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Why Green Mountain Power Is Embracing Energy Storage

By Josh Castonguay

It's simple, really: The energy industry needs to change. The bulk grid electricity system is antiquated, inefficient and costly to maintain. The current system has remained largely unchanged for the past 100 years, and it is no longer sustainable, given the threat of climate change that brings increasing severity of damage from storms. Imagine what the outcome would be for any other business that lost more than half of its product before it got to customers.

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At Green Mountain Power (GMP), it became clear that we had to forge a new path with innovative grid solutions that would transform this delivery system as we know it today, and an integral part of a transition to a distributed energy system is energy storage. This can come in a few forms, including thermal energy storage, which has been around for decades in the form of controlled water heaters and electric thermal storage units, and battery energy storage, which has more recently become a viable option on the grid because battery pricing is significantly declining. We realized early on that we needed to learn as much as we could, as quickly as we could, about how to tap into the many value streams that storage can provide our customers in transitioning from the bulk grid to a more cost-effective energy system that puts homes, businesses and communities in the center.

Large-scale storage, large-scale benefits

Our first venture into grid-scale energy storage was our Stafford Hill Solar/Storage Park. This started as a 2.5 MW landfill solar project and evolved into a solar and storage facility. In late 2013, shortly after we began design on the landfill solar project, the Vermont Department of Public Service and the U.S. Department of Energy joined forces to offer a grant to a project that deployed energy storage. GMP quickly partnered with a Vermont company, Dynapower, to design an integrated storage solution that would be paired with the already planned PV system on the landfill. At that time, based on the value streams, it made sense to look at two types of battery systems: lithium-ion and advanced lead acid.

We had developed a few key use cases to be provided by the energy storage project, including peak shaving, solar smoothing, frequency regulation, power quality/voltage management, and grid resiliency/islanding of a nearby emergency shelter. With this in mind, we developed a system that consisted of four 500 kW Dynapower multiport inverters, with each inverter connected to 625 kW of solar PV, 600 kWh of advanced lead acid batteries and 250 kWh of lithium-ion batteries for a total of 2.5 MW of PV and 3.4 MWh of battery storage. This design allowed for fast ramping provided by the lithium-ion batteries, with the longer-duration energy provided by the advanced lead acid batteries. Today, we are able to achieve both the fast ramping and longer energy duration, all with lithium-ion technology.

A main value stream that was identified for the system was participation in the ISO New England frequency regulation market, which was recently updated in terms of allowing new technologies such as battery storage. The Stafford Hill facility was the first battery project in ISO New England territory that was accepted into the frequency regulation market, and it provided ISO New England with a solid baseline of how well a fast-acting battery could perform against a market signal.

In addition to the revenues received to directly lower costs for customers from the regulation market, the solar+storage system has been successfully deployed to mitigate our peaks. On Aug. 12, 2016, New England hit its summer peak during mid-afternoon. We dispatched our Stafford project against that peak, providing nearly 2 MW of peak-reducing value from a combination of the solar and the storage during the peak hour – saving GMP customers nearly $200,000. That amount of savings demonstrates the tremendous value of storage to lower costs for customers and forge a new energy future.

In addition to grid-scale energy storage, behind-the-meter energy storage will play an increasingly important role in our grid transformation. Leveraging this type of energy storage creates an even more granular level of control and power quality management. With tight energy platform controls connected to distributed, behind-the-meter storage, we can optimize voltage on the grid and run the system much more efficiently, such as by using a technique called conservation voltage reduction.

Conservation voltage reduction, or CVR, is a practice whereby you lower the operating voltage of the distribution system and reduce the amount of energy consumed by certain types of loads. The trick is in how to ensure that your voltage will never drop below acceptable ranges as you move further down the distribution feeder. This is typically mitigated by setting voltage regulators to take into account the drop across the distribution system and results in an uneven voltage distribution down the line. With distributed storage resources, you can begin to tap into the reactive capabilities of the inverters and provide a much smoother voltage profile across the distribution network. The potential even exists to remove traditional voltage regulation equipment such as line regulators and capacitor banks. And, of course, behind-the-meter storage will provide the host customer with a clean, quite-maintenance-free backup power system that will automatically kick in during times of outage.

Just like grid-scale storage, these behind-the-meter systems can all be aggregated and utilized to reduce peak energy demand and reduce costs for all of our customers. If there is one word that I would use to summarize energy storage, it would be "flexible." As sure as I write this today, there will be even more value streams down the road provided by having a fast and flexible energy resource distributed around the grid. The vast majority of grid issues are resolved with either load, generation, reactive power, voltage controls or a combination thereof – energy storage can provide it all!

Going off the grid

As we began to deploy our energy home transformation offering known as the "eHome," which is a comprehensive energy makeover focused on reducing customers' cost and carbon while improving their comfort, it only made sense that we evolved and started offering customers a package that included battery storage and, from there, the ability for customers to go off-grid.

We look at the off-grid option as serving two main purposes: First, if a customer simply wants to disconnect – or is building and does not want to connect to the grid in the first place – we make that possible. Second, we believe there will be strategic locations across our system where it will actually become more cost-effective to serve the customer via an off-grid solution, rather than with traditional poles and wires.

Although we believe that the vast majority of customers will benefit from being interconnected to each other and sharing energy resources on the power grid, there will be pockets where it becomes more costly to maintain long, rural poles and wires in our Vermont service territory than it would be to serve customers through an off-grid solution. An example of this for GMP came in the form of a Vermont state campground. The only electrical loads at this campground were a few bathroom facilities with lights and hot water, and the park is only open during the summer months. This small amount of electricity usage still required a long, single-phase distribution line to feed it. This line required routine maintenance, such as tree trimming, and had to be put back up anytime a storm rolled through and knocked it down. It became clear that serving this small load on a seasonal basis could be easily achieved with an off-grid system, thus not only improving reliability for the campground, but also reducing costs for all of our customers by eliminating the need to maintain the line.

All of this work shows a focus on transforming our energy future; how we produce, deliver and consume energy; how we leave the planet better than when we found it; and how we improve customers' lives through reduced cost, improved comfort and greater reliability. The grid of the future will be one that relies on many interconnected, choreographed resources all working together to turn an energy-delivery model that is barely 50% efficient today into one that is more efficient and sustainable for homes, businesses and communities.

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