SmartWay Transport Partnership
U.S. Environmental Protection Agency

A Glance at Clean Freight Strategies
Improved Aerodynamics

Using a streamlined profile tractor with aerodynamic devices will reduce fuel costs by over $800 per year and eliminate over five metric tons of greenhouse gas emissions compared to a classic profile tractor.

What is the challenge?

Aerodynamic drag (wind resistance) accounts for most truck energy losses at highway speeds. Reducing drag improves fuel efficiency. The longer the drive and the higher the speed, the greater the potential efficiency benefits. Manufacturers made significant progress over the past two decades in reducing the drag coefficient (a measure of wind resistance) of a typical freight truck from about 0.8 to about 0.65 – an improvement of nearly 20 percent. Additional efforts to improve aerodynamics could result in a further 20 percent reduction in the drag coefficient. This could have a significant impact on fuel economy. For example, cutting drag by 25 percent could raise fuel economy up to 15 percent at highway speed.

What is the solution?

A number of options exist to improve aerodynamics and improve fuel efficiency.

Tractor Aerodynamics

Truck tractor aerodynamic options include roof fairings (an integrated air deflector mounted on the top of the cab), cab extenders (known as gap seals, which reduce the gap between the tractor and the trailer), side fairings, and a front bumper air dam (to reduce air flow beneath the truck). Truck manufacturers offer aerodynamic models that include a streamlined front profile, sloped hood, and a full package of add-on devices. These tractor models can improve fuel economy by up to 15 percent, when compared to similar models without aerodynamic devices. For a typical combination truck, improving aerodynamics by 15 percent would cut annual fuel use by up to 2,430 gallons and save up to $3,644 in fuel costs.

Trailer Aerodynamics

Trailer aerodynamics can be improved minimizing the gap between the tractor and the trailer, to reduce air turbulence. Specifying wheelbase and fifth-wheel settings that position the trailer as close to the rear of the tractor as possible can reduce tractor-trailer gap. Reducing trailer gap from 45 to 25 inches could improve fuel economy as much as 2 percent. Another innovative trailer option is to use side skirts. These panels hang down from the bottom of a trailer to enclose the open space between the rear wheels of the tractor and the rear wheels of the trailer. According to the manufacturers, trailer side skirts can improve fuel economy by up to 5 percent. Cargo "profile" is also important. On flatbed trailers, reduce drag by arranging cargo as low and smooth as possible. Secure loose tarpaulins and close the curtains on empty curtain-sided trailers to improve fuel economy by up to 2.5 percent and 4.5 percent, respectively.

Single Unit Truck Aerodynamics

Many new single-unit truck models incorporate a sloped hood and a more streamlined front profile as a standard feature in order to reduce drag. Rounded air deflector bubbles can be added to single-unit trucks with van-style bodies to reduce drag; manufacturers claim fuel economy benefits of 5 to 10 percent. This would yield annual fuel savings of 82 to 165 gallons, saving $124 to $247 in fuel costs. Single unit trucks with higher annual mileage could realize even larger benefits.

The results are in . . .

Using a streamlined profile tractor with aerodynamic devices (roof fairing, cab extenders, and side fairings) can reduce fuel costs by over $800 and eliminate over 5 metric tons of carbon dioxide per year compared to a classic profile tractor. When installed on van trailers, aerodynamic devices can produce comparable fuel and emission reductions. Some aerodynamic options are standard on many trucks, like a streamlined hood. Others may be purchased and installed for an additional cost. The initial expense of these options is often quickly recouped through fuel savings.

Next steps

Trucking firms should specify aerodynamic options when purchasing a new truck and consider adding aerodynamic devices to existing trucks. In most cases, the cost to purchase the devices is soon recovered in fuel savings. For more information on aerodynamic devices, contact your local truck dealer, truck equipment vendor, or trucking association.

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A Glance at Clean Freight Strategies
Idle Reduction

Reducing unnecessary truck idling can save fuel, reduce greenhouse gas emissions, cut air pollution, and save money. A typical long-haul combination truck that eliminates unnecessary idling could save up to 1900 gallons of fuel each year. Saving this much fuel annually would remove 19 metric tons of carbon dioxide (a greenhouse gas), reduce NOx and PM emissions, save nearly $3,000 in fuel costs, and lower engine maintenance costs.

What is the challenge?

Many long-haul truck drivers idle their engines during rest periods to:

- provide heat or air conditioning for the sleeper compartment
- keep the engine warm during cold weather
- generate electrical power for appliances

Studies by EPA and others suggest that long-haul combination trucks often idle up to eight hours per day, over 300 days per year. Typical combination trucks consume 0.8 gallons of diesel fuel during each hour of idling, using as much as 1,900 gallons of fuel each year per truck.

Using a heavy-duty truck engine to power cab amenities is inefficient. It consumes fuel unnecessarily; increases fuel costs, and causes emissions that contribute to climate change and air pollution. Today's diesel engines do not need to idle for long periods of time before and after driving. Unnecessary engine idling also contributes to engine wear, which increases truck maintenance costs, and shortens engine life.

What is the solution?

Several technological options can assist drivers in reducing truck idling.

- Auxiliary power units (APUs) are mounted externally on the truck cab. An APU typically consists of a small combustion engine and generator combination that can provide power to the truck when the main engine is shut off. Electricity from an APU can be used to power heating, air conditioning, and electrical accessories for the cab and sleeper.
- Automatic engine idle systems start and stop the truck engine automatically to maintain a specified cab temperature, or to maintain minimum battery charge. Drivers typically activate the system in the evening and program a desired temperature range.
- Truck stop electrification allows trucks to use electrical power from an external source. At properly equipped truck stops, drivers can shut the main truck engine off and plug into an electrical outlet that provides power for heaters, air conditioners, marker lights, and other accessories. Trucks need to be equipped with the required internal wiring, inverter system, and HVAC system to take advantage of truck stop electrification.
- Advanced truck stop electrification also provides electricity from an external source, but doesn't require the truck to be equipped with special systems. Truck parking bays are installed with equipment that provides the cab with electrical power, and heating, cooling, and other amenities like telecommunication hook ups, through an external console that fits into the truck's window frame. The truck-side console has temperature controls, an air supply and return pipe, a credit card reader, keypad, and 100 VAC outlet.

The results are in . . .

The amount of idling varies widely among trucks by season, type of operation, and driver practices. A typical long haul combination truck could idle up to 2,400 hours per year, which would use over 1,900 gallons of fuel. Using an APU instead of idling the engine could reduce this fuel use by 75 percent and eliminate over $2,000 in fuel costs plus over $300 in engine maintenance costs each year. Truck stop electrification can potentially eliminate all engine idling. However, because the systems can be used only at stations outfitted with appropriate equipment, not all the potential savings can be obtained immediately. Additional truck stop electrification spaces are planned along major interstate corridors.

Next steps

Truck fleets should examine engine-operating records to determine the percent of time spent idling to determine potential fuel and cost-saving benefits. Truck fleets may also check the availability of truck stop electrification facilities along frequent routes.

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A Glance at Clean Freight Strategies: Low-Viscosity Lubricants

Synthetic engine and drive train lubricants can improve fuel economy by about three percent, saving nearly 500 gallons of fuel and eliminating five metric tons of greenhouse gas emissions for a typical combination truck each year.

What is the challenge?

Lubricants reduce friction and wear of critical vehicle systems including the engine, transmission and drive train. Without lubricants, the moving parts inside these systems would grind together causing heat, stress and wear. Conventional mineral oil lubricants may have too high viscosity (internal friction that resists sliding and inhibits flow) to effectively slip between and lubricate the moving parts of these systems, particularly in newer truck components that are designed with close tolerances and tight fits. Conventional lubricants may also be heavy, making it harder for pumps, gears and shafts to move. These effects create energy losses and friction losses, and waste fuel. .

What is the solution?

Low-viscosity lubricants are less resistant to flow than conventional lubricants, a property that helps reduce friction and energy losses. Depending upon the application, low-viscosity lubricants may also contain additives designed to withstand the extreme pressure (EP) that could occur as the lubricant flows between tight-fitting parts. Low-viscosity lubricants may be made from synthetic or mineral oil blends with low-viscosity and EP additives. Manufacturers generally offer low-viscosity blends as “fuel economy” lubricants, since the fuel-saving potential of these products is significant. A national trucking association reports that synthetic transmission and axle lubricants can improve fuel economy by 0.5 percent in the summer and two percent in the winter (viscosity is temperature-dependent.) A paper published by a professional engineering society found that synthetic engine and transmission lubricants could improve fuel economy by five percent, with greater gains at lower speeds. Another paper from this same organization reports that synthetic gear lubricants can improve fuel economy by about three percent. European research demonstrates a three to five percent gain in truck fuel economy using low friction engine lubricants and a one to four percent gain using low friction transmission lubricants.

Synthetic and semi-synthetic lubricants typically cost more than conventional mineral oil lubricants. Truck service stations suggest that semi-synthetic oils cost about 50 percent more than conventional mineral oils. However, for most trucks, the fuel cost savings generally outweigh the higher product cost.

The results are in . . .

The combined effect of low-viscosity synthetic engine oils and drive train lubricants can improve fuel economy by at least three percent, saving nearly 500 gallons of fuel per year for a typical combination truck. Even with the higher cost of the synthetic oil, truck owners can save more than $500 per year. Additional cost savings may be possible due to reduced wear and maintenance. Switching to low-viscosity lubricants will reduce greenhouse gas emissions by five metric tons per year for each truck.

Next steps

Trucking companies should consider using low-viscosity lubricants to improve fuel economy. Synthetic oils are compatible with most truck systems, save fuel, and should provide net cost savings. Before switching lubricants, trucking companies should ensure that the product suits the intended application. Always check manufacturer specifications before switching engine, transmission or drive train lubricants. Companies should also consult manufacturer’s vehicle and parts owner manuals and service manuals for information and recommendations on lubrication specifications and procedures. Lubricating oil manufacturers and lubrication guides can provide information about product applications. Trucking associations, equipment manufacturer associations and trucking industry publications may provide additional information and case studies about the benefits and uses of various lubricants.

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A Glance at Clean Freight Strategies
Reducing Highway Speed

Reducing highway speed by five miles per hour can cut fuel use and greenhouse gas emissions by over seven percent while extending the life of a truck's engine, tires and brakes. A long-haul truck with 90 percent highway operation that reduces its top speed from 70 to 65 miles per hour could cut its annual fuel bill by $1,450 while eliminating nearly ten metric tons of greenhouse gas reductions.

What is the challenge?

A typical combination truck spends 65 percent or more of its operating time at highway speeds. Line-haul trucks spend even more time on highways. The impact of speed on fuel economy depends upon many factors including vehicle aerodynamics, engine speed and operating conditions. As a general rule of thumb, increasing speed by one mile per hour reduces fuel economy by about 0.1 miles per gallon. For a truck with poor aerodynamics, the fuel penalty may be nearly twice as great. Higher speed also leads to higher maintenance costs by increasing wear on the engine, tires and brakes.

What is the solution?

Speed management is an easy and effective way to save fuel, reduce emissions, and prevent excess wear. A trucking firm or driver can adopt a speed policy at little or no cost. The most successful speed management policies combine technology (e.g., speed settings on electronic engine controls) with driver training and incentive programs to encourage drivers to maintain speed limits. Most new truck engines are electronically controlled so the cost of changing maximum speed settings on these engines is negligible.

The results are in . . .

Although fuel savings may vary by vehicle and speed range, a national trucking association estimates that a combination truck driving 55 miles per hour uses up to 20 percent less fuel than a similar truck driving 65 miles per hour. Other analyses indicate that reducing the maximum speed of a typical long-haul truck from 70 miles per hour to 65 miles per hour could save about $1,450 in annual fuel costs. Reducing the maximum speed to 60 miles per hour could save an additional $1,850, bringing the estimated annual savings to $3,300.

Reducing speed can cut truck maintenance costs and reduce the frequency of maintenance work. The time between engine overhauls, for example, is directly related to fuel use. Holding maximum speeds at 60 rather than 70 miles per hour reduces engine wear and extends time between engine rebuilds, saving hundreds of dollars per truck each year while keeping revenue-earning equipment on the road. Fleets that adopt speed policies report added savings due to fewer brake replacements and other service work.

Reducing highway speed does increase travel time. Assuming ideal conditions, a trucker driving 60 miles per hour instead of 65 miles per hour could spend about eight percent longer on the road. Of course, the time difference may be less, depending upon road conditions, weather, traffic congestion, and road construction. If a trucking company pays its drivers by the mile or by the load rather than by the hour, reducing speed should not increase labor costs. It could reduce the productivity of trucking operations since slower trucks may carry fewer loads. However, the benefits of lower fuel and maintenance costs combined with less frequent out-of-service work and driver safety considerations may well outweigh any costs associated with increased delivery time.

Next steps

A trucking company interested in saving fuel and lowering the cost and frequency of its equipment maintenance should consider adopting a speed management policy, particularly if its trucks spend considerable time on highways. A number of well-managed truck fleets have programs in place to reduce highway speed and promote safe driving by using driver training, incentive programs and electronic engine controls. A trucking fleet interested in following these examples may learn more by reading articles and fleet profiles in truck industry publications. When purchasing new vehicles, a trucking company may also consider specifying equipment designed to optimize truck performance at lower maximum speeds. Trucking companies and drivers interested in learning more about the effects of speed on fuel economy may contact truck and equipment manufacturers or their state and national trucking associations.

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A Glance at
Clean Freight Strategies

Automatic Tire Inflation Systems

Automatic tire inflation systems can save tire maintenance costs and improve fuel economy by nearly 1%, saving 100 gallons of fuel and eliminating one metric ton of greenhouse gas emissions per year. Properly inflated tires also wear longer and have fewer punctures.

What is the challenge?

When not properly inflated, tires flex more under load, producing heat and increasing rolling resistance, which wastes fuel. Truck tires inflated ten pounds per square inch (psi) below recommended air pressure levels can reduce truck fuel economy from 0.5 percent to one percent. Heat and stress from improper inflation soften and deflect tire components, causing faster and more uneven wear, which shortens the life of the tire. Under inflated tires have more frequent punctures, increasing the risk of tire failures that could lead to costly road service and loss of revenue.

Despite these costs, a recent survey of combination trucks found that less than half the tires surveyed were within five percent of the recommended inflation pressure. Fleets may find it difficult to keep tires properly inflated since truck tires can lose up to 2 psi each month, even if the rim seal and valve stems are tight. This is because air molecules can permeate through tires. Temperature and load also affect tire pressure. For these reasons, tire manufacturers recommend checking tire pressure each week and establishing a tire maintenance program.

Even a good tire maintenance program may fall short of its aims. In part, this is because trailer tires have more impact on truck fuel economy than tractor tires, yet trailers are interchangeable and thus harder to monitor. Since the bulk of the load is carried in the trailer, a 10-psi under inflation in a trailer tire may have nearly twice the impact on truck fuel economy as the same amount of under inflation in a drive tire. Despite the importance of keeping trailer tires properly inflated, a fleet may not be able to inspect its trailers regularly. A trailer may be gone from the service yard for extended periods of time while on the road, at a customer's facility or at drop-off location waiting for a back haul. A fleet may not even own the trailers it hauls, but pick them up from a shipper or third party. These circumstances can place much of the responsibility for checking tire pressure onto drivers. However, one industry survey indicates only eight percent of truck drivers check tire pressure with a tire gauge before each trip.

What is the solution?

Automatic tire inflation (ATI) systems monitor and continually adjust the level of pressurized air in tires, maintaining proper tire inflation automatically, even while the truck is moving. One ATI system uses the vehicle's own air-brake compressor to supply air to all the tires. Another system uses self-contained compressors mounted on each hub that are powered by the rolling motion of the wheels. Once an ATI system is installed, it should not require any special attention from the driver.

The results are in . . .

ATI systems can extend tire life by eight percent or more. The systems eliminate the need to check tire pressure manually, saving time and labor while ensuring consistent and proper tire inflation. Installing an ATI system on a truck's drive axles and trailer costs up to $900, but can save over $200 annually in tire maintenance costs. For a typical long-haul combination truck, annual fuel savings could reach 100 gallons, saving $170 in fuel costs and eliminating one metric ton of greenhouse gas emissions. The cost of installing an ATI system in a line-haul truck is generally recouped in just over two years through fuel and maintenance cost savings. Truck fleets may realize additional savings from reducing the risk of expensive tire failure caused by under inflation.

Next steps

Line-haul carriers that find it too difficult or expensive to monitor tire pressure on a regular basis should consider installing automatic tire pressure inflation systems on drive and trailer tires. ATIs can be readily retrofitted onto existing trucks and trailers. Interested fleets can check with ATI manufacturers and truck and tire dealers for more information. Fleets may also contact tire manufacturers or their state or national trucking associations for more information about the benefits of proper tire inflation.

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A Glance at Clean Freight Strategies: Drivers Training

Driver training programs can help trucking companies save fuel and reduce greenhouse gas emissions by increasing drivers' skills, knowledge, and performance. A driver-training program that improves fuel economy by 5 percent could save over $1,200 in fuel costs and eliminate eight metric tons of greenhouse gas emissions per truck each year.

What is the challenge?

Even highly experienced truck drivers can boost their skills and enhance driving performance through driver training programs. Training that targets fuel efficiency can help drivers recognize and change driving habits that waste fuel. For example, driving 65 mph instead of 55 mph can use up to 20% more fuel. Idling an engine burns almost one gallon of fuel per hour. Driving with the engine rpm too high can waste several gallons of fuel each hour. Other common habits that reduce fuel economy are frequent or improper shifting, too-rapid acceleration, too-frequent stops and starts from failing to anticipate traffic flow, and taking circuitous routes.

A few simple changes in driving techniques can produce sizable fuel savings of 5 percent or more. A Canadian study estimates that many fleets could achieve a 10 percent fuel economy improvement through driver training and monitoring. For a typical combination truck, a 10 percent saving is the equivalent of nearly $2,500. A study for the European Commission estimates that an annual one-day driver-training course will improve truck fuel efficiency by five percent. Two trucking fleets in Canada documented the impact of driver training and found fuel efficiency improvements of 18 percent and 20 percent.

What is the solution?

Well-trained drivers can reduce fuel consumption by applying a number of simple techniques. These include: use cruise control where appropriate; coast whenever possible; block-shift (go from, for example, 2nd gear to 5th gear); brake and accelerate smoothly and gradually; progressive shift (upshift at the lowest rpm possible); limit unnecessary truck idling; start out in a gear that doesn't require using the throttle when releasing the clutch; limit unnecessary shifting; drive at the lowest engine speed possible; reduce parasitic energy losses by limiting the use of accessories.

Employers, vocational schools, and for-profit training organizations can teach drivers these fuel-saving techniques. Many trucking companies also monitor driver performance and may provide incentives to drivers who reduce fuel consumption. Electronic engine monitors can be used to review drivers' operating patterns and benchmark individual performance over time.

The results are in . . .

Fleets that improve fuel economy by at least 5 percent through driver training and monitoring programs can save more than $1,200 per truck each year in fuel costs and eliminate 8 metric tons of carbon dioxide emissions per truck each year. For a typical long-haul truck, the initial cost of training and the purchase of related equipment such as an electronic engine monitor and recorder could be recouped within two years from fuel cost savings. Trucking companies may realize even greater fuel and maintenance savings by using technologies that limit truck idling and highway speed.

Driver training may generate larger efficiency gains for vehicles in urban service, where shifting practices have more influence on fuel economy. Good driving practices are also part of courteous and safe truck operation that reflects well on the professionalism of the driver and his or her trucking company.

Next steps

Trucking firms should consider implementing driver-training programs to reduce fuel costs. To provide additional motivation, training can be combined with an incentive program to reward drivers for enhanced performance. Successful incentive programs pay bonuses regularly and frequently, set realistic goals, and are simple to administer. Fleets may contact their national or local trucking organizations for more details on improving driver performance and establishing a driver incentive program, and may contact their truck dealer or equipment vendor for information on engine monitors and other fuel-saving devices.