INL's strategic drivers include lowering energy consumption, securing supplies of critical energy materials and reducing waste.

Advanced Manufacturing

INL research to reduce waste, save energy and secure critical resources

Manufacturing plays a critical role in the U.S. economy, employing millions of people and contributing significantly to the nation's annual gross domestic product and exports. This sector involves converting a wide range of raw materials, components and parts into finished goods. It consumes large amounts of energy, water and other natural resources, such as rare earth metals. Many conventional manufacturing processes also produce waste streams.

Advanced manufacturing is a national science priority with emphasis on partnerships between industry, academia and national labs. To help U.S. manufacturing maintain a competitive edge, INL researchers are developing new processes and technologies to reduce the life-cycle energy consumption of manufactured goods and to ensure critical material supplies. INL's goal is to reduce waste by more than half through increased recovery, reuse, remanufacturing and recycling. INL's historic mission has fostered a number of core capabilities that are ideally suited to solve these challenges.

Reducing Waste

The lab has a rich history of expertise in chemical separations, solvent extraction, membrane technology, water cleanup and systems engineering.

Limited fresh water supplies and the cost of managing waste streams are two drivers for pursuing manufacturing processes that produce net-zero waste. In fact, advanced water treatment systems could turn industrial wastewater into a resource rather than a disposal cost. Similarly, dairy and sugar farms offer opportunities for agricultural waste recovery, reuse and recycling strategies.

Critical Materials

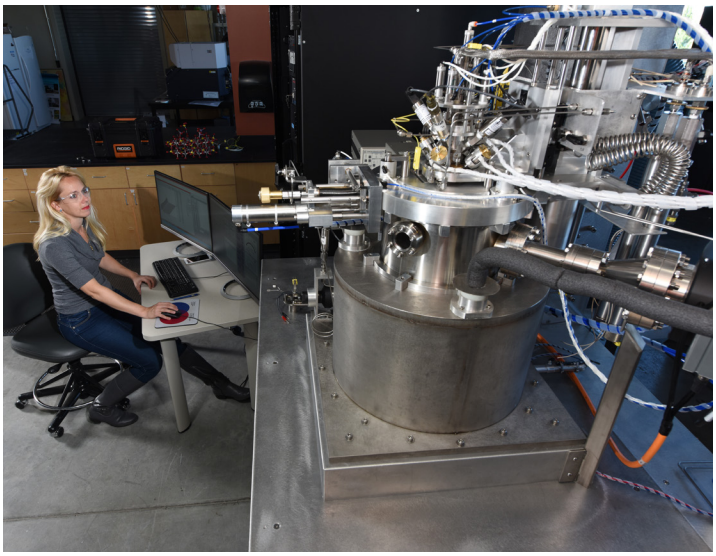
A net-zero waste manufacturing strategy must include end-of-life recycling for consumer products. Recycling efforts for critical materials could produce a host of valuable products, including metals, polymers, fibers and glass. Recovering and purifying critical materials requires advanced chemistry to separate specific elements from complex mixtures.

Changing the World's Energy Future

Idaho National Laboratory

INL research is helping ensure a sustainable domestic supply of critical materials.

The cutting-edge TAP reactor makes it possible to develop catalytic materials that consume far less energy and significantly reduce byproducts and waste.



Clean energy technologies could have trouble reaching consumers if a shortage of critical materials creates high or volatile prices. INL is helping ensure a sustainable domestic supply by developing technologies to improve recovery from consumer products, mining processes and coal fly ash. For example, INL helped develop a membrane solvent extraction system licensed to U.S. Rare Earths Inc. for recovering critical materials.

That work was part of the lab's contribution to the Critical Materials Institute, an Energy Innovation Hub the U.S. Department of Energy established in 2013 to assure supply chains of materials critical to clean energy technologies.

Improving Catalysis

Converting biomass to fuels, refining fossil fuels, and manufacturing bulk and specialty chemicals all require energy.

INL researchers are developing novel catalytic processes that use far less energy than conventional methods. Catalysis research at INL focuses on top energy-consuming chemicals, next-generation catalysts and process technologies. INL scientists and engineers have access to distinctive capabilities for catalyst synthesis, reaction testing, characterization, and modeling and simulation.

Advancing High-Performance Materials

INL has a deep history researching and developing strong, reliable materials for the nuclear energy industry. Advanced materials also will be needed for fossil energy, renewable energy and modern manufacturing.

Advanced modeling and simulation capabilities at the lab foster discoveries about how a material's structure, properties and performance are linked. INL research includes investigation of mechanical properties, physical properties, microstructural characterization and nondestructive evaluation.

Distinctive Capabilities

With the TAP — or Temporal Analysis of Products — reactor at INL, researchers can examine individual reaction steps of a complex catalytic mechanism.

Understanding how a material's composition can be used to direct a desired reaction sequence enables researchers to design advanced catalysts to deliver a specific product or chemical. The TAP reactor is located in the Center for Advanced Energy Studies, a public research facility that can be accessed by government, academic or industrial researchers.

For more information

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