Rising diesel fuel prices have renewed interest in fuel-saving technologies developed during the past decade at the Georgia Tech Research Institute (GTRI). The technologies, based on controlling air flow to reduce aerodynamic drag, could improve fuel efficiency of heavy trucks, potentially saving as much as 2.4 billion gallons of fuel per year.

Diesel fuel prices approaching $5 a gallon – and the resulting economic impact on products transported by truck – have renewed interest in fuel-saving technologies developed during the past decade at the Georgia Tech Research Institute (GTRI).

Use of pressurized air “active flow control” techniques combined with conventional aerodynamic streamlining could improve fuel efficiency by 8 to 12 percent in the heavy trucks used to transport a broad range of products. If installed throughout the U.S. trucking fleet, these technologies could save as much as 2.4 billion gallons of fuel per year.

“The dramatic increase in diesel prices has led the trucking industry to reconsider aerodynamic fuel efficiency improvements that might not have been cost effective only a few years ago,” says Robert Englar, a GTRI principal research engineer and principal investigator for the project. “Though there are technical challenges ahead, we believe our techniques for improving fuel efficiency offer significant potential to reduce the impact of these fuel cost increases. Beyond the trucking industry, that would help consumers who see the effects of fuel costs in everything they buy.”

Since diesel prices began their rapid increase, Englar has seen growing interest in the GTRI low-drag, active-flow-control aerodynamic technologies, which were developed with support from the U.S. Department of Energy starting in the late 1990s. He has received numerous requests for information from both large and small trucking companies.

Aerodynamic drag is the major component of heavy vehicle resistance at typical highway speeds, and overcoming that resistance requires increased energy use. Truck designers have reduced drag on the tractor portion of the vehicles by applying such aerodynamic streamlining approaches as roof fairings, but those have done little to address drag on the aft portion of the trailers.

The researchers have also evaluated aerodynamic improvements that involved rounding aft trailer corners, installing fairings around wheels and making other changes designed to better streamline the trailers.

These active-flow-control techniques are based on aerodynamic research done during the 1980s for applications on U.S. military aircraft. Beyond the fuel savings, they have also been shown to enhance braking and directional control for the heavy trucks without using any moving external parts, potentially improving safety.

“Aerodynamically, we have resolved unknowns raised in earlier testing, and the next step is to get this into a fleet of trucks for more extensive testing,” Englar explains. “At highway speeds, each 1 percent improvement in fuel economy would result in saving about...
200 million gallons of fuel for the U.S. heavy truck fleet. We believe that is worth pursuing.”

The fuel efficiency project began in the late 1990s with tests of simple scale-model tractor-trailers in GTRI’s low-speed wind tunnel. The researchers then applied those principles to a full-sized test truck, working with Volvo Trucks of North America and Great Dane Trailers, manufacturers of the basic tractor and trailer, respectively.

A series of highway-speed test runs at the Transportation Research Center’s Ohio fuel-economy test track demonstrated substantial fuel savings. The tests involved operating a test tractor-trailer for several different 45-mile runs around a 7.5-mile oval track at highway speeds of 65 and 75 miles per hour. A control truck that did not have either the aerodynamic improvements or pneumatic flow control system was operated under the same conditions to provide a comparison. For additional comparisons, the test truck was also run without the experimental blowing equipment.

The tests showed that the techniques could provide drag coefficient reductions of up to 31 percent, which translates to a fuel efficiency increase of 11 to 12 percent. When the energy required by the air compressor installed on the truck to provide the compressed air for these prototype tests was subtracted from those savings, those tests showed that the low-drag techniques could produce an overall fuel efficiency increase of 8 to 9 percent.

Before the pneumatic control system can be widely used in trucks, however, researchers will have to choose the best source of compressed air for the blowing system, Englar notes. Use of a more fuel-efficient compressed air power source, such as direct drive from the axles, should bring the 8 to 9 percent improvement closer to the measured 11 to 12 percent increase in practical application. Other practical issues – such as protecting the pneumatic surfaces from damage during docking – still must be resolved.

Englar is looking for a fleet owner willing to test the concept in real-world conditions. “The ultimate proof would be to apply this overall aerodynamic system to a small fleet of heavy trucks and run them on their normal cross-country routes for a month or so to measure the operational increases in fuel efficiency and safety,” he says.

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- Robert Englar, GTRI principal research engineer

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Fuel-saving technologies developed at the Georgia Tech Research Institute could save the U.S. trucking industry as much as 2.4 billion gallons of fuel each year.