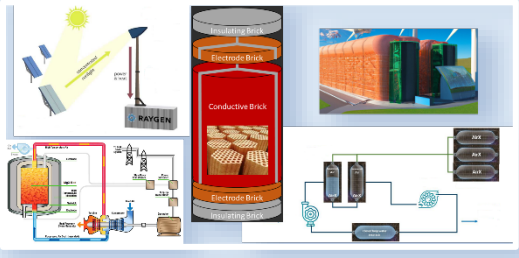
Supplemental Project Notice

COSTS AND PERFORMANCE OF EMERGING BULK ENERGY STORAGE TECHNOLOGIES



Examples of emerging bulk energy storage technologies

PROJECT HIGHLIGHTS

- Assess emerging bulk energy storage technologies that can move the needle on costs and/or performance
- Uncover new insights on long-duration energy storage technology design, cost, and performance
- Inform decision-making by performing multiple techno-economic studies on different bulk energy storage technologies

Key Research Question

Energy storage is a key enabler for a low-carbon future. As more variable renewable energy (VRE) in the form of solar and wind is installed and fossil power is displaced, substantial energy storage will be needed to provide grid stability and reliability. Energy storage can shift energy in time, storing excess energy when available, and then provide it later when needed. Energy storage can also provide critical ancillary services like spinning reserve, capacity, and frequency response, and can contribute to system inertia.

As VRE continues to grow, the specifications for energy storage will change requiring larger—or bulk—energy storage plants that provide longer durations of storage. Doing this cost effectively will be critical. Lithium-ion batteries will be challenged to be competitive at long durations, and lower-cost solutions will be needed.

The first set of developing non-battery energy storage technologies have advanced to technology readiness levels (TRL) beyond TRL 5 and have shown promise. Several novel energy storage technologies have emerged that, while less mature, have the potential to have low cost, high efficiency, and/or small footprints. In addition, several recently developed thermal energy storage systems may be able to provide both heat and power.

This project builds on Program 221's "Bulk Energy Storage Costs and Performance" supplemental project (3002021190), where the goal was to perform independent cost and performance studies on selected bulk energy storage technologies. This project will also execute techno-economic studies, but with emphasis on less mature, emerging energy storage technologies that have the potential to be transformational.

This project will focus on mechanical and thermal energy storage technologies. These storage types can encompass different technologies with different operating characteristics. Brief descriptions of each are:

- **Mechanical Energy Storage:** Stores either kinetic or potential energy. These systems are AC-to-to-AC and can be either synchronous or asynchronous. More novel systems include

adiabatic compressed air energy storage and advanced pumped hydro systems.

- **Thermal Energy Storage:** Works by heating up a thermal media to store energy. More novel systems produce heat from phase change or thermochemical reactions or utilize a medium that can be heated to extremely elevated temperatures.

The critical question for power generators faced with increasing VRE penetration and the energy storage needs brought along with it is: What are the costs and performance capabilities of these bulk energy storage systems at commercial scale? This project looks to examine an emerging set of energy storage technologies that can further improve on costs and/or performance.

Objective

This project's objective is to perform multiple techno-economic assessment (TEA) studies on distinct types of novel, less mature, bulk energy storage technologies applied at commercial scale. Technologies will be selected that have potential costs lower than $200/kWhe and/or round-trip efficiencies (RTE) greater than 50%. Other factors will also be considered, such as smaller footprints.

Approach

For this supplemental project, multiple TEAs will be performed collaboratively on a diverse set of novel, less mature, bulk energy storage technologies on a minimum of three and a maximum of six technologies. The final set of technologies will be selected from a list of qualified candidates in collaboration with members. These studies will be based at EPRI's traditional Wisconsin site, which is used for other EPRI cost studies, allowing for better comparisons. For each technology, an independent TEA with an AACE Class 5 cost study will be carried out working with a preferred engineering company. This is a feasibility-level study, appropriate for the lower maturity levels of the technologies. Results will include the process design, RTE, estimated capital and operations and maintenance costs, and an assessment of levelized costs.

Research Value

This project will provide cost and performance data on emerging, novel bulk energy storage technologies designed to be applied at commercial scale. These costs will be independent and objective, and helpful for planning purposes. Funders will obtain cost and performance data on multiple technologies, increasing their knowledge base on bulk energy storage to better assess which technologies might be a fit for their portfolio.

Project members will receive valuable information to help accommodate and enable the drive toward increasing VRE to help meet future low-carbon goals while maintaining grid stability in the most cost-effective way.

Deliverables

- Kickoff meeting to go over the project plan and the associated schedule and review the selected energy storage technologies.
- Quarterly webcasts—including a closeout webcast after the final reports have been published—to provide updates and lessons learned.
- Individual reports on TEA studies for commercial-scale applications of the emerging bulk energy storage for up to six selected technologies. The reports will include details on design, performance, capital costs, maintenance costs, and levelized costs for each.

Price of Project

The price to join the project is $50,000. The price can be paid over two years. This project is eligible for self-directed funds (SDF) and tailored collaboration (TC) funding. Note that three members will be needed for each cost and performance study performed on a selected novel, emerging energy storage technology. For example, conducting the study with five technologies would require 15 members for sufficient funding.

Project Status and Schedule

The start date for this project is September 2023. It is expected to take 12 months to complete.

Who Should Join

Members interested in adding larger-scale, non-battery energy storage to their portfolios should consider joining this project to obtain more accurate costs and performance for planning future bulk energy storage installations and to perform comparisons to other candidate energy storage technologies.

Contact Information

For more information, contact the EPRI Customer Assistance Center at 800.313.3774 (askepri@epri.com).

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