11 February 2022

ISP@AEMO.com.au

Dear AEMO ISP team,

RE: Hydro Tasmania response to the 2022 Draft Integrated System Plan

Hydro Tasmania welcomes the opportunity to provide a response to the Australian Energy Market Operator's (AEMO) 2022 Draft Integrated System Plan (ISP).

We strongly support robust and strategic system planning to assist with setting a pathway for future investment and to ensure security and reliability of supply in Australia for the long term. It is critical that the ISP provides a strong pathway that continues to support the energy transition that is occurring in the NEM.

Tasmania is uniquely placed to support Australia through the transition to cleaner sources of energy. The state has over 100 years of experience in managing a renewable power system, with storages and assets that can be repurposed to firm increasing shares of variable renewable energy (VRE). Tasmania offers flexible renewable energy generation and deep energy storage (both conventional and pumped storage hydro). In addition to Tasmania's flexible generation and storage capacity, the Tasmanian region has other diverse supply options, including wind with high capacity factors, and a demand profile that contrasts with the rest of the NEM. These characteristics make Tasmanian projects highly complementary to the efficient transition of the electricity sector.

Marinus Link is crucial to unlocking Tasmania's energy opportunities to support the energy transition by providing access to Tasmania's existing flexible and dispatchable capacity and deep storage, which is capable of cost-effectively integrating increasing shares of VRE in Victoria, and further across the NEM. In addition, Marinus Link will be capable of supporting optimal system security outcomes in the NEM, through the use of grid-forming inverter and Voltage Source Converter technologies. These technologies can allow for Marinus Link to provide critical and increasingly vital system services to maintain grid stability (i.e. fast frequency response), as well as the ability to operate in periods of very low system strength.

The 2022 Draft ISP forecasts a rapid retirement of coal-fired assets – significantly faster than that currently announced in the NEM but consistent with the views of many market participants. In light of this rapid transformation, it is clear that delayed or late delivery of critical transmission, energy storage and additional flexible capacity represents an increased risk for energy consumers. This risk should

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provide a strong signal to governments, market bodies, transmission network service providers and market participants, on the importance of swiftly progressing these strategic projects identified in the ISP.

We were pleased to note that the 2022 Draft ISP considers Marinus Link as a single actionable project with no regulatory staging requirements. Further, AEMO forecasts that Marinus Link will create substantial net market benefits under all modelled scenarios. This includes $4.6 billion in net market benefits across the forecast period under the Step Change scenario – the second highest of any actionable project assessed in the ISP. Hydro Tasmania's latest internal modelling supports AEMO's findings, and also suggests that Marinus Link delivers significant system and market benefits regardless of changes in the coal-fired generation closure trajectory. This is due to Marinus Link providing a cost-effective means for Tasmania to both import excess mainland wind and solar production during daytime hours, and export low cost Tasmanian energy to the mainland during the peak evening hours.

The ISP's Optimal Development Pathway (ODP) indicates that net market benefits will be maximised by delivering Marinus Link by 2027 and 2029 for Cables 1 and 2 respectively in the most likely Step Change scenario. We encourage all efforts to be made to ensure that this project is delivered in 2027 and 2029, or as soon as practical thereafter. In addition, we encourage AEMO to retain this timing in the ISP to continue providing strong signals as to what the market needs and when. In doing so, we can ensure Tasmania's energy resources can target outcomes that best support the ongoing transformation of the NEM.

Hydro Tasmania has made some additional comments regarding AEMO's 2022 Draft ISP captured in Attachment A. These additional observations relate to:

- **Scenario weightings** arising from the Delphi Panel process;
- Additional **sensitivity analyses** that AEMO could undertake to reflect potential limitations on resource build out;
- **Gas price assumptions** and the ability to firm extended periods of low VRE output;
- Modelling limitations when **forecasting storage requirements with 'perfect foresight'** under a least-cost optimisation model; and
- The role of strategic transmission investments delivering **competition benefits** in the NEM.

Hydro Tasmania appreciates AEMO's work to refine these important planning insights. If you wish to discuss any aspect of this submission, please do not hesitate to contact me ((03) 8612 6443 or Colin.Wain@hydro.com.au).

Yours sincerely,

Colin Wain
Manager Policy Development

Attachment A – Hydro Tasmania comments on Draft 2022 ISP

1. Scenario weightings

Hydro Tasmania notes the dramatic global acceleration of efforts – from national governments, the investment community and major industrials to lower greenhouse gas emissions. We believe this momentum is now unstoppable, and will inevitably be reflected in faster than expected transformation of the NEM.

Hydro Tasmania welcomes the outcomes of the Delphi Panel process, identifying that the Step Change scenario is the most likely to eventuate (50% weighting). We consider this closely aligns with observed market evolution to date, with a rapid build out of VRE, and increasing technical and economic pressures driving thermal generators out of the market. Given the clearly accelerating rate of change towards decarbonisation, we also agree with the Delphi Panel applying a significantly lower weighting to the Slow Change scenario (4% weighting).

2. Sensitivity analysis

Sensitivity analyses have been a valuable tool used throughout previous iterations of the ISP to provide a refined and nuanced level of insight regarding plausible future energy scenarios. Hydro Tasmania considers that there could be benefit in conducting some additional sensitivity analyses to broaden insights from the 2022 ISP.

i. Cost assumptions for battery technologies

The ISP anticipates considerable cost reductions for battery storage technologies across the forecast period. Shorter-duration storages have been proven to be highly effective in providing critical system services such as frequency control, and are becoming increasingly focussed on the role that they can play in the provision of bulk energy. This broad service provision demonstrates that battery technologies will have a critical role to play in our future energy mix, as well as other global power systems pursuing ambitious decarbonisation targets.

There is currently a large degree of uncertainty about trajectory of battery cost reduction, with the United States National Renewable Energy Lab recently forecasting capital cost reductions in the range of 28% to 75% by 2050[1]. Given this uncertainty, we consider it plausible that we will not see as aggressive a reduction on battery-storage costs as currently anticipated. Hydro Tasmania encourages AEMO to undertake some sensitivity analysis of battery cost assumptions, to better understand implications for the least-cost build out of the NEM, should these anticipated cost reductions not materialise as currently assumed.

ii. Slower than expected build out of Distributed Energy Resources

In addition to the above observation, Hydro Tasmania notes the dramatic increase in the modelled uptake of distributed energy resources (DER) under the Step Change scenario. While it is likely that we

[1] Cost Projections for Utility-Scale Battery Storage: 2021 Update

will continue to see a consumer-led transition of our market, we consider there will likely be some practical limitations to the uptake of DER from both a technical and economic viewpoint.

Hydro Tasmania would like to highlight that we are likely to see limitations in the ability of distribution networks to 'host' increasing shares of DER. This was the focus of Jemena's *DER Hosting Capacity Project*[2] (supported as part of ARENA's Advancing Renewables Program), and has also been observed as a key challenge to overcome in various locations in Queensland's distribution networks where extremely high shares of rooftop solar PV have been installed. Energeia's *Distributed Energy Resources Enablement Project – Discussion and Options Paper*[3] estimates that *"Australia's overall cost of mitigating over-voltage due to solar PV installations over the next 20 years is forecast to range by from $0.7 to $1.1 Bn, depending on the level of DER-adoption".* Energeia also noted that there are other issues from increasing DER adoption, additional to over-voltage, including thermal overloads, phase balancing, under-frequency control and the need to update protection settings.

We note that the Draft 2022 ISP uses data from CSIRO's *Small-scale solar and battery projections 2021* and Green Energy Market's (GEM) *Projections for distributed energy resources – solar PV and stationary energy battery systems* to obtain forecasts of rooftop PV for the different ISP scenarios. GEM does not consider distribution network constraints in their projections of small-scale systems, while CSIRO addresses the issue of distribution network constraints through limits on rooftop system sizes. This may be contributing in part to GEM's higher forecasts of DER uptake compared to CSIRO's projections. We consider CSIRO's projections more closely reflect real-world constraints on DER uptake, and recommend AEMO to consider using the mapping of CSIRO projections of DER to ISP scenarios shown below:

2021 Inputs Assumptions and Scenarios	Slow Change	Steady Progress	Progressive Change	Step Change	Hydrogen Superpower	Strong Electrification Sensitivity
Draft ISP 2022 mapping	CSIRO Slow Growth	Average of CSIRO and GEM Current Trajectory	Average of CSIRO and GEM Net Zero	GEM Sustainable Growth	GEM Export Superpower	CSIRO Rapid Decarbonisation
Hydro Tasmania's proposed mapping	CSIRO Slow Growth		CSIRO Net Zero	CSIRO Sustainable Growth	CSIRO Export Superpower	CSIRO Rapid Decarbonisation

In addition, we consider it likely that the market will reach a point where price incentives for the continued installation of domestic batteries and solar will no longer be financially beneficial. Therefore, we would like to encourage AEMO to consider these observations, and undertake some sensitivity analysis that reflects these practical limitations to the build out of DER under the core ISP Step Change scenario.

iii. Projections of small-scale battery uptake

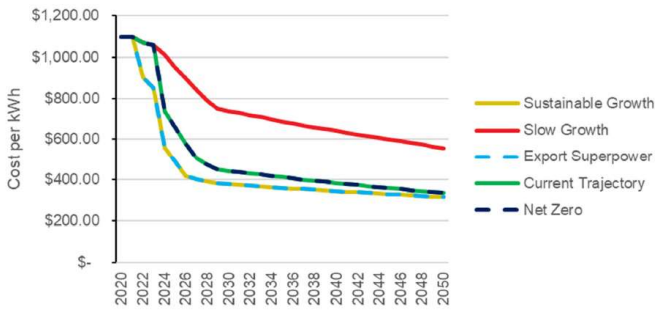
We note that Draft ISP 2022 uses data from CSIRO's *Small-scale solar and battery projections 2021* and GEM's *Projections for distributed energy resources – solar PV and stationary energy battery systems* to obtain forecasts of small-scale battery uptake for the different ISP scenarios – consistent with the approach for obtaining projections for DER uptake. We note that there is a significant divergence in

[2] https://arena.gov.au/assets/2020/08/jemena-der-hosting-capacity-interim-knowledge-sharing-report.pdf
[3] https://renew.org.au/wp-content/uploads/2020/06/Energeia.pdf

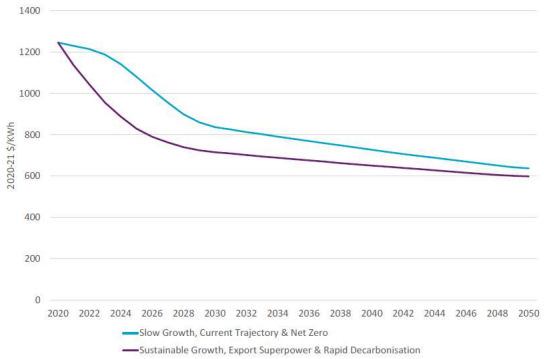
their respective projections – GEM is projecting approximately 40,000MWh of small-scale battery capacity in 2035 under the Sustainable Growth scenario while CSIRO's estimate is less than 15,000MWh. We also note that AEMO adopted GEM's projections under the Sustainable Growth scenario for the Draft ISP 2022's Step Change scenario.

We consider that a major driver of this divergence in battery capacity projections arises from the difference in their assumed capital costs for battery storage. For example, under the Sustainable Growth scenario, GEM adopts a capital cost of battery storage in 2035 of less than $400/kWh while CSIRO's estimate is approximately $700/kWh (see charts below).

GEM – Capital cost for small-scale battery storage by scenario



CSIRO – Capital cost for small-scale battery storage by scenario



In GEM's *Projections for distributed energy resources – solar PV and stationary energy battery systems* report, they note that CSIRO did not publish a specific estimate of the capital cost of a distributed battery and solar system in their 2020-21 GenCost report. As a result, they use a combination of CSIRO's GenCost projections of the capital cost of utility-scale 2-hour batteries, battery system quotes from South Australia's Home Battery Rebate Scheme, interviews with industry participants and some degree of judgement to inform their assumptions.

Noting that other inputs in the ISP modelling, such as build costs, are based on capital cost estimates from CSIRO, we consider that due to the CSIRO's deep expertise and for consistency with distributed PV estimates, the projections of battery uptake input should also be derived from capital cost estimates from CSIRO. We recommend AEMO apply the mapping of CSIRO projections of battery uptake to ISP scenarios consistent with our proposed mapping for DER (discussed above).

3. Gas price assumptions

We note that the Draft 2022 ISP foreshadows the potential for greater investment in long-duration storages in lieu of gas-fired generation to manage extended periods of low VRE output, but that *"under current assumptions, gas remains the most cost effective solution, complementing storages, to firm renewables"*. There remains a high degree of ongoing uncertainty about long-term gas prices and the role of gas in a carbon constrained future. For example, assumed Queensland gas prices are around 22% lower in the latest draft ISP than in the 2020 ISP.

Given this uncertainty, and the current importance of gas-powered generation in providing firming capacity in ISP scenarios, we encourage AEMO to consider futures (through sensitivity analysis) in

which gas-powered generation plays a smaller role, with a potentially greater contribution from storage, interconnection, and other technologies.

4. Storage and 'perfect foresight'

The draft 2022 ISP forecasts a significant increase in required storage assets (45 GW / 620 GWh to 2050) relative to previous iterations of the ISP. As a relatively new system optimisation consideration, we note the significant improvements made by AEMO to investigate the optimal role and volume of storages required in a least-cost future energy mix.

As a least-cost optimisation model, the ISP builds out future energy resources in the most cost-effective manner possible, and assumes perfect foresight which optimises dispatch of all generation and storage assets. However, as noted in AEMO's Draft 2020 ISP, '*…even minor inefficiencies in real world operations lead to the need for more storage or other forms of dispatchable generation, which will be analysed in detail in future ISPs."*[4]

While we appreciate and acknowledge the practical limitations that necessitate this modelling approach, it is important to recognise that modelled outputs are unlikely to reflect real-world outcomes. For instance, under the current modelling approach, the ISP will assume that shorter-duration storages will work in perfect harmony, and will collectively prolong their discharge to meet system demand over a longer period if the system requires it. However, in reality, as profit-maximising entities, these batteries will each respond in line with individual profit-maximising bidding strategies during periods of scarcity pricing.

Analysis by Hydro Tasmania has identified that with more realistic forecasts, more and longer duration storages are likely to be required to deliver similar system outcomes. To achieve a similar value to that predicted by a model with perfect foresight, a storage with 2-3 times the duration would be required when using real (imperfect) forecasts.[5]

We would welcome the opportunity to continue collaborating with AEMO to refine the way in which the ISP forecasts the need for short, medium and long-duration storage assets under high VRE scenarios.

5. Competition benefits

AEMO recently investigated the potential for the ISP to calculate competition benefits via the *Competition benefits in the integrated system plan* consultation process. As expressed throughout this consultation process, *"Hydro Tasmania has long held the view that major transmission projects and strengthening of interconnection between NEM regions offers an opportunity to deliver significant competition benefits for customers in the NEM."*

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[4] AEMO Draft 2020 Integrated System Plan, pg. 46.
[5] https://www.hydro.com.au/docs/default-source/clean-energy/battery-of-the-nation/storage-with-imperfect-foresight.pdf?sfvrsn=72e59528_4

In particular, we consider that investments that support the sharing of dispatchable capacity between regions (and subsequent uplift this will cause in contract market liquidity) can facilitate a more robust and competitive environment in the retail market. In doing so, we can safely assume that this increase in competitive tension in the retail market will result in significant benefits for consumers.

While we recognise and accept AEMO's rationale for not including competition benefits in the ISP modelling methodology, we consider this should still be acknowledged in a qualitative fashion in the final ISP. Doing so can acknowledge some of the practical limitations of the power system model, and highlight what might otherwise be unrecognised benefits arising from strategic transmission investments.