



Battery Technologies

Our Expertise

Materials Synthesis | Thermal Management | Machine Learning | Life Span Modeling | Safety Assessment | Systems Evaluation | X-Ray Diagnostics | Computer Engineering

The Need

Supporting Nationwide Electrification

A new era of electrification is on the horizon, and batteries play a critical role in storing energy from renewable sources to supply electricity for transportation, buildings, and grid applications. Emerging battery technologies must focus on reducing costs

while maintaining lifetime, performance, and high energy density. The growing popularity of electric vehicles requires greater energy and power requirements—including extreme fast charge capabilities—from the batteries that drive them.

The Solution

Optimize Battery Designs Across Applications

NREL's energy storage researchers push battery boundaries with cutting-edge imaging, modeling, and analysis tools to better understand the physical, chemical, mechanical, and structural properties of energy materials and storage systems.

NREL capabilities include:

- Evaluating and synthesizing novel battery materials.
- Optimizing battery architecture using state-of-the-art X-ray imaging.

- Developing new manufacturing techniques to reduce formation time while enabling extreme fast charging.
- Conducting battery lifetime prediction and optimization with physics-based machine learning and advanced computer modeling.
- Understanding battery failure characterization through modeling and experimentation to ensure system safety.
- Investing in the circularity of battery materials through reuse and recycling.

The Impact

Affordable, Reliable, and Safe Energy Storage

NREL's groundbreaking battery characterization methods have advanced our fundamental understanding of energy materials, accelerating the evolution of battery technologies. NREL's comprehensive approach encompasses materials innovation, system integration, performance, and safety evaluations. NREL research is driving the increased adoption of electric vehicles with extreme fast charging, reducing dependence on critical materials with

next-generation materials, and supporting nationwide electrification with integrated behind-the-meter storage systems.

Furthermore, NREL is at the forefront of lithium-ion battery recycling initiatives, leading the U.S. Department of Energy's ReCell Center and Lithium-Ion Battery Recycling Prize to ensure a more sustainable future for energy storage.

Partners

Denso | Ford | Hyundai | NASA | Shell | U.S. Advanced Battery Consortium | U.S. Department of Energy | U.S. DRIVE