VERIFI

10-Petaflop
Supercomputer

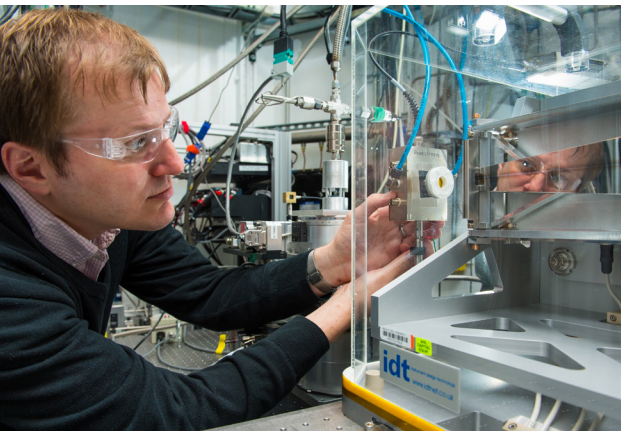
The Virtual Engine Research Institute and Fuels Initiative at Argonne National Laboratory

THE FIRST AND ONLY SOURCE IN THE WORLD FOR

- High-fidelity
- Three-dimensional
- End-to-end
- Combustion engine simulation/visualization and
- Simultaneous powertrain and fuel simulation,
- ***With*** uncertainty analysis!

Argonne
NATIONAL LABORATORY

OPTIMIZE ENGINE COMBUSTION FAST BY HARNESSING THE POWER OF N



ARGONNE'S VIRTUAL ENGINE RESEARCH INSTITUTE AND FUELS INITIATIVE (VERIFI) HAS THE EXPERTISE AND RESOURCES TO DELIVER THE ANSWERS YOU NEED

Harnessing an unequaled multidisciplinary team of experts in high-performance computing, fuel chemistry, combustion science and engine performance with some of the world's fastest supercomputers, most diverse engine labs and world's brightest X-ray beams, VERIFI offers a "Dream Team" environment at Argonne National Laboratory in which to answer your complex engine questions, verify the uncertainties associated with those answers and shrink your development timescales – at a greatly reduced cost. Argonne's scientists and engineers have a long history of successfully working with hundreds of companies to help solve their specific problems, delivering transformational technology and innovation.

YOU SUPPLY THE PROBLEM, VERIFI PROVIDES THE ANSWERS!

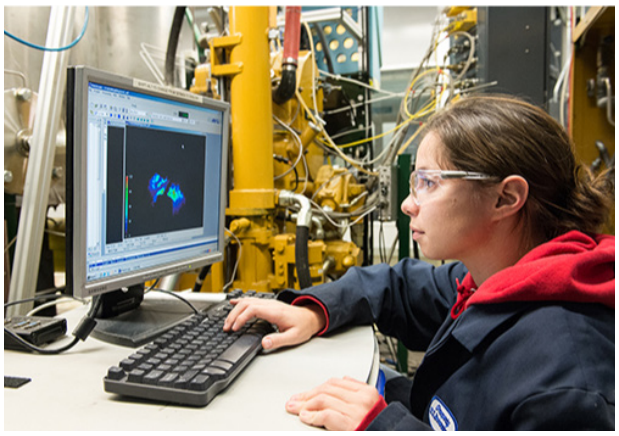
VERIFI'S FUEL CHARACTERIZATION FACILITIES ENABLE TAILORING OF MODEL FUELS

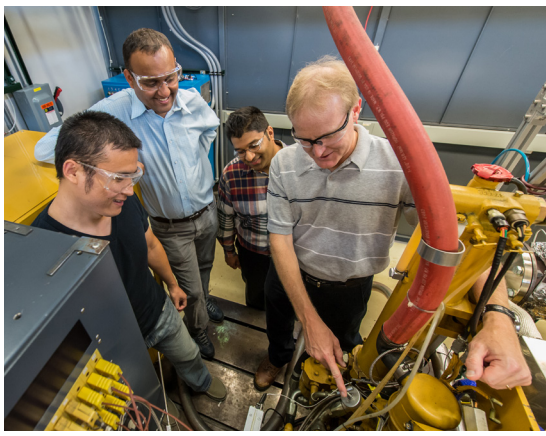
Argonne's array of rapid compression machines (RCMs) allows researchers to characterize critical aspects of real fuels used in combustion engines, encompassing a range of conditions relevant to modern engine operation. Once developed, such model fuels (surrogates) are then validated for use in engine simulations. Argonne's RCM facilities bridge the gap between conventional fuel metrics like research octane (RON)/motor octane (MON) and the specification needs of future combustion engines.

NEW HIGH-EFFICIENCY FUELS

Stringent new fuel efficiency and emissions standards taking effect in the next few years challenge engine manufacturers to find radical new approaches for enhancing combustion engine performance. The traditional method of designing and building a lab full of prototype engines has produced only incremental improvements in fuel economy and is time-consuming and expensive.

How will your company respond?





VERIFI'S WORLD-CLASS CHEMISTS QUANTIFY THE EFFECTS OF COMBUSTION

Argonne's world-class theoretical and experimental combustion chemists build models from first principles and validate them with uncertainty analysis. They work to understand and characterize the web of chemical reactions that takes place in the combustion process for a variety of fuels over a wide range of temperatures and pressures. Using state-of-the-art shock tube, flow reactor and RCM laboratories, they study combustion-like explosions and quantify their flow and chemical effects. The resulting chemical models are incorporated into computer simulations to predict and optimize the performance of combustion engines.

VERIFI'S SUPERCOMPUTERS DO THE "HEAVY LIFTING" OF COMPUTATION AND VISUALIZATION

The Argonne Leadership Computing Facility (ALCF) is home to unparalleled computing resources:

- Mira, a 10-petaflop IBM Blue Gene/Q system, one of the fastest supercomputers in the world
- Tukey, a visualization cluster that converts computational data into intuitive, high-resolution displays that enable engineers to instantly grasp the impact of design changes
- Fusion and Blues, Linux-based machines that run commercial simulation packages

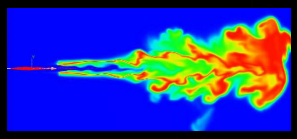
VERIFI'S TESTING CAPABILITIES PROVIDE UNMATCHED EXPERIMENTAL DATA TO VALIDATE SIMULATION MODELS

Using Argonne's "big machines" and tools, such as the Advanced Photon Source and Electron Microscopy Center, VERIFI researchers are uniquely able to see what is happening in fuel sprays, combustion and emissions and apply that knowledge to engine simulations. From there, engine researchers can regulate highly configurable test engines at Argonne's Center for Transportation Research facilities to validate simulation results against precise measurements, under a range of well-controlled operating conditions.

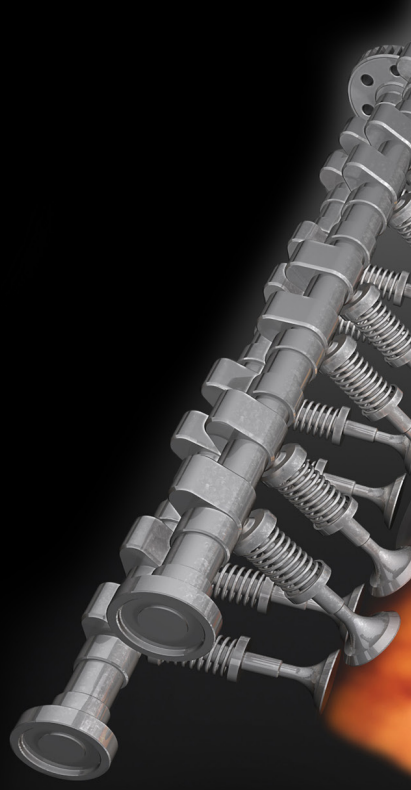
VERIFI'S COMPUTATIONAL SCIENTISTS & ENGINEERS PUT IT ALL TOGETHER FOR YOU

Argonne's highly qualified computational fluid dynamics experts – together with computational scientists – are dedicated to accelerating scientific and engineering breakthroughs. Working together with VERIFI's combustion and engine experts, they deliver **unprecedented high-fidelity, end-to-end combustion engine simulations and visualizations *with* uncertainty analysis — that are unavailable anywhere else in the world!** VERIFI's expertise can be applied to a wide range of engine design challenges.

From new fuels
to fuel injection
to combustion
to power
to emissions...



VERIFI creates design-optimizing simulations that can reduce your financial investment and cut years from your product development cycles.



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U.S. DEPARTMENT OF ENERGY

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