

# Unlocking Cost-Effective Grid Thermal Storage Assets for Renewables and Resiliency

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**Background/Objectives.** Armada Power has commercialized Battelle-licensed technologies for the past seven years to make the power grid more reliable, renewable, and cost effective. The Armada/Battelle technology has been deployed in thousands of homes in 10 states and is soon to be deployed in Canada to support a wide range of electric grid applications. The key to decarbonization of the electric power grid is increasingly dependent upon low-cost access to storage. The Armada/Battelle technology takes underutilized assets like a residential water heater and coordinates the usage of thousands of devices within milliseconds to balance outputs from renewable energy, real-time fluctuations in grid frequency, and optimizes against volatile energy prices. This presentation will highlight the need for maximizing all of the available storage to serve the high concentrations of renewable generation coming online in the next decade and provide real-world data and lessons learned on creating new policies and program designs to encourage further adoption of low-cost thermal storage technology.

**Approach/Activities.** Armada Power has collected data over seven years of commercial operations delivering a wide range of energy products to the electric grid. Revenue grade, real-time data from thousands of water heaters across the country has been analyzed for energy insights and their grid impact. Multiple control strategies and forecasting models have been developed and tested across this large customer base. The system is deployed in a variety of markets ranging from private microgrid installations to municipal, cooperative, and investor-owned utilities. These deployments demonstrate a method of bundling smaller, more nimble assets that effectively distributes energy storage close to point-of-use, while providing a single virtualized energy asset at utility scale.

**Results/Lessons Learned.** Armada Power's method of aggregating and managing water heating assets for the purpose of grid storage and resiliency provides two to four times more return than electrochemical batteries, and five to 10 times more energy management and cost effectiveness than smart thermostats. Stakeholder buy-in from regulators, utilities, end-use customers, and property owners is key to operating behind-the-meter energy storage and lessons learned and recommendations will be shared with this presentation. Furthermore, accurate measurement and verification along with robust cybersecurity countermeasures are critical as distributed energy storage continues to play a larger role in grid operations. This presentation will leverage real-world data to show how the impacts of aggregated water heater thermal storage management can provide reliability improvements, cost savings, and carbon reduction across a wide range of geographies, utility structures, and customer demographics.