets.
- The quantification and recovery timeframes of costs assumed for ISP projects and the discount rate applied in modelling.
- How avoided costs (including annualised build costs) amount to benefits under the ISP process.
- Integration of multi-sectoral forecasting with respect to emissions and electrification of load.
- How employment, education and health or other benefits not classified under the CBA defined market benefits are captured in the ISP modelling process.
- Delphi panel composition and selection of scenario weighting.
- Clarification of the capacity for storage type technologies modelled in the ISP.
- Clarification of sub-regional transfer limits and how forced outages are applied in the ISP.

The majority of these comments replicate or support similar points made in written submissions which are addressed in Section 4 and in the webinar recording.

[6] At https://aemo.com.au/-/media/files/major-publications/isp/2022/isp-methodology-webinar.mp4?la=en&hash=77EF3C9D0EEF34BC2C46BB72B1B1155A.

4. Discussion of *Draft ISP Methodology* submissions

This section presents material feedback raised by stakeholders in written submissions and verbal feedback from consumer representatives, and AEMO's response to each matter. These submissions were made in response to the *Consultation Paper – Draft ISP Methodology* published in April 2021[7].

4.1 Capacity outlook modelling

Feedback received	AEMO response
On modelling a decarbonising grid: **MUA** supported the inclusion of emissions trajectories and targets in modelling. **EA** recommended that AEMO consult further on multi-sectoral modelling of emissions constraints and electrification. Furthermore, AEMO should consider the role of offsets and biofuels, negative emission technologies and the feasibility of land use. EA also advised that AEMO should ensure consistency in the calibration of scenarios and inputs across ISP models and the AusTIMES multi-sectoral emissions model. **AI Group** commented that if all states have committed to it, net zero by 2050 should be included in the central scenario.	AEMO thanks the MUA for their support, and in response to EA notes that the outcomes of multi-sectoral modelling have been presented to the FRG in both May and June 2021. Further detail on the methodology and scenarios that underpin the modelling can be found in the *Multi-Sector Energy Modelling* report published as supporting documentation of the 2021 IASR. As much as practical, AEMO's forecasting incorporates relevant components as inputs to ensure model consistency (in the case of the multi-sectoral modelling, the economic, distributed energy resources (DER), and electric vehicle (EV) forecasts were adopted as inputs, and the energy efficiency forecasts were a key point of validation between both consultant outputs). With regard to the net zero target and its inclusion in the most likely scenario, AEMO's scenario collection now includes both a Steady Progress and a Net Zero 2050 scenario, to complement three other scenarios, all of which are detailed in the IASR. AEMO will be consulting on scenario weightings later in 2021, which will determine the relative likelihood of the scenarios documented in the IASR.

[7] At https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2021/isp-methodology/draft/consultation-paper-draft-isp-methodology.pdf?la=en.

Feedback received	AEMO response
Origin stated AEMO should incorporate policies that focus on responsiveness to peak demands, such as the Peak Demand Reduction Scheme (PDRS) in New South Wales. **Victorian Bioenergy Network** suggested the impact of climate change on hydro inflows should be considered.	AEMO confirms that it does model growth in the responsiveness of peak demand. This includes both traditional measures, such as temporary load reductions (known as demand side participation, or DSP) and the use of embedded generators, but also through use of coordinated battery storage (as virtual power plants) and flexible charging of EVs. The scenarios have different demand growth assumptions, and the NSW PDRS in particular is modelled in various forms of implementation in most scenarios to reflect the uncertainty of the scheme (the final design and legislation has yet to be revealed). In response to feedback on hydro inflows, AEMO notes that the impact of climate change on hydro inflows is considered and is documented in the *IASR*.
On sub-regional representation: **EA** supported the move to a sub-regional approach. **Powerlink** was pleased to see enhancement with respect to the sub-regional model representation	AEMO thanks EA and Powerlink for their support in the proposed sub-regional representation which aims to better reflect current and emerging intra-regional transmission limitations.
On generator retirements: **AGL** proposed that AEMO consider changes for generator operations that could impact early retirements, like two-shifting, seasonal mothballing, and minimum generation improvement. AGL further recommended the consideration of spot price curves and the inclusion of revenue from ancillary service markets or future operating reserve or inertia markets with respect to generators, potentially by using historical requency control ancillary services (FCAS) prices and consideration of system strength remediation costs for solar and wind plants. **PIAC** stated AEMO should assume generators may exit the market well before their intended closure date.	With regard to AGL's proposal, AEMO acknowledges that changes in coal operation will factor into retirement decisions. However, AEMO is not in a position to independently assess the technical and commercial implications of flexible operation on individual power stations, as well as the implications on maintenance, reliability, costs, and fuel supply contracts. AEMO has sought feedback from stakeholders to improve its modelling capabilities in this area but the information available remains limited. AEMO will consider the impact of changes in coal operation as much as practicable in the ISP, through periods of decommitment. This type of behaviour will be included as part of the revenue sufficiency assessment, and will be a feature in system security assessments for the future. AEMO confirms that its modelling does consider spot prices when forecasting wholesale market revenue for coal generation. At this stage, considerations about further revenue streams not directly associated with the wholesale energy market remain too challenging to incorporate into the ISP modelling, given the uncertainty around their materiality, and competition with new technologies. With regard to PIAC's observation, AEMO's revenue sufficiency assessments will provide further information on the drivers for potential generator exits before their intended closure date.
On anticipated projects: **PIAC** suggested that AEMO should not take as given government projects or plans that are uncommitted and/or unlikely, irrespective of their political popularity. **AGL** proposed categorising anticipated generation projects using consistent spot price curves. **Powerlink** supported the inclusion of an anticipated project where in AEMO's and the transmission network service provider's (TNSP's)	AEMO acknowledges that government projects should not be taken as a given without consideration of their development progress. AEMO will apply the anticipated project criteria for generation and storage projects consistently regardless of whether projects are financed by government or the private sector. If government-awarded funding is announced for a generation project, this is considered in the assessment of whether a project is sufficiently progressed towards meeting the finance commitment criteria. For such a generation project to be considered as anticipated, it must be in the process of meeting at least two other commitment criteria. In the case where government-awarded funding provides long-term investment certainty and is awarded as part of a large-scale program, AEMO may have regard to the eligibility criteria for this funding when considering a project's progress against other (non-finance) commitment criteria.

Feedback received	AEMO response
professional opinion the project is likely to proceed. Powerlink also noted that sensitivities should be performed where investments are highly dependent on such assumptions. **MUA** suggested including "sea areas" (not just land) for project commitment criteria questions.	AEMO does not agree that spot price curves should be used to assess anticipated generation projects as this would not result in an accurate view of whether a project may reach final investment decision. Rather, AEMO intends to track the final investment decisions of projects and include projects once they have demonstrated sufficient development progress against the project commitment criteria. While AEMO agrees in principle that projects should be included once AEMO and the TNSP form the opinion that a project is likely to proceed, AEMO's outlined approach minimises subjectivity in forming that opinion. AEMO applies a consistent and transparent framework to determine project advancement, through the use of the Generation Information survey dataset. AEMO agrees that sensitivities should be used to assess investments that are highly influenced by assumptions about anticipated projects, but considers that this can be done in either the ISP or the Regulatory Investment Test for Transmisison (RIT-T), depending on the individual circumstance. AEMO agrees with the suggestion to expand the project commitment criteria questions to include both land and sea rights.
On DER interactions: **TEC** stated DER investments should be optimised as a cost-effective part of the solution. **ETROG** referred to Powercor's proposals to invest in solutions to unlock 1.3 gigawatts (GW) of DER and 1.1 GW of energy storage, and stated these projects should be considered in the ISP. **Powerlink** commented AEMO should revise the rooftop PV forecast to align with recent installation rates and consider sensitivities where installation rates increase. **Origin** recommended that the effects of South Australia export constraints and the Energy Security Board's (ESB's) consideration for similar arrangements across the NEM should be incorporated so as to avoid overestimating the contribution of PV.	AEMO acknowledges that it is increasingly important to understand the interactions between transmission- and distribution-connected resources and is continuing to explore improvements in modelling DER behaviour. However, with regards to optimisation of DER investments, AEMO notes that the drivers of DER investment are often significantly different to those for large-scale investments, and as such a co-optimisation may not result in the right outcomes. AEMO has recently updated DER forecasts for each of the new scenarios which consider policy announcements, current customer trends and other potential impacts. Forecasts for distributed PV in particular have significantly increased compared to the 2020 forecasts. Further detail can be found in the 2021 IASR. AEMO's forecast of DER is not constrained by the potential impacts of export constraints, or other mechanisms to limit or constrain DER. Forecasts provide the projected unconstrained output from DER to enable the ISP to assess the potential benefits from greater amounts of DER and any potential implications on the ODP from high levels of DER. AEMO, TNSPs, and diustribution network service provioders (DNSPs) are working to explore how plans to accommodate high penetrations of DER can be leveraged by AEMO to support power system operation and the development of the ISP. DNSPs will continue to use their knowledge and experience to make investment decisions on their networks and in the longer term, assist AEMO in incorporating that information into the ISP where appropriate. The ESB's DER integration programme will continue to explore requirements to integrate DER
On included costs: **MUA** recommended that the ISP include a transition cost for REZs located more than 50 km from an existing coal-fired power station to reflect social costs of avoiding unemployment for coal-fired workforce, relocation and/or training of new workforce.	The NER, specifically clause 5.22.10(c)(1), require AEMO to consider specific classes of market benefits that could be delivered by development paths when preparing an ISP. In addition, the AER's CBA Guidelines require that AEMO exclude any market benefit which cannot be measured as a benefit to generators, DNSPs, TNSPs and consumers of electricity. AEMO acknowledges the importance of the views presented by MUA and ETU, and notes that the Australian Energy Market Commission (AEMC) is intending to undertake a review of the transmission planning and investment framework, including the ISP/RIT-T framework. MUA and ETU may wish to consider providing these views in that review.

Feedback received	AEMO response
MUA also suggested AEMO should undertake more integrated modelling that includes employment, education, and health to better understand the challenges and opportunities of the energy transition being modelled. **ETU** supported MUA's recommendation and also added that the transition cost should be determined in consultation with affected workers and communities and it would also account for the construction of new infrastructure and development of new supply chains to facilitate large-scale energy being built in new areas. **AI Group** recommended that emissions reductions benefits should be incorporated into the cost benefit analysis.	As a result, at present the wider economic benefits such as employment, health (including benefits from emission reductions), education, and other transition costs are captured in government policy and land management planning, which may in turn result in a direct impact on the electricity sector that can be included. AEMO's locational cost factors (documented in the IASR) consider the higher costs associated with projects which are located further away from population centres, ports, and other major infrastructure.
On system strength: **MEU** suggested that the modelling of system strength investments should reflect who pays, because variable renewable energy (VRE) generators could make different locational decisions based on who pays.	AEMO acknowledges the views presented by MEU on who pays for investments for system strength. The ISP is developed on the basis of the current framework for system strength, using the approaches defined in the *ISP Methodology*, including the assessments and considerations that AEMO must undertake. AEMO notes, however, that the AEMC is currently reviewing rules changes to revise the system strength frameworks, and has proposed alternative arrangements, seeking input prior to final determination later in 2021. MEU may wish to provide input into that review prior to its conclusion. AEMO confirms that the approach described in the *ISP Methodology* will initially prioritise projected investment in areas with surplus system strength, balanced against other factors (including but not limited to resource quality, land use, and network capacity). AEMO also notes that the ISP does not direct generation development and the location of new generation is determined by investors based a wide range of factors, which may lead to investments in other areas, including private investment in connection assets. Any supporting regulated network infrastructure, must, however, meet the requirements of the RIT-T and the NEO.
On coincident projects: **MEU** stated the ISP should recognise that delivering multiple major projects side by side will increase delivery costs.	AEMO recognises that delivery of multiple coincident projects will impact costs, both in labour and materials. Infrastructure Australia has partnered with AEMO to assess and understand the employment and material requirements for the transmission and generation projects identified in AEMO's 2020 ISP. This new analysis, scoped collaboratively with AEMO and commissioned by Infrastructure Australia from the University of Technology Sydney, aims to improve the understanding of labour and material requirements to inform and assist governments, TNSPs, project developers and market bodies. In addition, the Transmission Cost Database allows the selection of a known risk to reflect the impact on transmission costs of the concurrent delivery of large transmission projects that is attributable to competition for labour and materials. However, this has not been applied to the majority of Class 5a/b projects in the ISP as they are so far in the future (10-15 years), which means detailed construction schedules cannot be forecast with any accuracy. It is expected that the Class 3 and 4 projects estimated by TNSPs will have allowances included for market pressure, since these are to be constructed in the shorter time horizon.

Feedback received	AEMO response
On including the gas system in ISP modelling: **ISP Consumer Panel** recommended AEMO include gas optimisation to the maximum extent possible, include consideration of gas supply issues, and consider ways to improve co-optimisation and coordination in future ISPs. **Victorian Bioenergy Network** stated that there is no mention of the potential impact of a carbon tax on gas prices.	AEMO has further considered the approach to gas optimisation in multi-sector modelling conducted by CSIRO and described in detail in the IASR. The multi-sectoral modelling considers consumption of all energy sources across the economy and considers the degree of change affecting all energy sources to meet the decarbonisation needs of each scenario. This includes increased fuel-switching to electrification, hydrogen and/or biofuels, which have differing impacts on the gas system. In the ISP itself, the modelling of operation of gas-powered generators (GPG) will consider the technical and financial variables defined in the 2021 IASR, including natural gas prices. The ISP will also examine a low gas price sensitivity, to quantify the influence of this variable on potentially actionable ISP projects. This analysis will be conducted with regards to the parameters for each scenario, which includes carbon budgets for some (but not all) scenarios as informed by the multi-sectoral modelling. In conducting the ISP modelling, while carbon budgets may influence the long-term evolution of the power system, no carbon tax is applied.
On hydrogen: **AI Group** recommended that AEMO should consider which services the NEM could get from the hydrogen sector. **EWOSA** advised that AEMO should consult with the Australian hydrogen council in regard to hydrogen sites. **MEU** stated in a verbal feedback session that AEMO should not project where hydrogen sites might be located. In a separate written submission, the MEU provided feedback that the Hydrogen Superpower scenario should not be used to justify locationally specific investments because the potential scale and location of electrolysers is highly uncertain. The MEU recommended that for the purposes of the ISP, the Hydrogen Superpower scenario should just address the increased demand that might occur in each state as a result of electrolyser investment rather than trying to be more definitive in size and location of electrolysers. **MUA** supported the inclusion of hydrogen modelling and noted that offshore wind can supply the load at ports. **ISP Consumer Panel** reiterated that it had ongoing concerns around the treatment of hydrogen in the context of significant contemporary enthusiasm that is only supported by relatively high level, simplistic analysis. The panel stated that there is a need to reflect this uncertainty to the Delphi panel and is concerned that the conclusions of this scenario will become the	There are potential services that hydrogen electrolysers could provide to the NEM, such as FCAS or demand response. Due to the large amount of flexible storage and generation that are projected to be developed in the coming decade, and the wide range of potential sources of global FCAS providers, this is not seen to influence the ODP. AEMO has consulted with a wide range of stakeholders on the potential electrolyser sites for hydrogen production, through the series of 2021 IASR webinars and consultation. The Hydrogen Council were consulted and are aware of this approach. Potential electrolyser locations are required to be specified in the model inputs, in order to calculate the distance required to transport the electricity from the REZs to the electrolysers, which informs the overall cost in each state. AEMO considers that it will be more economic to produce hydrogen in some states than others, due to the combination of VRE resource and distance to electrolysers, so this approach allows the model to choose the least cost option (including onshore or offshore wind or solar). AEMO recognises that there remains substantial uncertainty regarding the uptake of hydrogen. However, equally, a future with a substantial uptake of hydrogen could materially influence the optimal design of the future NEM. The scenarios are intended to provide a broad coverage of plausible futures and repeated feedback has indicated that hydrogen is credible enough that it needs to be considered. The relative likelihoods of each scenario, and thereby the impact on actionable investments in the ISP, will be the subject of further stakeholder engagement (through the use of a targeted Delphi panel) in the second half of 2021. AEMO considers that there will be many remote areas where electrolysers are off-grid, such as in the mining sector. For the purpose of the ISP, the majority of hydrogen for transport, domestic and industrial use has been assumed to be on-grid, in order to understand the potential impact on the NEM.

Feedback received	AEMO response
focus of debate and advocacy, not the constraints on results from simplistic modelling. **PIAC** recommended AEMO reflect the speculation and uncertainty of the future economics of hydrogen production in all aspects of ISP modelling. PIAC also stated that electrolysers should be assumed to be grid-connected, and the transmission costs should not be recovered from other consumers.	AEMO acknowledges PIAC's comments regarding who should pay for transmission. As this is the subject of reviews being undertaken currently by the ESB and the AEMC, AEMO considers that these reviews are the best place to resolve these important concerns.
On biomass: **Victorian Bioenergy Network** stated that localised electricity and heat production from biomass can obviate the need for expensive grid augmentations. They also stated that the impact of shifting from gas space heating and hot water to electric heat pumps should be considered.	AEMO's multi-sectoral modelling explores the potential role for biomass and biofuels in multiple sectorsBioenergy is considered for the residential, industrial and transport sectors. The scenarios apply differing degrees of fuel switching, including consideration of alternative fuels.
On wind and solar: **MUA** and **ETU** suggested that offshore wind resources within 100 km of areas of the grid with spare hosting capacity should be incorporated into the 'shadow' resource limits used in capacity outlook modelling. Both parties also commented that the counterfactual model used to make a cost-benefit analysis for building new transmission lines should include offshore renewable resources, to make a full and accurate assessment of the costs and benefits of building new transmission lines to new REZs. If the counterfactual model used to make a cost-benefit analysis for building new transmission lines only includes onshore renewable resources, this should be transparently specified in the ISP. **ETU** also suggested that offshore wind must be included in the renewable resources considered for modelling the future production of hydrogen. **MUA** also recommended AEMO revise REZ areas to consider offshore wind and not rely on the 2018 DNV-GL report that did not consider any offshore renewable resources. In line with this recommendation, MUA commented that the availability of offshore wind resources in scenarios and counterfactual studies should be updated. MUA further suggested that different firm contribution factors should be used for onshore and offshore wind. **EA** supported the approach to calculating effective load carrying capacities for firm capacity calculations.	In response to this feedback, AEMO has introduced several new offshore wind zones (OWZs) as a form of REZs. The location of OWZs include Illawarra Coast, Hunter Coast, and North West Tasmania Coast. With this adjustment, where offshore wind resources are able to be developed and operate effectively without transmission augmentations, they may play a role in both the development paths and the counterfactuals for all scenarios. Offshore wind resources are diverse from onshore wind, which may in turn provide reliability benefits and higher firm contribution factors. AEMO acknowledges ETU's suggestion that offshore wind could support the production of hydrogen, and notes that this will be assessed within the described approach. In response to MUA's suggestion, AEMO notes that offshore wind resource quality is based on CSIRO data rather than DNV-GL data. AEMO thanks EA for its endorsement of this aspect of the methodology and for its continued engagement throughout the ISP process.

Feedback received	AEMO response
On additional analysis: **Monash University** recommended AEMO consider ramping and flexibility in greater detail in operability models. It argued that doing so could provide overall benefits including cost-effectiveness and reliability. Monash University further proposed that simulations could be run with randomised market factors and the results could then be regressed to determine the critical market issues that might undermine an individual investment. **EA** recommended AEMO consider the materiality of externalities that are too complex to model when presenting findings; for example, various modelling simplifications tend to favour long-duration storage at the expense of batteries. As pumped hydro has different locational requirements than batteries, any storage technology bias will result in different transmission network configurations and, potentially, actionable projects.	AEMO thanks Monash University for its submission, and the additional detail provided. AEMO acknowledges that the issues of ramping and flexibility are increasingly important. The capacity outlook model used in the ISP is computationally intensive, in part because it cannot focus on just a single year but needs to look at a full modelling horizon in sequence, given the critical importance of investment needs and timings as ISP outputs. AEMO continues to explore the balance between modelling this full horizon and increasing the granularity and detail of modelling. AEMO has made improvements in this regard for the 2022 ISP. AEMO will continue to explore how the capacity outlook models can incorporate further detail on a range of factors, as well as how additional modelling and analysis can support the ISP process, for example by exploring issues in time-sequential modelling. AEMO thanks EA for its suggestion and acknowledges that modelling does require various simplications. AEMO's inputs attempt to take into account the various locational requirements on pumped hydro, and this formed part of an upward adjustment made to pumped hydro costs during the 2020 ISP. AEMO notes this feedback and will consider what sensitivity testing may be required to understand the potential impacts of any modelling simplifications.

4.2 Time-sequential model

Feedback received	AEMO response
On the methodology and assumptions used in time-sequential modelling: **AGL** suggested AEMO consider forward contracting and the retailers' ability to hedge their portfolio in each region. **EA** recommended the adoption of partial and full transmission forced outage rates. **EA** also sought further clarity on how and when bidding behaviour models are used to consider portfolio effects and whether high wind cut-out or high-temperature derating is modelled. **Origin** stated AEMO should publish its wholesale price forecasts so that participants may undertake their own analysis.	AEMO acknowledges that complex dynamics and interactions such as forward contracting and hedging affect market operation and development. However, it is not possible or feasible to include many of these impacts in ISP modelling, due to their complexity, the availability of assumptions, or the ability to apply a systematic approach for their inclusion. AEMO uses forecast wholesale market outcomes as a means for approximating the overall financial outcomes for generators. Transmission outages are considered in the ESOO, which uses a very large number of modelling iterations. However, given their relatively low probability, it is not appropriate to explore them in ISP modelling, which generally focuses on a more limited number of iterations (given the sheer number of simulations across scenarios and development paths modelled in an ISP). A consideration of the potential impact of transmission outages is given through resilience analysis. Bidding models are primarily used in the assessments of retirement decisions and distributional effects, and exploration of system security and operability. At times, a bidding model may be used to support TOOT analysis. High wind cut-out is modelled for wind farms, as is high temperature de-rating for wind and solar. This is done through a physical model of the turbines/panels, with an additional cap imposed to ensure that wind and solar farms do not exceed the Summer Hot Day ratings as provided in Generation Information.

Feedback received	AEMO response
	AEMO does not publish its wholesale price forecasts, and instead publishes all inputs and methodologies to enable participants to undertake their own analysis and independently form views on forecast wholesale prices.
On constraint modelling: **Origin** stated clamping events (constraints placed on interconnectors to manage negative inter-regional settlement residues) may reduce the value of interconnectors and should be incorporated into the ISP.	Negative inter-regional settlements residues accrue where there are counter-price flows between interconnected regions in the NEM (that is, when electricity flows from a high-priced region to a low-priced region). The use of constraint equations to manage negative inter-regional settlement residues can impact the physical flow of electricity on interconnectors. However, these events are predominantly driven by participant bidding behaviour and network congestion, and are not typically observed in the ISP capacity outlook model. AEMO therefore does not consider inter-regional settlement residues, or their management, to be material in relation to approach applied in the ISP modelling.

4.3 Engineering assessment

Feedback received	AEMO response
On modelling limitations: **EA** argued that critical decisions on actionable ISP projects will be based on ODPs that have not been properly tested from a power system performance and an operational perspective (given analysis and findings from AEMO's Engineering Framework Program will extend beyond the 2022 ISP). They said that in the absence of more sophisticated approaches, AEMO's *ISP Methodology* would essentially determine ODPs based largely on a thermal capacity constraints only.	AEMO acknowledges the important points raised by EA, and is pleased to confirm that engineering analysis is included in both the capacity outlook and short-term modelling approaches. This engineering analysis considers a wide range of critical power system requirements, including thermal capacity, voltage stability, transient stability, and system strength. This consideration is included in all economic assessments. Please see Section 3.2.3, Section 4.1 and Section 4.2 of the *ISP Methodology* for details on the approaches undertaken.
On power system analysis: **MUA and ETU** stated that specific planning should be undertaken to ensure that the future grid provides secure supply for large industrial loads. This should be explicitly addressed in future ISPs to reduce community anxiety and preserve jobs. The Sustainable Growth and Export Superpower scenarios also need to include policy to support those industrial loads. **EA** suggested AEMO should recognise the significance of engineering limitations and report on load flow snapshots every five or 10 years for peak, typical and minimum demand conditions. This analysis should test system normal and critical contingencies from a thermal, voltage control and wider stability perspective."	AEMO confirms that network capability is assessed with load forecast and generation over the outlook period. If any significant load, including new loads identified in the Hydrogen Superpower scenarios, were to be modelled in a particular location, network capability will be assessed to supply the load. Network and non-network solutions will be identified to efficiently address significant network constraints. AEMO runs hourly market modelling for at least a 20-year period. Binding network constraints during this process are reviewed and load flow studies are conducted to investigate significant network congestion and power system performance. These studies, which are described in Section 4.1 of the *ISP Methodology*, include conditions such as peak demand, off-peak demand, and high levels of renewable generation. The outcomes of these studies are then used to review and adjust inputs to the capacity outlook model, such as required network augmentation options, which are then reassessed economically. This iterative process between economic and engineering ensures that final outcome of the economic assessments are technically feasible and supported by engineering analysis.

Feedback received	AEMO response
	AEMO also further considers the need for any power system security and reliability services in the NEM over the coming five years as part of its obligations to assess system strength, inertia and Network Support and Control Ancillary Services (NSCAS) requirements and shortfalls[8]. These assessments and those in the ISP are aligned.
On augmentation options: **EA** recommended AEMO incorporate control schemes and fast start plant into augmentation options (for example, an expansion to the Victorian System Integrity Protection Scheme [SIPS]).	To assess transfer capability, ISP modelling considers existing and committed special protection schemes (SPS), runback schemes, and SIPS. These include Basslink SPS, Murraylink runback scheme, generation run-back schemes, New South Wales – South Australia interconnector SIPS, and Victoria – New South Wales interconnector SIPS. AEMO confirms that it has incorporated a number of SIPS options to increase transfer capability along the ISP flow paths in the assessments that will be undertaken for the 2022 ISP. This includes options to increase transfer capability between Central Queensland and South Queensland, Northern New South Wales and South Queensland, and Central New South Wales and Northern New South Wales. For more details on augmentation corridors, network options, non-network options and transmission costs, please refer to the 2021 IASR and the *2021 Transmission Cost Report*. In addition to these options, AEMO will consult on non-network options for all actionable ISP projects.
On reporting detail: **EA** stated that AEMO should provide more detail on the nature of transmission limits and report on binding constraint statistics.	Following a two-stage consultation on the *ISP Methodology*[9] and a single-stage consultation on the 2021 IASR[10], AEMO has developed a fit-for-purpose capacity outlook model for the ISP. This model reduces the power system to 10 sub-regions connected by flow paths with notional transfer limits. While this capacity outlook model is validated against a time-sequential model that is somewhat similar to NEMDE, the constraint behaviour is not appropriate for assessing localised congestion risks because it is tailored only to assess the performance of major flow paths in the ISP and is not benchmarked for reporting on individual constraint equations. However, AEMO does provide extensive data on inputs and modelling outcomes from the ISP and the ESOO – this information can be used by participants to undertake their own analysis and independently form views on future network congestion.

[8] AEMO. *Planning for operability*, at https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/planning-for-operability.

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

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

4.4 Cost benefit analysis

Feedback received	AEMO response
On climate risk: **EWOSA** suggested AEMO's work on resilience should consider climate risks and recommend "no regret" options for interconnection.	AEMO notes that impacts from climate change are included in a number of inputs to the ISP[11], including hydro inflow and generator performance. Furthermore, the scenarios cover a range of futures, including differing emissions trajectories and climate impacts, and the cost benefit analysis serves to recommend a development path in the long-term interests of consumers of electricity by minimising the risk of over- and under-investment given all the uncertainties in the energy future. See Section 5 of the *ISP Methodology* for more information. AEMO acknowledges there is more to be done to consider climate risks in the ISP, and is endeavouring to do so. Following AEMO's collaboration with the Bureau of Meteorology (BoM) and the CSIRO in the Electricity Sector Climate Information (ESCI) project, AEMO intends to develop a series of compound extreme weather and power system case studies to further elucidate climate risks and their impact on the development of the power system. These case studies may be used to differentiate between investment options and may potentially inform qualitative resilience benefits for consideration in cost benefit analysis.
On market benefits and costs: **Powerlink** recommended the incorporation of intra-regional loss equations should be considered because it will materially impact the development path. Powerlink stated this modelling enhancement has been found in its recent market modelling, which it is willing to share with AEMO. **ISP Consumer Panel** also supported AEMO's approach to describing the principles that will guide the CBA, and suggested AEMO should take a similar approach in specifying guiding principles for other parts of the ISP.	AEMO acknowledges that both inter-regional and intra-regional losses can materially affect ISP outcomes, and addresses these as follows: • AEMO models inter-regional losses within the capacity outlook model. • Where consideration of intra-regional losses is material to the assessment of a particular asset, and where the potential actionable ISP project has marginal benefits, AEMO may undertake additional analysis to ensure any consumer benefits that arise from lower transmission losses are considered. • Please refer to Section 5.2 of the *ISP Methodology* for details on this approach. AEMO welcomes the ISP Consumer Panel's support for the guiding principles used in the CBA section of the ISP. AEMO will continue to explore options to describe the guiding principles for other aspects of the ISP.
On the annuity approach: **ISP Consumer Panel** expressed ongoing concerns around AEMO's annuity approach to costs and benefits, particularly the methodology for managing the uncertainty of future benefits and how this interacts with determining an approach to discount rates as part of the (IASR) workstream. Linked with this is the lack of consideration of stranded asset risk beyond the planning horizon as benefits are assumed to be greater than or equal to costs beyond this time period.	AEMO acknowledges the concerns raised by the ISP Consumer Panel and MEU, and has engaged in several subsequent discussions on the topic, in webinars and ISP Consumer Panel meetings. AEMO remains of the view that the annuity approach is the best available method to assess total systems costs when considering many investments with differing economic lives, including those which extend beyond the modelling horizon. For actionable projects, which are likely to be commissioned by 2030, approximately 80% of the total cost will be included in the modelling horizon using the central discount rate. AEMO considers that the high coverage of costs within the modelling period significantly decreases the risk that any potential stranding of assets beyond the modelling horizon would impact the decision to declare an ISP project as actionable.

[11] Inputs related to climate change are primarily sourced from the Electricity Sector Climate Information (ESCI) Project, at https://www.climatechangeinaustralia.gov.au/en/projects/esci/.

Feedback received	AEMO response
MEU disagreed with the use of an annuity approach and suggested three changes to accommodate its usage – a higher discount rate, a requirement that benefits match costs within the modelling horizon if a commitment to the investment is needed before the next ISP, and a growing cost of capital over time. **MEU** subsequently reiterated by email its concerns with the annuity approach, particularly making reference to the way in which the cost of transmission assets is recovered from consumers through the regulatory framework. Under this approach, which is based on the depreciated replacement value, the MEU points out that the cost paid by consumers peaks at a point that is beyond the midpoint of the asset life. The MEU stated that if AEMO is to apply an annuity approach it has to be done in accordance with the regulatory model by which asset costs are recovered.	AEMO has also committed to undertaking sensitivity analysis on the discount rate. By applying a higher discount rate, a higher percentage of the total cost will be captured within the modelling horizon. This will provide an indication of the sensitivity of the results to this approach for comparing costs beyond the modelling horizon. The sensitivity analysis will identify whether the ranking of candidate development pathways (CDPs) would change in applying different discount rates. AEMO acknowledges MEU's points, but considers that the way the costs of assets are recovered from consumers is not a permissible or appropriate consideration in the CBA analysis. NER 5.22.10(d) sets out the classes of costs that it can apply in the ISP. These are costs incurred in construction, operating and maintenance costs, and the cost of compliance with laws and other administrative requirements in relation to the construction of the development path; the way costs are subsequently recovered is not a consideration under the NER or the Cost Benefit Analysis Guidelines. AEMO's annuity approach is applied consistently for all build costs, whether associated with transmission, generation or storage so that the benefits of regulated assets can be assessed objectively against private enterprise investment to determine the most economically efficient outcome for consumers. The MEU's preferred application of the regulatory model for annual payments is not appropriate for all asset categories and therefore would potentially distort the economically efficient outcome. There also appears to be some perception that the net present value (NPV) of annualised costs is not the same as the NPV of the capital cost if assumed to be paid in full upfront and therefore the cost is under-estimated. It is true that the NPV of annualised costs over the planning horizon could be lower than the NPV of the full build cost if the planning horizon is shorter than the economic life of the project. However, the NPV of annual benefits would also only be considered over the planning horizon, and therefore be under-estimated. This means there is an implicit assumption that annual benefits for the remainder of the economic life of the asset (beyond the planning horizon) are greater than or equal to the annualised costs. Based on previous modelling experience, and expectation that current NEM transition will continue to progressively move away from fossil fuels to renewable generation sources, AEMO considers this implicit assumption to be reasonable. In the Draft ISP, AEMO will further outline whether or not it considers that to be a reasonable assumption for any actionable ISP projects identified. The MEU's response(s) indicates that there remain fundamental differences of view on the points raised. AEMO notes that the AEMC is expected to undertake a review of the transmission planning and investment framework, including the ISP/RIT-T framework, which provides the opportunity for MEU to present these views .
On Delphi technique: **ISP Consumer Panel** expressed support for the use of Delphi technique to determine scenario weights and recommended that the Delphi panel includes multiple consumer representatives, at least including representation of small distribution-connected consumers and large transmission-connected consumers. The Consumer Panel also suggested that the Delphi panel should have an independent facilitator and that the	AEMO thanks both the ISP Consumer Panel and PIAC for their suggestions on the Delphi panel. AEMO confirms that consumers will be appropriately represented, and to this end will be engaging further with both the ISP Consumer Panel and stakeholders more broadly on the make-up of the Delphi panel in coming months to ensure the panel provides appropriate representation of various stakeholder groups.

Feedback received	AEMO response
questionnaire and number of rounds be co-designed with involvement from the Consumer Panel. **PIAC** also expressed support for the proposed Delphi technique and recommended representation from residential, business, and commercial consumers. PIAC also recommended the avoidance of panellists who have commercial interests in certain scenarios.	
On optimal development path: **ISP Consumer Panel** supported the range of approaches proposed to select the ODP. **ISP Consumer Panel** also commented that the use of sensitivity analysis was appropriate and further suggested that AEMO should include a full list of sensitivities and link them to scenarios.	AEMO thanks the ISP Consumer Panel for its endorsement of the methods proposed to select the ODP. AEMO confirms that both the Draft ISP and Final ISP will detail the sensivities modelled for the purpose of determing the ODP. Section 2.3 of the 2021 IASR lists key input assumptions that AEMO intends to examine through sensitivity analysis. AEMO considers that there is value in retaining a degree of flexibility in which sensitivities are completed. If, for example, the ODP forecasts a relatively low level of GPG operation, the significance of a low gas price sensitivity would likely be low. However the list of sensitivities defined in the 2021 IASR is the minimum set of sensitivities that AEMO will consider in assessing the ODP. AEMO will be guided by modelling outcomes in the Draft ISP and Final ISP in deciding what other sensitivity analysis could help ensure the ODP is robust to uncertainties in key assumptions.
On transparency: **Origin** said the Draft ISP and Final ISP should detail the outcomes of the least-worst regret and TOOT analysis.	AEMO confirms that both the Draft ISP and Final ISP will detail the outcomes of the various methods used to determine and assess the ODP.

4.5 Other submissions

Feedback received	AEMO response
On reporting: **ISP Consumer Panel** welcomed the approach to producing a separate consultation summary report for the Methodology Issues Paper and suggested AEMO do the same for all future "major" ISP publications. **EA** suggested AEMO publish a separate 'tracked changes' version of the final *ISP Methodology* to assist stakeholders in comparing to the April draft document.	AEMO confirms that a tracked changes version of the final *ISP Methodology* will be provided. This is included on the *ISP Methodology* consultation page.

Feedback received	AEMO response
On further consideration: **ETROG** suggested avoiding investment towards consumers who are expensive to serve and might leave the grid. Consideration should be given to the prospect of consumers at the edge of the grid disconnecting and leaving the remaining consumer base to bear the fixed costs of their former connection. **Uniting Communities** recommended AEMO consider the possibility of communities at the edge of the grid adopting stand-alone systems. **MEU** stated the ISP should better take into account the potential for non-network solutions to achieve the same outcome as network solutions. MEU further recommended that the identified need should be articulated such that non-network solutions are duly included. This is particularly relevant to ISP actionable projects for which TNSPs assume that transmission is the optimal solution. MEU states that despite raising this point in the Issues Paper consultation earlier this year, and AEMO stating it was addressed, it feels this has not been addressed adequately. **Uniting Communities, AI Group and MEU** stated there needs to be ongoing scrutiny and a robust testing process for the efficient delivery of ISP projects and the effectiveness of network businesses.	AEMO acknowledges that communities at the edge of the grid may choose to adopt a stand-alone approach with localised supply, firming, and other essential system resources. However, while important considerations for the local area, the scale and impacts are not expected to be sufficiently material to affect the ISP modelling approach and outcomes. In response to the MEU comments on non-network solutions, AEMO acknowledges the importance of robust assessment of both network and non-network solutions. AEMO consulted on non-network options as part of the 2021 IASR consultation. AEMO also notes that the ISP already considers several non-network solutions, and AEMO will call for submissions for non-network solutions if a project is declared to be actionable. Any non-network submissions that are received will be assessed by AEMO and provided to the relevant TNSP for consideration in the RIT-T. AEMO endeavours to define the identified need in a way which does not bias the solution toward a particular technology. AEMO acknowledges that there is benefit in scrutinising and robustly evaluating the efficient delivery of ISP projects. AEMO considers that the ISP/RIT-T framework currently provides extensive mechanisms to protect consumers against inefficient outcomes (for example, the extensive analysis of the ISP including extensive and formal consultation on both inputs and outcomes prior to finalisation of recommendations, the subsequent extensive assessments and consultations by the TNSP during stages of the RIT-T, the ISP feedback loop, and the AER's consideration of contingent project applications). AEMO is aware of a pending rule change proposal (requested by Energy Users Association of Australia (EUAA), Delta Electricity, MEU, ERM Power and AGL) to consider the need for the RIT-T to be reassessed if a significant change in project costs occurs after the RIT-T is completed.[12] AEMO considers that any review of the regulatory frameworks for transmission should also focus on further streamlining the ISP and RIT-T processes, while preserving the necessary protections for consumers. In regard to the need for ongoing scrutiny of delivery of ISP projects and effectiveness of network businesses, it is noted that the AER performs this in its role as regulator of the network businesses.

[12] AEMC. *Material change in network infrastructure project costs*, at https://www.aemc.gov.au/rule-changes/material-change-network-infrastructure-project-costs.

Abbreviations

Term	Definition
AER	Australian Energy Regulator
Capex	Capital expenditure
CBA	Cost benefit analysis
CDP	Candidate development path
DER	Distributed energy resources
DLT	Detailed long-term (model)
DNSP	Distribution network service provider
DP	Development path
DSP	Demand side participation
EFOR	Equivalent forced outage rate
ESOO	Electricity Statement of Opportunities
FCAS	Frequency control ancillary services
FRG	Forecasting Reference Group
GPG	Gas-powered generation
GSOO	Gas Statement of Opportunities
HVAC	High voltage alternating current
HVDC	High voltage direct current
IASR	Inputs, Assumptions and Scenarios Report
IM	Integrated Model
ISP	Integrated System Plan
LWR	Least-worst regrets
LWWR	Least-worst weighted regrets
NEM	National Electricity Market
NOA	Network Options Assessment
NPV	Net present value

Term	Definition
NSP	Network service provider
NSCAS	Network Support and Control Ancillary Services
ODP	Optimal development path
PACR	Project Assessment Conclusions Report
PHES	Pumped hydro energy storage
POE	Probability of exceedance
REZ	Renewable energy zone
RIT-T	Regulatory Investment Test for Transmission
RRN	Regional Reference Node
RRO	Retailer Reliability Obligation
SRAS	System restart ancillary services
SRMC	Short Run Marginal Cost
SSLT	Single-stage long-term (model)
TNSP	Transmission network service provider
TOOT	Take-one-out-at-a-time (analysis)
USE	Unserved energy
VPP	Virtual power plant
VRE	Variable renewable energy