Canadian Trucking Alliance
Alliance Canadienne du Camionnage

Backgrounder:

Truck Efficiency and GHG Reduction Opportunities in the Canadian Truck Fleet

Report of the Study Conducted by the Rocky Mountain Institute (RMI) for the Canadian Trucking Alliance (October 2007)

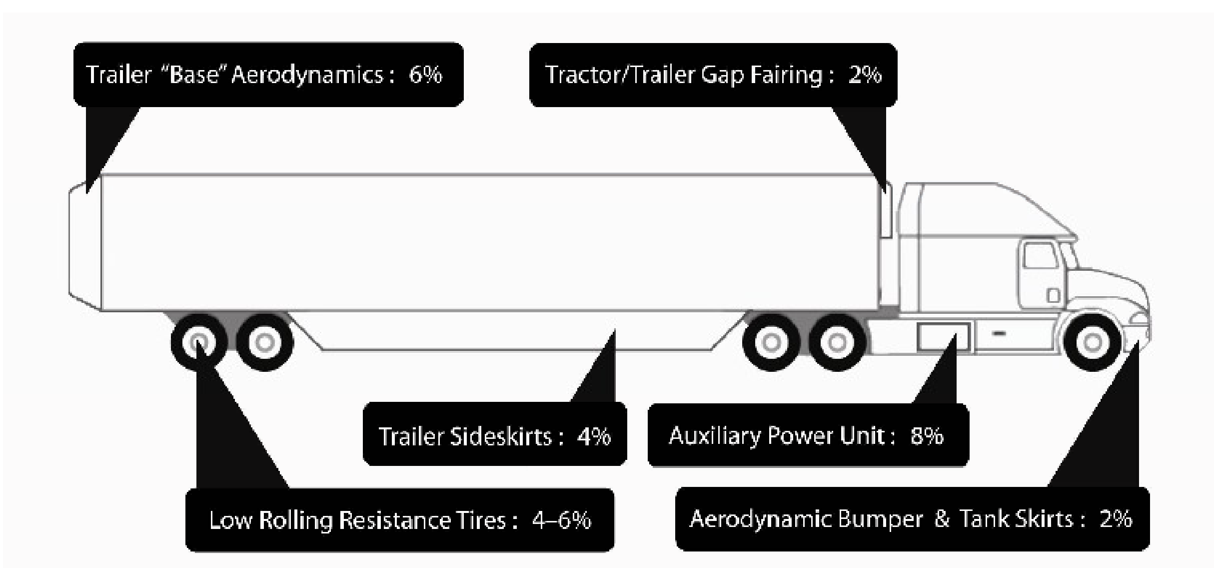
Smog-Free But Lower Fuel Efficiency

New emissions regulations have resulted in changes to engine architecture and after-treatment to control certain pollutants. These changes improve emissions (up to 95% cleaner than previous regulations required) but can cause a 3–8% decrease in fuel economy and similar increases in GHG emissions, depending on operational conditions. To meet 2010 emissions engine makers are considering various strategies including carrying liquid urea on-board and, separately, "next generation cooled EGR" which may also result in fuel economy reductions.

There are opportunities to increase overall truck efficiency to offset the decreases resulting from emission regulations. Only about 6.5% of the energy in each litre of diesel fuel is used to move the cargo and only 4.5% is used to move the tractor-trailer.   To break down where the rest of it goes, for each litre that is poured into the fuel tank, 56% is lost to thermodynamic effects in the engine, 12% due to idling, 2% to driveline and transmission drag, 19% to overcome aerodynamic forces, and 11% to tire rolling resistance. Rather than focus on the diesel engine—a tempting target since more than half of the total fuel energy used by a truck is lost in thermodynamics in the engine— the end of the chain, (is) where the opportunity for compounding savings (is).

Speed

Lower speeds also result in less aerodynamic drag. By simply reducing a truck's speed from 115 km/h to 105 km/h, it is possible to reduce the fuel consumption of the average truck by approximately 7% with no changes to the truck itself. Assuming trucks spend 75% of their time on highways, this speed reduction equates to a savings of 3,100 liters/y and 8.5 tonnes of GHG emissions/y for each truck. If 50% of Canada's Class-8 fleet achieved this result, it would save 460 million liters of fuel and 1.2 million metric tones of GHG emissions each year.



Aerodynamics

Aerodynamic devices can alone result in a 14% fuel savings and save 17 tonnes of GHG. Basic physics tells us that the majority of energy used to move a typical highway truck down the road is used to counter aerodynamic resistance. At 105 km/h, two thirds of the horsepower created by the engine is used to overcome aerodynamic drag. Of that, two thirds, a large portion is caused by aerodynamic drag on the trailer and the tractor-trailer connection. By making changes to the aerodynamics of the trailer it is possible to reduce drag by approximately 20%, resulting in approximately 10% lower fuel consumption for a truck traveling at 105 km/h.

Tractor Aerodynamics —Tractors that incorporate aerodynamic mirrors, full aerodynamic bumpers, and aerodynamic fairings on the fuel tanks typically use 2% less fuel than trucks without these features.[8] Together, we call these devices "Tractor Aerodynamics."

Trailer Aerodynamics -- Untapped energy-efficiency opportunity exists through additional attention to trailers as part of the tractor-trailer system. Approximately half of truck fuel consumption can be attributed to the forces acting on the trailer. In fact, more than 60% of total aerodynamic drag in a tractor-trailer unit is due to the trailer. Using currently available "bolt-on" solutions, the trailer could be reshaped to provide more than a 10% fuel economy improvement to the tractor-trailer system. It is important that the air flow as smoothly as possible as it moves from the tractor to the trailer. "Gap fairings" or "nose cones" on the trailer can deliver a 1–2% fuel savings. Aerodynamic systems attached to the rear of a trailer (known in the automotive community as the trailer's "base" such as "boat tails," or "rear drag devices") offer the greatest single aerodynamic efficiency opportunity. When the truck moves, the amount of drag created at the trailer base is equal to the drag created when air is forced around the front of the truck. Base flap aerodynamic systems have the potential to reduce the fuel consumption of long-haul fleets by 6%[10] and enhance vehicle safety without interfering with trucking operations. Side skirts are available for a variety of trailer styles—including trailers with movable rear axles, spread-axles, flat-beds, and pin-chassis—for container hauling. These devices offer a 4% fuel savings. Combined, the aerodynamic improvements from these three trailer solutions, Gap Fairings, Side Skirts, and Rear Drag Devices deliver a potential fuel savings of approximately 12% during over-the-road operation.

Low Rolling-Resistance Tires -- To move a truck at 105 km/h along a level highway, the average truck engine produces 220 hp (167 kW). Roughly 70 hp (52 kW) is required to overcome the drag caused by rolling resistance in the tires. By choosing tires with a strong emphasis on fuel economy instead of solely on wear characteristics, significant fuel savings are possible. New versions of common "dual tires" that have been designed for reduced rolling resistance can save up to 4% over standard tires. For greater savings, choosing "wide-base tires," sometimes called "super-singles," can save 4–6% over typical dual tires.

Engine-Idle Reduction -- Technologies that reduce idling time can help achieve significant fuel savings for fleets whose drivers spend their rest periods inside the truck. There are three types of APU systems that can provide full comfort to drivers. (1) Diesel APU (2) Diesel-Electric APU (3) Battery-Electric APU. A typical primary engine, usually rated for 350–550 hp, consumes approximately 3.76 litres of fuel for each hour of idle time. In contrast, an auxiliary power unit (APU) burns 0.76 lph or less. Battery-electric APU systems can provide electricity and cooling services while using zero fuel and are typically equipped with a diesel fired heater to provide warmth with extremely low fuel consumption rates (0.15 lph). These systems can improve a truck's overall fuel use by 8% or more depending on the amount of idling.

Overall Results

The "full package" of fuel-saving devices applied to an "average" Canadian truck driving 160,000 km/y and idling 1400 hours/y delivers an estimated 22% fuel savings and a greenhouse-gas emissions reduction of 39 tonnes per year. Assuming that the improvements to the truck will last ten years and that greenhouse-gas emissions reductions each year are maintained, investment cost per tonne of GHG "saved" is 86 C$/tonne of GHG. If the entire Canadian fleet of 294,000 trucks were to adopt these energy-efficiency technologies, Canadian truck owners and operators would save 4.1 billion litres of fuel and reduce emissions by 11,500,000 tonnes of GHG each year. This is equivalent to taking 64,000 Class-8 trucks or 2.6 million cars off the road.

RMI also analyzed a simple package of modifications—modifications deemed available, affordable, and achievable in the very short term. These modifications have the potential to reduce greenhouse-gas emissions at a cost of C$54/tonne of GHG. Fuel savings produced by this simple efficiency package are estimated to be 13% and each truck would avoid emissions of 23 tonnes of GHG/y. Assuming this simple package of energy-efficiency technologies were adopted by just 50% of the Canadian Fleet (147,000 trucks), Canadian truck owners and operators would save 1.2 billion litres of diesel fuel and reduce greenhouse-gas emissions by 3,400,000 tonnes of GHG per year. This is equivalent to taking 19,000 Class-8 trucks or 800,000 cars off the road.

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