2020 Integrated System Plan Consultation Summary Report

August 2020

A report for the National Electricity Market

Important notice

PURPOSE

AEMO issued a notice of consultation on the Draft 2020 Integrated System Plan (ISP) on 12 December 2019, along with a call for non-network options for the Queensland – New South Wales Interconnector (QNI) Medium and Victoria – New South Wales Interconnector (VNI) West projects.

This report summarises the submissions that were received, and provides AEMO's responses to the material issues raised in the submissions.

VERSION CONTROL

Version	Release date	Changes
1	3/8/2020	Initial release

Executive summary

A comprehensive plan for stakeholder engagement was enacted for the 2020 Integrated System Plan (ISP), running from early 2019 with a consultation on the inputs, assumptions and scenarios, through to 2020 with more recent consultations on the Draft 2020 ISP and non-network options.

A summary timeline of the various engagement activities is shown in Table 1 below.

Table 1 Consultation timeline

Key milestone	Date
Consultation on Scenarios, Inputs and Assumptions	February to August 2019
Renewable Energy Zones (REZ) briefing	13 August 2019
Preliminary modelling outcomes workshop	10 October 2019
Publish Draft 2020 ISP	12 December 2019
Consultation workshops on Draft ISP	Brisbane – 3 February 2020 Sydney – 4 February 2020 Melbourne – 5 February 2020
Draft 2020 ISP Webinar	11 February 2020
Formal consultation on Draft ISP	12 December 2019 to 21 February 2020
Formal consultation on Draft ISP QNI Medium and VNI West non-network options	12 December 2019 to 13 March 2020
ISP Progress updates	March, April, June 2020
Publish 2020 ISP and Consultation Summary Report	3 August 2020

The purpose of this report is to:

- Provide a summary of the feedback that was received from 54 submissions to the Draft 2020 ISP consultation, and the six submissions to the non-network options consultation for Queensland – New South Wales Interconnector (QNI) Medium and Victoria – New South Wales Interconnector (VNI) West.
- Document AEMO's responses to the material issues raised in the submissions.

Consultation on Draft 2020 ISP

The feedback received on the Draft 2020 ISP can be broken into 10 themes, listed in Table 2 below in order of frequency of mentions and stakeholder consensus.

Stakeholders were generally positive about the engagement process that was undertaken for the 2020 ISP, with many noting improvements on the 2018 ISP consultation process.

Given the scale and value of future development that is proposed in the ISP, many stakeholders emphasised the importance of ongoing engagement to ensure any plan is robust and fit for purpose, and there was in general a desire for even more extended and comprehensive engagements in the development of the future ISP, as well as post ISP on the outcomes.

Table 2 Summary of key themes

Themes	Frequency	Consensus
Strategic roll-out of transmission and interconnection, to unlock renewable energy generation development, is widely supported	23 stakeholders	High
There is general support for the role of the ISP in the transition underway in the National Electricity Market (NEM)	22 stakeholders	High
Renewable Energy Zones (REZs) are an effective way of coordinating strategic renewables development	17 stakeholders	High
There needs to be a greater acknowledgement of the climate change challenge	13 stakeholders	High
A more agnostic approach to storage technologies is desired	13 stakeholders	High
Costing of network options is complex, and further clarity is required on cost estimates for ISP projects	6 stakeholders	High
The engagement process has improved; however, it can be further strengthened	18 stakeholders	Medium
Technological solutions can support system security through the transition	15 stakeholders	Medium
There are concerns about generation intermittency and the level of dispatchable capacity in the NEM	13 stakeholders	Medium
The future role of Distributed Energy Resources (DER) is widely contested	14 stakeholders	Low

Consumers as a sector emphasised the need for AEMO to focus on consumer organisations even further, providing more facilitated engagements and supporting them to obtain their feedback, noting their current lack of resources and depth of technical expertise. The ISP Consumer Panel that AEMO is establishing, in accordance with the actionable ISP rules that came into effect on 1 July, will provide a primary means to address these needs.

AEMO reviewed feedback from the written consultation, in combination with that received from the February workshops and broader consultation on inputs and assumptions for use in 2020 Forecasting and Planning activities beyond the ISP, and it resulted in the following material changes to the inputs and modelling process:

- A minimum increase of approximately 30% in transmission capital costs, applied to all projects.
- An increase of approximately 50% in future uncommitted PHES capital costs.
- A decrease in large-scale battery costs (depending on storage depth) of 30-40% and an extension of utility battery life.
- A decrease in the size of future gas-powered generation (GPG) resulting in an increase in capital costs of 30-60%.
- Adjustments to the build limits of renewable energy in some renewable energy zones (REZs).
- Other feedback that was incorporated into the 2020 ISP includes:
- A focus on the roles storage systems will need to play and the requirements that are needed from it, rather than on specific storage technologies.
- Addition of a section on resilience and climate change.

- Expansion of the discussion on the potential impact of hydrogen on the future energy systems of eastern and south-eastern Australia.
- Increased focus on potential non-network options.
- Further consideration of options to implement large infrastructure projects in discrete stages, to provide flexibility in the optimal development path and facilitate potential deferral or advancement of significant investments to better manage risks for consumers.
- Increased clarity and description of data in the following areas:
- Capital cost estimation for transmission.
- REZ prioritisation.
- Ability of the grid to meet system strength and inertia requirements.
- Additional sensitivity cases were run to determine the impact of:
- Inclusion of TRET, if legislated
- Updated demand profiles to account for COVID-19 impact and record distributed PV sales in 2019
- Deferral of analysis of the potential future impacts on Marginal Loss Factors (MLFs) to a separate report, to be published after the Final 2020 ISP to allow for a more comprehensive assessment.

Consultation on non-network options

A second consultation was run from December 2019 to March 2020, to call for non-network options for the two actionable ISP projects identified in the Draft 2020 ISP – QNI Medium and VNI West.

Submissions relating to the VNI West consultation were directed to the Regulatory Investment Test for Transmission (RIT-T) process being run in parallel to the ISP by the relevant transmission network service providers (TNSPs) – AEMO Victorian Planning and TransGrid – and are therefore not included in this report.

A total of six submissions were received for the QNI Medium non-network consultation, of which four were confidential. Several of these proposed installation of batteries at either end of the QNI corridor to form 'virtual transmission'.

When developing credible options and candidate paths for the ISP, AEMO considers the potential for non-network options to either meet or partially meet the identified need, and this is incorporated in the analysis.

AEMO values the input from stakeholders who submitted responses to the non-network consultation. Each proposal was assessed for the ISP and shared with the respective TNSPs, Powerlink and TransGrid (after authorisation was received for confidential responses).

Contents

Tables

1. Stakeholder consultation process

AEMO has consulted on the Draft 2020 ISP to gather feedback and valuable industry insight before the issue of the 2020 ISP. The table below outlines the consultation program AEMO has undertaken.

Table 3 Consultation timeline

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2020 ISP Progress updates	March, April, June 2020
Publish 2020 ISP and Consultation Summary Report	3 August 2020

A series of workshops, held in Brisbane, Sydney and Melbourne in February, preceded the written submissions to the formal consultations. A summary of these workshops can be found on AEMO's website[1].

1.1 Purpose of this report

AEMO received 54 submissions to the formal consultation on the Draft 2020 ISP. These have been published on the AEMO website[2], except for five submissions which were withheld due to confidentiality. In addition, six submissions were received to the separate call for non-network options for QNI Medium; four of these were withheld due to confidentiality, and the remaining two are published on AEMO's website[3].

This report summarises the written submissions and provides AEMO's response. It also outlines areas where feedback has been incorporated into the modelling and write up of the 2020 ISP.

[1] At https://www.aemo.com.au/energy-systems/major-publications/integrated-system-plan-isp/2020-integrated-system-plan-isp.

[2] At https://www.aemo.com.au/consultations/current-and-closed-consultations/2020-draft-isp-consultation.

[3] At https://www.aemo.com.au/consultations/current-and-closed-consultations/draft-2020-isp-actionable-isp-projects-call-for-non-network-options-consultation.

2. Background

The first ISP was prepared by AEMO and endorsed by the COAG Energy Council in 2018. It has since guided industry and government on the investments needed for an affordable, secure and reliable energy future while meeting prescribed emissions trajectories.

The ISP is updated every two years, with AEMO presenting the Draft 2020 ISP on 12 December 2019.

AEMO consults on and publishes its scenarios, inputs, assumptions and methodologies to ensure its planning and forecasting publications are of the highest quality, with data that is fit for purpose and industry-reviewed, within a transparent process. AEMO undertook a consultation on scenarios, inputs, assumptions and methodologies for use in this 2020 ISP in early 2019[4].

The Draft ISP, for consultation, built on the analysis of the inaugural 2018 ISP and followed considerable industry engagement on the design of forecasting, planning scenarios and sensitivities.

The ISP sets out the optimal development path for Australia's energy future. It aims to ensure Australians enjoy affordable, secure and reliable energy for generations to come. The ISP will only serve its essential national purpose if it draws on constructive and critical input from all parties who may be affected by it. As such, AEMO has consulted widely over the past year in preparing the 2020 ISP.

2.1 Purpose of AEMO's consultation

The Draft 2020 ISP invited stakeholder feedback on any relevant issue related to the development of the ISP. It also invited submissions in response to the following specific questions.

Your views on the development options and actions

- Has AEMO considered the most appropriate development options for Australia's future energy system? If not, what other credible options should AEMO consider for the 2020 ISP?
- Has AEMO accurately described the identified need for upcoming actionable ISP projects? If not, how can that description be improved?
- What, if any, additional factors should AEMO consider when identifying which Renewable Energy Zones are best suited to further development?

Your views on the candidate and optimal development paths

- Has AEMO combined the development options into the most likely candidate development paths? If not, what other combinations should AEMO consider?
- Are there any other factors that AEMO should take into account when assessing the merits of candidate development paths?
- What, if any, additional factors should AEMO consider to assess the development and timing of VNI West?

[4] See https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/inputs-assumptions-methodologies/2019/2019-planning-and-forecasting-consultation-responses.pdf?la=en.

Your views on the ISP document and consultation

- Are there any aspects of the Draft 2020 ISP that require further or clearer explanation so that results are transparent and can be easily understood?
- What, if any, modifications should AEMO consider for the proposed 2020 ISP stakeholder engagement plan and timeline?

3. Summary of feedback

AEMO received feedback from 54 stakeholders during the consultation period for the Draft 2020 ISP; these stakeholders are listed in Table 4. Five submissions were confidential. The remaining non-confidential submissions are available on AEMO's website. AEMO also undertook a series of face to face and online engagements. AEMO would like to thank all who provided feedback throughout this process.

Submissions covered a broad range of issues, providing AEMO with a valuable perspective on stakeholders' collective view of the various proposed settings from the Draft ISP. While there was comprehensive coverage of issues, there were also common themes (although not necessarily consensus), as shown in Table 5.

Table 4 List of stakeholders who provided written feedback to the Draft ISP

AusNet Services	Greater Shepparton City Council
Australian Energy Storage Alliance (AESA)	Hydro Tasmania
Australian National University – Professor Andrew Blakers (ANU – AB)	Hydrostor
Australian National University - Australian National University's Centre for Aboriginal Economic Policy Research (ANU – CAEPR)	John Diesendorf
Australian Nuclear Association (ANA)	Lyon Group
Bioenergy Australia	Major Energy Users (MEU)
C & E McGauchie Terrick West	Maritime Union of Australia
Central Victorian Greenhouse Alliance (CVGA)	MMTechnology
Clean Energy Council (CEC)	Moyne Shire Council
Clean Energy Regulator (CER)	New Sky Group
CopperString 2.0 (CopperString)	Origin Energy
Delta Electricity	Paul Matthews
ElectraNet	Powerlink Queensland
Electric Power Consulting (EPC)	Public Interest Advocacy Centre (PIAC)
Energy Estate	RES Australia
Energy Networks Australia (ENA)	Smart Wires
Energy Queensland	Star of the South
Energy Users Association of Australia (EUAA)	TasNetworks
EnergyAustralia (EA)	Tesla Energy
ENGIE	University of New South Wales
ERM Power	UPC AC Renewables
ETU Australia (ETU)	Walcha Energy

Fluence	WestWind Energy
Gannawarra Shire Council	Winwick
GE Australia	

3.1 Summary of key themes

Table 5 provides an overview of the themes that emerged from the written submissions, ordered by level of consensus and frequency of mentions. Detailed analysis is provided in Section 4.2.

Consensus is measured by analysing the various perspectives put forward by stakeholders under each theme. If over two-thirds of stakeholders generally agree on the approach, idea or argument then there is a high consensus. Conversely, if less than a third of stakeholders agree on an approach, idea or argument and noted a variety of differing opinions, then consensus is considered low.

Table 5 Summary of key themes

Themes	Frequency	Consensus
Strategic roll-out of transmission and interconnection, to unlock renewable energy generation development, is widely supported	23 stakeholders	High
There is general support for the role of the ISP in the transition underway in the National Electricity Market (NEM)	22 stakeholders	High
Renewable Energy Zones (REZs) are an effective way of coordinating strategic renewables development	17 stakeholders	High
There needs to be a greater acknowledgement of the climate change challenge	13 stakeholders	High
A more agnostic approach to storage technologies is desired	13 stakeholders	High
Costing of the network options is complex, and further clarity is required on cost estimates for ISP projects	6 stakeholders	High
The engagement process has improved; however, it can be further strengthened	18 stakeholders	Medium
Technological solutions can support system security through the transition	15 stakeholders	Medium
There are concerns about generation intermittency and the level of dispatchable capacity in the NEM	13 stakeholders	Medium
The future role of Distributed Energy Resources (DER) is widely contested	14 stakeholders	Low

This report contains a detailed summary of stakeholder feedback covering the above themes, grouped according to the following sub-topics:

- Maintaining reliability and security during the transition.
- Future network.
- Renewable resources.
- Economics, regulation and policy.
- Social license and land use.
- Scenarios and modelling.
- The ISP document and process.

- Other.
- Feedback for the 2022 ISP.

A short summary of each theme is provided below.

Feedback with high consensus

Strategic roll-out of transmission and interconnection, to unlock renewable energy generation development, is widely supported.

There was broad consensus that strategic transmission development is the preferred approach to both unlock renewable energy resources and provide greater reliability. Stakeholders acknowledged that the current network is constrained and is hampering investment in and development of renewable energy generation.

There is general support for the role of the ISP in the transition underway in the National Electricity Market (NEM).

There was broad support for the development of the ISP to progress the transformation currently underway in the NEM. Stakeholders acknowledged that the change is complex, and the ISP provided some level of certainty to guide development and drive investment.

REZs are an effective way of coordinating strategic renewables development.

Many stakeholders support REZs. However, there were many differing views on which REZs to prioritise for development. Multiple stakeholders requested that AEMO undertake further work to provide clarity on REZs and refine the assessment criteria.

There needs to be a greater acknowledgement of the climate change challenge.

Climate change and resilience to major events is an increasingly important element for consideration when planning the future NEM. Many stakeholders noted that Australia has recently experienced several significant impacts to the supply as a result of bushfires and storm activity, and the likelihood of these events occurring again is predicted to increase as climate change progresses.

A more agnostic approach to storage technologies is desired.

Stakeholders understood the critical role storage was expected to play in the future NEM. Concern was raised by many stakeholders that the ISP is overly prescriptive of the type of storage technologies that would be needed. Some stakeholders raised concerns about the emphasis in the draft on the use of PHES over potential battery solutions, and this also highlighted the need for AEMO to focus more in the 2020 ISP on the type of role needing to be provided by storage, rather than on specific technologies as the solutions.

Costing of the network options is complex, and further clarity is required on cost estimates for ISP projects.

Several stakeholders raised concerns re the complexity of the costs assumed in the modelling for ISP projects and requested further clarity on the costs used in the modelling, particularly where a range of costs was quoted.

Feedback with some consensus

The engagement process has improved, however, it can be further strengthened.

Stakeholders were generally positive about the engagement process that was undertaken for the 2020 ISP, with many noting improvements on the 2018 ISP consultation process. Given the scale and value of future development that is proposed in the ISP, many stakeholders emphasised the importance of ongoing engagement to ensure that any plan is robust and fit for purpose, and there was in general a desire for even more extended and comprehensive engagements in the development of the future ISP, as well as post ISP on the outcomes.

Consumers as a sector emphasised the need for AEMO to focus on consumer organisations even further, providing more facilitated engagements and supporting them to obtain their feedback, noting their current lack of resources and depth of technical expertise.

Technological solutions can support system security through the transition.

The system security implications of moving to a high variable renewable energy (VRE) system were frequently discussed across the submissions. Some stakeholders warned of significant risks should traditional generators exit the NEM, noting that renewable technology is not yet at a point where it could be relied on to provide the same system services as a conventional synchronous generation source.

There are concerns about generation variability and the level of dispatchable capacity in the NEM.

There was mixed feedback from stakeholders regarding the level of dispatchable capacity required to maintain reliability as the NEM transitions. Some stakeholders cautioned against a rapid shift away from traditional coal-fired generators and suggested a more measured approach, as technological innovations mature and become proven solutions.

Feedback with mixed views

The future role of distributed energy resources (DER) is widely contested.

Most stakeholders noted that Australia's energy system is rapidly transforming, led in part by the significant uptake of household and commercial solar generation and energy storage technologies. Views were varied on the impacts and limitation of this uptake.

4. Discussion of submissions

4.1 Response to stated questions

Five stakeholders submitted responses to the questions posed by AEMO's Draft ISP, with each stakeholder choosing to answer only select questions. A summary of these responses is provided below.

4.1.1 Your views on the development options and actions

1. **Has AEMO considered the most appropriate development options for Australia's future energy system? If not, what other credible options should AEMO consider for the 2020 ISP?**

   TasNetworks and **Hydro Tasmania** both consider the development options outlined in the ISP to be appropriate. **TasNetworks** believes "there is further work required to refine the options to reflect practical rather than purely conceptual considerations." Likewise, **Hydro Tasmania** suggests that the network options considered in the ISP are appropriate. However, they consider that there continue to be issues with the underlying (modelled) supply options.

   GE Australia question the efficacy of using coal-fired closures as a trigger for investment in additional VRE, transmission and dispatchable capacity, and the signal such an approach sends to investors. They state, "a smoother, faster pathway could enable the transition to occur at a lower cost due to better management of workforce and equipment capacity constraints. It would also provide greater certainty to workers, suppliers and investors involved in the energy sector."

   Gannawarra Shire Council outline several points in support for the development of the Murray River REZ and Kerang route of the Victorian-New South Wales Interconnector West (VNI 7), including significant solar generation capacity, the benefits of upgrading existing adjacent transmission infrastructure and wider system security benefits of delivering VNI 7.

   AEMO's response

   The aim of the ISP is to set out an optimal development path for the National Electricity Market (NEM), with actionable and future ISP transmission projects and ISP development opportunities.

   The 2020 ISP benefits from two extensive rounds of consultation both on the inputs and scenarios, and later on, the draft report. In particular, stakeholder feedback on the draft ISP was used to refine and improve the inputs and modelling for the 2020 ISP.

   The scenarios, sensitivities and assumptions have been developed in close consultation with a broad range of energy stakeholders in the first 8 months of consultation leading to the draft ISP.

   The ISP's optimal development path is a rigorously developed plan based on comprehensive economic assessments and robust engineering studies, which test the costs and risks across multiple scenarios and also take into consideration the range of policy and power system needs. The projected resource developments and recommended grid projects in the ISP are the outcome of these rigorous engineering and cost-benefit assessments.

   While the ISP Rules pave the way for actionable transmission projects through the RIT-T process, there is no similar regulatory mandate for other resources, such as generation and storage. Rather the ISP informs the decisions of private developers. Market design is therefore crucial to ensure that the combination of both regulated and private investment that is realised will deliver the least cost outcome for consumers.

2. **Has AEMO properly described the identified need for upcoming actionable ISP projects? If not, how can that description be improved?**

TasNetworks and **Hydro Tasmania** note the considerable uncertainty in future demand, costs and longevity of existing assets. **TasNetworks** generally considers that the identified needs for actionable projects for which a Regulatory Investment Test for Transmission (RIT-T) is yet to be completed are adequate, specifically the need for Marinus Link. **Hydro Tasmania** note that flexible renewable energy resources and energy storage will be a critical part of the future NEM and developments that will bring forward such investments will be valuable in all plausible futures.

GE Renewables considers that a faster transition should be viewed as the basis of the plan and further note that there is scope for the ISP to play a broader role in driving generation investment rather than taking a transmission centric approach.

Gannawarra Shire Council further advocate for the VNI 7 project, noting several benefits of the route. They suggest that, "Perhaps AEMO could place more weight around social licence, land use, environmental risks and renewable resource and ensure the greater project is widely supported, and all values realised."

AEMO's response

AEMO acknowledges the views presented in submission on identified needs. The focus of the ISP is to ensure overall least system cost outcomes that optimise the net market benefits to consumers for the entire development path. It measures and develops the optimal development path entailing all ISP projects and identified ISP development opportunities as part of an integrated whole of system plan, rather than assessing any single transmission project individually.

Further, the ISP process is prescribed according to the National Electricity Rules (NER) and accompanying guidelines. The identified needs for transmission projects are a formal construct under the NER for the ISP and RIT-T. For actionable projects with RIT-T's already underway, in this ISP, AEMO has aligned the identified need with that defined in the respective RIT-T already underway. For future ISP projects AEMO will work with the responsible TNSP(s) to develop suitable identified needs for future projects. For many of these future ISP projects, AEMO has required the responsible TNSPs to undertake preparatory works ahead of the next draft ISP, to better inform that process.

3. **What, if any, additional factors should AEMO consider when identifying which Renewable Energy Zones are best suited to further development?**

TasNetworks considers that improvements have been made in identifying REZs since the 2018 ISP, however, there are some elements that should be considered for inclusion including active developer interest, system security considerations and climate change impacts.

Hydro Tasmania note, "The development of REZ with complementary energy resources should also be prioritised. This should not be based on existing demand patterns or supply patterns, but instead considered as part of the overall optimisation using a fine temporal resolution model that can understand the benefits of diversity when selecting candidate transmission options."

GE Renewables suggests that current land use (and hence the likely availability – or not – of economically viable sites) should be considered in the assessment of REZs.

Gannawarra Shire Council further advocate for the Murray River REZ and outlined several net market benefits of the project including solar resource, favourable social licence, appropriate landscape and location and development capacity.

AEMO's response

AEMO notes the considerable amount of feedback that was received with regard to REZs and acknowledges the importance of transparency in the decision making process concerning prioritisation of REZs.

In response to stakeholder feedback, AEMO has:

- Reviewed active developer interest within candidate REZs – while the original selection of candidate REZs was partially informed by developer interest, a review has confirmed information for most REZs and resulted in increasing the solar resource limit for the Mid North SA REZ from 600 MW to 1,300 MW.
- Developed a set of REZ design principles to ensure robust network planning and basic system security services are established (see Appendix 5 of the 2020 ISP).
- Investigated diversity between REZs (see Appendix 5 of the 2020 ISP in relation to "diversity and demand matching" and Appendix 6 in relation to "future power system operability").
- Reviewed resource and land use planning data for the Murray River REZ, resulting in an increase in the resource limit for the REZ.
- Engaged the Brattle Group to conduct a review of climate-resilient planning standards across select international locations, in order to understand how system planners are increasing the stringency of their planning criteria to account for climate change-related risks (see Appendix 8 of the 2020 ISP).

4.1.2 Your views on the candidate and optimal development paths

4. Has AEMO combined the development options into the most likely candidate development paths? If not, what other combinations should AEMO consider?

TasNetworks considers "the development options have been combined into plausible candidate development paths as they have been modelled to date". They further note strong support for the Marinus Link Project, showing positive net benefit in all scenarios bar the Slow Change scenario.

Hydro Tasmania propose that the ISP should investigate what a least-cost system plan would look like against the pure National Electricity Objective (NEO), also removing considerations of state-based policy.

GE Renewables further reiterate their support for a faster development timeline to be considered.

Gannawarra Shire Council note that the "most likely candidate" term should be applied to the Murray River REZ and VNI 7 and provided justification for why the two should be delivered as complementary projects.

AEMO's response

The NER and the AER's draft guidelines on cost benefit analysis define the framework which AEMO must follow when developing the multiple candidate paths and distilling these into the optimal development path. The outcome of this comprehensive set of assessments defines the developments and network projects, their timing, and location, to establish the least cost system plan that optimises the net market benefits to consumers. Public policy is also now defined in the ISP rules, which require AEMO to consider policy that meets the requirements specified in the rules when developing the ISP.

In this ISP, and giving consideration to the stakeholder feedback on the draft ISP, AEMO selected multiple candidate development paths, being the least-cost development paths for each of the five core scenarios, to test the option value of staging or accelerating some projects. These were tested with comprehensive economic assessments and robust engineering studies, the outcome of which is the ISP's optimal development path. The projected resource developments and recommended grid projects in the ISP are the outcome of these rigorous engineering and cost-benefit assessments.

5. Are there any other factors that AEMO should take into account when assessing the merits of candidate development paths?

TasNetworks suggest the inclusion of an analysis of competition costs and benefits to consumers and the risks of under-investment. Further suggestions include:

- Extending the sensitivity that looks at the effect on the optimal development path of the Queensland Renewable Energy Target (QRET) being repealed but being extended to the repeal of the Victoria Renewable Energy Target (VRET).
- Extending investigation of the impact of smelter closures in the Slow Change scenario to include those in Tasmania, noting the concerns re viability of two Tasmanian smelters.
- The utilisation of the recently updated Value of Customer Reliability (VCR) figures in the ISP.

Hydro Tasmania also advocate for the inclusion of the analysis of competition costs and benefits to consumers. "This should include analysis of the market impacts of additional interconnection, the benefits of sharing resources between regions, and adding to the pool of potential price setters in each NEM region."

Smart Wires propose that the use of power flow control on HumeLink should be reconsidered and assessment should be based on an evaluation of the net economic benefits it would deliver. Further, concerning QNI, considering the use of power flow control to optimise the capacity provided at each stage of development could ensure maximum utilisation of investment and valuable deferral of capital expenditure.

GE Renewables propose that there should be greater consideration of the risk of long-term outages at coal-fired generators, noting that acknowledging such risks could strengthen the case for earlier investment in VRE, transmission and dispatchable capacity.

AEMO's response

AEMO engaged with stakeholders extensively in the development of the scenarios, sensitivities and assumptions. In response to stakeholder feedback on the draft, AEMO refined assumptions and adjusted cost projections. The industrial load closure sensitivity was also extended to include closure in both Victoria and Tasmania.

The merits of candidate development paths are assessed across the ISP's scenarios to ensure that the optimal development path is in the overall interests of consumers, from either a risk neutral or risk averse approach. The most recent VCR figures are used when quantifying this risk. The ISP uses scenarios to ensure that the optimal development path is robust and adaptable given the uncertainties in forecasting which 'future scenario' will eventuate and material risks that may need to be mitigated. Further sensitivity analysis and cross-checks assists in understanding whether changes to input assumptions could materially impact the selection of the optimal development path.

The candidate development paths have been assessed considering the increased flexibility that early transmission works can deliver to enable earlier delivery of ISP projects in scenarios where this is optimal. This has led to the optimal development path including accelerated development of VNI West and Marinus Link with decision rules. This approach provides flexibility to stop investments if the Slow Change scenario eventuates (and is identifiable prior to final investment decisions being locked in) or other decision rules are not satisfied.

This ISP has assessed the application of alternative technologies when developing and assessing options to meet the identified need. Technologies such as power flow controllers and other static equipment are part of the design considerations in the ISP, and the detailed design phases in the RIT-Ts are expected to examine these further. For the future ISP project for QNI, AEMO intends to work with Powerlink and TransGrid on options including virtual transmission line approaches as well as transmission line augmentations

6. **What, if any, additional factors should AEMO consider to assess the development and timing of VNI West?**

TasNetworks propose further analysis on the benefits of increased system resilience on transmission projects, noting specifically the bushfire risk and impacts to the existing VNI interconnector in recent months.

Smart Wires supports the use of power flow control on VNI West, noting installation in the short term could begin to accrue benefits within a year of the project progressing.

Hydro Tasmania believes that there are substantial risks associated with the Draft's 2026-27 delivery timeframe for VNI West that should be accounted for. They also requested that AEMO test the accuracy of the present cost projections, "particularly in light of environmental and social challenges for overland transmission."

GE Renewables identifies that, with other active and proposed projects in the marketplace, the development of VNI West is likely to be impacted by resources constraints from Engineering, Procurement and Construction (EPC) contractors, utilities and Original Equipment Manufacturers (OEMs).

AEMO's response

This ISP utilises the decision rules and early works features of the new Rules arrangements for actioning ISP projects. These allow for projects such as VNI West to proceed now with early works and thereby be ready in case the market does not invest sufficiently in dispatchable capacity ahead of coal retirements, or the Step Change scenario unfolds, while preserving the ability to also slow down later if conditions change.

AEMO is continuing to improve its capability to model and evaluate resilience. On climate resilience, AEMO is collaborating with the Bureau of Meteorology and CSIRO on the Electricity Sector Climate Information (ESCI) Project[5]. AEMO is also improving its capability to evaluate the resilience of the network to other threats. More detail on our approach to resilience, and how it has been considered in the development of the 2020 ISP, can be found in Appendix 8 of the ISP.

AEMO has included Modular Power Flow Control (MPFC) technology in the VNI Minor upgrade. for other projects AEMO also assessed power flow control devices. AEMO expects that TNSPs will consider the merits of different power flow control technologies in more detail through the RIT-T process.

AEMO is aware of the potential constraints that may develop in coming years due to both the number and size of infrastructure projects within Australia. AEMO will undertake a value engineering exercise as part of the RIT-T for VNI West. Subject to timing and budget constraints, AEMO may be able to undertake a review of the broader constraints impacting projects, and work with TNSPs to develop industry wide approaches.

4.1.3 Your views on the ISP document and consultation

7. **Are there any aspects of the Draft 2020 ISP that require further or clearer explanation so that results are transparent and can be easily understood?**

TasNetworks:

- Suggest to include tables in the 2020 ISP, or include in downloadable workbooks, which explicitly list the timings applied for all interconnectors in all scenario, sensitivity and candidate development path combinations.
- Believes that the publication of a supplementary worksheet which contains the combinations of developments evaluated and the resulting total system cost of each would be valuable.

[5] For more information see https://aemo.com.au/initiatives/strategic-partnerships/planning-initiatives.

- Encourages AEMO to publish the time-sequential output data from ISP models, including:
  - Regional demand.
  - All generator, PHES and battery generation (or charging) power output (or consumption) aggregated to a regional level for each technology type.
  - Regional behind-the-meter generation and self-storage consumption.
  - All interconnector flows.

Hydro Tasmania considers the Draft 2020 ISP to be both clear and transparent and commend AEMO on its openness in discussing and identifying the limitations of the model and its underlying assumptions (such as the impact of perfect foresight) and how these may change the outcomes if better represented.

GE Renewables note that the ISP could provide a more unobstructed view on the role foreseen for large scale battery storage. "If we look solely at the current 'Large-scale Battery' category, it looks like they would play a minimal role in the future development of the NEM." which is inconsistent with the significant activity and interest we are seeing for locating large scale batteries at wind farms, solar farms and inside substations."

Gannawarra Shire Council acknowledges the scale and depth of information provided in the ISP and notes that the document is well laid out to allow the reader to work systematically through the report.

AEMO's response

The 2020 ISP continues to build the level of transparency of AEMO's modelling and outputs, and includes a wide range of information and data that is available from the web site. This information should address the requests received. Further, AEMO welcomes feedback on information that stakeholders think is needed in addition to what is provided in the online release.

Methodology updates have also been provided with the ISP to assist stakeholders in their understanding of the processes and approaches for the modelling. AEMO will continue to investigate ways to enhance stakeholder understanding.

AEMO has reviewed the cost input data for storage technologies, based on the strong feedback that was received in this area. Additional feedback received as part of the Inputs and Assumptions consultation on the latest GenCost data has also been taken into consideration with this response. The resulting revisions to cost assumptions are outlined in Section 4.3 of this report.

In developing the 2020 ISP, AEMO has focused on the attributes of any storage needs identified, rather than specific technology implementations. As a result, projections of utility scale storage are categorised in the 2020 ISP now in terms of depth of storage (shallow, medium, deep) for charging/discharge, rather than battery and PHES. The 2020 ISP provides deeper insights into the roles of different depths of storage. As a result of the change to cost assumptions, the 2020 ISP signals a much larger role for shallow storage (of up to 2 hours duration) than the Draft ISP.

8. What, if any, modifications should AEMO consider for the proposed 2020 ISP stakeholder engagement plan and timeline?

TasNetworks, and **Gannawarra Shire Council** believe the engagement to date has been satisfactory and the timeline appropriate.

Smart Wires acknowledges that "AEMO has demonstrated an openness to investigating traditional and non-traditional solutions to maximize the benefit for the NEM and ultimately for all consumers." However, they suggest that given time constraints and the breadth of analysis, "it may be beneficial to utilise some simplifications that would allow more iterations and improved responsiveness to feedback and suggestion."

GE Renewables suggest a greater level of engagement with Engineering, Procurement and Construction (EPC) companies, Original Equipment Manufacturers (OEMs) and utilities to acknowledge and better understand capacity constraints that may risk project delays.

AEMO's response

AEMO thanks the stakeholders for their responses. Planning for the 2022 ISP will commence following the publication of the 2020 ISP, and it is intended to include additional time for review of material, where practicable, ahead of workshops, and improved responsiveness to feedback. Further work will also be done in the 2022 ISP to understand resource and equipment supply constraints that may impact project timing.

4.2 Analysis of general responses

Of the 54 responses that AEMO received, 49 followed no formal response template. The following section provides a summary of the material issues raised in these submissions, divided into common themes. Feedback has been attributed, where possible, to individual stakeholders, to promote transparency and reflect the value of each input.

4.2.1 Maintaining reliability and security during the transition

There are concerns about generation variability and level of dispatchable capacity in the NEM

There is mixed feedback from stakeholders regarding the level of dispatchable capacity required to maintain reliability as the NEM transitions. Some stakeholders cautioned against a rapid shift away from traditional coal-fired generators and suggested a more measured approach as technological innovations mature and become proven solutions.

Conversely, many other stakeholders confidently stated that the NEM could rapidly transition to a VRE-dominated grid firmed with technological solutions and dispatchable energy sources.

There are also multiple suggestions for technological solutions and alternative energy sources to support the transition.

Bioenergy Australia, Tesla, Lyon, ERM, AusNet Services and **MM Technology** note that dispatchable energy sources and firming renewables technology will be increasingly important as the NEM transitions from centralised synchronous generation to intermittent generation.

However, **MM Technology** note that the rate of renewables development is currently not being met with sufficient firming capacity. The submission cautions, "the status of renewables firming is such that we simply do not have either the dispatchable firming assets or the storage capacity to overcome renewables intermittency". **Delta Electricity** furthers this argument, noting that there is considerable uncertainty around how storage or other types of dispatchable energy will "operate in the real world."

ERM questions whether the level of future firming capacity outlined in the Draft ISP is sufficient to support dispatchability and reliability.

Several stakeholders also noted a variety of firming and dispatchable technologies that could be better incorporated into the ISP.

Hydro Tasmania note the prevalence of deep storage capacity currently available in Tasmania.

Tesla advocate for a more significant role for large scale batteries as a firming technology.

Bioenergy Australia highlight that Biomass is a flexible and dispatchable form of energy that can be used to support reliability.

UPC AC and **AusNet Services** consider that peaking gas generators are an essential source of dispatchable energy and will play a role in managing peak demand in the future NEM.

EnergyAustralia further note that a reduction in firm capacity could lead to scarcity issues affecting retail prices and therefore, consumers.

Retirement of coal-fired generators

Both **Engie** and **Delta Electricity** question whether existing thermal plant reliability data and forecast capital expenditure was being overly pessimistic. **Delta Electricity** further note that, "continuation of existing coal-fired generators, e.g., through life-extensions and associated market mechanisms, maybe the lowest cost solution for ensuring system security and reliability while technical parameters are determined and technological developments progress."

GE Renewables and **AusNet Services** both note that there needs to be more planning for the decreasing reliability of the existing generators and the risks of more long-term outages in the future.

AEMO's response

The 2020 ISP considers the degree of transformation across the scenarios considered, relying on a mix of technological, consumer-driven and network solutions to demonstrate ways in which the future power system can continue to deliver reliability and security to consumers. The inclusion in the 2020 ISP of wider resilience considerations demonstrates this increased focus, and the ISP appendices also go into greater detail regarding operational challenges and the reliability of the future generation mix with the optimal development path network investments.

Ultimately, despite a forecast decline in coal capacity, the ISP demonstrates that a mixture of network and non-network solutions are required, including a mixture of renewable generation and dispatchable capacity, provided by a combination of storages of various depths, gas powered generation (GPG), and other peaking support. The utilisation of the existing generation fleet is an important consideration – the ISP does not advocate for complete replacement of the power grid, but rather for efficient investment to *support* the existing generation and transmission infrastructure, considering variations in the size of the role that distributed resources may have in future supply. AEMO thanks stakeholders for their perspectives on potential contributors to the future supply mix – as demonstrated in the 2020 ISP, AEMO believes that a mixture of solutions is important, and in a well-functioning market, the market is best placed to make the most cost effective technology investment choices to meet the power system needs.

AEMO also notes the conclusions of our Renewable Integration Study, which demonstrates that beyond 2025 – provided the recommended actions are undertaken *and* there are suitable investments in infrastructure to provide the required system services – the NEM can operate securely at significant levels of instantaneous wind and solar penetration. A key challenge for AEMO, as the market operator, and the industry at large, is the delivery of not only reliable, dispatchable capacity to support the transition to renewable sources of supply, but also the development of resources that can complement variable resources by providing grid-services to maintain power system security. Market reform to encourage and facilitate efficient investment in system services may deliver an efficient balance of network, non-network and customer-driven solutions.

A more agnostic approach to storage technologies is desired

Stakeholders understand the critical role storage will play in the future NEM. There is a concern raised by various stakeholders that the ISP is overly prescriptive of the type of storage technologies that will be used.

Many question the perceived overreliance on PHES at the detriment of large-scale batteries and other technologies. Some stakeholders even suggest that the ISP would disincentivise investment in batteries in Australia, potentially leading to higher cost storage solutions.

AESA, EPC, Hydrostor, Tesla, CEC, RES, and Fluence all note a similar desire for the ISP to take a more technology-neutral approach to storage and "instead present storage outcomes based on proposed roles." **RES** further notes that the ISP's 20-year timeline, "allows enough time for new technologies to develop and mature, and for regulations and the Rules to change and adapt to those new technologies."

AESA furthers the above argument and suggests that limiting technologies based on current costing and abilities is counter-productive and may discourage investment, "the market should choose the technology that best fits."

Building on the desire for a technology neutral approach to storage, several stakeholders propose alternative storage technologies that could play a more significant role in the future of the NEM. **Bioenergy Australia** note "Biomass can be considered a type of "green battery" with very high energy storage capacity, which is unaffected by temperature and indefinitely retains its charge." Similarly, **Hydrostor** note that compressed air energy storage is widely used around the world and could play a greater role, given the significant siting-viability and environmental restrictions on PHES.

Energy Estate and **EnergyAustralia** support the argument that there is an overreliance on PHES given limited suitable site availability for development, constructions costs and the economic threat of competing storage technologies. TasNetworks elaborate that even though some PHES sites have been identified, "further economic, environmental and engineering analysis is required to determine their actual practical potential."

GE Renewables, AusNet Services and **EnergyAustralia** question the limited role of Battery Energy Storage Systems (BESS) in the Draft ISP**. AusNet Services** note "the lack of utility-scale batteries appears to be clearly disconnected from what is happening in the market today." With **Fluence** further arguing that the value of large-scale battery-based energy storage solutions has been significantly underestimated in the ISP.

UPC AC questions AEMO's statement in the ISP that *"… Energy storage costs are slightly higher than in 2018"*. They note that as the uptake of batteries continues to grow their cost is rapidly falling.

However, **Hydro Tasmania** firmly supports the role of PHES in the ISP and the vital support services it can play. **Hydro Tasmania** also requests that AEMO recognise the importance of Deep Storage.

AEMO's response

AEMO has reviewed the cost input data for storage technologies, based on the strong feedback that was received in this area. Additional feedback received as part of the Inputs and Assumptions consultation on the latest GenCost data has also been taken into consideration with this response. The resulting revisions to cost assumptions are outlined in Section 4.3.

In developing the 2020 ISP, AEMO has focused on the attributes of any storage needs identified, rather than specific technology implementations. As a result, projections of utility scale storage are categorised in the 2020 ISP now in terms of depth of storage (shallow, medium, deep) for charging/discharge, rather than technology (battery and PHES). The 2020 ISP provides deeper insights into the roles of different depths of storage. As a result of the change to cost assumptions, the 2020 ISP signals a much larger role for shallow storage (of up to 2 hours duration) than the Draft ISP.

Biomass is an emerging fuel source that can have advantages in its ability to store energy – this is referenced in Appendix 10 of the 2020 ISP.

The future role of DER is widely contested

Most stakeholders note that Australia's energy system is rapidly transforming led in part by the significant uptake of household and commercial solar generation and energy storage technologies. Opinions are varied on the impacts and limitation of this uptake.

While it was noted that DER presents a significant renewable generation source, some stakeholders question the controllability of the technology and the impacts on the network, particularly at the distribution level.

Highlighting the diverging nature of opinion on DER, many stakeholders note that residential and commercial solar uptake is now being matched with distributed battery storage uptake, thereby improving system stability. Conversely, other stakeholders point out that battery uptake is nowhere near that of distributed PV and grid stability issues will become more common in future.

AESA, Powerlink, EUAA and **Energy Queensland** acknowledge that there is likely to continue to be significant uptake of DER in Australia. **Energy Queensland** note that in Queensland alone there is currently:

- Connection of 1,177 medium-large-scale DER (with 643 MW of total capacity), four committed projects in construction (with 205 MW of total capacity) and a further 91 projects in various stages of the application process (with a total of 3.95 GW estimated capacity).
- Connection of more than 580,000 small-scale residential and commercial-sized DER (with a total capacity of around 2,600 MW).

Further to this, **Delta Electricity, CVGA, Energy Queensland** and **PIAC** also contend that many organisations are investigating and developing micro-grids or mini-grids, that can support temporary islanding, thus improving resilience to significant system events.

Tesla note the additional research and analysis undertaken by AEMO on the role of DER in the NEM and supports AEMO's approach on aggregated batteries and the inclusion of Virtual Power Plants (VPPs) as a source of general market supply like grid-scale storage.

GE Renewables has requested further information on what digital capabilities AEMO thinks will be required to successfully manage the growth in DER as forecast in the ISP.

MM Technology raised its concern that the uptake of distributed PV is not being matched at the same rate as battery installations, potentially leading to a rapidly growing renewables source not being firmed or backed up. Furthering this argument, **Hydro Tasmania** note in the High DER scenario there is over 35 GW of behind the meter batteries installed as an input assumption, battery costs alone would total to almost $100b – which is an economically unrealistic cost for consumers to absorb.

Acknowledging the technical constraints of the network, **Paul Matthews** considers that significant uptake of DER, including electric vehicles, is technically not feasible and will place a significant strain on existing transmission and distribution networks. Likewise, **Walcha Energy** also contends that high rates of distributed PV uptake are likely to drive down daytime demand significantly. "Continual fluctuations and deep variations of output do not suit baseload coal generation plants."

Westwind Energy, however, considers the uptake of batteries in Australia to be quite significant and has urged for the uptake of batteries to be modelled exponentially, as opposed to linearly.

AEMO's response

Under AEMO projections of increasing DER, distributed PV generation is expected to drive minimum operational demand increasingly lower. Notwithstanding this, AEMO acknowledges that the significant uptake of DER will require a range of measures to address technical challenges before they become issues.

An indication of the requirements to support very high levels of DER along with other renewable energy have now been released in two public reports, the RIS[6] , and the Minimum Operational Demand Thresholds in South Australia report[7]. These reports outline and make recommendations on the needs to securely integrate high levels of DER penetration into the NEM.

The RIS outlined the significant impact that DER will have on the grid, particularly focussing on the next five years. The RIS identified that governance structures for the setting of DER technical performance standards, and enforcement of these standards, are inadequate, and made a number of recommendations that AEMO considers need to be undertaken to support high levels of DER and inverter-based resources more generally.

AEMO is also undertaking a range of work on DER integration through the DER program[8]. The ISP incorporates these findings in the long term planning framework where possible, and this is discussed further in Appendix 6 of the ISP. Various NSPs through the ENA's open energy networks are also conducting work on DER integration[9].

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[6] AEMO. *Renewable Integration Study: Stage 1*, at https://aemo.com.au/-/media/files/major-publications/ris/2020/renewable-integration-study-stage-1.pdf.

[7] AEMO. *Minimum Operational Demand Thresholds in South Australia*, available at https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/SA_Advisory/2020/Minimum-Operational-Demand-Thresholds-in-South-Australia-Review.

[8] AEMO. *DER Program*, at https://www.aemo.com.au/initiatives/major-programs/nem-distributed-energy-resources-der-program.

[9] ENA. *Open Energy* Networks, at https://www.energynetworks.com.au/projects/open-energy-networks/.

AEMO agrees that high rates of rooftop PV are likely to drive down daytime demand significantly. AEMO understands existing coal fleet is preparing their plant to better manage these fluctuations, and has explored this more deeply in Appendix 6 of the ISP.

Revised forecasts to be used in AEMO's upcoming 2020 Electricity Statement of Opportunities (ESOO) have confirmed that the outlook for DER uptake continues to provide a wide forecast range – and higher in 'upside' scenarios than previously considered, due to continued strong uptake since the ISP commenced. The updated demand sensitivity in the 2020 ISP includes a higher penetration of DER in the short, medium and longer term to assess the impacts of higher levels of DER on the optimal development path.

While the ISP (Appendix 7) considers the future power system security requirements to realise the optimal development path, AEMO will examine the implications of the extremes of DER penetration for system security in more detail in reports on the future requirements across the NEM for system strength, inertia, and Network Support Ancillary Services by the end of the year. This work will incorporate the 2020 ISP, along with revised demand forecasts prepared for the 2020 ESOO, and analyse in detail the outlook and the requirements for TNSPs to address projected future shortfalls.

Technological solutions can support system security through the transition

The system security implications of moving to a high VRE system are frequently discussed across submissions. Some stakeholders warn of significant risks should traditional generators exit the NEM, noting technology is not yet at a point where it could be relied on to provide the same system services as a conventional synchronous generation source.

Some stakeholders advocate that there are multiple technological solutions that can be relied upon to provide these same system services and ensure system security:

- **Tesla, Fluence** and **GE Renewables** contend that there needs to be a greater acknowledgement of the system support services provided by BESS. Noting the ISP should factor in multiple value benefits of energy shifting, synthetic inertia, transmission augmentation and value of frequency regulation.
- Similarly**, Greater Shepparton City Council** considers there are many advantages to considering the rapidly developing use of, and demand for, power electronics to control system strength, manage voltage, fault current and reactive power.
- **Hydrostor**, **Star of the South** and **UNSW** suggest a range of technologies and approaches to support system security such as compressed air energy storage, investigating offshore wind resources and HVDC transmission systems.

At the same time, stakeholders warn of increasing challenges:

- **Delta Electricity** cautions that technology is not yet at a point to support high VRE systems, noting that there needs to be a greater acknowledgment of the system support services such as inertia provided by traditional coal-fired generators.
- **Paul Matthews** also argues that the implications of transitioning to a high VRE system would lead to significant network issues, especially if electric vehicle usage climbs. He further contends that the sheer scale of batteries and PHES required to support the system would be vast and unfeasible.
- The **ETU** considers that there doesn't appear to be adequate planning to retrofit the network to incorporate the levels of synthetic inertia that will be needed to maintain grid stability and frequency into the future.

Additionally, some stakeholders consider the ISP needs to provide increased clarity about the system security needs of the future power system:

- **Westwind Energy** poses the question, "How does AEMO see this transition happening, and how will these services be procured in the future?" in response to the following point from Section C1.1 "*..., which means less inertia and other critical system services from traditional supply, which must also be replaced*".

- **AusNet Services** requests that Group 2 and 3 projects be developed and included in future ISPs both for Victoria and other jurisdictions, to address system strength, voltage management, and network resilience. They note that forecast of system strength needs to be undertaken and should consist of various factors that will degrade system strength over time, such as the retirement of conventional synchronous generation and connection of inverter-based generation technologies.
- **EnergyAustralia** note that the final ISP will highlight vital security needs out to 2030; however, "this time horizon is shorter than the ISP's forecast periods. Therefore, these considerations may still have a bearing on AEMO's optimal development path, and we remain concerned that system security considerations may jeopardise the modelled investment benefits."
- **ERM** note that it is unclear if the ISP has factored in the varying costs of power system services into the selection of potential development scenarios, or who would be required to fund these services.
- **Lyon Group** contends that the ISP hasn't given adequate recognition that wind or solar integrated with battery storage can provide electricity that has multiple system security benefits, and therefore defer network augmentation. The submission further notes that, "The false paradigm that appears strongly entrenched in Australia that utility wind and solar can only be uncontrolled power sources feeds into a false dichotomy that either is at or could be read as, being at the heart of the Draft ISP".

AEMO's response

AEMO recognises the scale of long-term challenges in maintaining power system security as the NEM evolves. At present, thermal power stations are providing most of the system services in the NEM and these services will need to be delivered through other means after the synchronous generation closes. The ISP considers these services and highlights when shortfalls may arise – which can trigger investment under the appropriate inertia[10] and system strength[11] frameworks.

The market incentives and regulatory frameworks will continue to evolve throughout the coming decades. The COAG Energy Council tasked the Energy Security Board with:

> *"…developing advice on a long-term, fit-for-purpose market framework to support reliability that could apply from the mid-2020s. By the end of 2020, the ESB needs to recommend any changes to the existing market design or recommend an alternative market design to enable the provision of the full range of services to customers necessary to deliver a secure, reliable and lower emissions electricity system at least-cost."*[12]

The ISP does not assess who should fund specific power system security services, rather, focusses on describing the needs and their timing. The provision of system strength is an example of this (discussed in detail in Appendix 7 of the ISP – including an example where system strength costs are approximately 2-3% of the total REZ cost).

Under the existing regulatory framework, obligations are placed on TNSPs to provide a minimum amount of system strength at key nodes, and connecting generators are required to remediate their impact on system strength. The ISP presents information to indicate the scale and timing of requirements, and remains open to different technologies that might evolve during the outlook period. Synchronous condensers are discussed and framed as an established and well-understood solution, but alternative technological solutions in inverter based resources, battery storage and power electronics are rapidly being developed and proven, and investment outcomes are left to the responsible parties.

AEMO's scenario-based approach considers a wide range of factors including EV and drivers of VRE. AEMO considers that this approach also sufficiently considers network issues that may arise due to these factors.

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[10] AEMC. *Managing the rate of change of power system frequency*, available at https://www.aemc.gov.au/rule-changes/managing-the-rate-of-change-of-power-system-freque.

[11] AEMC. *Managing power system fault levels*, available at https://www.aemc.gov.au/rule-changes/managing-power-system-fault-levels.

[12] COAG Energy Council. *Post 2025 Market Design for the National Electricity Market (NEM)*, at http://www.coagenergycouncil.gov.au/publications/post-2025-market-design-national-electricity-market-nem.

AEMO will provide more detailed long term outlooks of the requirements for system strength and inertia, and Network Support Ancillary Services, across the NEM, late in 2020. This work will incorporate the outcomes of the 2020 ISP, along with revised demand forecasts prepared for the 2020 ESOO, and analyse in detail the outlook and the requirements for TNSPs to address projected future shortfalls. Under the inertia framework, synthetic inertia can provide a role (termed "inertia support activities") in reducing the requirement for physical inertia.

Energy storage is another important feature in the ISP outlook period. The ISP optimises the need for energy storage against other technologies, and recommends an efficient mix of storage to be integrated with variable generation such as solar and wind farms. Because the ISP's approach is system-wide, recommendations are provided on a zonal basis rather than a project-by-project basis. Optimally locating these technologies can reduce the total network build required.

While AEMO does not agree that the projection of storage is infeasible, the 2020 ISP reports on storage differently from the Draft ISP – with more focus on storage depth rather than storage technology. While existing proposals are dominated by battery storage and pumped hydro projects, alternative storage technologies such as compressed air energy storage may also be feasible alternatives to meet the identified needs.

In relation to comments on HVDC and offshore wind, the ISP contains multiple options which have been consulted on for these technologies. The optimal development path includes Marinus Link which uses HVDC technology. Further, Appendix 9 of the ISP includes a worked example that compares a HVDC option against a HVAC option. Based on AEMO's input data, including development cost and resource quality, offshore wind is not developed in the ISP outlook.

There needs to be a greater acknowledgement of the climate change challenge

Climate change and resilience to major events was seen by stakeholders as an increasingly important element for consideration when planning the future NEM. Many stakeholders note that Australia has recently experienced many significant impacts to supply as a result of bushfires and storm activity, and the likelihood of these events occurring again is predicted to increase as climate change progresses.

Stakeholders have requested a further detailed analysis of the implications of climate change on the NEM, and greater acknowledgment of and planning for this implication in the ISP. Several stakeholders question if AEMO's forecasts have adequately accounted for operating for extended periods of extreme temperatures.

Delta Electricity, Hydro Tasmania, AusNet Services, EnergyAustralia, Walcha Energy and **ERM** highlight the increasing likelihood of adverse weather events, such as the risks of fire, flood and wind and the vulnerabilities of the system to these significant events. **Delta Electricity** note the bushfire and storm events of the 2019-20 summer and the impacts of drought at various times affecting the Snowy System and the Hydro system in Tasmania.

Hydro Tasmania furthers this point, noting that consideration of these impacts should be included in the selection of the optimum development path, suggesting the use of the High Impact Low Probability framework or a similar mechanism to ensure that system planning increases resilience to these future risks. The **CVGA** further argues that the system needs to be built to withstand 2050 and 2070 climate change projections.

Tesla highlights that deployment flexibility will become increasingly important as difficult to forecast High Impact Low Probability events occur more often. They suggest that AEMO could consider including climate change risk premiums and deployment flexibility benefits for fast-build asset types under some scenarios.

AusNet Services and the **CEC** both point out that severe weather events and climate change are likely to have a high impact on the transmission network. **AusNet Services** suggest that sufficient levels of regional and sub-regional reserves to enable a region to operate for a significant amount of time in the event of separation should be considered in the ISP. Alternatively, the **CEC** considers that future ISPs should focus on increasing the meshing of networks that interrelate with major interconnector upgrades, which would increase capacity on the lines, increase resilience to line outages and support system strength.

EnergyAustralia, ERM and the **PIAC** recommend that the operation of the system under potential weather extremes needs to be better assessed. **EnergyAustralia** questions whether AEMO's maximum demand forecasts remain robust given the increased likelihood of extreme temperatures. Similarly, the **PIAC** contends that changing average temperatures and diurnal heating and cooling patterns will likely affect energy consumption both on typical and extreme days. **ERM** suggests that a detailed assessment of all generation technologies under extreme conditions needs to be considered.

TasNetworks acknowledge and supports the work that AEMO has done to incorporate climate change impacts into the ISP however, suggests that AEMO utilise data on inflows to hydroelectric catchments in Tasmania from analysis recently undertaken by CSIRO into the modelling.

MM Technology argues that the recent droughts and bushfire events have galvanised the Australian public and press's attitudes towards climate change. They further note "Emissions from coalfired power stations have come to be seen as the only source of carbon dioxide emissions, which are taken then as being totally to blame for the drought and bushfires." The submission requests that the ISP should clearly outline the risks associated with a transition away from traditional generators to renewables firming.

AEMO's response

Power system resilience has been a common theme in recent ISP workshops and submissions. In response to this feedback, AEMO engaged the Brattle Group to conduct a review of planning standards across select international locations.

Resilience of a power system is a broader topic than simply climate change. The Brattle Group review provided an understanding as to how system planners are increasing the stringency of their planning criteria to account for climate change and other resilience-related risks. More detail on our approach to resilience, and how it has been considered in the development of the 2020 ISP, can be found in Appendix 8 of the ISP.

Interconnection between regions can support increased resilience to line outages and system strength. When building new transmission, using new routes can provide increased geographic diversity and separation. Subject to the appropriate cost-benefit assessments for new transmission and its routing, increased route diversity may provide a more economic solution to future challenges. The generation mix, particularly local storages and generation supplies can also play a key role, particularly where network diversity is not an economically efficient option. However, in all cases, rigorous cost benefit assessments are undertaken to weigh the benefits and costs of increased resilience when determining the final outcomes.

Notwithstanding the broader issues for resilience, AEMO considers with that there is an urgent need to focus on the risks of climate change when planning the future NEM.

AEMO is continuing to improve its capability to model and evaluate resilience. On climate resilience, AEMO is collaborating with the Bureau of Meteorology and CSIRO on the Electricity Sector Climate Information (ESCI) Project[13]. Work from this project has informed vulnerability scans, some ISP quantitative analysis, and is considered in the application of good planning practices that underpin the proposed NEM development path. In addition to climate resilience, AEMO is also improving its capability to evaluate the resilience of the network to other threats, such as Cybersecurity.

As reliable climate data becomes available, and climate trends are quantifiable, AEMO includes this information in its forecasts. In particular, the following trends are already explicitly captured within the modelling in developing the ISP:

- Temperature change – each scenario incorporates projected effects of temperature increases on consumer behaviour throughout the time horizon of the ISP; and
- Hydro inflow – each scenario incorporates changes in in hydrological inflows throughout the time horizon of the ISP. For Tasmania, AEMO recognised and applied more granular data recommended

[13] For more information see https://aemo.com.au/initiatives/strategic-partnerships/planning-initiatives.

by stakeholders, which identified a reduced degree of inflow reduction for the Tasmanian region, distinct from the previous Southern Australia climate zone.

4.2.2 Future network

Strategic roll-out of transmission and interconnection to unlock renewable energy generation development is widely supported

There is broad consensus that strategic transmission development is the preferred approach to both unlock renewable energy resources and provide greater reliability. Stakeholders acknowledge that the current network is constrained and is hampering investment in and development of renewable energy generation.

Many stakeholders advocate for a much faster development process, arguing that it is highly unlikely that new capacity would not be utilised, and that it would incentivise the development of wind and solar plants.

Conversely, one stakeholder warns that technology is evolving at such a fast rate that transmission might not be the right option in a few years' time, and newly developed assets would be underutilised and a burden to consumers.

Donald McGauchie, **ENA, Gannawarra Shire Council,** the **CEC** and the **CER** all argue in various ways that transmission is currently constraining the development of a faster transition to renewable energy generation. **ENA** further note that most high-value renewable generation is located in remote locations, and adequate transmission is essential to enable the value of these resources to be fully realised.

The **CER** argues that concerns about the risk of overbuilding by networks over the past ten years have largely subsided, and there is now a material risk of underbuilding in the transmission network. Likewise, **ANU** note that any surplus transmission capacity "is a small and temporary risk that will be rapidly absorbed with new wind and solar farms because of the compelling economics of PV/wind."

The **ANU, CEC** and **CER** also note that there is a danger of "continually playing catch up" with the transmission network, arguing that the sudden or unexpected early closure of a coal-fired generator would pose more significant system issues if the network is not in place to fill the gap with firmed renewables.

Moyne Shire Council suggests that a more strategic approach to transmission development is needed to better account for the land-use impacts. They note that the council had successfully advocated for powerline sharing and undergrounding of transmission developments in the shire to minimise the effects on local communities.

Hydro Tasmania, UPC AC and **RES** suggest that strategic transmission developments that promote high utilisation and tap into a diverse resource mix should be prioritised.

Delta Electricity warns that the rapidly changing technology environment could lead to many transmission assets being underutilised or stranded. The submission cautions against rapid investment in the network, noting that transmission owners face little to no risk as the assets are added to the regulated asset base, leaving consumers to wear the cost through increased bills.

John Diesendorf notes that with many parts of the grid congested, it is becoming increasingly challenging to take lines out of service for uprating or reconstruction on existing easements. He suggests that where this can still be done, and is a good fit for medium-term requirements, low-cost line uprating projects should be prioritised to allow the more expensive works to be deferred.

AEMO's response

In this ISP, AEMO has focussed on finding the right balance between the risks of under-investing in the system compared to that of over-investing.

The NEM is constantly evolving and inevitably forecasts require assumptions to be made that could change over time. A well designed ISP is robust, so these changes don't invalidate the optimal development path, but instead simply signal a pre-determined change in direction. An integrated plan must also reflect the time it

takes to design and construct major transmission and incorporate the ability and willingness of market participants to invest in resources that diminish the risk of uncertainty and delay.

To address these complexities, the ISP recommends progressing actions on several fronts to mitigate the risks of insufficient or late investments, while employing techniques such as project staging with decision rules to manage the risks of over-committing to future investment.

Staging of projects has the added benefit of pushing some capital expenditure out further into the future. This will allow consideration of any new technologies that have developed sufficiently in the meantime once each decision point in the optimal development path is reached.

The ISP undertakes a rigorous and comprehensive set of cost benefit analysis to ensure that these risks are appropriately considered. This approach also weighs the inherent asymmetry between the significant costs of early investment in large transmission projects, and the even more significant costs and risks of not having adequate resources available when needed to deliver affordable and reliable electricity.

Network options

Stakeholders discuss several strategic transmission projects in their submissions. Some are advocating for or against specific projects, while others provide alternative options. The following is a high-level overview of the projects mentioned.

VNI West

Donald McGauchie, Gannawarra Shire Council, RES and the **CVGA** all advocate for the "Kerang Link (VNI 7)" route of the project arguing that the development will unlock the resource potential of the Murray River REZ and remove constraints on several large-scale solar farms in the area. However, **UPC AC** argues that this route is more costly, and it should not be the responsibility of consumers to "bail out" developers that made unwise investments.

Greater Shepparton City Council and UPC AC advocate for the middle route (VNI 6) via Shepparton arguing it is the lowest cost option, enables similar renewable energy potential as other options and passes through zones with both solar and wind potential. **Shepparton City Council** also notes that the development would have more comprehensive economic benefits, allowing for the expansion of major industries in Shepparton City, currently constrained by the existing network capacity.

AusNet Services argues for an alternative variation not currently being considered noting potential shorter route length, lower cost to develop and a potentially quicker development timeline due to fewer outage constraints and the availability of greenfield land.

Marinus Link

Hydro Tasmania, TasNetworks, UPC AC and **GE Renewables** all advocate for the Marinus Link Project noting the benefits of unlocking additional deep storage capacity and Tasmania's high-value wind resources. There is a concern raised by multiple stakeholders over the Marinus Link timing in the Draft ISP, noting it does not align with the conclusions in TasNetworks' Project Assessment Draft Report (PADR) for Project Marinus RIT-T which states that the project is economic in 2028.

Conversely, **MEU** considers that the Marinus Link project does not provide value to consumers as Tasmania and Victoria already have adequate sources of generation and supply, noting that "generators in Tasmania will see significant benefit from access to a "free" interconnection with the mainland as this will provide a source of new business for them".

QNI Medium

Origin Energy requests that the ISP should include more details on QNI Medium (and any non-network options), similar to that which a Project Specification Consultation Report (PSCR) would usually provide, as much as it is practicable for AEMO to do so, given that TransGrid and Powerlink will not be consulting on the PSCR separately.

Powerlink also notes that they, along with **TransGrid,** have considered that 'virtual transmission lines' may form a viable option as part of a next stage upgrade of QNI and given the 2026-2028 draft ISP timeline for the upgrade, believe that there is adequate time to undertake a detailed assessment of the technical feasibility of these options.

CopperString

CopperString put forward its proposal for an interconnector linking the North West Mineral Province with the NEM, noting that the project would unlock large scale renewable resources in North Queensland while adding approximately 400MW of high load factor industrial load to the NEM.

Other network projects

John Diesendorf suggests several grid reinforcement projects in his submission, including completion of the 500kv ring from Bayswater to Bannaby to reinforce Sydney's supply. The submission also suggests prioritising the development of the New England REZ over Group 2 interconnection with Queensland.

ElectraNet proposes a possible extension of the 500kv network from Victoria into south-east South Australia as a low-cost option to unlock renewable energy in the area.

AEMO's response

VNI West

A number of alternative credible network options to VNI West were assessed and discounted in this ISP on the basis of benefits versus costs, including satisfying the identified need which included:

- Efficiently maintaining supply reliability in Victoria following the closure of further coal-fired generation and the decline in aging generator reliability – including mitigation of the risk that existing plant closes earlier than expected.
- Facilitating efficient development and dispatch of generation in areas with high quality renewable resources in Victoria and southern New South Wales through improved network capacity and access to demand centres.
- Enabling more efficient sharing of resources between NEM regions.

ISP modelling has determined that VNI West should be progressed for completion as soon as practicable, which is by 2027-28. Early works for this project should commence as soon as possible for completion in late 2024. This project is currently AEMO's preferred option to maintain system security and reliability in Victoria. It provides a prudent pathway to access sufficient dispatchable capacity to deliver into Victoria and, therefore, avoids the risk associated with earlier than planned exit of a major generator. It will also bring forward additional resilience benefits (for example, in case of an extended Basslink outage, a prolonged wind drought or another extended generator or transmission outage), address the increasingly pressing need to manage minimum demand in Victoria, open up new REZs, and provide Victorian consumers access to Snowy 2.0.

The preferred options for this actionable project are VNI West from north Ballarat via Shepparton to Wagga Wagga (which opens up the Central North REZ), or VNI West via Kerang and Dinawan to Wagga Wagga (which opens up the Murray River REZ). Despite differences in costs, these two options are very close in terms of net market benefits. The preferred route will be determined in the RIT-T. Variations of these options may also be tested if appropriate, including variations to the terminal stations and where they connect to the New South Wales network: see section D of the ISP, and Appendix 3.

Marinus Link

ISP modelling has determined that Marinus Link is beneficial in all scenarios except Slow Change. Provided cost recovery issues are resolved, this project should be progressed such that the first cable can be completed as early as 2028-29 (should the Step Change scenario emerge) or no later than 2031-32 (should the Tasmanian Renewable Energy Target be legislated or the Fast Change scenario emerge). This requires delivery of early works for both cables to be completed prior to a final investment decision in 2023-24. If by

then the Tasmanian Government does not legislate the TRET, or if there is no successful resolution on how the costs of the project will be recovered (from consumers and/or other sources) then the project schedule should be revisited. Marinus Link's first cable is on the least cost development path in all scenarios except for Slow Change. Marinus Link's second cable should be able to be completed as early as 2031-32, with the decision rules for its completion to be defined in the 2022 ISP.

QNI Medium

Largely due to increased transmission cost estimates, the optimal timing of the QNI Medium project has shifted from the late 2020s to the early 2030s. Based on this timing change, and partly also to the New South Wales Electricity Strategy, the project has been reclassified as a future ISP project. AEMO appreciates the submissions provided to the Draft ISP, but is currently unable to progress this project through the actionable ISP framework.

AEMO agrees that virtual transmission lines are a technically feasible solution to increasing the capacity of QNI, and will work with Powerlink and TransGrid to explore options. AEMO notes that proposals to accelerate the New England REZ in New South Wales include options for the network augmentations in New South Wales, and depending on the preferred solutions, may include some of the network proposed in the QNI Medium options.

CopperString

AEMO notes the possibility of the CopperString project as an option to connect the people and communities of Mount Isa and the North West Minerals Province to the NEM. As AEMO's resource information data does not extend to Mt Isa, the merits of this project were not able to be assessed in the 2020 ISP. Further assessment of the project may be considered once the funding and design arrangements are more progressed.

Other network projects

Other stakeholders identified a number of other projects within the NEM that they considered should be assessed in the ISP. These projects were assessed following the draft ISP, and have been included in the ISP as future ISP projects. Initial assessments of these projects are provided in Appendices 3 and 5 of the ISP, and the final assessment in this ISP is aligned with stakeholder inputs.

4.2.3 Renewable resources

REZs are an effective way of coordinating strategic renewables development

While many stakeholders support the development of REZs, there are differing views on which REZs to prioritise for development. Multiple stakeholders request that AEMO undertakes further work to provide clarity on REZs and refine the assessment criteria.

Acknowledging that high-quality REZs are often located in isolated regions, some stakeholders suggest that REZs located close to existing transmission infrastructure should be prioritised for development to minimise the required investment and minimise the costs to consumers.

Conversely, other stakeholders advocate for additional investment in transmission to realise the value potential of more isolated REZs.

The **CEC** suggests that AEMO undertake more work to provide further clarity on REZs, noting that they offer an excellent opportunity for the clean energy industry to coordinate efforts in locations that are well prepared to connect new generation. **Energy Estate** also notes that AEMO can now leverage work being done by the NSW and Victorian Governments to add further detail about REZs in the 2020 ISP.

TasNetworks notes support for the changes made to the REZ assessment criteria, however considers that there are still some criteria like system security issues, active developer interest, and climate risks that need to be further refined.

Furthering this argument, **MEU** notes that while in general, they support the locations selected for REZs, there is no certainty that these zones will be attractive to investors, or that the zones will be utilised to their maximum potential. Further noting, "The AEMO assumptions will have a significant bearing on the final "optimal approach" but there is no clarity on how AEMO reached its conclusions and made its assumptions for each REZ."

Hydro Tasmania contends that there are benefits in diversity in both the type and location of generation sources available. This is particularly true for variable renewable generation development. The development of REZs with complementary energy resources should also be prioritised.

To support the development of REZs, the **ANU** proposes that developing a few pilot REZs in each state with necessary grid augmentations and watching developer uptake/issues might be an excellent way to assess the success of the initiative and determine what needs to be fine-tuned.

ERM suggests that AEMO should consider the efficiency of energy delivery with direct transmission routes preferable to long, circuitous routes designed for the connection of potential new REZs.

John Diesendorf contends that grid augmentations supporting strategic REZ development cannot be relegated to Group 3 and should be initiated immediately. Development of strategic REZs is central to the ISP optimal development path, particularly with relation to NSW and Queensland. Likewise, **Walcha Energy** argues that it is of critical importance that the 2020 ISP refocus its priorities to facilitate REZ developments that can secure energy for major load centres

AusNet Services supports the need for potential Group 2 or Group 3 projects for Victoria, specifically plans to develop REZs to ensure network security as the coal fleet retires.

UNSW also notes that the Draft 2020 ISP assessment criteria for REZs appear to be robust however, recommends examining different network and technology alternatives to assess related transmission investments further.

Many stakeholders discuss several specific REZs in their submissions, and their feedback has been provided below by stakeholder submission:

Gannawarra Shire Council strongly advocates for the development of the Murry River REZ noting substantial solar resources, land availability and social licence. The submission also notes that the Murray River REZ already has 2,614MW of planning permits issued for projects ranging from 5MW to 510MW. There is also strong interest in another 3,150MW from developers keen to invest in the region.

John Diesendorf suggests the development of the New England and Central West REZs should be given priority, mainly because of their substantial-high-quality wind resources. He notes that grid development that connects the resources of these REZs is the least-regrets approach in the face of scheduled or sudden coal retirements.

Walcha Energy supports the development of the New England REZ, particularly the development portion of the REZ to the south of Armidale which has vast wind resources coupled with strategic high quality PHES capacity.

UPC also requests that the ISP more explicitly model the recently announced 3,000+ MW Central West REZ, noting that they perceive the potential of the Central West REZ is understated in the ISP. Similarly, the submission questions wind capacity factors for the north-west of Tasmania, noting in-house modelling contradicts AEMO's and underscores the value of the North West TAS REZ.

The **MUA** advocates for further investigation of offshore resources, particularly given the inclusion of Victorian Offshore REZ (REZ V5) that were identified by industry and subsequently included by AEMO.

ElectraNet considers that the Mid-North, Eastern Eyre Peninsula and South East are the most likely REZs for a major expansion in SA. The expansion of Eyre Peninsula is supported by ElectraNet's Eyre Peninsula Electricity Supply Options project, further noting they consider developments in this area are more likely than developments around Roxby North. In contrast, developments immediately north of Davenport remain highly likely.

AusNet Services questions why if the scorecard for the REZ in Central North Victoria (REZ V6) shows that it is a more promising area to develop an energy hub than the REZ in West Murray (REZ V2), AEMO has forecast more development to occur in the West Murray REZ. More detail is requested regarding the assumptions behind this forecast and the result should be further investigated.

The **CVGA** suggests that investment timeframes for the central Victorian region needs to be brought forward. In particular, they are advocating that the Murray River REZ and Central North REZ should be accelerated.

AEMO's response

AEMO notes the considerable amount of feedback that was received with regard to REZs, and acknowledges the importance of transparency in the decision making process concerning prioritisation of REZs.

As noted by several proponents, there are areas with very strong resources which are located far from existing transmission. The ISP determines the optimum prioritisation of REZs, differentiating between a high quality resource that is far from existing transmission, and a lower quality resource that has good access to existing transmission with spare capacity, while also valuing resources from a REZ that are diverse from other resources across the system to reduce the need for additional firming supplies.

The ISP optimises the overall system outcome across all generation, storage and transmission for the NEM, considering in detail each REZ and its attributes, in combination with the supporting network and other system needs. It determines the lowest cost optimal approach when taking into account all system costs, including generation capital, generation fuel, storage and transmission costs. The timing for REZ development, their prioritisation, scope, and location, are determined by the lowest cost optimal outcome.

This is also why some REZ in the optimal development path are later than some stakeholders would prefer – as the cost benefit assessments do not signal that earlier investment is optimal (based on costs and other inputs, including announced coal exit times). This analysis has considered the range of scenarios, and for example, in the Step Change scenario many REZs (and associated network augmentations) are developed earlier than in the Central scenario.

While AEMO's candidate REZs include the majority of proposed generation projects in the NEM, some stakeholders have noted that the location of some high priority REZs do not line up with current active developer interest. This is because the cost of the transmission needed to fully accommodate these projects is not justified by the overall cost-benefit analysis undertaken in the ISP – and as a result it prioritises other places which are more optimal overall to the system (and hence provide the greatest benefits to consumers).

While the ISP Rules pave the way for actionable transmission projects through the RIT-T process, there is no similar regulatory mandate for generation and storage resources to be built. Rather the ISP offers a signal to inform the decisions of private developers. The ISP projections and assessments are based on the inputs and assumptions available to the ISP. AEMO understands that other factors may come into play when developers decide where to locate their generation investments, and policy can also play an important part in this siting and timing. Developers should note that if their investments are not aligned to the optimal development path, then they may experience network congestion, operational impacts, and have increased costs for remediating system strength. In all cases, any transmission investment will need to pass rigorous cost-benefit assessments before it can be built.

In response to feedback on system security and climate resilience, AEMO has created a set of REZ framework and design principles (see Appendix 5 of the ISP), and has undertaken reviews of current approaches to planning and design considerations regarding how climate and other resilience factors are treated (see Appendix 8 of the ISP).

The suggestion of developing pilot REZs in each region will improve understanding of the risks and issues that may need to be addressed for all projects in the longer term. Programs such as the Central-West Orana REZ pilot in New South Wales (which is treated as committed in all scenarios due to government policy) will

support this approach. AEMO notes that currently the New England REZ is optimally timed in the ISP in the 2030s, but that this may be accelerated through New South Wales Government policy[14].

Renewable Integration Study

Four stakeholders mentioned the Renewable Integration Study (RIS) that was undertaken by AEMO, and not yet complete at the time of the ISP consultation process. The RIS report was released on 30 April 2020[15], and a separate consultation was subsequently held for the study. The discussion was predominately focused on stakeholders' desire for the findings of RIS to be integrated into the ISP to strengthen network reliability and security outcomes.

Delta Electricity notes that the ISP should further incorporate the findings of RIS, contending that the study will allow for an assessment of whether the economic scenarios can meet the technical requirements to support the NEM.

AusNet Services supports incorporating the findings of RIS into the final ISP, encouraging AEMO to consider how specific locational issues can be optimally addressed, with a similar approach to that taken for the ISP.

The **CEC** suggests there is potential for the RIS to become the system strength roadmap that complements the ISP transmission roadmap.

RES supports the work AEMO is undertaking as part of its RIS. However, they encourage AEMO to focus on characterising the desired behaviour from each technology rather than prescribe rigid requirements which risk stifling innovation through new technologies and concepts.

AEMO's response

AEMO has employed a feedback loop between the RIS and the ISP. The draft 2020 ISP established the core inputs for the RIS and the RIS supplied insights into the 2020 ISP. The majority of RIS Stage 1 insights were related to operational and short-term measures to ensure the security of the power system out to 2025. The RIS concluded that beyond 2025 – provided the recommended actions were undertaken *and* there are suitable investments in infrastructure to provide the required system services – the NEM could operate securely at even higher levels of instantaneous wind and solar penetration.

As the 2020 ISP forecasts that by 2035 there could be periods of very high renewable generation, it is imperative that the recommended actions are completed and the market reformed to ensure the necessary system services are available when needed: see Appendix 7 of the ISP.

AEMO will leverage work from the RIS and the ISP when undertaking the detailed assessments as part of the 2020 System Strength, Inertia and Network Support and Control Ancillary Services (NSCAS) reports due to assess requirements and declaration of any new shortfalls by the end of 2020.

4.2.4 Economics, regulation and policy

Investment and cost allocation

There is significant contention surrounding the investment task for the ISP. While stakeholders generally agree that investment is required to support the transition of the NEM, how that is funded is widely contested.

Stakeholders note the complex task of modelling the costs of a future system in a highly uncertain world and commend AEMO on the job done. However, there are many requests for additional clarity on cost inputs and assumptions.

There is also a common request for the ISP to investigate non-network options and technological enhancements that may delay or mitigate the need for expensive transmission developments.

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[14] New South Wales Government. *New England to light up with second NSW Renewable Energy Zones*, available at https://www.nsw.gov.au/media-releases/new-england-to-light-up-second-nsw-renewable-energy-zone.

[15] AEMO. *Renewable Integration Study: Stage 1*, at https://aemo.com.au/-/media/files/major-publications/ris/2020/renewable-integration-study-stage-1.pdf.

CVGA, ENGIE and **Hydro Tasmania** acknowledge the complexities of developing an ISP under a high degree of uncertainty, noting the risk of overburdening consumers with the cost of inefficient investments versus ensuring the security of supply to maintain low price volatility. **Hydro Tasmania** further considers that the 'under-investment risk' could cause not just the over-use of more expensive forms of generation but could also lead to potential consumer costs from diminished competition.

ERM also suggests there is a clear need for cost-efficient investment and development of the NEM's transmission network to ensure system security during the transition away from traditional generators and "one-sided markets". The **EUAA** further argues that it is unreasonable to expect that consumers continue to shoulder the entire risk and cost of building the 21st Century NEM.

AusNet Services proposes that a centrally coordinated planning approach would potentially smooth the investment cost across multiple regions and multiple connections. They contend that, "this would be a significant improvement on current processes which are not coordinated and require individual locational investments undertaken by private parties who have limited interest in enabling shared benefits (across multiple private and regulated parties) from their investments."

Lyon Group considers that AEMO is in an unenviable position in developing the Draft ISP and is caught between parts of the industry calling for additional spending on transmission and other parts of the industry wanting delays in the much-needed market and regulatory reform.

The **CEC** and **ENA** note that the ESB had been tasked with reviewing the cost allocation models for the development of new assets. The **CEC** supports this review insofar as it may support faster transmission infrastructure development. The **CEC** also notes that industry is willing to have an open dialogue on different funding models that better coordinate transmission and generation investment. Further, **ENA** also considers that this work must at least consider an option based on beneficiaries-pays.

Hydro Tasmania contends that cost-benefit analysis guidelines for the ISP and RIT-Ts should appropriately account for the competitive benefits that transmission investment can bring. Including the ability to protect against price shocks in the event of unplanned plant outages, changes in market concentration and liquidity; and greater customer choice.

Relating to the investment forecast of the ISP, the **ANA** and **EPC** acknowledge the costings of the scenarios put forward is complicated. **EPC** note, "that while the plan provides relative cost indications between the plan, no direct comparisons are made with existing price/cost levels."

MEU argues that given the whole ISP Group 1 projects will cost about $6.8 billion and will result in an increase of 30% to the TNSPs regulated asset base, a higher level of verification is needed. The submission points out that "the process for estimating the capital costs is not clear in the ISP and the assumption is that stakeholders will accept that AEMO and the TNSPs have prepared the costing to reflect the reality of these. What is absent is an independent assessment that the costs proposed are realistic and within acceptable margins of error."

EnergyAustralia further contends that the ISP identifies marginal net benefits of $1.6 billion, or only 2% of total system costs, relative to the counterfactual cases. Noting, "this seems within the bounds of modelling noise and suggests a degree of false precision, particularly when deviations from the efficient/optimal case are recommended based on hypothetical least regret costs."

ERM supports this argument, referencing an independent review of the proposed Project EnergyConnect conducted by the Australian Energy Regulator (AER) as a project that has grossly overstated benefits. They argue there is a need for clarity regarding the consideration and definition of estimated costs in the ISP.

EUAA calls for increased clarity on cost estimates for transmission projects in the ISP, and calls for further sensitivities to be run on capital costs, noting: 'A relatively small change in assumptions e.g. a relatively small movement towards the upper bound capex, can quickly remove these market benefits'.

Delta Electricity note that the investment task is substantial and may require government backing. The submission contends that TransGrid already has a significant pipeline of works at various stages through the

development process and the ability of the networks to raise capital, even in a regulated environment, will be an essential factor in whether the large-scale projects proposed for the period 2030 to 2040 proceed.

Powerlink and **Origin Energy** suggest that the ISP should look at refining development methodologies and consider the costs and benefits of staging larger projects to keep the optimal development path flexible and minimise costs for consumers.

Tesla, Fluence, AESA, Walcha Energy, CEC and **Smart Wires** all urge for greater acknowledgement of the potential system benefits and revenue streams provided by various non-network and technology solutions that could potentially delay or supplement capital-intensive network investments.

AEMO's response

In this ISP, AEMO has focussed on finding the right balance between the risks of under-investing in the system compared to that of over-investing.

The NEM is constantly evolving and inevitably forecasts require assumptions to be made that could change over time. A well designed ISP is robust, so these changes don't invalidate the optimal development path, but instead simply signal a pre-determined change in direction. An integrated plan must also reflect the time it takes to design and construct major transmission and incorporate the ability and willingness of market participants to invest in resources that diminish the risk of uncertainty and delay.

To address these complexities, the ISP recommends progressing actions on several fronts to mitigate the risks of insufficient or late investments, while employing techniques such as project staging with decision rules to manage the risks of over-committing to future investment.

Staging of projects has the added benefit of pushing some capital expenditure out further into the future. This will allow consideration of any new technologies that have developed sufficiently in the meantime once each decision point in the optimal development path is reached.

The ISP undertakes a rigorous and comprehensive set of cost benefit assessment to ensure that these risks are appropriately considered. This approach also weighs the inherent asymmetry between the significant costs of early investment in large transmission projects, and the even more significant costs and risks of not having adequate resources available when needed to deliver affordable and reliable electricity.

When developing credible options and candidate paths for the ISP, AEMO considers the potential for non-network options to either meet or partially meet the identified need, and this is incorporated in the analysis.

In response to stakeholder suggestions, further clarity has been provided in the ISP on capital cost estimates for the major projects, including uncertainty ranges. The value used in modelling, and the cost uncertainty ranges are clearly articulated for each project: see Table 14 in section E of the ISP, and further details are provided in Appendix 3, for each project. A summary of the costs for transmission projects is also available on the AEMO website[16].

The cost benefit assessments undertaken in the ISP are compliant with the AER's draft CBA guidelines as at the time of this ISP. This will ensure that RIT-Ts can utilise this ISP in their respective cost benefit assessments and approvals, when the CBA guidelines are promulgated.

Accordingly, the 2020 ISP has refined the assessment of economic benefits provided by the ISP projects by comparing to a counterfactual which excludes network investments entirely. This has identified that intra- and inter-regional network solutions contribute significantly to the efficient delivery of the future power system outlined in the optimal development path. More information on this refinement is available within the ISP and its appendices.

As this ISP is the first to utilise the new actionable ISP rules and the draft AER CBA Guidelines, lessons learnt during this ISP will inform reviews by ESB and AEMC on future regulatory models and frameworks. AEMO welcomes stakeholder feedback on the application of the new arrangements in this ISP, and looks forward to working with all stakeholders on how to best apply the arrangements in the 2022 ISP.

[16] See https://www.aemo.com.au/-/media/files/major-publications/isp/2020/final-2020-isp-transmission-projects-cost-summary.pdf?la=en

As noted above, a number of stakeholders expressed views on the desirability of the ISP driving developments in renewables at an earlier time than the optimal timing in the optimal development path. While the ISP Rules pave the way for actionable transmission projects through the RIT-T process, there is no similar regulatory mandate for other resources, such as generation and storage. Rather the ISP offers a signal to inform the decisions of private developers. Market design is therefore crucial to ensure that the combination of both regulated and private investment that is realised will deliver the least cost outcome for consumers.

Similarly, it is not within the ISP's mandate to make changes to the transmission regulatory framework and cost allocation models. This is the role of the AEMC and ESB: AEMC has been tasked by COAG to undertake a review of and make recommendations on funding models under its COGATI programme. In parallel, the ESB is currently consulting on an interim framework for the development of REZ and the cost allocation models, and ESB together with AEMC is conducting a 2025 market review.

AEMO is aware of the potential for the large pipeline of future infrastructure projects to impact resource availability, with possible cost implications, and will be carrying out further review of the infrastructure planning in the 2022 ISP.

Regulation

There was a broad dissatisfaction expressed by stakeholders with the existing regulatory processes for new infrastructure development. Many stakeholders argue that the RIT-T process is outdated, and more suited to patchwork network development rather than broader system transformation.

Many stakeholders call for reform and note concurrent work underway by other agencies to facilitate this process. There is support for incorporating the first step of the RIT-T into the ISP, with stakeholders agreeing that it would speed up the development process.

Several stakeholders are concerned at the erosion of the regulatory process, contending that the RIT-T provides essential oversight and governance, ensuring that investment choices are robust.

ANU, John Diesendorf, the **CEC** and the **ETU** all argue in various ways that the current modelling and approval processes are inappropriate for the ongoing rapid transition of the electricity system. The **ETU** further recognises and agrees with the multiple priority and short-term projects in the ISP, however, notes a deep concern with the limitations of the RIT-T process inhibiting genuinely fit for purpose transmission expansion and augmentation. **John Diesendorf** goes further in arguing that AEMO needs to develop an optimal ISP unconstrained by the old RIT-T process, which is more suited to a power system developing by minor extensions and replacements. The **CEC** further recommends that the ISP develop a more visionary approach to transforming the transmission network that is not restricted by the RIT-T process.

Lyon Group supports the above arguments and considers that delays in market and regulatory reforms in the sector make it inevitable that the plan will produce a less than optimum result. They state "we would go further and assert that, without urgent appropriate market and regulatory reform, the Plan will not drive transmission planning and investment decisions that result in an optimisation of network and generation investment decisions, it will cause an inefficient allocation of large amounts of capital, it will deliver lower economic and community-wide benefit, likely lead to higher prices to consumers than necessary and undermine Australia's international competitiveness."

The **CEC** agrees that the removing one step of the RIT-T is a positive action to speed up the process. However, they argue that the ISP optimal development path has, to date, been limited to mapping the investment path for regulated assets that are designed to pass the RIT-T. This process fails to capture the additional benefits that consumers could experience through a more rapid transition of the energy system with a quicker and greater build out of the transmission network.

Energy Queensland highlights that there are a substantial number of regulatory changes that are currently being progressed in the market by various bodies, including the ESB, the AEMC as well as AEMO, and cautions that these changes should be complementary so as not to create a situation that results in perverse or inefficient outcomes for electricity customers.

Likewise, **PIAC** argues that the NEM needs a planning and investment framework that delivers investment efficiency that provides benefits across many regions to manage the transition effectively. This is the central challenge in the work that the AEMC and ESB are doing through a number of workstreams, in parallel to the development and integration of the ISP, such the AEMC's Coordination of Generation and Transmission Investment (COGATI).

The **EUAA** notes the challenge for AEMO in being given a task to develop an "actionable" ISP where recommendations can be implemented quickly to facilitate the NEM transition in the most efficient way, while also meeting community expectation on system reliability, security and cost. However, they further note, the ESB proposed ISP rule changes that are designed to speed up the process comes at the expense of critical oversight and governance. "Therefore, in addition to maintaining 5.16.6 (NER), we believe it is important that the AER maintains a key oversight and governance role …"

Energy Networks Australia also seeks to reinforce that while a primary focus of the ISP is to identify future system needs and AEMO will incorporate the first stage of the RIT-T (Project Specification Consultation Report) into future ISPs, TNSPs will continue to provide significant input, analysis and support to AEMO in conducting its analysis. The final ISP should be prepared, taking into account and facilitating the subsequent review phases to be undertaken by TNSPs. Throughout the RIT-T / cost-benefit process, once the need has been identified, the inputs, options and costs to address the need are tested to ensure they are rigorous and efficient.

Delta Electricity recommends that as well as providing 12 weeks following the release of the Draft ISP for proponents to suggest non-network options, stakeholders wishing to propose non-network options should be included in the joint planning process. **Delta Electricity** further indicates that to provide a more transparent approach to the future consideration of non-network options, the AER should be required to assess carefully, and report on, how non-network options were considered as part of the relevant RIT-T.

ERM contends that all electricity market development must adhere to the NEO. As a system planning document, the ISP cost-benefit analysis (CBA) considers theoretical system costs and wholesale energy market prices, rather than consumer costs specifically. Therefore, **ERM** recommends that any fast-tracking of projects through the RIT-T process, due to ISP priority, ensure that rigour and integrity of the regulatory investment test process is maintained. Further noting that this is particularly important as when calculating the Net Present Value (NPVs) of net market benefits using CBA, the identification of an optimal development path is not required to include the project of lowest net cost.

ElectraNet notes current AER guidance that the identified need should be framed as an objective rather than as a means to an objective, consistent with promoting the fundamental principle of competitive neutrality. At the same time, it is considered that the identified need should be clear and sufficiently detailed to allow RIT-T proponents to focus their efforts on assessing options that directly address AEMO's intended objective in specifying the identified need.

AEMO's response

While the ISP Rules pave the way for actionable transmission projects through the RIT-T process, there is no similar regulatory mandate for other resources, such as generation and storage. Rather the ISP informs the decisions of private developers. Market design is therefore crucial for both regulated and private investment to deliver the least cost outcome for consumers.

Similarly, it is not within the ISP's mandate to make changes to the transmission regulatory framework and cost allocation models. This is the role of the AEMC and ESB: AEMC has been tasked by COAG to undertake a review of and make recommendations on funding models under its COGATI programme. In parallel, the ESB is currently consulting on an interim framework for the development of REZ and the cost allocation models, and ESB together with AEMC is conducting a 2025 market review.

The ISP defines the optimal development path to develop the future NEM, and provides a roadmap to help navigate decisions on small and large-scale infrastructure investments over the coming decades. The ISP falls

under the current regulatory framework in the National Electricity Rules. As such, the ISP must apply the regulations of the day in its processes.

This ISP is the first to utilise the new actionable ISP rules and the draft AER CBA Guidelines as at time of this ISP, and lessons learnt during this ISP will inform reviews by ESB and AEMC on future regulatory models and frameworks. AEMO welcomes stakeholder feedback on the application of the new arrangements in this ISP, and looks forward to working with all stakeholders on how to best apply the arrangements in the 2022 ISP.

Policy environment

The fluid and dynamic nature of government policy is raised frequently throughout the submissions. Many stakeholders identify policy as a hindrance that is binding the ISP to suboptimal outcomes and higher costs.

Reflecting the importance of climate change, discussed in Section 4.2.1, three stakeholders request that AEMO align all scenarios with the obligations of the Paris Agreement and achieving net-zero emissions by 2050.

Delta Electricity, Origin Energy, ENA and **Powerlink** would all like greater clarity on how the NSW Electricity Strategy and the NSW Energy Package were incorporated into the ISP. **Origin** has requested that AEMO explain the rationale for how it has interpreted the impact of the strategy on the ISP, given the limited details on the plan. **Powerlink** has also requested further analysis, particularly with regards to the implications on the optimal timing and scale of the development path for QNI.

EPC, Hydro Tasmania and **ANA** all suggest that the ISP should also include consideration of what a least-cost system plan would look like against the pure National Electricity Objective (NEO) and without variations induced by state-based policy considerations. **ANA** notes that the existing policies force AEMO to plan scenarios that miss out on taking advantage all the best available technologies and **Hydro Tasmania** further contends that policy is itself a fundamental uncertainty. It would be useful to remove that lens to provide information on costs and benefits for customers.

Conversely, **Tesla** recommends the ISP include a broader range of energy policy mechanisms in some scenarios, even if they have not been legislated yet or policy design is undefined, as these policies will still have a significant impact on new build capacity in the new term – particularly for storage.

The **CVGA, the CEC** and **ElectraNet** suggest that AEMO should align each ISP scenario with achieving the objectives of the Paris Agreement and achieving net-zero emissions by 2050 at the latest. **ElectraNet** considers that it is highly likely that the NEM will decarbonise ahead of the rest of the economy and reach zero emissions sometime before 2050.

TasNetworks supports the QRET sensitivity being included in the Draft 2020 ISP and considers this should be expanded to include several Victorian policies in the ISP[17] to provide stakeholders with a clearer understanding of the overall system costs and effect that such policies are having on the optimal development path. **TasNetworks** further supports the inclusion of all relevant Commonwealth and State Government policies[18] likely to have a material impact on the optimal development path in the ISP. However, note the limited time in which to finalise the 2020 ISP, suggests these are held over for scenario inclusion until the 2022 ISP or ISP interim update.

AEMO's response

AEMO acknowledges stakeholder feedback in this area, and is pleased to be able to note that much of the feedback was able to be incorporated in this ISP.

Government policy is an important input to the ISP, as it not only drives investment, but incorporates broader community concerns and requirements. For this reason, AEMO has included policies which fit into the criteria

[17] Victorian Renewable Energy Target (VRET) and uptake assumptions on the Victorian Energy Efficiency Certificate (VEEC) schemes.

[18] Policies identified: The New South Wales Energy Strategy including three shortlisted projects: a gas plant in Port Kembla, a renewable and pumped hydro scheme for northern New South Wales and an upgrade of the Vales Point coal generator at Lake Macquarie. The submission also notes that there have been two other recent UNGI announcements that are relevant to the ISP. These include a 220 MW gas fired plant in Dandenong, Victoria and a 132 MW gas fired plant for Gatton, Queensland.

as outlined in the latest amendment to the National Electricity Rules. Federal emissions reduction targets and state renewable energy targets, together with the Central-West Orana REZ Transmission Link, meet these criteria and have been included in the ISP. The ISP and the related inputs and assumptions workbook, together with the input, assumptions and scenarios report, documents the policies amongst other assumptions used and how these have been applied in the ISP.

AEMO welcomed the feedback in 2019 on the inputs, assumptions and scenarios and again in early 2020. This was used to update key inputs and assumptions to finalise the 2020 ISP. AEMO looks forward to continuing to engage with all stakeholders on this ISP and during the preparation of the next ISP. To this end, AEMO will be commencing consultation on choice of scenarios for inclusion in the 2022 ISP in the second half of 2020.

4.2.5 Social licence and land use

Social and land use risks are increasingly important considerations when considering development locations. Several stakeholders note that proposing developments near sensitive land uses such as National Parks and high-value agricultural land is likely to cause community resistance and delays.

Similarly, early identification of traditional owner groups in ISP development paths is encouraged to ensure that native title is acknowledged and landholder consents are obtained correctly.

Two stakeholders also note the increasing trend of corporate renewable electricity procurement and how said demand will further incentivise the development of renewables in the future.

There is increasing acknowledgment of the potential "cost of delay and capital investment" impacting the development of projects**. Hydro Tasmania** and **GE Renewables** both note that the plausibility of projected project delivery timeframes and the accuracy of the present cost projections need to be further tested, particularly in light of environmental and social challenges for overland transmission.

John Diesendorf argues that Wollar is not a suitable location for the proposed 500 kV hub envisioned in the Draft ISP, noting that any transmission lines would have to traverse large National Parks and Nature Reserves surrounding Wollar. This could not gain a social licence and would be an unacceptable bushfire risk route.

The **ANU** likewise urges further acknowledgement of indigenous property rights in the form of native title that ISP projects may affect. "This is an important step in the process of securing legal rights and obtaining native title and landholder consent for any proposed renewable energy developments in these regions."

Energy Estate and the **CER** would like the ISP to take into account the anticipated growth in corporate renewable electricity procurement. The **CER** notes that "there is a strong shift in private companies to adopt a lower emissions footprint ambition voluntarily. As large-scale Generation Certificate prices decline, voluntary demand can be expected to grow substantially." **Energy Estate** also notes that the increasing social licence requirements for organisations are incentivising many to pursue climate-friendly energy sources.

Moyne Shire Council argues that there needs to be a state or federal mechanism to ensure that REZ developments occur where there is a proper alignment with community interests. Noting a significant issue for councils is the proliferation of powerlines associated with wind energy generation facilities impacting on visual amenity, agricultural operations, bushfire management and road safety. They contend there is a need for proactive coordination of power line infrastructure within REZ, and this should be signalled in the ISP, with suggestions on how this can be facilitated through AEMO regulatory pathways and advocacy.

AEMO's response

AEMO agrees that there are important social considerations that play a part in any major infrastructure projects, including land use alternatives, native title and environment. While the ISP does not consider detailed routes at the local level, it does incorporate large-scale considerations such as significant national park areas, pre-existing community concerns from previous development, and known competing land uses such as agriculture (including irrigated areas).

The selection of candidate REZs in the ISP involved multiple stakeholder workshops and consultations. This selection process considered a range of land-use information such as cadastral parcel density, land cover,

road access, terrain complexity, population density and protected areas. While AEMO doesn't select specific easements when considering transmission network options, high-resolution land-use mapping data is used to mitigate the risks of land-use barriers later in the process. As network projects progress towards investment stages, more detailed assessments (e.g. social or environmental impact assessments), can impact on project feasibility.

The specifics of route selection for transmission must necessarily occur during the RIT-T process and afterwards during the consequential project planning and implementation by the responsible TNSPs. This involves comprehensive stakeholder engagement, engineering assessments, and land and environmental planning assessments, which are far beyond the scope of the ISP in its limited timeframes and costs.

AEMO continues to welcome the feedback and inputs from stakeholders in relation to community acceptance of particular REZ including any particular issues or concerns, and will endeavour to incorporate this advice when developing future ISP.

AEMO notes views relating to a potential government mechanism to ensure REZ developments are aligned with community interests. AEMO considers that the REZ framework has the potential to improve the coordination of powerlines that connect renewable energy projects and encourages input from state and federal governments in the REZ identification process. AEMO notes the New South Wales Government's selection of priority REZs in its Transmission Infrastructure Strategy[19] – including Central-West Orana (in the vicinity of Wollar), New England and South West NSW. Appendix 5 of the ISP outlines AEMO's REZ framework and design principles that are intended to balance robustness and efficiency in designing REZs.

4.2.6 Scenarios and modelling

AEMO conducted extensive engagement on scenarios, inputs, assumptions and methodologies in 2019. The consultation on the Draft ISP was not intended to revisit these assumptions. However, many stakeholder submissions suggest variations or consideration of new scenarios and inputs. Below is an overview of requests:

Tesla, UPC/AC, and Fluence would like AEMO to update its input assumptions concerning the role of BESS in the system, **Tesla** further noting that there is a "divergence between AEMO's input assumptions and what is being observed in the market". The **Tesla** submission further notes that AEMO's modelling should incorporate the additional capabilities and flexibilities beyond energy generation provided by stand-alone battery storage, such as ancillary services and system security .

ANU, City of Shepparton, CVGA, CEC and **PIAC** suggest that AEMO should include a scenario which requires net-zero fossil fuels by 2050. **ANU** and **GE Renewables** further contend that current AEMO modelling doesn't adequately account for the uptake of solar and wind, and the current step change scenario is overly pessimistic.

Engie requests that AEMO undertake a sample market-based modelling to assess the robustness of the benefits claimed. **Engie** also suggests an additional thermal plant reliability sensitivity be considered.

Hydro Tasmania suggests several variations and adaptions to the existing modelling including analysis of the competition benefits of increased interconnection, a review of regional cost multipliers, uncertainties associated with construction risks such as resourcing, construction and developer constraints and greater consistency in the modelling with respect to demand assumptions.

UPC AC notes strong support for more significant modelling of the Central-West Orana REZ, suggesting an additional sensitivity should be considered, noting there are likely broad implications of the business case for QNI Medium and Large. Similarly, the submission notes that the timing of Snowy 2.0 is optimistic and suggests an additional sensitivity regarding the delay of the project.

Further topics raised include:

[19] NSW Government. *Transmission Infrastructure Strategy*, at https://energy.nsw.gov.au/renewables/clean-energy-initiatives/transmission-infrastructure-strategy#-nsw-transmission-infrastructure-strategy-.

- Why the model preferences wind and PHES resources in Victoria over Tasmania?
- Increased concern that the ISP augmentations proposed will not allow efficient generation investment and that congestion and poor Marginal Loss Factor (MLF) outcomes will continue.
- The ISP doesn't adequately account for peaking gas development.

AusNet Services considers that the additional connection capacity requirements for Victoria is too low, and notes that this is in contrast with the current AEMO position that the Victorian network is not able to support the volume of existing new VRE project proposals. **AusNet Services** also suggests that AEMO should consider longer-term options for battery storage, as well as greater recognition of peaking gas to provide reliability and system security.

The **CEC** questions why in the central scenario large-scale wind and solar capacity is not projected to increase until 2025 and will not materially increase until 2027, they suggest this is either a flaw of the projections not matching up with market trends or in the assumptions feeding into the modelling.

Energy Estate proposes further consideration of State-based load and corresponding State-based generation development be undertaken, and an assessment be undertaken of the possible impact of that on the inter-regional settlements market. The submission notes that this may lead to a greater emphasis on intra-State upgrades in the short term.

Energy Queensland argues that the current modelling of DER also needs to consider scenarios where the uptake of different categories of DER diverges. Further noting there is significant potential for differences in the pace of uptake considering the various technologies, costs, resources and potential markets of the individual DER categories.

The **EnergyAustralia** submission notes that AEMO should acknowledge the inherent limitations of the least cost modelling approach. Further, the submission outlines in detail some recommendations to improve the modelling process that was provided in the 2019 Forecasting Inputs Consultation Paper, noting that there is some ambiguity as to whether, or which, inputs from this would be updated and incorporated in the final ISP. **EnergyAustralia** also encourages AEMO to release more modelling details that affirm how the optimal development path and associated generation mix will deliver against peak demand conditions.

The **ETU** referred to an earlier submission to the GenCost study, noting concerns with the representation of different energy types, leading to flaws in the model assumptions. The **ETU** also argues that there should be a greater acknowledgment of the role of offshore renewable deployments in the ISP, despite noting evidence of the system strength benefits due to their generation profile.

The **MEU** argues that there ia a high degree of conservatism embedded in the AEMO forecasting process, noting perceived issues with: demand and consumption forecasts; the timing and size impacts of potential changes in the supply chain mix; and the impacts of demand-side participation. The submission suggests that there needs to be some modelling to assess whether the optimal approach is still the best approach should the forecasts of future consumption, demand, generation mix/timing/size and DNSP involvement prove to be conservative.

Origin submits that confidence in modelling could be improved by weighting scenarios, explaining AEMO's rationale for its choice of modelling in more detail, and providing additional sensitivities. The submission noted a desire for a more detailed explanation of the drivers behind the modelling outcomes, especially concerning the optimal development path and recommended projects.

Powerlink requests more in-depth power system analysis of all scenarios (not just Central), including system strength and MLF robustness. Further, the submission considers that there could be greater validation of cost-benefit analysis using time-sequential modelling that is more granular and inclusive of all relevant transmission constraints. **Powerlink** also suggests the Central Queensland – Southern Queensland (CQ-SQ) would benefit from further scenario analysis, particularly taking account of the development of renewable generation in northern Queensland.

ERM propose that a low demand scenario investigating muted electrification of other areas is worth investigating. Further, **ERM** requests that AEMO further investigate the impacts of multiple smelters around

the country, not just in Victoria, ceasing operations and the effect that would have on grid stability. The submission also suggests that the scenario modelling options should not solely consider input assumptions and sensitivities, but also the potential for adjusted timing of implementation of currently indicated preferred options, noting it remains somewhat unclear if this "least regrets" analysis was applied to the potential staging of options, where some parts of the preferred option could be put in place initially until there is greater certainty that the total project is required.

The **PIAC** question if using probability-weighted scenarios would lead to a different optimum development path.

TasNetworks notes there is a range of uncertainties and modelling inconsistencies that likely underestimate the value of Marinus Link to the NEM, yet none that overestimate the value. The submission also argues that ensuring the utilisation of the latest data in modelling, including hydro inflows in Tasmania, optimal timing sensitivity analysis, and consideration of modelling limitations, will ensure the value proposition of Marinus Link is adequately reflected. **TasNetworks** suggests that AEMO should consider the impact the closure of the two Tasmanian smelters would have on the ISP.

ElectraNet considers that Future ISPs should extend the modelling horizon to 2050 to adequately take into account likely future requirements for net-zero carbon emissions and the 2020 ISP should minimise the risks of emissions-intensive investments becoming stranded beyond 2040.

The **EUAA** requests greater clarity on what numbers were used in the ISP and why, noting there appears to be no discussion of what sensitivity analysis was done on different Capex assumptions.

AEMO's response

AEMO appreciates the significant amount of feedback that was received on the draft 2020 ISP in the area of input assumptions, and has reviewed this extensively. The 2020 ISP benefits from two extensive rounds of consultation both on the inputs and scenarios, and later on, the draft report. In particular, stakeholder feedback on the draft ISP was used to refine and improve the inputs and modelling for the 2020 ISP.

A number of changes were made to cost inputs for the modelling post the draft 2020 ISP. These changes are outlined in Section 4.3 of this report and discussed in detail in the 2020 ISP document and its appendices.

Concern that the uptake rates of distributed PV assumed were too low was noted. Updated forecasts prepared for the 2020 ESOO have been tested as a sensitivity in this ISP. An industrial load closure sensitivity, with large load closures in both Victoria and Tasmania, has been included in the analysis, along with a delayed Snowy 2.0 sensitivity (among others).

In response to stakeholder suggestions, further clarity has been provided in the ISP on capital cost estimates for the major transmission projects, including uncertainty ranges. The value used in modelling, and the cost uncertainty ranges are clearly articulated for each project.

A more detailed explanation of the drivers behind the modelling outcomes, especially concerning the optimal development path and recommended projects has been included in the ISP. Weighting of scenarios has been introduced, in line with the new Draft CBA Guidelines.

The role of gas relative to alternatives such as batteries in providing peaking support is assessed thoroughly in the ISP. Appendix 6 of the ISP provides detailed discussion of the operability of the NEM under various candidate development paths, using half-hourly time-sequential modelling of snap-shot years, and appendices 2 and 4 provide greater insights into the cost benefit analysis and the resource mix under each scenario and candidate development path.

The amount of VRE development in the optimal development path is what the ISP has determined optimal to meet both local requirements, including delivery of the VRET by 2030, and reliability requirements in each region.

VRE projects that are committed or anticipated at the time of modelling are included as part of the optimal development path. While developer interest is included in the candidate REZ identification process, specific future VRE generation projects are not modelled individually, rather generic wind and solar projects are

selected by the model to fulfil the input policy requirements such as state renewable energy targets and cost-effectively replace retiring coal-fired generation. Offshore wind resources were included in the available resource inputs to the modelling, but are not currently part of the least cost optimal development path, due to their higher development costs.

The ability of the each region to connect more generation and storage projects has been modelled in detail, including reliability and system strength considerations. This, in combination with the reduction in battery costs identified in GenCost 2019-20, has contributed to the revised timing of some projects, such as VNI West, QNI Medium and Large, Marinus Link, and a range of generation outcomes.

4.2.7 The ISP document and process

There is general support for the role of the ISP in the transition underway in the NEM

There is broad support for the development of the ISP to support the transformation currently underway in the NEM. Stakeholders acknowledge that the change is complex, and the ISP provides some level of certainty to guide development and drive investment.

AESA, CopperString, Greater Shepperton City Council, Hydrostor, Tesla, UNSW, AusNet Services, CVGA, CEC, Energy Estate, Lyon Group, MUA, Smart Wires, ElectraNet, CER and EUAA consider the ISP to be an essential roadmap to guide the energy transition currently underway in the NEM.

Engie, MM Technology, UPC/AC, EnergyAustralia and Fluence acknowledge the significant amount of analysis that has been undertaken and some noted the improved process that AEMO has implemented to develop the 2020 ISP.

RES and **Tesla** note that formal planning is essential to ensure the transition results in a reliable and affordable renewables-centric system.

The engagement process has improved, however, can be further strengthened

Stakeholders are generally positive, with some even congratulatory about the engagement process that was undertaken for the 2020 ISP, and many noting improvements on the 2018 ISP consultation process. Given the scale and value of future development that is proposed in the ISP, many stakeholder responses emphasise the importance of ongoing engagement to ensure that any plan is robust and fit for purpose.

ENA, Tesla, UNSW, UPC/AC, AusNet Services, CEC, EnergyAustralia, Energy Estate, ERM, Smart Wires, PIAC, TasNetworks, and **EUAA** are all supportive of the program of engagement to date, with many noting the improved process and increased opportunities for input that has been available.

Engie encourages AEMO to "continue on the path of continuous improvement and high participant involvement".

The **ETU** raise concern over the lack of engagement with industry workers and unions and urged AEMO to undertake a review of the current engagement process to guide improvements in the 2022 process.

Both the **MEU** and the **EUAA** consider the engagement process to be heavily focused on informing rather than consulting. Both organisations also note that consumer advocate groups are often resource and time-constrained and urge AEMO to develop a consumer engagement process that acknowledges these limitations.

GE Renewables urge greater engagement with "supply-side" businesses such as OEMs and EPCs to inform development timelines.

Energy Queensland request that future engagements better involve distribution networks.

There are a number of suggested improvements to the ISP document

Stakeholders suggest several material improvements to the ISP document to improve readability, help to better understand the content, and bolster transparency. Some suggestions are listed below:

- Envisage ways to more clearly present information and outcomes to allow meaningful comparisons between scenarios.
- Add a chapter on climate change.
- Provide more information to support low connection requirements for Victoria listed in Table 6 on page 55 of the Draft ISP.
- Provide greater clarity on the source of the costings, how they were calculated or what they reflect (e.g. the average of sensitivities calculated for each scenario, what weighting has been put on each calculation, etc.) for the table valuing "least regrets."
- Provide more transparency and clarification on several aspects of the ISP, including around the outcomes of the modelling, drivers behind the optimal development path and terminology used in the ISP.
- Provide an explanation of the difference between the Draft 2020 ISP documentation (page 74) and Powerlink's own Generator Capacity Guide. Referred to as 'Existing Spare Capacity', Table 17 of the ISP may be interpreted to be the network hosting capacity; however, this is not the case.
- Provide a supplementary worksheet which lists the combinations of developments evaluated and the resulting total system cost of each. This has been highlighted as a valuable next step.
- Relabel some of the Draft 2020 ISP Appendices as a Supplementary Report, as a number of the appendices do not appear to be directly referenced in the Draft ISP.
- Insert a summary table of the assumptions used in the Cost Benefit Analysis and a discussion of the confidence that AEMO/TNSPs have in these cost estimates. Box 1 (p. 26-7) lists the improvements since the 2018 ISP that have been the result of stakeholder consultation, but makes no mention of network Capex.
- Provide further detailed discussion of network Capex cost estimates.
- There is an excel spreadsheet showing a significant range of capital costs for the Group 1, 2 and 3 projects. Then these numbers are repeated in the discussion of each project in Appendix 6 of the Appendices document. More clarity could be provided on which number within that range was chosen and why.

AEMO's response

AEMO values the feedback on the 2020 ISP engagement process, and intends to continue on the path of improvement for upcoming ISPs. The 2020 ISP benefits from two extensive rounds of consultation both on the inputs and scenarios, and later on, the draft report. In particular, stakeholder feedback on the draft ISP was used to refine and improve the inputs and modelling for the 2020 ISP.

AEMO has also endeavoured to incorporate much of this feedback into the 2020 ISP and would welcome further feedback on whether this has addressed some of the concerns raised. Other opportunities will remain for all stakeholders to continue to engage with the ISP, through dedicated workshops, the Forecasting Reference Group and the AEMO Consumer Forum.

In addition, a Consumer Panel will be set up for the 2022 ISP and beyond. This will allow a small group of specialised consumer representatives to participate in further detail in the decision making processes of the ISP. The panel will also assist with the design of the 2022 ISP Consumer Engagement Plan.

4.2.8 Other

Some stakeholders discuss subjects that are considered outside of scope for the 2020 ISP; these include Hydrogen, Nuclear Power and Distribution Network impacts.

Hydrogen

Four stakeholders raise Hydrogen in their submissions, with most noting that industry and political signals are indicating it will play a role in the future energy mix of the NEM, and that the ISP should reflect this.

Donald McGauchie, MM Technology, Winwick Business Solutions, and **AusNet Services** all recommend that Hydrogen should have been included in the ISP.

Donald McGauchie notes that governments should work together to develop and deliver a detailed transition plan that will most likely include hydrogen.

MM Technology argues that excluding hydrogen from the 2020 ISP is a mistake as the Olympics later in 2020 will demonstrate the importance of hydrogen to the future Japanese economy and the world, and also because hydrogen is one of the critically important longer-term firming technologies.

Winwick Business Solutions advocates for extending the NEM into Western Australia to develop the "Sunny Scheme" which would involve large scale renewables and hydrogen hubs in northern Western Australia and interconnection with neighbouring Asian countries. The scheme would turn Australia into the "Battery of Asia".

AusNet Services questions why the ISP didn't include a discussion of the potential development of hydrogen generation given both Federal and State Governments have announced hydrogen strategies and funding. They further encourage AEMO to outline its plans to incorporate qualitative analysis of potential hydrogen projects in its future studies within the 2020 ISP.

Nuclear

Three stakeholders raise nuclear energy in their submissions, with two advocating for consideration of nuclear power in the future NEM and one requesting it be modelled for comparative price purposes to prove it doesn't economically stack up against renewables.

The **ANA, CEC** and **EPC Consulting** advocate for further thought be given to the inclusion of nuclear power in the ISP modelling. Arguing, nuclear power is internationally recognised as a legitimate generation source and should, as a minimum, be included for comparative purposes.

The **ANA** further notes that there are currently many under-construction or planned projects in nations of far less wealth than Australia and/or with more constrained grids.

The **CEC** also notes that even though nuclear power is currently highly politicised and socially unpalatable in Australia, that might not always be the case and providing evidence that nuclear power doesn't stack up economically against other generation sources would be beneficial.

Distribution networks

Although distribution networks are noted in many submissions, three stakeholders spoke in detail about the implications of the energy transition on distribution networks, particularly as DER uptake continues to increase.

Energy Networks Queensland, Paul Matthews and the **CER** all discuss the impacts of the NEM transition on distribution networks.

Energy Queensland notes that although the ISP is intended to be a whole of NEM exploration of the future power system, energy distribution is out of the scope of the Draft ISP. While the submission recognises that there is significant complexity in including impacts originating from distribution networks in the ISP, it also notes that the document clearly emphasises the effects of the changing dynamics of DER connected at the distribution level. As the manner in which DER is operated has a significant impact on local distribution networks, **Energy Queensland** expects that AEMO would coordinate an assessment of those impacts in collaboration with distribution network service providers and that the requirement for this assessment is included in the ISP's scope to ensure it covers the whole of the market as intended.

Likewise, the **CER** acknowledges the innovations that many DNSPs are currently implementing to support higher uptake of DER across the NEM, conversely leading to more significant generation volumes.

Paul Matthews highlights the system constraints that a highly electrified society would have on the existing distribution network, noting that high levels of electric vehicle uptake would stress the network and require DNSPs to undertake costly system upgrades regularly.

AEMO's response

Hydrogen

AEMO is continuing to monitor the development of hydrogen policies and research programs across the nation, and has included an expanded section on hydrogen in the 2020 ISP – see Appendix 10, Sector Coupling. It is intended that hydrogen is considered in more detail in the 2021 IASR and subsequent ISPs.

Nuclear

As per AEMO's previously stated position, nuclear power will be considered if and when it becomes legal under Australian law. In this case government policy would be used as the criteria for its inclusion, in a similar manner to other public policies.

Distribution networks

AEMO agrees that DER will continue to play an expanding role in the future of the NEM. High levels of DER uptake will introduce more challenges in operating the distribution and transmission networks. The recently released Renewable Integration Study[20] has outlined the significant impact that DER will have on the grid, particularly focussing on the next five years. The RIS identified recommended improvements in governance structures for the setting of DER technical performance standards, and noted that enforcement of these standards will be required.

AEMO is also undertaking a range of work on DER integration through its DER program[21]. The ISP seeks to incorporate these findings in the long term planning framework where possible. Energy Networks Australia (ENA) and AEMO are working on proposals to integrate DER and distribution constraints into wholesale markets, and for distribution network service providers (DNSPs) to extend their technical capability to monitor, calculate and communicate network constraints for DER[22].

4.2.9 Feedback for 2022 ISP

Some of the feedback received in the submissions relates to topics or detail that was not able to be covered in the 2020 ISP, but will be reviewed for consideration for the 2022 ISP. This included:

- Conduct greater engagement with "supply-side" businesses such as OEMs and EPCs to inform development timelines, with consideration of infrastructure resource constraints.
- Conduct greater engagement with distribution networks.
- Consider impact of micro-grids.
- Consider impact of resource and material constraints on cost and schedule for construction of large energy projects, and competition with other infrastructure projects.
- Consider potential impacts of hydrogen and bioenergy on the ISP.

[20] AEMO. *Renewable Integration Study: Stage 1*, at https://aemo.com.au/-/media/files/major-publications/ris/2020/renewable-integration-study-stage-1.pdf.

[21] AEMO. *DER Program*, at https://www.aemo.com.au/initiatives/major-programs/nem-distributed-energy-resources-der-program.

[22] ENA. *Open Energy* Networks, at https://www.energynetworks.com.au/projects/open-energy-networks/.

4.3 Summary of changes to ISP modelling

As a result of the feedback received from the consultation submissions, combined with feedback from the workshops and stakeholder meetings, and the GenCost consultation, the following changes were made to key capital cost assumptions for the 2020 ISP.

Table 6 Cost assumption changes for Final 2020 ISP

Item	Cost change relative to Draft 2020 ISP (%)	Basis	Links/Further references
Transmission	Increase in capital costs of 30% approximately	Each major transmission project identified in the ISP that had completed or was progressing through the RIT-T process had demonstrated an approximate 30% increase in cost from initial estimates, due to a range of factors. As a consequence, AEMO in collaboration with the responsible Transmission Network Service Providers (TNSPs), increased its capital cost estimates on all identified ISP transmission projects by approximately 30% as adjusted for the specific project circumstances. Marinus Link cost was adjusted to reflect updated information on HVDC works and pre-construction activities. REZs included network designs which also incorporated a 30% increase on network costs within the REZ, and some projects had variations where better information was available.	Summary: Inputs and Assumptions workbook, 'Augmentation Options' tab[23] Cost summary table[23] Background: costs for staged projects are provided in Appendix 3 of ISP
PHES	Increase in capital costs of 50% (excluding committed projects)	Feedback received during the consultation was that PHES costs were under-estimated in the Draft ISP, and a high degree of uncertainty exists for desktop cost estimates of this type. In addition, it was recognised that there are higher risks and barriers to investment in PHES compared to other forms of storage, as evidenced by the higher number of utility scale battery projects currently being planned across the NEM. Anecdotal evidence provided in submissions, in discussions with some proponents and through engagement with reputable consultants with experience in PHES developments, suggest an increase in costs of approximately 50% was more appropriate. This magnitude of increase is aligned with experience in other major infrastructure projects, where it was noted that major infrastructure projects by their nature can experience capital cost increases over initial estimates during the implementation. For clarification, the capital cost increases foreshadowed for PHES projects only apply to future uncommitted PHES projects, and do not apply to the Snowy 2.0 project. AEMO considers Snowy 2.0 as a committed project and is not aware of any changes to the capital costs since the publication of its feasibility study.	Summary: Inputs and Assumptions workbook, 'Build Costs' tab[23] Background: Based on Stakeholder feedback and GenCost 2019-20 report
Large-scale batteries	Decrease in capital costs of (30 to 40)%	Feedback from both the ISP and IASR consultations indicated that the projections of battery costs applied by AEMO in the modelling could be high by a factor of 30-40%. It was also noted that many companies now plan to extend battery life by replacing battery modules mid-life while retaining the balance of plant equipment.	Summary: Inputs and Assumptions workbook, 'Build Costs' tab[23] Background: GenCost 2019-20 report

[23] https://aemo.com.au/energy-systems/major-publications/integrated-system-plan-isp/2020-integrated-system-plan-isp/2020-isp-inputs-and-assumptions

Item	Cost change relative to Draft 2020 ISP (%)	Basis	Links/Further references
Gas-powered generation	Increase in capital costs of between 30 to 60%	The GenCost consultation received feedback that smaller aero-derivative type gas-turbines and reciprocating gas engines, which provide greater flexibility compared to the larger industrial open-cycle turbines, are more likely developments in the future NEM. This results in an increase of 30-60% in GPG costs per kW for the modelling (but may be a more efficient solution).	Summary: Inputs and Assumptions workbook, 'Build Costs' tab[24] Background: GenCost 2019-20 report

Other feedback that was incorporated into the 2020 ISP includes:

- Adjustments to the build limits of renewable energy in some REZs – based on feedback specific to certain REZs, AEMO adjusted the information applied in modelling pertaining to the ability to develop new generation in those areas.
- Extension of utility battery technical life, from 15 to 20 years.
- Generation project development updates – revised data was taken from AEMO's February 2020 Generation Information release and discussions with Transmission Network Service Providers, reflecting up-to-date development status for new generation projects and expected closures of existing generators.
- The ISP focuses on the roles storage systems will need to play and the requirements that are needed from it, rather than on specific storage technologies.
- Addition of a section on resilience and climate change.
- Expansion of the discussion on the potential impact of hydrogen on sector coupling within the energy systems of eastern and south-eastern Australia.
- Increased focus on potential non-network options.
- Further consideration of options to implement large infrastructure projects in discrete stages, to provide flexibility in the optimal development path and facilitate potential deferral of significant investments.
- Increased clarity and description of data in the following areas:
- Capital cost estimation for transmission.
- REZ prioritisation.
- Ability of the grid to meet system strength and inertia requirements.
- Additional sensitivity cases were run to determine the impact of:
    - Inclusion of TRET.
    - Updated demand profiles.
- Deferral of analysis of the potential future impacts on Marginal Loss Factors (MLFs) to a separate report, to be published after the Final 2020 ISP to allow for a more comprehensive assessment.

[24] https://aemo.com.au/energy-systems/major-publications/integrated-system-plan-isp/2020-integrated-system-plan-isp/2020-isp-inputs-and-assumptions

5. QNI Medium and VNI West non-network options

The consultation on non-network options for QNI Medium and VNI West projects ran for 12 weeks from the publication of the Draft ISP in December 2019.

5.1 QNI Medium

AEMO received six submissions to the QNI Medium non-network options consultation, of which four were confidential. The following is a high-level discussion of the confidential submissions and a more detailed examination of the two open submissions.

5.1.1 Confidential submissions

A total of four confidential non-network submissions were received in response to the AEMO ISP stakeholder consultation on the QNI Medium Upgrade. Of these submissions, some recommended installing a battery energy storage system (BESS) at either end of the existing QNI, to provide a System Integrity Protection Scheme (SIPS) service. This would allow the existing QNI to be operated closer to its capacity limit without compromising system security.

One confidential submission recommended the use of a PHES scheme in New South Wales. This would support increased deployment of VRE in the local area and reduce transmission constraints and system security issues in northern New South Wales.

5.1.2 Public submissions

GAIA provided a public submission, proposing to install a BESS at its proposed Bonshaw Solar Farm, at the Dumaresq Substation. There is also the potential of GAIA installing a second BESS, at the Liddell Substation. The BESS is expected to provide system services, but these have not been specified.

The **Tasmanian Small Business Council** (TSBC) submission outlines the initial findings of an assessment they have undertaken of the cost to consumers of the Marinus Link project, as a case study which they consider to be applicable to other interconnector projects. The TSBC consider the case for interconnectors in the ISP to be flawed, based on a number of inputs, including the low assumed uptake of battery systems.

The TSBC put forward an alternative to Marinus Link, called Battery Link, which they believe may also be applicable to other interconnector projects. They believe that greater capacity than Marinus Link can be provided through "new large-scale batteries … (1,000MW plus 100MW pa) and an additional 500MW gas-powered generation, increasing every second year at 250MW up to 1,500MW" and that this will also impact the need for other interconnectors. In addition, consumer uptake of behind the meter batteries and EVs is expected to further reduce the requirement for interconnectors.

AEMO's response

AEMO values the input from stakeholders who have submitted responses to the non-network consultation. Each proposal was assessed for the ISP and shared with the respective TNSPs, Powerlink and TransGrid (after authorisation was received for confidential responses). The concept of virtual transmission lines offers one opportunity as an alternative or partial alternative to network augmentation in the development of the future

power system. Depending on the actual technology solutions, this may be suitable as part of a hybrid alternative for the proposed QNI Medium project. However, following finalisation of the modelling and assessments for the ISP based on input received during the consultations, QNI Medium has been reclassified as a future ISP project. AEMO will work with Powerlink and TransGrid to explore the feasibility of non-network options to improve the transfer capability of QNI (potentially under a new RIT-T).

5.2 VNI West

The consultation for VNI West non-network options was included in the RIT-T for the project, run by AEMO Victorian Planning and TransGrid as the responsible TNSPs. The Project Specification Consultation Report was published in December 2019, and submissions closed on 13th March 2020[25]. Submissions to the VNI West consultation have been reviewed by the ISP team and incorporated into the development of the ISP where appropriate. The RIT-T will consider submissions further when developing the Project Assessment Draft Report.

[25] See https://aemo.com.au/initiatives/major-programs/victoria-to-new-south-wales-interconnector-west-regulatory-investment-test-for-transmission/stakeholder-consultation.