Why Utilities Should Use Storage: The Importance & Benefits

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The past two decades have proven important for the advancement of utility-scale Battery Energy Storage Systems (BESS). Energy storage is expected to play an increasingly important role in the Smart Grid and the advancement of the power grid particularly to accommodate increasing penetration of variable renewable energy resources such as wind and solar power. Developments of renewable energy resources imposes many uncertainties and variabilities in power grids. One of the best approaches to mitigate these stochastic disturbances is thought the use of BESS. BESS is a battery equipped with bidirectional converters which can absorb or inject active and reactive power at the designated set points. Using BESS helps power grids and utilities to assist with the integration of renewables and to assist with increases in customer reliability and power quality.

Grid energy storage (also called large-scale energy storage) is a collection of methods used to store electrical energy on a large scale within an electrical power grid. Electrical energy is stored during times when production (especially from intermittent power plants such as renewable electricity sources such as wind power, tidal power, solar power) exceeds consumption, and returned to the grid when production falls below consumption. BESS can provide different benefits to all parts of electric grid. Rest of this essay focuses on the benefits of using BESS for different parts of the power grid especially utilities.

Using BESS has several benefits for the utility regarding the electricity supply for the grid. Electricity supply benefits from BESS are: *electric energy time-shift* and *electric supply capacity*. Electric energy time-shift is storage of energy when its price is low and use of the stored energy when the price is high. These are sometimes referred to as buy low–sell high transactions. The benefit comes from the difference between the low cost incurred or price paid for energy that is stored and the high cost or price that is avoided, net of energy losses during storage and net of the related cost to own and to operate the storage. For example, at night there is usually limited need for electricity and there is often more supply than there is necessary. At those times, the cost to generate electricity and the price for that electricity are relatively low. But during weekdays, for example summer weekdays, electric energy use is high and as are the cost to produce and the price to purchase the electric energy. The second electric supply benefit for the utility, electric supply capacity, is related to a reduced need for electricity generation equipment (i.e., capacity). BESS reduces the need to install generation capacity then the benefit from storage is the avoided or reduced cost associated with building and owning that generation equipment.

BESS has several benefits for electrical grid infrastructure. BESS is used to improve the effectiveness, efficiency and cost-effectiveness of the existing electrical transmission and distribution (T&D) systems and to reduce the need for T&D equipment (managing T&D congestion and deferring/avoiding the need for additional T&D equipment). To improve T&D equipment performance, BESS is connected at or near parts of the T&D systems where there are problems to improve the performance of T&D equipment. The result is that the same T&D equipment has a higher capacity and thus can transmit more energy. As a summary, BESS allows use of the capital for other projects reduces the financial risk associated with lump investments.

Other benefit of BESS is for electrical grid operations. Although most of the cost for electricity generation and delivery are for energy and power, costs incurred for grid operations and ancillary services are not negligible, accounting for several percent of total costs. These ancillary services are: reserves or backup power, frequency regulation (stabilizing the alternating current (ac) frequency at which the grid operates-60 Hz), and "Voltage regulation" that is required to maintain the voltage of the grid. Storage is somewhat or even much better as ancillary services resources than the conventional fossil-fueled generation approach. There are two key reasons. First, most types of energy storage can start-up quite quickly and the output from and input to most storage types can be varied quite rapidly. So, they are more responsive and flexible as ancillary services "resources." Second, storage system life and wear are somewhat or even much less sensitive to output variability than they are for electricity generation that is used for ancillary services. (Ideally, most types of generation operate at a constant rate (power), at their "design point," which minimizes wear, fuel use and total cost per unit of energy output). The benefit is reduced cost relative to generation-based ancillary services including reduced need for generation capacity (equipment), and reduced generation operations cost, for fuel, maintenance and wear. Additionally, storage can provide all of the ancillary services and the same storage can be used for other benefits.

BESS help for higher renewables integration. BESS plays a key role in the integration of renewable energy (RE) electricity generation into the electricity grid of the future (renewables integration). A particular interest is use of storage to assist with the effective and reliable integration of RE generation whose output is variable, primarily wind and solar and possibly including ocean wave and tidal generation. Three key challenges include accommodating: output variability, a temporal (time-related) mismatch between generation and demand, and undesirable electrical effects caused by RE generation. Output variability can be either short-duration or long-duration. Short duration variability – lasting a few seconds to many minutes – is caused by fluctuations in wind speed, sometimes involving significant moment-to-moment variations, and rapid fluctuations of solar energy due to clouds. Long term variability occurs from year-to-year, season-to-season, day-to-day and most importantly, throughout each day. Storage can be used to address both short-duration and long-duration variability. To address short-duration variability, storage output fluctuates in such a way that it cancels out the RE generation's variable output. For example, if wind generation output drops due to lower windspeed, then storage output is increased by the amount needed to

compensate. To address longer-duration variability throughout a day, storage discharges to "fill-in" when the RE generation is not producing full power. The effect – of storage used in in concert with variable RE to address daily variability is what is sometimes called "firming"–meaning that the result is constant power output, especially during peak demand time.

Other benefit of BESS is for electricity end-users. These benefits can be categorized in two sections: electricity *bill management and reducing/avoiding losses due to electric service quality and outages*. Both are avoided costs. Bill management involves storage use to reduce the end-user's cost to purchase electricity. The bill management benefit may reduce cost for and use of electric energy or reduce/avoid financial losses for and use of electric energy and reduce maximum power draw (known as electric demand). There are also two similar but distinct subcategories of benefits for reducing/avoiding financial losses due to electric service quality and outages. The first could be referred to as a power quality (PQ) related benefit. It accrues if storage (e.g., an uninterruptable power supply or UPS) is used to reduce/avoid costs that would be incurred – without the storage – due to poor power quality (i.e., the electricity delivered by the grid does not have sufficient quality). The second subcategory – which could be referred to as a reliability benefit – is similar to the PQ benefit. It accrues if the storage is used to reduce/avoid costs associated with electric service disruptions – "outages."

Summary:

This essay covered the importance of BESS for utility as well as several benefits of using BESS: 1) for the utility through electric energy time-shift and electric supply capacity, 2) for the grid infrastructure through improving the effectiveness, efficiency and cost-effectiveness of the existing electrical transmission, 3) for the grid operations through providing different types of ancillary services such as frequency regulation, reserves, voltage regulation, 4) for renewable energy integration through mitigating the fluctuations and uncertainties caused by renewable generation resources, and 5) for electricity end-users through bill management and reducing/avoiding losses due to electric service quality and outages.

References:

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