Combustion Research Facility

Creating the Science of Clean, Low-Carbon Transportation

In response to the growing demand for clean, low-carbon transportation, the global automotive industry is intently searching for new engines and fuels that can meet the need. For the science to support their solutions, many will turn to the Combustion Research Facility (CRF), an international leader in developing cleaner, more efficient transportation since its creation by the Department of Energy (DOE) at Sandia National Laboratories more than 35 years ago.

Basic knowledge about engine combustion built over nearly four decades at the CRF has made nearly every car on the road today cleaner and more fuel efficient.

Within the CRF, staff and visiting researchers have greatly expanded fundamental knowledge of combustion processes by pioneering research into new science and applied concepts. With a focus on difficult real-world challenges and a mandate to share results openly, the CRF has been instrumental in helping the automotive and trucking industries improve their products. As one industry leader has stated, nearly every vehicle on the road today is cleaner and more efficient because of work at the CRF.

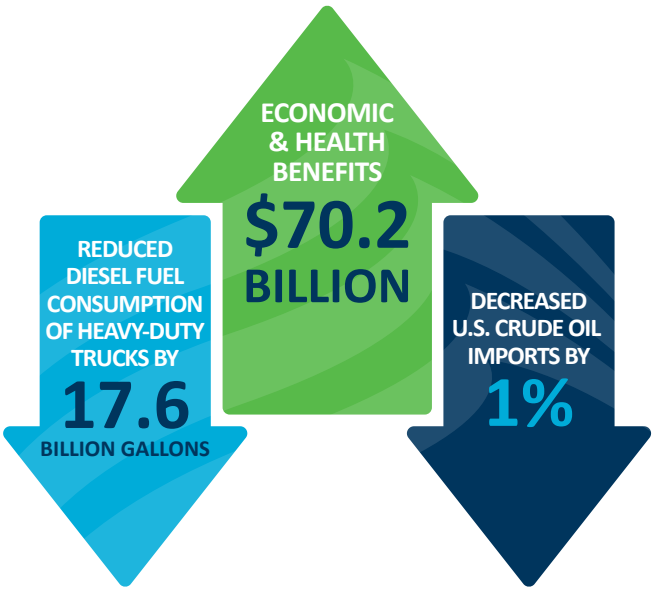
ADVANCES IN COMBUSTION SCIENCE

Improving the environmental profile of engines, which will remain a pillar of transportation for years to come, requires intimate knowledge of thousands of chemical reactions—and the fluid flows that affect them—that take place in engines over micro-seconds. To gain this knowledge, CRF researchers develop advanced laser-based diagnostics and innovative hardware, such as engines with "windows" into their combustion chambers, to apply these laser diagnostics and run an array of experiments.

The researchers then analyze the scientific data from these experiments to create new conceptual frameworks and distill their understanding into open-source computer models that industry can apply to design better performing, cleaner, and more efficient products.

A WORLD OF IMPACT

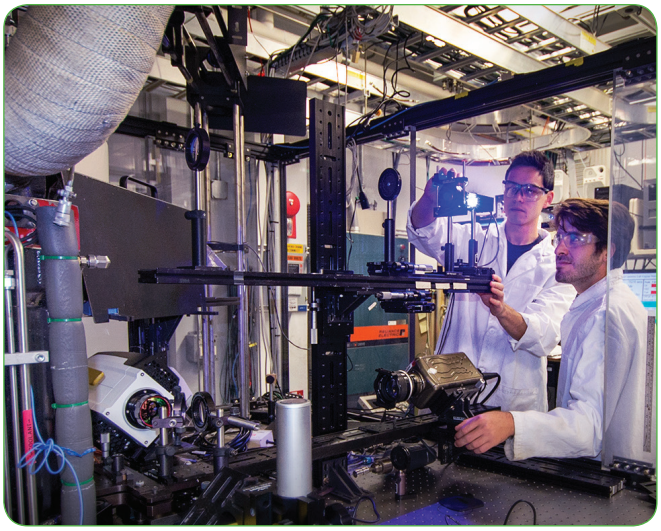
An independent study of just two of the CRF's many research areas—the application of laser and other optical diagnostics to engine combustion, and combustion modeling for heavy-duty vehicles—found that DOE's investment yielded total economic and health benefits of $70.2 billion (in 2008 dollars) from 1995–2007. These gains resulted from CRF work credited with helping reduce the diesel fuel consumption of heavy-duty trucks by 17.6 billion gallons and decrease U.S. crude oil imports by 1%. Further, the knowledge base created at the CRF underlies more than a dozen important technologies, including fuel injection, homogenous charge compression ignition combustion processes, exhaust gas recirculation, and low-emissions diesel fuel formulations.



Besides documenting immense benefits from CRF research, an independent study showed that knowledge created at the CRF underlies many important products, including fuel injectors and low-emissions diesel fuel formulas. *From a 2010 study by Albert Link of the University of North Carolina at Greensboro*

In addition, several industry achievements were supported by CRF collaborations:

- Reduced soot and nitrogen oxide emissions through cleaner, higher-performance engine designs
- Decreased carbon monoxide formation within the engine—a more efficient and economic process than controlling emissions at the tailpipe
- Reduced product development cycles and costs within U.S. industry through increased use of simulations to design new engines



Equipment designed and housed at the CRF allows researchers to observe and record combustion phenomena to create the understanding industry needs to improve engines and fuels.

REFOCUSING THE FUTURE OF TRANSPORTATION

Drawing on its extensive resources, expertise, and networks, the CRF is a major contributor to initiatives aimed at transforming the future of transportation. For example, the CRF is a leader in a national effort to create engines and new fuels, including biofuels, expressly designed to operate together to increase efficiency and reduce greenhouse gas emissions.

To maintain its momentum, the CRF continually pursues collaborations with industry, academia, and government focused on leading-edge research that helps DOE meet national goals and aids industry in resolving challenging technical issues that in turn can impact U.S. economic competitiveness.

To learn more about the CRF's work and collaboration possibilities, contact:

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