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From: Hydrostor

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Re: **Hydrostor's submission to AEMO's Draft 2024 Integrated System Plan for the National Electricity Market**

Hydrostor welcomes the opportunity to comment on the Australian Energy Market Operator's (**AEMO**) Draft 2024 Integrated System Plan (**ISP**) for the National Electricity Market (NEM). First, Hydrostor commends AEMO on the detailed roadmap provided for the clean and reliable energy transition and appreciates the impressive scale of modelling and analysis involved.

Hydrostor is a global leader in the development of utility-scale long duration energy storage (**LDES**) solutions, using its proprietary Advanced Compressed Air Energy Storage technology (**A-CAES**). A-CAES is a cost-effective, reliable, and commercially ready technology that is currently deployed in Canada, with advanced development projects in Australia and in the United States. Hydrostor's proprietary design utilises existing and proven equipment and supply chains in a clean energy technology configuration. Among Hydrostor's large-scale A-CAES projects is the 200MW, 8-hours project in Broken Hill, NSW, which was recently awarded an LTESA by the NSW Government.

This submission focuses on four key areas of feedback in answering the question as to whether the proposed plan gives confidence of delivering reliable, secure, and affordable electricity through the NEM, and supports the reduction of Australia's greenhouse gas emissions:

- Absence of A-CAES in system modelling despite it being commercially available and a uniquely direct replacement for fossil fuel-based generation.
- Energy storage classifications and planned capacity
- Gas-powered generation capacity increase despite reduction targets and the updated National Energy Objectives (**NEO**)
- Increase in expected deployment of coordinated Consumer Energy Resources (**CER**)

General feedback to question 1: Does the proposed optimal development path help to deliver reliable, secure and affordable electricity through the NEM, and reduce Australia's greenhouse gas emissions? If yes, what gives you that confidence? If not, what should be considered further, and why?

Hydrostor considers that what is proposed in the Optimal Development Plan for the Step Change scenario broadly provides a roadmap through the energy transition based on existing knowledge and research. It stresses the importance of timely development to deliver the energy transition. However, the ISP reads as optimistic, and further consideration should be given to the significant reliance on Coordinated CER, a reduction in the LDES required, and an increase in gas-powered generation (**GPG**) to

provide “firming and back-up” to firm and shape Variable Renewable Energy (**VREs**). While the increased capacity planned for Coordinated CER itself is concerning, the increase in fossil-based backup generation reduces the planned requirement for longer-duration storage and has a questionable ability to reduce Australia’s greenhouse gas emissions. These concerns are enhanced by how the CIS will procure to the ISP’s roadmap.

In its current form, the ISP also picks technology winners and losers. Despite it being awarded an LTESA by the NSW government, A-CAES is not genuinely considered as a commercially available technology. What is concerning is that the benefits provided by A-CAES in comparison to both coordinated CER, battery storage more broadly and GPG are not considered in the ISP. Rather, it is mentioned as an emerging technology.

The storage categories do not align with international standards that recognise the capacity contribution and operational characteristics associated with energy storage technologies at different durations. It effectively merges different storage duration purposes into the same category. Where 4-hour duration, and fast frequency response is most cost effectively covered by lithium-ion batteries (**BESS**), non-BESS longer duration storage is able to provide significant system stability services as well as balancing supply and demand across longer durations. To provide the same benefit BESS would need additional technology (e.g. synchronous condensers or synthetic inertia) incurring higher costs. As the ISP is a plan to guide investment, creating a category for storage that requires well established BESS technology to compete for capacity with longer duration synchronous storage, will ensure further procurement of 4-hour storage to the detriment of longer-duration storage projects.

It appears the ISP does not reflect current state and territory policy. Specifically, NSW legislated 2.4GW long-duration energy storage (defined as 8 hours +) by 2030. This single jurisdiction target will therefore take up 67% of the total 3.6GW of medium duration storage allocation by 2030. This will then leave 1.2GW of medium duration capacity for all other NEM jurisdictions. It is unclear if the intention of the ISP is to limit medium duration storage in other jurisdictions or to comment on NSW policy. Finally, the conflict between NSW’s long-duration energy storage and other current procurement processes by state governments, and the ISP storage duration categories. The ISP therefore does not reflect state-led policy which in turn will further distort the signals for investment the ISP is designed to send.

The following sections explore these issues in further detail.

Lack of A-CAES in System Modelling

It is concerning that some commercially ready technologies are not included in AEMO’s modelling. A-CAES specifically has not been considered despite its inclusion in CSIRO’s GenCost report. Furthermore, it was inaccurately characterised as an emerging technology, even though the Silver City Project in Broken Hill, NSW, fits the category of an anticipated non-network project which has passed the RIT-T, been awarded an LTESA, and is anticipated to be online by the end of 2027. Another of Hydrostor’s projects, a 500

MW, 8-hour A-CAES facility in California has recently signed one of the world's largest energy storage contracts, worth around US$1 billion.

One of the key benefits of A-CAES is that it can be flexibly sited where the grid needs it, close to load centres. This in turn prevents stranding transmission and can displace further transmission investment. Further, being a type of synchronous generation, A-CAES can provide system strength services, providing an emission-free replacement for fossil-fuel based generation.

Long duration technologies can provide dispatchable capacity to support firming and VRE integration, as well as network support capacity, which supports the retirement of coal-based generation. Non-battery based long duration storage such as A-CAES and pumped hydro also have the additional benefit of being 50 year+ resources that do not degrade. This allows these resources to be amortized over a longer period when compared to battery-based technologies which translates to lower costs for rate payers. Furthermore, the lack of degradation means that the projects do not have to be continuously augmented. These key benefits of non-battery-based storage long-duration energy storage technologies have not been considered in the ISP.

Energy storage classifications

While the ISP recognises the need for varied storage technologies and depths, the categories defined do not necessarily correlate with current analysis of durations and purpose. The three key categories are defined as:

- Shallow duration, for intra-day shifting with a focus on capacity, fast ramping and FCAS for up to 4 hours,
- Medium duration, for intra-day shifting driven by the daily shape of energy consumption and solar cycles, for 4-to-12-hour durations, and
- Deep storage, for VRE droughts and seasonal smoothing, more than 12 hours of duration.

These categories were developed in response to submissions to the 2020 ISP, which had a focus on batteries and Pumped Hydro, rather than the purpose of other available technologies of varying durations. Despite the creation of "medium duration storage" of 4- to 8- hours, the 2022 ISP carved out 2GW specifically of 8-hour or more duration as the longer duration was modelled as essential to the roadmap. The ISP acknowledges overlaps between the categories, and the specific carve out would suggest that the medium duration storage category as currently defined is not fit for the purposes stated.

Other jurisdictions tackling similar challenges of ensuring reliability, affordability and a commitment to rapid decarbonisation have defined energy storage duration categories differently. NSW legislated a long-duration storage target of 8+ hours, creating a distinct definition to meet the needs beyond the 2- to 4- hours (inclusive) category provided by battery technology. The US states of New York and California have also based the definition of short duration storage on summer peak hours, where between 2-6 hours is common. New York also included up to 8 hours for winter peaks. Therefore, both jurisdictions make a clear distinction between short duration storage and long duration,

defining long duration storage as 8 hours and above (NYSERDA, 2022) (Stratagen, 2020). It is true that the UK's Department for Business, Energy and Industrial Strategy also released a report on the Benefits of Long Duration Energy Storage (Department for Business, Energy & Industrial Strategy, 2024) which has similar categories and definitions as the Draft 2024 ISP. However, the Short Duration Storage category is defined as durations of 4-hours or lower, which is suited to addressing short duration balancing needs with very fast flexibility. The categories themselves were informed by the working definition of Long Duration Energy Storage as having greater than 4 hours of storage and including technologies beyond BESS.

Further review into the storage categories is required, as this roadmap is then procured towards by the CIS. Without this consideration, the ISP would limit investment in technologies which are highly competitive at the lower end of the "medium duration" bracket but do not provide all the benefits of the higher end of the "medium duration" bracket. The risk is that 4-hour BESS technologies are over-procured and over-subsidised because the need for resources providing longer than 4 hours is not clearly spelled out in this draft. While it is not necessarily the responsibility of the ISP to solve for CIS procurement outcomes, it does inform the type and scale of technologies/resources that are eventually eligible for the support towards commercialisation the CIS provides.

Hydrostor is concerned by the decrease in new medium and long duration storage capacity between the 2022 ISP and now. The most pressing need stated in the 2022 ISP was for an increase of medium duration storage capacity to 9GW, which specifically called out at least 2GW of storage with at least an 8-hour duration. The 2024 Draft ISP has reduced the requirement for medium duration storage to 3.48GW. There are two issues requiring more analysis with this reduction. The first, as mentioned above, is the legislated storage targets of state jurisdictions. Specifically, NSW has mandated a long-duration storage (8 hours +) of 2GW, that then reduces the remaining target to 1.48GW across all other NEM jurisdictions. While Victoria has not yet carved out target storage durations in its 6.3GW storage legislated target by 2035, it has been made clear that a future target does not include existing projects underway (bilaterally procured by the state). Therefore, the ISP is missing an important input that is being driven by state policy and should be optimised into the overall system plan.

The second issue is that the reduction has also coincided with an increase in both the reliance on coordinated CER, but more concerningly, increased reliance on new gas-powered back-up and firming generation, from 10GW in 2022 to 16.2GW in 2024. It could be argued that despite commentary in the ISP that medium duration storage was reduced in the ISP to allow for an increase in Coordinated CER, it is just as likely that the category was reduced to allow for an increase gas-powered generation.

Increase in Gas Powered Generation

The AEMC's Final Decision on the National Energy Objective Amendment solidifies both the Commonwealth, and State and Territories commitments to reducing greenhouse gas emissions. While the updated guideline will only be in effect for the 2026 ISP drafting process, that is not to say greenhouse gas emissions reductions do not need to be considered in the ISP.

Most concerningly is the almost 7GW increase to the total GPG target. Taking into consideration replacing existing capacity retirements, the ISP is proposing 13GW of new GPG capacity to be deployed within the NEM. The ISP acknowledges that these gas-powered generators are not forecast to run frequently, and further analysis needs to be undertaken on where these new plants could be built given renewable energy generation targets set in legislation.

Jurisdiction	**Target**
Commonwealth	82% national renewable target by 2030
ACT	100% electricity from renewable generation (achieved)
NSW	12GW VRE by 2030, 2GW of long duration energy storage
QLD	80% electricity from renewable energy by 2035
SA	100% electricity from renewable energy by 2030
TAS	200% electricity from renewable energy by 2040
VIC	95% electricity from renewable energy by 2035

With most NEM jurisdictions targeting 100% electricity from renewable energy, and leaving NSW, QLD and VIC as the only jurisdiction that could host new GPG to be used to support energy supply during periods of renewable drought and extreme peak demand.

In this regard, AEMO has used the concept of gas as “backup” and as “firming” interchangeably. From reading, this would suggest that the role of gas-powered generation to be the same as that of energy storage of 8 hours or more. The question of greenhouse gas emissions is somewhat addressed by the potential for hydrogen as an alternative, however, only forecasts a small contribution from hydrogen as it is a relatively expensive fuel to use at scale. LDES, with additional reliability (8-10 hour + duration) is a strong substitute for conventional gas resource capacity, especially LDES which provides synchronous generation. This is explored in depth in the UK and the PJM transmission patch in the north-eastern US. Allowing for commercially ready and emerging LDES technologies rather than relying on GPG will better align the ISP with the NEO. This will also send signals to developers early enough to develop in time, rather than further delay these signals which we know will change in the 2026 ISP.

Another source of conflict in the 2024 ISP, is that AEMO considered the need for gas-powered generation over other firming/backup resources, to provide reliability during “deep VRE droughts” in the middle of winter. Where this argument falls over, is that winter is when gas is most constrained due to an increase in use of gas heating. CSIRO’s GenCost report does call out, that the dead of winter is when there may be constraints in the pipeline preventing GPG from securing the fuel required to meet demand. The lower levelised cost of electricity within the report was caveated with the ability to source low-cost fuel. These additional variables, and the likelihood of fuel constraint does not fit the rest of the detailed roadmap, where these droughts and constraints are considered more robustly.

Finally, the ISP, and the GenCost report which underpins the modelling, do not considered the ability to finance gas projects, or the social license risk associated with trying to develop a new gas-powered generation plant. Many financiers are starting to factor in climate change risk into their product structures and are facing significant shareholder pressure to stop financing new fossil fuel projects. Moreover, financial institutions will give significant regard to policy concerns like renewable energy targets, and the low capability factor, into the risk of any new project. When looking at renewable energy targets for beyond 2035, there is a high risk these new plants will become stranded assets. Therefore it is unlikely the private sector will invest in gas peaking plants.

Increase in expected deployment of Coordinated Consumer Energy Resources

The value to the system of increasing the proportion of CER under coordination is well established. When coordinated, CERs can increase resilience, support the grid through both peak shaving and load balance, and can help avoid network upgrades. It is also well established that CERs are increasing exponentially across Australia. What isn't well established, is how almost 38GW of CER storage will be induced to being coordinated. The capacity allocated to Coordinated CER therefore is a risky proposition, as the ISP only considers financial motivation behind consumers decision making.

The ISP is resting an optimistic amount of capacity on the market being able to demonstrate value to customers, especially where there is research suggesting they are better off (a faster pay back) if they self-consume from their installed solar and battery arrays, rather than give up control (IEFFA, 2022). The financial incentives required would need to be significant to encourage customers to make the switch. Further policy and regulatory reform are required to ensure the market can integrate CER effectively, allowing for enticing products. However, this only covers the financial aspect of decision making.

Recognising the limits of the ISP which is not equipped to delve into the realm of behavioural psychology, consumer behaviour and decision making cannot be ignored in this case. In fact, rather than projects AEMO can plan for and send investment signal to, the amount of CER subscribed to VPP rests on the ability of the energy industry as a whole to rebuild trust with customers who were largely motivated to invest capital in CER because of a distrust of the industry. In fact, "to regain control" of their energy is a genuine motivation for the uptake of solar PV and home batteries (Mazaengarb, 2022). Further, when considering Electric Vehicles, the decision to relinquish control of the battery is significantly more complex than a financial proposition. "Range Anxiety" is already a well-studied phenomenon, where electric vehicle drivers fear being stranded without enough charge for their journeys (Giuseppe Rainieri, 2023). Many drivers will have a "just in case" mentality of keeping their vehicle's fuel topped up, as use of a vehicle isn't always planned, and the fear of not having enough charge could be greater than any perceived financial benefit. To that end, there are millions of more variables to overcome for coordinated CER by the sheer number of customers multiplied by motivations outside of just financial.

The potential risks to the system of CER not being coordinated are not being debated. The realisation of potential benefits is being hampered by consumer confidence, and therefore likelihood of allowing coordination. The amount of market and industry reform required is significant, and therefore is treated differently to other emerging technologies, considered (like LDES), which do not neatly fit the existing market frameworks and therefore have not been well considered.

Conclusion

The central thesis of the Draft 2024 ISP is “Renewable energy connected by transmission, firmed with storage and backed up by gas-fired generation is the lowest cost way to supply electricity to homes and businesses throughout Australia’s transition to a net zero economy”. While this is a commended plan, the balance between elements within the analysis does not consistently reflect current policy, distorting the signals it is trying to create. The ISP is not a forecast, but a roadmap for the energy transition, and as such needs to consider the inputs equally and in their full context. LDES (defined as 8 + hours) provides significant benefit to the market and has been discounted by inconsistent consideration of current policy and technology bias. A-CAES specifically is commercially viable and available to provide low cost firming to support the energy transition.

Hydrostor appreciates AEMO’s work to refine this imperative roadmap. If you wish to discuss any aspect of this submission, please do not hesitate to contact me 0402742904 or Sara.Taylor@hydrostor.ca.