Energy storage for renewables being written into Ontario policy

Systems such as pumped hydro storage offer peak and off-peak value

by Robert Eeuwes.

Concerns about climate change, aging energy infrastructure, and energy security have driven great interest in renewable energy, but the nature of energy sources like wind and solar is that they can be intermittent. That variable has increased the need for energy storage (and smart grids), concepts that may increase the value of a project's balance sheet.

The idea of developing energy storage systems in Ontario is becoming more prevalent in provincial energy policy. For example:

- On December 2, 2013, Ontario's Ministry of Energy (MOE) released its Long-Term Energy Plan (LTEP), which included a procurement target of 50 MW for storage technologies;
- The Ontario Power Authority (OPA) is designing a Large Renewable Energy Procurement Program (replacing Large FIT) that is expected to give priority to generation projects that incorporate energy storage systems; and
- The Independent Electricity System Operator (IESO) and the OPA are designing a new procurement framework specifically for energy storage technologies.

As a long-standing leader in renewable energy such as hydro and nuclear generation technology, Ontario has been increasing the amount of wind and solar generation in its electricity supply mix. The LTEP has targets of 10,700 MW of wind, solar and bioenergy by 2021 (each source representing 11 percent, 3 percent and 3 percent of total energy production respectively).

Although wind and solar power generation provide low-carbon, "green" and increasingly cost-effective methods of producing renewable electricity, their intermittent nature poses challenges to electrical grid operation and stability. In Ontario, the IESO forecasts electricity consumption and production every five minutes, determining which generators are used and which are curtailed or dispatched.

It has been common practice for electrical grid operators to curtail wind and solar resources during periods of oversupply or unfavorable market conditions. However, this practice can weaken a project's balance sheet and may increase the lifetime cost of electricity from curtailed generators. The use of the established technology of "pumped storage" has been introduced as a possible solution to these limitations.

Pumped Storage – how it works

The storage of electricity comes in many forms: from advanced lithium batteries, compressed air systems, flywheels, molten salt heat storage systems, to pumped hydro storage systems (pumped hydro being the most widely-used storage system today representing 99 percent of installed storage capacity worldwide (127 GW)).

Pumped hydro storage produces electricity similarly to the way a hydroelectric power plant produces electricity. During high-demand periods, electricity is produced by turbines spun from water flowing from an upper reservoir into a lower reservoir. When demand is low (and electricity rates are low), the same system pumps water from the lower reservoir back into the upper reservoir. This process repeats itself when needed, acting as a very large storage battery.

In Ontario, there is only one pumped hydro storage facility in operation, the Sir Adam Beck Pumped Storage Facility in Niagara Falls. During off-peak periods (nighttime), Ontario Power Generation diverts water from the Niagara River, filling its 300 hectare reservoir. During peak periods, this water is released, creating up to 174 MW of hydro

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power. Northland Power Inc. has recently proposed building a 400 MW pumped hydro storage project in Marmora, Ontario, using an old open pit mine and an upper reservoir closed-loop configuration. Combination pumps/generators will pump water into the upper reservoir during off-peak periods and then release the water down a shaft (four times the height of Niagara Falls) into the mine during peak periods to generate electricity.

The world is moving towards producing and consuming a large percentage of its electricity from renewable fuel sources. By 2030, renewables are expected to account for 48 percent of total power generation capacity installed worldwide. Although much of this production will be provided by hydro generation, wind and solar are expected to dominate this growth, rising from 5 percent (wind) and 2 percent (solar) in 2012, to 17 percent and 16 percent by 2030. As more electricity is generated by intermittent resources like wind and solar, energy storage systems like pumped storage may soon become commonplace.

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