

Go Yellow, Go Green Campaign



Background

Overview: There are increasingly more opportunities to make school bus fleets more ‘green’ with both new vehicles and retrofits of older buses. While school buses have always provided the safest mode of transportation for school children they have been criticized in the past for the soot and smog that was inherent with older diesel engines. However, newer engines and after-treatment technologies have greatly reduced emissions, making the case for school buses even stronger from a safety, efficiency and environmental perspective.

These new technologies represent additional costs but also present opportunities for contractors to improve their fleets, better serve their communities, and distinguish themselves from competitors or public fleets that may use older, dirtier vehicles. This paper provides an overview of the efforts to go green, what technology is available and at what cost, and how contractors can take advantage of available funding opportunities to present a greener yellow fleet. NSTA is committed to educating its members and the public at large about new and improved clean school bus technology, funding available to speed its deployment, and how this new “green” yellow fleet can provide the safest possible school transportation option for the country.

Background: New diesel vehicle emissions requirements are partially a response to concerns about emissions of soot and smog-forming gases. These concerns have been particularly pronounced with respect to school buses and have prompted Federal and state programs to accelerate adoption of clean diesel technologies on school bus fleets.

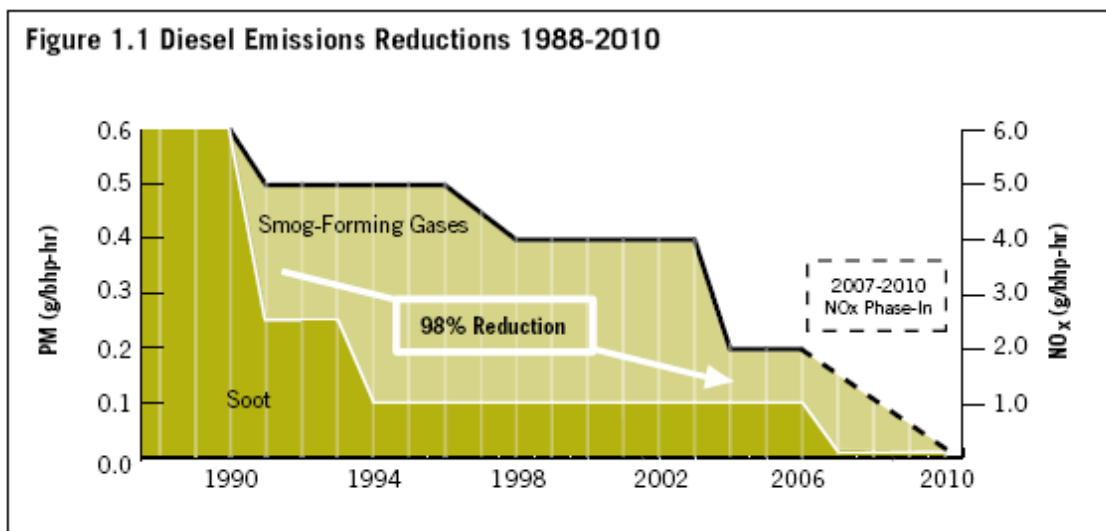
NSTA has been a leader in the school bus industry and the diesel community in general in working towards positive solutions that will help reduce emissions from school buses in ways that are both good for the environment and cost effective for school transportation providers. A major area of emphasis has been promoting “retrofit” technologies to reduce emissions from buses and securing public and private funding for their installation. These technologies are highly cost effective in reducing pollution but often do not reduce the cost of operating a vehicle and can, in fact, slightly increase costs. Nonetheless, many school bus operators have embraced the new technology as another way to demonstrate a commitment to the community and to differentiate their fleets in a positive way from older public or competitor fleets.

This document is intended to:

- **Highlight some of the more common retrofit technologies**

- Explain what financial assistance is available to help acquire these technologies
- Direct readers to additional informational resources

Clean Diesel Technology: The U.S. has made great strides in reducing emissions from diesel equipment. Through the development of cleaner fuels, more efficient engines and emissions control technologies, today's diesel vehicles are 98 percent cleaner than those manufactured less than 20 years ago. Tougher standards are set to take effect in 2010. Much of this improvement has been made possible through new engine technology, after-treatment devices like particulate traps and catalysts, and access to ultra low sulfur diesel (ULSD) fuel, which was made available everywhere beginning October 15, 2006.



Source: U.S. EPA On-Highway Heavy Duty Diesel Emissions

Legacy Fleet: Because diesel equipment is so durable, older technology vehicles, which have much higher pollution levels, can remain on the road for up to 20 years. This legacy fleet presents both a challenge and an opportunity because many of the technologies available to cut emissions on new vehicles can be added to older buses, and can significantly reduce emissions.

These after-treatment and new vehicle technologies are not inexpensive but there are generous Federal and state programs as well as private funding to help pay for most, if not all, of the cost of their adoption. There are limited tax credit opportunities for hybrid and natural gas buses. To help reduce the cost of new alternative fueled vehicles. For older vehicles, there are a number of competitive grant programs described below to help pay for retrofits, which can include the five "Rs" of repowering, refueling, replacing, rebuilding and retrofitting older vehicles.

Technology

The following paragraphs summarize what is available under the Diesel Emission Reduction Act (DERA), how the technologies work and what they cost.

- **Idle Reduction:** Installing idle reduction technologies such as Auxiliary Power Units (APUs) or fuel-operated heaters (FOHs) conserve fuel and reduce emissions. Fuel-operated heaters can be highly cost effective by heating engine coolant in order to reduce the need for engine idling. They cost between \$1,000 and \$3,000 and are available from EPA-approved vendors. APUs provide cooling as well as heating and electrical power from an auxiliary engine. APUs cost considerably more than FOHs, but are useful in hot climates, particularly for special needs transportation. For more information on anti-idling technologies and their benefits, as well as a list of vendors approved by EPA, please go to <http://www.epa.gov/otaq/diesel/idle-ncdc.htm>

- **Retrofit or After-Treatment:** Contractors may choose to go “green” with newer retrofit technology that will reduce emissions. These technologies include diesel particulate matter (PM) filters or traps (\$5,000 to \$10,000) and diesel oxidation catalysts (DOCs). Highly Oxidizing precious metal **PM filters** are on new buses since January 1, 2007, but may be retrofitted on older buses with verified engines for \$5,000 to \$10,000. You can expect reductions in PM, HC and CO of 90%, and 0-5% of NOX; but their optimal use requires high temperature operating conditions that allow contaminants to be burned off. In some school bus operations, it may be difficult to attain the proper temperatures; therefore, it is important to run the necessary tests to make sure your conditions are favorable prior to ordering PM filters. **DOCs** are OEM on 2004 and newer buses but can be added to older vehicles for \$1,000 to \$2,000. You can expect reductions in PM of 20% - 40%, and 90% reductions of both HC and CO. On new buses since January 1, 2007, **Diesel Crankcase Emissions Filters** also can be purchased for verified engines for \$500 to \$1,000 and should be used with a DOC for 25% reduction in PM.

- **New Vehicles:** Federal funds may be used for early replacement of older buses with new “greener” buses. Operators may receive up to 25% of the cost of a new bus meeting the 2007 emission standards or up to 50% of the cost of a bus meeting 2010 standards. Note that EPA will not allow funds to be used for new buses that are part of a regular replacement schedule, and you must destroy any bus that is replaced using EPA funds. Check with the leading manufacturers for more information on buses and which emissions standards they meet:

- Blue Bird: <http://www.blue-bird.com/products/school/>
- IC Corporation: <http://www.ic-corp.com/portal/site/ICCorp>
- Thomas Built Buses: <http://www.thomasbus.com/>
- **Fuels:** Funding may be used to purchase fuels or refueling facilities for natural gas, biodiesel or other alternative fuels. Purchase and use of *biodiesel* fuels can reduce emissions of PM but could actually be worse for communities with ozone problems, since bio-fuel use increases NOx emissions. Also, DERA grant funding only covers the increased cost of alternative fuels. Therefore, whenever biodiesel is selling for less than regular diesel, funding would not be available. All of the school bus engine manufacturers have approved use of fuel containing up to 5% biodiesel content (B5). Operators should check with their engine manufacturers first before pursuing higher biodiesel content fuels like B20.

Natural Gas: Buses that run on compressed natural gas (CNG) became commercially available as of 2003 and were able to produce very low emission rates. Over the years, the advantages of CNG buses in terms of emission rates have been greatly reduced as diesel powered school buses equipped with newer engines, properly functioning particulate traps and burning ULSD fuel have produced comparably low emission rates; in addition, CNG buses are between 17% and 14% less fuel efficient than conventional diesel buses. Buses that run on natural gas can cost up to \$30,000-\$40,000 more than diesel buses and have a substantially lower driving range than diesel buses. For example, one manufacturer cites a driving range of 300 miles versus just over 400 miles for a diesel bus. Perhaps the largest impediment to their wide-spread adoption is the lack of an adequate network of refueling stations, meaning that districts and operators choosing this technology often have to install refueling stations for their fleets and depend on the limited availability of stations should they need to use the buses for long-distance travel. Despite that, sales for such buses remain strong, in part due Federal funding and tax incentives that are available to help reduce the additional cost of CNG buses or to assist with the cost of adding refueling infrastructure. For more information on CNG school buses, please check the following web sites: <http://www.ngvc.org/>

Propane: Along with natural gas, the fastest-growing types of alternative fueled buses are those powered by propane. The newest technology features an OEM dedicated engine powered by Liquid Propane Injection. Propane fuel typically costs 30% less per gallon than gasoline; and propane buses show decreased emissions of soot, smoke and particulates virtually down to zero and run significantly quieter than diesel buses. Propane is also 90 percent domestically produced. In addition, the new buses reduce oxides of nitrogen, which contribute to smog, by 60 percent over new diesel buses. Like CNG, propane buses require a new fueling infrastructure. The infrastructure, although a significant additional cost, can be as much as 80% less than the cost of the CNG

refueling infrastructure. For more information, please see:

<http://www.propanecouncil.org/> or <http://www.cleanfuelusa.com/>

Hybrid Technologies: School buses' frequent start and stops make them ideal for use of hybrid diesel-electric systems. Advanced Energy working with Enova and IC Corporations has developed the first plug-in hybrid school buses. Hybrid buses have improved fuel efficiency 40% to 70%, depending on the vehicle's duty cycle, and reduce up to 90% of emissions when compared to regular diesel-powered school buses. Hybrid buses also have shown reduced maintenance needs for both the brakes and transmission. However, their two leading technologies, the charge-sustaining system and the charge-depleting system, add significantly to the price of a bus (in 2008, the additional cost was approximately \$90,000 and \$150,000 more, respectively). A portion of these costs could be offset through the use of Federal tax credits which will be available once the fuel efficiency of these vehicles is approved by the IRS as meeting the Federal requirements.

Fuel Cell Buses: Vehicles can be powered using advanced fuel cell technology that produces energy by chemical reaction using a variety of potential fuel sources. Fuel cells have a great deal of potential to operate more efficiently than internal combustion engines. They are being used in a limited number of transit fleets and several manufacturers are looking at this as one of the technologies of the future. However, these vehicles are still under development and their costs remain prohibitively high. Our assessment is that except in demonstration form, this technology is years away from commercial application.

Funding Sources

U.S. EPA:

Clean School Bus USA: Congress and the U.S.EPA began to tackle the problem of diesel exhaust through the "Clean School Bus USA" program in 2003. The program provided funding for school bus retrofits, which were defined broadly to include repowering, refueling, rebuilding, retrofitting and replacing diesel school buses with newer clean diesel or alternative fuel vehicles and equipment. Under this program, EPA solicited grant applications and awarded \$27 million in grants during fiscal years 2003 to 2007 for retrofits to existing school buses and for the use of biodiesel as a school bus fuel. Local communities received grants for retrofits of public and privately operated fleets and NSTA was awarded the single largest grant in 2003 for \$500,000 which was used to provide sub-grants to school districts and their private contractors. In addition, numerous contractors worked with their local communities to submit grant applications through the local school districts which were used to fund school bus retrofits of

private fleets. The Clean School Bus USA program is now being administered through the DERA program which is described below.

Diesel Emission Reduction Act (DERA): The Diesel Emission Reduction Act (DERA) was authorized as part of the comprehensive Energy Policy Act of 2005 (Public Law 109-58) and established a voluntary national and state-level grant and loan program to reduce diesel emissions. It passed the Congress with strong bipartisan support. Specifically, DERA:

- Authorizes EPA to oversee the expenditure of 70 percent of funds;
- Allocates 20 percent of funds to states to develop retrofit programs with an additional 10 percent as an incentive for states to match federal dollars;
- Establishes project priorities (for public fleets and projects that are more cost-effective and affect the greatest number of people); and
- Includes provisions to stimulate the development of new technologies, encourage more action through non-financial incentives and require program accountability.

It is important to remember that the DERA program is intended to provide a source of funding for diesel retrofits of all kinds of diesel equipment, not just school buses, so competition is now open to over 11 million legacy vehicles and stationary engines, rather than just the 450,000 school buses on the road. However, school buses remain a major focus of the program because of the sensitive populations of school children that are involved.

Annual Funding Opportunities: EPA typically administers the DERA grant program through their regional Diesel Collaboratives. Information concerning grant solicitations is generally available on the EPA web site (<http://www.epa.gov/cleandiesel/grantfund.htm#cur-opportunity>) which includes links to the various Diesel Collaborative websites and is periodically updated to reflect new grant fund solicitations. Note that most applications for annual funding are due in the late spring and early summer. NSTA will annually post information on the NSTA web site (www.yellowbuses.org) concerning grant solicitations as this information becomes available.

Eligibility criteria: DERA grant funds may be provided to U.S., regional, state, local, tribal or port agencies with jurisdiction over transportation or air quality; and nonprofit organizations or institutions that represent or provide pollution reduction or educational services to persons or organizations that operate diesel fleets; or that have as its principle purpose the promotion of transportation or air quality. State agencies, local school districts, federally recognized Indian tribes, municipalities, metropolitan planning organizations (MPOs), cities and counties are all eligible entities under this program.

For local school bus contractors, this means that they must either partner with their local school district, state or local transportation or air quality governmental entity or a nonprofit entity, such as an air quality advocacy organization or school transportation trade association. NSTA

has received funds under both Clean School Bus USA and DERA. Funds that NSTA receives are used to purchase equipment which is distributed to member school bus contractors.

Eligible Uses of Funding: Funds may be used for verified retrofit technologies, incremental costs of early replacement or repowering of vehicles with certified engine configurations, and reduction of long-duration idling with approved technologies.

Priority funding is available for projects that:

- maximize public health benefits;
- are most cost-effective;
- include certified engine configuration, verified technology, or emerging technology that has a long expected useful life and that will maximize that useful life;
- conserve diesel fuel;
- serve areas
 - with highest population density;
 - are in poor air quality areas;
 - receive a disproportionate amount of pollution from diesel fleets; or,
 - involve the broader community in attacking air quality problems.

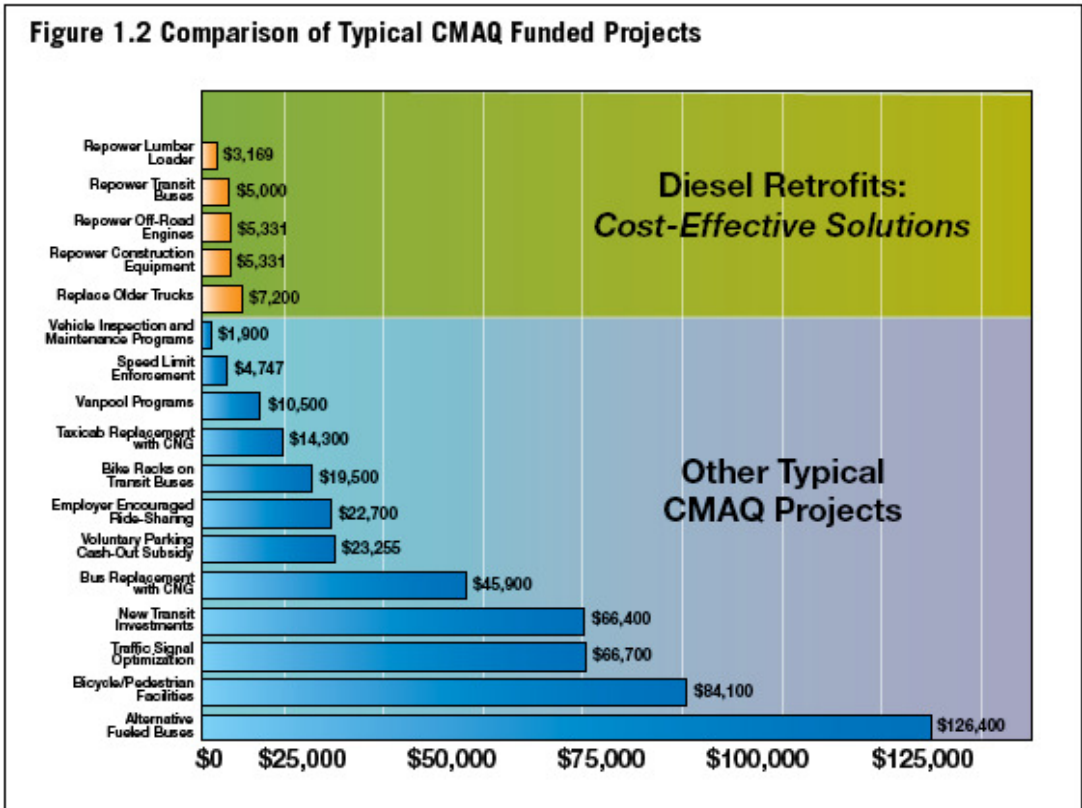
How to apply The application process is spelled out in each region’s application package. Generally, an applicant must present a project proposal, a budget, and a work plan to accomplish the goals of the project. Applicants must submit data on their fleets, their operations and their communities so that EPA can judge whether they are in a high density and poor air quality area. They also need to provide estimates of the amount of emissions reduction they will accomplish and the cost-effectiveness of the project. Information that NSTA needs in order to apply on behalf of members can be found on the NSTA website.

DOT’s Congestion Mitigation and Air Quality Improvement Program (CMAQ)

Overview: In addition to EPA’s DERA program, federal funds for diesel retrofits are available under the Congestion Mitigation and Air Quality Improvement (CMAQ) Program administered by the Department of Transportation. CMAQ provides a large pot of dedicated revenue out of the federal highway trust fund primarily to help communities to meet Federal Clean Air Act standards. CMAQ funds target communities that are generally referred to as “nonattainment”

areas to pay for projects that ease congestion or improve air quality. Although funds are administered differently in each state, most states split decision-making authority over these funds between the state DOT and metropolitan planning organizations (MPOs) with responsibility for urban areas in the state.

Nationally, CMAQ funding provides over \$1.7 billion each year to local MPOs in nonattainment areas. Much of the money goes for highway projects that ease congestion but communities can also fund projects that reduce emissions from stationary or mobile sources. In 2005, as part of the Safe, Accountable, Flexible, Efficient Transportation Equity Act – a Legacy for Users bill (SAFETEA-LU), Congress established a priority for diesel retrofit projects in carrying out the CMAQ program. Success in accessing CMAQ dollars depends on persuading your local MPO of the benefits of retrofit projects in addressing local pollution problems relative to overall cost in comparison to other eligible projects. The cost effectiveness of retrofit projects in addressing pollution problems is the major reason for the priority for such projects established by Congress. For example, the Diesel Technology Forum has compared a variety of CMAQ eligible projects and found that diesel retrofits have much lower costs per weighted ton of contaminants reduced than other projects.



Source: www.dieselforum.org/retrofit-tool-kit-homepage/cost-effectiveness-comparisons/

Eligibility criteria: Funds are apportioned to state transportation agencies based on a formula that accounts for population and the level of pollution in a region. Contractors interested in pursuing funding subsidy under the CMAQ program are encouraged to work with NSTA and their local MPOs.

Funding Availability: Each fiscal year's funds are available for obligation by the states for a four-year period. Funds that are not obligated after four years are considered lapsed and return to the federal government. There are differences from state to state in how often funding decisions are made, how often there are solicitations for projects or how far in advance funds are obligated. Also, the total amount available covers a wide range of eligible project categories and diesel retrofits are often only a small portion of the funding history, notwithstanding the preference established for such projects by Congress. Therefore, competition for funding can be intense.

How to Apply: CMAQ projects can be proposed by cities, counties, transit and transportation authorities, state DOTs and private and nonprofit entities in cooperation with a lead public agency.

All CMAQ projects must be included in the region's latest conforming plan and transportation improvement program by a sponsoring MPO. As a result, interested recipients should contact local planners, legislators and MPOs to inform them of potential retrofit projects and learn more about the local process for getting projects included on the TIP. SAFETEA-LU places added emphasis on the cost-effectiveness criteria in the selection of projects for CMAQ funding. As a result, applications that include quantitative emissions reduction estimates, cost-effectiveness figures and provide more than 20% of the required matching funds are likely to be more attractive.

State Programs

A number of states have promoted retrofit projects and clean diesel through programs going back 10 years or more. Some of the early leaders in this effort include California and Texas which have well established clean diesel programs but they each have unique features and differing funding levels and sources and differing emphasis in terms of the type of vehicles covered and the pollutants of greatest concern.

As a result of the \$15 million provided in 2008 to encourage the development of state programs, all states now have diesel emission reduction programs that encourage greater dissemination of information about clean diesel options and/or provide financial and technical assistance for operators of vehicle fleets. Some of the states have focused much of their effort on school buses and continue to assist public and private fleet operators with the cost of diesel retrofits. NSTA recommends that contractors contact their state director of pupil transportation or environmental agency for more information about funding opportunities and grant application procedures. Additional information on state programs may be found at www.dieselforum.org. A sample of state programs are summarized below:

- **Texas** – The Texas Emission Reduction Plan (TERP) is modeled on the Carl Moyer program in California with the emphasis on heavy duty and off road diesel equipment and reducing NOx. In 2005, the Texas legislature added a school bus emission reduction program that would focus on PM but thus far has not provided funding.
- **Ohio** – In 2006, Ohio created a Clean School Bus Fund for diesel retrofits in the state. Initial funding was \$1 million taken from enforcement penalties and is available for diesel retrofits of both publicly and privately owned school buses.
- **Massachusetts** – Governor Patrick announced MassCleanDiesel in June 2008, a program that plans to retrofit about 5,500 diesel-powered school buses by 2010. Pollution controls will be installed using \$16.5 million in state and federal funds

- **Connecticut** -- The legislature dedicated \$8.5 million in 2007 to school bus retrofits. School districts or municipalities can apply for reimbursement for emission control technology or closed crankcase ventilation systems purchased through state contracts and installed on public or private vehicles. .

NSTA case histories:

GEORGE KRAPF JR. & SONS, INC.

The objective of the George Krapf Jr. & Sons, Inc. (Krapf) Clean School Bus Program was to demonstrate the use of Johnson Matthey's EPA verified CRT particulate filter technology on twenty diesel school buses owned by Krapf and operated on routes in the West Chester Area School District (WCASD). This project proved that clean diesel technology like the CRT particulate filter was applicable to the Krapf fleet and that it did significantly reduce the emissions of particulate matter (PM), carbon monoxide (CO), and hydrocarbons (HC).

Prior to seeking funding from NSTA, Krapf purchased four CRT particulate filters for use on their buses that serve the Great Valley School District. There were no operating or maintenance problems as a result of these installations. Krapf then cooperated with Johnson Matthey, an EPA/CARB verified technology vendor, to meet with school districts to promote the use of CRT particulate filters.

This development led to the WCASD's application for funding from NSTA to purchase ten CRT particulate filters. This was later revised for the purchase of ten additional filters. Upon notification of the award, a selection process for the vehicles, based on the buses meeting the technology requirements of the filter technology, remaining in the fleet for five years and being run on routes in the district approximately 100 miles per day, was completed. WCASD then ordered the first 10 of part# CRT2108, P) # 145297 diesel particulate filters (DPF). The order was placed with delivery taking approximately six weeks.

A Johnson Matthey application engineer trained Krapf mechanics during a one day, eight hour period. During this stage, it was determined that the bracket to hold the apparatus in place had to be modified. The manufacturer offered technical support on a continuous basis for the lifetime of the DPF. Krapf personnel routinely monitor these vehicles for any change in performance level. Drivers have been instructed to report any irregularities that may take place. To date, no problems have been encountered.

This project included the WCASD, Krapf and Johnson Matthey as partners in the program. All partners participated financially through the provision of site facilities, in-kind services, and product discounts. The entire grant was used to purchase DPFs. The installation and maintenance costs were covered by Krapf as well as providing the services of a consultant to prepare the application and the various reports.

Throughout the grant period, the fact that all three partners were within ten miles of each other was a great advantage in completing this project. The modification of the bracket is an excellent example.

The DPF reduces PM, HC, and CO by 90% or more. On an annual basis, the amount of PM is reduced by .075 tons per bus per year. For 20 buses over a five-year period, this amounts to 3.75 tons of PM. At various press and promotional events, the “white handkerchief” test proved to be a popular means to demonstrate the effectiveness of the DPF.

Krapf has worked with other districts to pursue funding for this activity. Through grants from Pennsylvania’s Department of Environmental Protection, the Federal Environmental Protection Agency, and NSTA, Krapf has been able to retrofit 160 vehicles. The process of educating the public about the advantages of the various clean diesel technology must be on-going. The additional costs associated with these activities will prove to be difficult for many districts and operators to deal with. There has to be a strong commitment from the total community to promote clean air initiatives.