A 3-mile-per-gallon improvement in fuel efficiency may not sound like a big leap, but applied to large, Class 8 trucks it may lower the country’s energy bill by $5 billion. With this goal in mind, BMI Corporation is working to make shipping more affordable and efficient, and with the help of OLCF computing resources it is able to go from concept to product in half the time of traditional research and development.

And the company is not alone.

In an increasingly competitive international economy that presents increasingly complex problems, high-performance computing (HPC) has become an essential ingredient for industrial success. For the last two years, the OLCF has opened its doors to American companies through ORNL’s Industrial High-Performance Computing Partnership Program, giving them the resources to drive innovation at blazing speed.

The program is bringing together some of the brightest researchers in American industry. The partnership helps industry create cutting-edge technologies that may not have been possible otherwise—pushing forward in areas ranging from security to energy efficiency. In addition, collaboration between industry and government works to answer the questions arising from the fast-paced world—continually presenting never-before-seen challenges—that is HPC. Supercomputing has grown exponentially, and the development curve is pointed exponentially upward.

General Motors (GM) is working to boost automobile fuel efficiency by incorporating thermoelectric materials into cars’ exhaust systems, allowing them to capture energy in the form of waste heat that would otherwise be lost. The Boeing Company is employing computational fluid dynamics to model the most efficient airplanes possible. General Electric (GE) is promoting renewable energy by working on the next generation of turbines to power machines in both air and water. And Ramgen Power Systems is designing a product to bury carbon dioxide (CO₂) underground, keeping it out of the atmosphere.

With help from the OLCF, these companies are creating a fleet of next-generation American technologies. HPC has been called a game-changing technology, and with the Industrial HPC Partnership Program, more and more companies will be able to change the game in their own fields.

Shaping the shipping industry

The world is realizing the importance of sustainable energy. As limited resources sustain a continually growing population, innovation in many industries is becoming imperative.

Take transportation, for example. Engineering services company BMI Corporation, based in Greenville, South Carolina, collaborated with its sister company SmartTruck and with researchers from ORNL, the National Aeronautics and Space Administration, and the Boeing Company to improve the efficiency of the country’s biggest gas guzzlers.
BMI’s goal in working with the transportation industry has always been to improve aerodynamics and efficiency, be it on the race track, in the air, or on the interstate. The company collaborated with the Aeron Corporation to design the first supersonic business jet, ran simulations to improve the cruising abilities of the MD900 commercial jetliner, worked with NASA on the Sprint Series vehicles’ aerodynamic profiles, and helped Ford Motor Company improve aerodynamics for its hydrogen concept cars.

For the last two years, though, BMI has focused on America’s massive fleet of Class 8 tractor-trailers. These 18-wheeler monsters deliver roughly 75 percent of consumer products in the United States every year, some traverse more than 130,000 miles in a year. Unfortunately, they also emit millions of pounds of CO₂ in the process.

“There has not been much investigation into how to make trucks aerodynamic. But we’ve shown we can make big systems very aerodynamic—just look at planes. You can do the same with trucks if you do it right,” said BMI founder and CEO Mike Henderson.

In an effort to reduce tractor-trailer emissions, BMI set out to design a practical add-on to improve efficiency. The company’s SmartTruck UnderTray system is the first phase of a project BMI hopes will change freight transport.

The company needed the power of a supercomputer to do the job, as it learned early on when it ran atmospheric simulations on a computer cluster with 96 processing cores. With that system BMI was unable to simulate the more complex fluid-dynamical models being generated. With Jaguar, however, BMI suddenly had access to 224,000 cores, making previously impossible calculations a reality.

The company’s R&D efforts were an ecletic affair, incorporating supercomputer simulation on Jaguar, aerodynamics testing in collaboration with Boeing and with NASA’s Kennedy Space Centre, and closed-track fuel-efficiency runs. The resulting UnderTray system is a collection of polycarbonate forms strategically placed underneath and on the sides of Class 8 truck trailers. BMI believes it is close to getting trucks over the 9 mile-per-gallon mark—a 33 percent increase in efficiency from today’s most advanced trailers.

Considering that Class 8 trucks travel over 130 billion miles per year, UnderTray technology could lead to a reduction of 16.4 million tons of CO₂ in the atmosphere (about half of China’s total emissions in 2007). It could also cut annual fuel costs by about $13,500 per truck by reducing each truck’s yearly fuel intake by 4,500 gallons.

BMI used the FUN3D fluid dynamics code developed by NASA to simulate wind resistance on trucks, modeling half the truck and trailer using over 100 million grid points. The research team looked for realistic add-ons that could be installed by purchasers on site, giving the more significant improvementsadd-ons that could be installed by purchasers on site, giving the more significant improvements...