June 10, 2020

Jessica Savage
Director

Independent Electricity System Operator
1600-120 Adelaide Street West
Toronto ON M5H 1T1

via email: engagement@ieso.ca

RE: Storage Design Project Feedback – Long-term Design

Dear Ms. Savage,

This submission is in response to the IESO's request for feedback following the webinar held on May 20, 2020. We thank you for the opportunity to provide feedback and advice on the IESO's Storage Design Project.

Effective July 1, 2020, the members of CanWEA and CanSIA, will merge to become the Canadian Renewable Energy Association under the leadership of Robert Hornung, with a new mandate representing companies active in the wind energy, solar energy and energy storage industries in Canada.

Our vision for the Canadian Renewable Energy Association is a central role for wind energy, solar energy and energy storage in the transformation of Canada's energy mix. Making our vision a reality will require advocacy, stakeholder engagement and collaboration. This new Association is the right tool for our diverse members who are uniquely positioned to deliver clean, low-cost, reliable, flexible and scalable solutions for Canada's energy needs and as such we are well positioned to put forward this submission to the IESO to inform the Storage Design Project.

We recognize the importance of the Storage Design Project (SDP) and the effort that has been made by the IESO and other stakeholders to-date to enable greater participation for energy storage within the IESO-Administered Market (IAM). The focus of the webinar on May 20, 2020 was on the long-term vision for energy storage participation and integration into the IAM. We continue to recommend that the IESO explore options that can be undertaken in parallel with the IESO's advancement of the Market Renewal Program. We assert that the IESO needs to consider the implementability of the long-term design as well as how the storage design may affect near-term opportunities of energy storage, such as non-wires alternatives and hybrid energy systems (i.e., solar and/or wind plus energy storage).

While the IESO has objected to the inclusion of hybrid energy systems within the scope of the SDP, we note that other Canadian markets are incorporating the potential for hybrid energy systems within their framework. Specifically, the Alberta Electricity System Operator's (AESO's) short-term market implementation requirements for energy storage participation[1] sets out a clear participation model for hybrid energy systems. For the purpose of dispatch in the electricity markets, the AESO is proposing that a pool participant with a hybrid facility may choose to either aggregate the technologies on site under a single pool asset or keep the technologies as separate assets.

[1] https://www.aeso.ca/assets/Uploads/Overview-of-Short-term-Market-Implementation-Requirements-for-Energy-Storage-Participation-FINAL.pdf

The AESO has recognized the near-term potential for hybrid energy systems within the market as has been evidenced by recent market activity. For example, the Alberta Utilities Commission recently approved the Drumheller Solar & Battery Storage Project acknowledging that the project is in the public interest providing social, economic, and environmental benefits[2].
Additionally, we recently completed a discussion paper to reflect on the benefits of co-locating energy storage with variable renewable energy. While the discussion paper focuses on the broad, system-wide benefits of hybrid energy systems, it is attached to this submission for the IESO's further consideration.

Going forward, we recommend that the IESO dedicate more time for broader discussion with stakeholders to review options and present analysis. While the IESO has presented a significant amount of information during recent webinars, little time has been allocated for input from participants. Nor has the IESO taken the time to provide detailed responses to written feedback that has been received. As the IESO moves forward to finalize detailed design proposals it is imperative that feedback from the sector is incorporated into the IESO's plans to ensure support for future Market Rule amendments that may be required to integrate energy storage.

We thank you for this opportunity to provide comments, and we look forward to next steps in the discussion.

Sincerely,

Robert Hornung
President
Canadian Wind Energy Association
and
Incoming President and CEO
Canadian Renewable Energy Association

Wesley Johnston
President and CEO
Canadian Solar Industries Association

Incl. Discussion Paper: Hybrid Energy Systems: Reviewing the Case for the Co-location of Renewables and Energy Storage
Feedback form: esag-20200520-feedback-form-CanWEA_CanSIA FINAL.docx

[2] https://www.energy-storage.news/news/alberta-utilities-commission-approves-solar-plus-storage-project-as-in-the

Energy Storage Design Project – Feedback Form

May 20, 2020

Date Submitted: 2020/06/10	**Feedback Provided By:** Company Name: CanWEA and CanSIA joint submission Contact Name: Brandy Giannetta, Regional Director Ontario Contact Email: [redacted]

Following the May 20, 2020 Energy Storage Advisory Group (ESAG) meeting to discuss the Energy Storage Design Project, the IESO is seeking feedback from participants on whether the design proposals captured within the presentation offer pragmatic solutions for the participation of energy storage in the IESO Administered Markets in the long-term. The IESO will work to consider feedback and incorporate comments as appropriate and post responses on the engagement webpage.

The referenced presentation and design document can be found under the May 20, 2020 entry on the ESAG webpage.

Please provide feedback by June 10, 2020 to engagement@ieso.ca. Please use subject: *Feedback: Energy Storage Design Project*. To promote transparency, this feedback will be posted on the ESAG webpage unless otherwise requested by the sender.

Thank you for your time.

Topic	Feedback
State-of-Charge (SOC) Management: The IESO has proposed an SoC Management Lite approach that will provide the the same market access as a generator and account for the practical operating realities of a storage facility	**On April 4, 2020, CanSIA (on behalf of NEXUS members) submitted feedback to indicate preference for the Self-SoC Management approach recognizing that ESRs may provide services to multiple entities (i.e., wholesale market, grid operations, customers) and therefore optimizing SoC should be left to ESR owners/operators since they have best visibility into the daily and lifetime objectives of the ESR asset.** **We note that other parties have indicated support for Self-SoC Management and have also provided rationale for optionality of SoC Management approaches recognizing that ESRs of different sizes, connection configurations (Dx vs. Tx) or use-cases may be best served by different approaches to SoC Management. While the IESO responded to the "themes" of the recommendations from parties at a high-level, the IESO did not acknowledge the nuances of submissions from parties.** **We have concerns with the SoC-Lite approach recommended by the IESO. Before finalizing the approach for SoC management in the long-term design, we recommend that the IESO provide additional analysis, that includes:** **1) High-level cost/benefits analysis between Self-SoC Management and SoC-Lite (i.e., investment in IESO tools and relative benefits obtained through greater IESO management/control of SoC)** **2) Risk assessment of Self-SoC management (i.e., magnitude of risk associated with infeasible schedules, alternative approaches to managing infeasible schedules should the arise, etc.)** **3) Risk assessment of SoC-Lite (i.e., greater IESO intervention in market, etc.)**

Topic	Feedback
	4) Implementability of both SoC-Lite management and Self-SoC management approaches (i.e., to what extent could each approach be developed in parallel to the MRP) **5) Feasibility assessment of providing optionality to ESRs (e.g., ability to select either Self-SoC or SoC-Lite depending on preferences/use-case)** **6) Worked examples of ESR use-cases under both SoC-Lite and Self-SoC management approaches (e.g., distribution-connected ESR providing services to LDC and offering excess capability to IESO-administered markets).** **Overall, we assert that additional analysis is required before finalizing the approach for SoC management.** **Although the IESO has to-date resisted including hybrid energy systems (e.g., solar and/or wind plus energy storage), we recommend that the IESO evaluate the implications of the SoC management approaches for hybrid energy systems, especially as long-term design proposals are under consideration. Wind and solar are already participating in the IESO-Administered Market and the IESO has indicated a desire for more flexibility from all resources; therefore, it is logical that operators of existing renewable energy facilities would consider adding energy storage or that new renewables would be built with energy storage.** **Further, given the timelines for the long-term design (i.e., post 2023 when MRP is completed), the IESO should anticipate the start of renewable projects coming off contract and should seek options to maximize the value of these assets, as they are well positioned to continue to operate at optimal capacity post contract expiry.**

Topic	Feedback
	As indicated in our cover letter, the AESO is moving forward with consideration for hybrid energy systems in parallel with discussions about integration of stand-alone storage in recognition of the benefits of hybrid systems. It is an appropriate consideration at this time.
Market and Facility Registration: Storage facilities may either register as a dispatchable facility or, if less than 10 MW, a self-scheduling facility Storage facilities will be modelled as a single resource with the capability to inject, store and withdraw energy	**As stated in CanSIA's submission on March 3, 2020, we believe that no self-scheduling should be allowed for ESRs with an installed capacity greater than 1 MW. The IESO has indicated that future consultation is required with a broader stakeholder group to reconsider self-scheduling options due to potential implications with other resource types, however it is unclear what other resources would be impacted by this decision. The IESO could simply require that any Energy Storage Facility be dispatchable above 1 MW and this decision would not impact other market participants.** **It is disconcerting that the IESO is presenting this as an area for further stakeholder consideration without engaging with a more substantive discussion with the ESAG as long-term design proposals are being considered.** **Following the implementation of MRP, wholesale consumers will have the option to become Price Responsive Loads (PRLs) and will participate in the Day-Ahead Market (DAM) but will continue as non-dispatchable in real-time. We request that the IESO provide a review for the potential treatment of ESR loads as PRLs, especially during the period post-MRP implementation and prior to the adoption of long-term design.**

Topic	Feedback
Offer Curve: Energy storage offer curves will be continuous over the charging and discharging range	**We have no concerns at this time with the approach recommended by the IESO.**
Price Setting: Dispatchable electricity storage resources should be able to set the market clearing prices for energy and operating reserve	**We have no concerns at this time with the approach recommended by the IESO.**
Regulation Service: Similar to generators, storage resources will be enabled to provide multiple services including regulation, energy and operating reserve	**We support this outcome.**

General Comments/Feedback:

Please see cover letter for additional context and considerations.

Hybrid Energy Systems

Reviewing the Case for the Co-location of Renewables and Energy Storage

Discussion Paper

March 2020

CanSIA

CANADIAN SOLAR INDUSTRIES ASSOCIATION | L'ASSOCIATION DES INDUSTRIES SOLAIRES DU CANADA

Hybrid Energy Systems

Reviewing the Case for the Co-location of Renewables and Energy Storage

This paper provides an examination of the merits of co-locating energy storage with Variable Renewable Energy (VRE) versus developing stand-alone energy storage facilities. This paper further discusses the benefits of co-location and the current status of hybrid energy systems in the Alberta and Ontario electricity markets, as well as summarizes the barriers and ongoing market and regulatory developments occurring in Ontario and Alberta.

CanSIA developed this paper in consultation with members of Nexus - a strategic project founded by CanSIA and operating in collaboration with the Canadian Wind Energy Association (CanWEA) that focuses on customer adoption of energy management technologies and enabling broader uptake of renewable energy.

The Canadian Solar Industries Association (CanSIA)

240 Bank Street, Suite 400,
Ottawa, ON - K2P1X4
www.cansia.ca

Prepared by

Power Advisory LLC

dunsky

CanSIA
CANADIAN SOLAR INDUSTRIES ASSOCIATION | L'ASSOCIATION DES INDUSTRIES SOLAIRES DU CANADA

Executive Summary

Over the past decade, the cost of installing and operating VRE resources has fallen dramatically leading to growth in VRE resources connected and delivering electricity to the grid. As a result, the needs of the power system are evolving as the supply mix changes. **Co-location of energy storage with VRE resources (aka "hybrid energy systems" or "hybrid projects") offers many benefits to the power system, including greater flexibility, direct cost savings, and reduced ecological footprint.**

There are regulatory and market activities underway in both Alberta and Ontario that will create opportunities for the co-location of energy storage and VRE facilities. A majority of stakeholders and market participants agree that the regulatory framework must evolve to meet the challenges of the future. **Enabling co-location of energy storage and VRE facilities can be an important part of the solutions needed to address electricity system needs**.

Barriers that must be addressed include:

- Lack of a definition of energy storage resources or hybrid projects in the regulatory frameworks;
- Lack of unique participation models in wholesale electricity market design to allow hybrid projects to offer their full capabilities into the market;
- Restrictions that limit the ability of hybrid projects to offer multiple services from a single facility; and
- Unequal treatment with respect to transmission & distribution rates and limited inclusion of hybrid projects in system planning and regulated utilities.

Updating regulatory frameworks to capture the benefits of hybrid projects is important to meeting future system needs related to cost effectiveness, clean energy, and reliable electricity service.

Content

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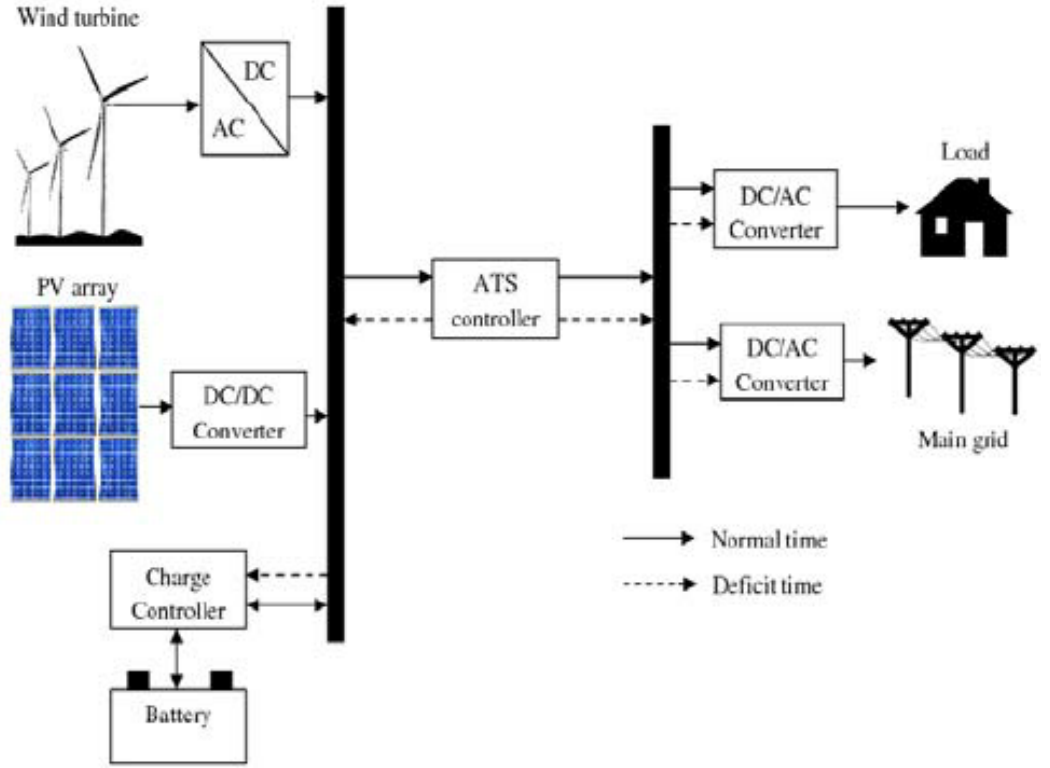
1. Introduction
Background

The regulatory frameworks in both Alberta and Ontario are evolving in recognition of the changing nature of the electricity system. The Alberta Electricity System Operator (AESO) and Independent Electricity System Operator (IESO) have both launched undertakings to review their wholesale market design to appropriately integrate energy storage resources.

The activities by the AESO and IESO follow a broader theme underway in the United States. Following the Federal Energy Regulatory Commission (FERC) Order 841, Regional Transmission Operators (RTOs) and Independent System Operators (ISOs) are overhauling their market designs to allow energy storage resources to participate in a fair and equal manner.

Enabling the co-location of energy storage with VRE sites is an important component of the market design changes being considered and their participation in meeting future electricity system needs.

Hybrid Energy Systems

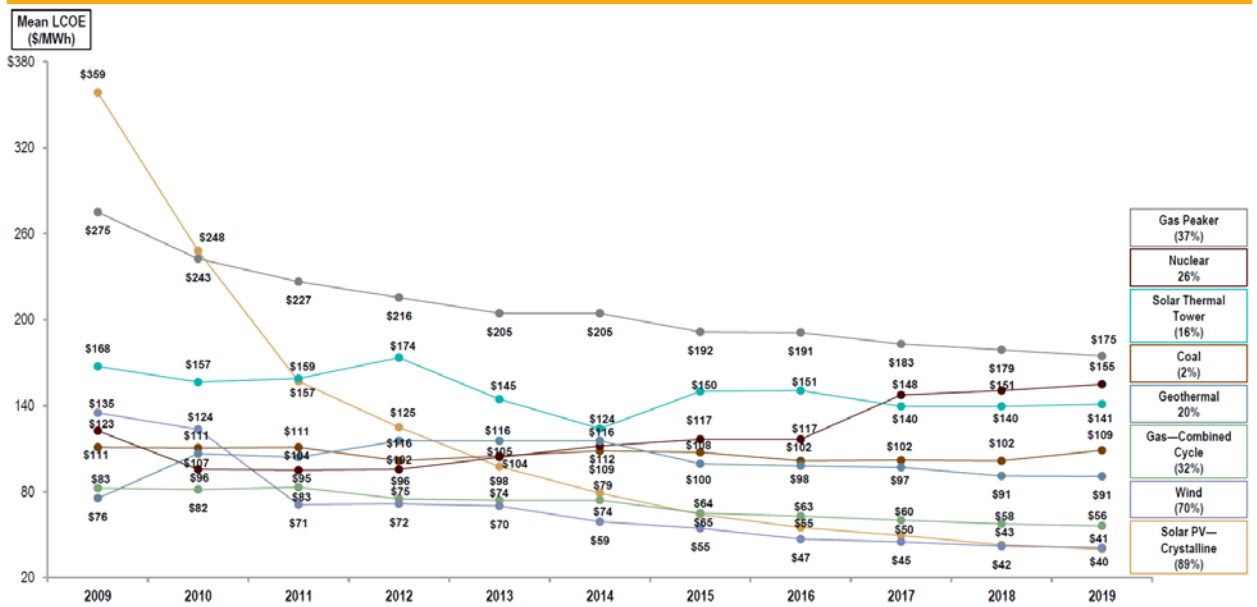


Source: https://www.researchgate.net/figure/PV-Wind-Battery-Hybrid-System-Configuration_fig1_260124765

Reasons for Interest in Hybrid Energy Systems

The electricity sector is undergoing a significant period of change due to innovative and emerging technologies and evolving customer preferences. In part due to these changes, there are several reasons why interest in co-locating energy storage with VRE resources is growing.

Lazard's Levelized Cost of Energy Estimates by Fuel Source



1. **The cost of VRE resources has fallen dramatically over the past decade.** According to investment experts Lazard, the levelized cost of energy (LCOE) for solar generation has fallen by ~90% and wind generation has fallen by 70% from 2009 to 2019. VRE resources in many jurisdictions are now the lowest cost new supply option.

2. **Co-location of energy storage at VRE sites can reduce the volatility of production and assist in maintaining reliability standards.** Given there is broad consensus across Canada (and globally) that electricity systems should be reliable, cost-effective and clean, maintaining reliability standards with a supply mix composed of large amounts of VRE resources is becoming an important focus in electricity market design.

3. **The demand-side of the electricity sector is rapidly changing as well.** Electricity customers are being offered new products and services through distributed energy resources (DERs) to manage their costs and meet their needs (e.g., smart appliances, rooftop solar PV, fuel switching in space heating and transportation). The adoption of DERs is changing the load shape leading to greater uncertainty for the system operators. Hybrid energy systems can provide system operators with a reliable and flexible resource to meet the challenges of growing variation in consumption patterns.

Source: Lazard's Levelized Cost of Energy Analysis, Version 13.0, slide 7. https://www.lazard.com/media/451086/lazards-levelized-cost-of-energy-version-130-vf.pdf

Benefits of Hybrid Energy Systems

The co-location of VRE and energy storage brings several unique benefits and opportunities to grid.

Greater Flexibility

- Co-location of VRE and energy storage provides greater flexibility in service offerings. For example, solar and wind generation can offer low-cost, emission-free and consistent energy production over a long operating life, and energy storage can offer multiple electricity services to wholesale markets, grid operators, and/or directly to customers. This means the resources could work together to offer a combined product (e.g., firm capacity by shifting energy production to peak demand hours), or separately to meet multiple system needs (e.g., real-time energy production from solar and wind generation while offering operating reserve from the energy storage resource).

Ecological Footprint

- Co-location of VRE and energy storage reduces land acquisition requirements and therefore reduces the ecological footprint. This can lead to simpler applications for permitting and greater likelihood of community approval.

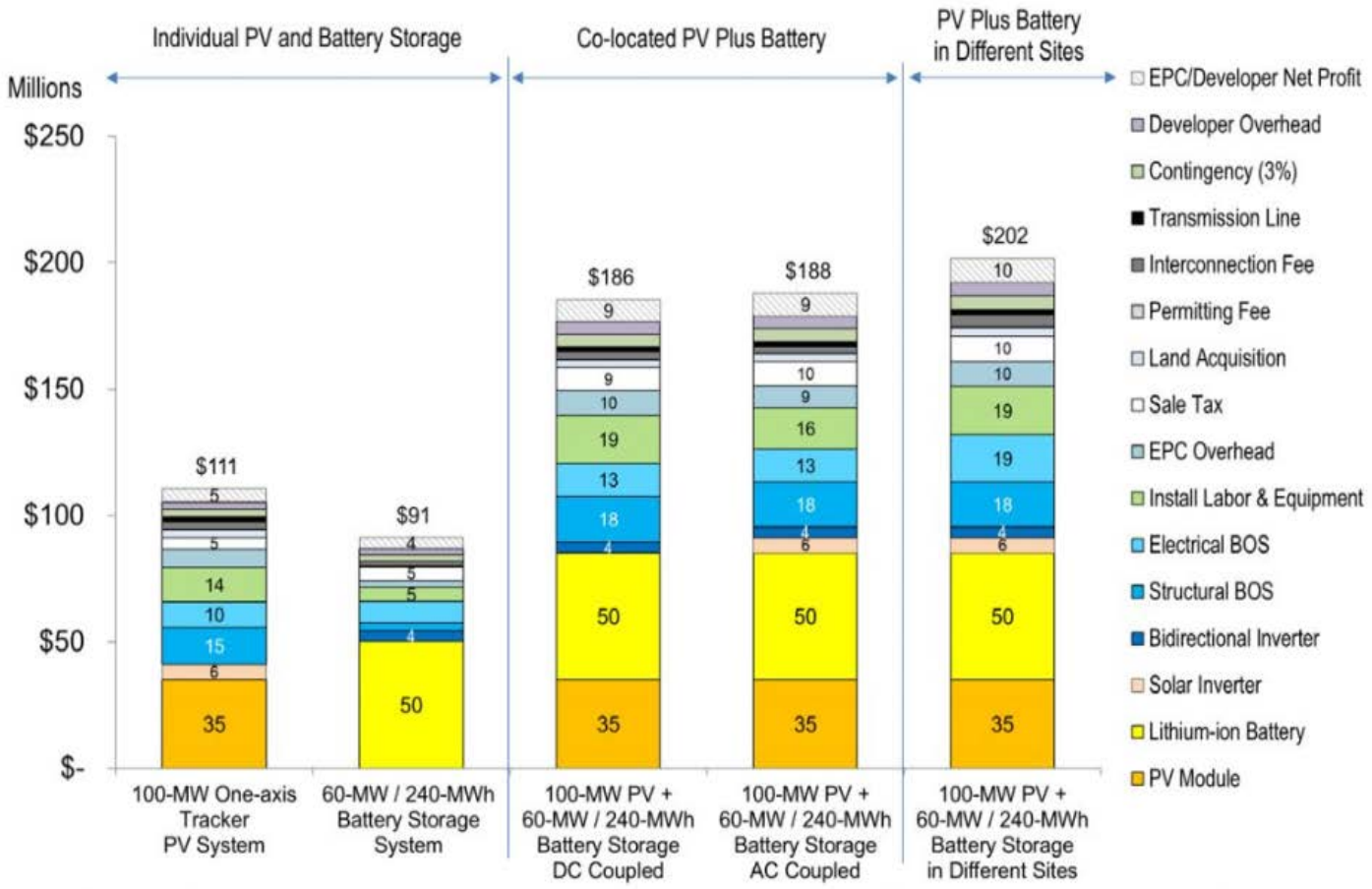
Direct Cost Savings

- Co-location of VRE and energy storage can offer direct cost savings in the development of the project compared to stand-alone facilities by sharing the burden of site acquisition, development, permitting and connection approval through a single site. The design and installation costs of the site equipment can also lead to cost savings through shared hardware (e.g., switchgears, transformers, interconnection facilities. etc.), operation and control functions. The National Renewable Energy Laboratory (NREL) estimates that co-location can reduce system costs by ~8% for DC-coupled solar+storage facilities compared to solar generation and energy storage developed on separate sites *(as further illustrated on the next slide)*.*

*Note, there are no recent studies for wind-storage hybrid energy systems, however it is anticipated that there would be similar direct cost savings

Benefits of Hybrid Energy Systems

2018 Cost Benchmarks for PV-plus-storage systems (4-hour duration) in different sites and same sites (DC & AC coupled cases)

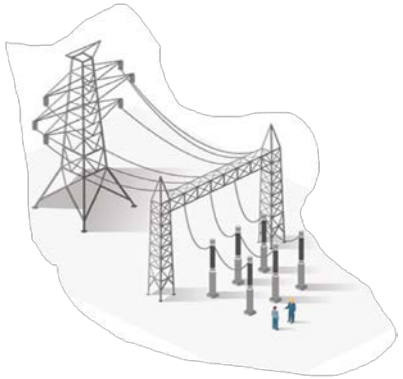


As demonstrated by NREL, the costs to develop solar PV and battery sites at different locations is greater than developing solar+storage hybrid energy systems at a single location. While there are no recent reports on wind+storage hybrid energy systems, it is logical that similar cost efficiencies would be realized through reduced costs related to:

- site preparation,
- land acquisition,
- permitting,
- interconnection,
- installation labor,
- hardware (i.e., sharing of hardware such as switchgears, transformers, and controls), and
- overhead.

Source: https: 2018 U.S. Utility-Scale Photovoltaics-Plus-Energy Storage System Costs Benchmark, page v. https://www.nrel.gov/docs/fy19osti/71714.pdf

Benefits of Hybrid Energy Systems



Customer	Grid Operators	Wholesale
• Hedge against future energy price volatility • Reduce demand charges • Environmental objectives • Time-of-use bill management • Power quality correction • Back-up power	• Distribution investment deferral • Transmission investment deferral • Outage management support • Load restoration • Transmission congestion relief • Power quality support	• Real-time energy • Resource adequacy • Supply mix emissions reductions • Ramping • Regulation services • Voltage support • Reactive power • Black start • Operating reserve (i.e., spinning & non-spinning)

Regulatory and Market Barriers for Hybrid Energy Systems

The wide-scale deployment of hybrid energy systems in both Alberta and Ontario faces several barriers.

Definition of Energy Storage

- **Currently there does not exist a definition of energy storage resources or hybrid projects across the regulatory framework.** Without a definition, there is confusion and limited transparency about the treatment, responsibilities, and obligations to these resource types. This leads to ad-hoc treatment by distribution facility owners and transmission facilities owners during the interconnection processes and participation in the wholesale electricity markets.

Participation Model

- **There is no defined participation model for hybrid projects in the wholesale electricity markets**. Instead, hybrid projects would have to register and participate under existing participation models (e.g., register and participate as a solar generation resource) which limits the capabilities and attributes that the hybrid project can offer the market. For example, there is no ability for a hybrid project to submit an energy offer and energy bid for the same location. This means the hybrid project is limited in its ability to respond to market signals and maximize their value. For example, the AESO does not accept negative quantity offers from generation facilities. A negative quantity would allow a hybrid project to offer withdrawal of electricity during periods of oversupply.

Regulatory and Market Barriers for Hybrid Energy Systems

Multiple Services

- **In addition to no defined participation model, hybrid projects would not be able to offer multiple services from a single connection point**. For example, a hybrid project cannot offer real-time energy production and regulation service in Ontario from the same location; the services must come from different facilities. The inability to offer multiple services severely restricts the capability of hybrid projects to offer their full suite of services to the electricity market.

Transmission and Distribution Costs

- **From a distribution and transmission tariff design perspective, the cost allocation of transmission and distribution costs to hybrid projects may not be fair and equitable**. Most rate designs allocate cost to large consumers based on that customer's peak demand during a given month (i.e., non-coincident peak). For hybrid projects that may withdraw energy during off-peak hours when the power system is not constrained, the cost allocation does not fairly reflect the fact the facility is not burdening the system. Instead, an interruptible service tariff design or shifting some costs to power system coincident peak is more appropriate.

Regulatory and Market Barriers for Hybrid Energy Systems

Regulatory and Planning

- **There are barriers for hybrid projects to offer services to distribution and transmission system owners** to meet power system needs in the power network. Issues include cost recovery for the regulated utility for non-wires alternatives (NWAs) investments or service agreements with customers and determining which entity (i.e., regulated utility, third party provider, or customer) must be responsible for merchant risk exposure in seeking value stacking opportunities (e.g., sale of additional services to the wholesale electricity market). Further, the planning process must be evolved so that NWAs options can be assessed appropriately compared to traditional wires investments. A key first step is for power system planners to augment system planning processes to include engagement with stakeholders after identifying system needs but before recommending solutions. This will provide an opportunity for alternative solutions (e.g., services from hybrid projects) to be proposed and assessed.

Status in Canadian Electricity Markets

The development of hybrid projects in Alberta and Ontario is still in early stages. Most applications have focused on off-grid systems for remote connections (e.g., cottages, remote communities, etc.). There is a slow but growing number of residential applications where rooftop solar generation is paired with a home energy storage resource (e.g., Telsa Powerwall)

In Alberta, there are a number of solar+storage projects under development including the Drumheller solar and battery storage project supported by Emissions Reduction Alberta (ERA). The project is expected to be 16.5 MWdc solar generation facility combined with a 8MW/8MWh battery storage system. There are currently no wind+storage hybrid projects in either market.

In both jurisdictions, there are market and regulatory undertakings underway that will impact the future potential for hybrid

Alberta Utilities Commission (AUC)	Alberta Electricity System Operator (AESO)	Ontario Energy Board (OEB)	Independent Electricity System Operator (IESO)
Distribution System Inquiry	• Maintain energy-only market • Emissions Reduction Alberta funding for storage projects • Energy Storage Roadmap • Dispatchable Renewables and Energy Storage Review	• Joint policy consultations on Utility Remuneration and Responding to DERs • DER Connections Review	• Market Renewal Program • Innovation Roadmap and White Paper Series • Energy Storage Advisory Group (ESAG)

Source: https://www.eralberta.ca/projects/details/drumheller-solar-and-battery-storage-project/

Removing Regulatory and Market Barriers – AUC

The AUC launched a Distribution System Inquiry (DSI) to examine the evolving nature of electric generation, consumption, storage, and the power system to understand the implications on the grid, incumbent utilities, consumers, grid managers, and the overall regulatory framework.

- The first phase of the DSI focused on how innovative and emerging technologies could impact distribution system design, operation, capital requirements and cost of providing service.
- The second phase focuses on the interplay between the emerging technological changes identified in the first phase and the social, economic, legislative and regulatory framework governing existing distribution utilities.

The DSI will examine the ability of current rate design to send price signals that ensure cost effective investment in distribution systems and to avoid, or at least minimize, uneconomic bypass of regulated activities. Overall, the AUC DSI is a broad and comprehensive assessment of the potential evolution of the distribution system and could provide significant opportunities for the co-location of energy storage resources and VRE resources.

- For example, changes to the Alberta regulatory structure through the AUC DSI could allow hybrid projects to offer services to regulated entities while also participating in the AESO's wholesale electricity market.

Removing Regulatory and Market Barriers – AESO

Following their election victory in June 2019, the United Conservative Party announced a 90-day review of Alberta's electricity market system, specifically whether a capacity market should be adopted or if Alberta should stay with the existing energy-only market design. In July 2019, the government announced that Alberta would retain the energy-only market design based on overwhelming preference among stakeholders.

Subsequent to the announcement, the Government issued a letter to the AESO directing it to examine if any changes to the existing energy-only market are needed, including but not limited to:

1. Price floor/ceilings,
2. Shortage pricing, and
3. Market power and market power mitigation.

The maintenance and potential evolution of Alberta's energy-only market design has the potential to benefit hybrid energy systems. Flexibility and a wide range of service offerings means that hybrid projects should be able to quickly adjust to meeting emerging system needs. For example, hybrid projects can offer energy during supply shortages in peak demand seasons and ancillary services during shoulder seasons all while delivering low cost energy to the system from the renewable generation resources.

Removing Regulatory and Market Barriers – AESO

The AESO published its Energy Storage Roadmap which was developed in response to the AESO's 2018 Dispatchable Renewables and Energy Storage report. From the AESO's perspective, there are three motivators for change:

1. **Level playing field**: Lack of clarity for energy storage resources (i.e., AESO Authoritative Documents do not comprehend the unique attributes of energy storage resources, thus acting as barriers to connection and participation)
2. **Value and benefits**: energy storage resources can optimize variable renewable generation; energy storage resources can reduce Transmission & Distribution costs; and energy storage resources could reduce the cost of frequency regulation
3. **Other jurisdictions**: Maintain best practices with respect to design changes in other jurisdictions, such as those responding to FERC Order 841, which aims to remove barriers to the participation of energy storage in wholesale electricity markets

In Alberta, Emissions Reduction Alberta (ERA) announced funding for seven energy storage projects in March 2019 and the AESO has received connection requests for 4 projects with planned in-Service dates of 2020-21.

More information on the Energy Storage Roadmap: https://www.aeso.ca/market/current-market-initiatives/energy-storage/
More information on FERC Order 841: https://www.eralberta.ca/projects/details/drumheller-solar-and-battery-storage-project/

Removing Regulatory and Market Barriers – AESO

Based on the AESO's Energy Storage Roadmap, the AESO clearly sees multiple benefits of energy storage resources and recognizes the existing barriers to their participation in Alberta's electricity markets. More importantly, the AESO recognizes that energy storage integration will require changes to the broader regulatory framework for electricity in Alberta (i.e. legislation, regulation, AESO Authoritative Documents) and has identified itself as the primary facilitator for required changes (i.e., the AESO is owning the broader process at this time).

- Short-term implementation is driven by the connection requests and industrial system designations (ISD) of the 7 ERA energy storage resource projects
- Long-term implementation will address broader energy storage barriers and integration issues for energy storage resources including changes outside of the AESO's direct responsibilities (e.g., legislative changes if recommended)

The timeline and commitment of the AESO is encouraging for hybrid project development in Alberta. The AESO is targeting to have short-term implementation measures completed, as well as refinement of the roadmap for long-term implementation within 2020. It is therefore reasonable to assume that the development of hybrid projects in Alberta could begin immediately and provide significant benefits to market participants and the Alberta electricity system.

Removing Regulatory and Market Barriers – OEB

The OEB is undertaking a series of consultations that will change the regulatory framework and open opportunities for hybrid projects.

Specifically the Utility Remuneration and Responding to DERs consultations aim to promote good outcomes and protect the consumers in the context of an evolving energy sector.

- The results of the consultation will likely lead to changes in the OEB's guidelines and codes that will create or expand opportunities for hybrid projects. Potential changes will encourage electric utilities (i.e., Local Distribution Companies (LDCs), transmitters) to explore NWAs, which could create a process for hybrid projects to offer services directly to utilities.

In addition, the OEB is undertaking a review of DER connection processes.

- The purpose of the review is to "identify any barriers to the connection of DERs, and where appropriate to standardize and improve the connection process. The review will be focused on connection of electricity generation and storage facilities connected to the distribution system, either in front or behind the distributor's meter.". For hybrid projects, the connection review should help lower barriers and provide better access to the electricity system to offer services.

More information on the OEB's consultation on Utility Remuneration and Responding to DERs:
https://www.oeb.ca/industry/policy-initiatives-and-consultations/responding-distributed-energy-resources-ders

Removing Regulatory and Market Barriers – IESO

Ontario's IESO is undertaking an ambitious market design overhaul to update and evolve the wholesale electricity market through the Market Renewal Program (MRP)

- The IESO's MRP will implement locational marginal pricing for supply resources, a day-ahead market and unit commitment enhancements. The changes are expected to provide greater transparency and increased efficiency in the wholesale market for scheduling, dispatch, pricing and settlement. The market design changes should create or expand opportunities for hybrid projects by capturing their benefit of flexible service offerings.

At the same time, the IESO has a launched an innovation and sector evolution white paper series following the publication of their Innovation Roadmap

- The white paper series is "intended to support the creation of a shared, fact-based understanding of emerging economic, technical, environmental, and social issues, opportunities and trends with the potential for significant future impact on Ontario's electricity system and broader electricity sector and in particular on electricity market efficiency, affordability and reliability."
- To that end, the IESO published four papers in 2019 and intends to publish two more in 2020 and 2021, respectively. The paper topics include NWAs markets, DER expanded participation in wholesale markets, and consumer preferences. The many benefits of hybrid projects are an important input into the white paper series and an influence in the potential market design changes that are expected to follow.

More information on the IESO's MRP: http://www.ieso.ca/en/Market-Renewal
More information on the Innovation and Sector Evolution White Paper Series: http://www.ieso.ca/en/Sector-Participants/Engagement-Initiatives/Engagements/Innovation-and-Sector-Evolution-White-Paper-Series

Removing Regulatory and Market Barriers – IESO

In addition, the IESO has launched an energy storage design project to address barriers in the wholesale electricity market design. The design project is derived from the IESO's "Removing Obstacles for Storage Resources in Ontario" report based on activities and feedback from the Energy Storage Advisory Group (ESAG). The objective is to establish an enduring participation model for energy storage resources in Ontario's electricity market and will be enacted over three stages:

1. An interim framework to clarify the current extent of energy storage participation that is enabled (including participation in the upcoming capacity auction)
2. Changes to allow for the provision of regulation service, energy and operating reserve (this depends on the software and tools upgrade being undertaken in parallel and is targeted for completion in Q1 2022)
3. Establishment of an enduring participation model to enable more efficient scheduling (this too is dependent on the upgrade of the Dispatch Scheduling and Optimization (DSO) tool and settlement systems)

More information on the energy storage design project: http://www.ieso.ca/Sector-Participants/Engagement-Initiatives/Engagements/Energy-Storage-Advisory-Group

Principles to Support Hybrid Energy Systems

Regulatory frameworks in other jurisdictions are evolving to address the challenges of the future electricity system. Ensuring a fair and level playing field for the co-location of energy storage resources at VRE sites is an important component to meeting the objectives of the power system (i.e., safe, reliable, cost effective and clean).

To that end, the following principles are key to supporting the development and optimization of hybrid projects:

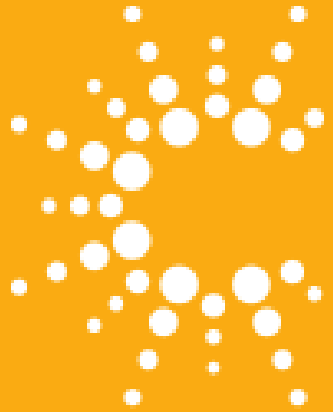
1. Establish a market participation model for hybrid projects that allows them to offer their full attributes and characteristics into the electricity market.
2. Ensure that multiple electricity services can be offered from a single facility so that hybrid projects can maximize the value of their flexibility for the benefit of the power system.
3. Augment power system planning processes to appropriately assess the viability, cost and scalability of hybrid energy systems compared to other traditional options in meeting power system needs.
4. Amend or adjust the regulatory framework and permitting process to support the development of hybrid projects. Further, encourage where practical the installation of energy storage resources at existing VRE sites.

Concluding Remarks

As VRE resources become the lowest cost new supply in many jurisdictions, as well as the preferred choice for customers to meet some or all of their energy needs, the characteristics of the electricity grid will change. Co-location of VRE resources with energy storage can offer greater flexibility to meet evolving electricity system requirements with direct cost savings and a smaller ecological footprint.

Regulators and system operators in Alberta and Ontario have begun to explore market design and regulatory framework changes that would enable energy storage to better participate. However, there are several areas that must be addressed to enable hybrid projects as well.

To maximize the benefits of hybrid projects, the barriers identified should be addressed by ensuring appropriate definitions for energy storage, addressing the participation model, enabling multiple services, addressing transmission and distribution costs, and improved planning.



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