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Greenhouse Gas Management for Medium-Duty Truck Fleets

A Framework for Improving Efficiency and Reducing Emissions

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Introduction

Medium-duty trucks, identified as Classes 3–6, are the workhorses of the American economy. These vehicles deliver food and beverages to restaurants and convenience stores, drop off packages at homes and offices, serve as mobile workshops for all types of technicians, and perform thousands of other daily tasks. They also use a lot of fuel – over 8 billion gallons a year.

This fuel represents a significant cost for the businesses that use these vehicles to deliver products and services. In addition, the combustion of fuel contributes to global warming.

In this paper, PHH and Environmental Defense Fund highlight over a dozen strategies to increase fuel efficiency of medium duty trucks. For many of the steps, we highlight the actions of companies that are already successfully implementing them. In the examples where one of our organizations was directly involved, we include a brief description of our role. We hope that these stories help to illustrate opportunities for some of these strategies in your fleet.

By increasing their efficiency, companies can reduce costs and decrease emissions of carbon dioxide—the main contributor to human-caused global warming. Medium-duty trucks emit an average of over 13 metric tons of carbon dioxide per vehicle each year. Focusing on reducing these emissions—including ongoing emissions measurement—needs to be at the core of any comprehensive fleet "greening" effort.

In this long-term effort to reduce fuel use and emissions, everyone benefits from sharing information—both success stories and resources. To facilitate this, we have created an open source Wiki, which can be found at http://work-truck-efficiency.wikidot.com. Please consider adding your successes and lessons learn from improving efficiency and reducing emissions to this site.

TYPES OF DIESEL EMISSIONS: Diesel-powered vehicles produce two types of environmental impacts. This paper focuses on reducing their contribution to global warming. In addition, diesel vehicles also create near-term human health impacts as a result of emitting particulate matter and smog-forming pollution. These emissions are linked to heart and lung ailments, low birth weight in infants, and stunted lung development in children.

The introduction of ultra-low sulfur diesel and the 2010 diesel engine requirements place stricter regulations on particulate matter and nitrogen oxides and are intended to reduce these emissions by 95%. Existing diesel vehicles, of course, will continue to pollute. However, many pre-2010 diesel vehicles can use retrofit devices to reduce emissions. To increase the adoption of these devices, the U.S. federal government and several states have made funding available to purchase some of these devices. More information is available at edf.org/greenfleet.

Select lower-carbon vehicles

The most important environmental decision a fleet manager makes is which vehicles to have in the fleet. Relatively minor changes in vehicle selection can result in significant environmental—and financial—benefits over time. Consider the following strategies when choosing vehicles for your fleet.

IN PRACTICE: For years, Frito-Lay used 24-foot Class 6 straight trucks for urban grocery store deliveries. It recently found they could use a 20-foot Class 5 straight truck to do the same job, with a fuel savings of roughly 10%.

Move to lower GVW trucks

Lighter and less powerful trucks are more fuel efficient. A company can reduce fuel use significantly by "right-sizing" its fleet—selecting trucks that are no larger or more powerful than necessary for their application. Avoid the common pitfalls of spec'ing the entire fleet based on a "greatest power demand" scenario, when such a scenario can be served with a few larger vehicles. Within the same GVW class, it may be possible to choose a more efficient engine that can do the job at hand.

Fuel economy effect of truck class downsizing[i]

Truck class	GVWR range	Average fuel economy (mpg)	Fuel efficiency benefits of downsizing
3	10,001 – 14,000	10.5	24% (from class 4)
4	14,001 – 16,000	8.5	8% (from class 5)
5	16,001 – 19,500	7.9	13% (from class 6)
6	19,501 – 26,000	7.0	9% (from class 7)
7	26,001 – 33,000	6.4	

Consider high-efficiency advanced technology vehicles

Hybrid electric vehicles, hydraulic hybrids and electric vehicles all have the potential to increase the fuel efficiency of trucks and reduce emissions. Fuel efficiency improvements between 15% and 50% are likely from these advanced technology engines. These vehicles are particularly well suited for urban pickup and delivery and other short haul markets. They are also a good fit for fleets with auxiliary power needs, such as utility trucks, which can draw power from the electric battery to run onboard equipment, eliminating idling and further increasing fuel savings.

IN PRACTICE: Medium-duty hybrid trucks have arrived. There are nearly 2,000 of these vehicles on the road today. FedEx, UPS, Pepsi, Coca-Cola, Purolator Courier, AT&T, and Florida Power & Light are among the over-150 companies that have these vehicles in their fleets. Depending on duty-cycle, these vehicles can slash global warming emissions up to 50% and decrease particulate matter (soot) by over 90% over traditional diesel vehicles. They are available in many models, including: Utility, Step Van, Delivery, PTO, Refuse and Step-in.

The first commercially available medium-duty hybrid trucks hit the road in 2005 through a partnership between FedEx and Environmental Defense Fund. Today, over 115 fleets contain medium- to-heavy-duty hybrid vehicles. There are almost 2,000 of these cleaner vehicles on the road. They are available in over 35 models and in every truck class. The performance and maintenance records of these vehicles are strong.

The most significant barrier to further expanding the market for these vehicles remains the up-front cost. Hybrid trucks typically cost between $23,000 - $45,000 more than traditional trucks. Price, of course, differs between applications and models while bulk purchases can help push the price toward the lower end of the spectrum. Still, for many applications, the trucks' payback is beyond the time limit of most companies.

To support the use of hybrid vehicles, the U.S. federal government and many states have funding available to help fleets purchase cleaner and more fuel-efficient vehicles. Grants, rebates and tax credits can help bring down the incremental costs of advanced technologies and make the business case for cleaner trucks. Under the most generous of these programs, fleets can achieve a 2.5 year ROI from their hybrid truck.

Incentives may impact financing arrangements and as a result, the total financial benefits of the incentives need to be evaluated. Further, incentive programs can be complicated to navigate, because their benefit can depend on a particular fleet's specific situation. However, the payoffs can be significant, so it is worthwhile for a fleet to do its homework and investigate these programs.

IN PRACTICE: In 2009, Sysco Foods received funding to help put 25 hybrids on the road in Maryland, through a grant from Maryland Clean Cities, a program funded by the Department of Energy through the American Recovery and Reinvestment Act.

Explore lower-carbon fuels

Not all fuels are created equal in terms of greenhouse gas emissions. Diesel, gasoline and other fuels all emit different amounts of carbon. Data on the carbon content of fuels is available from the U.S. EPA on volume basis. For example, per gallon, gasoline emits 8.81 kg of carbon dioxide and diesel emits 10.15 kg. Of course, other variables are important to take into account as well, such as the energy content of the fuel and the efficiency of the engine. Consider that due to its higher energy content and more efficient combustion process, a diesel vehicle can travel about 30% farther on a gallon of fuel than a comparable gasoline model.

All fuels have emissions associated with their creation that aren't factored into EPA's tailpipe numbers. There are some fuels that have a lower greenhouse gas emissions profile when combusting the fuel, but this benefit is reduced or eliminated by an energy-intensive manufacturing process. Fleets seeking to reduce their greenhouse gas footprint should do their due diligence to make sure that their fuel choices don't simply push emissions up the production chain.

Spec for efficiency

Some of your vehicle components can be optimized to achieve better fuel efficiency and lower emissions. Many of the options listed below can work for both new and existing vehicles.

Deploy alternative power sources for auxiliary operations

Alternative power for auxiliary operation can reduce fuel use. Examples include using electric motors instead of the truck engine to operate hydraulics on auto carriers and to power the operation of lift gates, and the use of cold plates in refrigeration units.

Install routing software

Vehicle tracking and routing software can monitor fleet operations and ensure that vehicles use the most efficient routes and maintain schedules. Fleets with dense multi-stop delivery networks are likely to benefit the most from software solutions to improve routing. Improved routing reduces unnecessary mileage, which also reduces fuel consumption. The level of fuel and emissions savings from this strategy will vary greatly depending on a fleet's operating characteristics.

Reduce vehicle tare weight

By reducing the tare (empty) weight of the truck, fuel economy is improved. Less weight reduces both inertial loads and rolling resistance. Fuel economy savings can be particularly substantial in smaller truck classes because tare weight makes up a larger portion of gross vehicle weight. Tare weight can be reduced through the use of lightweight components, such as aluminum wheels and other body parts. The fuel economy improvement for each 1,000 pound weight reduction in tare is shown below.

IN PRACTICE: Kraft Foods operates a large and diverse fleet, most of which needs to be temperature-controlled. For its frozen DiGiorno pizzas business unit, Kraft recently purchased an International Durastar diesel-electric hybrid delivery truck equipped with a RouteMax refrigerated body. The unit also includes a cold plate refrigeration system. The hybrid system nearly doubles the amount of time that the cold plate provides cooling. The system is expected to save as much as 1,400 gallons of fuel per year compared with a traditional diesel-powered refrigerated blower unit.

Fuel Economy Effect of Tare Weight Reduction Truck[ii]

Truck Class	GVWR range	Average Tare Weight (lbs)	Fuel economy improvement for each 1,000 lbs of tare weight reduction
4	14,001 – 16,000	10,343	5.6%
5	16,001 – 19,500	10,413	4.7%
6	19,501 – 26,000	13,942	3.9%
7	26,001 – 33,000	18,094	2.8%
8A	33,001 – 60,000	23,525	1.9%
8B	60,000+	28,979	1.1%

Adjust electronic control modules (ECM)

Electronic control modules (ECM) started to appear in vehicles during the 1980s. They are a class of onboard computers that include the engine control unit and transmission control unit. These computers help direct the management of the engine and transmission. Some ECMs can be modified to reduce fuel consumption by reducing top speeds, cutting idling and lowering transmission RPMs.

Install automatic engine shutdown

Approximately 7% of all single-unit truck fuel use is associated with idling and this percentage is much higher for certain types of trucks. Reducing engine idling is an opportunity for all truck fleets. Any fleets whose drivers make frequent stops or wait in their vehicles for long periods may benefit from the use of idling-control technologies. Automatic engine shutdown can be programmed through the ECM. Trucks that lack an ECM-based shutdown capability can utilize available retrofit technologies.

Make transmission adjustment

The fuel efficiency of a truck is heavily influenced by the transmission and engine throttle operation. It is often possible to reprogram the automatic transmission control unit so that trucks upshift at lower speeds. Factory settings for automatic transmissions are often based on maximizing power, not fuel economy. Of course, it is important to look closely at duty cycle to make sure you aren't underpowering the vehicle, which can be just as bad from a fuel and maintenance perspective.

Limit vehicle speeds

Speed reduction is one of the most effective strategies for improving fuel efficiency. Truck power requirements (and fuel use) tend to increase in an exponential manner above 40 mph, so limiting top highway speeds is a particularly effective way to save fuel. Many fleets choose to limit their trucks' top speed to between 60 and 65 mph.

Change to low-rolling resistance tires

Tires have a direct impact on fuel economy. The amount of the impact depends on the rolling resistance of the tire model. A tire with lower-rolling resistance loses less energy in the consistent cycle of deformation and recovery as it rolls. According to the Transportation Research Board, reducing the average rolling resistance of tires 10% can equate to a 1 to 2% increase in fuel economy.

Install aerodynamic improvements

Aerodynamic resistance can be improved by lowering a vehicle's drag coefficient. All vehicles can benefit from a more aerodynamic cab design, which can include the design of the front bumper, grill, hood and mirrors. For single-unit trucks with van-style bodies, there are additional potential benefits from improving the aerodynamics of the cargo space. Aftermarket devices are designed for medium-duty trucks.

IN PRACTICE: Two years ago, PoolCorp's fleet management provider, PHH, conducted a maintenance and repair study of PoolCorp's medium and heavy trucks. As a result of this study, PHH made a number of recommendations, including adjustments to the Engine Control Unit (ECU) settings of PoolCorp's trucks. These adjustments limited the top speed of the trucks to 70 mph, and engine idle intervals were set at a maximum of five minutes. On the trucks where the adjustment was completed, PoolCorp has seen a 4% improvement in fuel economy.

IN PRACTICE: Staples has reprogrammed the transmissions on all of its single-unit trucks. The trucks have automatic transmissions and Staples modified the transmission control unit to lower the RPM threshold to shift into higher gears. The net effect of this strategy and speed governing (a 60 mph limit was implemented at the same time) was a fleet-wide increase in fuel economy of 12-16%.

IN PRACTICE: LKQ, a leading aftermarket parts supplier for the automotive industry, recently conducted a pilot of PHH Onboard®, a telematics solution. During the pilot, LKQ was able to reduce idling by 62% and significantly reduce speeding and after-hours use. All of this added up to a savings of 15.9 gallons per vehicle per month. Across the entire fleet, this would mean a 5,300 ton reduction of GHG emissions.

Engage drivers in reductions

How a vehicle is operated significantly affects fuel consumption and emissions. The drivers of your company's vehicles have a vital role to play in reaching corporate greenhouse gas emission reduction goals.

Inform drivers about fuel-smart driving practices

Smart driving habits decrease fuel consumption. Companies can inform drivers about these habits and provide clear guidance on their adoption. EPA lists a series of tips on optimizing fuel economy. A few high-impact ideas that are substantially under the control of drivers are minimizing idling and avoiding aggressive driving behaviors, such as speeding and jackrabbit starts.

Recognize driver performance

Fleets that track vehicle performance by driver or vehicle can leverage the competitive instinct of their drivers. Consider openly ranking drivers by achieved mpg, time spent idling or other criteria.

Provide drivers with meaningful incentives

Fleets that can track vehicle-specific fuel-consumption and mileage (or other relevant metrics) can provide drivers with performance incentives. These can be helpful because the financial benefits of saving fuel accrue to the company, not the driver. Consequently, sharing even some of the savings with drivers can have a positive impact on program results. Incentives need to be meaningful enough to influence drivers, but not so substantial as to incite gaming. The actual rewards you offer should reflect your drivers' preferences and your organization's culture.

IN PRACTICE: Early in 2008, Poland Spring decided to focus on reducing idling time. Through an existing onboard computing system, they knew their fleet was idling for as much as 1,400 hours per month during the winter months. Chris McKenna, the fleet manager at Poland Spring, decided to openly rank drivers to pinpoint those that were idling the most. "All we did was talk to them about it, and put a list up in the break room," McKenna told us. "Human nature—no one wants to be at the bottom of the list." To sweeten the deal, the ten drivers who had the lowest idling time got a gift card for fuel they could use in their own cars. The results were dramatic. Year over year, idling time dropped from 1,400 hours in February 2007 to 1,000 hours in February 2008 to just 380 hours in February 2009. Cutting idling time has reduced the fleet's fuel consumption by 8,000 gallons and greenhouse gas emissions by about 77 tons per year. Depending on fuel costs, cutting idling time has saved the company thousands of dollars a year—roughly $20,000 during 2008, for example. "We didn't have to come up with elaborate rules," McKenna says. "We just made suggestions and asked them to use their own best judgment."

Track GHG emissions

As you consider implementing one or more of these strategies, it is important to understand your starting point. Successful fleet environmental management means actively measuring and reducing your fleet's greenhouse gas emissions over time.

Create fuel and mileage data capture systems

Carbon dioxide emissions, the dominant greenhouse gas emitted from trucks, can be tracked from good fuel consumption data. Each fuel type has a volume-specific carbon dioxide coefficient. If you don't currently have information on your fuel usage, consider working with your fuel card provider to get this data. Creating a good data capture system for fuel consumption is a necessary first step to managing emissions.

Set greenhouse gas emissions baseline

To set an appropriate baseline, companies should calculate emissions for the past several years. Although eventually a single year is selected as the baseline, it is important to look at the data from multiple years to identify unusual trends and ensure the right starting point is selected. The baseline year will be the year against which future progress is assessed. Therefore, you want to make sure you don't select a year, for example, that had an unusually high or low amount of miles traveled, as it won't be a fair comparison for normal operating conditions.

Consider goals and metrics for tracking emission reductions

An emission reduction goal can provide structure for a fleet "greening" effort and keep the focus on the ultimate desired outcome: lowering greenhouse gas emissions. When setting the goal, consider the variety of strategies available to reduce greenhouse gas emissions. Companies should set aggressive, but achievable reduction goals and timelines.

To track progress against your goal, consider tracking other metrics in addition to total fleet greenhouse gas emissions. Some other possible metrics include: Greenhouse Gases per Miles Traveled, Greenhouse Gases per Vehicle, and Greenhouse Gases per Ton Mile.

At least once each year, calculate the greenhouse gas emissions from your fleet and compare progress via your chosen metrics. This data can also be used in public reporting programs such as EPA Climate Leaders, the Carbon Disclosure Project and new carbon registries, which are of increasing interest to investors. It can also be included in your company's social responsibility or annual report.

DIFFERENT GHG EMISSIONS

Vehicles emit greenhouse gases mainly during the combustion of fuel. The most prominent greenhouse gas emitted is carbon dioxide (CO_2). Methane (CH_4) and nitrous oxide (N_2O) are emitted in smaller quantities. Vehicles also contribute to global warming through non-combustion releases of air conditioning refrigerants (HCFCs). Additionally, particulate matter from diesel vehicles (also known as "black carbon") can have a significant, short-term warming effect.

Emissions of methane and nitrous oxide are most accurately tracked via vehicle miles traveled. To track these, companies should know the annual miles of each vehicle and the corresponding vehicle model year. To fully account for emissions of HFCS, fleets need data on the capacity of each vehicle's air conditioning system, its rate of leakage, any system recharges and charge at time of disposal. There is no standardized method presently to account for the global warming impact of a fleet's emissions of black carbon particles.

Given that carbon dioxide emissions comprise the vast majority of greenhouse gas emissions from trucks— over 99% under normal operating circumstances—and are the easiest to track, we recommend that fleets focus first on measuring and reducing carbon dioxide.

The road ahead

Rising energy costs and climate change are long-term businesses challenges. They are particularly relevant to truck fleets, which consume a lot of fuel and are highly visible to customers and the general public. Fortunately, tools and technologies exist today that can get us started on the road towards our lower-emissions future.

Throughout this paper, we've highlighted many of these tools and technologies. Of course, in the medium-duty truck realm, there is no such thing as a one-size-fits-all solution. The fleets that are most successful in cutting emissions will be the ones that explore unique solutions for each of their distinct duty cycles, experiment with unconventional ideas and exchange lessons learned with their peers.

Time is of the essence too, so take a look at your own fleet. What changes can you make to cut fuel costs, reduce greenhouse gas emissions and improve your corporate image?

Here are some resources to help you:

Select lower-carbon vehicles

- CalStart
  http://www.calstart.org/learning-center.aspx
- Makes and Models of Hybrid Medium and Heavy Duty Trucks, EDF
  http://innovation.edf.org//page.cfm?tagID=13394
- State and Federal Incentives, U.S. Department of Energy
  http://www.afdc.energy.gov/afdc/incentives_laws.html
- Hybrid Trucks Financial Incentives Guide
  www.edf.org/hybridincentives
- West Coast Collaborative,
  http://westcoastcollaborative.org/

Explore lower-carbon fuels

- Alternative Fueling Station Locator, U.S. Department of Energy
  http://www.afdc.energy.gov/afdc/locator/stations/
- California low-carbon fuel standard
  http://www.energy.ca.gov/low_carbon_fuel_standard/

Spec for efficiency

- Diesel Tuning, Reprogramming diesel engines for better fuel efficiency, Fleetmag.com, December 2009
  http://www.fleetmag.com/print/Fleet-Maintenance/Diesel-Tuning/1$3226
- Idle Reduction Related Links, U.S. Department of Energy
  http://www.afdc.energy.gov/afdc/vehicles/idle_reduction_related.html
- Cascase Sierra Solutions Equipment Guide
  https://secure.cascadesierrasolutions.org/downloads/documents/CSS-Guide-Fall08-Web.pdf
- U.S. EPA Smart way program
  http://www.epa.gov/smartway/

Engage drivers in reductions

- Gas Mileage Tips, U.S. EPA and DOE
  http://www.fueleconomy.gov/feg/drive.shtml
- Fuel-Smart Driver Training: Tips and Tools, EDF
  http://www.edf.org/greenfleet

Track GHG emissions

- Direct Emissions from Mobile Combustion Sources, U.S. EPA
  www.epa.gov/stateply/documents/resources/mobilesource_guidance.pdf
- The Climate Registry: General Reporting Protocol
  www.theclimateregistry.org/protocols.html
- Carbon Dioxide emissions coefficient, U.S. Department of Energy
  www.eia.doe.gov/oiaf/1605/coefficients.html
- Environmental Defense Fund-NAFA Fleet Emissions Calculator
  www.edf.org/greenfleet
- Defining 'Green' Metrics, Fleet Financials, November 2009
  www.fleetfinancials.com/Article/Story/2009/11/Defining-Green-Metrics.aspx

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[i] ICF International. Opportunities to Reduce Greenhouse Gas Emissions from Trucking. Prepared for Environmental Defense Fund. December 2009

[ii] Same as above (ICF)