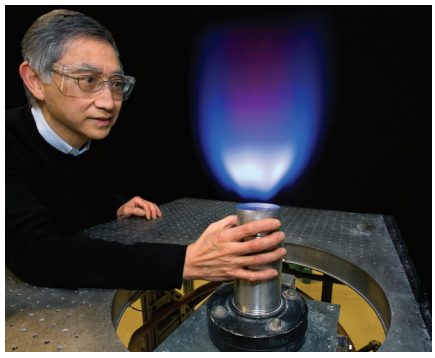
Advanced Scientific Computing for Discovery

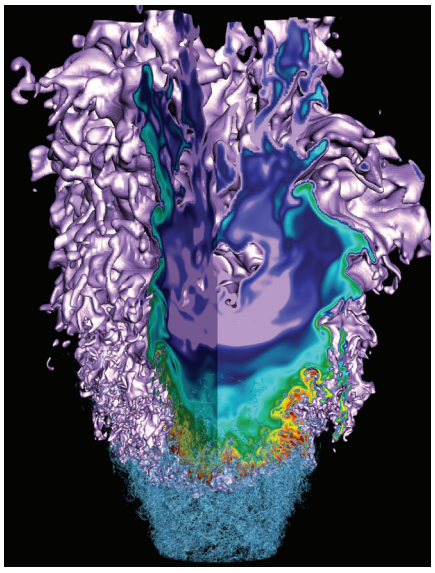
High-performance computers and lightning-fast data networks are transforming energy research. Environmental data from around the globe is collected and analyzed, while computer simulations are used to predict the behavior of everything from materials for batteries to the effects of the changing climate. At Berkeley Lab, a small army of experts — applied mathematicians, computer scientists, as well as chemists, physicists, and biologists — are pooling their talents to solve some of the nation's most important problems. At their fingertips are the supercomputers of NERSC, the National Energy Research Scientific Computing Center at Berkeley Lab, and ESnet, the world's fastest scientific data network, which can transport datasets 10 million times larger than those familiar to consumers using the Web.

Burning Fuel More Efficiently

While Berkeley Lab scientists like Robert Cheng are actively pursuing alternative energy sources, they also recognize that combustion of fuels will remain a centerpiece of heating, transportation, and power generation for the foreseeable future. The idea is to make it much more efficient. Combustion is a mix of chemical processes that occur so quickly they cannot be measured in the laboratory, but new computer simulations are helping to find ways to reduce the amount of fuel burned and its resulting pollutants.

Ultra-efficient, low-swirl burner technology, developed at Berkeley Lab and simulated on NERSC computers is being evaluated for zero-emissions fossil-fuel plant designs.





High-Performance Computing — A Tool for Energy Science

Turning Waste Heat into Electricity

Computer simulations and high-speed data analysis have become indispensible for scientists throughout the field of energy research. Simulations run at NERSC uncovered the hidden talent of a well-known class of semiconductors called highly mismatched alloys. Oxygen impurities allow these inexpensive, Earth-abundant, and nontoxic materials to convert waste heat from power plants and other sources into electricity. The technology could save up to $1 trillion annually and prevent an estimated 500 million tons of carbon emissions.

Finding Hidden Oil and Gas Reserves

Oil and gas deposits can be buried three miles below the ocean floor, under another mile of seawater. But a 3-D modeling technology developed by Berkeley Lab scientists using NERSC is making it possible to uncover with unprecedented accuracy these otherwise hidden resources.

Cracking the Genetic Code for Renewable Energy

The genomes of plants, fungi, and microbes are routinely sequenced by Berkeley Lab researchers at the Department of Energy's Joint Genome Institute (JGI). By decoding this information, researchers can track, model, and replicate the natural processes that convert plant material into biofuels. Massive amounts of this genetic information — more than 60 trillion letters of DNA code each year — are delivered via ESnet to more than 1,700 users worldwide.

Berkeley Lab's New Computational Research and Theory Facility

Berkeley Lab's computer science activities are currently divided between the hillside campus above UC Berkeley and NERSC headquarters in downtown Oakland. These activities will be consolidated in the Computational Research and Theory (CRT) facility, now under construction at Berkeley Lab. The CRT will accommodate supercomputers, associated infrastructure, and approximately 300 staff. Designed to take advantage of the cool breezes of the Berkeley climate, the CRT will set a new standard in energy efficiency for high-performance computing. The CRT is set to open in early 2015.

For more details and the latest news, visit **www.lbl.gov**.

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