



# Electrification and Energy Infrastructures

The Electrification and Energy Infrastructures Division (EEID) focuses on developing innovative capabilities for electric energy devices and systems. EEID is targeting breakthroughs to improve the reliability, sustainability, and efficiencies of energy systems, electric grid protections and controls, and advancements in power electronics. The division comprises internationally recognized staff who possess expertise encompassing nearly all areas of applied science and engineering.



*At ORNL's Grid Operations Analytics Laboratory, scientists are developing breakthroughs in monitoring, modeling, controls, and hardware to enhance power grid security and resilience.*

## Innovating Energy Systems

Our core programs address critical scientific challenges in 13 interdisciplinary research themes across the dimensions of energy, global and regional change, and sustainability.

**Emerging and Solid-State Batteries**—Conceives, researches, and develops disruptive chemistries and materials for high energy and power density solid-state batteries and emerging electrochemical storage systems.

**Energy Storage and Conversion Manufacturing**—Develops advanced manufacturing schemes and pilot-scale devices into emerging energy storage and conversion research.

**Electronics & Embedded Systems**—Conducts advanced research, development, test, and evaluation of electronic devices and systems.

**Power Systems Resilience**—Conducts transformational R&D for energy security and resilience through advancement of modeling, simulation, and real-time monitoring of the electric grid.

150  
Staff

13  
Core research  
groups

112  
Patents\*

174  
Invention  
disclosures\*

34  
IEEE senior  
members

\* past 5 years



"We're pushing the envelope with our science and technology, while matching our capabilities with others at the lab to create stronger R&D teams."

**Rick Raines, Director, Electrification and Energy Infrastructures Division**

**Grid Components and Controls**—Designs, develops, and implements advanced control systems (e.g., microgrids, protection and controls) and integration of novel energy system components.

**Power Electronics Systems Integration**—Designs, develops, and deploys power electronics for grid-connected systems through packaging, magnetics, hardware prototyping, system architecture, and integration (e.g., power electronics-based substation), and real-time power electronics systems simulation.

**Grid Communications and Security**—Conducts the research, development, testing, and evaluation of modern communication devices and systems for energy applications.

**Grid-Interactive Controls**—Designs, develops, and deploys advanced control algorithms and methods for building energy efficiency and grid connectivity.

**Electrical Signals and Processing**—Designs, develops, and deploys state-of-the-art signal capture, interrogation, and analysis techniques for energy systems characterization and security applications.

**Sensors and Controls**—Designs, develops, tests and evaluates sensor devices and sensory systems for real-time situational awareness.

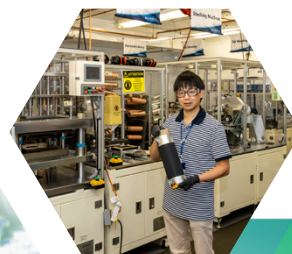
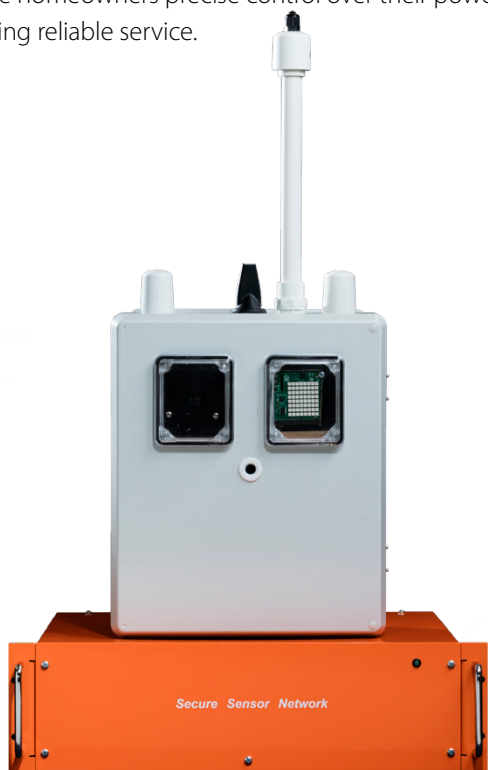
**RF & Intelligent Systems**—Designs and develops advanced and intelligent systems using radio frequency communications and machine learning for small electromagnetic signature systems.

**Energy Systems Analytics**—Designs, develops, deploys, and analyzes advanced machine learning and decision science algorithms and techniques for energy applications.

**Multimodal Sensor Analytics**—Conducts advanced research, design, and development of algorithms and systems employing computational sensing approaches with images and signals.

## Strengthening Grid Security and Resilience

EEID's staff works closely with public and private partners to develop breakthroughs for the resilience and security of one of the nation's most critical assets: the power grid. ORNL's close working relationship with the Chattanooga Electric Power Board has resulted in a living laboratory where EEID breakthroughs in visualization and monitoring are being tested and implemented to create one of the most modern, efficient, and secure grid networks in the nation. We are working with Southern Company on two Smart Neighborhood projects in Alabama and Georgia where EEID technology is managing microgrid resources—solar power and battery energy storage—as well as smart home appliances to give homeowners precise control over their power supply and demand at a lower cost while ensuring reliable service.



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