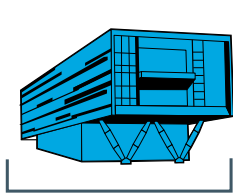
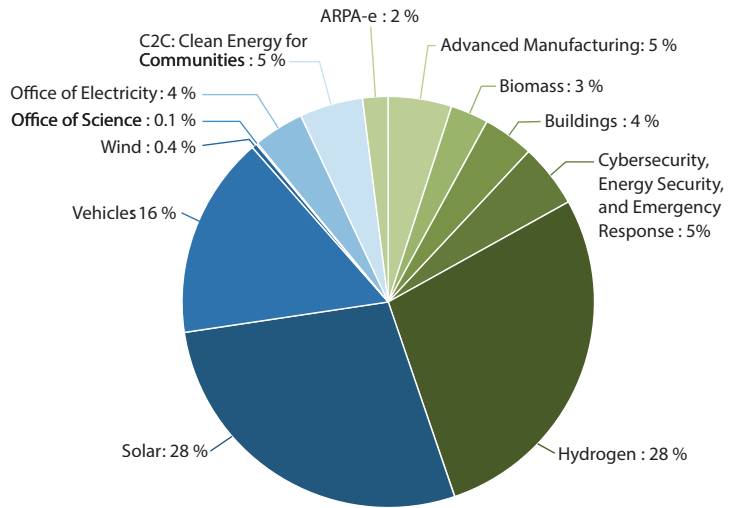




Energy Systems Integration Facility Stewardship Summary: Fiscal Year 2022

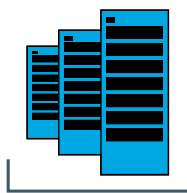
Change is coming fast to energy systems, and faster by the day. Only at the Energy Systems Integration Facility (ESIF) can our science stay ahead of evolving energy systems, and that is thanks to deep investments by the U.S. Department of Energy (DOE) in the National Renewable Energy Laboratory's (NREL's) research capabilities for clean energy. This past year, ESIF researchers directly contributed to scientific breakthroughs in decarbonized transportation and electric vehicles (EVs), smart buildings, hydrogen fueling, control systems, grid management, cybersecurity, and more.

DOE Sponsors of ESIF FY 2022 Projects



164

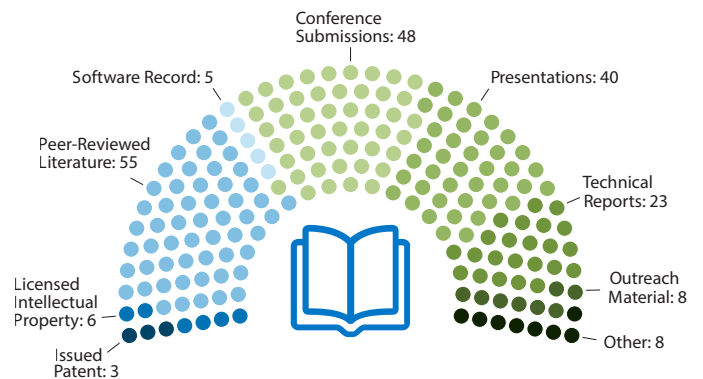
ESIF Laboratories Total Users



555

High-Performance Computer Data Center Total Users

2022 Research Outcomes



Visit the ESIF Stewardship Summary web page for more stories of the facility's capabilities and research. ESIF is a flagship component of the nation's most powerful research capability for clean energy technology validation—NREL's Advanced Research on Integrated Energy Systems platform.



Infrastructure and Capability Upgrades

NREL is constantly modernizing and scaling the ESIF's state-of-the-art capabilities to help researchers develop and validate emerging energy technologies that are secure, resilient, affordable, and clean. These additions were made in Fiscal Year 2022:



NREL acquired a Hyundai IONIQ 5, which represents a new era of EVs with higher power capacities and faster charge times.



A 150-kW Tritium charger brings the ESIF its first DC-fed high-power charging unit, a tool for envisioning the "gas station" of the future.



In the hydrogen laboratories, 12 new low-temperature electrolysis stations allow researchers to study innovations in hydrogen production that enhance performance and reduce capital costs.



A new lithium iron phosphate battery energy storage system (two units at 250 kW each) is ready to power microgrid and grid-edge projects.



NREL researchers developed a robust grid-forming inverter test bed that studies how renewable energy can improve grid stability.



A new thermal energy research asset uses water cooling to assess energy-saving opportunities in buildings.



Construction commenced on the ESIF's new Energy Security and Resilience Laboratory.

Facility R&D Impact

These are a few of the FY 2022 achievements made by NREL researchers and partners from industry, academia, and DOE.

Silica Sand Offers Low-Cost Path to Long-Duration Energy Storage

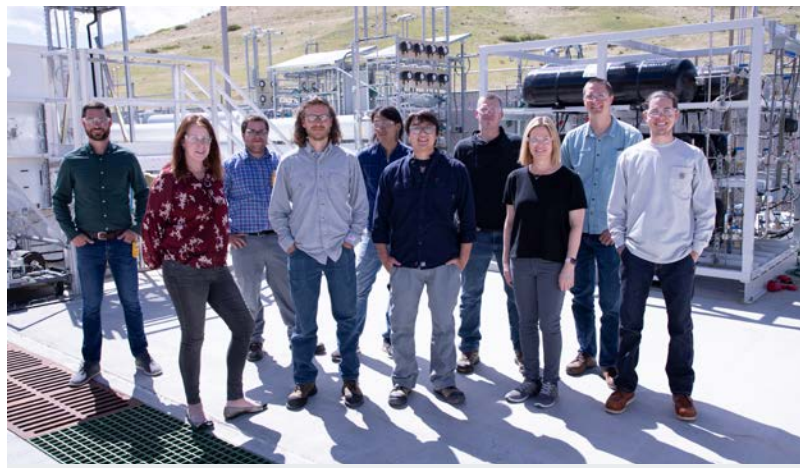
An NREL researcher devised an innovative method of storing excess renewable power in superheated sand until it can be reused for thermal or electric loads.

Sponsor: *Advanced Research Projects Agency-Energy*

Electric Vehicle Manufacturers Mobilize Around Charging Cybersecurity at NREL

Leaders in the EV industry—such as Ford Motor Company, Rivian, BMW, and Eonti—successfully demonstrated digital trust between vehicles and charging stations.

Sponsors: *SAE International and Eonti*



Hydrogen Vehicle Milestone

Last summer, NREL and its industry partners filled a heavy-duty hydrogen storage system, like what would be found on a fuel cell electric semi-truck, with 80 kgs of pressurized hydrogen gas in under 10 minutes. This volume would power a fully loaded long-haul truck for more than 700 miles. The demonstration was a milestone in a field that has mainly focused on light-duty vehicle, and was made possible by DOE's investment in a heavy-duty hydrogen fueling research station at the ESIF, developed in collaboration with industry partners Air Liquide, Honda, Shell, and Toyota.

Industry Partners Demonstrate System Restoration Using Inverter-Based Microgrids

Using the ESIF's Advanced Distribution Management System Test Bed, Central Georgia Electric Membership Corporation and the software company Survalent demonstrated enhanced system recovery and resilience for utility-owned microgrids.

Sponsor: *DOE Office of Electricity*

From Components to Systems, NREL and Partners Enhance Cybersecurity of Solar Power Plants

A multilevel approach allows partners to detect and mitigate cyberattacks on photovoltaic plants.

Sponsor: *DOE Office of Energy Efficiency and Renewable Energy (EERE) Solar Energy Technologies Office*

Auto-Detection of Contaminants Improves Hydrogen Quality

A contaminant detector that checks hydrogen purity after every fill for reliable operation of fuel cell vehicles.

Sponsor: *California Air Resources Board and the DOE EERE Hydrogen and Fuel Cell Technologies Office*