



ENERGY SYSTEMS  
INTEGRATION FACILITY

U.S. DEPARTMENT OF ENERGY



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## Energy Storage Laboratory

At NREL's Energy Storage Laboratory in the Energy Systems Integration Facility (ESIF), research focuses on the integration of energy storage systems (both stationary and vehicle-mounted) and interconnection with the utility grid. Focusing on battery technologies, but also hosting ultra-capacitors and other electrical energy storage technologies, the laboratory will provide all resources necessary to develop, test, and prove energy storage system performance and compatibility with distributed energy systems. The laboratory will also provide robust vehicle testing capability, including a drive-in environmental chamber, which can accommodate commercial-sized hybrid, electric, biodiesel, ethanol, compressed natural gas, and hydrogen fueled vehicles. The Energy Storage Laboratory is designed to ensure personnel and equipment safety when testing hazardous battery systems or other energy storage technologies. Closely coupled with the research electrical distribution bus at ESIF, the Energy Storage Laboratory will offer megawatt-scale power testing capability as well as advanced hardware-in-the-loop and model-in-the-loop simulation capabilities.

### Laboratory Specifications

- This laboratory provides 9,600 sq. ft. of space
- Environmental chambers, both medium sized for battery pack, capacitor, and electronics testing, and a very large drive-in environmental chamber
- Wind turbine simulator
- Robust safety design to handle any kind of battery or energy storage system
- REDB plug-in bus connections for easy connection to any ESIF laboratory or resource
- Can accommodate:
  - Floor space equivalent to up to two 20 ft. ISO containers
  - Large commercial vehicles up to city-bus size
  - Large battery systems, power electronics packages, and integrated system tests

- Power conversion equipment for energy storage
- Ultra- and super-capacitor systems
- DC systems, such as commercial microgrids

### Partner with Us

Work with NREL experts and take advantage of the state-of-the-art capabilities at the ESIF to make progress on your projects, which may range from fundamental research to applications engineering. Partners at the ESIF's Energy Storage Laboratory may include:

- Battery manufacturers
- Energy storage system integrators and installers
- Vehicle charging station integrators, vehicle manufacturers
- Utilities
- Certification laboratories
- Government agencies
- Universities
- Other National laboratories

### Contact Us

If you are interested in working with NREL's Energy Storage Laboratory, please contact:

#### ESIF Manager

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### Major Laboratory Equipment

- DC Power Testing Station 250 kW, up to 900 Vdc
- Environmental chamber large enough to drive vehicles into
- Electrical research bus connections
- PV simulator power supply
- Process liquids and gases (natural gas, biodiesel, cooling water, heating water, compressed air)
- Advanced data acquisition and monitoring equipment
- Typical Microgrid system components
- Grid simulator
- AC load banks
- Bidirectional DC supplies
- Research Chiller
- Research Boiler
- SCADA Data Collection and Control System
- PV Simulator

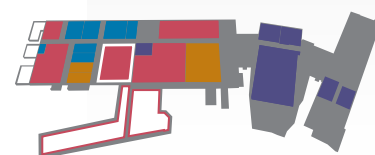
### Application Scenarios

#### The following types of tests:

- Performance
- Efficiency
- Safety
- Model validation
- Long duration reliability

#### Performed on the following equipment types:

- Vehicle batteries (both charging and discharging V2G)
- Stationary batteries



#### National Renewable Energy Laboratory

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