The Adoption of Technologies, Policies, and Systems for Improving Fleet Fuel Performance

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16. Abstract

The dramatic rise in fuel prices and growing environmental concerns are pressing freight transportation companies to pursue new systems and methods to improve fuel efficiency and reduce their environmental impact. While select major carriers appear to be leading efforts to adopt technologies that support a dramatic improvement in fuel performance, there appears to be little understanding as to the breadth and depth of efforts being taken by the broader motor carrier community, consisting of over 20,000 companies of all sizes.

The purpose of this study was to investigate the level of adoption of technologies and policies to support improved fuel efficiency among motor carrier fleets.

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THE ADOPTION OF TECHNOLOGIES, POLICIES, AND SYSTEMS FOR IMPROVING FLEET FUEL PERFORMANCE

Final Report
November 2007

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INTRODUCTION

In October 2005, Wal-Mart posed a challenge to truck manufacturers to develop and implement technologies that will allow for the doubling of fleet fuel efficiency from 6.5 to 13.0 miles per gallon by 2015. In February 2006, the United Parcel Service announced it would purchase 50 new-generation hybrid delivery trucks in two sizes from International Truck and Engine Corporation and Freightliner LLC. The dramatic rise in fuel prices and growing environmental concerns are pressing freight transportation companies to pursue new systems and methods to improve fuel efficiency and reduce their environmental impact.

Technologies such as advanced hybrid systems and redesigned body panels that reduce drag are examples of technologies that may lead to significant fuel efficiency improvements. At the same time, policies such as those to reduce truck idling time illustrate a more immediate means to influence performance. The Environmental Protection Agency (EPA), through their SmartWay Transport Partnership, is facilitating the adoption of new technologies and methods by motor carriers and encouraging shippers to consider fuel efficiency and environmental impact as part of their transportation decisions.

While select major carriers appear to be leading efforts to adopt technologies that support a dramatic improvement in fuel performance, there appears to be little understanding as to the breadth and depth of efforts being taken by the broader motor carrier community, consisting of over 20,000 companies of all sizes.

The purpose of this study was to investigate the level of adoption of technologies and policies to support improved fuel efficiency among motor carrier fleets. The specific research questions to be addressed in this study include:

1. What is the current state of adoption of each of the various technologies, methods, and policies?

2. What is the anticipated extent of future adoption of current and future technologies, methods, and policies?

This report discusses the types of systems and technologies currently being employed as a means to improve fuel performance among Class 8 motor carrier fleets. The technologies discussed were then incorporated into a survey distributed to fleet management organizations. The survey inquired about current and future plans for adoption of the technologies identified, current operating performance, and expectations for future performance. A comparison among companies operating enclosed trailers is also presented as a means to assess the potential impact among fleets with similar equipment characteristics. Finally, study conclusions and implications are presented, followed by suggestions for future research. Recent technologies, such as hybrid drive systems, have been excluded from the study due to the low rate of likely adoption this early in their development.

FUEL PERFORMANCE INITIATIVES

Efforts to improve the fuel efficiency of Class 8 truck fleets range from driver training and policy enforcement to more dramatic changes involving the implementation of hybrid drive trains and airflow management systems. A number of industry and industry/government partnerships are pursuing research into more complex methods that involve significant unit design and equipment modifications.

The 21st Century Truck Partnership, formed in April 2000, consists of government agencies, research institutions, industry members, and other concerned organizations. The ultimate goal of the partnership is "safe, secure, and environmentally friendly trucks and buses, using sustainable and self-sufficient energy sources that enhance America's global competitiveness" (US Department of Energy 2006 p. 1). The five areas of focus for the partnership include engine systems, heavy-duty hybrids, parasitic losses, idle reduction, and safety.

Research institutions investigating technologies to improve fuel performance and environmental impact include the Rocky Mountain Institute, Argonne National Laboratories, and Oak Ridge National Laboratories. In addition, US government institutions, including the EPA, Department of Energy, Department of Transportation and Department of Defense, are involved in the 21st Century Truck Partnership, as well as other research consortiums.

In the United States, the EPA's SmartWay Transport Partnership provides carriers with information and analytical tools to evaluate the benefits of specific equipment and management strategies. Through their certification program, member organizations gain access to low-interest loans to retrofit equipment with fuel-saving technologies.

In Canada, a similar program, FleetSmart, is operated by Natural Resources of Canada Office of Energy Efficiency. A recent FleetSmart benchmark study surveyed approximately 100 Canadian-based motor carrier fleets regarding their efforts to improve fuel performance. Forty-two companies responded to the survey. Technologies and policies that were being used by carriers included improving aerodynamics, installing in-cab fuel performance displays, providing driver training, monitoring tire inflation, restricting maximum speed, reducing idling time, initiating driver incentive programs, ensuring regular vehicle maintenance, remote monitoring of engine performance, and installing efficiency add-ons such as cab heaters and auxiliary power units (APUs) (Ogburn and Ramroth 2007).

Table 1 outlines estimated fuel performance improvements identified in a series of studies and articles.

Table 1. Performance estimates from current articles and studies

	Ang-Olson/ Schroeer (2002)	Kilcarr (2006B)	Smartway (2004)	Bachman, Erb, Bynum	Langer (2004)	Ogburn, Ramroth (2007)
Power Unit						
Auto Shutdown	5.9%					
APU	8.9%		(75%)*		1.5-6%	8% (80%)*
Heaters	3.4%					
Speed	13.6%	10%	20%			7%
Transmission		5%			2%	
Tires/Wheels						
Low Resistance		10%			3%	4%
Super-wide	2-5%		2-5%	6-12%	3%	4-6%
Auto-Inflation	0.5-1%	3%	0.5-1%			
Aerodynamics			15%**	5-12%**		14%**
Cab Extender	1-2%	3%	2%		2.5%	1-2%
Cab Fairing	6%	10%			2%	2%
Bumper-Dam		1.5%				
Mirrors		1-2%				
Trailer Skirts	5-18%	3%	5%			4%
Trailer Tail						6%
Management						
Training	5-20%		10%			

*The values in ( ) are based on an estimated reduction in the amount of fuel used to operate the main engine for power.
**Based on an unspecified combination of aerodynamic features.

The following section describes technologies and practices listed in Table 1, along with other actions that may be employed in an effort to improve fleet fuel performance. The technologies and practices are separated into five categories, including power unit technologies, tire and wheel technologies, aerodynamics, management policies, and information system technologies.

While emissions regulations implemented in 2002, and most recently in 2007, are helping to reduce the impact of fleet operations on the natural environment, changes in engine and exhaust requirements and the adoption of ultra-low sulfur diesel have reduced fuel performance by an estimated three to four percent. Some technologies employed to help offset this reduction and ultimately improve fuel performance are described below.

Power Unit Technologies

Power unit technologies include equipment that may affect the configuration of engine, cab, chasse, and drive-train systems. Many of these technologies are specified during initial unit purchase; e.g., the selection of transmission type and configuration. Other technologies may be retrofitted to existing units, as in the case of APUs.

Automatic Shutdown: Automatic shutdown systems provide a method to ensure the reduction in the time power units are left idling during overnight parking or waiting to complete a scheduled delivery or pick up. A similar outcome can be addressed through management policies that require shutdown; however, the automated system helps ensure compliance with no-idle policies. Such shutdown devices are estimated to contribute as much as a 5.9% improvement in fuel performance by eliminating unnecessary idle time (Ang-Olson and Schroeer 2002).

Transmissions (Automated, Automatic): Transmission technologies affect fuel performance in two ways. From a mechanical perspective, the electronics in automatic and automated systems help ensure the most effective shift timing. From a human resources perspective, automated transmissions are not as susceptible to driver variation as a result of distraction or fatigue. (Kilcarr 2006A). Estimated improvements in performance range from 2%–5% (Kilcarr 2006A; Langer 2004)

Automated transmissions automatically determine gear selection. Pneumatic or electronic actuators move the shift forks and rails. No foot clutch is needed. Automatic transmission shift via electronic controls help eliminate the potential for torque loss during shifting. When manual transmissions are specified for units, firms pay closer attention to the number and ratio of gears. This determination is influenced by application and operating conditions (Kilcarr 2006A).

Transmission selection is an important specification issue that is influenced by the type of operation the unit is expected to serve, the engine power selection, the rear-axel ration, and driver habits among the factors.

Speed Governor Implementation: Reducing highway speed can have a significant impact on mileage performance. Whether mandated through policy or implemented via systems such as engine governors, estimated fuel improvement from such actions range from 7%–20% (Ogburn and Ramroth 2007; SmartWay 2004) depending upon the original and reduced speed levels. For example, simulations of long-haul truck operation show a near 14% improvement in fuel economy as average speed decreases from 70 to 55 mph (Ang-Olsen and Schroeer 2002).

Auxiliary Power Units (Diesel/Battery): APUs improve overall fuel performance by significantly reducing the time a power unit is left idling. The common practice for many operators of power units with cab sleepers is to run the primary engine at idle to power heating, ventilation, and air-conditioning (HVAC), and accessory systems when parked for an extended rest period or overnight. Installation of a small diesel generator or battery power unit dramatically reduces or eliminates the use of fuel for such operations. Overall fuel improvement is estimated to be as much as 8% or, when considering just the fuel burned during the idling period, the estimated savings is as much as 80% (Ogburn and Ramroth 2007).

Bunk Heaters: Bunk heaters serve a similar, though more limited, purpose as APUs. They provide heat to the cab living quarters during cool weather operation and therefore allow for engine shutdown rather than idling for extended periods.

Hydrogen Injection System: Hydrogen injection systems provide a means of onboard electrolysis to create hydrogen gas. The hydrogen gas is then included in the combustion mixture. Including hydrogen in the fuel mixture results in a more complete combustion and results in increased power, fuel performance, and lower emissions.

Tire and Wheel Technologies

Tire and wheel technologies are being used to reduce weight and rolling resistance in fleets. The EPA estimates that heavy trucks use as much as 15%–30% of fuel consumption to overcome rolling resistance (variability is due in part to the current weight of the unit and load). Each of the methods addressed can be included as part of an original vehicle configuration or can be installed on existing fleet vehicles. Technologies such as the installation of low-rolling resistance tires can be employed on trailers, as well as power units.

Low-Rolling Resistance Tires: Tire technologies and materials are helping reduce the amount of rolling resistance created by automotive and truck tires. For heavy trucks, a 3% reduction in rolling resistance is estimated to improve fuel efficiency by one percent. The current level of technology is estimated to help reduce fuel consumption by 3%–6% (Langer 2004, Ogburn and Ramroth 2007).

Single-Wide Tires: Single-wide tires support improved fuel performance in part as a result of lowering the rolling resistance in vehicle operation due to materials, and also as a smaller contact footprint than a dual tire configuration. In addition, single-wide tires typically reduce wheel weight by several hundred pounds.

A study by Oak Ridge National Laboratories indicated that replacing the standard truck configuration of two thinner tires per wheel with a single-wide tire improves fuel efficiency and provides more stability. The study estimated a 2.9% fuel savings from newer generation single-wide tires (ORNL 2006). Tests of a Michelin wide-base tire showed an improvement of 3.7%–4.9 percent. Computer simulation suggested an improvement of 2.7% (Ang-Olsen and Schroeer 2002).

Aluminum Alloy Wheels: Aluminum wheels support improved fuel performance predominantly as a result of their lower weight than traditional metal-cast wheels.

Automated Tire Inflation: A 10 psi reduction in tire pressure is estimated to reduce fuel efficiency by 0.5%–1% on heavy duty trucks. Automated tire systems facilitate improved performance by monitoring tire pressure and ensuring that pressure remains at an optimal level (Ang-Olson and Schroeer 2002).

Nitrogen Tire Inflation: Nitrogen tire inflation is expected to improve fuel performance because of the lower likelihood of pressure loss. In addition to the fuel performance improvement, nitrogen inflation is expected to help tires run cooler, improve tread life, reduce oxidation of tire components, and reduce rim and wheel corrosion.

Aerodynamics

Methods to improve tractor-trailer aerodynamics can have a significant impact on fuel performance for vehicles operating at speeds above 45 mph. Highway speeds require more significant amounts of energy to overcome aerodynamic drag. Such drag dramatically increases as vehicles operate at higher speeds. Components that improve tractor and trailer aerodynamics can be specified on new vehicles or added to existing vehicles.

A Rocky Mountain Institute report of efficiency opportunities in Canadian fleets suggests that modifications to trailer aerodynamics can reduce drag by as much as 20% and lead to an approximate 10% decrease in fuel consumption for trucks operating at 105 kilometers per hour (approximately 65 mph). These improvements are identified with tractor trailer configurations employing a traditional box-type trailer.

Power unit modifications include roof fairings, cab extenders, aerodynamic bumpers and mirrors, and fuel tank fairings. Trailer modifications can include trailer skirts, trailer tails, and other means to affect wind flow around the trailer unit.

Cab Extenders: Cab extenders reduce the gap between the sides of the tractor unit and the trailer. This may also be accomplished to some extent with the use of a trailer fairing that attaches to the front of the trailer unit. Reducing the gap from 45 to 25 inches shows a 1%–2% improvement (Ang-Olsen and Schroeer 2002). In general, employment of extenders is expected to improve performance between one and three percent (Kilcarr 2006B; Smartway 2004; Langer 2004; Ang-Olson and Schroeer 2002).

Aerodynamic Mirrors: Aerodynamic mirrors reduce the wind resistance alongside the tractor unit and are estimated to help improve fuel performance between one and two percent (Kilcarr 2006B).

Roof Fairings: Roof fairings help direct the flow of air above and around the trailer. Savings of as much as 10% are estimated for trucks traveling at an average speed above 45 mph (Kilcarr 2006B). Compared with trucks with no fairings, improvements of 15% have been identified (Ang-Olsen and Schroeer 2002, Smartway 2004; Bachman, Erb and Bynum; Ogburn and Ramroth 2007).

Trailer Skirts: Trailer skirts line the sides of a trailer unit between the wheels and reduce drag alongside the trailer. Skirts are estimated to improve fuel performance by 3%–5% on average (Kilcarr 2006B; Ang-Olson and Schroeer 2002; Smartway 2004, Ogburn and Ramroth 2007).

Trailer Tails: The airflow around the back end of a trailer can contribute to overall drag. Trailer tails that attach to the back end of a trailer unit to direct air more smoothly around the trailer are estimated to provide an additional 6% fuel savings (Ogburn and Ramroth 2007).

Management Policies

Management policies can help focus driver attention on factors that contribute to improving fuel performance. Perhaps the least expensive means to reduce fuel consumption, management policies rely on driver compliance.

No Idling Policy: A 2006 report by Argonne National Labs estimated that over 1.5 billion gallons of diesel fuel may be lost annually to long-duration idling (Gaines, Vyas and Anderson 2006). Estimates of fuel consumption range from 1,800 to 2,400 gallons of fuel per truck, per year. Establishing an idling policy related to the use of main engine operations during overnight parking and waiting during shipment drop-off and pick up can significantly affect performance in a manner similar to that achieved with the implementation of idle-reduction technologies.

Reduced Warm-up Time: New engine technologies are reducing the need for engine warm-up and warm-down periods. Here again, any actions to reduce warm-up time serves a similar purpose as an effort to reduce idling time.

Required Use of Electric Wayside Facilities: More truck stop facilities are beginning to outfit their parking areas with connections for electrical power, Internet service, HVAC, and other similar devices. The use of these facilities offers a more efficient means of accessory operations than running the main power unit. Mandating their use when available offers another means to reduce vehicle idling and gain the related fuel performance improvements.

Maximum Speed Policy: As noted earlier, speed reduction strategies can significantly reduce fuel consumption. As an alternative to system installation such as governors, such a policy can achieve much of the same benefit with compliance.

Driver Training for Fuel Performance: Variation in performance due to driver skills and practices can be significant. Some estimates of fuel performance improvement resulting from driving skills suggest as much as a 35% difference (Kilcarr 2006B). The benefits of training vary a great deal more than the implementation of particular systems; however, training may very well be one of the most inexpensive and productive ways to improve performance.

Fuel Performance Benchmarking: Fuel performance benchmarking employs an incentive plan to encourage drivers to focus more on their driving habits. Some companies will use benchmark criteria combined with financial incentives to motivate drivers to pay attention and change behaviors that will contribute to improved performance.

Required Maintenance: Maintenance operations support fuel performance by assessing the wear and tear on fleet operations and ensuring that fuel systems, air intake systems, drive systems and so forth, remain in top working order.

Information System Technologies

Information system technologies support improvements in fleet fuel performance by helping identify and implement improvements in the routing and scheduling of fleet operations and by providing systems to monitor ongoing performance as a base from which to implement improvements in systems and training.

Wireless Transportation Management Systems: Satellite-based transportation management systems (TMS) provide a means to communicate with drivers and monitor unit operation. System features can include the monitoring of truck operations from speed, to fuel consumption, to other more detailed engine operating factors. Such systems can also provide updated information regarding routing to help drivers circumvent areas of congestion and improve fuel performance.

Onboard Fuel/Systems Performance Monitoring: Onboard monitoring systems help drivers to better monitor their fuel consumption and adopt habits that may help improve fuel performance.

Fuel Management Systems: While they don't directly influence fuel performance, fuel management systems help improve overall fleet fuel costs by providing information regarding fueling locations that offer lower fuel prices considering their current fuel levels and present and future routing.

Advanced Routing and Scheduling Systems: Routing and scheduling systems help improve fuel performance by scheduling pickup and delivery activities to reduce potential idling. They also support better performance by directing drivers to loads that minimize empty driving time and help improve load planning and fuel consumption per load.

CURRENT AND FUTURE STATE OF ADOPTION

This study was directed at companies operating Class 8 tractor trailer fleets. Before implementation, a review of research and popular publications supporting the motor carrier industry was completed in an effort to document the types of equipment, information technologies, and corporate policies that were being employed by carriers in an effort to improve fuel performance. The list formed the foundation to lead interviews with operations managers at four large motor carrier companies, as well as with researchers in the logistics transportation arena. Notes from the interviews were reviewed and compared with content from the literature review to identify any other methods to improve fuel performance using equipment, information technologies, or corporate policies.

Reviews and interview responses led to the development of a survey instrument to be distributed to individuals responsible for the management of Class 8 motor carrier fleets, including private, contract, and common carrier organizations. In addition to demographic data, the survey questions focused on four categories of methods that may be used to improve fuel performance. The categories included tractor equipment technologies (18 items), trailer equipment technologies (5 items), management policies (7 items) and information system technologies (5 items). The survey addressed current and future actions that may be taken to address fuel performance concerns. Specifically, respondents were asked to address the state of policy, method, and technology adoption by indicating whether they had completed implementation, were in the process of implementation, had plans for implementation in the next 1–2 or 2–4 years, or had no plans for implementation.

In addition, the survey addressed issues related to motor unit replacement strategies, compliance with federal emissions regulations, and expectations of changes in fuel performance that may result from technology and regulation. Finally, participants indicated the estimated percentage of total miles traveled above 45 miles per hour and whether or not they currently participated in the EPA SmartWay Transport Partnership.

With regard to the current average fleet mileage, the survey asked participants to categorize their performance in miles per gallon (mpg) into one of 12 categories, ranging from fewer than 5 mpg to between 7.8 and 8.0 mpg. Each category represented a 0.3 mpg range. While this does not provide for a more refined analysis, this question type was selected in an effort to encourage subject responses. In cases where open-ended questions were presented for such specific information, participants frequently chose not to respond either because of competitive concerns or the need for specificity. The draft survey was reviewed for content, language, and structure by experts in survey development, as well as industry practitioners.

The survey was distributed through e-mail to the individual representing the highest level of management in either fleet operations purchasing or fleet maintenance at 24,000 carriers who subscribed to Commercial Carrier Journal. The e-mail provided a link to an online, two-page survey, which could only be administered once to anyone who chose to participate. The e-mail linked to the survey was redistributed to the population two weeks after the first distribution with a request for participation if they had not already done so. A list of survey questions is provided in Appendix A.

Of the initial distribution of 24,000 e-mail surveys, a total of 164, or less than one percent, of surveys were completed. The poor level of participation was attributed to the potential for survey fatigue among the participants, the potential for deletion from e-mail despite efforts to present the distribution as distinctive from e-mails referred to as “spam,” and the perceived length and detail of the survey questions.

Of participating organizations, 31% classified themselves as private carriers, 12.5% as contract carriers, 35.1% as common carriers, and 14.3% as a combination of common and contract carriage (see Figure 1). The 7.1% of participants who selected the “other” category consisted of government-related organizations. Fleet sizes, as shown in Figure 2, ranged from fewer than 10 motor units (26.8%) to more than 1,000 motor units (4.2%).

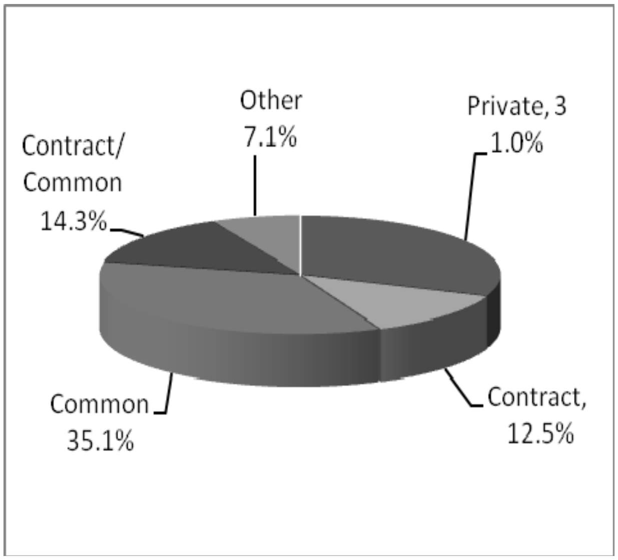

Figure 1. Fleet type

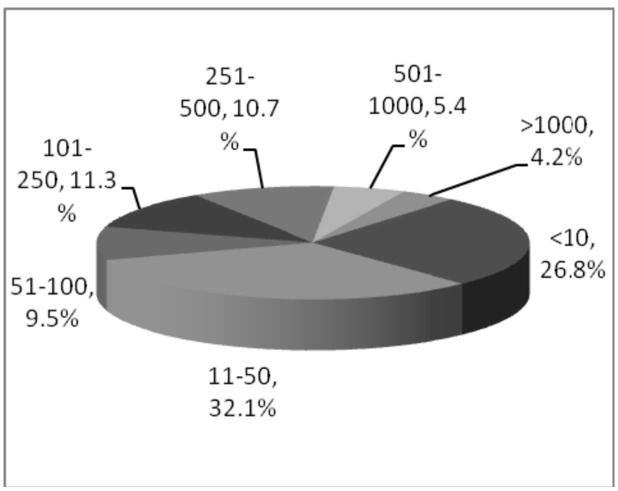

Figure 2. Fleet size

Participants were asked to break down their trailer type by percentage into seven categories, including box-van, flatbed, temperature-controlled, tanker, soft-sided, auto-hauler, and other (see Figure 3). The majority (98 participants) indicated at least 50% of their fleet included box-van or temperature-controlled. The average age of motor units was in the two to three years (30.4%) and more than four years (33.3%) categories (see Figure 4).

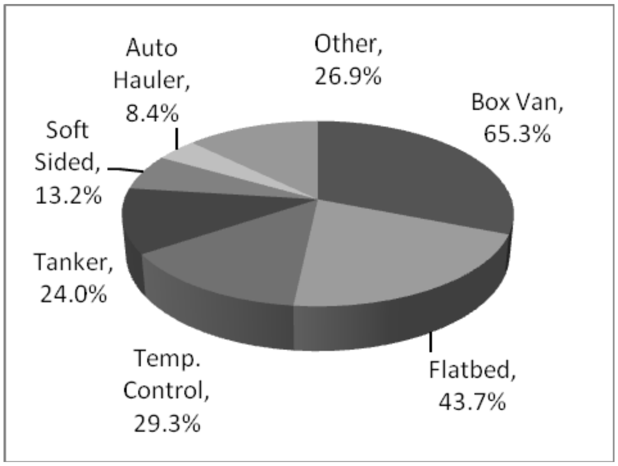

Figure 3. Trailer type

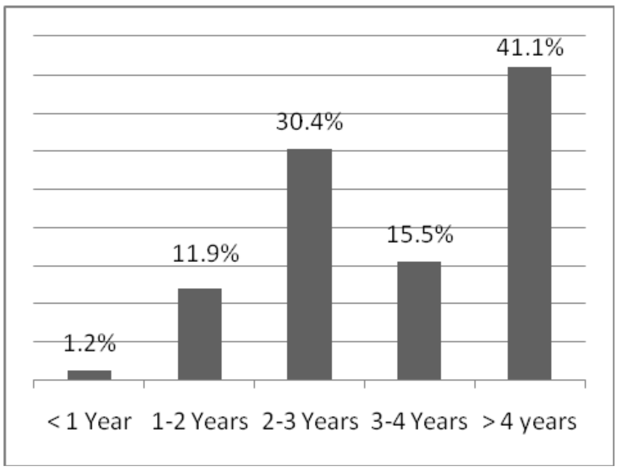

Figure 4. Average age (power units)

Of the 164 participants, 84% indicated that over 50% of their total miles included speeds above 45 miles per hour. Forty-four percent indicated that over 75% of their total miles were traveled at speeds above 45 miles per hour.

Fuel performance for those participating in the survey centered in the 5.7–5.9 mpg range with a rather normal distribution from fewer than 5.0 mpg to 7.5–7.7 mpg (see Figure 5).

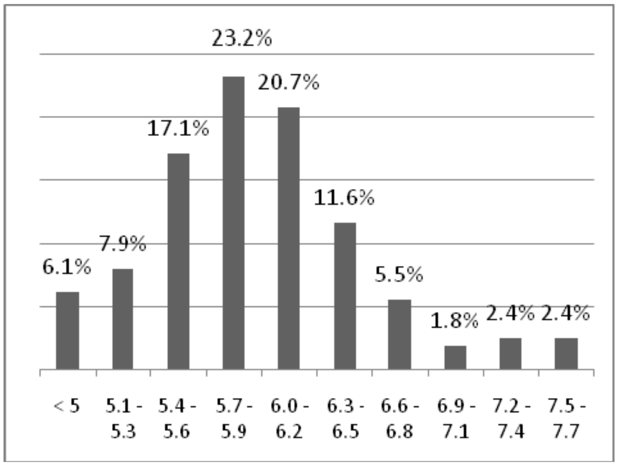

Figure 5. Average mileage

In most cases, carriers acknowledged it was too early to assess the impact from the new engine standards at the beginning of 2007. In response to a question about motor unit replacement strategies over the next two years, almost 10% indicated they planned to employ an engine rebuild over a new unit purchase.

The following sections address the adoption of technologies, policies, and methods employed by carriers to improve fleet fuel performance. The sections represent four categories, including motor unit technologies, trailer technologies, management policies, and information system technologies. These categories vary from the original discussion by separating tire and wheel technologies and aerodynamics into their application on the motor unit and trailer, respectively.

In each section, results are ranked by the current and planned level of adoption among survey participants beginning with those that have been fully implemented, those that are in the process of implementation, those that are expected to be implemented in the next 1–2 years, the next 2–4 years, and those in which participants have no plans for future adoption.

Motor Unit Technologies

Each of the graphs in these sections represents the extent of current or planned adoption of mechanical technologies that may be installed on tractors in an effort to improve fuel performance.

Motor unit related technologies that have been or are in the process of being adopted by at least 50% of participants include two engine-related systems, three aerodynamic modifications, and a drive-train related system.

Governors to limit top vehicle speeds have been implemented in nearly 65% of participants, with another 10% in the process of adoption. Aerodynamic components, including cab extenders, mirrors, and roof fairings have been or are in the process of being implemented by nearly 60% of participants. Approximately 60% of participants have implemented or are in the process of implementing automated shutdown systems as a means to reduce engine idling. Finally, alloy wheels have been installed by approximately 44% of participants, with another 25% in the process of implementation.

Those systems seeing little current or planned adoption include battery APUs, waste heat systems, hydrogen injection, and nitrogen tire inflation (see Figure 6).

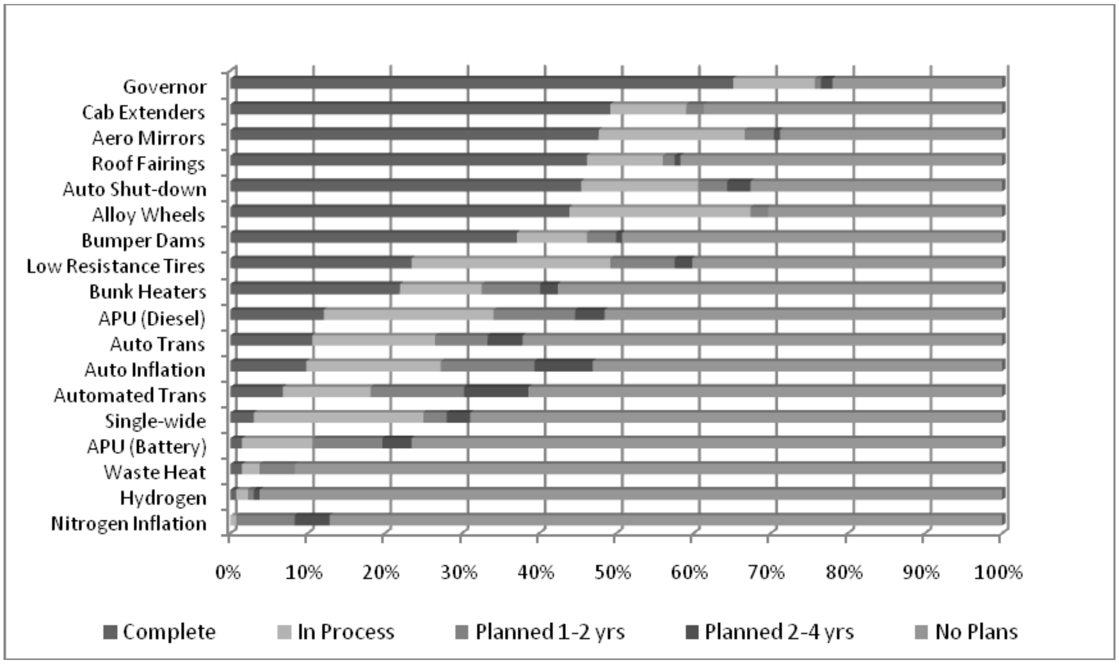

Figure 6. State of motor unit technology implementation

Trailer Technologies

Trailer technologies appear to be focused on wheel modifications, including alloy wheels to lower trailer weight, and the application of low-rolling resistance tire technologies. In both cases, approximately 50% of participants have implemented or are in the process of implementation. The remaining systems include single-wide tires, trailer skirts, trailer tails, and nitrogen tire inflation, and are expected to see little adoption in the next four years (see Figure 7).

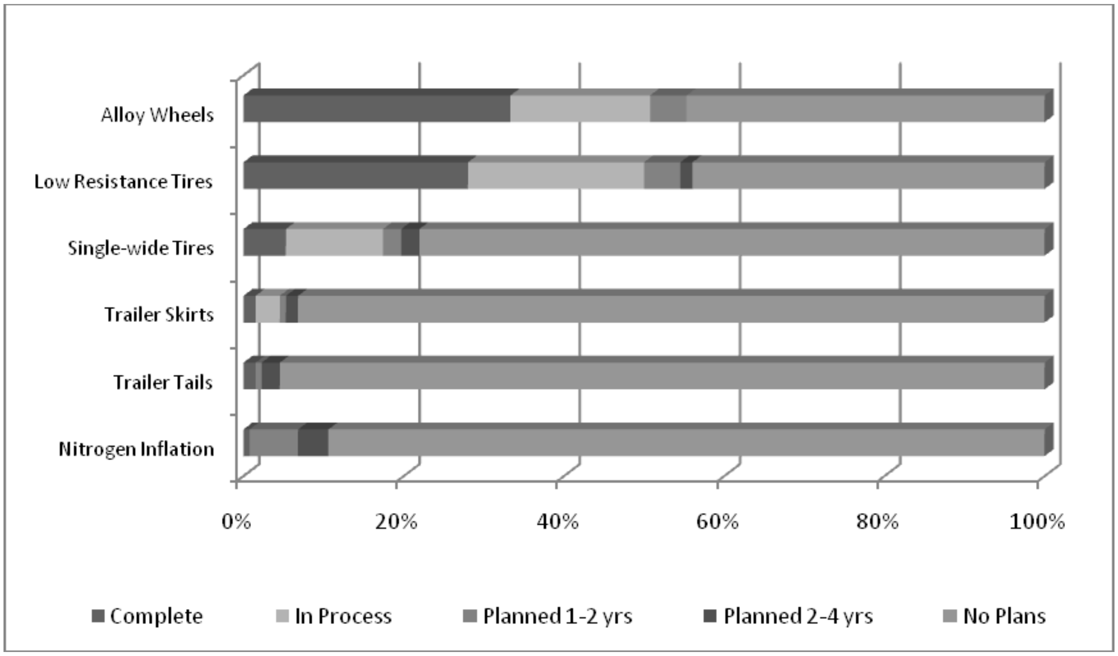

Figure 7. State of trailer technology implementation

Management Policies

Management policies appear to be seeing broad adoption across Class 8 carrier operations. Scheduled maintenance has been implemented by nearly 90% of participants with most of the remaining participants in the process of or planning implementation in the next two years.

Over 80% of participants have adopted or are in the process of adopting a maximum speed policy, followed closely by no idling, reduced warm-up, fuel benchmarks, and driver training. The only management policy that appears to have little support of participants at this point is the mandatory use of electric wayside facilities. This is likely influenced by the limited availability of such facilities at the present time (see Figure 8).

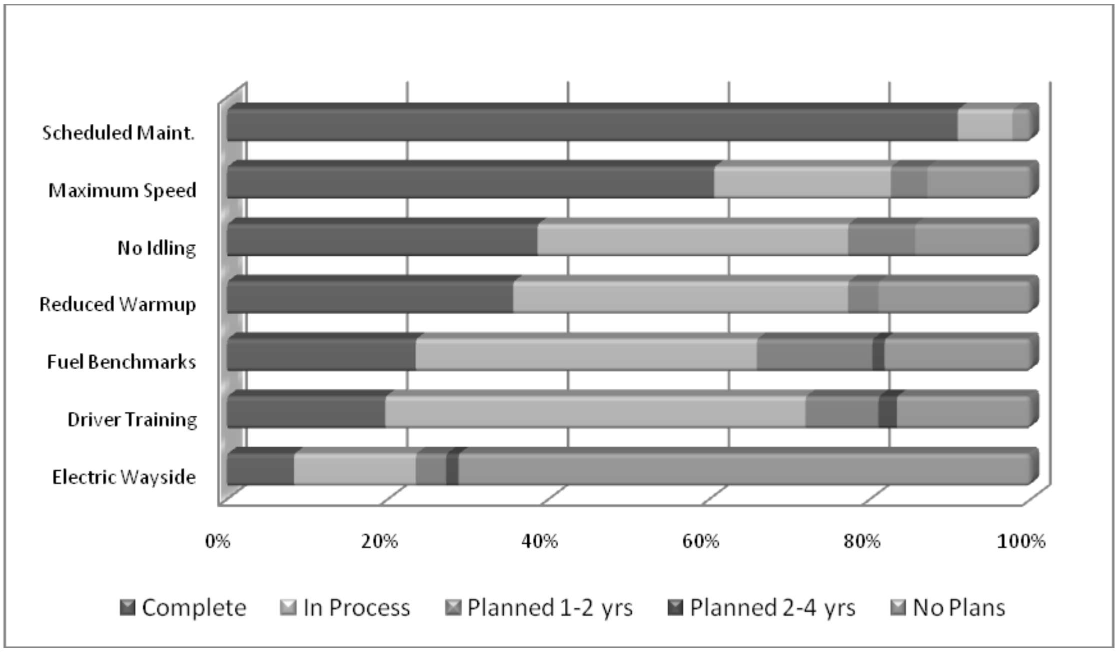

Figure 8. State of management policy implementation

Information System

Routing and scheduling, onboard monitoring, wireless TMS, and fuel management systems appear to have a similar level of current and planned adoption with between 20 and 25 percent of participants having completed implementation of such systems and an additional 15%–20% of participants in the process of adoption.

Wireless TMS with monitoring is the least likely to be implemented with less than 20% having completed implementation and approximately an additional 20% in the process of adopting or planning adoption in the next four years (see Figure 9).

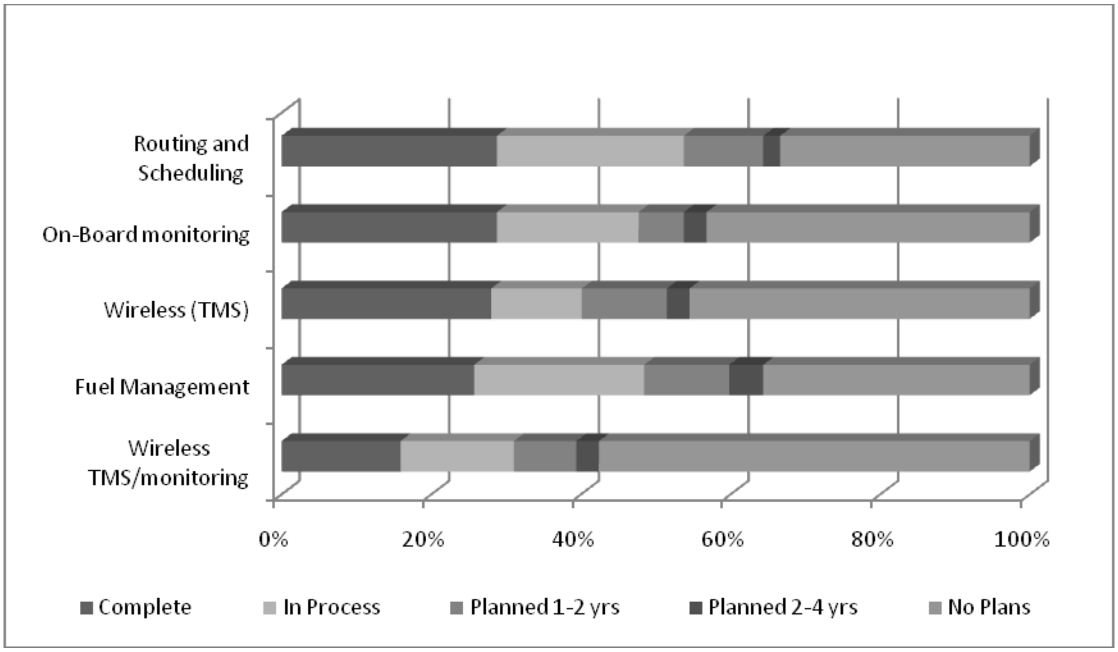

Figure 9. State of information system implementation

TECHNOLOGY IMPLEMENTATION COMPARISON

In an effort to assess whether current policies, methods, or systems employed by carriers were supporting improved fuel performance, a subset of study results was evaluated to compare the performance of carriers who have adopted or are in the process of adopting alternative technologies, policies, and systems with those who have not initiated adoption. This particular analysis was limited in two ways. First, the analysis includes responses from only those carriers operating either box-van or temperature-controlled trailers to ensure a more consistent configuration among units. Second, the analysis is limited to those methods where each category (implemented, or not implemented) had more than 27 responses for comparison. This was established as a cutoff because cases with fewer observations may have a significant level of variance and do not represent an effective sample size. A total of 96 survey participants indicated that the majority of their trailers were box-van or refrigerated units.

The samples were separated into two categories: those participants who have adopted or are in the process of adoption represented “Implemented,” and those who plan adoption in the next 1–2 or 2–4 years, or those with no plans, represented “Not Implemented” as a response.

While implementation of equipment and systems suggested improved fuel performance in each of the nine categories illustrated, the only statistically significant difference showed in the implementation of bunk headers ($p = 0.036$) (see Figure 10).

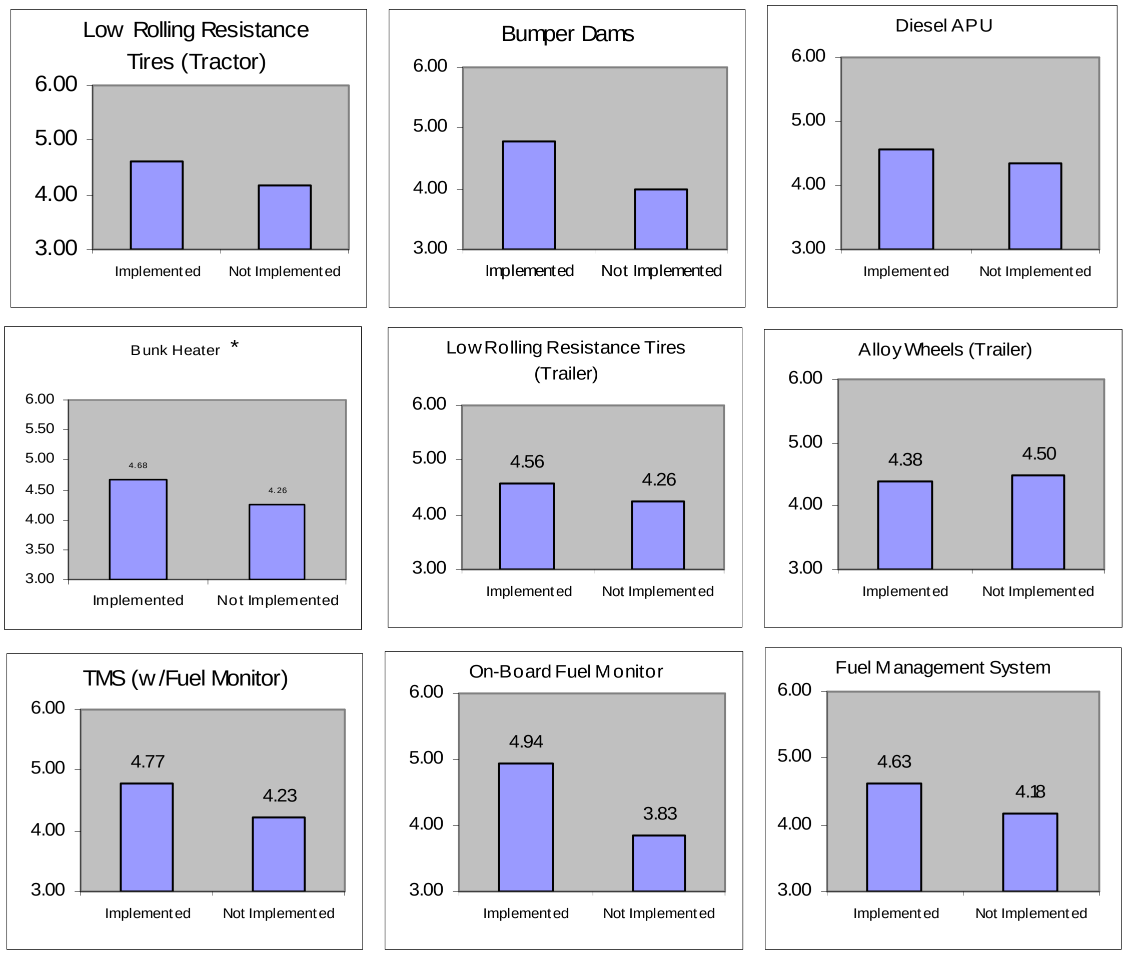

Figure 10. Fuel performance comparison (implemented vs. non-implemented)

Survey participants were asked to assess their expectation of changes in fuel performance opportunities over the next twelve months, three years, and five years. Results indicate that carriers anticipated little change over the next twelve months. Over three years, the general consensus appears to be more broadly split, with most responses ranging between a one and nine percent decrease and a one and nine percent increase in performance. Over five years, a slightly larger proportion anticipates that performance will improve, rather than get worse (see Figure 11).

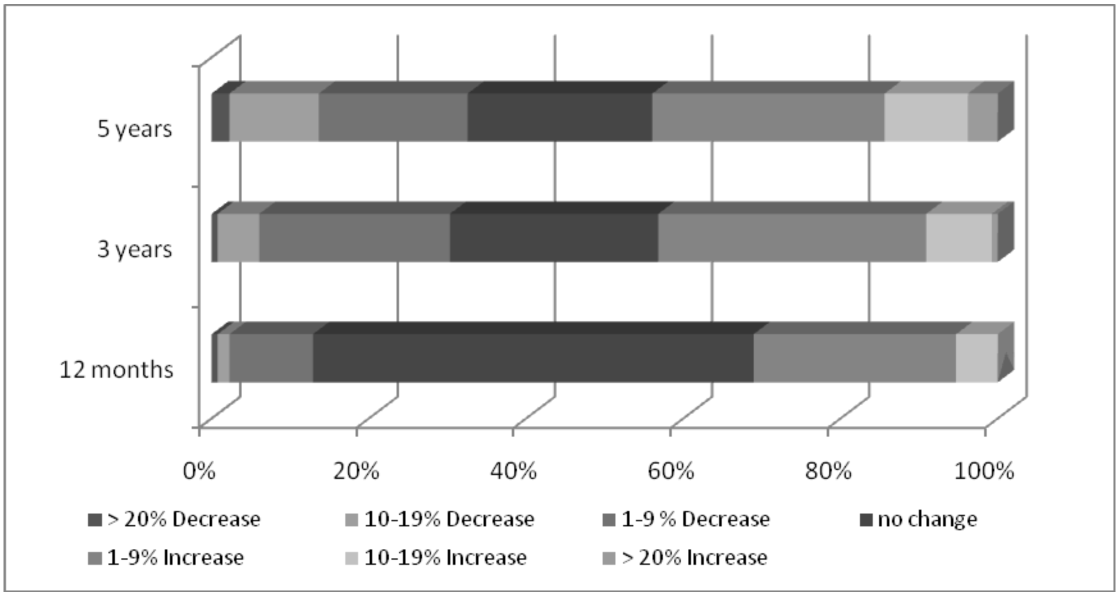

Figure 11. Expected future fuel performance change

Finally, participation in the EPA SmartWay Transport Partnership is small among participants at just over 12% (see Figure 12).

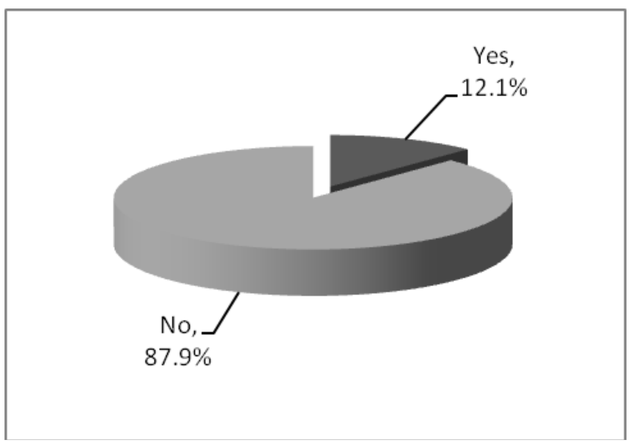

Figure 12. SmartWay participation

CONCLUSIONS AND IMPLICATIONS

Increasing fuel costs and a growing concern for environmental impact are spurring a significant effort to develop new technologies to improve fuel performance across all transportation modes, not least of which are Class 8 motor carriers. The impact of increasing oil prices, and consequently fuel costs, extends beyond the transportation sector to include the cost of production and processing of foods, building materials, manufactured products, and a broad range of services.

Recently, advanced technologies, including hybrid power trains incorporating battery technologies and fuel cells, have been receiving much attention and research funding. Yet there are existing technologies, systems, and even management policies that can have a more immediate impact on fuel performance. This research sought to assess the extent of current and future adoption of technologies, systems, and policies that have a track record of contributing to improved performance.

This study was directed at over 24,000 motor carrier companies in the United States. Of that population, 169 carriers responded to the survey distributed by e-mail. While the response rate was low, the distribution of carrier sizes ranged from fewer than 10 power units to more than 1,000 power units. Fuel performance for the groups surveyed averaged between 5.7 and 6.2 mpg. Of the 18 motor unit technologies evaluated, only one (speed governors) was reported as having been adopted by more than 50% of respondents. Four additional technologies were adopted by more than 40% of respondents. Of six trailer technologies listed, two (alloy wheels and low-rolling resistance tires) had been adopted by more than 25% of respondents. Of seven management policy actions that support fuel performance improvement, scheduled maintenance activities have been adopted by more than 90% of respondents, and a maximum speed policy had been implemented by nearly 60% of respondents. Finally, of the five information technologies assessed, four have been implemented by more than 20% of respondents.

These results suggest that there remains a significant opportunity for Class 8 motor carriers to improve fuel performance with the implementation of existing equipment, technologies, and policies. While suppliers to the industry direct efforts at equipment that may provide major improvements in operating performance, such technologies will likely not be ready for widespread adoption for a number of years. In the meantime, increases in fuel costs make adoption of existing technologies more attractive from a financial perspective. In the United States, programs such as SmartWay are also providing a financial incentive through low-cost loans for carriers to acquire APU systems and aerodynamics, yet participation is low within the surveyed group.

Future Research

Research into technologies and systems to improve fleet fuel performance generally incorporate structured experimental designs to ensure that conditions remain consistent as alternative units and configurations are tested. Such studies provide the grounding from which to bring new technologies to market. The present study and future studies like it make a contribution by assessing the level of adoption and providing insights as to the benefits of technologies in practice. While the variables assessed are not exhaustive and operating conditions are not controlled, this research begins to offer some insight into the state of practice and future opportunities for improvement across the motor carrier industry.

Results of the present study indicate a relatively low rate of adoption of existing technologies, systems, and policies. The industry would benefit from more depth analyses to validate these findings and gain a better understanding of factors contributing to the low rate of adoption. Replications of this study would also begin to provide a longitudinal assessment illustrating adoption of current and new technologies, systems, and policies across the motor carrier industry. This assessment may present input that can be used to better predict the impact of current and future technologies on the industry, the broader economy, and the environment. It may also offer a means to validate existing models of adoption in this particular domain.

The present study suffered from a poor level of participation among the motor carrier population. Future studies should investigate methods to help improve participation either by employing another method of data collection or perhaps focusing the analysis on more specific populations in an effort to focus collection efforts. For example, an analysis of carriers operating primarily enclosed van equipment may be implemented using a phone survey or by using an initial call to identify key informants and encourage their participation in a survey distributed via e-mail.

The importance of improving fuel performance among all modes of transportation will continue to grow as costs rise, other economies grow and require greater volumes of freight transportation, and as environmental concerns become more critical.

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APPENDIX A. SURVEY INSTRUMENT

• What systems and equipment contribute to improved fuel performance?
• Which management policies support improved fuel performance?

These are just a few of the questions being investigated as part of study by Missouri State University. Please complete the following 2 page survey identifying the equipment, systems, and policies that contribute to improved MPG performance of Class 8 fleets.
Your responses are anonymous and are not tied to specific e-mail addresses or companies. As a subscriber to CCJ, you will receive a copy of the final report.

If your organization utilizes owner/operators as well as company owned vehicles, please base your answers on the company owned portion of your fleet.

1. How would you describe your fleet as a transportation provider?
(Private Fleet, Contract Fleet, Common Carrier, Combination Common/Contract, Other)

2. How many company owned Class 8 Tractor units are in your fleet?
(<10, 11-50, 51-100, 101-250, 251-500, 501-1000, >1000)

3. How many company owned trailer units are in your fleet?
(<10, 11-50, 51-100, 101-250, 251-500, 501-1000, >1000)

4. Indicate the breakdown between TL and LTL services provided by your company. (Total should = 100%)
    Truckload
    Less-than-Truckload
    Other

5. If you answered "Other" as part of your response to number 4, please indicate the other type of service you provide.

6. Indicate the percentage breakdown of trailer types in your fleet. (total should = 100%)
    Box Van
    Flatbed
    Temperature Controlled
    Tanker
    Soft Sided
    Auto-hauler
    Other

7. If you answered "Other" as part of your response to number 6, please indicate the other type of trailers you operate.

8. What is the average age of your company owned tractor fleet?
(1 year or less, 1-2 years, 2-3 years, 3-4 years, >4 years)

9. What percentage of total fleet miles are traveled at speeds above 45 MPH?
(1 – 100% at 5% increments)

10. What percentage of your tractor fleet meet 2007 EPA Engine standards?
(1 – 100% at 5% increments)

11. Considering your motor unit replacement strategy over the next two years, what percent of those replacement units do you expect to address with engine rebuild vs. new unit purchase? (1 – 100% at 5% increments)

12. What is your current average fuel performance (MPG)?
(< 5 MPG, 5.1-5.3 MPG, 5.4-5.6 MPG, 5.7-5.9 MPG, 6.0-6.2 MPG, 6.3-6.5 MPG, 6.6-6.8 MPG, 6.9-7.1 MPG, 7.2-7.4 MPG, 7.5-7.7 MPG, 7.8-8.0 MPG, > 8 MPG)

13. How has your fuel performance changed since the implementation of 2007 EPA Standards?
(fewer miles per gallon, about the same, more miles per gallon, too early to tell)

14. For each of the following tractor equipment technologies, indicate the current status of fleet implementation. (Complete, In Process, Planned 1-2 yrs, Planned 2-4 yrs, No Plans)

Low Rolling Resistance Tires
Single-wide Tires
Aluminum Alloy Wheels
Nitrogen Tire Inflation
Cab Extenders
Roof Fairings
Aerodynamic Mirrors
Bumper Dams
Automated Tire Inflation
Auto Shut-down
Automatic Transmissions
Automated Transmissions
Speed Governor Implementation
Auxiliary Power Units (Diesel)
Auxiliary Power Units (Battery)
Waste Heat Recovery System
Bunk Heaters
Hydrogen Injection System

15. For each of the following trailer equipment technologies, indicate current status of fleet implementation. . (Complete, In Process, Planned 1-2 yrs, Planned 2-4 yrs, No Plans)

Low Rolling Resistance Tires
Single-wide Tires
Aluminum Alloy Wheels
Nitrogen Tire Inflation
Trailer Skirts
Trailer Tails

16. For each of the following management policies, please indicate the current status of fleet implementation. . (Complete, In Process, Planned 1-2 yrs, Planned 2-4 yrs, No Plans)

No Idling Policy
Reduced Warm-up Time
Required Use of Electric Wayside Facilities
Driver Training for Fuel Performance
Fuel Performance Benchmarking
Maximum Speed Policy
Required Scheduled Maintenance

17. For each of the following information system technologies, please indicate the current status of fleet implementation. . (Complete, In Process, Planned 1-2 yrs, Planned 2-4 yrs, No Plans)

Wireless Transportation Management Systems (TMS)
Wireless TMS with remote performance monitoring
On-Board fuel/systems performance monitoring
Fuel Management Systems
Advanced Routing and Scheduling Systems

18. Considering you fleets current average MPG, how do you believe your fuel performance will change over the next....
(> 20% Decrease, 10-19% Decrease, 1-9 % Decrease, no change, 1-9% Increase, 10-19% Increase, > 20% Increase)

12 months
3 years
5 years

19. What types of equipment do you believe will most improve fuel performance over the next five (5) years? (Hybrid Diesel/Electric, Hybrid Fuel Cell/Electric, Body Design/Aerodynamics, Improvements in Diesel Technology, Other)

20. Do you currently participate in the EPA SmartWay Transportation Program?
(Yes, No)

21. Which best describes your position in your organization?

Corporate Management/Corporate
Official
Transportations/Operations/Safety
Management
Maintenance/Fleet Management
Purchasing Management
Other (please specify)

22. Which best describes the primary industry you serve?

Agricultural/Livestock
Automotive
Bulk Chemical/Petroleum
Construction
Mining/Logging/Excavating
Household Product Manufacturing
Food and Beverage Product
Manufacturing
Food Service Wholesale
Waste Management/Recycling
Government (Federal/State/Local)
Manufacturing/Processing
Retail Product Delivery
Wholesale Delivery
Package Freight Services
Health Care
Manufacturing/Wholesale
Other (please specify)

23. If you have identified other equipment, systems, or management policies that are helping your company improve fleet fuel performance, please share them with us in the space provided below.