Distributed Energy Storage Benefits on Both Sides of the Meter

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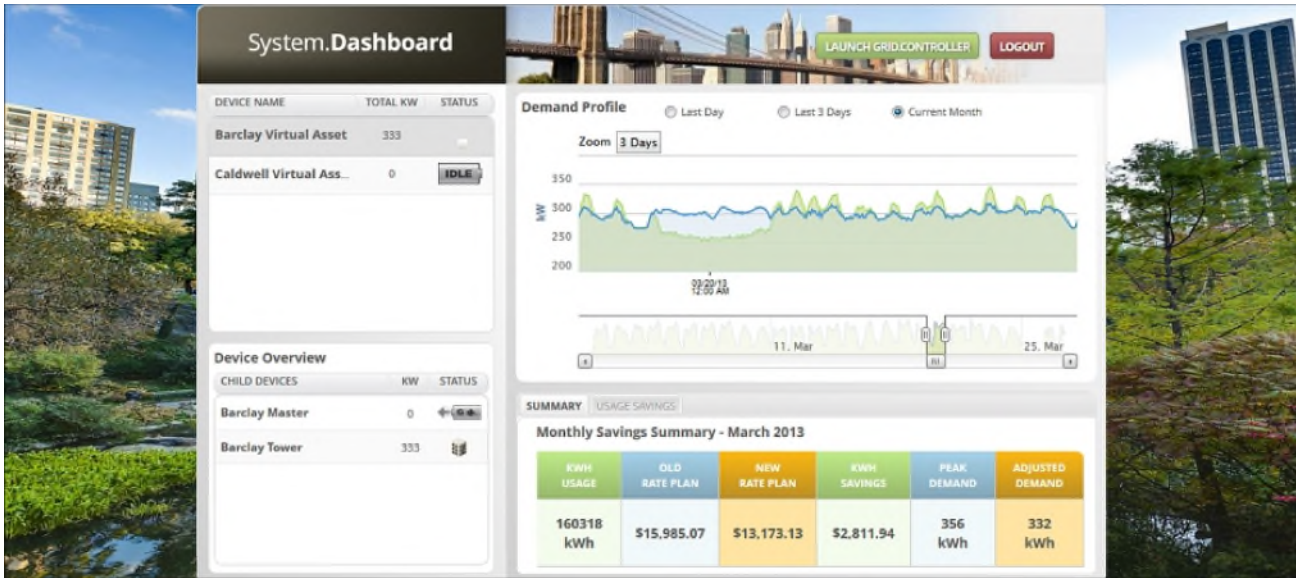
Solar and wind are excellent sources of clean, renewable energy, but as they contribute a larger share to the generation fleet, their integration will become increasingly challenging. The reason: solar and wind cannot be dispatched in the same way as other sources of energy, such as nuclear, hydro, and fossil fuels. Because the grid must operate “just in time,” with generation continually matching demand to maintain stability, special accommodation is required to efficiently integrate a significant contribution from the sun or the wind. Their intermittent production and tendency to produce peak power during periods, don’t always align nicely with peak demand times.

Battery storage has long been recognized as a way to integrate more solar and wind energy into the grid. Deploying intelligent energy storage at the very edge of the grid, where energy is consumed, creates some compelling benefits on both sides of the meter. The benefits of such distributed energy storage (DES) derive from its ability to create and reduce demand by consuming and generating power, respectively. In effect, this makes demand dispatchable by enabling it to be increased or decreased as desired to accommodate changing grid conditions. And, by making demand more dispatchable, it also becomes easier to integrate at higher penetration levels of solar and wind generation.

Customer Gains

The image below shows how a commercial customer time-shifts demand by increasing “demand” at night to charge the batteries (in this case, preferably using wind energy), and then “generates” electricity to reduce peaks in demand throughout the day.



The benefits of DES to the customer can be considerable. The ability to time-shift demand enables commercial and industrial (C&I) customers to cap demand charges during the day, and take full advantage of reduced time-of-use rates at night. Under most rate structures, C&I customers are able to achieve a payback of the investment in a DES system in five to seven years. The payback can be even shorter if solar energy is integrated, or by participating in the local utility's demand response program, which DES facilitates in a less disruptive manner.

DES also makes it easier to integrate onsite solar generation by accommodating periodic spikes in demand and passing clouds with less disruption to the customer, and more stability for the grid. Depending on the capacity and capabilities of the onsite solar and DES systems (potentially as part of a microgrid), the customer should be able to survive a power outage, again with little or no disruption to operations.

The Utility Side of the Meter

There's equal benefit from distributed energy storage on the other side of the meter for all utilities that generate, transmit, and/or distribute electricity. DES is beneficial for wind generation because these power plants are most often located away from the hub of a city, in sparsely populated rural settings, where winds happen to blow the strongest. However, transmission to distant population centers is required. But, the real problem involves the temperament of the wind, which often tends to peak in the evening, when energy demands are relatively low.

The Renewable Energy Certificate (REC) market allows wind producers to earn credits only for power actually put onto the grid. For this reason, producers often find it necessary to pay other generation resources to ramp or shutdown during periods of low demand (such as at night) to qualify for the production credit. In the spring of 2010, for example, the cost of getting other resources to go offline went as high as 10¢/kilowatt-hour.

The intermittency of wind and solar requires other generation resources to step in and support grid stability during a drop in wind speed or a lack of sunshine on a cloudy day. For small levels of penetration, such intermittency is easy to accommodate. For larger levels of renewable integration, however, this is a problem. Integrating energy storage with distributed solar installations enables the batteries to act as a buffer, ensuring a constant and dispatchable power output from the PV system. Traditional baseload and peaker plants will benefit from the demand-leveling effect of DES with a reduction in start-ups and ramping rates, resulting in reduced equipment wear, fuel use, and emissions.

Similar benefits accrue to transmission and distribution utilities, based on more efficient utilization of the existing transmission and distribution (T&D) infrastructure. I2R losses are minimized with the ability to transmit and distribute power during periods of low demand. DES also makes C&I customers more likely to participate in demand response programs, and reduce power consumption even more during DR events. Changes, including growth in distributed generation and the adoption of electric vehicles (EVs), become less threatening to grid stability. DES systems can also be operated to enhance grid stability by providing ancillary services, such as frequency and voltage support, as well as power factor correction.

By increasing the utilization of existing T&D infrastructure, utilities will be able to postpone and possibly avoid a costly expansion or upgrade as demand grows and renewable generation increases. Finally, North America (and the entire planet for that matter) stand to benefit from greater use of clean, renewable sources of energy that are integrated into a more stable and reliable electric grid. DES can even help society achieve another important objective: energy independence from greater use of EVs — charged, of course, with clean solar and wind energy.

Conclusion

As the contribution of solar and wind generation increases to 20 percent or more, as it likely will under Renewable Portfolio Standard mandates, the deployment of distributed energy storage at the edge of the grid affords an opportunity to make this clean energy more dispatchable and firm. Indeed, by delivering benefits on both sides of the meter, DES has the potential to transform the way electricity is generated, transmitted, distributed, and consumed. It is for this reason that utilities should be providing incentives for their C&I customers to deploy intelligent distributed storage from renewable sources.