Energizing Ontario’s Electricity Sector With Energy Storage

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Agenda

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• Ontario’s Electricity Grid
• Benefits of Adding Storage to Ontario’s Electricity Grid
• How Commercial & Industrial Customers Can Reduce Electricity Costs With Storage.
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About Storage Power Solutions

• SPS is a proud Canadian Company, that designs, manufacturers and distributes Lithium-iron-phosphate (LFP) based battery energy storage.

• Our storage systems are designed for a variety of applications, including battery storage coupled with double-conversion UPS to reduce customer energy costs while providing high quality power to a facility with fully reliable back up power.

• SPS has over 100 years of proven experience in power electronics, energy storage, UPS and renewable energy.
  • Deployed over 1.5 GWh of lithium-based energy storage and over 4.5 GWh of Ni-Cd, Ni-Mh and VRLA based critical infrastructure.

Our Vision is to provide 100% available, low cost, clean power for all by enabling the digital grid of the future.
Setting the Context – How the Electricity Grid is Changing

• Shift from large, centralized generators transporting electricity across long distances.

• Distributed Energy Resources (DER) generates and distributes power closer to customers and load requirements.

• Enablers:
  • Technology cost reductions
  • Industrial Conservation Initiative (ICI).
  • Net metering.
  • Feed-in-Tariff and Micro-FIT.
  • Conservation that supports behind-the-meter generation.
  • Time-of-Use (TOU) pricing.
  • Demand response auctions.

• DER’s now make up more than 10% of Ontario’s installed capacity.
The Promise of Energy Storage

- Efficiently match electricity supply and demand.
- Harness the power of intermittent and distributed renewable resources to offset fossil-based peaking generation.

**Energy Storage promises to be as profound a disruption to the energy sector as the Internet was to computers**
What is Energy Storage?
Simply put, energy storage captures energy produced at one time for use at a later time

**Battery Energy Storage** uses chemicals to absorb and release energy on demand. Batteries are dispatchable reducing electricity demand in peak hours. Consumers install these systems to reduce rates, improve power reliability and reduce their dependence on potentially unreliable grid. These systems also provide fast responding voltage regulation and other ancillary services to the grid. Coupling batteries with renewable energy generation allows that energy to be stored during times of low demand and released during peak demand.

**Pumped Storage** works by pumping water from a lower reservoir to an elevated reservoir to store energy in the gravitational potential of the water.

**Compressed Air Energy Storage** Compressor pressurizes air and drives into a vessel for storage. CAES provides long-duration storage like pumped hydro, but has the key advantage of being able to be flexibly sited where the grid needs it.

**Flywheels** drive a motor to spin a rotating disc mass to create kinetic energy. Flywheels cycle very quickly.

**Power-to-Gas** uses the electrolysis of water to convert electrical energy into hydrogen. Can provide ancillary services or operating reserve. P2G also enables the movement of energy from the electrical grid to the natural gas grid and back. The hydrogen produced from can also be blended into natural gas or combined with CO2 to create RNG.

**Supercapacitor banks** use the magnetic field between plates as a storage medium and, similar to flywheels, can charge and discharge very quickly.
The Promise of Energy Storage

- Like a swiss army knife, energy storage can perform multiple grid functions simultaneously.
- Well-suited to providing ancillary services, capacity & operating reserve.
- Cost effective solutions to defer transmission & distribution infrastructure investments, due to its modularity and ability to enhance system capacity.
- Customer-sited energy storage has also become widely used to manage electricity costs as technology costs have fallen.

Different Energy Storage Technologies Provide Different Grid Services

- **Inertia**
  - Pumped Hydro
  - CAES

- **Frequency Response**
  - Battery Storage
  - Flywheels
  - Power to Gas
  - Supercapacitor

- **Operating Reserve**
  - Battery Storage
  - Flywheels
  - Power to Gas
  - Supercapacitor

- **Time Shift/ Energy Arbitrage**
  - Battery Storage
  - CAES
  - Power to Gas

- **Capacity**
  - Firm Renewables
  - Battery Storage
  - CAES
  - Power to Gas
  - Facility Peak Demand Reduction

- **Demand Response**
  - Non Wires Soln
  - Firm Renewables
  - Battery Storage
  - Pumped Hydro
  - CAES
  - Power to Gas

- **Long Duration Storage**
  - Demand
  - Volt-Var Support
  - Black Start

- **Real-Time**
  - 0-5 Seconds

- **Sub-Seconds**
  - 0-1 Minutes

- **Seconds**
  - 1-60 Minutes

- **Minutes**
  - 1-12 Hours

- **Hours**
  - 1-30 Days

- **Days/Months**

Time Scale of Service Provided by Energy Storage
The Cost of Energy Storage Has Declined

- The capital cost of battery energy storage has declined by 75% to less than $150/kWh and is on track to decline a further 33% by 2023 to < $100/kWh.
- Solar & storage generation is now cheaper to build than new gas plants and by 2032 will be cheaper to build & operate compared to existing gas plants.

Rocky Mountain Institute, The Growing Market for Clean Energy Portfolios
Ontario’s Electricity Grid is Increasingly Reliant on Natural Gas

- While 90% of Ontario’s energy mix is non-carbon emitting, Ontario is increasingly reliant on natural gas to supply peak energy demand.

- According to the IESO, natural gas fuel share will increase from 10% in 2019 to 20% by 2040.

- Electricity sector emissions are currently ~90% below 2005 levels and are expected to increase to 70% below 2005 levels by 2030 due to increased utilization of existing gas fleet.

- Reducing peak demand will reduce GHG emissions through lower usage on natural gas fired generation on the margin.
The Rising Cost of Electricity in Ontario

- Cost of electricity supply includes Hourly Ontario Electricity Price (HOEP) and the Global Adjustment price.
  - Overall rates have doubled since 2009.
  - While HOEP has been stable, the Global Adjustment has increased significantly since 2009.
    - 9% increase in GA in 2020.
    - For a mid size (Class B) customer the GA rate ranges between 9.9 - 11.5 c/kWh.
- The GA is complex!
  - A settlement mechanism for differences between HOEP and regulated rates for OPG’s nuclear and hydroelectric generating stations; payments to gas-fired and renewable facilities and other nuclear stations, and the cost of delivering CDM programs (until 2021).
- GA now makes up 70% of the typical electricity bill.
Benefits of Adding Storage to Ontario’s Electricity Grid

- Economic valuation study by Energy Storage Canada (June 2020) quantified a $2.7-$4 billion benefit of adding 1,000 MW of energy storage.

- Wholesale Market:
  - Energy storage can provide $1.1 billion to $3.1 billion in gross savings in the wholesale market.

- Maximize Transmission and Distribution Investment
  - Energy storage can provide $457 million to $840 million in gross savings over the next decade.

- Direct-to-Customer Savings
  - Energy storage can help electricity customers manage individual costs by shifting peak consumption, resulting in lower Time-of-Use rates and reduced demand charges.
  - Energy storage can also help shift renewable energy output – largely from solar generators – from low-value to high-value hours.

*Figure 1. Energy Storage Value in Ontario Under Low, Base, and High Scenarios*

Customers who have a peak demand > 1 MW are eligible to opt into the Industrial Conservation Initiative as a Class A customer.
- Manufacturers and Greenhouses > 500kW also eligible.

Class A customers pay Global Adjustment (GA) based on their percentage contribution to the top five peak hours of energy use in Ontario over a 12-month base period (May 1 to April 30).

The ICI is used as a peak reduction tool by the IESO.
- In 2018, ICI delivered an average demand reduction of approximately 1,600 MW.

Class A customers who are able to reduce electricity demand during the top 5 hourly system peaks each year can save as much as 70% on their electricity costs.
How Does the Industrial Conservation Initiative (ICI) Work?

• A customer’s Peak Demand Factor (PDF) is set each year (May 1st-April 30th).
  • Customers opt into the ICI program from May 1st-June 15th.
• The PDF is used to calculate their monthly GA over the following 12-month adjustment period, which runs from July 1st to June 30th.
  • Total monthly Ontario-wide GA cost x the customer’s PDF.
• Important to note that due to COVID-19, IESO has paused the ICI program. Class A customers will not need to anticipate and reduce their electricity demand during peak hours for the current base period (May 1, 2020 – April 30, 2021).
  • Class A customers will maintain their peak demand factor assessed from the 2019/2020 base period to determine their Class A Global Adjustment charges during the July 2021 - June 2022 adjustment period.

The PDF is calculated by dividing the sum of the customer’s coincident MW demand with the 5 top system MW peak demand (called the Adjusted Quantity of Energy Withdrawn)
Illustrative Example: A Large Office Building With 1.5 MW Peak & 2-Hour Battery Storage

- On July 9th, IESO Peak Tracker forecasts a peak at 5 pm.
- Office deploys its battery storage over this period to reduce its coincident peak demand to 0.
- Battery is charged during off-peak period.
- Bill savings:
  - Reduced GA via lower PDF.
  - Energy price savings (HOEP) between peak/off-peak.
  - Demand Response (if registered participant).
- Despite electricity bill savings, predicting peaks can be challenging.
- Recommend any potential ICI participant seek assistance from energy demand management company.
  - Look for a holistic program to (1) reduce via energy efficiency, (2) reduce demand through curtailment, and (3) consider demand response options including battery energy storage.

*Example for illustrative purposes only. Participants are strongly encouraged to seek advice from an energy management consulting firm.*
Energy Storage With a Double Conversion Uninterruptible Power Supply Improves Power Quality, Reliability & Resiliency

Power Factor Correction
• Double Conversion UPS provide additional benefits of power factor correction by providing reactive power input & output for voltage and frequency correction.
• Double Conversion UPS fully isolates customer’s energy supply from the grid.

Filtering of Harmonics
• Active filtering of selected harmonics. Double Conversion UPS inverter galvanically isolates the AC input and DC bus from the customer load, eliminating all neutral line common-mode noise coupling.

Fast Ramp Rates
• 100 MW/min. ramp rate with 4 quadrant charge and discharge capability.

As well, Double Conversion UPS-based solutions for behind the meter customer applications, greatly reducing and simplifying the utility permitting process.
Non-Wires Solutions

- Non-Wires Solutions such as generation, storage, demand response and energy efficiency may be cost effective alternatives to address regional transmission and distribution constraints.

- While centralized resources may have the advantage of economies of scale, DERs may be the lower-cost solution, as they can be deployed in a locationally targeted manner and sited close to load.
  - Example; transmission grid constraints identified to replace End of Life equipment in Orillia in 2025-2028.

- Future opportunity for utility-initiated NWS programs where owned distributed energy resources can generate revenue to provide required grid services.

Areas with Anticipated Needs

Numerated, detailed list of needs can be found in the appendix.

- Various sections to be refurbished due to EOL needs
  - M6E/M7E: in-service 2026
  - E8V/E9V: in-service 2026
  - D1M/D2M: in-service 2028
Summary

• Energy storage efficiently matches electricity supply and demand and can harness the power of intermittent and distributed renewable resources to offset fossil-based peaking generation.

• Energy storage can also provide a variety of grid services to support the electricity grid.

• Ontario’s electricity grid is expected to move to a more distributed energy resource model, due to declining cost of renewables and energy storage.

• Ontario has an opportunity to reduce increased reliance on natural gas by deploying energy storage. Deploying 1000 MWh is forecast to reduce ratepayer costs by $2.7-4 Billion.

• Large customers > 1 MW can significantly reduce electricity costs through participation in the Industrial Conservation Program and by lowering their peak consumption compared to the system peak.

• Energy storage provides other customer benefits including reliability, power quality and resiliency. Future opportunities include NWS.
Thank You

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