Power Advisory LLC

Katherine Sparkes
Director – Innovation, Research & Development
Independent Electricity System Operator
1600-120 Adelaide Street West
Toronto, ON M5H 1T1

March 6, 2020

Dear Katherine,

On February 4, 2020, the Independent Electricity System Operator (IESO) released the *Energy Storage Design Project Draft Design Document for Stakeholder Comment* (the "Design Document") and was discussed during the IESO's Energy Storage Advisory Group (ESAG) February 18, 2020 meeting[1].

Power Advisory LLC has coordinated this submission on behalf of a consortium of renewable generators, energy storage providers, and industry associations (i.e., the "Consortium[2]") providing high-level comments on the Design Document.

General Comments and Support

Overall, the Consortium is supportive of the Design Document. This work represents a focused initiative continuing with needed integration of energy storage within the IESO-Administered Markets (IAM).

The Consortium is particularly pleased with IESO's acknowledgment and commitment to enable multiple energy storage technologies towards supply of energy, capacity, operating reserve, and multiple ancillary services within the IAM, along with direct participation of energy storage as IAM market participants and indirect participation of energy storage through demand response (DR) IAM market participants.

Evolving Energy Storage Participation within IAM

The Consortium has three main comments regarding subsequent phases of integrating energy storage within the IAM beyond the Energy Storage Design Project (the "Project") initiative.

First, it is not clear why the Project is not within the scope of IESO's Market Renewal Program (MRP). Considering that MRP represents fundamental reforms to the design and rules of the IAM, which will necessitate changes to IESO scheduling, dispatch, pricing, and settlements systems and tools, efficiencies and clarity to integrate energy storage within the IAM seem to be appropriately placed within the scope

[1] See http://www.ieso.ca/en/Sector-Participants/Engagement-Initiatives/Engagements/Energy-Storage-Advisory-Group

[2] The members of the Consortium are: Axium Infrastructure; BluEarth Renewables; Boralex; Brookfield; Canadian Wind Energy Association; Capstone Infrastructure; Cordelio Power; EDF Renewables; EDP Renewables; Enbridge; ENGIE; H2O Power; Innergex; Kruger Energy; Liberty Power; Longyuan; NextEra Energy Canada; Pattern Energy; wpd Canada; and, Canadian Solar Industries Association.

of MRP. Therefore, the Consortium recommends that IESO re-consider this and include energy storage integration, including the Project, within the scope of MRP.

However, assuming that decisions have been finalized and the Project will not be included within the scope of MRP, the Consortium recommends that IESO clearly define subsequent stages of the Project through commitments to integrate energy storage within the systems and tools that enable the scheduling, dispatch, pricing, and settlements within the IAM. This point is supported by work undertaken by the U.S. Federal Energy Regulatory Commission (FERC) through their Order 841[3]. Order 841 mandates the U.S. wholesale markets under FERC's jurisdiction[4] to file proposed changes to their respective market designs and rules toward fulsomely integrating energy storage within these markets. Therefore, IESO should follow similar changes that have been proposed, and subsequently endorsed by FERC, by the applicable Independent System Operators (ISOs)/Regional Transmission Operators (RTOs) towards fulsomely integrating energy storage within the IAM.

Second, while it is initially understood why the scope of the Project only addresses energy storage that is eligible to by registered market participants within the IAM, the Consortium recommends that IESO address in subsequent phases direct and indirect participation of non-market participant energy storage within the IAM. For example, these energy storage facilities could be embedded within distribution systems and/or 'behind-the-meter' (BTM) of customers that may or may not be registered market participants within the IAM. Considering the growing number of energy storage facilities that are BTM resulting from, for example, Industrial Conservation Initiative (ICI) incentives to avoid Global Adjustment (GA) charges, these energy storage facilities represent opportunities towards providing multiple solutions to meet broader Ontario power system needs (e.g., operability and flexibility, supply of ancillary services, etc.).

Third, building on the second point above, the Consortium recommends that IESO address in subsequent phases integration of 'hybrid' energy storage projects that can be co-located within wind and solar generators and other resources (e.g., DR, etc.). Hybrid projects are rapidly being developed and are proving to be superior to alternative supply sources, due to cost effectiveness and desired supply attributes (e.g., fast ramp up/down, non-emitting, etc.)[5]. Considering the significant amount of wind and

[3] See https://www.ferc.gov/whats-new/comm-meet/2018/021518/E-1.pdf

[4] ISOs/RTOs within FERC's jurisdiction that have filed proposed changes to their market design and rules to integrate energy storage within their respective wholesale electricity markets are California ISO (CAISO), Southwest PowerPool (SPP), Midcontinent ISO (MISO), PJM, New York ISO (NYISO), and ISO-New England (ISO-NE).

[5] In 2019, Arizona Public Service competitively contracted for energy storage to be co-located with operating solar generation beating out 'peaking' gas-fired generation mainly due to lower costs (see https://www.enr.com/articles/46550-batteries-edge-out-natural-gas-peaking-plants-in-arizona-rfp). Energy Storage News article in 2019, *Solar-plus-storage is 'chasing gas off the grid'*, sites study showing hybrid energy storage and solar generation more cost effective in California relatively to gas-fired generation (see https://www.energy-storage.news/news/solar-and-storage-plants-chasing-down-gas-generators). In June 2019, the Los Angeles Department of Water and Power announced contract for hybrid energy storage (800 MWh) and solar generation (400 MW) at 3.3¢/kWh ($US), resulting from a competitive solicitation (see https://www.utilitydive.com/news/los-angeles-solicits-record-solar-storage-deal-at-199713-cents-kwh/558018/?mc_cid=a32e3f1286&mc_eid=b75749fb3f).

solar generation operating in Ontario today, these facilities have significant potential to be 'paired' with energy storage in the future. Such hybrid projects also project to be very cost-effective, in part because of utilization of existing assets, rapidly declining costs of energy storage, and can specifically supply IESO identified power system needs (e.g., operability, flexibility, etc.). Appendix A provides more information on declining costs of energy storage and hybrid projects.

Other ISOs/RTOs are recognizing the potential of hybrid projects. In 2019, the California ISO (CAISO) launched a Hybrid Resources stakeholder consultation[6] by issuing a Hybrid Resources Initiative Paper. After receiving submissions from stakeholders, CAISO is presently working with stakeholders to finalize a Straw Proposal towards a late Q3/early Q4 2020 submission to their Board of Governors. In January 2020, the New York ISO (NYISO) launched a Hybrid Storage Model stakeholder consultation[7]. The objective of this consultation is to explore and propose a participation model to integrate: i) renewable generation co-located with small energy storage; ii) renewable generation co-located with large energy storage; iii) thermal generation co-located with energy storage; and, v) renewable and thermal generation paired with energy storage via bilateral contracts. NYISO is presently working with stakeholders to develop a participation model with plans to finalize it for a stakeholder vote later in 2020.

Appendix B lists some of the announced hybrid projects in the U.S. that have mainly resulted from executed contracts between utilities and project developers.

The Consortium will be happy to discuss the contents of this submission with you at a mutually convenient time.

Sincerely,

Jason Chee-Aloy
Managing Director
Power Advisory LLC

cc:
Terry Young (IESO)

[6] See http://www.caiso.com/StakeholderProcesses/Hybrid-Resources

[7] See https://www.nyiso.com/documents/20142/10252714/Hybrid%20Storage%20Model_MIWG_Jan%2013%202019.pdf/caf29abe-a431-a2d1-358d-43326153824a

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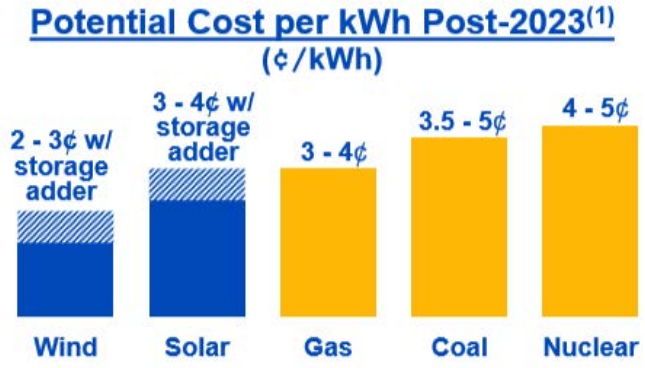
Appendix A – Declining Costs of Energy Storage and Hybrid Projects

Regarding declining energy storage costs in the U.S., Lazard reports "… significant cost declines across most use cases … Observed cost declines have been most pronounced for Lithium-ion technologies over the past year … Cost declines were more pronounced for storage modules than for balance of system components or O&M …"[8].

Regarding hybrid energy storage and solar generation in the U.S., Lazard reports "Project economics analyzed for solar PV + storage systems are attractive for short-duration wholesale and commercial use cases … Combining energy storage with solar PV can create value through shared infrastructure (e.g., inverters, interconnection) and reducing the need to curtail production by delaying the dispatch of electricity onto the grid … Energy storage is increasingly being sold with commercial and residential solar PV systems to provide customers with reliability benefits and demand charge mitigation … Wholesale solar PV + storage projects can offer attractive returns when combining multiple revenue streams, while commercial and residential solar PV + storage use cases rely on avoiding high retail energy or demand charges"[9].

NextEra Energy forecasts hybrid energy storage and wind generation, and hybrid energy and solar generation, to be amongst the most cost-effective supply resources in the future (see Figure below)[10]. For some regions in the U.S., hybrid energy storage and wind generation are forecast to be the most cost effective of all supply resources (2¢/kWh to 3¢/kWh ($US)) in the post-2023 timeframe.



[8] See p. 10 of Lazard's *Levelized Cost of Storage Analysis – Version 5.0*, located at https://www.lazard.com/media/451087/lazards-levelized-cost-of-storage-version-50-vf.pdf

[9] See p. 10 of Lazard's *Levelized Cost of Storage Analysis – Version 5.0*, located at https://www.lazard.com/media/451087/lazards-levelized-cost-of-storage-version-50-vf.pdf

[10] See http://www.investor.nexteraenergy.com/~/media/Files/N/NEE-IR/news-and-events/events-and-presentations/2019/morgan-stanley-presentation-vfinal.pdf, (1) represents potential projected cost per kWh ($US) for new build wind, solar, and gas-fired generation, excluding Production Tax Credit (PTC) and Investment Tax Credit (ITC), projected per kWh operating cost ($US) including fuel for existing nuclear and coal-fired generation, based on NextEra Energy internal estimates

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Appendix B – List of Select Announced U.S. Hybrid Projects

- Arizona Public Service and First Solar – solar (50 MW) and storage (135 MWh)
- Portland General Electric and NextEra Energy – wind (300 MW) and solar (50 MW) and storage (30 MW)
- Kauai Island Electric Cooperative and AES – solar (28 MW) and storage (100 MWh)
- Kauai Island Electric Cooperative and SolarCity – solar (13 MW) and storage (52 MWh)
- Tucson Electric Power and NextEra Energy – solar (100 MW) and storage (30 MW)
- Dong Energy and ORSTED – solar (420 MW) and storage (40 MW)
- Nevada Energy and EDF Renewables – solar (200 MW) and storage (75 MW)
- Nevada Energy and 8Minute Solar – solar (300 MW) and storage (135 MW)
- Nevada Energy and Quinbrook Infrastructure/Arevia Power – solar (690 MW) and storage (380 MW)
- 21 utility members/other customers of Western Farmers Electric Cooperative and NextEra Energy – wind (250 MW) and solar (200MW) and storage (800 MWh)
- Helios Energy and GE – solar (3 MW) and storage (12 MWh), and solar (2 MW) and storage (8 MWh)
- Capital Dynamics and 8Minute Solar – solar (400 MW) and storage (300 MW)
- Los Angeles Department of Water and Power and 8Minute Solar – solar (200 MW) and storage (150 MW), and solar (200 MW) and storage (150 MW)
- EBCE and EDPR Renewables – solar (100 MW) and storage (30 MW)
- Florida Power & Light Babcock Ranch – solar (74.5 MW) and storage (10 MW)
- Florida Power & Light Manatee Energy Storage Center – solar (409 MW) and storage (900 MWh)
- Nevada Power and Crescent Dune Solar – solar (110 MW) and storage (110 MW)
- Kauai Island Electric Cooperative and AES – solar (14 MW) and storage (14 MW)
- Hawaiian Electric and AES – solar (30 MW) and storage (30 MW)
- Maui Electric and AES – solar (60 MW) and storage (60 MW)