Energy &
Homeland Security

ENERGY STORAGE

Sandia's vision of a modernized grid includes a growing role for energy storage. Sandia's work in energy storage includes diverse research and engineering efforts that range from basic R&D to large-scale demonstrations and deployments. We focus on making energy storage safe, reliable, and cost effective through research innovations of both new and existing technologies.

ENERGY STORAGE FOR A MODERN ELECTRIC GRID

Cost-effective energy storage could solve many of the current challenges faced by the nation's electric grid:

- rapid decarbonization of the power sector
- increasing the number of renewable energy sources and the clean energy they produce
- the growing need for resilience against natural disasters and severe weather events

Modernization of the nation's grid infrastructure is critical for the nation's economic vitality and the ability to achieve a clean energy future.

SANDIA CONTRIBUTION AREAS

Sandia's work in energy storage spans the entire breadth of these challenges by applying expertise in materials research, modeling and analysis, power electronics and power conversion systems, safety and reliability, demonstration projects, and policy and outreach to advance grid-connected energy storage.

Materials research

Our knowledge of material interactions and detailed investigations of critical relationships among structure, property, processing, and performance of materials lead to novel electrochemical systems innovations. Sandia's energy storage teams include multidisciplinary experts in inorganic and organic chemistry, electrochemistry, materials science, and computation. Integration of our efforts with academic and national laboratory partners provides expanded understanding of fundamental battery science, while working with industrial collaborators provides the connection to industry that motivates practical solutions for real-world battery problems.

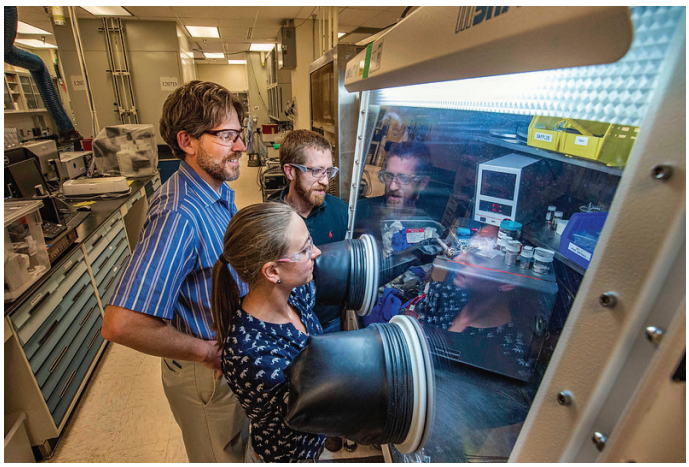
Analytics

Sandia models, develops, and analyzes storage-based solutions to a variety of electrical grid technical challenges such as improving grid reliability and resilience and enhancing renewable energy integration. We developed an open-source Python-based application suite called QuESt to make energy storage analytics research tools available to utilities and other users. Additionally, we manage the DOE Global Energy Storage Database, providing research-grade information on grid-connected energy storage projects and relevant state and federal policies.

Read more about the QuESt application suite for energy storage evaluation at www.sandia.gov/ess/ess/tools-resources/quest.

Power conversion system technologies

Power electronics and power conversion system (PCS) research focuses on developing a flexible, scalable, and highly reliable PCS to support the expanding role of energy storage in power delivery systems. Research efforts in this area range from synthesis and characterization of new power processing materials to full-scale validation of advanced converter topologies and control schemes.



Sandia battery materials researchers at work. Photo by Randy Montoya.

Safety and reliability

Sandia integrates testing expertise and thermal-reaction knowledge to better understand the risks involved in deploying advanced battery technologies. Research includes understanding thermal runaway behavior and its consequences, long-term reliability of batteries and the impacts of degradation

on safety, and multi-scale thermal modeling to understand safety at scale.

We also host https://batteryarchive.org/, an online repository for easy visualization, analysis, and comparison of battery data.

Demonstrations and validation

Sandia is a leading DOE lab in the performance testing, analysis, and implementation of energy storage systems. We review potential projects to evaluate the need and determine the optimal size. We then work with industry to deploy energy storage systems. Sandia also works closely with DOE on the Energy Storage for Social Equity (ES4SE) initiative.

Demonstrations team members test a new battery installation.

Policy and outreach

We engage directly with state and federal policymakers to obtain and share perspectives on best practices in energy storage policymaking. Our mission is to provide independent, objective, and neutral analysis on industry best practices, lessons learned from specific regulatory and legislative proceedings, and cross-state comparisons. Sandia also conducts educational energy storage webinars for state policymakers across the country.

The DOE Global Energy Storage Database, which Sandia hosts and manages, provides research-grade information on grid-connected energy storage projects and relevant state and federal policies.

Learn more at sandia.gov/ess-ssl/gesdb/public.

UNIQUE R&D FACILITIES

The Advanced Power Electronic Conversion Systems (APEX) Laboratory supports the development of advanced power conversion topologies and intelligent control strategies. Research focuses on robust and fault-tolerant conversion systems for utility-scale energy storage. Applications of interest range from individual cell-level battery interfaces to cascaded and modular multilevel conversion systems.

The Battery Abuse Testing Laboratory (BATLab) is a nationally recognized leader in energy storage system safety research, with cutting-edge research programs, the highest quality testing results, and leadership in battery safety and reliability. In addition to core battery abuse testing capabilities, the BATLab is home to the most comprehensive battery calorimetry laboratory, battery component analytical and diagnostic capabilities, and extensive failure-analysis and characterization tools.

The Energy Storage Test Pad (ESTP), in conjunction with the Energy Storage Analysis Laboratory (ESAL), provides long-term performance testing and validation of electrical energy storage systems.

STRATEGIC PARTNERSHIPS

Sandia's work strongly supports knowledge-share as we collaborate extensively with a variety of organizations and institutions that are all focused on advancing the field of grid energy storage. We partner with industry, universities, and other national laboratories to propel forward the development and integration of energy storage technologies in the electric grid infrastructure.

FOR MORE INFORMATION

Learn more about our entire scope of our program at Energystorage.sandia.gov.

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U.S. DEPARTMENT OF ENERGY NNSA National Nuclear Security Administration

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