

*Our advanced transportation research involves on-the-road vehicle systems analyses and data integration.*



## Energy and Environment Science & Technology

*Enhancing U.S. competitiveness through clean energy transitions*

In the next 25 years, we will be sharing our planet with more than 9 billion people. This will drive an 80 percent increase in electricity demand. National transitions in power generation, expanded development of renewable energy systems and limited water resources are presenting new global opportunities.

Idaho National Laboratory's Energy and Environment Science and Technology Directorate (EES&T) is responding with innovations in transportation systems, clean energy, advanced manufacturing and environmental sustainability. Each day, the directorate conducts performance science-based research to produce solutions with worldwide impact.

### **Advanced Transportation**

A number of factors are driving efforts to modernize transportation with new vehicles, fuels and manufacturing standards. INL's work to improve energy storage and electric vehicle systems is based on scientific understanding, computational

analysis, experimental design, testing and validation, and uncertainty analysis.

The lab's on-the-road vehicle systems analyses and data integration makes it possible to validate and improve industry designs while helping establish U.S. and international standards for testing, regulation



*INL's Clean Energy Integration program has the ability to model, simulate and test system dynamics at multiple scales.*

Changing the World's Energy Future

*INL experts in chemical and materials separations science are addressing critical resource availability, reuse and material substitution challenges.*



and performance. EES&T also researches fuel cells and hydrogen systems to provide energy storage alternatives.

The Biomass Feedstock National User Facility is helping industry deploy biomass-based fuels and chemicals by providing proof-of-concept tests. The user facility includes an industrial-scale Process Development Unit, a Biomass Feedstock Characterization Laboratory and a Bioenergy Feedstock Library, which houses more than 70,000 samples representing nearly 100 types of crops.

#### **Clean Energy Integration**

To ensure reliable and economic operation of the evolving grid, it is essential to develop new technologies, methods and devices and validate them prior to field deployment.

At the microgrid test bed, INL experts test dynamic storage and load-balancing options. Laboratory engineers are helping put these concepts into practice in isolated U.S. communities and at U.S. military bases around the world.

INL resources also can use real-world data, hardware and software for real-time grid simulations. Research projects can incorporate the lab's electric vehicle charging data and renewable energy generation to create grid-scale simulations. These capabilities also are connected to other national labs and universities to study how electricity can be rerouted across vast distances to address disruptions.

The lab's work is helping accelerate cost-effective integration of clean energy sources, including geothermal, wind, nuclear and solar power. Such hybrid energy systems offer improved economic competitiveness and resource efficiency. INL is building a hybrid energy test bed to understand the technical issues associated with coupling nuclear, renewable and fossil energy sources to produce electrical and nonelectrical energy products.

#### **Advanced Manufacturing**

The manufacturing sector converts a wide range of raw materials and components into finished goods. It also consumes large amounts of energy, water

and other natural resources. EES&T's strategic drivers include lowering energy consumption, securing supplies of critical energy materials and reducing waste.

Advanced manufacturing research relies on process systems science and engineering, coupled with modeling and experimental validation. INL is addressing critical resource availability, reuse and material substitution challenges.

INL is working to develop manufacturing processes with net-zero waste and new ways to convert carbon into useful fuel sources. INL researchers also apply their expertise in performance science to understand how materials behave in harsh environments.

#### **Environmental Sustainability**

Transportation, energy production and competitive manufacturing require new approaches to environmental surveillance and sustainability, including use of autonomous systems. Careful monitoring and mitigation of environmental, energy and water impacts involves greater collaboration among government, academic and industry organizations. INL staff helps ensure nuclear materials from around the world are safely recovered, transported and stored.

#### **Collaboration is in Our DNA**

Making foundational contributions is in our DNA, and INL collaborations include national and international research enterprises. The lab's exceptional talent, INL's modern infrastructure and its effective partnerships are the essential elements of research with impact.

#### **For more information**

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