ENERGY STORAGE CANADA

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ESC Response to IESO's Pathways to Decarbonization Report

BACKGROUND:

The Environmental Registry of Ontario (ERO) posting follows the release of the IESO Pathways to Decarbonization (P2D) study late last year. As anticipated, the Ministry of Energy is now seeking stakeholder input, specifically on the "No Regret" recommended actions contained in the report.

These recommended actions from the report include:

- The acceleration of current efforts to acquire new non-emitting supply, including the implementation of recent conservation and demand management directives.
- Beginning the planning and siting work for new nuclear, long-duration storage and waterpower facilities, as well as transmission infrastructure, to allow for faster implementation.
- Innovation and investment in low carbon fuels, such as clean hydrogen, as they are untested at scale. Further work and investment are needed to determine if they can replace some of the flexibility that natural gas currently provides the system.
- Galvanizing collaboration amongst stakeholders, including Indigenous communities.
- Ensuring that regulatory, approval and permitting processes are ready to manage future investment at scale.
- Establishing an open, transparent, and traceable process to measure progress and demonstrate the results of decisions and actions taken along the way.

INTRODUCTION

- The province is on the cusp of a massive period of energy transformation. We are already witnessing this in the conversion of steelmaking to electric arc furnaces, new large-scale manufacturing facilities coming to the province, and the electrification of transportation. This is stretching the ability of Ontario's system to provide energy, capacity, and ancillary services to keep pace with demand.

- Concurrently, aging assets such as nuclear facilities are reaching the end of life, which will compound the scarcity of resources. The need for new resources commences in the mid-2020s at an approx. 3-4 GW deficiency, going up to an approx. 16 GW deficiency by the end of the 2030s. To decarbonize our electricity system and keep pace with demand, the Independent Electricity System Operator ((IESO) has forecasted the need for approx. 69 GW of non-emitting power (at present Ontario has approx. 29 GW of non-emitting capacity).

- The provincial and federal governments are focused on decarbonization, not just for our electricity system, but of all energy production and use. This includes building heat, industrial processes, and transportation. As electrification will be a substantial means of decarbonization, this will drive our need for power ever further (electricity accounts for approx. 16% of all energy use in Ontario).

- Energy storage at various levels of duration, especially long duration, must be considered early in the planning and procurement process. Effective planning and procurement models that understand and account for projects with longer development timelines will help to improve or expand resource participation options and better enable alignment of resources to system needs.

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- ESC is supportive of streamlining regulatory, approval and permitting processes to site this level of new clean generation, storage, and transmission infrastructure as it will be important to enabling the growth and expansion of the system including the removal of distribution charges on distributed connected energy storage resources.

- Ontario's electricity system is built on thousands of kilometers of high voltage wires, much over 50 years old. Not only does Ontario need more power, but we need better power quality (reliability) to serve larger and more sensitive loads (advanced manufacturing, data centres, etc.). Storage needs to be a consideration to help improve the resiliency of the system.

- Energy storage technologies will be critical to knitting the system together and enabling the energy transition to be successful. ESC is supportive of Ontario's approach to prioritizing storage in the current Long-Term procurements. Storage should continue to be a focus for all future procurements as well – whether it's enabling hybridization of existing facilities, standalone storage, or long duration technologies.

- Planning is often heavily focused at the bulk system level. While new investments are needed at this level, including pairing storage with intermittent resources, much can be done in the form of DERs at the distribution level.

- Not only do we need new non-emitting electricity supply, but we need technologies, like energy storage, that will help to optimize electrification and ensure greater transmission-distribution interoperability. The consumer can also be greatly empowered, through DERs, transactive energy and two-way power flow.

- The bulk system and market operator (IESO), as well as LDCs, will need to be nimble to quickly enable and facilitate the ability for new and emerging technologies (i.e., hybrids, etc.) and participants (i.e., new DER models) to seamlessly integrate and provide services to the system.

- Further, there is a need for revenue certainty to unlock the value of behind the meter (BTM) storage. As with all other resource types, revenue certainty is a pre-requisite for building more BTM assets. This could be in the form of capacity contracts, a new program, etc. Current timelines for market integration are too slow and even then, they do not address the revenue certainty requirement that will get projects built.

ERO POSTING QUESTIONS

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?

   - Under Ontario's hybrid market design, new transmission-connected and directly-connected distribution energy storage projects will only be developed following IESO procurements or through rate-regulated supported development. As such, accelerated infrastructure buildout

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starts with flexible and robust procurement processes. Currently, the IESO has indicated they do not have the available staffing to complete more than a few procurement processes at one time and as such they are focused on purely global provincial capacity needs. This means that regional capacity needs, non-wires solutions and other cost-effective solutions cannot move forward. Perhaps most importantly, procurement processes do not mean that the province must execute proposed projects, but it provides an option to perform price discovery and determine what the most cost-effective solution is available. For this reason, ESC recommends that the IESO (and other utilities) increase their procurement activities to ensure all cost-effective solutions are being explored before committing to investments and development. As the first gate to any infrastructure buildout in the electricity sector, adequate and robust procurement processes are a necessity and critical to streamlining regulatory approval and permitting processes, including the removal of distribution charges on distribution-connected energy storage resources. For LDCs, the need for regulatory reform that would enable such innovation needs to be prioritized.

- There has been limited development of large energy storage facilities in Ontario. The province should establish a unique regulatory, permitting and approval process for storage including guidance for municipalities and other communities to ensure all entities are prepared for the investments in energy storage resources in the province.

- Further, thought should be given on how to harmonize federal and provincial regulations where possible and recognize efforts made by project proponents at other levels of government.

2. The IESO's Pathways Study recommends beginning planning and siting for new resources like 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?

- The IESO's Pathways Study clearly indicates the need for long-duration energy storage to meet Ontario's decarbonization needs. Early engagement by the province, system operator and developers are an opportunity to highlight the need for long duration energy storage and their benefits.
- As recognized in the IESO's P2D "no regrets recommendations" and the fact that the Federal ITCs are set to expire in 2033, steps need to be taken now on LDES technologies, so that they can be ready to be deployed in the next decade when the need is greatest.
- Due to the uncertainties surrounding the P2D forecasts related to 15 GW of imported Blue Hydrogen and the longevity of fossil fuel generation due to Federal Standards and ESG priorities, ESC recommends that the IESO:
    - Set an initial minimum target of 2GW of LDES by 2035; and
    - continue the unsolicited proposal process for those projects already underway; and
    - implement other commercial pathways for new proposed LDES projects.
- Other commercial pathways could include long-term contracts, rate regulation, RFPs, conditional or otherwise.
- Given the long lead times associated with LDES projects, steps need to be taken now to have these assets ready to be deployed when the need is greatest in the 2030's, otherwise IESO

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and government will scramble to "keep the lights on" and be forced to rely on more expensive, dirtier options, that still may not provide the necessary capacity.

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?

- ESC believes that leveraging the energy storage sector as a key resource in accelerating decarbonization efforts in Ontario is prudent and cost effective.
- Experience with renewable generation and other clean energy resources in other jurisdictions suggests additional investments in clean energy resources in the near-term is required to lower costs of electricity for the system and ratepayers. Further, investment in energy storage resources being made by the IESO now (i.e., 2,500 MW by 2030), will be able to optimize the additional renewable generation and nuclear generation in the Ontario system and lower energy costs for customers as demand growth is expected to accelerate. With federal government carbon pricing expected to increase to $170/tonne by 2030, alternative energy resources that can reduce the amount of energy from gas-fired generation will be critical to maintaining a cost-effective energy system.
- Over time, energy storage resources can offer balancing services as the cost-effectiveness of renewable generation decreases over time with more additions.
- There is significant value for Ontario from energy storage resources with different duration timeframes that support the conclusions of the IESO's Pathways Study.
- Finally, energy storage resources can and should be paired with existing and new resources to maximize value of established connection points to the Ontario transmission and distribution system. Currently, the IESO has no path or option for pairing energy storage with existing facilities and this creates a significant disadvantage for Ontario in meeting future energy needs and lowering energy costs for customers. A great example of this is pairing storage with nuclear power.
- Energy storage complements Ontario's existing and future nuclear assets due to its high-capacity factor, which was greater than 90% throughout the day, demonstrating the critical role that nuclear plays in providing stable, reliable electricity.
- Pairing clean baseload supply like nuclear power with flexible storage solutions can counteract a potential rise in emissions in Ontario while simultaneously maintaining the flexibility and reliability our electricity system needs.
- Combining long duration energy storage with baseload supply will mitigate the need for Ontario electricity customers to pay for peaking capacity and can flatten demand loads.
- Increasing energy storage capacity in Ontario's grid would allow the province to "soak up" surplus non-emitting baseload supply when demand for electricity is lower. The result is both environmental benefits in the form of lower GHG emissions and lower costs to electricity consumers.

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What are your expectations for the total cost of energy to customers (i.e., electricity and other fuels) because of electrification and fuel switching?

- With appropriate investment in a diversified supply mix (i.e., nuclear, hydroelectric, renewables, bioenergy) and energy storage resources, ESC firmly believes that total cost of energy to customers can be maintained, and even potentially reduced, during electrification and fuel switching. In the interim, gas-fired generation can be used to firm and balance the system as new energy storage and energy sources are developed to meet the requirements of a net-zero electricity system.
- As demonstrated in ESC's value of energy storage to Ontario paper (*Unlocking Potential: An Economic Valuation of Energy Storage in Ontario — Energy Storage Canada - the Voice and Network for the Energy Storage Industry in Canada*), there is strong potential for cost savings from investing in energy storage resources.

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 the costs of new clean electricity infrastructure?

   - Ontario's energy system should seek to balance affordability, reliability, and climate-resilience. Potential cost increases are a challenge for businesses, particularly those less shielded by price fluctuations, where there are impacts to competitiveness. However, concerns around affordability cannot preclude investments in the supply and transmission infrastructure needed to facilitate economic growth and ensure ratepayers can keep the lights on. Rather, costs should be managed through the planning process.
   - Energy storage resources offer benefits to the existing electricity system, particularly if sited throughout the power system to manage and reduce constraints. As mentioned in response to question 1, ESC firmly believes the IESO procurement process does not yet have the ability to fully explore and secure regional non-wires solutions and regional energy storage solutions. This forces Ontario to make ineffective investments and will lead to higher costs for customers.
   - Falling energy storage costs along with Federal ITCs will help to reduce the cost impact of storage and other non-emitting resources, but Ontario ratepayers would benefit further from increased alignment with provincial energy procurements and federal programs.
   - Finally, the establishment of hybrid facilities and co-locations with existing energy sites will maximize the benefit for customers.

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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?

   - A focus on hydrogen and other non-emitting fuels should not be at the cost of leveraging existing technology that is available today, like storage.
   - The IESO's Pathways Study makes a bold assumption that hydrogen production will occur out of province and the capability to import will be developed without any cost to Ontario. ESC believes that solutions developed in Ontario will be more cost-effective, particularly when considering these missing costs.
   - Therefore, as indicated above, Due to the uncertainties surrounding the P2D forecasts around 15 GW of imported Blue Hydrogen and the longevity of fossil fuel generation due to Federal Standards and ESG priorities, ESC recommends that the IESO:
     - Set an initial minimum target of 2GW of LDES by 2035; and
     - continue the unsolicited proposal process for those projects already underway; and
     - implement other commercial pathways for new proposed LDES projects.
   - Other commercial pathways could include long-term contracts, rate regulation, RFPs, conditional or otherwise.
   - Given the long lead times associated with LDES projects, steps need to be taken now to have these assets ready to be deployed when the need is greatest in the 2030's, otherwise IESO and government will scramble to "keep the lights on" and be forced to rely on costlier, dirtier options, that still may not provide the necessary capacity.

6. The IESO's Pathways Study recommends greater investment in new non-emitting supply, including energy efficiency programs.

   Following the end of the current 2021-2024 energy efficiency framework how could energy efficiency programs be enhanced to help meet electricity system needs and how should this programming be targeted to better address changing system needs as Ontario's demand forecast and electrification levels grow?

   - ESC believes that directly connected energy storage and behind the meter storage should be considered as an energy efficiency measure (ICI, new CDM framework, net-metering, etc.). Further, energy storage can increase the utilization of existing wires network, reducing losses and investment needs.
   - This is particularly important when considering the benefits of energy storage as a non-wires solution in regional and local planning.

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7. The IESO's Pathways Study includes a scenario for over 650 MW of new large hydroelectric capacity to meet system needs in 2050.

   A recently released assessment estimates that there may be potential to develop 3,000 to 4,000 megawatts of new hydroelectric generation capacity in northern Ontario and 1,000 megawatts in southern Ontario.

   What are your thoughts on the potential for development of new hydroelectric generation in Ontario by private-, Indigenous- and government-owned developers?

   While the capital costs for hydroelectric generation may be higher than nuclear, wind, solar, and natural gas, do you support investing in large scale hydroelectric assets that may operate for over a hundred years?

   - No comment but support the work by the Ontario WaterPower Association and WaterPower Canada.

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?

   - While transmission investments will be required, energy storage resources are an excellent, cost-effective and expediated resource to meet system needs and maximize existing transmission and supply mix capabilities.
   - Further, energy storage resources can minimize investment in large transmission by investing in non-wires alternatives (small scale storage or storage near load centres) – an underused resource in Ontario, compared to other jurisdictions that have well established DER market and regulatory structures.

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

- With the various parties involved in energy system planning, ESC would recommend steps be taken to optimize the level of coordination between various utilities, municipalities, and Indigenous communities in support of sites as they are being developed.
- Will the IESO be coordinating with the OEB on their Framework for Innovation Initiative to consider the role LDCs and distribution sector will play in the decarbonization pathways?
- We would like to clearly understand the total amount of long-duration storage the system can accommodate without an artificial cap based on the three pumped hydro projects currently in the unsolicited proposal pathway.
- One key thing missing from this report is information related to the nature of the load profile and resulting Effective Load Carrying Capacity (ELCC) of various resources. Essentially, given the

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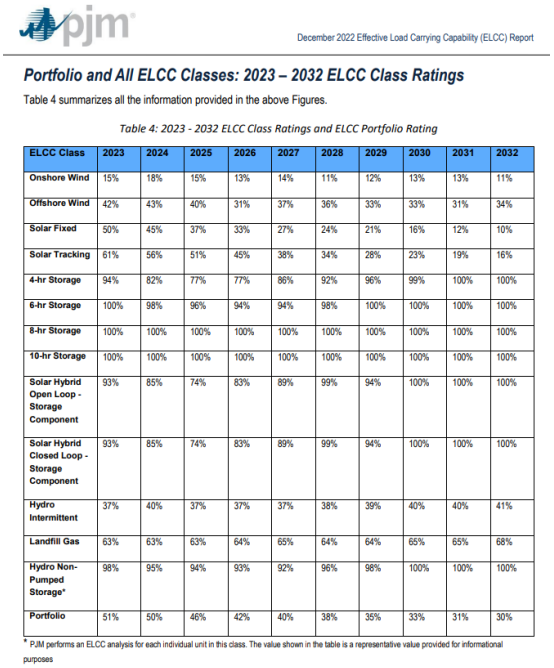
annual 8760 hourly load profile and the mix of capacity and energy resources on the system, what is the ability for each type of resource to contribute to the supply of peak capacity. As an example, PJM has started publishing this information on an annual basis and incorporates it into their capacity procurement processes:

https://www.pjm.com/-/media/committees-groups/committees/pc/2021/20210420-special/20210420-item-03b-how-effective-load-carrying-capability-works.ashx
https://www.pjm.com/-/media/planning/res-adeq/elcc/elcc-report-december-2022.ashx



December 2022 Effective Load Carrying Capability (ELCC) Report

Portfolio and All ELCC Classes: 2023 – 2032 ELCC Class Ratings

Table 4 summarizes all the information provided in the above Figures.

Table 4: 2023 - 2032 ELCC Class Ratings and ELCC Portfolio Rating

ELCC Class	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Onshore Wind	15%	18%	15%	13%	14%	11%	12%	13%	13%	11%
Offshore Wind	42%	43%	40%	31%	37%	36%	33%	33%	31%	34%
Solar Fixed	50%	45%	37%	33%	27%	24%	21%	16%	12%	10%
Solar Tracking	61%	56%	51%	45%	38%	34%	28%	23%	19%	16%
4-hr Storage	94%	82%	77%	77%	86%	92%	96%	99%	100%	100%
6-hr Storage	100%	98%	96%	94%	94%	98%	100%	100%	100%	100%
8-hr Storage	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
10-hr Storage	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Solar Hybrid Open Loop - Storage Component	93%	85%	74%	83%	89%	99%	94%	100%	100%	100%
Solar Hybrid Closed Loop - Storage Component	93%	85%	74%	83%	89%	99%	94%	100%	100%	100%
Hydro Intermittent	37%	40%	37%	37%	37%	38%	39%	40%	40%	41%
Landfill Gas	63%	63%	63%	64%	65%	64%	64%	65%	65%	68%
Hydro Non-Pumped Storage*	98%	95%	94%	93%	92%	96%	98%	100%	100%	100%
Portfolio	51%	50%	46%	42%	40%	38%	35%	33%	31%	30%

* PJM performs an ELCC analysis for each individual unit in this class. The value shown in the table is a representative value provided for informational purposes

- Considering implementing something like the table above would help to provide an increased understanding of the ability for storage of varying durations to contribute to meeting peak demand.
- In addition, energy storage should not be limited to 10–12-hour duration. There are other technologies available with longer durations, as a minimum, it would make sense to model 24- and 26-hour duration energy storage resources.
- Given the long-term nature of the report, outcomes can be very sensitive to model assumptions. ESC recommends giving particular consideration to:
  - Emission Performance Standard changes – initial report used 370 tonne CO2e/GWh however this standard has now changed to 310 tonnes C02e/GWH
  - ESC also recommends looking at an alternative scenario/sensitivity case of a linearly decreasing EPS to zero tonne CO2e/GWh by 2035
  - Adding the effect of ITC on initial build costs and clean energy credits as an additional revenue stream for renewables for the next generation of the report would be helpful. Again, sensitivities are helpful in these scenarios to measure effect of ITC.