Applications of Battery Energy Storage Systems

Energy Arbitrage

There are numerous applications for energy storage in the electricity market, both at the distribution and transmission levels.
In this document, we are mostly going to review distribution-level applications.

Behind-the-Meter Applications

For most of the electricity industry's history, the involvement of the grid was to cover, essentially, if not exclusively, what was upstream of the customers' meters — namely generation assets and the extensive transmission and distribution network that delivered power to customers.
While the "traditional" industry's definition of their business domain typically stopped at the customer meter, there is a universe of possibilities on the other side of the meter. While the industry counts the billions of dollars it has invested in assets upstream of the meter, there is probably as much, if not more, invested on the customer side of the meter if one counts all the devices that consume electricity. Few studies exist on how much may lie Behind The Meter (BTM) — and these numbers are likely to rise given the drastic changes that are inevitable in how to generate, distribute and consume electricity [1].

Below is one of the common applications of a BTM solution:

Energy Arbitrage

Under the electricity market environment, the electricity price of power generation changes with time. Energy arbitrage is a simple concept: electricity is stored when costs per energy unit (KWh) are low and used or sold when the costs are high. This method can be utilized with small home batteries, medium-sized storage systems in commercial buildings, or utility-scale batteries. In all cases, the basic principle is saving the difference between low and high energy costs. The concept remains the same: The Energy Storage System (ESS) charges during the off-peak (lowest price) period and discharges during the on-peak (highest price) period, which generates profits for the asset owner through price arbitrage

[1] "Behind and Beyond the Meter: Digitalization, Aggregation, Optimization, Monetization" by "Fereidoon Sioshansi" and published by "Academic Press", 2020

For instance, a factory is charged 8 cents/kWh during off-peak hours, and 15 cents/kWh during peak hours. In this scenario, if the batteries are charged during the off-peak period, then discharged when the higher rate is being applied, a simple load displacement from the grid to the batteries, would save around 7 cents per KWh for the customer.

As the infrastructures age and demand increases, utilities tend to pass the costs associated with building new electricity infrastructure and maintaining and refurbishing existing generation resources which will improve the economics of arbitrage for heavy consumers.

The primary source of arbitrage value is the ability to charge a BTM battery with off-peak period supply, or solar-produced electricity, and use the stored electricity to substitute for grid supply during peak periods. Continued expansion of time-of-use metering policies, solar production, and decreasing mining and manufacturing costs of raw materials for solar and storage technologies will also be another accelerating factor for more arbitrage projects in the near future

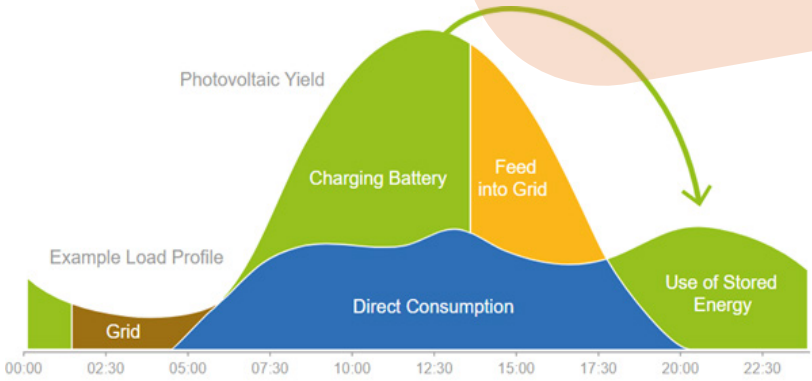

Figure 1: Generic storage arbitrage with solar integration

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