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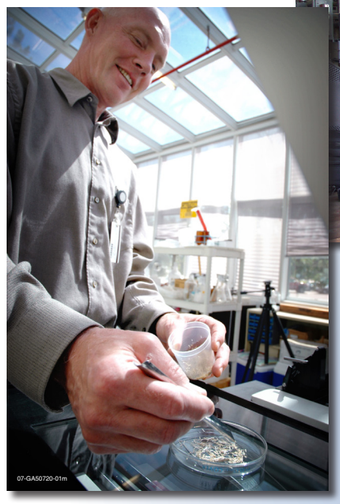
integrate material flows into existing industrial infrastructures. Engineers use virtual computational and experimental fluid dynamics, and finite element stress analysis to provide insight into biomass collection and preprocessing operations.

Customer Base

The development of customer alliances and partnerships based on strategic programs and scientific capabilities are critical objectives. As the directorate focuses human and capital resources on core sciences and engineering applications, the laboratory realizes a direct benefit in the form of greater subject matter competency and competitiveness.

The number of INL customers within the DOE has grown, and includes a variety of national program offices for Science, Biomass Programs, Energy Efficiency/Renewable Energy, Fossil Energy, Industrial Technology, Civilian Radioactive Waste Management, and Environmental Management. In addition, there are federal agency programs and research initiatives within the Environmental Protection Agency, and Departments of Interior, Agriculture, and Defense that are supported.

Examples of INL systems engineering expertise include (clockwise from upper left), the equipment and processes to sustain a supply of biomass feedstock commodities, producing a hydrogen-rich gas from Naval logistics fuels, liquefying natural gas, and monitoring and testing alternative fuels at an alternative fuel filling station that supports advanced internal combustion engine vehicles.



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For more information

Energy and Environment Science and Technology Directorate

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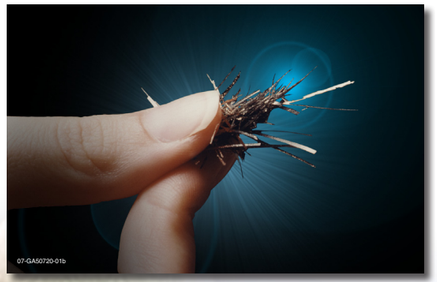

More than 300 scientists and engineers in this directorate perform basic and applied research that leads to clean energy technologies and water resource management strategies.

Energy and Environment Science and Technology

Research leadership for clean energy and water

Uncertainties about energy production and capacity, energy security, and environmental impacts grip our nation and affect our daily lives. The Energy and Environment Science and Technology (EE S&T) Directorate's award-winning researchers address these and many other of the nation's important energy issues. These include developing clean, safe and secure energy resources. This also includes the rebirth of nuclear energy and the integration of energy development with water management and environmental protections.

The directorate researches the development of bioenergy, unconventional fossil and energy storage technologies, and advances energy systems integration covering a spectrum of power-producing systems. It also supports nuclear materials research; testing plug-in hybrid electric vehicle performance; membrane separations science; supercritical fluids research; and ion mobility spectrometry.

Three divisions within the directorate carry out multi-

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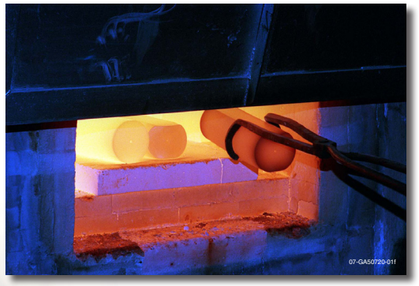
The Energy of Innovation

INL Idaho National Laboratory



autonomous unmanned aerial and ground vehicle operations.

Organization and Structure

The directorate maintains a vibrant portfolio of capabilities related to energy security and environmental protection. These capabilities are aligned with major research programs and are organized into the following divisions.

- **Energy Systems & Technologies** – embodies science and engineering functions related to hybrid energy systems that enable clean, safe and secure energy resource development and carbon management; efficient use of fossil and renewable energy systems; conversion of coal-to-liquid fuel technologies; advanced vehicle testing and transportation technologies; virtual and computational engineering, modeling and simulation; and systems integration.
- **Environmental & Natural Resource Management** – guides development strategies for water and energy development and use; proscribes management of hazardous and radioactive materials, and researches methods to assure that byproducts and wastes from nuclear and non-nuclear energy development can be safely minimized, treated, stored, transported and disposed of; and protects the nation's ability to safely produce and use energy resources.
- **Science & Engineering** – discovers the composition, properties, structures, energy and reactions of known and unknown substances; develops synthetic polymers; fabricates and tests structural materials and welding technologies; devises measurement systems and noncontact sensors; captures and uses organisms living in extreme environments; increases knowledge and understanding of chemical, biological and geophysical processes in subsurface environments; and innovates autonomous robotic/human systems.

Many of EE S&T's scientific and engineering capabilities are aligned with major laboratory programs, such as those represented in the photos above (clockwise from top left):

- ***Advanced polymer nanostructure research***
- ***Wind energy development***
- ***Structural alloy formulation***
- ***Pathogen detection***

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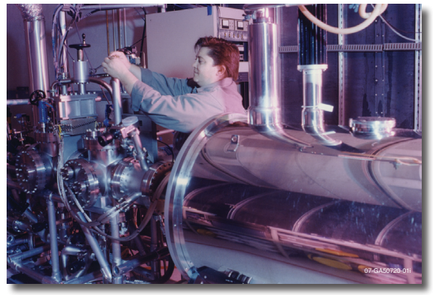
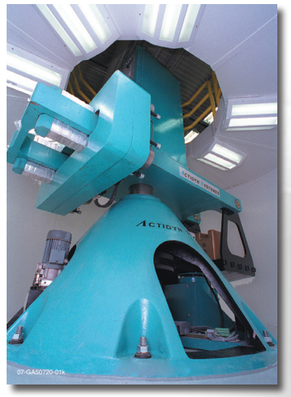
program research and development activities that complement INL missions. For example, research to model coal-to-liquid fuel technology; natural gas liquefaction; multipath contaminant fate and transport modeling; managing the life cycle of carbon; and harvesting nature's biodiversity are in its research purview. Additional projects involve detecting priority pathogens; using extremophiles in industrial processes; developing methods and technologies for hazardous waste management; designing and proving advanced welding systems; and innovating





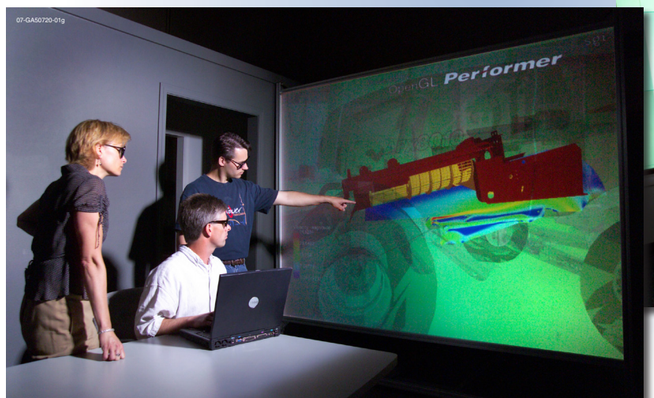
INL's basic science research includes the following features (clockwise from upper left):

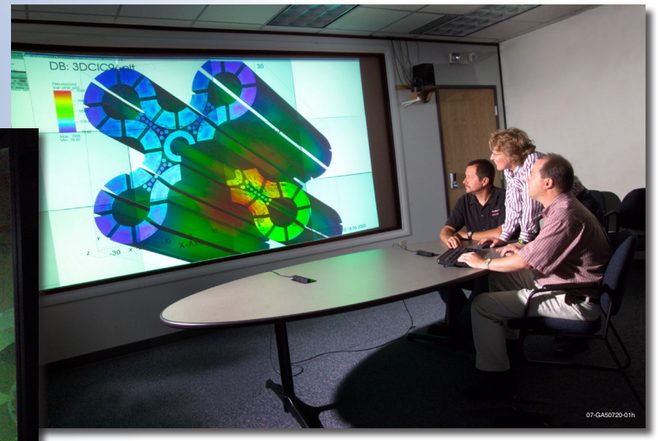
- ***Fourier Transform Mass Spectrometry***
- ***Nuclear materials modeling, testing, and analytical capabilities***
- ***Separations and actinide science facilities***
- ***Microbiological and geological systems science.***

Science Base

By conducting basic and applied research, scientists develop new knowledge, discover characteristics and mechanisms, understand complex systems, and measure and predict targeted behaviors. The quality of this research shapes INL's reputation with its customers. To enable future technological advances, the directorate is building vital programs to establish nationally and internationally recognized research. An example of this is the Biological Systems Department's capacity to identify the genetic makeup of extremophilic organisms that most favorably impact industrial processes.

Engineers use virtual engineering software to accelerate the modeling and design of structural elements and processes to harvest biomass and transform feedstocks into industrial commodities (below); scientists access world-class computational capabilities in INL's Center for Advanced Modeling and Simulation to view results of complex 3-D modeling (right).





Engineering Base

The directorate advances a successful engineering legacy by developing and demonstrating innovative solutions and processes that integrate complex energy systems. A key example of this expertise is INL's Bioenergy Program. This bioenergy initiative promotes the use of discarded plant material, or stover, in the production of biofuels. The processes involved present challenges to mechanize and

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