Ontario Energy Storage System Interconnection Modernization

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1. Executive Summary

Energy Storage Solutions (ESS) are a rapidly emerging technology that offers electricity consumers a cost-effective and flexible energy management option. ESS deployed as a load displacement resource can give customers control of their consumption profiles to reduce electricity costs along with meeting their electricity service needs.

The regulatory framework for the connection of ESS in Ontario restricts the deployment of load displacement ESS for electricity consumers in the province, specifically due to:

- Unpredictable treatment by Local Distribution Companies (LDCs);
- Lack of definition of energy storage resources or their treatment by LDCs in the Distribution System Code (DSC);
- Inconsistent application of the load displacement exclusion from the DSC; and
- Contradictions with the Conservation First Framework.

Based on Stem's robust experience in advanced energy storage for commercial and industrial facilities, ESS can offer significant advantages to Ontario electricity consumers. To unlock the full value of energy storage, Stem has the following recommendations for Ontario's regulatory framework with respect to connections to the grid:

1. Define a separate LDC responsibility for the treatment of energy storage in the DSC;
2. Require consistent treatment of load displacement resources across Ontario;
3. Establish an expediated connection process for load displacement resources;
4. Require LDCs to develop resources to aid siting of distributed energy resources in their service territory; and
5. Clarify connection cost responsibility for customer load reduction activities.

The recommendations will allow Ontario's electricity consumers to lower their electricity costs and serve their evolving energy needs to meet the challenges of the future.

2. Background

Over the past decade, the cost of ESS has fallen dramatically, with close to an 80% reduction of lithium-ion battery prices since 2010. It is estimated that almost 700 megawatt-hours of ESS has been deployed in the US in 2018 and the global ESS market could add almost 8 GWh in 2019. In the US, the energy storage market could more than double to $973 million in 2019 compared to an estimated $474 million in 2018 thanks in large part to government policy, regulation and electricity market design changes[1].

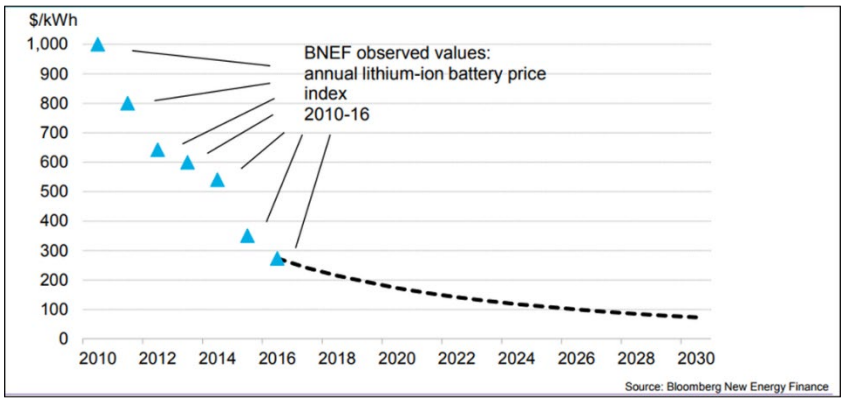


Figure 1: Annual Lithium-Ion Battery Price Index -Source: Bloomberg New Energy Finance (BNEF)

ESS offers a wide range of desirable characteristics to consumers including emergency back-up supply and power quality improvement. ESS deployed as load displacement resources (i.e., used to shift a customer's consumption from the electricity grid; also known as non-export embedded resources) can give electricity consumers unique capabilities to mitigate their electricity costs. In short, the emergence of cost-effective ESS has the potential to offer significant value for electricity consumers in Ontario.

3. Connection Issues for ESS

The ability of load displacement ESS to offer electricity cost mitigation among other benefits to large electricity consumers is hampered by the existing regulatory framework in Ontario. Specifically, connection issues unique to the Ontario electricity sector are restricting the ability of ESS to offer the full range of benefits from load displacement for consumers. The regulatory framework in Ontario includes legislation, regulation, codes (e.g., DSC), and rules that govern the electricity sector in Ontario including LDCs and the

[1] https://www.greentechmedia.com/articles/read/four-trends-to-watch-in-the-energy-transformation-of-2019?utm_medium=email&utm_source=GridEdge&utm_campaign=GTMGridEdge#gs.we5pN1Mr and https://www.greentechmedia.com/articles/read/five-predictions-for-the-global-energy-storage-market-in-2019#gs.XZs9jFoz for more information. See the U.S. *Energy Storage Monitor* report by Wood Mackenzie and the Energy Storage Association - https://www.woodmac.com/research/products/power-and-renewables/us-energy-storage-monitor/

regulator, i.e. the Ontario Energy Board (OEB). The following sub-sections list priority connection issues that are hindering the deployment of load displacement ESS for the benefit of customers.

3.1. Unpredictable treatment by LDCs

In Ontario, there are over sixty (60) LDCs with vastly different service territories and customer composition. Some service territories cover large rural areas with a couple thousand residential and small commercial customers. Other service territories are dense urban areas with well over 100,000 customers composed of industrial, large commercial and residential customers. The large number of LDCs has led to an uneven application of codes and rules for the treatment of ESS requesting connection to Ontario's distribution networks. For example, some system conditions can trigger costly protection & control (P&C) schemes (e.g., transfer trip) that halt or delay ESS projects in one LDC service territory, while similar system conditions do not trigger any costly system investments in another service territory. The unpredictable requirement for transfer trip is often the most significant cost burden and regulatory hurdle for ESS projects. Without consistent standards, it is difficult for ESS projects to avoid constrained areas of the distribution system or work with customers to deliver the energy services those customers desire. Further, the coordination between the connection LDCs (i.e., the LDC who owns the service territory where the ESS is proposing to connect to) and the upstream distributor or transmitter (e.g., the entity that owns the upstream substation) has not been transparent and has been at times contradictory. Responsibility for communication and coordination of connection activities between the two connection authorities in some instances has not been transparent, further delaying connection of load displacement ESS.

3.2. No definition of treatment for energy storage

The OEB's DSC defines the responsibilities for LDCs to load customers and to generators requesting connection to the distribution system; however, the code has no unique treatment for energy storage systems (ESS). As such, energy storage systems are pigeon-holed into processes that were designed for resources they are not well suited for. The unique characteristics and capabilities of energy storage are therefore not appropriately considered during the connection application process.

3.3. Application of load displacement exclusion in the DSC

While the DSC states responsibilities of LDCs to new generators either directly connected or behind-the-meter, there exists an exemption for resources that are solely for the purpose of load displacement (i.e., non-export behind-the-meter resources).

LDCs are expected to outline the load displacement connection processes within their Conditions of Service (i.e., standard terms and conditions for connection and operation on their distribution network). In practice, many LDCs provide little to no unique treatment for load displacement resources or energy storage. Instead, load displacement resources are treated as if they were a connection that will export energy to the distribution system despite the reduced impact to the operation of the distribution network compared to resources that inject energy into the grid. In some cases, the load displacement treatment assumes the behind-the-meter resource is only used for emergency service and not for broader customer value. The result is an overly restrictive connection capability assessment and burdensome protection & control costs that are unnecessary and ultimately restrict the capabilities of ESS sophisticated power electronic controls.

3.4. Contradiction to Conservation First Framework (CFF)

For load displacement resources, the application of exporting connection requirements contradicts the conservation first framework that exists in Ontario. Under existing legislation (CITE), the OEB and LDCs are supposed to encourage and incentivize conservation efforts that reduce demand from the grid. Load displacement resources are not appropriately being recognized as an effective conservation and demand management activity. Conservation from energy storage resources provides two benefits for rate-payers. First, energy storage can reduce consumption during high demand periods and second, energy storage can significantly increase the utilization of existing generation, transmission and distribution assets without straining the power system. Overall, the connection of load displacement ESS should be encouraged by LDCs and the OEB to support the CFF.

4. Proposed Recommendations

Rapid growth of energy storage installations has demonstrated the value to power systems and customers; however, barriers still exist that limit the potential of energy storage. In jurisdictions across North

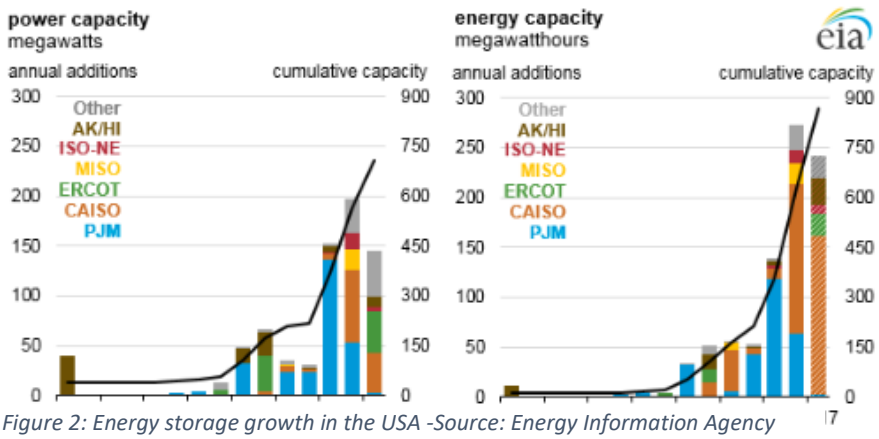


Figure 2: Energy storage growth in the USA -Source: Energy Information Agency

America, regulatory frameworks are being reviewed and updated to support the deployment of energy storage in a fair and efficient manner. Energy storage in Ontario faces both similar and unique challenges to offering their services to customers and providing additional value to the power system.

To assist in addressing these challenges, this paper proposes the following recommendations to assist in resolving connection issues for load displacement ESS.

4.1. Independent responsibility for energy storage in the DSC

The DSC outlines LDC's responsibilities to both load customers and generation customers. While energy storage resources have the capability to act as either a load or a generator, they are unique and therefore should have unique treatment in Ontario's regulatory framework. It is recommended that a new LDC responsibility to energy storage resources be created in the DSC that reflects energy storage's physical operating characteristics and attributes. The LDC responsibilities to energy storage should include response to connection request applications, requirements for a connection agreement, access to the energy storage site, and what conditions should be included in the LDC's Conditions of Service. Further, the DSC should clarify what distribution system investments are appropriate to assign to energy storage resources during connection, and what distribution systems investments should be funded by distributors for the benefit of all distribution customers. In short, the DSC should be expanded to clearly state for LDCs and energy storage providers the expectations for engagement in Ontario.

4.2. Consistent treatment of load displacement resources

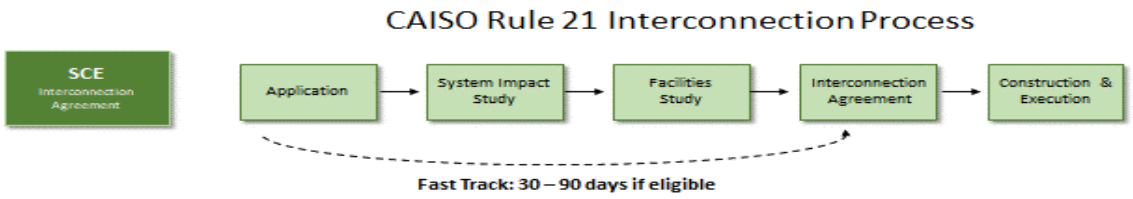
Section 6.2.1 states that LDC responsibilities to generators do not apply to generation used exclusively for load displacement purposes. In practice, the treatment of load displacement resources is described within each LDC's Conditions of Service. Most Conditions of Service do not consider energy storage for load displacement purposes and have inconsistent treatment of load displacement resources in general. Load displacement resources are an important tool for customers to manage electricity costs but the value they can provide is restricted without consistent treatment. The DSC should address the primary requirements for treatment of load displacement resources, including energy storage. The requirements should describe the different treatment between a load displacement resource (i.e., a resource that does not export to the grid) and an embedded resource that may export to the grid including but not limited to the connection process, operating requirements and communication standards.

4.3. Establish an expediated connection process for load displacement resources

The impact on the distribution system differs for embedded resources that export and embedded resources that do not export (i.e., load displacement). Effectively, load displacement resources are similar to investing in energy efficiency to reduce consumption; therefore, the impact on the distribution system should be less than an embedded resource that may export to the distribution system[2]. Given the lower impact of load displacement, it is recommended that an expediated connection process for load displacement resources be established (see box at bottom with information on California's Electric Rule 21 Fast Track Application).

What is a Fast Track application?

The "Fast Track Application" is an application to participate in the Fast Track process for expedited interconnection. Fast Track is intended for projects up to 3MW (SCE) or 5MW (PG&E) for interconnection requests and allows an eligible facility to bypass some interconnection studies if it meets a series of "screens".



The expeditated connection process should include shorter timelines for Connection Impact Assessments (CIAs) and standard connection agreements, if applicable. There should be no capacity size restrictions since by definition load displacement resources are only offsetting existing load and will not export to the grid. The connection agreement should include standards and operating requirements that ensure load displacement resources will not under reasonable circumstances export energy to the grid.

[2] The proposed approach is similar to the California Rule 21 Interconnection. Electric Rule 21 is a tariff that describes the interconnection, operating and metering requirements for generation facilities to be connected to a utility's distribution system. The tariff provides customers wishing to install generating or storage facilities on their premises with access to the electric grid while protecting the safety and reliability of the distribution and transmission systems at the local and system levels. Generating facilities that do not export to the grid or sell any exports sent to the grid (Non-Export Generating Facilities) are not subject to CAISO Tariff.

It is recommended that within DSC Section 6 "Distributors' Responsibilities", a new subsection titled "Responsibilities to Load Displacement Resources" be adopted with the following proposed language:

- *This section applies to the connection of load displacement resources including all net energy metering facilities, "Non-Export" facilities, and qualifying facilities intending to sell power at avoided cost to the host utility.*
    - *"Non-export" facility means when a generator or energy storage facility is sized and designed such that the generator or energy storage facility output is used for host load only and is designed to prevent the transfer of electrical energy from the generator or energy storage facility to the Distribution system.*
- *This section does not apply to the connection of generation or energy storage facilities that intend to participate as Market Participants in the IESO-Administered Markets except for load displacement resources intending to become Demand Response Market Participants*
- *A distributor shall make every reasonable effort to respond promptly to a customer's request for connection. In any event a distributor shall respond within 5 business days to a customer's written request for a load displacement resource connection with a confirmation that the request is complete or a notice of additional information needed. A distributor shall complete an Expediated Connection Assessment (ECA) within 15 business days of the date when the request is confirmed complete.*
- *The distributor is responsible for posting their ECA process including a description of the connection assessment screens the ECA process will perform.*
- *If the load displacement resource passes the ECA, and there are no identified upgrades required for connection, the distributor will offer a connection agreement within fifteen (15) business days following the ECA results.*
- *If the load displacement resource passes the ECA, but there are identified upgrades required for connection, the distributor will deliver a cost estimate of such upgrades within fifteen (15) business days following the ECA results.*
- *If the load displacement resource does not pass the ECA, the distributor may hold a meeting with the customer to determine the next steps and recommended options for the load displacement resource, which may include conducting a Connection Impact Assessment.*

4.4. Require LDCs to develop resources to aid siting of distributed energy resources

The power system is a complex network that is difficult for external parties (e.g., ESS developers) to determine where connection locations face the lowest barriers to entry. Some locations in the power system may be constrained where even the connection of load displacement resources will potentially lead to distribution system issues. The current connection process does not provide any indication of these constrained areas until after a CIA is complete which is a waste of funds and effort. Instead, a proactive approach would be for LDCs to develop resources to aid siting of distribution energy resources. For example, the Massachusetts Department of Public Utilities (DPU) has ordered all public utilities (e.g., LDCs) to publish the following information to guide new connections:

- Monthly report summarizing the number of projects requesting connection by distribution feeder
- A feeder saturation map that shows the level of feeder saturation (i.e., oversubscribed) for each city/town in the LDC's service territory
- Service quality reports for each distribution feeder including feeder characteristics, line automation, rating information and interruption information

As part of the Feed-In Tariff (FIT) program, LDCs were expected to produce estimations of connection capability by distribution feeder and substation; therefore, a similar approach for load displacement should be completed by LDCs respecting the differences between load displacement and embedded exporting resources.

LDCs draft feasibility reports (e.g., Hydro One's Form A) that provide guidance to new connections. LDCs should at a minimum provide draft feasibility reports upon request by connection point that include the following information: (1) feeder voltage; (2) feeder name; (3) feeder rating (e.g., MW) (4) voltage at proposed location; (5) single- or three-phase service availability; (6) distance from three-phase service if only single-phase service is available; (7) aggregate installed capacity of embedded generation on a particular feeder; (8) aggregate pending capacity (submitted connection applications that are not yet connected) of embedded generation on a particular feeder; (9) whether the site is served by a radial network, secondary network, or spot network; (10) minimum load information on a feeder; (11) description of available feeders within 0.25 miles of

the proposed location; and (12) other potential constraints or critical items that may jeopardize the project.

Where constraints exist, LDCs should identify and publish information on constrained areas. The information should include reasoning for the constraints and describe the steps being taken to address the system constraints. Specifically, one-off installations of transfer trip schemes to connect ESS may be a less cost-effective solution compared to alternative solutions that address the system constraint broadly and allow customers to realize the value of ESS without the cost burden of transfer trips.

4.5. Clarify connection cost responsibility for customer load reduction activities

Since in many cases constraints for load displacement can be exacerbated by energy efficiency activities, LDCs should be motivated to address load displacements constraints to support the CFF and ensures customers have the opportunity manage their energy costs. As a general rule (consistent across North America), a customer connecting a load displacement resource is not responsible for costs associated with addressing power flow or voltage constraints on the associated feeder or substation. The OEB in late 2018 issued amendments to the DSC (as well as the Transmission System Code (TSC)) related to cost responsibility rules for load customers under the principles of beneficiary pays[3]. As with energy efficiency, customers shouldn't be assessed costs on the grid for taking demand away and potentially reducing costs for other rate-payers. This rule should be formalised in the DSC to ensure consistent application across all LDCs.

[3] See OEB's Regional Planning and Cost Allocation Review (EB-2016-0003) - https://www.oeb.ca/industry/policy-initiatives-and-consultations/regional-planning-and-cost-allocation-review