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February 13, 2018

Transmitted electronically to: dispatchablerenewables@aeso.ca

RE: AESO Dispatchable Renewables & Electricity Storage Initiative Stakeholder Questionnaire

In addition to our submission via the online template, please find enclosed CanSIA's responses to the following questions in the Alberta Electric System Operator (AESO) Dispatchable Renewables & Electricity Storage Initiative stakeholder questionnaire:

- Type of dispatchable renewable or electricity storage project(s) you are building, have built, and/or operate, including size and location (Q3)
- Your interest in future development of dispatchable renewables or electricity storage projects in Alberta and why (Q4)
- The role for dispatchable renewable resources and electricity storage in Alberta (Q5)
- The need for dispatchable resources, particularly renewable based, and/or electricity storage within Alberta, now and in the future as Alberta transitions to 30% renewables by 2030 (Q6)
- Other dispatchable resources (technologies) to consider, now and in the future (Q7)
- Other jurisdictions to learn from (Q8)
- The barriers that exist today to developing more dispatchable renewables and/or storage (including, but not limited to: financing, construction, technology, permitting and approvals - including environmental, legislative or regulatory framework, etc (Q9)
- The pros and cons of dispatchable renewables and/or electricity storage in Alberta (Q10)
- Please provide any other general comments and/or feedback you feel would be helpful to the AESO with respect to dispatchable renewables and storage (Q11)

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3. Type of dispatchable renewable or electricity storage project(s) you are building, have built, and/or operate, including size and location

CanSIA understands Dispatchable Renewables to be renewable electricity generation facilities with the ability to shut down, start up, raise or lower generation, or curtail generation. No generation facility has the ability to be available at 100% of its nameplate capacity for 100% of the time. For this reason, CanSIA recommends that the AESO base its definition of Dispatchable Renewables on the ability for it to respond to requests from the system operator to shut down, start up, raise or lower generation, or curtail generation to a large degree of total nameplate capacity at given times but not require that the facility must be able to do so at all time.

As such, examples of Dispatchable Renewables would include large-hydro, biomass and geothermal and variable renewable energy (i.e. solar or wind) combined with energy storage and/or flexible loads (i.e. "demand-response"). A solar facility that can reduce, increase or shift a large portion of its load for several hours should be considered to be Dispatchable Renewables. Furthermore, since 2013, wind power in Alberta is dispatched in the energy-only market without the use of energy storage or demand response.

Energy storage can be integrated into all scales of solar facility. Integration with flexible loads is more typical for behind-the-meter applications (although aggregating multiple flexible loads proximal to the generator can be equivalent in function).

CanSIA understands that our Members are not currently integrating energy storage into their facilities greater than 5 MW currently under development in Alberta primarily because the structure of the Renewable Electricity Program does not consider the power pool price capture of facilities and as such it would be a competitive disadvantage to do so. However, the inclusion of energy storage at a later stage of development of these projects could be easily accommodated if there were reason to do so.

CanSIA understands that our Members are currently exploring the potential of integrating energy storage and/or flexible loads with their solar facilities less than 5 MW in applications including demand charge management for industrial consumers, uninterrupted power supplies for commercial consumers and micro-grids for communities and campuses.

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4. Your interest in future development of dispatchable renewables or electricity storage projects in Alberta and why

Achieving Alberta's legislated target of 30% of electricity production from renewable energy resources in 2030 will significantly reduce greenhouse gas emissions and contribute toward Canada's target of 90% non-emitting electricity. However, CanSIA believes that there are countless reasons why Alberta should and will exceed that target in that time-frame and that the combination of storage with solar facilities will play in role in enabling that to be the case.

For generators, the addition of storage to solar facilities could increase their revenues captured from the energy market (subject to changes in the policy and regulatory framework including moving away from the Indexed-REC and/or changes in compensation under Micro-Generation for example) and from the capacity market (by increasing the UCAP and reducing the risk of penalty) and ancillary services markets and/or could decrease an electricity consumers electricity delivery charges or enable them to optimise their energy costs through arbitrage.

For consumers, it is expected that by the mid-2020's on-site solar-plus-storage generation and/or load flexibility will be a less expensive supply option for many consumers in Alberta than the consumption of grid electricity. For some today, this is expected to be the case much sooner. Furthermore, a scenario where natural gas provides 70% of electricity supply presents significant risks for consumers associated with over-reliance on a single fuel source for the province. Dispatchable Renewables presents an opportunity to diversify the energy supply and hedge risk for all consumers.

5. The role for dispatchable renewable resources and electricity storage in Alberta

The role of Electricity Storage and Demand Response will increase in importance as the penetration of variable generation in the system increases from low to high and above Alberta's 30% by 2030 legislated target. The co-location of energy storage and demand response with solar facilities can be considered to include: variable generator capacity firming; variable generator ramping service; variable generator smoothing; curtailment mitigation; time shifting/arbitrage; peaking capacity; VAR support; frequency

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regulation and response (regulating reserve); spinning reserves; non-spinning reserves (supplementary reserves); transmission and distribution asset deferral; peak shaving; uninterruptible Power Supply; and power quality.

6. The need for dispatchable resources, particularly renewable based, and/or electricity storage within Alberta, now and in the future as Alberta transitions to 30% renewables by 2030.

The advancement of Dispatchable Renewables and Energy Storage in the pre-2030 time-frame can address system reliability concerns while avoiding lock-in to high emissions post-2030.

The AESO modelling completed for the Capacity Market design has shown that Energy Storage is not essential for managing grid stability pre-2030. However, energy storage can provide many of the same services as thermal generation and may do so more economically and efficiently in this time-frame. Furthermore, the co-location of storage with solar can provide the same benefits at lower cost than locating solar and energy storage separately.

Canada has a national emissions target of 30% below 2005 levels by 2030. Alberta's 30% renewable electricity target by 2030 will make a significant contribution to that target. However, Canada also has a national emissions target of 80% below 2005 levels by 2050 with which Alberta must align. If there is a significant build-out of new natural gas-fired facilities in Alberta pre-2030, this would lock-in Alberta to significant greenhouse gas emissions in the electricity sector for decades ahead or which would run the risk of becoming stranded before being fully depreciated. Alberta needs to begin to create the conditions for investment in Dispatchable Renewables as soon as possible to ensure that investment in the electricity sector is consistent with our long-term emissions reductions goals and that cost-effective opportunities to advance Dispatchable Renewables are not lost.

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7. Other dispatchable resources (technologies) to consider, now and in the future.

CanSIA recommends that AESO consider dispatchable technologies including: customer-sited and utility-scale solar-plus-storage; operated independently or in combination with flexible loads (including electric vehicles); and as a single facility or aggregated as a portfolio (i.e. a "virtual power plant").

8. Other jurisdictions to learn from.

As of 2016, the USA electro-chemical and electro-mechanical technologies projects have been deployed mostly in the Pennsylvania-New Jersey-Maryland (PJM) ISO, (240 MW), followed by Electric Reliability Council of Texas (ERCOT) (50 MW). PJM ISO installations are mostly third-party ownership models, with few utility-owned installations. Customer-owned installations are more plentiful than utility-owned. However, the rated power size of the storage is smaller per installation.

Canadian installations are small by comparison, and much of the energy storage is pump hydro storage in Ontario. Most of the electrochemical and electromechanical energy storage is also deployed in Ontario.

Ireland and Hawaii provide models for the AESO to study given their islanded grid nature and high integration ambitions for renewable penetration.

Other jurisdictions for review include: South Australia partnership with Tesla; California: (see: www.caiso.com/Documents/UsingRenewablesToOperateLow-CarbonGrid.pdf); New England; Ontario; Texas; and New York: (see: Smartcharge for EVs). Recent coverage of interest includes: as alternatives to gas peakers in California, Colorado and Minnesota (see: "Gas Under Threat? California Regulators Target PG&E Natural Gas Plants With Energy Storage" https://www.greentechmedia.com/articles/read/natural-gas-under-threat-california-pge-gas-plants-energy-storage#gs.d9gRYuA and "Xcel Energy has hopes for wind and solar projects with battery storage" http://www.startribune.com/xcel-energy-has-hopes-for-wind-and-solar-projects-with-battery-storage/470207143/) and in Arizona to extend the duration of solar generation for a number of hours to cover evening peak loads (see: "APS teams with First Solar on plant with battery storage" http://tucson.com/business/aps-teams-with-first-solar-on-plant-with-battery-storage/article_b92842ef-

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a63e-5dea-b182-e1e75fc6dbfa.html); as virtual power plants (see: "Tesla Australian Virtual Power Plant Cheaper Than U.S. PV https://about.bnef.com/blog/tesla-australian-virtual-power-plant-cheaper-u-s-pv/ and "Alectra study identifies residential solar storage potential" http://www.marketwired.com/press-release/alectra-study-identifies-residential-solar-storage-potential-2210272.htm) and for individual electricity customers (see: "Alectra Energy Solutions and AMP to develop energy storage solutions for their Ontario customers" http://www.marketwired.com/press-release/alectra-energy-solutions-amp-develop-energy-storage-solutions-their-ontario-customers-2226609.htm and "Solar energy project exceeds expectations in Summerside" http://www.cbc.ca/news/canada/prince-edward-island/pei-summerside-solar-energy-1.4407066).

9. The barriers that exist today to developing more dispatchable renewables and/or storage (including, but not limited to: financing, construction, technology, permitting and approvals - including environmental, legislative or regulatory framework, etc.

Technical, economic, commercial, operational, GHG quantification and regulatory barriers were identified for energy storage in Alberta:

a) Technical barriers are technology specific and include examples such as geographic requirements for Compressed Air Energy Storage (CAES) and pumped hydro, cycle life, high operating temperature for some batteries, experience with design life estimation, runtime and round-trip efficiencies.

b) Economic barriers are significant in the current market design with low prices and low price volatility, and high capital costs. AESO tariff determination for energy storage is a significant barrier for energy storage economics. Revenue opportunities are limited due to the participation rules in the operating reserves market.

c) Commercial barriers include lack of long-term contracting capabilities in the current market design and a lack of sufficient experience in operations of energy storage in Alberta for lenders to be comfortable. There are few data sources for historical energy storage costs for CAES and few installations and little public data on energy storage costs.

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d) Operational barriers include the size requirements for the operating reserve market which eliminates some technology types. Some have been lowered since the adoption of AESO Rule 502.13 for battery connections and AESO 502.14 for battery operations. Alberta has limited energy storage knowledge, skills and training. AESO dispatch requirements are unclear and may require switching between generator and load for dispatch.

e) GHG Quantification barriers are extensive since there are no protocols that address project-specific offsets for energy storage. Quantification methodology needs to be developed for energy storage projects on a stand-alone basis.

f) Policy and regulatory barriers include a legislative gap and a lack of market rules for how energy storage participates in energy or operating reserves markets. The new tariff is not attractive for energy storage. Storage is not currently considered in planning the transmission system. Currently, none of Alberta's electricity or energy acts reference energy storage and the provincial regulatory rules for permitting energy storage are unclear or not contemplated.

The existing AESO rules were written for a generation system dominated by thermal generation. Modifications to rules have been undertaken to allow participation of energy storage, however, the solutions, including the currently proposed tariff, do not facilitate wide-scale deployment of energy storage. The treatment of facilities that have storage and solar on the same site is not fully considered. CanSIA recommends a wholesale review of tariff, operating requirements and market rules (energy, ancillary services and capacity) with a view to facilitating Dispatchable Renewables at large scale. It is not the role of AESO tariff and rules to encourage one technology over another, but rather to provide a level playing field for all technologies, and the current rules are not balanced in their consideration of Dispatchable Renewable facilities compared to thermal generation.

10. The pros and cons of dispatchable renewables and/or electricity storage in Alberta

The development of Dispatchable Renewables will facilitate the move to higher renewable penetration levels. Many will cite the current costs of storage as a problem; however, fair market structures that recognize the

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full value of solar-plus-storage and/or demand response will allow developers to identify the economic market opportunities and develop non-emitting electricity generation facilities. With increasing penetration of variable renewable electricity generation comes the risk of increased curtailment. By storing electricity that would otherwise be curtailed, energy storage facilities can recover RECs or carbon offsets that would otherwise be lost.

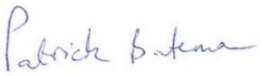
11. Please provide any other general comments and/or feedback you feel would be helpful to the AESO with respect to dispatchable renewables and storage.

The Renewable Electricity Program (REP) does not consider a facility's power pool price capture. As a result, the ability of a facility to capture higher energy market revenues is not recognized. As such, despite the many benefits and potential cost-effectiveness – there is no advantage in the REP for a develop to include storage with their facility. CanSIA recommends that the AESO consult with industry on the use of the "Benchmark-REC" for future REP rounds so that a facility can be rewarded for having a high power pool price capture.

Also, rules in the Capacity Market need to consider the value provided by dispatchable renewables and energy storage.

Thank you for your consideration.

Sincerely yours,



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