Accelerating Innovation in Energy Storage

How PNNL combines cutting-edge science with end-use domain expertise to speed the development, validation, and implementation of next-generation battery technologies.

Pacific Northwest NATIONAL LABORATORY

Durable, low-cost energy storage is a necessary enabler for the broad decarbonization of the nation's energy system and the green electrification of the global economy. In partnership with industry, academia, and other research organizations, PNNL is leveraging a distinctive competency in battery materials and systems to accelerate the discovery, development, and validation of next-generation energy storage systems that will deliver advanced performance at lower costs, and with higher reliability than today's batteries.

ENABLING A CLEAN, FLEXIBLE, RESILIENT U.S. POWER GRID

Affordable grid-scale energy storage is a requirement for broad decarbonization of the electricity supply and building a more resilient and flexible power grid. To meet aggressive carbon reduction goals in the next decade the innovation cycle for new battery technologies must be greatly accelerated, requiring discovery informed by end-use and an R&D process that is streamlined by computational modeling and data analytics, and the use of state-of-the-art research tools.

PNNL's signature capability in grid storage technologies is based on a deep knowledge of how the grid works and how energy storage can best be deployed to achieve the nation's resiliency, flexibility, and decarbonization goals. Under the leadership of DOE's Office of Electricity, PNNL has supported more than 26 MW and 100 MWh of storage deployments and assessments across the country, engaging with industry stakeholders, utilities, regulators, and policymakers to develop a thorough understanding of the potential value energy storage investments can provide to the power grid. PNNL is also leading stakeholder engagements focused on the reliability and safety of new grid energy storage technologies.

In the laboratory, PNNL is pioneering the use of physics-informed data models, combined with artificial intelligence and machine reasoning, to enable faster identification of the most promising battery materials from the millions of potential candidates. PNNL is using these tools to create new battery technologies for low-cost, long-duration grid energy storage applications and, in one case, has created a promising organic molecule that has demonstrated more than four months of stable cycling in lab tests.

Recognized as a leader in grid-scale energy storage, PNNL was recently selected to be the home of the DOE Office of Electricity's Grid Storage Launchpad, a new 85,000 ft^2 R&D facility that will support collaboration of scientists and engineers from across the nation to accelerate the development and validation of grid energy storage materials and technologies. Construction of the new facility—supported by additional investments by the state of Washington, Battelle, and PNNL—is scheduled to begin this year and be completed in 2023.

DRIVING DECARBONIZATION OF TRANSPORTATION SYSTEMS

Transportation is currently the fastest growing source of CO_2 emissions in the United States. Creating the battery systems that can enable widespread electrification of the nation's light- and medium-duty vehicle fleet at an affordable cost will contribute significantly to our ability to achieve net-zero carbon emissions by 2050.

At PNNL, battery experts are focused on identifying and resolving the fundamental challenges in battery materials and systems that hinder their large-scale deployment in electric vehicles. As the leader of the DOE's Battery500 Consortium, PNNL is successfully addressing fundamental barriers in materials and materials integration to enable safe next-generation high-energy lithium metal batteries that can double the driving range of electrical vehicles at a significantly reduced cost. To date, the Battery500 Consortium has achieved more than 100 stable cycles in a 400 Wh/kg lithium metal battery through innovation in electrolytes, electrode architectures, and cell design and fabrication.

PNNL is also a key partner in DOE's Joint Center for Energy Storage Research, or JCESR. This partnership focuses on delivering the fundamental science breakthroughs that can provide an accelerated path to the design and development of new materials for next-generation batteries that feature better performance and longer lifespans for a diversity of applications.

CREATING A COMPETITIVE ADVANTAGE FOR U.S. MANUFACTURING

Translating innovation in energy storage to the manufacturing sector, to create a strong domestic manufacturing base, will create millions of new, high-quality jobs, and assure that the best batteries are built in the United States for export to the world.

Leveraging the innovation and expertise created in the laboratory through the discovery and development of new battery materials and systems, PNNL scientists and engineers work directly with domestic industry partners to develop, validate, and demonstrate scalable manufacturing approaches for emerging battery materials and technologies. PNNL's Grid Storage Launchpad is designed to facilitate these collaborations with a full complement of capabilities to accelerate translation of fundamental science discoveries into practical devices; demonstrate the scalability of devices to de-risk the technology for industry; and validate new technologies under realistic service conditions, as defined by end-use stakeholders. For example, PNNL is currently working with a specialty chemical manufacturing company to scale up synthesis of single crystal Ni-rich cathode materials that will pack at least 25% more energy into tomorrow's Li-ion battery technology.

ABOUT PNNL

Pacific Northwest National Laboratory advances the frontiers of knowledge, taking on some of the world's greatest science and technology challenges. Distinctive strengths in chemistry, Earth sciences, biology, and data science are central to our scientific discovery mission. PNNL's research lays a foundation for innovations that advance sustainable energy through decarbonization and energy storage and enhance national security through nuclear materials and threat analyses.

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February 2021
PNNL-EX-10248

Pacific Northwest
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