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RE: **ERO Number: 019-6647**
IESO's Pathways to Decarbonization Study
Hydrostor Inc. Submission

I. OVERVIEW

Hydrostor is pleased to offer its response to ERO Posting 019-6647 regarding the Independent Electricity System Operator's (IESO) Pathways to Decarbonization Report (P2D).

Hydrostor is a Canadian developer of long-duration, utility-scale energy storage based in Toronto, Ontario. We have developed proprietary Advanced Compressed Air Energy Storage technology (A-CAES) that is being deployed around the world.

With our proven track-record of success, Hydrostor understands that large scale energy infrastructure development is crucial to the future of Ontario. With this perspective, we respectfully submit the following overarching comments to frame our recommendations throughout this submission:

> ***Long-duration energy storage*** (LDES) is a prerequisite to achieving decarbonization in Ontario's energy grid.
>
> It is in ratepayer interests to consider all viable LDES technology types to maximize ***viability***, ***cost-effectiveness***, ***flexibility*** and ***responsiveness*** to demand.
>
> A-CAES is an ***overlooked technology*** in Ontario, that has been proven in other jurisdictions to be a significant accelerator of decarbonization while maximizing *reliability*, *affordability* and *sustainability* for ratepayers.

A-CAES provides low-cost, long-duration energy storage that is 100% emissions-free and can be flexibly located. In 2022, Goldman Sachs Asset Management and the Canada Pension Plan Investment Board made historic investments into Hydrostor to propel the development of A-CAES projects globally. In 2023, Hydrostor executed a 200 MW / 1,600 MWh power purchase agreement in California, USA, at the Willow Rock Energy Storage Centre.

A-CAES has unique advantages as a long-duration energy storage solution. It can be constructed in places where other forms of large-scale synchronous generator-based storage cannot (like pumped hydro and traditional-CAES). Unlike battery storage technology, A-CAES is cost-effective at long durations (6 hours+), has an exceptionally long service life of over 50 years without degradation and without any requirements for augmentation, and it provides numerous grid benefits like synchronous inertia. A-CAES is entirely non-emitting and provides reliable long discharge durations which offers a compelling alternative to carbon emitting capacity technologies.

The following submission provides Hydrostor's detailed recommendations to preserve the ability to leverage A-CAES technology in Ontario through no-regret actions today.

II. RECOMMENDATIONS

A. Launch a Request for Proposals for Long-Duration Energy Storage:

Hydrostor recommends that the IESO explore a 2,000 MW contingent procurement process for long-duration energy storage projects (8 hours or more), based on the pathways to decarbonization for Ontario's electricity grid. The initial 2,000 MW procurement should be intended to leverage LDES simultaneously with the integration of new intermittent resources and incremental nuclear generation.

The contingent procurement should address reliability impacts projected after 2029 and reduce the province's reliance on natural gas. To achieve early 2030 commercial operation timelines for credible, cost-effective long-duration technologies like pumped hydro or compressed air, development must commence immediately.

A contingent procurement approach offers several benefits for the IESO. First, it allows for adjustments to future long-duration market needs, enabling the IESO to terminate contracts if market needs are lower than expected. Second, the IESO can minimize exposure by committing to a cost cap on termination, limiting it to the development costs funded on a project. Finally, this process enables developers and investors to begin critical planning, siting, and environmental assessments for long-duration projects today, with the

assurance that their costs will be covered as downside protection. This proactive approach is essential for meeting the early 2030 online requirements for long-duration resources.

B. Develop a Framework to Maintain Optionality of all LDES Resource Types

All LDES technologies are large infrastructure projects, with long-term development timelines, sometimes spanning decades. Contracting for billions of dollars in development costs a decade in advance gives rise to significant risks, that if manifested, would result in serious ratepayer regrets. Maintaining options for all viable LDES technology types mitigates against the risk of committing too much investment, too early.

In the past, Ontario has led the way in developing large energy infrastructure projects, such as nuclear generation, while providing ratepayers with off-ramps should the need for that technology diminish over the development timeline. These past decisions have yielded significant benefits for ratepayers.

Ultimately, future procurement must be guided by these same principles. The overall objective must be to protect the best interest of ratepayers. The rapidly evolving LDES industry continues to quickly change the value-proposition of different technology types. A-CAES now offers flexibility, cost-effectiveness and system benefit that is simply unmatched by conventional LDES storage types like pumped-hydro. Its value has been realized in other jurisdictions as a proven technology.

It is incumbent on policymakers to respond to market advancements by considering A-CAES, amongst all other LDES technologies. A competitive procurement that evaluates all LDES technology types against each other is a no-regret decision that serves the interests of Ontario ratepayers.

Hydrostor recommends the following procurement framework:

1. **Project Identification**: Developers identify suitable projects based on technical, economic, and environmental criteria.

2. **Prequalification**: Require proof of technical expertise, financial capacity, prior experience, and technology viability.

3. **Contingent Procurement Announcement**: Contingent RFP for 2,000 MW of long-duration storage (8-hour minimum duration requirement), with commercial operation by 2030, located where needed and contingent on future system needs.

- **Development Cost Recovery**: allow for recovery of development costs up to the point of proposal submission, to be overseen for prudency by the IESO or OEB.

4. **Contract Structure**: Offer up to 40-year contracts, with options such as contracts for differences, capacity contracts, or tolling contracts.

5. **Proposal Evaluation**: Assess proposals based on price and consider non-price factors. Non-price factors can include feasibility, technical capabilities, economic benefits, environmental impact, and alignment with Ontario's decarbonization objectives.

6. **Contract Award**: Award contracts, clarifying project continuation is contingent on future system requirements.

7. **Development Milestones**: Set a timeline and milestones for project development, including planning, siting, assessments, permitting, and construction.

8. **Progress Monitoring**: Regularly monitor project progress and communicate with developers to ensure alignment with system needs.

9. **Contingency Termination**: Allow system planners to terminate contracts (by an outside date) and refund development costs up to a cap if projects are no longer required in the form of contractual off-ramps.

10. **Project Commissioning**: If deemed necessary, commission and integrate projects into Ontario's energy grid.

This framework enables Ontario to secure long-duration storage resources while mitigating risks and ensuring cost-effectiveness. It protects developers and ratepayers if projects ultimately become unnecessary at a predetermined point in their long development cycles.

To ensure Ontario can achieve its decarbonization goals, action must be taken now for projects to reach commercial operation by 2030. For example, the procurement process could begin in December 2023, contingent contracts signed by mid-2024, and the outside date for contingency termination could be set as the end of 2025.

III. CONSULTATION QUESTIONS

Hydrostor is pleased to provide its comments to the following questions posed by the Ministry of Energy:

1. **The IESO's Pathways Study recommends streamlining regulatory, approval and permitting processes, citing that it can take five to 10 years to site new clean generation and transmission infrastructure.**

   What are your thoughts on the appropriate regulatory requirements to achieve accelerated infrastructure buildout? Do you have specific ideas on how to streamline these processes?

Hydrostor believes that to accelerate infrastructure buildout, the province should establish an accelerated permitting pathway for projects that significantly contribute to clean energy, economic growth, and development. Additionally, enhancing decision-making and system planning to ensure timely procurement can provide developers who have access to various technologies such as advanced compressed air energy storage, pumped hydro, and nuclear, with adequate time to plan for the necessary permitting processes. The proposed procurement framework Hydrostor described in section II B of this submission would allow long-duration energy storage developers to permit in a timely manner.

2. **The IESO's Pathways Study recommends beginning work on planning and siting for new resources like new long-lived energy storage (e.g., pump storage), nuclear generation and waterpower facilities.**

   What are your expectations for early engagement and public or Indigenous consultations regarding the planning and siting of new generation and storage facilities?

As a long-duration energy storage project developer specializing in advanced compressed air energy storage, we believe that early engagement and inclusive consultation with the public and Indigenous communities is crucial to the successful planning and siting of new generation and storage facilities. Early engagement allows us to understand the unique concerns, expectations, and interests of various stakeholders, including local communities, Indigenous groups, and regulatory authorities. This collaborative approach helps us identify potential challenges and opportunities while ensuring that our project aligns with the region's social, environmental, and economic goals.

In addition to early engagement, we are committed to maintaining an open and transparent dialogue throughout the project lifecycle, ensuring that Indigenous knowledge and perspectives are integrated into the planning process. By incorporating this feedback, we can co-create mutually beneficial solutions that address potential

impacts on the environment, cultural heritage, and local economies. We recognize the importance of building strong, respectful relationships with Indigenous communities and the public to foster trust and support for our projects, ultimately contributing to a more sustainable and resilient clean energy future for all.

Furthermore, it is critical for the province to immediately initiate procurement mechanisms for long-lived long-duration energy storage and other resources to ensure that they have the appropriate time for planning and construction.

3. **The IESO's Pathways Study shows that natural gas-fired generation will need to continue to play an important role in the system for reliability in the short to medium term. The IESO's assessment shows that most of the projected Ontario demand in 2035 can be met with the build-out of non-emitting sources, but some natural gas will still be required to address local needs and provide the services necessary to operate the system reliably.**

   Do you believe additional investment in clean energy resources should be made in the short term to reduce the energy production of natural gas plants, even if this will increase costs to the electricity system and ratepayers? What are your expectations for the total cost of energy to customers (i.e., electricity and other fuels) as a result of electrification and fuel switching?

Hydrostor supports additional investments in clean energy resources to decrease the reliance on natural gas plants and move towards a more sustainable energy future. Hydrostor encourages the Government of Ontario and the Independent Electricity System Operator to consider long-duration energy storage technologies as an effective way to reduce the need for natural gas plants.

Long-duration energy storage refers to technologies capable of storing electricity for 8 hours or more, which can help balance grid supply and demand. Long-duration storage options encompass chemical batteries such as lithium-ion and flow batteries, as well as mechanical storage solutions like flywheels and compressed air energy storage. These storage technologies can charge during periods of excess electricity production (using existing resources) and discharge during peak demand, thus reducing the need for natural gas plants.

Compressed air energy storage is a particularly attractive alternative to natural gas plants, as its rotating machinery offers similar ancillary grid benefits without the associated emissions. Traditional compressed air energy storage projects have been in operation for many years in Germany (290 MW, commissioned in 1978) and Alabama (110 MW, commissioned in 1991). With our advanced compressed air energy storage, Hydrostor has

signed an offtake agreement at our 500 MW Willow Rock project in California, and was selected as the preferred option to provide back-up power through our 200 MW Silver City project in New South Wales.

Implementing long-duration energy storage solutions can be cost-effective and contribute to lowering overall expenses for the electricity system. Additionally, when comparing storage options, long-duration energy storage offers much better value for customers than doubling investments in shorter duration storage systems, due to lower marginal costs.

In delaying the procurement of long-duration energy storage, the province risks procuring assets in the future with even higher costs (additional solar and wind required in the future due to their lower capacity factors or higher cost short-duration energy storage systems) to electricity ratepayers for the replacement of dispatchable capacity. Long-lead and long-life assets such as compressed air storage, pumped hydro and nuclear can help reduce the cost of clean energy resources but require advanced planning and development.

In the short term, investing in clean energy resources and long-duration energy storage technologies may lead to increased costs through additional procurements and planning for the electricity system and ratepayers. However, in the long run, these investments can contribute to lowering total energy costs for customers as a result of increased efficiency and reduced dependence on fossil fuels.

Other jurisdictions have already begun the procurement process for long-duration energy storage to meet expected system needs in the future. In Australia, New South Wales has targeted 2,000 MW of long-duration storage by 2030. In California, the California Public Utilities Commission has mandated 1,000 MW of long-duration storage be procured before 2030, allowing sufficient time for these long-lead resources to come online. These long-duration storage additions will be critical to maintain a reliable grid in light of retirements of older thermal resources and increasing electricity demand from customers.

4. **The IESO's Pathways Study highlights emerging investment needs in new electricity infrastructure due to increasing electricity demand over the outlook of the study. The IESO pathway assessment illustrates a system designed to meet projected demand peaks almost three times the size of today by 2050, at an estimated capital cost of $375 billion to $425 billion, in addition to the current system and committed procurements. Please see supporting materials for illustrative charts on capacity factor and cost by resource type.**

Are you concerned with potential cost impacts associated with the investments needed? Do you have any specific ideas on how to reduce costs of new clean electricity infrastructure?

Hydrostor recognizes the potential cost implications of investments required for new electricity infrastructure to address rising demand. However, we believe that implementing long-duration energy storage technologies can mitigate these costs by enhancing grid efficiency and reliability.

Incorporating long-duration storage into clean energy infrastructure can directly reduce costs by optimizing excess grid electricity usage and discharging when needed. With increased dependence of non-emitting power (69 GW projected by 2050), long-duration storage can balance supply and demand, improving grid efficiency. This reduces costs associated with intermittency, as it diminishes the need for additional backup generation or expensive grid reinforcements. Additionally, long-duration storage can provide ancillary services like frequency regulation and voltage support, contributing to grid stability and cost-effectiveness.

Hydrostor recommends adopting competitive procurement processes for non-emitting resources to lower clean energy infrastructure costs, as evidenced by successful long-term energy service agreements in New South Wales with strike prices below $50/MWh for wind and $35/MWh for solar.

We also advise procuring long-lead and large-scale infrastructure contingently to reduce future costs. System planners often focus on immediate needs, resulting in high-cost procurements. To ensure low-cost procurement of long-duration energy storage as non-emitting resources such as solar, wind, and nuclear deployment increases, proactive procurement is essential.

By integrating long-duration energy storage technologies and employing competitive procurement strategies, Ontario can minimize the cost impacts of new clean electricity infrastructure investments while ensuring a sustainable and reliable energy future.

Finally, Hydrostor notes that Ontario would not be alone in the process of making large investments in its electricity infrastructure. Many jurisdictions are already taking sizable steps today, including the United States through the Inflation Reduction Act and expansion of the Investment Tax Credit, the Net-Zero Industry Act in Europe, and mass procurements of renewables and storage in India and China.

5. **The IESO's Pathways Study recommends that for a zero-emissions grid by 2050, investment and innovation in hydrogen (or other low-carbon fuels) capacity could be required to replace the flexibility that natural gas currently provides the electricity system.**

   Do you have any comments or concerns regarding the development and adoption of hydrogen or other low-carbon fuels for use in electricity generation? What are your thoughts on balancing the need for investments in these emerging technologies and potential cost increases for electricity consumers?

Hydrostor recognizes that the Pathways to Decarbonization report incorporated 15 GW of blue imported Hydrogen to achieve net-zero without fully considering alternative technologies such as long-duration storage. While Hydrogen may have a role in Ontario's decarbonized energy mix, its application in the report may be overly optimistic in terms of cost and efficiency.

Considering that Hydrogen is not yet widely tested and commercially deployed, relying on this technology to achieve net-zero in system planning necessitates further diligence and analysis. The report assumed that Hydrogen would become cost-effective by 2036 and be imported from outside the province, while cost-effective technologies like long-duration energy storage are already available today.

The IESO should explore replacing some of the Hydrogen use cases with alternative technologies such as long-duration energy storage, nuclear, hydropower, and others. Conducting sensitivity analyses that include additional technologies will help better understand the true impact of using Hydrogen in the decarbonization process.

8. **The IESO's Pathways Study suggest that significant transmission capacity will be needed to help balance intermittent sources of electricity (e.g., wind and solar) and to ensure cost-effective supply can be delivered to meet growing demands from electrification and economic growth. Transmission will also be required to balance intermittent supply with dispatchable supply (such as natural gas and energy storage) and meet demand in regions with retiring assets.**

   What steps should be taken to ensure that transmission corridors can be preserved, and lines can be built as quickly and cost effectively as possible?

Hydrostor agrees that new transmission infrastructure will be needed to integrate renewable resources and accommodate increasing numbers of interconnections. In addition, to ensure timely and cost-effective transmission corridor preservation and line

construction, the Province of Ontario should also consider non-wires alternatives. Solutions such as energy storage can often address regional needs without deploying transmission lines, reducing environmental impacts and providing economic benefits.

Before proceeding with transmission line development, the province should conduct a full lifecycle cost analysis comparing non-wires alternatives to transmission deployment. This comprehensive evaluation will help identify the most efficient, sustainable, and cost-effective solutions for the region's energy infrastructure.

9. **Do you have any additional feedback on the IESO's "no-regret" recommendations?**

Hydrostor strongly recommends that the province follows up on the "no-regret" recommendations from the IESO's Pathways Study, and specifically that the province commence the process for procuring long-duration energy storage. Long-duration energy storage will reduce overall costs to ratepayers in the long-run and help streamline the decarbonization process.