Fuel Saving/Emissions Reducing Technologies and Incentives: Use and Preferences among Diesel Truck Owners in the Baltimore Region

Final Report

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1.0 INTRODUCTION

In December 2006, the American Transportation Research Institute (ATRI) was selected by the Baltimore Metropolitan Council (BMC) to conduct a survey of diesel truck owners operating in the Baltimore, Maryland region to identify fuel saving/emissions reducing technologies (FSERTs) which may be of interest.\(^1\,\,^2\) Financial mechanisms which could assist with the purchase of these technologies were also to be identified.

ATRI, with input from BMC staff, developed a survey questionnaire for distribution to diesel truck owners. Assistance in creating the survey was also provided by the Maryland Departments of Transportation (MDOT) and the Environment (MDE), as well as trade associations located in the Baltimore area. A survey distribution plan was developed which involved distributing the survey directly to a list of more than 700 recipients as well as providing notices through a variety of trade associations which have members operating diesel trucks in the Baltimore region.

Brief descriptions of each FSERT investigated in this study are provided in Chapter 2. The potential attraction of these technologies rests with the fact that for many trucking companies, fuel represents the second-highest operating expense, accounting for as much as 25 percent of total operating costs. Quite simply, the use of fuel saving technologies can save money. Beyond this, the Baltimore region does not meet the National Ambient Air Quality Standards for fine particulate matter (PM2.5) and 8-hour ozone. Through the use of emissions reducing technologies, improvements to the region’s air quality can be achieved.

Descriptions of the incentive-based programs being investigated are also provided. These programs, which include the U.S. Environmental Protection Agency’s SmartWay Transport Partnership and various state and local incentive programs, have received growing attention as a means of fostering the deployment of FSERTs among diesel truck owners.

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\(^1\) The American Transportation Research Institute is the trucking industry’s 501(c)(3) not-for-profit research organization. It is engaged in critical research relating to freight transportation’s essential role in maintaining a safe, secure and efficient transportation system. For more information, visit www.atri-online.org.

\(^2\) The Baltimore Metropolitan Council (BMC) is a private nonprofit organization committed to identifying regional interests and developing collaborative strategies through plans and programs which will improve the quality of life and economic vitality throughout the region. BMC’s Board of Directors includes the Mayor of Baltimore City, the County Executives of Anne Arundel, Baltimore, Harford and Howard counties, and a Carroll County Commissioner. For more information, visit www.baltometro.org.
An analysis of survey responses is provided in Chapter 3. This analysis describes current and planned use of FSERTs by diesel truck owners in the Baltimore region. Interest in the use of these technologies with incentives available as well as interest in different types of incentive programs is also explored.

Finally, recommendations for identifying potential program participants and for establishing an incentive program targeting diesel truck owners in the Baltimore region is provided in Chapter 4.
2.0 TECHNOLOGIES AND PROGRAMS INVESTIGATED

2.1 Fuel Saving/Emissions Reducing Technologies

This section provides brief descriptions of each fuel saving/emissions reducing technology which was included in the survey questionnaire. These descriptions are not meant to be all inclusive, but rather provide a reference for the types of technologies which may be of interest to diesel truck owners operating in the Baltimore region and could be incorporated into an incentive program.3

2.1.1 Automatic Tire Inflation Systems

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. ATI systems use either the vehicle’s own air-brake compressor to supply air to all the tires or use self-contained compressors mounted on each hub powered by the rolling motion of the wheels. Once an ATI system is installed, it is not expected to require any special attention from the driver.

ATI systems are estimated to extend tire life by 8 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 and trailer axles costs as much as $900 but is estimated to save over $200 annually in tire maintenance costs. Annual fuel savings are estimated to be 0.6 percent for a typical long-haul combination truck.

2.1.2 Auxiliary Power Units

Auxiliary power units (APUs) are mounted externally on the truck cab. An APU typically consists of a small combustion engine and generator combination.

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3 The technology descriptions contained in this section have been summarized based upon information obtained primarily from EPA’s SmartWay web site, www.epa.gov/smartway. Supplemental information was obtained from other sources, where necessary. ATRI makes no assurances as to the accuracy of the technology descriptions, costs, or emissions reduction estimates.
that can provide power to the truck when the main engine is shut off. APUs can provide heat, air conditioning, power for electrical devices, and engine heat. APUs may be fueled directly from the truck’s diesel fuel tank or from a bank of rechargeable batteries.

The amount of idling varies widely among trucks by season, type of operation and driver practices. A typical long haul combination truck is estimated to idle as much as 2,400 hours per year while consuming over 1,900 gallons of fuel. Installing an APU costs as much as $9,000 but, by eliminating main engine idling, can reduce overall fuel consumption by as much as 8 percent and save an estimated $300 in engine maintenance costs each year.

2.1.3 Bunk Heaters

Bunk heaters, or direct fired heaters, are devices that can reduce idling by providing in-cab heat for drivers in cold temperatures. Some models offer an engine heating option that will also warm engine fluids overnight. These devices do not include any air conditioning capabilities. Bunk heaters are mounted in the cab of a truck and are typically fueled directly from the truck’s diesel fuel tank. The approximate cost for this device is $1,000. When used to eliminate main engine idling in cold temperatures, bunk heaters are estimated to reduce overall fuel consumption by 5 percent and save an estimated $150 in engine maintenance costs each year.

2.1.4 Diesel Oxidation Catalysts

A diesel oxidation catalyst (DOC) is a device added to the exhaust system of a truck that reduces the amount of particulate matter (PM) and other pollutants emitted. The device is generally a large honeycomb structure with an active catalyst made up of a layer of precious metal. DOCs are expected to have a negligible impact on fuel consumption. DOC costs are dependent upon the size of the engine and can range from $1,000 to $2,000 per unit while providing emission reductions ranging from 20 to 50 percent for particulate matter. DOCs reduce emissions of carbon monoxide (CO) and hydrocarbons (HC) as well.
2.1.5 Diesel Particulate Filters

Diesel particulate filters (DPFs) are similar to diesel oxidation catalysts and are one of the major technologies being employed to meet the new 2007 heavy-duty diesel engine emissions standards. A DPF is considered a “flow-through” device whereby the exhaust is forced through a honeycomb shaped, ceramic filter that is blocked at one end. Because of this design, it is important to monitor the exhaust back pressure and ensure the DPF is cleaned properly so the filter does not become blocked. Most filters are designed to clean themselves (referred to as passive regeneration) but this requires an elevated engine temperature to burn off the trapped particulate matter (PM). For vehicles that don’t meet the minimum temperature requirements, the filter will trigger what is referred to as an "active regeneration event." This means that some diesel fuel will be passed through the engine un-combusted and will be burnt over the catalyst, allowing the PM within the filter to be burned away. DPFs cost roughly $8,000 or more while providing PM reductions ranging from 50 to 90 percent. DPFs also reduce CO and HC emissions.

2.1.6 On-Board Plug-In Systems

On-board plug-in systems can include inverter kits and wiring packages to distribute electricity throughout the truck cab to run appliances, TVs, microwaves, and other on-board electrical devices. These systems allow for a connection to an external power source, such as an electrical plug or truck battery, to power cab comfort devices without running the truck’s main engine. Installing an on-board plug-in system can costs from a few hundred dollars to a few thousand dollars, depending upon the extent of equipment needed, and can be used to eliminate main engine idling.
2.1.7 Single Wide Tires

Single wide-base tires can improve truck fuel economy by reducing rolling resistance and tare weight (empty weight). Tire rolling resistance accounts for nearly 13 percent of truck energy use. Most combination trucks have dual tire assemblies on the drive and trailer axles, with two sets of wheels and tires at each end of an axle.

A single wide-base tire and wheel is lighter than two standard tires and wheels. Total weight savings for a typical combination truck using single wide-base tires on its drive and trailer axles ranges from 800 to 1,000 pounds. This weight savings can reduce fuel consumption or increase cargo capacity for trucks that are weight-limited. Wide-base tires have lower rolling resistance and aerodynamic drag and generate slightly less pass-by noise than do dual tires.

A single wide-base tire costs about the same as two equivalent dual tires and a single wide-rim wheel typically costs about $130 less than two standard wheels. While retrofitting existing trucks with wide-base tires and wheels may not be cost-effective, for new trucks, the "payback" is instantaneous, since the initial savings could exceed $1,000. In addition, fuel economy improvements of 2 to 5 percent are expected when compared to equivalent dual tires.

2.1.8 Trailer Fairings

Trailer fairings, or trailer side skirts, extend down from the bottom of the trailer to cover part of the open space between the tractor and the rear wheels.

Aerodynamic drag (i.e., wind resistance) accounts for most truck energy losses at highway speeds. Reducing drag improves fuel efficiency. The longer the drive and the higher the operating speed, the greater the potential efficiency benefits. The cost of trailer fairings can be as much as $2,400 and have been estimated to improve fuel economy by up to 5 percent.
2.2 Incentive-Based Programs

This section provides summaries of programs which encourage the use of fuel saving/emissions reducing technologies. These programs have been initiated at many different levels of government, ranging from the federal government to state and local government entities. As highlighted in this section, a number of different approaches are being used to encourage the deployment and use of FSERTs.

2.2.1 SmartWay Transport Partnership Program
(www.epa.gov/smartway/index.htm)

The U.S. Environmental Protection Agency’s SmartWay Transport Partnership is a collaborative, voluntary program between EPA and the freight industry. The Partnership creates market-based incentives that challenge companies shipping products, and the truck and rail companies delivering these products, to improve the environmental performance of their freight operations through the use of the FSERTs described above.

Similar to the Energy Star program, SmartWay partners can publicize participation by using the SmartWay logo on websites, marketing materials and packaging. In addition to receiving recognition as a SmartWay carrier, partners also improve energy efficiency, thereby saving money while reducing greenhouse gas emissions and improving air quality.

SmartWay has also joined with the Small Business Administration (SBA) to develop an Express Loan program to assist with the purchase of FSERTs. This program is offered through certain SBA lenders to help trucking companies with gross receipts of $23.5 million or less finance FSERTs. Companies can borrow from $5,000 to $25,000 with no collateral and flexible loan terms. (For more information, see Appendix A.)

By 2012, ground freight transportation is projected to consume over 45 billion gallons of diesel fuel and produce over 450 million metric tons of carbon dioxide annually. The SmartWay program aims to significantly reduce these emissions by saving between 3 to 6 billion gallons of diesel fuel each year, thereby eliminating at least 33 million metric tons of CO2 emissions and as much as 200,000 tons of NOx emissions per year.
2.2.2 State and Local Incentive Programs

A number of incentive programs have been established to encourage the use of FSERTs. These programs, which have been established primarily at the state level, use a variety of financial mechanisms to help diesel truck owners offset a portion of the cost of various FSERTs. These programs include:

- Grant programs which provide direct funding (which is considered taxable income) to offset a portion of a technology’s purchase and installation cost;
- State tax credits which offset a percentage of the purchase price of targeted technologies by reducing a business’ tax liability; and
- Loan and lease-to-own programs which provide preferred interest rates and repayment terms for the purchase and installation of certain technologies.

These programs establish specific eligibility requirements which must be met in order to qualify, such as limits on the size and location of an eligible business, percentage of operating time occurring in a specific area, and tracking/reporting requirements. The amount of cost offset and types of technologies targeted by these incentive programs vary widely. A summary of financial incentive programs is provided in Appendix A.
3.0 SURVEY ANALYSIS

3.1 Background

From March through April 2007, ATRI conducted a survey of motor carriers operating diesel trucks in the Baltimore region to determine current and planned use of fuel saving/emissions reducing technologies (FSERTs). Carrier contact information was obtained through a variety of sources, including the Baltimore Metropolitan Council, Maryland Motor Truck Association and the Maryland Port Administration. Carriers were contacted by e-mail, fax, postal mailing, or telephone and asked to complete a short survey collecting information on demographics, current and planned use of FSERTs, and preferences for incentive programs aimed at increasing FSERT use. In addition, notices were distributed through other trade associations, including the Mid-Atlantic Petroleum Distributors Association, Maryland Aggregates Association, Maryland Ready Mix Concrete Association, and Maryland Asphalt Association. More than 60 usable surveys were collected, representing responses from approximately 8 percent of directly contacted recipients.  

3.2 Respondent Demographics

The survey respondents reflect a broad range of businesses operating diesel trucks. These businesses include trucking companies servicing the Port of Baltimore, making interstate deliveries, providing refuse services, as well as other vocations. Figure 1 presents a breakdown of the respondents by primary type of business.  

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4 This estimated response rate does not account for the fact that some of the direct contacts may not operate diesel trucks. These recipients were asked to pass along the survey to associates who operate diesel trucks. In addition, it is uncertain how many responses were generated as a result of notices rather than direct contacts.

5 Throughout this report, the terms “truckload” refers to companies which transport one full trailer to one customer, “less-than-truckload” refers to companies which transport multiple shipments in one trailer, and “intermodal” refers to companies which haul freight to ports, rail yards and airports.
Respondents also reported on both fleet size and total annual revenues. Fifty-one percent of respondents operated ten or fewer trucks, 32 percent operated between 11 and 50 trucks, 5 percent operated between 51 and 100 trucks, and 13 percent operated more than 100 trucks. Only one respondent operated more than one thousand trucks. All carriers combined operated a total of 4,130 trucks with a median of 10 trucks. While nearly 27 percent of respondents reported operating no trailers at all, those operating both trucks and trailers averaged 1.9 trailers per truck with a median of 15 trailers.

When asked about the average number of trucks operating in the Baltimore region each month, 60 percent of respondents operated ten or fewer trucks, 30 percent operated between 11 and 50, and 10 percent operated 51 or more trucks. Only one respondent operated more than one hundred trucks in the Baltimore region. Among all respondents, a total of 1,083 trucks were operated in the Baltimore region during a typical month with a median of 8 trucks. In the case of trailers, 27 percent of respondents operated no trailers in the Baltimore region. For those operating trucks and trailers in the Baltimore region, an average of 1.7 trailers per truck was reported with a median of 10 trailers.

Figure 2 summarizes the survey respondents by total annual revenue category. Forty-one percent of companies reported total annual revenues of less than $3 million while 30 percent of companies reported revenues between $10 and $50 million. Only one company reported revenues of over $100 million.
Carriers were also asked to provide data on average monthly per-truck mileage and idling hours within the Baltimore region. Once outliers were removed from the analysis, average monthly travel within the Baltimore region was calculated at 2,711 miles (median 1,500 miles) and average monthly idling time within the Baltimore region was calculated at 26 hours (median 12.5 hours). Several respondents reporting travel within the region did not report data on monthly idling. This may be an indication that idling is either not closely monitored or is not viewed as an important aspect of these operations. As a comparison, this average monthly idling time matched the time reported in a prior ATRI study for the operation of day cabs, which tend to be used for local and regional operations, similar to many of the operations likely to be found in the Baltimore region.

6 A number of responses to this question appeared to fall outside of what was considered “reasonable.” Per-truck responses such as 160,000 monthly miles traveled or 2,000 monthly hours of idling time within the Baltimore region are unattainable, indicating the respondent may have misunderstood the question. Some respondents may have reported total fleet mileage and idling hours rather than per-truck metrics. To account for these outliers, two benchmarks were established to exclude responses which appear outside the “reasonable” range. Monthly per-truck responses over 10,000 miles or over 300 hours idling within the Baltimore region were excluded from the mileage or idling analyses.

7 American Transportation Research Institute, Idle Reduction Technology: Fleet Preferences Survey (February 2006).
3.3 Current Use of Fuel Saving/Emissions Reducing Technologies

Carriers were asked to provide information on the use of several different types of FSERTs. Thirty-seven percent of respondents currently used some type of FSERT on at least one truck or trailer. Figure 3 details the percentage of carriers using the different types of FSERTs identified in this study and the total number of trucks or trailers equipped with each particular technology.\(^8\)

![Figure 3: Current Use of FSERTs](image)

Figure 3 illustrates that some of the technologies with the highest percentage of respondent usage did not translate into large numbers of trucks or trailers using these technologies (e.g., on-board plug-in systems, single wide tires). Other technologies have been adopted by larger carriers, leading to these systems dominating the installed base of FSERTs (e.g., automatic tire inflation, diesel particulate filters).

\(^8\) Refer to Chapter 2.0 for a description of each of these technologies.
3.4 Factors Influencing Current Use

Even though reducing the data set into various subcategories limits the explanatory power of the analysis due to the smaller number of cases, this type of analysis can be helpful in exploring potential relationships. Using statistical cross tab analyses to identify potential relationships between various responses, a number of factors influencing FSERT usage were identified. A discussion of these factors, which include a carrier's knowledge of the SmartWay Partnership, total annual revenues, type of business, total number of trucks, and number of trucks operating in the Baltimore region, is provided below.

Knowledge of the SmartWay Partnership: Carriers familiar with the SmartWay Transport Partnership were more likely to use some type of FSERT than carriers not familiar with the program. Nearly 60 percent of carriers familiar with SmartWay were using FSERTs while only 25 percent of carriers not familiar with SmartWay were using FSERTs. Similarly, 57 percent of carriers using FSERTs were familiar with SmartWay compared to only 23 percent of carriers not using FSERTs.

Total Annual Revenues: While an insufficient number of responses were received to make a statistical claim, it appears that total annual revenues may hold some degree of influence over the use of FSERTs. Fifty-four percent of carriers with revenues above $10 million employed some type of FSERT while only 26 percent of carriers with revenues of $10 million or less used any type of FSERT. Revenues had no significant impact on whether a carrier was familiar with SmartWay.

Type of Business: Even though segmenting responses by type of business provides only a small sample size for each business segment, a carrier's type of business was significantly related to knowledge of the SmartWay program. Refrigerated and tank truck carriers were the most likely to be familiar with SmartWay while only one-third of truckload and less-than-truckload carriers had knowledge of the program. None of the carriers in the moving and construction/contractor segments reported being familiar with SmartWay.

Use of automatic tire inflation systems and auxiliary power units was reported more frequently by truckload and refrigerated carriers, while use of single wide tires was reported more frequently by less-than-truckload, refrigerated and tank truck carriers. Use of bunk heaters was also reported more frequently by refrigerated carriers.

Number of Trucks in Fleet and Number Operating in the Baltimore Region: The number of trucks a carrier operated and the number of trucks operated in the Baltimore region both influenced whether a carrier used FSERTs. In
order to test the effect of number of trucks on FSERT usage, carriers were grouped into categories for both the overall number of trucks and the number of trucks operated in the Baltimore region. In both cases, operating a larger number of trucks increased the likelihood of using FSERTs. Seventy-eight percent of carriers operating more than 100 trucks currently used FSERTs compared to 31 percent of carriers operating 100 trucks or less. Among carriers operating 10 trucks or less, only 20 percent used FSERTs. Within the Baltimore region, 83 percent of carriers operating more than 50 trucks used FSERTs versus only 33 percent with 50 trucks or less.

The relationship between number of trucks and knowledge of SmartWay largely mirrored the relationship between the number of trucks and use of FSERTs. Carriers operating large numbers of trucks were much more likely to be familiar with the SmartWay program. Seventy-eight percent of carriers operating a total of more than 100 trucks and 83 percent of the carriers operating more than 50 trucks in the Baltimore region were familiar with SmartWay compared to 20 percent of carriers operating a total of 10 trucks or less and 21 percent of carriers operating 10 trucks or less in the Baltimore region.

Knowledge of SmartWay compared to Number of Trucks: The number of trucks a carrier operated proved to have an effect on FSERT usage independent of knowledge of SmartWay. Among carriers reporting knowledge of the SmartWay program, 86 percent operating more than 100 trucks used FSERTs compared to 50 percent operating 10 trucks or less. In the Baltimore region, among carriers with knowledge of SmartWay, all of the carriers operating more than 50 trucks used FSERTs compared to 57 percent of carriers operating 10 trucks or less.

Satisfaction with FSERT Systems: Generally, carriers using FSERTs reported high levels of satisfaction. At least 75 percent of FSERT users, except for users of diesel oxidation catalysts and trailer fairings, reported being either "somewhat satisfied" or "very satisfied" with these technologies. Sixty percent of diesel oxidation catalyst users and 40 percent of trailer fairing users reported this level of satisfaction. Only one user reported being "very unsatisfied" with any particular technology.

3.5 Future Use of Fuel Saving/Emissions Reducing Technologies

In addition to asking respondents about current use of FSERTs, the survey asked respondents to report on planned use of FSERTs within the next five years. Figure 4 identifies both the percentage of carriers and the number of trucks or trailers with planned installations. It is important to keep in mind these
responses include both carriers planning to add to existing bases of FSERTs as well as carriers planning to add new or multiple technologies.

In total, 15 carriers, or approximately 24 percent of respondents, plan to install some type of FSERT within the next five years. Similar to current usage, planned use of some technologies by larger carriers tends to dominate the number of trucks or trailers to be equipped with these technologies (e.g., automatic tire inflation, diesel particulate filters).

Surprisingly, diesel particulate filters (DPFs) had both the highest percentage of respondents planning to use this technology as well as the highest number of trucks to be equipped. One possible explanation for this high level of response is that beginning in 2007; all new heavy-duty diesel trucks incorporate DPFs to meet stringent federal engine emission standards. As a result, planned use of DPFs represents some combination of companies planning new truck purchases and/or retrofitting existing trucks within the next 5 years.
Other technologies with higher levels of planned usage over the next 5 years include auxiliary power units (APUs), diesel oxidation catalysts (DOCs), automatic tire inflation (ATIs) systems, and single wide tires (SWTs). While APUs, ATIs, and SWTs are expected to provide cost savings (and emission reductions) by reducing fuel consumption, DOCs can be characterized as an emission reducing technology that does not reduce fuel consumption. Although it is unclear exactly what factors are spurring interest in the use of DOCs, possible explanations could include: (a) the “packaging” of DOCs with fuel saving technologies under the SmartWay program in order to offset the added cost of this technology; or (b) use by environmentally-conscious companies as a relatively low-cost emissions reducing option. Respondents did not report any planned use of trailer fairings within the next 5 years.

Separating respondents into those already using some form of FSERT and those not using any FSERT reveals something about the relationship between existing and future FSERT use. Carriers currently using FSERTs were much more likely to plan FSERT installations within the next 5 years than those not using these technologies. Figure 5 presents the percentage of carriers planning to install FSERTs within the next five years, separated by current users of FSERTs and non-users.

![Figure 5: Planned Use of FSERTs within 5 Years by Usage Status](image-url)
3.6 Factors Influencing Future Use

Similar to the factors influencing the current use of FSERTs, a carrier’s knowledge of the SmartWay Partnership, total annual revenues, type of business, total number of trucks, and number of trucks operating in the Baltimore region, also influenced planned usage within the next five years. A discussion of each of these factors is provided below.

Knowledge of the SmartWay Partnership: As with current usage, knowledge of the SmartWay program was shown to be associated with plans for future FSERT installation. Thirty-six percent of carriers familiar with SmartWay planned to install FSERTs within the next five years, while only 18 percent of those not familiar with SmartWay planned installations. Similarly, 53 percent of carriers planning to install FSERTs within the next five years knew about the SmartWay program compared to 30 percent of carriers not planning installations.

Total Annual Revenues: Carriers with over $10 million in total annual revenues were more likely to plan FSERT installations within the next five years, with 46 percent of these companies planning installations compared to only 12 percent of carriers with revenues of $10 million or less.

Type of Business: The results of this analysis largely mirrored the effects of business segment on current usage. Refrigerated and tank truck carriers were most likely to plan FSERT installations within the next five years while carriers in the moving and construction/contractor segments indicated the fewest plans for installing these technologies.

As was done with current FSERT usage, carriers with knowledge of SmartWay were selected to determine whether industry segment had an independent effect on FSERT installation plans. Although not enough cases are available for a statistically significant finding, refrigerated and tank truck carriers were among the most likely to plan FSERT installation within the next five years.

Refrigerated and tank truck carriers were also the most likely to be already using some type of FSERT and the most likely to plan additional installation within the next five years. The truckload and less-than-truckload segments were among the middle when asked about current and future FSERT usage. The moving and construction/contractor segments were the least likely to use FSERTs or to plan installations within the next five years.
The planned use of auxiliary power units was reported more frequently by both truckload and refrigerated carriers, while the planned use of diesel particulate filters was reported more frequently by truckload carriers.

**Knowledge of SmartWay compared to Type of Business:** Carriers in certain industries were more likely to be aware of SmartWay and those aware of SmartWay were more likely to currently use FSERTs and plan future installations. Additionally, carriers from certain industry segments were more likely to use FSERTs and plan to use FSERTs in the future. In an effort to determine whether industry segment affiliation has any effect on FSERT usage beyond knowledge of the SmartWay program, an analysis was conducted in which only respondents with knowledge of SmartWay were selected. With only these respondents selected, industry affiliation was tested against FSERT use and planned installation.

It appears that type of business has an independent effect on FSERT usage, even among carriers with knowledge of the SmartWay program, refrigerated and tank truck carriers had some of the highest rates of current and future planned usage.

**Number of Trucks in Fleet and Number of Trucks Operating in the Baltimore Region:** As with current usage, carriers operating large numbers of trucks and large numbers in the Baltimore region were more likely to plan FSERT installations within the next five years. Seventy-five percent of respondents operating more than 100 trucks planned installations within the next five years compared to 17 percent of carriers operating 100 trucks or less. Eighty-three percent of carriers operating more than 50 trucks in the Baltimore region planned installation compared to 21 percent of carriers operating between 11 and 50 trucks and 18 percent operating 10 trucks or less.

As was done with the analyses of current FSERT installations, respondents with knowledge of SmartWay were selected and analyzed to determine if the number of trucks operated had an independent effect on plans for FSERT installations. This analysis revealed that even among carriers having knowledge of SmartWay, 86 percent of carriers operating more than 100 trucks planned FSERT installations within five years and all of carriers operating more than 50 trucks in Baltimore planned to do the same. Among carriers operating 100 or fewer trucks, only 15 percent planned FSERT installations in the next five years and among carriers operating 50 or fewer trucks in the Baltimore region, only 14 percent planned installations.

**Truckload Carriers: A Special Case:** Truckload carriers with knowledge of SmartWay were very likely to use FSERT technologies and to plan for installations in the future. The current and planned usage levels among these...
carriers far exceeded the levels expressed by truckload carrier unfamiliar with the SmartWay program. As some truckload carriers appear to be strong adopters of FSERTs, an opportunity exists to expand the use of these technologies to other truckload carriers through additional education and outreach efforts, such as SmartWay.

3.7 Role of Incentives

One of the goals of this study was to examine whether incentives could serve to increase the deployment of FSERTs, and if so, what types of incentives would be most effective. Figure 6 details the technologies respondents reported interest in if incentives were available, both for current users of FSERTs and non-users.

![Figure 6: Interest in FSERTs if Incentives are Available](image)

In total, 46 carriers, or approximately 73 percent of respondents, indicated interest in one or multiple FSERTs if incentives were available. This is more than triple the number of carriers planning installations within the next 5 years and represents an increase in interest for each FSERT listed (compared to Figure 5). FSERT interest with incentives available also increased across each type of

**Figure 6: Interest in FSERTs if Incentives are Available**

In total, 46 carriers, or approximately 73 percent of respondents, indicated interest in one or multiple FSERTs if incentives were available. This is more than triple the number of carriers planning installations within the next 5 years and represents an increase in interest for each FSERT listed (compared to Figure 5). FSERT interest with incentives available also increased across each type of
business segment, especially among the construction/contractor, specialized/flatbed and bulk haul businesses.

Automatic tire inflation (ATIs) systems generated the highest interest among both FSERT users and non-users. This may be a result of ATIs being one of the lowest costs FSERTs among those studied as well as providing the additional benefits of reduced maintenance and improved tire wear. Carriers in the truckload, refrigerated, bulk haul, tank truck, specialized/flatbed, construction/contractor, and moving businesses expressed higher levels of interest in ATIs.

Diesel particulate filters generated the second highest interest among both users and non-users. Again, it is unclear whether this interest is related to obtaining DPFs as part of new truck purchases or as retrofits on existing trucks. Carriers in the truckload, less-than-truckload, and construction/contractor businesses expressed higher levels of interest in DPFs. Interest in DPFs, in combination with diesel oxidation catalysts (DOCs), seems to indicate a high degree of interest in obtaining emissions reducing technologies.

Single wide tires (SWTs) generated a high level of interest among FSERT users while non-users showed less interested in this technology. Although not investigated as part of this study, this disparate interest could be a result of SWTs being less cost-effective as a retrofit strategy and, therefore, more closely associated with new truck and trailer purchases. Carriers in the refrigerated and tank truck businesses expressed higher levels of interest in SWTs.

Interest towards on-board plug-in systems was fairly high among non-FSERT users and would appear to indicate access to electrical outlets at operating locations. For the other idle reduction technologies, higher levels of interest for auxiliary power units (APUs) were expressed by truckload carriers while refrigerated carriers expressed higher levels of interest in both APUs and bunk heaters.

While interest in FSERTs through the use of incentive programs can be expected from current FSERT users, the strong interest shown by non-users of FSERTs indicates the potential to expand FSERT use through incentives. This willingness to consider FSERTs among current non-users is important since FSERT users tend to plan future use of these technologies. The potential to attract non-users to these technologies is a positive indication of the potential for incentive programs.
3.8 Preferences Towards Financial Tools

Respondents were asked which types of financial tools would be most helpful in assisting with the purchase of FSERTs. As shown in Figure 7, tax credits were identified as the most helpful financial tool by 63 percent of respondents followed closely by grants which were selected by 60 percent of respondents. These financial tools were more than twice as popular as the other two types of financial tools listed – low interest loans and lease-to-own programs. No variables were found to have any significant effect on which incentive programs a carrier would prefer.

![Figure 7: Preferred Financial Tools](image)

When asked what the highest interest rate respondents would accept for a loan or lease program, a range of responses between zero and 20 percent was given. On average, the highest interest rate respondents were willing to accept was 6.86 percent (median 7.00 percent). This rate was approximately 80 percent of the Prime Interest Rate during the time the survey was conducted. No carrier variables had an effect on the highest acceptable interest rate.

In addition to identifying the types of financial tools which would be most helpful, respondents were asked to identify preferred entities for obtaining financial assistance. As shown in Figure 8, 46 percent of respondents selected banks, followed by government entities (35 percent) and truck dealerships (30 percent).
Government administered financial programs were viewed nearly as favorable as those administered by banks and more favorable than those administered by other entities. Figure 8 summarizes the responses to this question. Again, no significant relationships were found between any variables and the entities respondents prefer to work with.

![Figure 8: Preferred Entities for Obtaining Financial Assistance](image)

### 3.9 Summary

This study reveals there is a real opportunity for expanding the use of FSERTs in the Baltimore region. In addition to an existing base of installed FSERTs (both in number of companies and number of trucks), respondents reported plans to continue FSERT deployment over the next five years, possibly related to the relatively high level of satisfaction reported. Respondents showed an even higher level of interest in FSERTs if incentives were available to reduce the cost of these technologies. And despite the lack of plans for installation among carriers that currently do not use FSERTs, these companies show a strong willingness to consider numerous FSERTs if incentive programs were in place to promote them and a strong willingness to work with multiple incentive administrators.
4.0 CONCLUSION AND RECOMMENDATIONS

Based on an analysis of survey responses received from diesel truck owners operating in the Baltimore, Maryland region, the availability of financial incentives could increase use of fuel saving/emissions reducing technologies (FSERTs). With respondents’ average monthly per-truck travel and idling in the region calculated at slightly more than 2,700 miles and 26 hours, respectively, the deployment of FSERTs could reduce per-truck fuel consumption and corresponding carbon dioxide (CO2) emissions, while, in some cases, reducing particulate matter and oxides of nitrogen (NOx) emissions throughout the Baltimore region.

Several factors were identified which appear to influence a carrier’s current and planned use of FSERTs. These factors include a carrier’s knowledge of the U.S. Environmental Protection Agency’s SmartWay Transport Partnership, total annual revenues, type of business, and number of trucks operated.

Carriers familiar with SmartWay were more than twice as likely to use or plan to use FSERTs as carriers unfamiliar with the program. Similarly, total annual revenues and number of trucks also appear to influence a carrier’s current and planned use of FSERTs. Carriers with total annual revenues over $10 million were twice as likely to use FSERTs and three times more likely to plan to use FSERTs within the next five years compared to carriers with revenues of $10 million or less. Carriers operating more than 100 trucks (or more than 50 trucks in the Baltimore region) were twice as likely to use or plan to use FSERTs.

A carrier’s type of business appears to have some influence over current and planned use as well. Carriers in the refrigerated and tank truck businesses indicated greater current and planned use of FSERTs while carriers in the moving and construction/contractor businesses indicated little current or planned use.

When presented with the possibility of financial incentives being available to reduce the cost of FSERTs, interest more than tripled from planned usage levels. Interest in each type of FSERT also increased. With incentives available, current FSERT users favored automatic tire inflation (ATIs) systems, diesel particulate filters (DPFs), single wide tires (SWTs), and diesel oxidation catalysts (DOCs) while non-users favored ATIs, DPFs, on-board plug-in systems, auxiliary power units, and DOCs. The combined interest in both DPFs and DOCs indicates a high level of interest in emissions reducing technologies.

The interest in FSERTs shown by non-users points towards the potential to expand FSERT use through incentives. This willingness to consider FSERTs among current non-users is important since FSERT users tend to plan future use
of these technologies. In addition, interest across each type of business segment increased, especially among businesses which did not express high levels of current or planned use.

Tax credits were identified as the most helpful financial tool followed closely by grants. These financial tools were more than twice as popular as the other two types of financial tools listed – low interest loans and lease-to-own programs. While multiple entities for obtaining financial assistance were identified, banks and local, state or federal government agencies were selected by more than one-third of respondents. No carrier-specific variables were found to have any significant effect on the type of incentives offered or the entity administering such a program.

This study highlights how incentive programs can be used as a powerful tool for advancing the use of FSERTs. While interest was expressed in technologies which reduce fuel consumption, a great deal of interest was also expressed in technologies which provide solely emissions reductions (e.g., diesel oxidation catalysts and diesel particulate filters). Incentives also appear to minimize many of the factors influencing FSERT usage and non-usage, thereby acting to equalize interest among different sizes and types of businesses.

The following recommendations are likely to help advance the use of FSERTs among diesel truck owners operating in the Baltimore area.

- Outreach and education can play a significant role in expanding the use to FSERTs. The Baltimore Metropolitan Council (BMC) should explore opportunities to expand upon the existing work of the U.S. EPA’s SmartWay Transport Partnership by working with Baltimore area trade associations to provide FSERT education and to further identify which technologies may, or may not, be of interest to specific business segments. Efforts targeting businesses operating smaller number of trucks may be particularly beneficial. In addition, local businesses which attract truck trips could also be targeted by this type of outreach/education effort.

- Incentive programs have been successful in other jurisdictions and there appears to be interest in this type of program in the Baltimore region. While some diesel trucks operate exclusively in the Baltimore region, many trucks operating in the region travel beyond the region as well. BMC should explore opportunities to partner with other jurisdictions and/or agencies to develop an incentive program to reduce the cost of FSERTs. By partnering with others (e.g., cities, states, Mid-Atlantic Diesel Collaborative, EPA), the scope of the program could be expanded,
potentially capturing a larger number of eligible trucks, while leveraging local dollars.

- Tax credits were identified as the most helpful form of financial assistance. While tax credits may have limited appeal at the local level, credits at the state and federal level have been used to advance technology deployment. BMC should identify the local taxes or fees businesses operating diesel trucks may pay (generally or by specific business segments) and explore whether some percentage of FSERT purchases should be allowed to generate a credit against these taxes or fees. Alternatively, BMC should explore the potential role state and/or federal tax credits may have in increasing FSERT usage in the Baltimore region.

- Grants were identified as being the next most helpful form of financial assistance. Several grant programs have been established at the local level (see Appendix A – Gateway Cities Council of Government and local provisions contained in the California Air Resources Board and Texas Commission on Environmental Quality grant programs). BMC should explore potential funding sources which could be used to establish an FSERT grant program. In addition to local resources, potential funding partners could include other jurisdictions and/or agencies. In conjunction with identifying funding sources, eligibility criteria and a program administrator will also need to be identified.

- As an alternative to the two preferred forms of financial assistance, BMC should explore a low interest loan or lease-to-own program. While these types of financing contain many of the same features as a grant program (i.e., initial funding source, eligibility criteria, program administrator) the advantage of these programs is that the initial funding is paid back over time, with interest, by program participants and the income tax ramifications of grants can be avoided. However, because these programs require repayment, participation is not expected to be as high as a grant or tax credit program. Success for loan or lease-to-own programs is also greatly influenced by the interest rate which is offered. For instance, survey respondents indicated the average highest acceptable interest rate would be approximately 8 percent of the Prime Interest Rate. While a grant program is preferred from a participation standpoint, a low interest loan or lease-to-own program should be considered as an alternative when exploring the feasibility of this type of program in the Baltimore region.
Appendix A

Summary of Financial Incentive Programs

A. Arkansas Department of Environmental Quality
   (www.adeq.state.ar.us/poa/envloans.htm)

   The Arkansas Department of Environmental Quality (ADEQ) offers a Small Business Loan Program which provides low-interest loans to Arkansas small businesses to institute pollution prevention measures. Loans are available for up to $45,000 at 80% of the Prime Interest Rate with loan terms of up to 10 years.

   Eligible Arkansas businesses must employ 100 or fewer individuals and provide proof of profitable operations and a demonstrated ability to repay the loan. Eligible technologies include idle reduction devices, low rolling resistance tires, tractor and/or trailer aerodynamics, and exhaust aftertreatment devices.

B. California Air Resources Board
   (www.arb.ca.gov/msprog/moyer/moyer.htm)

   The California Air Resources Board’s Carl Moyer Memorial Air Quality Standards Attainment Program provides incentive funds for the incremental cost of cleaner than required engines and equipment. Up to $140 million a year of incentive funding is available.

   Projects must satisfy a list of eligibility criteria, including being “cost-effective” and operating at least 75 percent of the time in California or in a specific area of the state. Eligible technologies include certain new vehicle purchases for port or rail yard operations, engine repowers, exhaust aftertreatment devices, and idle reduction devices.

C. Gateway Cities Council of Government (Los Angeles County, CA)
   (www.gatewaycog.org/cleanairprogram/index.html)

   Under the Gateway Cities Fleet Modernization program, a qualifying commercial truck owner who trades in an older diesel truck for a newer, cleaner model receives grant funding that pays for a large part of the “replacement truck.” More than 75% of the funding for the fleet modernization program ($20 million) has been provided by the Port of Los Angeles.
To qualify, owners must meet eligibility requirements and be able to demonstrate commercial operation of the old truck in the South Coast Air Basin for the past two years. On average, the grant assists the owner of an older truck (pre-1993) with the purchase of a 2004 or newer diesel truck and pays for approximately 75% of the replacement truck. The old truck is destroyed.

D. Minnesota Pollution Control Agency
(www.pca.state.mn.us/programs/sbomb_loan.html)

The Minnesota Pollution Control Agency offers a Small Business Environmental Improvement Loan Program to assist small businesses with environmental projects. Collateral-backed loans are available from $1,000 to $50,000 at an interest rate of 4 percent or one-half the Prime Interest Rate, whichever is greater at the time the loan is awarded. A repayment term of not more than 7 years is required.

Eligible Minnesota businesses must have less than 50 full-time employees, an after-tax profit of less than $500,000, a net worth of less than $1,000,000 and demonstrate an ability to repay the loan. Eligible technologies include idle reduction devices, low rolling resistance tires, tractor and/or trailer aerodynamics, and exhaust aftertreatment devices.

E. New Jersey Department of Environmental Protection
(www.njmta.org/images/pages/Grant_Pre_Approval_Application.pdf)

The New Jersey Department of Environmental Protection offers a grant program, the New Jersey Trucker’s Challenge, with funding in the amount of $750,000 from the State of New Jersey and the U.S. Environmental Protection Agency. The New Jersey Motor Truck Association administers the program.

Eligible businesses must be domiciled in New Jersey and operate vehicles with 1994 or newer engines at least 50% of the time in the state. Eligible technologies include auxiliary power units, bunk heaters and exhaust aftertreatment devices.

F. Oregon Business Energy Tax Credit
(www.oregon.gov/ENERGY/CONS/BUS/docs/Truck.pdf)

The State of Oregon, through the Oregon Department of Energy, offers a Business Energy Tax Credit for the purchase of efficient truck technologies. The tax credit is 35 percent of eligible project costs.
Eligible applicants must file taxes in Oregon and register the truck and/or trailer being equipped with these technologies in Oregon. Eligible technologies include idle reduction equipment, aerodynamic packages, single-wide tires, and automatic tire inflation systems.

G. Oregon Clean Diesel Retrofit Tax Credit
(www.deq.state.or.us/msd/taxcredits/txcp.htm)

The State of Oregon, through the Oregon Department of Environmental Quality, offers a Clean Diesel Pollution Control Tax Credit for the purchase of add-on (retrofit) emission control equipment. Approved devices are eligible for a state tax credit of up to 35 percent, depending upon the amount of use taking place in Oregon.

Eligible applicants must be Oregon taxpayers and be the owner/operator of the diesel truck being retrofitted. Eligible technologies include diesel oxidation catalysts and diesel particulate filters.

H. Oregon Everybody Wins Lease Program
(www.cascadesierrasolutions.org/index.php)

The Oregon Departments of Transportation and Energy fund the Everybody Wins Lease program to help finance the deployment of fuel saving/emissions reducing technologies. Approximately $5 million in funding has been used to capitalize this program which is administered by a third-party, not-for-profit organization.

Only trucks base-plated in Oregon are currently eligible to participate in the program which offers special financing as part of this lease-to-own program. The program administrator purchases the chosen technologies and pays for installation while the truck owner pays back the cost over a period of up to 60 months.

I. Pennsylvania Department of Environmental Protection
(www.depweb.state.pa.us/enintech/cwp/view.asp?a=1413&q=503219)

The Pennsylvania Department of Environmental Protection offers a Small Business Advantage Grant Program to help businesses acquire energy efficient or pollution prevention equipment. Although funding for fiscal year 2006-07 has been completely expended ($185,000), 50 percent matching grants, up to a maximum of $7,500, were available. This program could reopen in July 2007 pending passage of the state’s budget.
Eligible businesses must be located in Pennsylvania and have no more than 100 employees. Purchasers of auxiliary power units to eliminate idling during layovers have been awarded funding through the program.

J. Texas Commission on Environmental Quality
(www.tceq.state.tx.us/implementation/air/terp)

The Texas Commission on Environmental Quality administers an Emissions Reduction Incentive Grants Program. The program provides grants to offset the incremental cost of reducing NOx emissions from high-emitting mobile diesel sources. More than $100 million was allocated to the program in fiscal year 2006.

Projects must satisfy a list of eligibility criteria, including being “cost-effective” and operating at least 75 percent of the time in specified nonattainment counties. Eligible technologies include certain new vehicle purchases, engine repowers and exhaust aftertreatment devices.

K. U.S. Environmental Protection Agency/Small Business Administration
(www.epa.gov/smartway/financing.htm#truckloans)

The U.S. Environmental Protection Agency’s SmartWay Partnership has joined with the Small Business Administration (SBA) to make Express Loans available for the purchase of fuel saving/emissions reducing technologies. The Express Loan program partners with Bank of America, Business Loan Express, Superior Financial Group, and other SBA lenders to offer small trucking companies no collateral, flexible term loans. Small trucking companies can apply on-line, or by telephone, and borrow from $5,000 to $25,000.

Companies with $23.5 million or less in gross receipts are eligible for the Express Loan program. Eligible technologies include idle reduction devices, low rolling resistance tires, aerodynamic equipment, and exhaust after-treatment devices.

L. Virginia Department of Environmental Quality
(www.dba.state.va.us/frameset.asp?URL=http://www.deq.state.va.us/)

The Virginia Department of Environmental Quality, through the Virginia Department of Business Assistance, offers a Small Business Environmental Compliance Assistance Revolving Loan Fund. Loans are available in amounts up to $100,000 and will carry an interest rate of 3 percent, with favorable repayment terms based on the borrower’s ability to repay and the useful life of the equipment being purchased.
Eligible Virginia businesses must employ less than 100 employees and be classified as a small business under the federal Small Business Act. Eligible technologies include the purchase and installation of equipment needed to comply with the Clean Air Act or to implement voluntary pollution prevention measures.

M. Wisconsin Department of Commerce
(www.commerce.state.wi.us/BD/BD-CA-Diesel-Grant-Program.html)

The Wisconsin Department of Commerce administers the Wisconsin Diesel Truck Idling Reduction Grant Program to reduce diesel truck idling. Although funding for fiscal year 2006-07 has been completely expended ($1 million), grants of up to 70 percent were available for the cost and installation of idling reduction equipment. This program will begin accepting applications on July 1, 2007; however, funding is dependent upon passage of the state’s budget.

Eligible businesses must be common, contract or private motor carriers operating vehicles with 1999 or newer engines, headquartered in Wisconsin, and are purchasing and installing idle reduction equipment.