

Energy Storage Procurement – Phase II Backgrounder November 23, 2015

Value of Energy Storage

Sometimes referred to as the “Swiss Army knife” of electricity resources because of its multifunctional nature, grid-scale energy storage has the potential to transform how power systems are planned and operated. Energy storage systems can provide a range of real-time balancing services by acting as loads and/or generators, as required.

Unlike other forms of energy, electricity has not generally been stored in large quantities. As a result, the electricity system has historically been operated on a “just-in-time” basis – with decisions about electricity production based on real-time demand and the availability of transmission to deliver it. This paradigm is now changing with the emergence of new, more cost-effective energy storage technologies, which allow electricity to be captured and dispatched whenever required.

Energy Storage Procurement – Phase II Results

Ontario’s Independent Electricity System Operator (IESO) is seeking to better understand how energy storage projects can be integrated and operated in the Ontario market. Today’s announcement marks an important milestone in the second phase of the IESO’s energy storage procurement by confirming which proponents have received a contract offer.

These projects have the ability to store energy during times when demand for electricity and associated prices are low and re-inject it into the grid during periods of greater need and higher prices.

After a rigorous, competitive procurement process, the IESO has selected five proponents for contract offers, representing nine projects totalling 16.75 megawatts (MW). These projects include three different energy storage technologies: solid battery (four projects, 8 MW); flow battery (four projects, 7 MW); and compressed air (one project, 1.75 MW).

The costs associated with these projects are expected to be approximately \$9 million per year.

The successful proponents and projects are:

<i>Proponent</i>	<i>Technology</i>	<i>Capacity (MW)</i>
Ameresco Canada Inc.	Battery – Solid	2.0
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SunEdison Canada Origination LP.	Battery – Flow	2.0
SunEdison Canada Origination LP.	Battery – Flow	1.0
SunEdison Canada Origination LP.	Battery – Flow	2.0
NextEra Canada Development & Acquisitions, Inc.	Battery – Solid	2.0
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NRStor Inc.	Compressed Air	1.75
Baseload Power Corp. (formerly 2443453 Ontario Inc.)	Battery – Flow	2.0

Proponent and Project Information

Baseload Power Corp.

The company bringing the Milton project to Ontario is Baseload Power Corp. (formerly 2443453 Ontario Inc.) in partnership with Milton Hydro Distribution Inc. Baseload Power Corp. is an energy company based in Ontario that develops, builds, and operates advanced power and battery technology projects for utilities and a variety of industrial, commercial and residential applications. The project is a 4-hour 2 MW flow battery with the ability to store up to eight MWh of energy. The name of this technology comes from the fact that the charge carriers are in a liquid form and flow past the electrodes during times of charging and discharging. Flow batteries have a number of advantages:

- the amount of electricity (in kWh) they can store is limited only by the size of the liquid storage tanks;
- deep charging and discharging can occur over a large number of cycles without significant degradation;
- end of life recharging can be almost instantaneous by replacing the liquid in the storage tanks and recovering the spent material for re-energization;
- the equipment is non-flammable and emission free without containing any heavy metals; and
- the complicated and expensive parts of the system — the electrodes and membrane separating the two charge carriers — can be relatively compact and still handle a large amount of kWh of storage.

The Milton project will be located on the site of Milton Hydro's new head office in an area in close proximity to other large electricity consumers. The project will feed into the Milton Hydro distribution system, providing support for the grid if needed and the storage of less expensive off-peak power for use at higher cost peak times.

"Electricity storage is the new frontier for the energy industry and we are very pleased to be working together in a dynamic public-private partnership with the IESO and Milton Hydro Distribution Inc. to build a leading edge flow-battery in Milton, which will support the electrical grid when needed and use the electricity Ontario already produces more efficiently. Ontario has always been at the forefront of innovation in electricity and we look forward to showcasing our landmark project and the Gildemeister's storage technology across the globe." – Jonathan Sandler, President and CEO of Baseload Power Corp.

Ameresco Canada Inc.

Ameresco has been awarded two Energy Storage Facility Agreements. Under each, Ameresco will design, build, own, operate and maintain a 2 MW, 4-hour "Battery Solid" energy storage system facility (two facilities with a capacity of 2 MW each, for a total of 4 MW) on Newmarket Hydro's distribution grid, absorbing power during periods of excess energy supply and providing it back to the grid when energy demand is high. In addition to providing this basic "peak shaving" function these systems will also provide on-going grid reliability and stability as more renewable energy comes on-line in the area.

"Ameresco is pleased to bring its leadership to the IESO energy storage pilot project and assist the IESO in creating ratepayer value and environmental benefits through the time-shifting of energy consumption and production as well as to demonstrate the value of future ancillary services to be derived from these energy storage facilities. Ameresco prides itself on its entrepreneurial spirit and innovation and we look forward to working with both the IESO and Newmarket Hydro at the forefront of the developing market for energy storage systems." – Bob McCullough, President, Ameresco Canada

SunEdison Canada Origination LP.

SunEdison will provide a total of 5 MW/20 MWh of energy storage systems over three separate projects utilizing flow battery technology with plant controls that will deliver energy to the IESO grid. The battery system will use a Vanadium Redox chemistry. SunEdison is pleased to be working with Essex Energy Corporation on two of the pending projects.

NextEra Canada Development & Acquisitions, Inc.

NextEra Energy Canada's Parry and Elmira energy storage projects will utilize lithium ion batteries to store energy produced during off-peak demand periods in order to re-inject that electricity into the system during times of peak demand, as instructed by the IESO. Each project will be designed to deliver up to 2,000 kilowatts of power for up to four hours. The projects are located in close proximity to existing distribution facilities where they will connect to the local distribution grid. In addition to the batteries, the projects will also include the required inverters, transformers, and associated power equipment to efficiently and safely move electricity on or off the grid.

"NextEra Energy Canada is delighted to have been selected by the IESO to build two battery energy storage projects. We look forward to working with the IESO to incorporate cutting-edge storage technology into Ontario's electrical system." – Al Wiley, Vice President, Development, NextEra Energy Canada

NRStor Inc.

NRStor Inc. is a leading energy storage developer, owner and operator focused on commercializing advanced energy storage technologies. NRStor has partnered with General Compression Inc., a cutting edge supplier of fuel free compressed air energy storage technology, to deliver over seven MWh of storage capacity to the IESO.

"We are excited that NRStor, in partnership with General Compression, has been awarded this contract with the IESO. The IESO is a world leader in deploying advanced energy storage resources to support the power system. Fuel free compressed air energy storage can offer tremendous benefits to Ontario ratepayers and we look forward to locating this innovative project in Ontario." – Annette Verschuren, Chair and CEO of NRStor

Technologies Selected for Phase II Contracting

Battery – Flow

While a conventional battery houses energy in one cell or package, a flow battery stores its energy in chemically reactive liquids, held in two tanks separate from the actual battery cell. The system pumps the two liquids from the tanks into a cell where a chemical reaction releases electrons that supply power onto the grid. To recharge the battery, the flow is reversed: electricity produced on the grid is channelled into the cell, breaks the chemical bond and pumps

the liquids back to their respective tanks. This technology is scalable as larger tanks can store and provide more energy.

Battery – Solid

Solid state (lithium ion, nickel-cadmium, sodium sulfur) batteries are typically used today to charge laptops, cell phones and other devices. Unlike flow batteries, solid state batteries are divided into two sides by a perforated layer called an electrolyte. As the battery charges, chemical ions move through the electrolyte from the positive to the negative and from the negative to the positive electrode as the battery discharges.

Compressed Air

Compressed air energy storage (CAES) is a way to store energy by compressing air at very high pressures and storing it in large underground caverns, depleted wells or aquifers or other forms of contained reservoirs. The compressed air can be released and run through turbines to generate electricity when power is needed.

Energy storage can be provided by a wide range of technologies. In addition to the above-listed technologies, some other examples include:

- Pumped hydro
- Flywheels
- Thermal storage
- Superconducting magnetic energy storage
- Electrochemical capacitors
- Hydrogen (including power-to-gas)