

National Applied Energy Simulation Center

Improving Truck Fuel Economy by Computationally and Experimentally Reducing Aerodynamic Drag

The basic configuration of the Class 8 tractor-trailer has not changed in decades. Statistics from 2006 show that, on average, each of the 2.2 million semi-trucks on U.S. highways consume 12,800 gallons of fuel annually—roughly 12% of America’s total petroleum usage. A mere 2% reduction in the aerodynamic drag of these tractor-trailers would save 285 million gallons of diesel fuel each year, greatly reducing fuel costs and greenhouse gas emissions.

Using LLNL’s large-scale computer platforms and advanced fluid dynamics codes, this effort has identified aerodynamic improvements that boost semi-truck fuel efficiency by more than 10%. When implemented, these improvements will save \$8.3 billion annually in fuel costs alone (based on June 2010 retail diesel prices). The results have been validated and verified in wind-tunnel tests conducted in partnership with NASA at the Ames Research Center.

Lawrence Livermore National Laboratory (LLNL) is conducting aerodynamic research on heavy vehicles using its capabilities in high-performance computation (HPC) modeling and simulation. In partnership with industry, this Department of Energy- (DOE-) sponsored initiative couples HPC with physical experimental validation to accelerate the design, prototyping, and deployment of energy-saving



Critical drag-producing regions, such as the trailer base, underbody, and tractor-trailer gap, were assessed using high-performance computing. The resulting aerodynamic improvements could save \$8.3 billion annually in fuel costs alone.

technology, rapidly transforming the 30-year-old tractor-trailer design. The drag-reducing improvements already achieved in this program will be introduced in the marketplace in just over 2 years.

Sponsored by the DOE Office of Energy Efficiency and Renewable Energy’s Vehicle Technologies Program, this effort also seeks to expand collaborations with industry in designing the next generation of highly aerodynamic Class 8 heavy vehicles. To this end, LLNL has already partnered with several key members of industry, including:

- Navistar Corporation, Inc.—tractor manufacturer
- Kentucky Trailer—trailer manufacturer
- Frito Lay—large fleet operator
- Freight Wing, Inc.—developer and manufacturer of aerodynamic devices
- Michelin—manufacturer of low-rolling-resistance super single tires

This effort has already designed and tested several concepts and devices for Class 8 heavy vehicles that reduce drag by more than 20% and boost fuel economy by more than 10%. This translates into 2.8 billion gallons of diesel fuel saved per year, equivalent to roughly 2.5 million tons of CO₂ not released into the atmosphere.