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Case ID:M23-058P^
Published: 7/15/2023

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Energy Storage Dispatch Optimization Model for Maximizing Electrical Cost Savings

Energy usage in the industrial sector has been increasing since 2007 and has been the largest energy consuming sector in the US (e.g., at nearly 33 quadrillion Btus in 2018). Industrial facilities are not only the largest end-use consumer of energy, but account for one-third of the total peak power demand in the US. This creates several challenges as demand is expected to more than double by 2050. Through means of industrial demand-side management (IDSM), energy and demand price structures incentivize industrial facility owners to adjust their demand profiles to better accommodate generation and distribution, resulting in less strain on the power grid.

Several strategies allow users to participate in IDSM. One strategy is to use an energy storage system (ESS) to shift energy use such that the cost-savings of the user is maximized. Assuming that the pricing structure offered by the utility is reflective of their goals, maximizing the savings of the user is equivalent to maximizing the desires of the utility. In short, the user can use their ESS to decrease demand during on-peak hours by discharging the ESS (i.e., peak clipping) and the ESS is charged during off-peak hours (i.e., valley filling). Together, peak clipping and valley filling accomplish load shifting and result in a flatter demand profile for the industrial facility. ESSs are seen as the key to achieving global energy transformation due to the revolutionary changes they bring to energy production and consumption modes. Thus, there is a need for a model that optimizes control strategies of an ESS utilized by large electricity consumers (e.g., industrial users).

Researchers at Arizona State University have developed an optimization model for maximizing the electric cost savings of an energy storage system (ESS) using industrial demand profiles under a time-of-use rate structure. Additionally, this optimization model is run varying three parameters: the size of an ESS to optimize the size for a facility, the type of ESS to identify differences in the optimal for each technology, and the load profiles impact on the optimal size of each ESS. The model also allows users to maximize their electrical cost savings by shifting usage from on-peak to off-peak usage times, reducing their peak power demand, while fully considering the cost of discharging the ESS.

Related publications: A comparison of optimal peak clipping and load shifting energy storage dispatch control strategies for event-based demand response

An energy storage dispatch optimization for demand-side management in industrial facilities

Potential Applications:

- Energy storage systems (ESSs)

Benefits and Advantages:

- Model was tested on lithium-ion battery ESSs, supercapacitor ESSs, and compressed air ESSs
- Maximizes return on investment
- Identifies significant differences in the optimal size of each energy storage system due to their varying performance parameters