

Future of battery storage technology

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Lithium-ion batteries keep getting better and cheaper, but researchers are tweaking the technology further to eke out greater performance and lower costs. Some of the motivation comes from the ...

From more efficient production to entirely new chemistries, there's a lot going on. The race is on to generate new technologies to ready the battery industry for the transition toward a future...

While still in the research phase, advancements in electrolyte and electrode materials are paving the way for future applications. Implications for the Future. These emerging battery technologies hold the promise of transforming energy storage, impacting industries from automotive to consumer electronics.

As the world transitions to renewable energy, 2024 has been pivotal in advancing sustainable battery technology. Several promising innovations and trends are helping reshape the industry, making it possible to eliminate widespread dependence on fossil fuels to power everyday life. 1. Lithium-Sulfur Batteries. The rise of electric vehicles (EVs ...

Chemistry scientists Cyrus Kirwa and Jaclyn Cole conduct research into redox relithiation, a form of battery recycling and one of numerous battery research initiatives at NREL. Photo by Werner Slocum, NREL

In the 200 years after its invention, the extraordinary battery has undergone significant evolutions to meet modern applications. These self-contained energy sources are key to our increasingly connected society, powering our communication and transportation networks.

With the shift to renewable energy, a new era of electrification is on the horizon, supported in large part by the breakthrough battery designs that researchers at the National Renewable Energy Laboratory (NREL) believe are at our fingertips.

"NREL's battery research team brings together a diverse range of experts--physicists, chemists, and engineers--to meet complex challenges in energy storage," said NREL Senior Energy Storage Engineer Matt Keyser. "Our research spans the scale of technology readiness and battery research, from atom-scale materials science to full-scale systems."

From left, Kandler Smith, Matt Keyser, and Andrew Colclasure lead the electrochemical energy storage research at NREL, providing a holistic approach to modeling and diagnostics, materials development, and battery safety. Photo by Werner Slocum, NREL

Today's predominant choice for advances in energy storage, lithium-ion (Li-ion) batteries gained popularity as a lighter and more powerful alternative to lead-acid or nickel-metal hydride designs. These batteries allow

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users to control energy flow for repeated, high-speed charging and discharging--powering everything from cell phones to laptops, electric vehicles (EVs), and large-scale stationary storage. Ongoing research at NREL continues to refine Li-ion batteries to meet the unique needs of different applications.

What does the future of battery storage hold? In the transition to a more electrified society, batteries will play an essential role in helping store energy from renewable sources to supply electricity for buildings, transportation, and grid applications. Emerging battery technologies must focus on reducing costs, while maintaining lifetime and density performance. Using ultramodern capabilities and world-class laboratory facilities, NREL's energy storage researchers continue to push battery boundaries with materials development, thermal management, diagnostics, and modeling.

Silicon may be one of the next big battery material upgrades. As EVs continue to gain popularity, researchers have identified silicon as a promising opportunity to increase the energy density of vehicle batteries. Recent research from the NREL-led Silicon Consortium Project (SCP) has found that replacing the graphite typically used in Li-ion battery anodes with silicon may pave the way to reduce battery pack size by 25%-30% and increase driving range by 30%-40%.

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