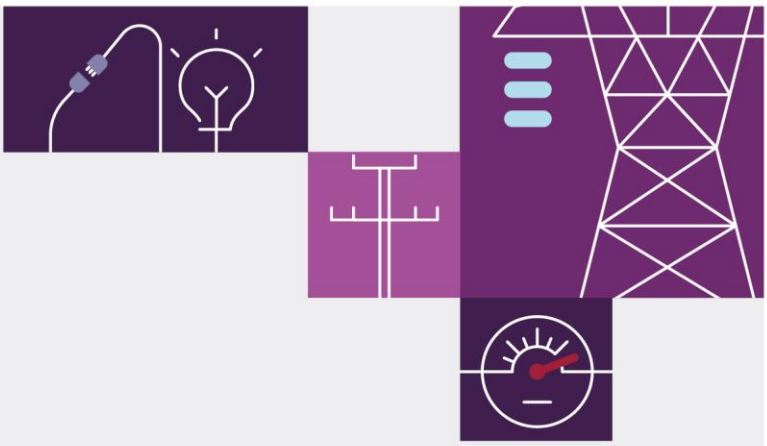
AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Consultation paper – Update to the ISP Methodology

March 2023

Consultation paper

For the Integrated System Plan (ISP) for the National Electricity Market



Important notice

Purpose

AEMO publishes this consultation paper on an update to the ISP Methodology pursuant to National Electricity Rules (NER) 5.22.8(d) and the Australian Energy Regulator's Forecasting Best Practice Guidelines. This paper attaches the Draft ISP Methodology incorporating updates developed consistent with the Australian Energy Regulator's Cost Benefit Analysis Guidelines. This paper includes key information and context for the methodology used in AEMO's *Integrated System Plan* (ISP).

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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.

Consultation notice

AEMO is publishing this paper to consult on an update to the current ISP Methodology, released in August 2021, through a single-stage consultation process. This consultation paper is published pursuant to National Electricity Rules (NER) 5.22.8(d) and in accordance with the Australian Energy Regulator's (AER's) Forecasting Best Practice Guidelines[1].

AEMO provides a Draft ISP Methodology as an attachment to this consultation paper, incorporating the updates proposed in this paper. This paper also includes targeted consultation questions. AEMO welcomes feedback on the Draft ISP Methodology and on the matters considered in this paper.

AEMO is proposing eight updates to the ISP Methodology

The primary updates proposed in this paper include:

- Accounting for **transmission project lead time uncertainty** by reviewing and extending lead times based on recent evidence.
- Better reflecting the **impact of fossil-fuelled generation on renewable energy zone (REZ) transmission limits** by adding additional variables to existing equations.
- Creating new intra-regional loss equations to account for the **network losses for REZs and sub-regions**.
- Aligning **assumed renewable energy resource quality** in REZs with historical performance by incorporating values consulted on with stakeholders through the *Inputs, Assumptions and Scenarios Report* (IASR) process.
- Allowing for **potential inclusion of a value of carbon emissions** in the ISP modelling process, were an explicit emissions value able to be appropriately quantified.
- Explaining how AEMO may use informed judgement to finalise the Optimal Development Path (ODP) with reference to **consumer risk preferences** by incorporating evidence-based risk metrics where available.
- Better reflecting expected energy reservation practices in the **dispatch behaviour of storage devices** by applying storage capacity limits consulted on through this methodology update process.
- Using data from actual events to incorporate a more realistic representation of the **duration of demand-side participation (DSP) response** in the ISP modelling process.

Stakeholder submissions are welcomed in response to this consultation paper

All stakeholders are invited to provide a written submission to any matters discussed in this consultation paper, or in the attached Draft ISP Methodology. **Submissions should be sent via email to ISP@aemo.com.au and are required to be submitted by 5.00 pm (AEST) Monday 1 May 2023.**

Please identify any parts of your submission that you wish to remain confidential, and explain why. AEMO requests that, where possible, submissions should provide evidence and information to support any views or claims that are put forward.

[1] AER. Forecasting Best Practice Guidelines. August 2020. At https://www.aer.gov.au/system/files/AER%20-%20Forecasting%20best%20practice%20guidelines%20-%2025%20August%202020.pdf.

Prior to submissions closing, AEMO will host a 90-minute webinar on Thursday 20 April 2023, from 2.30 pm to 4.00 pm (AEST). At the webinar, AEMO will present the key changes proposed for the update to the ISP Methodology, and allow time for questions. Stakeholders can sign up to attend the webinar here[2].

AEMO will consider all feedback and will publish the final update to the ISP Methodology on 30 June 2023. Following publication, AEMO will host a second webinar on 13 July 2023 that will summarise key changes to the final ISP Methodology, summarise key feedback, and outline how this feedback has been considered. Stakeholders can sign up to attend the webinar here[3].

Consultation questions provided in this paper

Transmission project lead time uncertainty

1. Is the revision of project lead times to reflect recent project delays an appropriate method to incorporate lead time uncertainty in the ISP? If not, what is an appropriate alternative?
2. What evidence can AEMO and project proponents collect to appropriately adjust project lead times?
3. What risks should AEMO consider when assessing transmission project lead times for the ISP?

Impact of fossil-fuelled generation on REZ transmission limits

4. Do stakeholders agree that the REZ transmission limit formulations should be updated to include fossil-fuelled generation? If not, why not?
5. Are there any alternative methods to accounting for fossil-fuelled generation in REZ transmission limits that AEMO should consider?

Network losses for REZs and sub-regions

6. Do stakeholders agree that the impact of network losses for REZs and sub-regions is worth quantifying in the modelling? If not, why not?
7. What alternative methods could be considered for incorporating network loss impacts for REZs and sub-regions?

Assumed renewable energy resource quality

8. Do you agree with the consistent use of land use data for screening potential VRE sites to both REZ resource limit and wind resource traces in the REZ trace development process? If not, why not?
9. Do you have a view on the proposed changes to the high wind and medium wind tranches, and the resulting capacity factors?

Potential inclusion of a value of carbon emissions

10. Do stakeholders agree that the ISP Methodology should be updated to be flexible in response to near-term changes to the National Electricity Objective (NEO)? If not, why not?
11. Do stakeholders agree with AEMO's proposed approach to incorporate a value of carbon emissions? If not, what alternatives should be considered?

[2] At https://events.teams.microsoft.com/event/478db1cf-787b-4914-adf0-010d11efc071@320c999e-3876-4ad0-b401-d241068e9e60.

[3] At https://events.teams.microsoft.com/event/d9ddcab6-8c36-4159-8db5-89c41084aa4e@320c999e-3876-4ad0-b401-d241068e9e60.

Consumer risk preferences

12. Do you agree with the proposed provision to apply evidence-based consumer risk preference metrics in the ISP? If not, why not?
13. What factors should be taken into account when preparing metrics to capture consumer risk preferences as they relate to the ISP?

Dispatch behaviour of storage devices

14. Do you consider it reasonable for AEMO's ISP models to reduce the reliable contribution from storage devices (particularly shallow storage devices) to reflect imperfect foresight? If not, why not?
15. Do you consider a limit on the storage capacity of storage devices, particularly on short-duration devices, to be the most appropriate way to restrict the performance of energy storage to approximate limited foresight and reservation of energy?
16. In what other ways could AEMO reduce the 'perfection' of foresight in its time-sequential model to improve model accuracy?
17. Do you agree that an 'up to 50%' limit on storage capacity is an appropriate limit value? If not, what should the limit be, and what evidence can be used to support an alternative limit?

Duration of demand-side participation response

18. Is the limitation of energy available for DSP for the reliability-response price band in the ISP modelling process reasonable? If not, why not?
19. Do you agree with the proposed two-hour duration limit for DSP reduction for reliability purposes? If not, what alternative value do you propose, and why?
20. Is it reasonable to limit the energy available for DSP to just the reliability-response band?

Contents

Figures

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.

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 consultative approach to developing the 2024 ISP.

In the development of this update to the ISP Methodology, AEMO will address the binding elements of the Australian Energy Regulator's (AER's) Forecasting Best Practice Guidelines (FBPG)[4] and the Cost Benefit Analysis Guidelines (CBA Guidelines)[5]. This includes:

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

This section notes the purpose of the ISP Methodology, before listing the updates AEMO proposes to consider in this consultation, and how this consultation fits in to the 2024 ISP development process.

1.1 Purpose of the ISP Methodology

AEMO's ISP Methodology sets out the methodologies for:

- **Modelling applied in the ISP.** This includes the capacity outlook models, time-sequential model and engineering assessment.
- **Cost benefit analysis (CBA) used in the ISP.** This includes:
  - AEMO's approach to applying the steps outlined in the AER's CBA guidelines,
  - Differentiating between scenarios and sensitivities and their treatment in informing the determination of the optimal development path (ODP), and
  - Outlining how AEMO will determine weights for scenarios.

The combination of the processes described above leads to the determination of the ODP for an ISP. The ODP optimises net economic benefit to all those who produce, consume and transport electricity in the market.

1.2 Updates to the ISP Methodology considered in this consultation

AEMO is required to review its ISP Methodology at least every four years. When reviewing the ISP Methodology outside of the four-yearly process, AEMO is required to run the single stage consultation process set out in the FBPG (Appendix B).

[4] AER. Forecasting Best Practice Guidelines. August 2020. At https://www.aer.gov.au/system/files/AER%20-%20Forecasting%20best%20practice%20guidelines%20-%2025%20August%202020.pdf.

[5] AER. Cost benefit analysis guidelines – Guidelines to make the Integrated System Plan actionable. August 2020. At https://www.aer.gov.au/system/files/AER%20-%20Cost%20benefit%20analysis%20guidelines%20-%2025%20August%202020.pdf.

The current ISP Methodology was published in August 2021, but AEMO considers several matters warrant an earlier review and an update to the current ISP Methodology. These are:

- Accounting for **transmission project lead time uncertainty** by reviewing and extending lead times based on recent evidence.
- Better reflecting the **impact of fossil-fuelled generation on renewable energy zone (REZ) transmission limits** by adding additional variables to existing equations.
- Creating new intra-regional loss equations to account for the **network losses for REZs and sub-regions**.
- Aligning **assumed renewable energy resource quality** in REZs with historical performance by incorporating values consulted on with stakeholders through the *Inputs, Assumptions and Scenarios Report* (IASR) process.
- Allowing for **potential inclusion of a value of carbon emissions** in the ISP modelling process, were an explicit emissions value able to be appropriately quantified.
- Explaining how AEMO may use informed judgement to finalise the Optimal Development Path (ODP) with reference to **consumer risk preferences** by incorporating evidence-based risk metrics where available.
- Better reflecting expected energy reservation practices in the **dispatch behaviour of storage devices** by applying storage capacity limits consulted on through this methodology update process.
- Using data from actual events to incorporate a more realistic representation of the **duration of demand-side participation (DSP) response** in the ISP modelling process.

The Draft ISP Methodology published with this consultation paper incorporates the eight matters noted above and considered in detail for stakeholder feedback in Section 2. Additional non-consequential changes have also been made. All changes (except for formatting and some typographical changes) are shown as tracked changes compared to the current ISP Methodology. .

1.3 2024 ISP development process

Figure 1 shows the ISP process as a whole and current progress on all elements for the 2024 ISP[6]. In addition to this ISP Methodology update consultation, two other consultations that will inform the 2024 ISP are underway:

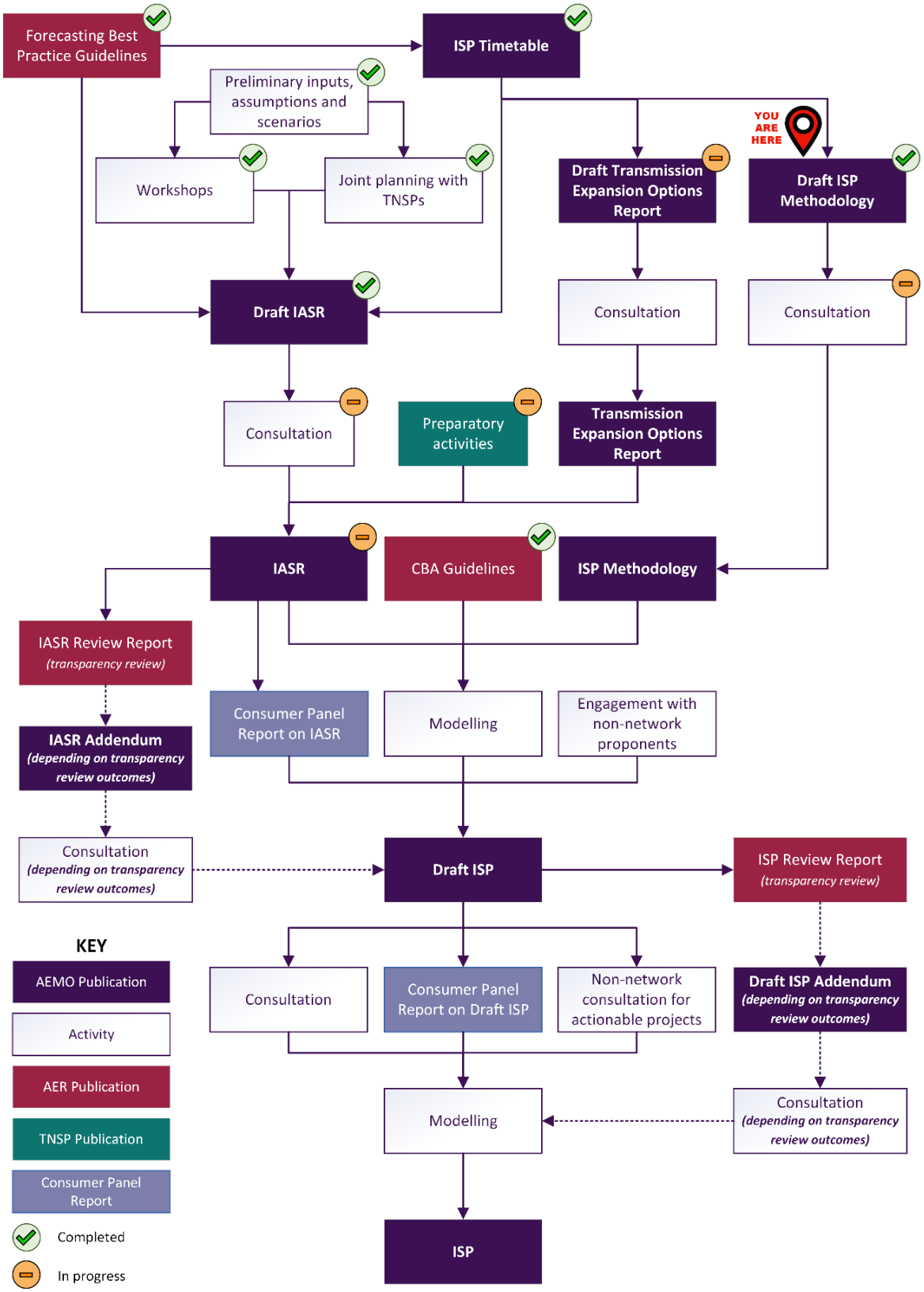
- **The 2023 *Transmission Expansion Options Report* (TEOR)** will present the transmission augmentation options and costs for the 2024 ISP. The development of the TEOR will include a draft report being released by the end of April 2023, a public webinar on 18 May 2023, and an opportunity for written consultation[7].
- **The 2023 IASR** will catalogue the range of inputs, assumptions and scenarios for the 2024 ISP. At the time of publication of this paper, AEMO has received submissions on the Draft 2023 IASR, has hosted a webinar, and will continue to finalise responses to feedback before publishing the final 2023 IASR in July 2023[8].

[6] The 2024 ISP Timetable provides more information on the key milestones of the 2024 ISP development process, at https://aemo.com.au/-/media/files/major-publications/isp/2022/2024-isp-timetable.pdf?la=en.

[7] Consultation materials for the TEOR will be available from late April 2023 onwards at https://aemo.com.au/consultations/current-and-closed-consultations/2023-transmission-expansion-options-report-consultation.

[8] Consultation materials for the IASR are available at https://aemo.com.au/consultations/current-and-closed-consultations/2023-inputs-assumptions-and-scenarios-consultation.

Figure 1 Navigating the ISP process



Note: The diagram above has been amended from the version published in the 2024 ISP timetable by adding a box containing "Draft Transmission Expansion Options Report" and "Transmission Expansion Options Report" with an additional "Consultation" box. The IASR will consider transmission development options and non-network alternatives.

2 Proposed methodology updates

This section proposes updates to the ISP Methodology to address eight key matters:

- Transmission project lead time uncertainty (Section 2.1).
- Impact of fossil-fuelled generation on REZ transmission limits (Section 2.2).
- Network losses between REZs and sub-regions (Section 2.3).
- Assumed renewable energy resource quality (Section 2.4).
- Value of carbon emissions (Section 2.5).
- Consumer risk preferences (Section 2.6).
- Dispatch behaviour of short-duration storage devices (Section 2.7).
- Duration of DSP response (Section 2.8).

The Draft ISP Methodology published as an attachment to this consultation paper shows how AEMO proposes to incorporate these updates.

AEMO welcomes feedback on these proposed updates and has provided targeted consultation questions at the end of each section. AEMO also welcomes feedback on relevant and material issues not described in this consultation paper.

2.1 Transmission project lead time uncertainty

The ISP ODP is strongly affected by the lead times and expected in-service dates (EISDs) assumed for transmission projects. Transmission projects include:

- **Flow paths** – the portion of the transmission network used to transport significant amounts of electricity across the backbone of the interconnected network to load centres.
- **REZs** – the network required to connect renewable generation in areas where clusters of large-scale renewable energy can be developed using economies of scale.

These projects may already be committed or anticipated projects[9] from transmission network service providers (TNSPs) and other organisations, or they may be more speculative options which are less certain or progressed.

Shorter or longer transmission project lead times can influence which transmission projects are selected as actionable projects in the ODP, or as future projects, as well as the capacities and locations of other development opportunities (generation and storage projects) included in the ODP.

[9] Committed transmission augmentation projects meet five criteria relating to planning consents, construction commencement, land acquisition, contracts for supply and construction of equipment, and necessary financing arrangements. Anticipated projects are in the process of meeting at least three of the criteria. Details about the criteria are provided in AEMO's Transmission Augmentation Information publication, at https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-planning-data/transmission-augmentation-information.

Existing approach

Under the current methodology, if the optimal timing of a transmission project under an ODP aligns with the project's EISD (or at least is within EISD + 1 year), the project can be identified as an actionable ISP project. This is applied as follows:

- For committed and anticipated projects, AEMO receives updates on EISDs from relevant parties as these projects are already progressing through the regulatory approval pathway and in the case of committed projects have already completed the relevant regulatory process for that project. These EISDs are included in the transmission expansion information published as part of the final IASR (and consulted on in the TEOR) for the relevant ISP. In some cases, new information received through feedback on the draft ISP can be used to update project data such as EISDs for the final ISP.
- For projects which are not committed or anticipated, AEMO will model these in accordance with a lead time and EISD as nominated in the relevant IASR (and its sub-report, known originally as the *Transmission Cost Report* and in future versions as the *Transmission Expansion Options Report*). For projects that are identified as actionable ISP projects in a particular ISP, the National Electricity Rules (NER) require that the ISP set a date for Project Assessment Draft Report (PADR) publication within six to 24 months of the publication of that ISP. AEMO's interpretation of this requirement in the current ISP Methodology is that it means a project may be identified as actionable where the CBA has concluded that the project should proceed at the EISD (or EISD + 1 given the two-year cycle of the ISP), although this is also subject to the outcome of the ODP selection[10].

Updates proposed

Transmission project lead times are becoming increasingly uncertain. There are several factors that can cause delays[11], including but not limited to:

- **Supply chain issues relating to the delivery of materials and equipment.** For example, KPMG's "Market Sounding Report on Transmission"[12] identified that supply chain pressures are resulting in up to 40% increase in capital expenditures and that several stakeholders believed the increase in costs may cause damaging delays to transmission projects. Potential supply chain risks and their impact on transmission projects were raised by multiple submissions as part of the 2022 ISP consultation.
- **Workforce and skills shortages.** Infrastructure Australia's Market Capacity[13] report found that public infrastructure projects face an expected shortfall of infrastructure connected labour of 248,000 roles in 2023. This projected skills shortage will likely be exacerbated by competition between states and regions.
- **Time to engage with communities and stakeholders on the project.** As is increasingly being noted across the sector, including in the Stage 3 report of the Australian Energy Market Commission's (AEMC's)

[10] Pages 72 and pages 75-76, as well as a case study in Table 5. AEMO, ISP Methodology, August 2021. At https://aemo.com.au/-/media/files/major-publications/isp/2021/2021-isp-methodology.pdf?la=en.

[11] AEMO acknowledges that these factors also apply to other energy infrastructure projects relevant for the ISP such as generation and storage projects but considers transmission projects in this consultation paper because the ISP ODP is related to the regulatory approval process for some transmission augmentation projects in the NEM. That is, considering these matters as they relate to transmission projects is relevant for the selection of the ODP.

[12] KPMG. Market sounding report on transmission. August 2022. At https://www.energynetworks.com.au/resources/reports/2022-reports-and-publications/market-sounding-report-on-transmission/.

[13] Infrastructure Australia. Infrastructure market capacity report. December 2022. At https://www.infrastructureaustralia.gov.au/sites/default/files/2022-12/20221219_IA_Market-Capacity-Report.pdf.

Transmission Planning and Investment Review[14], facilitating community engagement and the acceptance of major transmission investments is an important element that needs to be incorporated in the timeline for delivery of a transmission project.

AEMO considers that the ISP framework must better incorporate the uncertainty associated with transmission project lead time, and therefore with the EISD for any individual project.

AEMO has identified two options for incorporating this uncertainty into the Draft ISP Methodology, and ultimately into the ISP, although only one is recommended:

- **Introduce an 'actionable window'.** This would extend the window of time beyond the EISD under which a project could be considered beneficial. This change would be included by substituting references to 'EISD + 1 year' with 'EISD + actionable window' and the inclusion of a definition of an 'actionable window'. This could be a time period of around three to five years based on observation of supply chain, market and regulatory pressures on transmission project lead times.
- **Revise the EISDs to reflect observed project delay factors.** AEMO currently seeks input from transmission project proponents on project lead times for inclusion in the ISP modelling process. Under this option, AEMO would review and possibly extend the proposed project lead times from project proponents to acknowledge and incorporate the greater uncertainty observed in delivery of these major infrastructure projects. This would also allow AEMO to quantify the delay risk caveats often noted by project proponents when lead time estimates are provided to AEMO. This process could occur through existing joint planning arrangements. AEMO would endeavour to consult publicly on these EISDs, for example in the Draft TEOR, the IASR, or the Draft ISP, before their application in the ISP modelling.

AEMO's current preference is to include the second option in the Draft ISP Methodology. Consultation on the TEOR (part of the IASR process) would include consideration of project lead times for individual transmission projects, as would consultation on the Draft ISP.

Consultation questions

1. Is the revision of project lead times to reflect recent project delays an appropriate method to incorporate lead time uncertainty in the ISP? If not, what is an appropriate alternative?
2. What evidence can AEMO and project proponents collect to appropriately adjust project lead times?
3. What risks should AEMO consider when assessing transmission project lead times for the ISP?

2.2 Impact of fossil-fuelled generation on REZ transmission limits

REZs are represented in capacity outlook modelling for the ISP through the application of:

- Resource limits that cap the amount of generation that can be supported by the REZ, and
- Transmission limits that set the amount of power that can be transferred from the REZ through to the shared transmission network.

As the electricity sector transformation continues, changes to the expression of transmission limits are needed to better account for the impact of retiring fossil-fuelled generation.

[14] Information about the AEMC's transmission planning and investment review, reference number EPR0087, is at https://www.aemc.gov.au/market-reviews-advice/transmission-planning-and-investment-review.

Existing approach

At present the transmission limits defined for REZs specifically define how much total variable renewable energy (VRE) can be dispatched within a REZ for export to the shared transmission network. The limits do not have load, interconnector or fossil-fuelled generation terms defined. Instead, these factors are usually accounted for by checking that the transmission limit reflects historical or statistical outcomes relating to loads, interconnectors or fossil-fuelled generators, or in some cases through applying manual offsets.

In the current approach, if there is significant fossil-fuelled generation within or near a REZ boundary, the typical output from that generator is assumed to be online at the time when the limit is expected to be reached and the transmission limit is set accordingly. As such, should that generation retire, the transmission limit will be set too conservatively and will not permit additional VRE to be planted within the capacity outlook model up to the true transmission limit. This would effectively result in a reduction in the modelled transmission capacity, although the actual transmission capability would not be affected by the retirement.

For previous ISPs, manual offsets have been added to REZ transmission limits to correct this situation once fossil-fuelled generation retirements are known.

Updates proposed

To eliminate the need for manual modelling corrections through use of offsets, and given the expected increase in future retirements of fossil-fuelled generators, AEMO proposes to allow fossil-fuelled generators to be included as specific terms in the transmission limits for REZs. AEMO has already applied this method in draft form for the preparation of the REZ limits issued in Draft 2023 IASR for the Gippsland REZ (V5) and Darling Downs REZ (Q8).

This approach does not seek to change the definition of a REZ to include fossil-fuelled generation. Rather, this approach would recognise that transmission that supports REZ connections may be shared with other generators, and the network representation should treat these with improved transparency.

This approach will mean that when fossil-fuelled generation retires, or is dispatched at lower than typical historical levels, the model will allow transmission network capacity previously assumed to be used by that generation to be automatically freed-up for potential use by additional VRE (or any other additional generation). This will ensure the model uses future available network capacity before any REZ network expansions are taken up.

At the same time, AEMO proposes also to update the formulation of REZ transmission limits to incorporate relevant impact from nearby flow paths, for example the impact of a flow path augmentation on a REZ transmission limit. This will allow for a better representation of the REZ transmission limit, like the impact of adding a term to incorporate fossil-fuelled generator impact.

These improvements are shown in Section 2.3.4 of the Draft ISP Methodology, as well as some edits to enhance clarity of descriptions for the elements of the equation. These updates are intended to increase the accuracy of the REZ transmission limits and therefore give more confidence in the timing and need for any future REZ network expansions recommended through the ISP.

Consultation questions

4. Do stakeholders agree that the REZ transmission limit formulations should be updated to include fossil-fuelled generation? If not, why not?
5. Are there any alternative methods to accounting for retiring fossil-fuelled generation in REZ transmission limits that AEMO should consider?

2.3 Network losses for REZs and sub-regions

As electricity flows through the transmission and distribution networks, energy is lost due to electrical resistance and the heating of conductors. The ISP Methodology outlines how the modelling processes account for energy lost through the networks, to make sure that enough supply is assumed to account for both meeting the needs of electrical loads and the energy that will be lost through transportation through the networks.

Current approach

The current ISP Methodology accounts for losses between the five NEM regions either by building network losses into the electricity demand assumptions or through explicitly calculating loss equations for flows between regions.

Inter-regional loss factor equations are usually calculated and applied for transmission interconnector circuits as they are at present, and then adjusted to account for potential future network augmentations. Generator marginal loss factors are not dynamically calculated or updated within the market model, and are set to the latest current values, or set to values of nearby generation for new entrants.

If a REZ is not on an inter-regional flow path, these inter-regional marginal loss equations will not reflect the potential change in network losses. For example, network losses could increase due to additional generation causing higher line flows within the REZ, in cases where this additional generation is transported to a remote load centre rather than used by a local load.

Although post-calculation of losses could be done when calculating benefits for the ISP, this would not allow for the ISP models to dynamically take increasing losses into account when determining optimal placement of new generation, and therefore could impact on the ODP recommended by the ISP. For the 2022 ISP, penalty cost factors were applied to new generation in the Q1 and Q2 REZs to reflect the impact of network losses in those REZs. The subsequent modelling results indicated that this matter justifies an amendment to the existing approach.

Updates proposed

To support better representation of how network losses associated with sub-regions are represented in the ISP, AEMO proposed in the Draft 2023 IASR to create new sub-regions and associated sub-regional loss equations. For example, in Queensland this included the creation of separate North Queensland and Central Queensland sub-regions. This proposed change to the sub-regional topology also supports additional modelling outcomes, including providing more granular information on key intra-regional transmission limitations and augmentations which are not well approximated by interconnectors and REZs.

AEMO is proposing to reflect this enhanced treatment of network losses in the Draft ISP Methodology by adding an option for inclusion of loss equations and marginal loss factor equations for intra-regional flow paths (Section 2.3.6 of the Draft ISP Methodology) as well as a minor update to the list of limitations of the regional topology (Section 2.3.1 of the Draft ISP Methodology).

Consultation questions

6. Do stakeholders agree that the impact of network losses for REZs and sub-regions is worth quantifying in the modelling? If not, why not?
7. What alternative methods could be considered for incorporating network loss impacts for REZs and sub-regions?

2.4 Assumed renewable energy resource quality

AEMO monitors power system and market developments to continuously improve its forecasting and planning publications. Through this monitoring, AEMO has identified an opportunity to enhance the ISP assessment of wind and solar resource quality.

Existing approach

In the current ISP Methodology, wind and solar resource traces for new entrant REZ candidates are produced using a site selection process that identifies locations likely to be appropriate candidates for development of new VRE generation. The solar or wind resource is then aggregated across selected sites within each REZ to produce representative VRE resource traces for that REZ for new-entrant solar and wind generators.

For solar profiles, AEMO estimates the solar resource by averaging the resource quality across a subset of locations within the REZ, considering existing and anticipated projects where appropriate. For wind profiles, REZs are split into two tranches to distinguish available resource quality, given the large variance that may exist in wind resource across a REZ.

AEMO currently uses the following percentiles to distinguish between the high and medium wind resource quality tranches for REZs:

- High wind tranche is taken from top 5% of wind resource quality sites.
- Medium wind tranche is taken from the top 20% of wind speed quality sites (excluding sites that fall within the first tranche).

The choice of the percentiles for the tranches – 5% and 20% – was based on a calibration process that aligned the resulting wind resource with historical performance.

Updates proposed

AEMO received stakeholder feedback on this matter in the Draft 2023 IASR consultation, and now considers that more accurate generation profiles can be modelled for REZs if more granular information about sites which are unsuitable for development is incorporated into the resource assessment process. AEMO proposes to use a desktop assessment of land use data to provide an initial screening for sites which are unsuitable for development. This process considers a range of factors that may impact the viability of VRE development, for example:

- Environmental and ecological constraints – such as threatened ecological communities, threatened flora and fauna habitats, and Ramsar wetlands.
- Cultural heritage – such as UNESCO World Heritages sites, and areas with Indigenous or other historical heritage.
- Land planning – such as national and state parks, and proximity to residential areas.
- Proximity to airports and other restricted areas.

AEMO has amended the Draft ISP Methodology to take the limits reflecting site development factors described above, that were previously only considered in overarching REZ resource limits, and apply those to the VRE resource projection as well.

As a result of applying this approach consistently across both REZ resource limits and resource quality, AEMO proposes to amend the data set used to identify sites deemed suitable for development, and to adjust the percentiles for both the high and medium wind resource quality tranches to better align resulting REZ resource quality (often referred to as 'capacity factors') with the performance of recent wind farm developments. The proposed changes for inclusion in the final 2023 IASR are:

- Changing high wind to the top 15% of the wind sites deemed suitable for development (previously top 5% of all wind sites).
- Changing medium wind to the top 40% of the wind sites deemed suitable for development, excluding those falling in the first tranche (previously top 20% of all wind sites).

The choice of the percentiles for the tranches – 15% and 40% – is still based on a calibration process with reference to historical performance, similar to the process used for previous assessments, but these updated percentiles now reflect the latest historical data. In addition, these percentiles will be applied to an amended set of sites deemed suitable for development, intended to better reflect the range of factors that may impact the viability of VRE development.

The indicative generation capacity factors resulting from the proposed changes discussed in this section were presented for consultation in the Draft 2023 IASR workbook[15].

AEMO has not proposed to apply this approach for solar resource traces, because the variability of solar insolation across a REZ is much less volatile than wind speeds.

AEMO is proposing to remove the percentile values from the Draft ISP Methodology, and permit this updated resource projection to be included in the ISP Methodology with precise values to be consulted on through the IASR process.

Consultation questions

8. Do you agree with the consistent use of land use data for screening potential VRE sites to both REZ resource limit and wind resource traces in the REZ trace development process? If not, why not?
9. Do you have a view on the proposed changes to the high wind and medium wind tranches, and the resulting capacity factors?

2.5 Potential inclusion of a value of carbon emissions

The National Electricity Objective (NEO), as laid out in the National Electricity Law[16], is *to promote efficient investment in, and efficient operation and use of, electricity services for the long-term interest of consumers of electricity with respect to:*

- *Price, quality, safety, reliability and security of supply of electricity; and*
- *The reliability, safety and security of the national electricity system.*

[15] AEMO. 'Capacity factors' worksheet, Draft 2023 Inputs and Assumptions Workbook. December 2022. Accessible via https://aemo.com.au/consultations/current-and-closed-consultations/2023-inputs-assumptions-and-scenarios-consultation.

[16] At https://www.legislation.sa.gov.au/__legislation/lz/c/a/national%20electricity%20(south%20australia)%20act%201996/current/1996.44.auth.pdf.

In August 2022, Energy Ministers agreed to fast track the introduction of an emissions reduction objective into the NEO. A consultation published by the Australian Government, seeking views on the Draft Bill and accompanying consultation paper, closed in February 2023[17].

Current approach

AEMO currently accounts for emissions reductions explicitly in its ISP modelling via the use of emission constraints to represent carbon budgets. More information on the implementation of emission constraints can be found in Section 2.4.5 of the current ISP Methodology. The determination of these carbon budgets is underpinned by multisectoral modelling and is consulted on though the IASR process.

The current approach ensures that emission outputs in the ISP are driven by scenario-specific long-term assumptions regarding temperatures, and consider the relative efforts to decarbonise not just the electricity system but the wider Australian economy.

Updates proposed

While emission outcomes differ across scenarios, the value of emissions reductions beyond those required by policy or scenario settings is not explicitly incorporated into the ISP cost-benefit analysis at present. Currently, the NER require the ISP and Regulatory Investment Test for Transmission (RIT-T) to consider specific classes of market benefit and these do not currently include emissions reduction.

Once the NEO is amended to include an emissions reduction objective, consideration should be given as to whether an additional class of benefit is required to estimate the value of emissions reductions beyond those required by policy or scenario settings. Consideration of an additional class of market benefit in the ISP would require a rule change, an amendment to the CBA Guidelines, or agreement by the AER before Draft ISP publication. If it is not appropriate or premature to allow this additional class of market benefit to influence ISP outcomes, AEMO may instead consider including analysis and commentary in the ISP regarding the value of carbon emissions for information purposes only.

AEMO considers that the most appropriate method to incorporate an emission reduction objective in the NEO in the ISP CBA process would be to apply a ‘value of carbon emissions’ which would represent the value of investments that reduce carbon emissions beyond the existing ISP scenario parameters.

AEMO proposes to amend Section 5.2 of the ISP Methodology to incorporate the possibility of the use of a value of carbon emissions in the capacity outlook modelling.

Consultation questions

10. Do stakeholders agree that the ISP Methodology should be updated to be flexible in response to near-term changes to the NEO? If not, why not?
11. Do stakeholders agree with AEMO’s proposed approach to incorporate a value of carbon emissions? If not, what alternatives should be considered?

[17] See https://www.energy.gov.au/government-priorities/energy-and-climate-change-ministerial-council/priorities/national-energy-transformation-partnership/consultation-proposed-legislative-changes-incorporate-emissions-reduction-objective-national-energy-objectives.

2.6 Consumer risk preferences

AEMO's ISP Consumer Panel for the 2022 ISP highlighted the need for AEMO to further examine how the draft ODP reflects consumer risk preferences. As a result, AEMO conducted a targeted engagement and incorporated the outcome in the final 2022 ISP. AEMO now considers that quantification of consumer risk preferences can be improved and may be used to inform the selection of the ODP.

Existing approach

The ISP determines an ODP which represents a major infrastructure investment on behalf of current and future consumers. The ODP optimises transmission, generation and storage investments to meet consumers' future energy requirements. In order to ensure that the final ODP selection appropriately reflects consumers' level of risk neutrality or aversion, the current ISP Methodology provides for AEMO to use professional judgement in the selection of the final ODP. This is considered to be consistent with the AER's CBA Guidelines.

Updates proposed

For the 2022 ISP, targeted engagements with consumer advocates and representatives were used to incorporate a consideration of consumer risk preferences. AEMO has now engaged a consultant to support the preparation of consumer risk preference metrics specifically relevant for the ISP, through conducting focus groups and a survey. This work is novel, and the results are not yet known.

AEMO may choose to use evidence-based consumer risk preference metrics as part of applying professional judgement to finalise the selection of the ODP. AEMO has proposed amendments to Section 5.8 of the Draft ISP Methodology to explain how this may be done.

Consultation questions

12. Do you agree with the proposed provision to apply evidence-based consumer risk preference metrics in the ISP? If not, why not?
13. What factors should be taken into account when preparing metrics to capture consumer risk preferences as they relate to the ISP?

2.7 Dispatch behaviour of storage devices

Actual NEM dispatch is dynamic, in that dispatch decisions are made by market participants for the current period with only imperfect knowledge of what will happen in following periods. For short-duration storage devices in particular[18], device operators must balance the benefits of discharging now against the risk that it may be even better to wait a little longer.

Existing approach

AEMO's forecasting and planning models have perfect foresight within each simulated day. This can lead to exaggerated assumptions about ideal dispatch of storage devices – that is, assumptions that storage devices can

[18] 'Short-duration' storage devices can maintain their rated power discharge rates for four hours or less before their energy is exhausted.

or will be dispatched at their full capacity rate at exactly the period when their output is most required by the power system.

Under the current ISP Methodology, all storage is modelled in both the time-sequential model and the capacity outlook model as fully available to the energy market, up to the generation capacity (megawatts [MW]) and storage capacity (megawatt hours [MWh]) outlined in the IASR (subject to other technical limitations).

Updates proposed

In Section 3.3.3 of the Draft ISP Methodology, AEMO proposes to limit the storage capacity (in MWh) of storage devices in both the time-sequential model and the capacity outlook model to better reflect AEMO's understanding that storage devices (short-duration in particular) are not and will not be operated exclusively to meet power system needs at the precise time they are most required. Rather, it is expected that in practice some energy will either be used before the time of maximum need or will be reserved for use in future periods.

This update would recognise that in developing optimal capacity solutions, the ISP models should balance the perfect foresight inherent in dispatch and capacity optimisation modelling, and adjust the level that can be relied upon to reflect earlier usage to take advantage of market circumstances or energy retained in reserve in case the opportunity for it is even greater in following periods.

AEMO proposes to limit the storage capacity of storage devices. This is effectively equivalent to preventing the device from discharging its full energy capacity within a single day or given period, to reflect the energy reservation practice noted above.

Subject to feedback received on this consultation paper, and through AEMO's Forecasting Reference Group consultation process over Q2 2023, AEMO proposes to limit dispatch of storage devices by up to 50% of their rated energy storage, as follows:

- Consult on a derating factor up to 50%, with the final Methodology to rely on stakeholder engagement to explore something that is more staggered as follows:
  - For devices with less than 2 hours of storage, reduce storage capacity by 50%.
  - For devices with 2 to (less than) 4 hours of storage, reduce storage capacity by 25%.
  - For devices with 4 to (less than) 8 hours of storage, reduce storage capacity by 10%.

These values are proposed based on discussions with relevant market participants, and observation of historical performance of both utility-scale and distributed-scale short-duration storage devices of different storage durations.

This limit would also apply to aggregated embedded energy storages (including virtual power plants [VPPs] and electric vehicles to grid) as aggregated embedded energy storages (and electric vehicles to grid) are generally modelled consistently with the treatment of large-scale energy storage devices within the ISP.

An alternative approach would be to limit the power output (in MW). This would effectively be equivalent to throttling the generation output from the device. This is not AEMO's preferred approach as it is considered that limiting storage capacity better aligns with the intent of the reservation behaviour described above, and therefore should be a better representation of market participant behaviour.

AEMO proposes to proceed with its preferred option, which is to limit the storage capacity of storage devices in the ISP models. In the Draft ISP Methodology, AEMO updates Section 2.3.7 and Section 3.3.3 to refer to the use of this limit on short-duration storage capacity in both the capacity outlook and time-sequential model.

AEMO is seeking stakeholder feedback on the proposed limit value explained above and welcomes any input on the proposed value or evidence to inform the use of an alternative value. The final limit will be published and updated through the IASR process, rather than recorded in the Draft ISP Methodology.

Consultation questions

14. Do you consider it reasonable for AEMO's ISP models to reduce the reliable contribution from storage devices (particularly shallow storage devices) to reflect imperfect foresight? If not, why not?
15. Do you consider a limit on the storage capacity of storage devices, particularly on short-duration devices, to be the most appropriate way to restrict the performance of energy storage to approximate limited foresight and reservation of energy?
16. In what other ways could AEMO reduce the 'perfection' of foresight in its time-sequential model to improve model accuracy?
17. Do you agree that an 'up to 50%' limit on storage capacity is an appropriate limit value? If not, what should the limit be, and what evidence can be used to support an alternative limit?

2.8 Duration of demand-side participation response

AEMO's modelling of the use of DSP is based on observed reduction from a 'baseline' load profile triggered by either high prices or by reliability events[19]. High-price events are categorised by price bands, the lowest of which is $300-500/MWh and the highest is $7500/MWh up to the market price cap. Reliability events cover periods of very low reserve (Lack of Reserve [LOR] 2 and LOR 3)[20], when there is high risk of load shedding. In AEMO's ISP models these events are characterised by prices reaching the market price cap.

AEMO considers that forecast DSP utilisation should reflect the duration of response to actual trigger events, in addition to the level of demand reduction. Whereas the lower price bands triggering DSP response have been observed to last upwards of 12 hours, conditions corresponding to the reliability response band typically do not exceed two hours in duration. For example, in calendar year 2022 the New South Wales region saw 30-minute average prices exceed the $300/MWh threshold for a total of 1248 hours (14% of the year), and the longest continuous duration above the threshold was 134 hours. In contrast, the longest actual LOR 2 events in New South Wales during this period lasted 1.5 hours.

Existing approach

Under the current ISP Methodology, the modelled limits on DSP are the capacity available for dispatch in each price band. Under this approach, each tranche of DSP can be dispatched:

[19] For details see AEMO's *Demand Side Participation Forecast Methodology*, August 2020, at https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2020/demand-side-participation/final/demand-side-participation-forecast-methodology.pdf.

[20] See AEMO's reserve level declaration guidelines, at https://www.aemo.com.au/-/media/files/electricity/nem/security_and_reliability/power_system_ops/reserve-level-declaration-guidelines.pdf.

- On a continuous basis for as long as the regional price remains above the DSP price band, or
- At the market price cap for the reliability response tranche.

AEMO's current ISP Methodology has no restriction on the continuous activation of DSP for many hours or days continuously. While this approach was appropriate when the DSP market was less developed, it is no longer consistent with the observed operation of DSP participants in practice or with expectations for future operation of DSP in the NEM.

Updates proposed

As outlined in Section 3.3.6 of the Draft ISP Methodology, AEMO is proposing to limit the ISP modelling representation of daily energy contribution from the reliability-response band of DSP. AEMO is not proposing to limit the demand response at lower price bands, on the understanding that DSP accessed through lower price bands is called upon more frequently and for longer durations than DSP accessed through the reliability-response band.

AEMO is proposing to limit the daily energy contribution from the reliability-response band of DSP to a maximum of two hours of continuous operation, as this is the expected duration of typical peak unserved energy (USE) events and aligns with the duration of trigger events upon which the DSP forecast is based.

AEMO proposes to proceed with the use of energy limits on DSP in the ISP process, and has amended Section 3.3.6 of the Draft ISP Methodology accordingly.

AEMO is seeking stakeholder feedback on the proposed limit value explained above, and welcomes any input on the proposed value or evidence to inform the use of an alternative value. The final limit will be published and updated through the IASR process, rather than recorded in the Draft ISP Methodology.

Consultation questions

18. Is the limitation of energy available for DSP for the reliability-response price band in the ISP modelling process reasonable? If not, why not?
19. Do you agree with the proposed two-hour duration limit for DSP reduction for reliability purposes? If not, what alternative value do you propose, and why?
20. Is it reasonable to limit the energy available for DSP to just the reliability-response band?

A1. Abbreviations

Acronym	Term
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
CBA	Cost benefit analysis
DSP	Demand side participation
EISD	Earliest in-service date
FBPG	Forecasting Best Practice Guidelines
IASR	*Inputs, Assumptions and Scenarios Report*
ISP	*Integrated System Plan*
MW	Megawatt/s
MWh	Megawatt hour/s
NEM	National Electricity Market
NEO	National Electricity Objective
NER	National Electricity Rules
ODP	Optimal development path
PADR	Project Assessment Draft Report
REZ	Renewable energy zone
RIT-T	Regulatory Investment Test for Transmission
TNSP	Transmission network service provider
VRE	Variable renewable energy