

# ELECTRICITY INFRASTRUCTURE

*Modernizing the power grid to accelerate decarbonization. Developing innovative technologies to make the grid more resilient, reliable, and secure. Partnering with industry to deploy solutions and validate outcomes.*

## PRIORITIES

New grid architectures to support decarbonization, resilience, and security

Artificial intelligence and machine learning for real-time sensing, analytics, and control

Scalable transactive control to manage energy demand

Grid cyber situational awareness and response

Next-generation grid-scale energy storage technologies

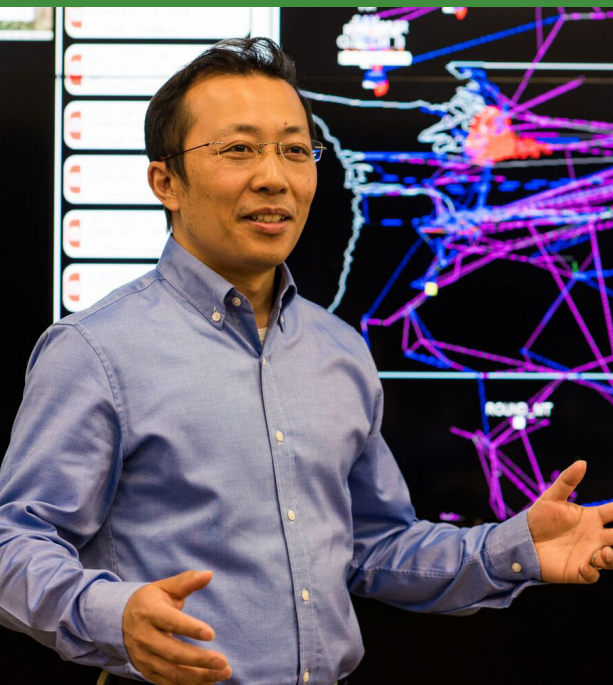
High-resolution real-time tools and grid data sets to validate new technologies





## MISSION

The power grid plays a central role in our nation's economic prosperity and national security, while providing comfort, convenience, and safety to 330 million Americans. But the power grid must be transformed to meet the challenges of a rapidly changing energy landscape. Pacific Northwest National Laboratory (PNNL) is committed to being the national R&D leader in helping the nation build a cleaner, more resilient, and secure power grid.



## WHAT WE DO

PNNL scientists and engineers focus on enabling more clean energy resources, while also improving the resilience, security, and flexibility of the nation's power grid. This means building resilience against all challenges and threats, including natural disasters, cyberthreats, and resource intermittency. It means developing cyber solutions to identify and mitigate threats across both information technology and operational technology systems. And it means providing grid operators with the situational awareness and control capabilities they need to plan and manage a rapidly changing energy resource mix.

We achieve these outcomes by delivering real-time grid management tools and architectures; accelerating development of grid energy storage; improving building efficiency and grid resiliency through transactive energy controls; and providing national-scale cyber awareness and response.

From basic research to field deployments, we collaborate with industry stakeholders. We apply new technologies, such as exascale computing, artificial intelligence, machine learning, and novel approaches to materials science to solve key grid modernization challenges.

While much of our research takes a longer-term view of what the grid will require in a decade or two, PNNL's commercialization portfolio has many licensable and open-source tools and technologies that utilities and technology vendors can put to use today to improve operations and accelerate time to market.

## KEY PROJECTS

- North America Energy Resilience Modeling
- Energy Storage Materials Initiative
- Advanced Grid Modeling Program
- Data Model Convergence Initiative
- Resilience through Data-driven, Intelligently Designed Controls
- Cybersecurity Risk Information Sharing Program

## FACILITIES

Electricity Infrastructure  
Operations Center

Building Operations  
Control Center

Systems Engineering  
Building

Power Electronics  
Laboratory

Energy Sciences  
Center

Grid Storage  
Launchpad

# Grid Modernization Laboratory Consortium

PNNL co-leads the Grid Modernization Laboratory Consortium, a group of 14 national laboratories that works in collaboration with more than 200 industry partners on national grid modernization goals set forth in the DOE's Grid Modernization Initiative's Multi-Year Program Plan.



## Grid Storage Launchpad

The \$75 million Grid Storage Launchpad facility at PNNL is scheduled to be completed in 2023. As a U.S. Department of Energy Office of Electricity R&D facility for the nation, the GSL will accelerate next generation grid energy storage technologies through independent testing and validation of performance under realistic grid operating conditions.



## ACCOMPLISHMENTS



### A Roadmap for Tomorrow's Power Grid

PNNL's groundbreaking grid architecture work has been adopted in at least 26 states and in multiple countries to support decarbonization and other grid modernization outcomes. The reference architectures and principles are used widely by utilities, including at Duke Energy, HECO, and the NY DPS/Joint Utilities, and almost half of U.S. state regulatory bodies.



### Speeding Recovery Following Extreme Events

Using an artificial intelligence driven analysis of imagery from satellites and other sources, PNNL's Emergency Response team has provided emergency responders and utilities with timely, detailed damage assessments to energy infrastructure for more than 40 natural disasters, including wildfires, hurricanes, floods, and earthquakes in the last three years.



### Integrating More Clean Energy Resources

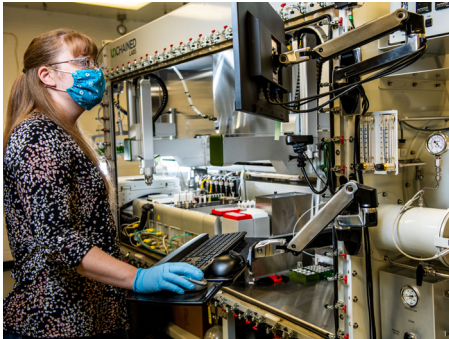
Scheduling generation for the day-ahead electricity market is an increasing challenge for grid operators amid continually increasing distributed energy resources. To help solve this problem PNNL partnered with MISO and other industry partners to develop a solution that executes these complex calculations 35x faster, while also guaranteeing cost within 0.1 percent of optimal.

# ACCOMPLISHMENTS



## Understanding Impacts of Transactive Energy

PNNL scientists are doing high-fidelity simulation of transactive energy control impacts at scale on customers, distribution, and bulk system operations based on the ERCOT market in Texas. The study quantifies the economic and operational impacts of transactive energy in status quo, as well as medium- and high-distributed energy resource penetration scenarios.



## Accelerating Grid Energy Storage

Making grid energy storage cost effective requires new materials and battery system designs. PNNL is taking a new R&D approach by utilizing digital twin technology and physics-informed database models to accelerate analysis of tens of millions of potential chemistry combinations and more quickly identify the most promising candidates for further testing and development.

# CONTACTS

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# ABOUT PNNL

Pacific Northwest National Laboratory draws on signature capabilities in chemistry, Earth sciences, and data analytics to advance scientific discovery and create solutions to the nation's toughest challenges in energy resiliency and national security. Founded in 1965, PNNL is operated by Battelle for the U.S. Department of Energy's Office of Science. DOE's Office of Science is the single largest supporter of basic research in the physical sciences in the United States and is working to address some of the most pressing challenges of our time.