

**RESEARCH OF THREE SUPPLEMENTAL EMISSIONS
REDUCTION MEASURES FOR POTENTIAL IMPLEMENTATION
IN THE NYMTC REGION**

Prepared for

**THE NEW YORK METROPOLITAN TRANSPORTATION
COUNCIL**

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Section A:

Summary of Recommendations

Introduction

Emisstar was asked by NYMTC to research the following three emission reduction measures for potential implementation in the NYMTC region.

- a. Use of Biodiesel fuel with diesel particulate filters in diesel powered vehicles.
- b. Accelerated replacement, scrappage and/or retrofit options for diesel powered trucks, school buses, taxis and black cars.
- c. Regional idling reduction, including enforcement, public education and supporting equipment.

This section of our report consolidates our primary recommendations.

Program Recommendations

Emisstar recommends that NYMTC and/or its member counties and cities implement a targeted diesel emission reduction program with the following components:

1. Fleet modernization with retrofit program;
2. Rebate style retrofit program;
3. Dealer/distributor supported vehicle diagnostic, repair and modernization facilities;
4. Idle reduction summit;
5. Lease/loan program for idle reduction technologies;
6. Biodiesel/DPF research; public fleets implementation
7. An education and outreach campaign to promote the above programs as well as idle reduction.

Comparison of SIP Creditable Recommended Programs if funded with \$10,000,000

Program	Annual funds	Truck model year	Annual operation	Number of Trucks	Total PM Reduction (over 5 years)	Total NOx reduction (over 5 years)
1	\$10,000,000	Pre '88 with '04	60,000 miles	200	114.3 tons	1,586.5 tons
2	\$10,000,000	1994 - 2006	49,000 miles	1,000	65.2 tons from DPF	N/A*
5**	\$10,000,000	1994 - 2006	1,000 hours	1,163	~0.4 tons	661.4 tons

(The estimates in this table exclude administrative costs and assume class 8a trucks for programs #1 and #2 to be conservative—Class 8b trucks could yield greater reductions. Program #5 uses EPA designated idling emissions rates.)

*If a NOx plus PM retrofit technology is installed NOx could also be reduced.

** Assumes program installs 13.9 hp APUs.

Funding Recommendations

While the identification of funding sources was not a prime objective of Emisstar's work under this Project, Emisstar recommends that NYMTC pursue the following funding sources:

- Congestion Mitigation and Air Quality program (CMAQ). CMAQ provides significant flexibility to fund multiple types of retrofit projects.
- State Supplemental Environmental Project (SEP) funds. (Federal SEPs are prevented from funding diesel retrofit projects.)
- New York Power Authority funds (to target electrification of engines, truck-stop electrification, and installation of plug-in active diesel particulate filters)
- State Infrastructure Banks for loans to fund onboard idle reduction technologies and Smartway fuel saving technologies.

Note: Biodiesel already receives federal subsidies, which has reduced the price of the fuel to the point where it is comparable to that of diesel, making biodiesel acceptable to many fleets.

Depending on the funding levels Congress sets, the federal Diesel Emissions Reduction (DERA) could become an additional significant source of funds for diesel emissions reduction programs in 2008.

Summary of Program Recommendations

1. Fleet Modernization with Retrofit

Based on the strategies Emisstar has analyzed for NYMTC, a fleet modernization program with retrofits may have the greatest potential for a successful voluntary emissions reduction program for onroad diesel vehicles. This type of program targets older heavy duty diesel vehicles and subsidizes, with grant funds, their retirement and replacement. In addition to having cleaner engines, the new or newer trucks are retrofitted with control devices to further reduce their emissions. In the absence of this type of accelerated fleet modernization program, the owners of these trucks would not purchase significantly cleaner trucks when their current trucks break down. Instead, they purchase the lowest priced trucks they can afford that are able to haul their products and these affordable trucks tend to be the oldest and dirtiest trucks on the road today. This is a particular problem for regional air quality because these old trucks travel primarily within the region and produce 5 to 10 times as much pollution as newer trucks.

The components that make a fleet modernization/ accelerated replacement program Emisstar's primary recommendation for NYMTC include:

- **Driver/truck owner interest. Interest in these programs is high** because a truck owner can obtain a newer truck at a significantly reduced price. While most truck owners do not like the idea of an emission control device being installed on their vehicles, under this program they are willing to accept it because the newer truck with the retrofits

provide significant improvements over their existing trucks in terms of reliability and fuel economy.

- **Achieve the most significant reductions in NOx and PM from a single mobile source.** The trucks this program targets are those with no or minimum existing emissions controls. Many of these types of vehicles are spewing more than 11g/bhp-hr of NOx and 0.6 g/bhp-hr of PM. Even without including a retrofit device, replacing one of these old trucks with a 2004 truck is equivalent to taking four 2004 trucks off the road.
- **Relatively low administrative costs.** Significant reductions are coming from fewer sources, **which minimizes the number of participants to oversee.**
- **Very cost effective.** This targeted fleet modernization program would cost \$4500-\$9000 per ton of NOx or approximately \$32-\$74 per pound of PM¹.
- **Verifiable.** With GPS technology or annual reporting, the actual vehicle miles traveled in an area can be recorded and reported to the agency administering the program.
- **Potential funding.** Fleet modernization is CMAQ-eligible as well as eligible for funding from sources such as DERA/DERP, state SEPs or others.
- **Added benefits.** The improved fuel economy benefits of these newer trucks also reduces greenhouse gas emissions. The improved reliability and structural integrity of the newer trucks frequently makes them safer than the older trucks for the drivers and others on the road.

2. Rebate style retrofit program

In addition to implementing a fleet modernization program, Emisstar recommends that NYMTC establish a rebate style retrofit program. We offer this recommended approach because replacing entire trucks is not always financially feasible or, in the case of newer trucks, does not achieve as significant emissions benefits as with the replacement of older trucks. Another reason for implementing a rebate program versus a traditional grant program is to reduce the administrative burden both for the administering agency and the recipient of the technology. For example, the administering agency would specify a list of pre-approved technologies and specific rebate amounts for these technologies for various types and ages of trucks. Annual mileage estimates would be based on those listed in the regions MOBILE emissions model. A truck owner would simply indicate the retrofit technology on the list that they were seeking to install and sign a contract indicating they will continue to operate their vehicle within the metropolitan area for the specified number of miles and years. Upon approval from the administering agency, the truck owner would purchase the technology, install it and submit a request for the rebate. To further reduce the administrative work for the agency and the truck owner, a GPS system could be installed for automatic tracking and reporting.

Emisstar recommends that NYMTC institute a retrofit rebate program for the following reasons:

- **The simplified application process will get more participation.** Many vehicle owners are deterred from participating in traditional grant programs because of the administrative

¹ This assumes that a pre-1988 truck is being replaced with a 2004 truck, grant subsidy to purchase the 2004 truck and retrofit is on average \$50,000, and the 2004 truck will operate for 40,000-80,000 miles per year over five years. In reality most of these trucks will be on the road significantly more than five years.

burden of applying for the grant having to seek reimbursement for the funds, and being weighed down by the ongoing reporting requirements.

- **Verifiable reductions:** Installing an EPA or California ARB verified retrofit device with a GPS tracking system (or an annual reporting requirement) will provide quantifiable, verifiable emissions reductions that can be used in the state implementation plans, transportation conformity, or both. (Further research could be done to determine if EPA would accept the mileage estimates from the MOBILE6 model in place of ongoing reporting.)
- **Cost-effective:** By establishing minimum use requirements in the metropolitan area, truck and engine model years, and specifying eligible technologies, a rebate program has the potential of obtaining PM reductions at approximately \$78 per pound of PM reduced².
- **Potential funding.** A rebate type program would be CMAQ-eligible as well as eligible for other funding from sources such as DERA, state SEPs or others.
- **Administrative cost control:** While there may be significant administrative costs involved with establishing the program, such as determining the technologies and truck model years that are eligible and setting the minimum annual mileage criteria, the administration of the program will not be particularly labor-intensive once the program is running.

3. Dealer/distributor supported vehicle diagnostic, repair and modernization facilities.

Emisstar proposes the development of a multi-agency supported, multi-purpose program that establishes a vehicle diagnosis, repair and modernization facility to accommodate short and long-haul vehicles looking to participate in the U.S. EPA SmartWay Transport Partners program. Ideally, these facilities would be located in a major port or distribution hub in metro New York or New Jersey.

This facility could be a one-stop shop for vehicle owners seeking grant-funded equipment upgrades, engine replacements or retrofits as well as idle reduction and other SmartWay technologies with preferred rate financing. If located within the New Jersey or New York Port community, the facility will serve the simultaneous purposes of addressing local drayage fleet modernization activities and serving the long-haul trucking community. Key staff at these facilities would be trained on all facets of the diesel emissions reduction programs available to truckers. Depending on the host facility (e.g., truck OEM dealer or authorized maintenance facility), the emissions reduction expert on-site could be fully or partially subsidized by one of the agencies. If there is no government subsidy for staff, these facilities could receive compensation through the services they provide and from designated mark-ups on the technologies they install. Additional savings may be possible in the retrofit programs if the administering agency requires retrofit technology vendors to bid the price of their technologies under this program. Installation costs could also be bid. This step of setting prices through bidding should lead to lower costs.

² Assumes class 8a truck, any model year between 1994-2006, average annual mileage of approximately 49,000 (based on TX Mobile6 model estimates), expected to operate at least 5 more years with a ARB verified diesel particulate filter retrofit device installed that reduces PM by 85%.

The reasons Emisstar recommends the establishment of these vehicle diagnostic, repair and modernization facilities include:

- **One-stop shopping.** By having centers specialized in diesel emissions reductions, there is a greater likelihood that more than one emissions reduction strategy will be installed on trucks. This will lead to greater emissions reductions per truck and fewer vehicles for the administering agency to track.
- **On site experts to assist truckers with their technical questions and administrative/financing challenges.** Onsite experts accustomed to working with truckers will be able to answer questions and may increase participation because they understand the issues and concerns of the truckers. Furthermore, most truckers are not used to participating in government grant or rebate programs. The local experts will be able to help them through the process. In the best case, the grant and rebate portions of the technology installations would be handled by the dealer and the trucker would just be committing to the use requirements.
- **Economies of scale and improved efficiency leads to reduced costs.** Since these facilities will be doing numerous installations, the efficiency of the staff should improve over time, which should translate into reduced costs for the program and greater incentive for the facility to support the success of the programs.
- **Subsidies for Education and Outreach.** New provisions in CMAQ place a priority on such activities, not only for retrofit and fleet modernization, but in support of staff who promote, educate and conduct outreach.
- **Quality Assurance.** Since these facilities will have experts on site and the facilities will be installing many of the same technologies, they will not only be able to do the installations more efficiently, but are more likely to do the installations correctly. This will help ensure that all the technologies installed will operate as intended.

4. Idle reduction summit.

Under the NYMAQI accord, Emisstar recommends that the NYMTC Clean Technologies Group convene an Idling Summit in New York City to address the regionalization of an expanded education and enforcement effort. Ideas to stimulate the discussion may include: 1) Changing the way authorized enforcement agencies record information about violators – across all counties – to create an actionable and clear compliance picture; 2) Expanding ticketing and enforcement authority to DSNY as a way of addressing idling in the refuse vehicle sector; 3) Coordinating a regional idling “sweep” and follow-on education, outreach and compliance program; 4) Establishing an anti-idling sign purchase program for counties that is supported by the NY State prison system (if needed); and 5) Further harmonization of statutes including removal of sleeper berth exemptions to promote TSE and APU adoption.

5. Loan program for idle reduction Auxiliary Power Units (APU) and SmartWay technologies.

While idle reduction may not generate as many SIP or conformity-creditable emission reductions as the above recommendations, Emisstar recommends that NYMTC establish and implement an

APU and SmartWay deployment program modeled after Oregon's *Everybody Wins* lease program. In contrast to the Oregon program, Emisstar recommends that out-of-state (if possible) as well as in-state licensed vehicles be made eligible under this program as long as significant operation of the vehicles falls within the New York non-attainment area. One step that will further help the success of any APU program is to allow truckers to exceed the gross vehicle weight rating on roads in New York State by the weight of the APU (approximately 400 lbs). This allowance would mean that trucks would be able to carry the same load after they purchase the APU as before it was installed.

The reasons Emisstar recommends this program include:

- **Driver/truck owner interest.** Interest in this type of program would be high because obtaining an APU or other SmartWay technologies could provide significant fuel and cost savings to the truck owner almost immediately.
- **Very cost effective.** Since the program is a loan/lease program in which the capital costs will be repaid to the state, the cost of the program will be mostly limited to the administrative costs and costs of subsidizing the interest rate on the loans. These reduced costs will mean real emission reductions at lower total costs than those incurred under a grant program.
- **Verifiable.** With GPS technology or annual reporting, the actual vehicle miles traveled using the SmartWay technologies and the operation of the APU within a designated area can be recorded and reported to the agency administering the program.
- **Potential funding.** This program is CMAQ-eligible and also could be run under the State Infrastructure Bank program. Other sources such as DERA/DERP, state SEPs could fund the program.
- **Added benefits.** The improved fuel economy benefits of the APUs and SmartWay technologies will reduce greenhouse gas emissions.

6. Biodiesel Recommendations

Emisstar has concluded that there are significant opportunities for increased use of biodiesel with and without DPFs in the New York Metropolitan area. This is based upon biodiesel's enhancement of possible DPF regeneration, promoting potential use for low exhaust gas temperature applications; a public fleet alternative fuels mandate that can be satisfied by use of B20 blends; and varied and substantial funding sources to defray the higher cost of biodiesel, making biodiesel use economically commensurate with petrodiesel blends. As such, the following recommendations are suggested:

- Promote further research into biodiesel/DPF synergies (soot regeneration)
- Encourage use of biodiesel B20 blends for public fleet alt fuel requirement
- Develop and implement an education campaign denoting the emissions benefits, competitive cost, maintenance and warranty issues, and increased heavy-duty engine manufacturer support associated with biodiesel, when compared with petrodiesel.

7. An education and outreach campaign to promote the above programs and idle reduction and to educate fleets on the benefits of biodiesel.

Significant PM emission reductions³ can be gained through the use of biodiesel and Emisstar's research indicates biodiesel is compatible with diesel particulate filters⁴. Moreover, the success of the above programs and the increased use of biodiesel will be greatly enhanced by an education and outreach program targeting operators of diesel trucks in the New York Metropolitan area.

Additional Recommendations

While there are additional information and recommendations in the body of this report, Emisstar also recommends the following for successful programs.

- The region should establish one administering agency for these programs to give truck owners one-stop shopping and one set of program rules to follow.
- Establish an enforcement program for local idling laws and periodically check the trucks that have received grants to ensure that the retrofit technology (if any) is installed.
- Keep it simple. Since these proposals are voluntary, reducing the administrative burden for the end user will increase participation.
- Work with the regional trucking and product delivery associations to promote the program and, ideally, review the program specifics during development.

³ 10%-24% reductions in PM when using 20% biodiesel and 80% petroleum diesel blends.

⁴ See the biodiesel section of this report.

Section B

Accelerated Replacement of Vehicles – Fleet Modernization

Background:

Emisstar was asked by NYMTC to assess and recommend accelerated replacement and scrappage options for diesel powered trucks, school buses, taxis and black cars. For this report, Emisstar reviewed applicable programs around the country for both light-duty and heavy-duty vehicles and summarized three of them in order to provide background for our recommendations.

Diesel trucks remain a strong asset to the US economy and deliver most of the products we consume. New, cleaner heavy-duty trucks tend to be involved in long-haul use, while older, high-emitting diesel trucks tend to operate mostly in and around major metropolitan areas. One of the best ways to clean up older fleets of trucks with high-emitting engines is to replace them with new or newer trucks. The newer trucks have cleaner engines that meet tighter federal emissions standards, emitting up to 99% less PM and NOx.

Technology uses and benefits

Light-Duty Vehicle Programs

Light-duty vehicles include passenger cars and light trucks. By and large, the programs established for these vehicles are geared towards private vehicle owners and are frequently tied to inspection and maintenance (I/M) programs. There are a number of hurdles to overcome when implementing such programs.

I/M programs can be implemented to require that older cars at least meet the weaker emissions standards they were originally built to, however it should be noted that older vehicles are grandfathered by federal statute. In most cases, it is very difficult to implement regulations requiring a reduction of emissions for existing privately owned vehicles. Regulating the existing fleet of privately owned vehicles is limited to actions such as implementing contract requirements on public projects, permit requirements on restricted vehicles (City tour busses or airport busses) or copying California regulations.

While beneficial, scrappage/retirement programs targeting privately owned light-duty vehicles involve significant administrative efforts by public agencies to implement and manage. An additional concern of such programs is in devising and implementing methods that ensure that scrapped vehicles are not simply the “spare” or dilapidated vehicles that rarely operate anyway.

The benefits of targeting light-duty vehicles were quantified in a document prepared for California’s San Joaquin Valley Air Quality Management District meeting of January 10, 2006. According to the document, older, light-duty vehicles (pre-1990 model years) account for 56 percent of the ROG and 41 percent of the NOx emissions from all light-duty vehicles in 2005 despite accounting for only 19 percent of the vehicle population and less than 13 percent of the vehicle miles traveled (statewide). Generally, these older vehicles emit more pollutants because

of less restrictive emission standards and increased wear and tear on drive train and emission control components. Additionally, the subset of older vehicles that are not well maintained have a higher probability of being high emitters. As a result, older vehicles tend to be major contributors to ozone and particulate matter pollution in California.

An innovative program aimed at enforcing emissions testing of light-duty vehicles has been implemented in Dallas County, Texas. The Dallas Emissions Enforcement Program, called DEEP, has been operating in western Dallas County for two years as a pilot program. In that time it has impounded nearly 850 vehicles because of counterfeit or fraudulent state inspection stickers. About 10 percent of those vehicles, which cannot pass emissions inspections, are ultimately abandoned at impound lots. In the past, funds were not available to repair or scrap these vehicles, so they were auctioned off, returning the vehicles to the road. Because the pilot project demonstrated that a potentially large number of cars may be avoiding emissions testing, the program has received a \$132,950 grant in order to continue implementation. The grant money will be used to pay for repairs to those cars which will then be donated to charitable programs throughout the county, or to crush those that are beyond repair⁵.

Heavy-Duty Vehicle Programs

Examples of heavy-duty vehicles include tractor-trailer rigs, cement mixers, refuse trucks and school buses. Accelerated Replacement/Fleet Modernization programs for these diesel vehicles and equipment are operating successfully and tend to lead to greater emissions benefits and have lower administrative and implementation costs than do scrappage programs for light-duty vehicles. Also, funding for programs targeting heavy-duty vehicles is more widely available than for light-duty vehicles.

Older commercial heavy-duty diesel vehicles and equipment are significantly more polluting and have a significantly longer operational life than light-duty gasoline-powered vehicles. According to the U.S. Environmental Protection Agency, heavy-duty trucks and buses today account for about one-third of NOx emissions and one-quarter of particulate emissions from all highway cars and trucks, even though they only comprise 2% of the total number of vehicles on the roadways.

Heavy-duty diesel vehicles have been identified as large contributors to both ozone precursor and particulate matter emissions. Beginning in 1987, diesel engine manufacturers have been required to meet federal emissions standards. These standards have been significantly tightened over the years to the point where diesel engines manufactured in 2007 produce approximately 99% less particulate matter than those manufactured in 1987. By 2010, onroad diesel engines will produce approximately 85% less NOx than similar engines manufactured in 1987. See Table 1 for more information on EPA Emission Standards for Heavy-Duty Diesel Engines.

Since the New York City metropolitan area has limited funds and limited administrative resources to implement programs, Emisstar has focused its analysis and recommendations on fleet modernization programs for heavy-duty diesel vehicles and, to a limited extent, programs for school buses. School buses are better candidates for retrofits and are addressed more

⁵ Dallas Business Journal, online article, September 25, 2006, <http://www.bizjournals.com/dallas/stories/2006/09/25/daily8.html>

thoroughly in the retrofit section of this report. In addition, creating vehicle age restrictions for taxis and black cars as a requirement for new and renewed operating permits or licenses may be the best way to get the older vehicles in these categories off the road.

Table 1
EPA Emission Standards for Heavy-Duty Diesel Engines, g/bhp-hr
(Source: Dieselnet.com)

Year	HC	CO	NO _x (Unless Specified)	PM
Heavy-Duty Diesel Truck Engines				
1988	1.3	15.5	10.7	0.60
1990	1.3	15.5	6.0	0.60
1991	1.3	15.5	5.0	0.25
1994	1.3	15.5	5.0	0.10
1998	1.3	15.5	4.0	0.10
Oct 2002*	n/a or 0.5 (NMHC)	15.5	2.4 or 2.5 (NMHC + NO _x)	0.10
2004**	n/a or 0.5 (NMHC)	15.5	2.4 or 2.5 (NMHC + NO _x)	0.10

* Due to a consent decree, engine OEM's (Caterpillar, Cummins, Detroit Diesel, Volvo, Mack Trucks/Renault) were required to meet 2004 emissions standards in October 2002. Some manufacturers did not meet this deadline, paid penalties and/or met the deadline in a phased approach. By mid-2003 most of these consent decree engines met the 2004 standard. (Navistar/ International was not required to meet the standard until 2004.)

**The standard changed to focus on NO_x + non-methane hydrocarbons (NMHC)

Model Analysis: Review of Advantages and Challenges

The most noteworthy and successful diesel vehicle fleet modernization and replacement programs have been implemented in California and Texas. These programs provide grants to replace older, high-emitting trucks with new or newer, lower-emitting trucks and have the following similarities:

- Grant amounts are determined by a cost-effectiveness calculation—the level of expected emissions reduction from replacing a truck determines the dollars granted. This depends on factors such as the age of the retired vehicle and average annual miles of travel.
- The programs promote the accelerated replacement of trucks that would not likely occur through normal attrition.
- The programs have tracking and reporting requirements, utilizing global positioning systems (GPS) in some cases.
- The programs are regarded as cost-effective and successful in significantly reducing emissions.

Following is a brief introduction to three of the most established programs identified by our research with an accompanying table highlighting their similarities and differences.

Texas Emissions Reduction Plan (TERP) Replacement Program

The TERP program is focused on NO_x reductions and includes the replacement, repowering or retrofit of primarily on-road and off-road diesel equipment and vehicles. To date, TERP has granted \$414 million to a variety of diesel emission reduction projects. Of this amount, \$78 million has been granted for a total of 1897 on-road truck replacements. NO_x reductions from these truck replacements are calculated to be 14,300 tons, at a cost per ton of \$5,480. The Texas program relies on the cost-effectiveness of NO_x reductions as the primary criteria for selecting projects to fund. Specifically, Texas ranks applications and gives preference to those projects that achieve NO_x reductions at the lowest cost per ton of NO_x reduced. There are a number of specific program requirements, most notably that new trucks (or emissions control device) must emit at least 25% less NO_x than the old vehicles and at least 75% of annual mileage must be driven in a TERP-eligible area. These areas are currently the Dallas-Fort Worth, Houston-Galveston-Brazoria, and Beaumont-Port Arthur non-attainment areas. In the past, TERP-eligible areas have included 41 non-attainment and near-nonattainment counties in Texas. The TERP program is funded by a combination of state-wide surcharges on the sale of diesel trucks and equipment, title transfer fees, and commercial truck safety inspection fees. Other programs developed by the State of Texas under the TERP umbrella include a simplified rebate program, a program designed for small businesses, and grant programs targeted to specific vehicle types.

Gateways Cities Drayage Truck Fleet Modernization Program

This program targets drayage trucks operating in the greater Los Angeles area. Drayage trucks travel a short distance, frequently transporting containers from the port to the railyard. The operators are paid a minimal flat rate per load and tend to utilize some of the oldest trucks on the road. It has been determined that operators use these trucks until they cannot be repaired then replace them with similar, inexpensive, old trucks.

The program targets drayage trucks with pre-1987 model year engines, is overseen by the Gateway Cities Council of Governments and administered by consultants working for the Council. The replacement trucks must have engines of 1999 model year or newer. The average grant award is \$25,000 per truck. A new and unique aspect of this program is that PM control retrofit technology is required to be installed on most of the newer trucks that are replacing the old trucks, thus combining a retrofit and a replacement program. The idea behind this is to take advantage of the 'window of access' to the replacement truck to obtain the most emissions reductions possible from that truck, recognizing that it will continue to operate for a number of years.

Earlier in the program, reflash of the Engine Control Unit (ECU) was required on model year 1994-1998 trucks determined to have an emission defeat device. The program now requires at least 1999 model year engines in the replacement trucks, in order to avoid the ECU reflash step. Another requirement is that awardees must drive 85 percent of their annual mileage within the boundaries of the South Coast Air Basin. Finally, GPS technology is installed on the truck to facilitate tracking of location, mileage, and program administration.

Since the start of the drayage fleet modernization program in 2002, more than 350 trucks have been replaced, at a cost of approximately \$8 million. The replaced vehicles are expected to reduce emissions by approximately 193 tons per year of NOx and 42 tons per year of PM⁶.

Sacramento Fleet Modernization Program

The Sacramento Air Quality Management District (SAQMD) piloted the first Fleet Modernization program. This program targets trucking industry segments that routinely operate older trucks, such as the hauling of rocks, dirt, logs and construction materials. Similar to the Gateway Cities program, the Sacramento program targets trucks with pre-1987 engines and new trucks must have 1999 model year engines or newer. GPS tracking technology is installed to track and report mileage. SAQMD may add additional PM control technology to the new truck at its expense. South Coast Air Quality Management District, Bay Area Air Quality Management District, and the San Joaquin Valley Air Quality Management District have or are in the process of implementing Fleet Modernization programs. This is in part due to legislative changes that now allow the Carl Moyer program to fund the Fleet Modernization projects.

In 2002, the EPA and ARB approved funding of \$4.7 million for the Gateway Council of Governments (COG) to launch Clean Air Program (CAP). Since then, Gateway has successfully received over \$29M from the Ports of Los Angeles and Long Beach, ARB, South Coast Air Quality District, and EPA for funding their fleet modernization program, use of diesel emulsions and installations of diesel oxidation catalysts on port equipment.

Comparison of Three Truck Replacement/Fleet Modernization Programs

	TERP	SAQMD Fleet Modernization	Gateway Cities Drayage Trucks
Pollutants Covered	NOx focused	Initially NOx, now also PM	Initially NOx, now also PM
Target Vehicles	Minimum of 25% NOx reduction required, no specific model years targeted.	Pre-1987 trucks operating in industries such as rock hauling, dirt hauling, log hauling. New trucks must be 1999 or newer.	Pre-1987 drayage trucks. New trucks must be 1999 or newer.
Eligible Vehicles	On and off road trucks and equipment.	Onroad trucks only	Onroad trucks only
Grant \$\$	Average \$41,300 per truck	Average \$25,000 per truck	Average \$25,000 per truck

⁶ U.S. EPA Office of Transportation & Air Quality on-line article, "A Glance at Clean Freight Strategies: Gateway Cities Diesel Fleet Scrappage Program for Drayage", www.epa.gov/smartway.

	TERP	SAQMD Fleet Modernization	Gateway Cities Drayage Trucks
% Cost Paid	Will pay up to 80% of the cost of the newer truck but actual average is approx. 40%	Pays approx. 70% of the cost of the newer truck	Pays approx. 70% of the cost of the newer truck
Old Vehicle Rules	Old trucks useful remaining life certified by the applicant and third party mechanic.	AQMD staff inspects old truck to ensure it is still operational.	Contractor inspects old truck to ensure it is still operational.
Scrap Rules	Scrapping preferred, old trucks may be exported out of state permanently. ⁷	Old trucks and engine block must be scrapped/destroyed. Most parts can be salvaged or resold. Scrappers preapproved by AQMD.	Old trucks and engine block must be scrapped/destroyed. Most parts can be salvaged or resold. Scrappers contracted by consulting firm administering program.
Retrofit Rules	No PM retrofit required at this time.	Per contract, AQMD may add PM control technology to truck at AQMD expense.	PM control technology now required to be installed on most newer trucks.
Reporting	Grantee must report mileage driven twice/year.	Installed GPS tracking technology reports mileage to AQMD.	Installed GPS tracking technology reports mileage to program administrator.
Region covered	75% of mileage must be in designated ozone nonattainment areas within state.	75% of mileage must be in Sacramento metropolitan area	85% of mileage must be in South Coast Air Basin.
Funding Sources	Fees on title applications, sales of diesel trucks, off-road equipment, and truck safety inspection fees.	EPA, California ARB	EPA, California ARB, Port of Los Angeles, South Coast Air Quality Management District

Components of a Successful Program

- Target operators of trucks that tend to utilize old trucks in applications where a broken-down vehicle would most likely be replaced with an equally old truck or one with only modest emissions improvements.
 - California programs require truck owners to stay in the same line of work in which their current/old truck is operating. However, this requirement may not be necessary, as these truckers typically do not change the markets they serve.

⁷ As of December 2006, TERP now requires old trucks to be scrapped.

- The program should provide materials and support in English, Spanish, and possibly other languages.
- Vehicle scrappage should be done by prequalified vendors or vendors under contract with the agency administering the program.
- Ideally, a program should be implemented closely with prequalified used truck dealers. At a minimum, education of dealers is essential. The Gateway Cities program is a good model demonstrating dealer involvement. In Texas, the business opportunity combined with education outreach by the Texas Commission on Environmental Quality and Emisstar LLC have incentivized dealers to get involved and assist applicants.
- A public/industry awareness program needs to be implemented.
- A strong audit and enforcement program needs to be established.
- If funding permits, retrofits should be added to all replacement trucks older than model year 2007.
- Replacement programs should be considered for non-road machines, possibly starting with forklifts because they are numerous and high NOx emitters.
- GPS tracking is recommended to track usage and location, determine the emissions benefits, ensure compliance with the program rules, and reduce administrative burden. Offering a free GPS system can also be an added incentive to potential participants.
- Trucks to target, based on program and emissions reduction focus.
 - If the program is NOx focused target replacing pre-1990 trucks with trucks that meet the 2004 or equivalent emissions standard. Each truck replaced under this scenario would reduce NOx by approximately 77% and PM by 83%.
 - If PM reduction is the focus pre-1994 trucks should be targeted and replaced with 1994 or newer trucks. Each truck replaced under this scenario would reduce PM by 60% - 83% and NOx by 0% - 53%.
 - If the program is to reduce both NOx and PM, Emisstar suggests replacing pre-1994 trucks with trucks that meet the 2004 emissions standard or equivalent. Each truck replaced under this scenario would reduce PM by approximately 60% - 83% and NOx by 50% - 77%.
- If PM is even a modest focus of the program, PM retrofits should be installed on all the new/newer trucks. If funds permit, a PM/NOx control retrofit device would be best to install. These emissions control technologies (or retrofit devices) are more likely to be accepted by operators when they are getting a new/newer truck with grant funds, then they later, even if the retrofit device was free. This aversion to retrofit devices is because

they do not provide any economic or performance improvements to the truck, even if they was provided at no cost.

- Significant funding is needed to incentivize the operators of old trucks to buy newer trucks rather than repairing their current trucks or buying similar high- emitting trucks.

School Buses and Refuse Trucks

- Since most school buses are owned by or under contract with school districts, the districts can be required by statute to replace and scrap their oldest buses or install emission control devices like particulate filters and closed crank case ventilation.
- Refuse trucks owned or under contract with cities, counties and other local governments can be given the same requirements as school buses. However, private refuse haulers, carters and junk hauling trucks serving individuals or businesses would not be subject to these laws. One method of regulating these trucks would be via permits to operate in the area of the local government.
- While the mandating of emissions reductions for school buses and refuse trucks is effective, the costs of replacing vehicles or deploying retrofit technology will, without other funding sources, ultimately be borne by the regulated entities or passed through to their customers.

Funding:

Replacement/Fleet Modernization projects have been funded by the following:

- Taxes or fees on vehicle licenses
- Vehicle registration fees
- Title application fees
- SEPs - Supplemental Environmental Projects
- Tire disposal fees
- Safety inspection fees
- Emissions testing fees
- State general revenue
- Bond measures
- Federal earmarks
- CMAQ funds
- Indirectly, Clean Cities Funding supported program promotion

See the Funding Section of this report for additions discussions about many of these funding sources.

Section C

Regional Idling Reduction Education, Enforcement and Technology Implementation in Metropolitan New York

Overview

In the New York Metropolitan region, we face considerable energy and air quality challenges related to transportation. Technology is playing a role in meeting these challenges, through fleet modernization, exhaust after-treatment, alternative fuels, hybridization and creative financing or incentives. For most regulated fleet owners, however, and for those governmental agencies responsible for system-wide transportation and air quality planning, the real challenge lies in striking a balance between technology adoption, end-user acceptance and the recognition of some form of emission allowances, such that two fundamental improvements occur: 1) economic payback is captured by the end user, and 2) net energy and air quality improvements inure to the region.

For this report, Emisstar conducted research on regional idling programs, a potential emission reduction measure for implementation in Metropolitan New York, including education, enforcement and technology deployment options. A summary table of technology uses and benefits is provided, as well as a review of existing programs that may be applicable to the region. From the research, an implementation scenario is developed and a set of key conclusions provided. Overall, the goal of this research effort is to provide NYMTC and its Clean Technology Group members with information about the type of idle reduction programs to consider implementing in the region.

Defining the Problem

Preventable vehicle idling contributes to the region's impaired air quality. A typical Class 8 diesel tractor, for instance, emits 135 grams of oxides of nitrogen and 3.65 grams of particulate matter per hour under idle, while consuming a gallon or more of fuel. In fact, according to the Bureau of Transportation Statistics and the U.S. EPA, in 2003 all modes of transportation combined accounted for 66% of the nation's pollution from carbon monoxide, 47% of oxides of nitrogen, 35% of volatile organic compounds, 5% of particulate matter, 6% of ammonia, and 4% of sulfur dioxide. Thus, the contribution of mobile source emissions to the human and natural environment is considerable, especially in areas of non-attainment along the major I-95 corridor and, more locally, at large private truck stop facilities, port facilities and major distribution areas like Hunts Point where heavy duty diesel vehicles have a greater propensity to congregate.

But the idling problem is in no way limited to Class 8 heavy-duty diesels alone. School buses, public and private transit fleets, refuse trucks, light duty passenger cars and Class 3 through 7 diesels all contribute in one way or another to the idling problem. And it is a preventable one. In fact, New York City law allows - and most surrounding New York counties are following suit with - a maximum 3 minute vehicle idling time limit within County boundaries. This means that, with very few exceptions, almost every single vehicle operating within the New York Metro

Area’s roadway system should shut down after no more than 180 seconds at idle. Education and enforcement therefore play a critical role in reducing preventable vehicle idling.

Technology Uses and Benefits

Fortunately, the NYMTC region is poised to become the beneficiary of energy efficiency and low emission improvements already commercialized and ready for deployment. Through the EPA SmartWay program, for instance, technology bundling in the form of aerodynamic aides, wide tires, and in-cab heaters offer fleets an opportunity to realize energy savings while enhancing environmental performance. GPS systems can track the performance of SmartWay kits vehicle to vehicle, enabling the proper distribution of emission allowances or credits, regardless of interstate or trans-boundary travel.

Two prominent idle reduction technologies developed in the private sector may offer help with idling compliance, vehicle fuel savings, and be accretive to the transportation conformity budget. The first, shore power and advanced travel center electrification, are **stationary** off-board solutions (more commonly referred to as Truck Stop Electrification or TSE and Shorepower) that bring in-cab services like power, climate control, and internet right to the operator, who then power off the vehicle. The second, such as Auxiliary Power Units (APU) or generators, are **mobile** solutions that travel with the vehicle. A summary table of stationary and mobile solutions, including average costs and benefits or drawbacks (*italicized* font) is presented below:

Table 1: Summary of Stationary and Mobile Idle Reduction Technologies

Stationary

Name	Description	Cost	Benefits/ <i>Drawbacks</i>
Truck Stop Electrification	Service module provides HVAC, power, internet, cable and telephone directly to driver, who connects control unit to truck window using universal adaptor.	\$15,000 per space \$2.25 per hour rental	<ul style="list-style-type: none"> • Immediate fuel and emission savings • Typically uses off-peak electricity • Reduces engine wear and tear • Funded under 2005 Federal Highways Act & permitted at Public Rest Areas • <i>High capital cost of installation</i> • <i>Limited to areas that could accommodate infrastructure</i>

Shorepower	Provides an “RV” style electrical pedestal, shorepower, which connects to vehicle’s HVAC system. Both systems work together to eliminate idling.	\$ 5,000 per space \$4,000 per truck	<ul style="list-style-type: none"> • Most OEMs offer shorepower adaptable kits on new vehicles • Reduces engine wear and tear • <i>Very few installations nationwide</i> • <i>Cost: Trucks have to install systems to use shore power</i> • <i>Adds weight</i>
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Mobile

Name	Description	Cost	Benefits/Drawbacks
Engine Idle Management	Programmable automatic engine idle systems start and stop the truck engine automatically based upon duration at idle or internal cab temperature conditions.	\$1000 or less	<ul style="list-style-type: none"> • Inexpensive and easy to install • Best for delivery trucks • State of CA requirement in 2007 • <i>Main engine will run to maintain cab temperature</i> • <i>Not liked by truckers because the starting and stopping interrupts driver sleep</i>
Direct Fired Heaters	Small, lightweight diesel-fuel fired heater mounted inside cab that provides heat for driver comfort.	\$1,500	<ul style="list-style-type: none"> • Approximately 5% fuel savings @ 1200 hours idling/yr • Reduces engine wear and tear • <i>No air conditioning capabilities</i> • <i>No power to run TV or other appliances</i>

Auxiliary Power Units	Small outside-cab mounted diesel generator that provides heat, air-conditioning, and electrical power.	\$8,000	<ul style="list-style-type: none"> • Approximately 8% fuel savings @ 2400 hours idling/yr • Full amenities w/out running main propulsion engine • Reduces engine wear and tear • <i>Weight</i> • <i>APU emissions > 2007/2010 model year engine</i>
Inverter/Chargers/battery bank	Takes incoming AC power from alternator or outside source and recharges battery bank to full capacity; draws 12 volt DC power from batteries and inverts it to 120-volt AC for on-board appliances.	\$1,250	<ul style="list-style-type: none"> • Quiet, environmentally friendly • OEM or aftermarket installation • No maintenance • Provision for shore power • Fast payback

With the trucking industry consuming nearly 1 billion gallons of fuel each year by idling, according to EPA and Department of Energy statistics, both stationary and mobile technologies offer immediate solutions to fleets that need to improve operating efficiency and meet State and local compliance requirements.

Model Analysis: Review of Model Programs

This section of the research offers a brief analysis of two model programs achieving successes in the area of idling education, outreach, enforcement or technology deployment.

New Jersey Diesel Risk Reduction: Effective Education, Outreach and Enforcement

Through the Stop the Soot campaign, a statewide commitment to reduce harmful soot by 20 percent during the next decade, NJDEP is combining effective education and outreach with real enforcement measures to address unnecessary vehicle idling throughout the state. This effort is augmented by \$2.1 million in EPA funding to further support educational efforts, implement TSE at the Vince Lombardi Rest Area along the NJ Turnpike and, through a partnership with the NJ Motor Carriers Association, offer an APU, bunk heater and tailpipe retrofit incentive program.

What distinguishes the NJ program from other State efforts is the use of enforcement alerts and targeted “sweeps” in combination with education and effective follow-up. Upon issuing an

Enforcement Advisory, the DEP targets various types of diesel and gasoline powered vehicles that operate on the roadways of the state. These include charter buses, public-transportation buses, and long-haul and short-haul trucks. Inspectors target bus staging areas, convenience stores, public entertainment venues, retail centers, truck yards, warehouse distribution facilities and commercial loading and unloading zones to ensure the state's 3 minute idling rule (N.J.A.C 7:27-14) is being honored. During these so called sweeps, vehicle and property owners are made aware of state restrictions and provided information about idling laws, fuel consumption and public health issues related to idling. In lieu of paying fines, property owners can put up "no-idling" signs on their property. More than 6,000 signs thus far, manufactured by inmates from the State penitentiary system, have been placed into the community this way.

School bus idling is addressed through a voluntary "No-Idling Pledge" program, whereby school Superintendents sign a pledge committing their district to eliminating idling while loading students, to following routine bus preventative maintenance practices, and to using the newest buses on the longest routes. The NJDEP also partnered with the NJ Asthma coalition to create an "Asthma Free" school award, bringing into attention the outstanding efforts of participants throughout the state. This combination of education, awareness, outreach and recognition is a good example of an effectively integrated programmatic approach to curtailing statewide idling.

Lastly, the State is in the process of establishing through regulatory amendment a uniform 3 minute idling regulation (with some exemptions) and looking to phase out the Class 8 long-haul truck sleeper berth exemption by 2010 – a move that may increase future TSE participation.

The *Everybody Wins* lease program: Technology Deployment

The *Everybody Wins* lease program, created under the auspices of the Lane Regional Air Protection Agency, Lane County, Oregon, and later expanded under the non-profit organization Cascade Sierra Solutions, augmented a State grant and a tax-credit with a lease-to-own contract mechanism allowing the creative financing of APU to truck owners and fleets. The program, started in 2004, resulted in 350 upgrades and annual fuel savings of over 700,000 gallons—along with an estimated emission reduction of 103 tons NO_x and 2.7 tons PM using EPA emission factors.

During the two years of operating the *Everybody Wins* lease program, LRAPA claims the following lessons were learned:

- Truckers with good credit history are an excellent financial risk – with less than 1% in uncollectible accounts;
- There is an extreme lack of awareness with the owner-operator market of solutions available to save fuel and reduce emissions;
- Most owner-operators are unaware of rules until enforcement action is taken.
- Many truck owners lack the initial capital to upgrade their trucks - even if there is a reasonable return on investment.

The *Everybody Wins* program is financed by a loan to Cascade Sierra Solutions from the Oregon Department of Energy and the Oregon Department of Transportation. This special financing establishes a lease-to-own program, whereby Cascade Sierra Solutions purchases the energy efficiency or low emission technology of the truck owner's choice, pays for the installation, and

collects loan payments from the truck or fleet owner over a 60 month term. Cascade also offers shorter lease terms and no pre-payment penalties. When the lease is paid off, ownership of the equipment transfers to the truck owner. Only trucks that are base-plated in Oregon are eligible for this special financing arrangement.

Implementation Scenarios

Implementation scenarios depend on a host of factors, including the nature of the fleet and its operating conditions, voluntary or mandatory setting, available funding, and overall program objectives (education/enforcement vs. SIP creditable). For instance, voluntary measures may work effectively for some fleets, such as school buses, but may not work well for others, such as those fleet drivers whose fuel is paid by the company.

Our research effort recognizes the NYMTC members need to establish SIP creditable measures but also support non-creditable or potentially creditable scenarios as well. In this context, we propose the following:

Non-Creditable: Coordinated Education and Enforcement Programs

While New York and New Jersey are recognized by the trucking community as states that uphold the idling restrictions and issue tickets, the Office of Attorney General (OAG) office claims actual enforcement of violators is far and few between. And on top of that, the fact that ticket issuers collect very little meaningful information about fleets themselves makes the enforcement process of persistent violators nearly impossible without actual in field compliance sweeps.

In the past, inconsistency in state or local vehicle idling restriction laws and the impracticality of some provisions within these laws created formidable obstacles to promoting awareness, knowledge, industry acceptance and compliance. This is all changing. Harmonization of local idling regulations, higher fuel prices and operating costs, and the commercialization of multiple on-board and stationary idle reduction technologies presents real opportunity for coordinating a meaningful effort to thwart needless idling of passenger, light, medium and heavy duty on-highway vehicles.

Under the NYMAQI accord, Emisstar recommends that the NYMTC Clean Technologies Group convene an Idling Summit in New York City to address the regionalization of an expanded education and enforcement effort. Ideas to stimulate the discussion, for instance, may include: 1) Changing the way authorized enforcement agencies record information about violators – across all counties – to create a much more actionable and clear compliance picture; 2) Expanding ticketing and enforcement authority to DSNY as a way of addressing idling in the refuse vehicle sector; 3) Coordinating a regional idling “sweep” and follow-on education, outreach and compliance program; 4) Establishing an anti-idling sign purchase program for counties that is supported by the NY State prison system (if needed); and 5) Further harmonization of statutes including removal of sleeper berth exemptions to promote TSE and APU adoption.

Potentially Creditable

Dealer / Distributor Supported Vehicle Diagnostic, Repair and Modernization Facility

As a potentially creditable measure, Emisstar proposes the development of a multi-agency supported, multi-purpose program that establishes a Dealer/Distributor supported vehicle diagnosis, repair and modernization facility to accommodate short and long-haul vehicles looking to participate in the SmartWay Transport partners program. Ideally, this facility will be located in a major port location or distribution hub in metro New York or New Jersey. Working with private and state financial institutions, the facility will offer preferential financing options to vehicle owners seeking equipment upgrades, engine replacements, or retrofit and idle reduction installation. If located within the New Jersey or New York Port community, the facility will serve the simultaneous purpose of addressing drayage fleet modernization activities in addition to serving the long-haul trucking community.

Creditable

Emisstar proposes the creation of a three year technology implementation program combining two fully transportation conformity crediting technologies – TSE and APU. The program will be supported by NYMTC, potentially by the Bi-State Motor Carriers Association, and by other local, regional and in the case of EPA, national interests with the knowledge base and resources to support such an undertaking. The goal of the program is to fund, deploy and accumulate transportation conformity credit for the reduction in heavy duty vehicle idling from the use of EPA recognized stationary and mobile idle reduction technologies.

A. Truck Stop Electrification

Emisstar recommends that NYMTC utilize currently ongoing research efforts to identify an in-region network of potential TSE locations at public rest area locations. Rest area locations must have the right traffic volume and on-site amenities to attract and retain revenue producing customer base. This effort should target 2005 Transportation Bill allowances for this technology application.

B. Mobile In-State or Multi-State APU program

Emisstar further recommends that NYMTC establish and implement an APU deployment program modeled after the Everybody Wins lease program or – in the event NY State DOT, CMAQ or Infrastructure bank funding cannot be secured – the NJDEP APU reimbursement program. An APU program, ideally subsidized through State DOT and Federal CMAQ or by EPA SmartWay loans, is another recognized and conformity creditable approach to meaningful idle reduction – although the issue of interstate travel does play a role when performing off-model estimations.

For quantifying transportation conformity credit established by TSE and APU program implementation, refer to the “*Guidance for Quantifying and Using Long-Duration truck Idling Emission Reductions in State Implementation Plans and Transportation Conformity.*” U.S. Environmental Protection Agency, Office of Transportation and Air Quality – Transportation and Regional Programs Division. EPA420-B-04-001. January, 2004.

Other Key Conclusions and Observations

- In the absence of additional federal regulations of the existing diesel fleet of vehicles, economic incentives, in the form of greater operating efficiency, fuel savings, or advantageous financing mechanisms for fleet upgrade and/or modernization, remain the most viable way of increasing private sector participation and obtaining measurable improvements in air quality.
- Education and enforcement programs alone will not be enough. These actions must be packaged together with real technology choices to increase end-user knowledge, promote the benefits and stimulate adoption of idle reduction technologies that create real reductions.
- In a national survey conducted in 2005 to gather information on the extent of idling and use of idle reduction technologies among trucking companies, the American Transportation Research Institute found that 55% of respondents use automatic engine shutdown devices, while 36% of respondents with sleeper cabs (Class 8b vehicles) currently utilize mobile on-board technologies. When asked about future technology options, 28% of the respondents with sleeper cabs expected to use a direct fired heater and auxiliary power unit over the next five years.
- A regional program should use education, enforcement and a combination of mobile and stationary technologies to reduce idling, although funding and implementation will require non-traditional coordination and collaboration.
- Restrictions on idling and idling enforcement should be followed with training, education and the creation of anti-idling programs to address persistent violation and promote lasting behavioral change.
- From a full-fuel cycle of emissions and cost effectiveness standpoint, operators of sleeper cabs with low annual idling (< 1000 hrs) should use stationary off-board stationary off-board technology while operators with high annual idling demand (> 2500 hrs) should use mobile on-board technology.
- While public education and enforcement are lynchpins of any effective idle reduction program, regional or otherwise, these actions alone will not generate State Implementation Credits (SIP) applicable to the NYMTC transportation conformity budget. Only the deployment of idle reduction technology in the form of mobile on-board

or stationary off-board solutions will create quantifiable, real, permanent, and creditable reductions recognized by EPA.

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20. *Telephone Interview*. Paul Bubbosh, U.S. Environmental Protection Agency.
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Other Resources

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Section D

Use of Biodiesel with Diesel Particulate Filters

Overview

All the studies and analyses by engineers, scientists, government officials and policymakers, performed to-date, underscore the benefits associated with use of biodiesel, as a viable and effective diesel emissions control technology. Biodiesel has been shown to substantially and consistently reduce PM, HC and CO, with quantitative values dependent upon engine type and vehicle equipment duty-cycle.

Biodiesel exhibits a synergistic effect when used with a passive diesel particulate filter, through three mechanisms: lowering regeneration temperature, increasing regeneration rate, and increasing the concentration of organic fraction of PM which may promote superior PM-reduction performance from diesel oxidation catalysts. These preliminary results are based upon limited testing and warrant further evaluation.

While NO_x effects are still the subject of considerable debate, new studies suggest that NO_x emissions are only slightly variable with fuel composition, engine type and test cycle, and are not an impediment to use of biodiesel in blends up to B20. A number of studies that featured actual emissions testing, including the seminal Montreal Biobus study of 2002, demonstrated no statistically significant NO_x increases with a variety of biodiesel blends.

Federal, state and regional funding mechanisms are increasingly making biodiesel very cost competitive with petrodiesel with a typical cost premium, after implementation of these funding mechanisms, of approximately four cents per gallon. Rapidly increasing biodiesel production in the United States – over 60% from 2004 to 2005 alone – will increase supply and drive down “per-gallon” consumer cost.

Why Biodiesel?

Biodiesel is an oxygenated fuel that can be used alone or blended with conventional diesel fuel (“petrodiesel”), and is manufactured from one of three primary sources, or “feedstocks” [1, 2]:

- Virgin Vegetable Oils: soy, mustard, canola, rapeseed or palm oils.
- Animal Fats: poultry by-products, tallow, fish oils, pork lard, etc.
- Restaurant Waste Oils: such as frying oils.
- Trap Grease: grease from restaurants grease traps, or float grease from waste water treatment plants.

Contrary to popular belief that it is simply comprised of raw vegetable oils or animal fats, biodiesel is a highly refined organic product manufactured through a process known as transesterification. Through transesterification, the raw feedstocks denoted above are chemically reacted with alcohols such as methanol to produce what is generally referred to as biodiesel. It is rapidly becoming an attractive alternative fuel source because it is renewable, it can be used

either pure or in blends with any type of diesel fuel (“standard” low-sulfur or ultra-low sulfur diesel), it requires no engine modifications for modern, pre-1993 diesel engines, and it significantly reduces emissions of certain components of diesel exhaust, most specifically PM, HC and CO.

Biodiesel is produced in pure form as “neat” or 100% or B100, but is most typically blended with diesel fuel in concentrations of 5% biodiesel to 95% petrodiesel (“B5”) or in concentrations of 20% biodiesel to 80% petrodiesel (“B20”). Concentrations greater than B20 tend to be rare in the U.S. and require unique handling and operating techniques, while concentrations below B5 exhibit diminished emission reductions and tend to not be cost-effective from an environmental standpoint.

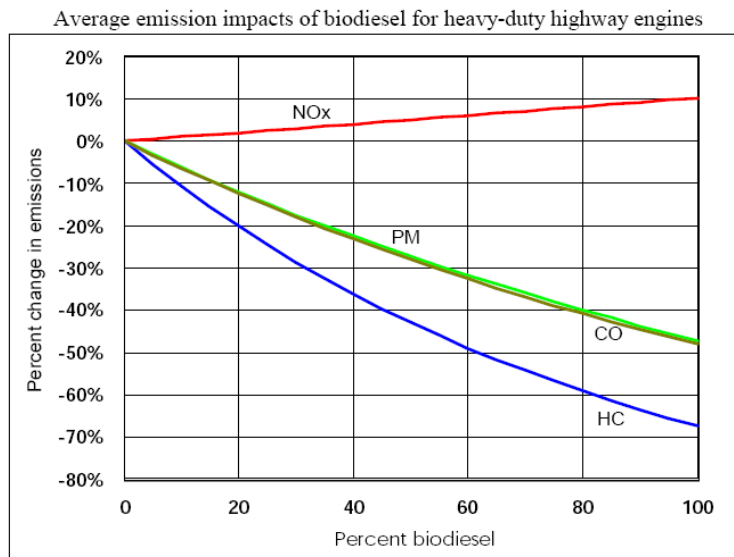
Performance Characteristics

Biodiesel performance can be evaluated both when used alone or in conjunction with diesel particulate filters (DPFs). A considerable amount of scientific work has underscored the benefits of the use of biodiesel blends in heavy-duty diesel engines as a stand alone, alternative, renewable fuel. On the other hand, far less research has been performed investigating the interaction of the use of biodiesel blends with DPFs. Most of this research has been conducted under the auspices of the National Renewable Energy Laboratory (NREL), and almost all of the results demonstrate significant emissions reductions with little if any deleterious effect upon engine power, durability or maintenance requirements.

a) Emissions

i) Biodiesel “stand alone”

A number of studies and tests have been performed to assess the impact of the use of biodiesel in diesel engines on the four EPA-regulated “criteria pollutants”, particulate matter (PM), oxides of nitrogen (NOx), hydrocarbons (HC), and carbon monoxide (CO). Paramount among these tests was EPA’s 2002 data analysis of pre-existing data obtained from a number of emissions testing and evaluation programs [3]. Their analysis showed, on average, substantial PM, HC and CO reductions, with NOx increases dependant upon the concentration of biodiesel utilized:



Since this evaluation, a number of additional efforts to further quantify PM, HC and CO reductions, as well as better understand the NOx increase (often referred to as the “NOx disbenefit”) from the use of biodiesel, have been performed. For PM, HC and CO, all of these studies corroborate substantially lower PM, HC and CO values, with specific data sets indicating even greater reductions of these three constituents for 2004 model year and newer engines. The NREL study, for example, revealed PM reductions in excess of 24% (as opposed to the more typical 10-12%) for 2004 and newer model year engines [4,8].

Regarding NOx emissions, the work of NREL and others supports EPA’s conclusions of approximately 3% NOx increase for B20 blends, while other studies, such as the Montréal Biobus Project, report no NOx increase, and even NOx reductions, depending upon the biodiesel feed stocks (virgin vegetable oils vs. animal fats, etc.), engine type and test cycle [4, 5, 6]. Renewed interest by EPA, other government agencies, academic institutions and national laboratories is underway to quantify biodiesel effects on diesel engine NOx emissions. Regardless, it is critical to keep in mind that the effect of biodiesel blends of up to B20 have very minimal, and substantially unquantifiable effects upon NOx emissions and should not be viewed as a viable reason to exclude B5 or B20 blends from being part of a diesel emissions reduction program for New York.

ii) Biodiesel with DPFs

Few scientific investigations have been undertaken on the use of biodiesel with DPFs. Most have been performed by NREL as part of US Department of Energy (DOE) programs. As such, while the methodology, data analysis and resultant conclusions have considerable merit, additional corroborative investigation – suggested by NREL themselves – is necessary as a means of add to our knowledge base concerning the interaction between biodiesel and DPFs.

The scientific evidence to-date suggests that use of biodiesel, in a typical B20 blend with DPFs, is environmentally very favorable and should be given serious consideration as part of a comprehensive emission reduction strategy. Rather than being a detriment, biodiesel enhances DPF performance in four key operational areas:

(1) Emissions Performance

Biodiesel in blends of B5, B20 or even B100 reduces PM, HC and CO, and tends to increase NOx, although NOx results are the subject of considerable renewed study. Use of biodiesel with a passive DPF (PDPF) tends to follow this same emissions pattern, but has little effect upon overall emissions reductions. For example, in one study, use of a PDPF with conventional diesel fuel, produced reductions of PM, HC and CO of 97 to 99%, and no change in NOx emissions. Use of the same PDPF, on the same engine, but with B20, produced nearly the same emissions results. While more testing needs to be conducted, it appears that use of biodiesel has little effect upon PDPF emissions reduction performance [7, 8, 3, 14]. However, as noted in the three sections which follow, use of biodiesel results in significant improvement and in PDPF operation.

(2) Regeneration Temperature

Passive diesel particulate filters are the type more commonly deployed on on-highway vehicles and nonroad construction equipment. They rely on engine exhaust temperature to effectively regenerate to remove trapped PM (“soot”). Often, PDPFs cannot be installed on specific vehicle or equipment types because the engine exhaust temperatures are too low for effective regeneration. Use of biodiesel significantly lowers the required PDPF exhaust gas regeneration temperature to the point where PDPFs become a potential emission control technology candidate for these types of vehicles and pieces of equipment. For example, studies by NREL have shown reduction of threshold exhaust gas temperatures, necessary for regeneration, by 45°C for B20 blends, and over 110°C for B100 pure biodiesel [7,8]. This is very significant in that it potentially expands the number of on-highway vehicles as well as pieces of nonroad equipment, that normally would not be able to use PDPFs due to insufficient exhaust gas temperatures, to be able to use these highly effective PM-reduction devices. The alternative to this “B20+DPF” approach would be using conventional petrodiesel and having specify more costly and complicated *active* DPFs or far less effective PM-reduction devices such as diesel oxidation catalysts.

(3) Regeneration Efficiency

PDPFs need to regenerate accumulated soot (forming carbon dioxide and water vapor) as part of their normal operating mechanism. Improper or poor regeneration performance will result in excessive soot loading, and in extreme instances, can cause PDPF plugging which can render the vehicle or piece of equipment inoperable. As noted above, use of biodiesel lowers the temperature at which soot starts to regenerate, helping to preclude excessive soot build-up, especially for those applications with marginal exhaust temperatures. However, in addition to lowering regeneration temperatures, studies have shown that use of biodiesel also *reduces the amount of time* required for the PDPF to regenerate and remove soot buildup in the device. This is significant for optimizing the operation of the PDPF, maximizing engine performance, and reducing the total amount of time that soot remains in the PDPF. During soot buildup, and prior to the regeneration event, engine exhaust backpressure increases, mildly reducing engine power and adversely affecting fuel economy. By reducing the amount of time required for soot regeneration, these two critical factors affecting engine performance are improved, potentially making use of ASTM D6751 biodiesel blends with PDPFs a more attractive proposition for fleets. While considerable in-use field studies still need to be performed, use of biodiesel blends is clearly directionally advantageous, and may mitigate diminished engine power and increased fuel consumption, often associated with use of PDPFs and conventional diesel fuel.

(4) PM Composition

PM is composed of two major types of constituents, organic carbon (“OC”) and elemental carbon (“EC”). PDPFs, which are typically coated with a catalyst, are very effective at removing both EC and OC, resulting in 95+% PM removal efficiencies. Diesel oxidation catalysts, on the other hand, are very effective at removing the OC component, but not the EC component. However, DOCs are far less costly, easier to install, and require virtually no maintenance when

compared with PDPFs. Very preliminary studies have shown that use of biodiesel, especially in B20 blends, dramatically increases the percentage of OC, and reduces the percentage of EC, in diesel PM. If DOC use with conventional diesel fuel removes, on average, 25% of PM (all of it OC), and use of B20 doubles the percentage of OC as these preliminary studies indicate, then use of B20 with a DOC may result in PM reductions of close to 50%. Testing of this B20+DOC combination has yet to be performed, but as with biodiesel's favorable effect upon regeneration temperature and time, described above, B20's influence on percent OC in diesel exhaust is directionally very favorable.

b) Vehicle Operation – Power, Fuel Consumption, Cold Weather Performance

Much has been written and discussed regarding potential adverse effects of the use of biodiesel upon overall engine performance. In particular, concerns have been expressed regarding reduced engine power, increased fuel consumption and poor cold weather performance manifesting in fuel filter plugging. In the past, many of these concerns were, indeed, well grounded, since there was considerable variability in biodiesel fuel quality. With the advent of strict, well-enforced biodiesel fuel quality standards which are outlined in greater detail below, virtually all of these performance concerns have been identified, and are in the process of being addressed. However, with the proliferation of biodiesel plants throughout the US, one must be wary of off-specification (not to ASTM standards) blends arriving in the marketplace.

Regarding engine power and associated fuel consumption effects, biodiesel does have a lower energy content than conventional “petrodiesel”, with B100 containing approximately 10% less energy per volume. However, this deficiency is largely unnoticed in blends up to B20. Furthermore, the reduced energy content of biodiesel is largely offset by biodiesel's higher cetane value, which translates into improved combustion efficiency. As a result there is little laboratory evidence, and no in-use field experience to indicate any significant power loss or fuel consumption increase through use of biodiesel blends up to B20.

Regarding cold weather performance, B100 will start to solidify or “wax” at temperatures approaching freezing [9] and clearly cannot be used in cold weather climates. Some fleets prefer to limit biodiesel use to B5 in very cold climates [5], while other fleets have reported few if any problems using B20 under continuous cold-weather operation [10]. In general, use of ASTM-quality biodiesel for blends up to B20, especially from producers that manufacture in compliance with BQ 9000 requirements, precludes most issues related to adverse cold weather operation or fuel filter plugging.

c) Durability And Component Wear

The superior lubricity of biodiesel tends to favor less, rather than greater engine component wear, and this observation has been corroborated by a number of in-depth, long-term studies on heavy-duty, on-highway vehicles operating in both cold and warm weather climates [5, 11, 12]. Indeed, assuming one uses ASTM specification fuel, which is the US industry standard that all fuel providers must adhere to, one can expect no long-term engine durability or wear effects from use of biodiesel blends up through B20. These studies, supported by conversations with

fleet managers, also confirm that use of biodiesel up through B20 result in no increased maintenance requirements or costs.⁸

Regarding component compatibility [16], it has been documented that biodiesel will degrade certain types of hoses, engine gaskets, seals, glues and plastics with prolonged exposure. Natural rubber and polypropylene and other vinyl based compounds, typically used on diesel engines manufactured before 1994, are particularly susceptible, and use of biodiesel, even in blends as low as B5, should be avoided. On the other hand, engine components made from nylon, Teflon or Viton are impervious to even pure biodiesel, and all engines manufactured after 1993 use these newer, biodiesel-resistant materials. Furthermore, biodiesel has no known effect upon stainless or carbon steel materials which typically are used in fuel lines.⁹ As such, there are no materials compatibility concerns with use of biodiesel on the predominantly post 1993 diesel engines used today in both on-highway and nonroad applications.

Biodiesel Fuel Quality

a) ASTM D6751¹⁰

One of the greatest impediments to the widespread acceptance and use of biodiesel has been the varying quality of biodiesel fuel through the US. To improve biodiesel quality and to ensure nationwide consistency, the US Biodiesel Board, in conjunction with the American Society of Testing and Materials (ASTM) has developed ASTM specification D6751, which establishes specifications for biodiesel blend stock to be specifically mixed with conventional diesel fuel. ASTM D6751 is not a specification for pure B100, for which no US-based specification currently exists [13]. Rather, it is a specification for a biodiesel blend stock for conventional petrodiesel fuels. While the specification was written for B100, it is not intended for the use of 100% biodiesel in diesel engines. Rather, it is written as the fuel quality specification for the *biodiesel component* that is to be *blended* with petrodiesel fuels, resulting in biodiesel/diesel fuel blends. Most importantly, adherence to this specification will preclude the type of fuel handling and engine operational problems that have plagued use of biodiesel blends in the past.

b) BQ-9000

Building upon the ASTM D6751 biodiesel blends specification, the Biodiesel Board developed BQ-9000 which takes that specification and overlays a quality systems program that specific biodiesel manufacturers can adopt [17]. The program incorporates precepts governing storage, sampling, testing, blending, shipping, distribution, and fuel management practices through a formalized certification and



⁸ As an extreme example, Keen State College in New Hampshire has been switching from B20 use in the winter, to B100 use in the summer, with no reported adverse effects upon engine performance, durability or maintenance requirements.

⁹ Biodiesel also has no known effect upon aluminum.

¹⁰ Europe has a version of ASTM D6751 entitled "EU 14214". Like ASTM D6751, it provides specifications for biodiesel, but unlike D6751, can be applied to pure B100 as a stand alone biodiesel specification.

accreditation process that includes on-site facility inspections. Increased commitment to BQ-9000 by biodiesel providers will help ensure consistent fuel quality.

c) Engine Manufacturer Biodiesel Recommendations

In recent years, engine manufacturers have stated to accept use of biodiesel in their engines. While most will only allow for use of B5 blends to maintain warranty requirements, some are now accepting, or willing to start the process of accepting blends up to B20 [1]. This has been underscored by the recent Engine Manufacturers Association (EMA) announcement in support of B20 through a draft EMA biodiesel specification [29]. Current engine manufacturer recommendation for use of biodiesel are encapsulated below [1]:

Manufacturer	Position
Engine Manufacturers Association (EMA)	B5 acceptable if it meets D 6751.
Caterpillar	Many engines approved for B100; for others only B5 is acceptable. Must meet D 6751.
Cummins	All engines approved for B5; must meet D 6751.
DaimlerChrysler	B5 acceptable for all vehicles, but must meet D 6751.
Detroit Diesel	B20 approved for all engines/vehicles, but must meet DDC specific diesel fuel specification.
Ford	B5 acceptable for all vehicles, but must meet both D 6751 and EN 14214.
General Motors	B5 acceptable for all vehicles, but must meet D 6751.
International Truck and Engine	B20 acceptable for all engines, but must meet D 6751.
John Deere	B5 acceptable for all engines, but must meet D 6751.
Volkswagen	B5 acceptable for all engines, but must meet fuel quality standards (D 6751 or EN 14214).
Fuel Injection Equipment Manufacturer	Position
Bosch	B5 acceptable for all vehicles, but must meet EN 14214.
Delphi	B5 acceptable for all vehicles, but must meet D 6751.
Stanadyne	B20 acceptable for all vehicles, but must meet D 6751.

Source: IFQC Biofuels Center. See also, NBB, Fact Sheet: Standards & Warranties, available at http://biodiesel.org/resources/fuelfactsheets/standards_and_warranties.shtm.

Costs and Funding

Four specific funding opportunities have been implanted, all on the Federal level, to defray the cost associated with manufacturing and marketing biodiesel.

a) EAct 1992

Under the auspices of the US Department of Energy (DOE), EAct requires government fleets to use a certain percentage of alternatively fuelled vehicles (ATVs) in their fleets. Since there are few cost-effective options for purchasing *heavy-duty* ATVs, federal and state fleets can meet up to 50% of their heavy-duty alternative vehicle requirements through use of biodiesel. Taken in the form of a credit, fleets are allowed to use 450 gallons of biodiesel in heavy-duty vehicles in lieu of purchasing heavy-duty ATVs. Specifically, fleets must purchase and use the equivalent of 450 gallons of pure B100 in a minimum B20 blend in their heavy-duty fleet vehicles to earn “one ATV credit.”

In 2005 Congress extended EAct which among other key renewable fuels provisions extends the biodiesel tax credit (see below) through 2008 [28].

b) Biodiesel Tax Credit

While EAct has a direct influence upon government fleet use of biodiesel, the Biodiesel Tax Credit [24] assists to defray the cost difference of biodiesel for the private fleet or consumer. Passed by Congress in 2004 as part of the JOBS Act, blenders that blend B20 made from virgin vegetable oils (soy, canola, etc.) would receive a 20 cents per gallon tax credit and B5 blenders a five cents per gallon credit. Blenders using biodiesel manufactured from recycled oils would receive half these credit amounts. This tax incentive is taken at the blender/petroleum distributor level and is typically passed onto the consumer. In conversations with biodiesel end-users, all have benefited from this credit “pass down” making the cost of a B20 blend, on average, four cents a gallon more than conventional diesel.

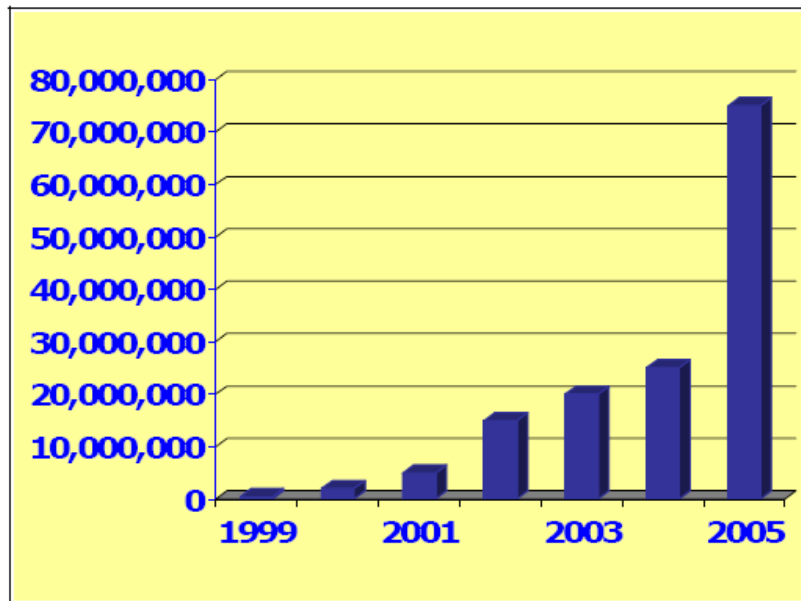
c) USDA Commodity Credit Corporation Program [30]

Another significant influence upon biodiesel production and consumption is the USDA’s Commodity Credit Corporation Bioenergy Program. This program makes monies available to eligible producers of bioenergy fuel, based on the quantity of bioenergy produced during a fiscal year that exceeds the quantity of bioenergy produced during the preceding fiscal year. “Bioenergy fuel” includes ethanol *and* biodiesel. With a prescribed payment schedule as part of the program, in the first quarter of 2006, over \$4.25 million was paid out to biodiesel producers amounting to approximately 36 million gallons of production.

Availability

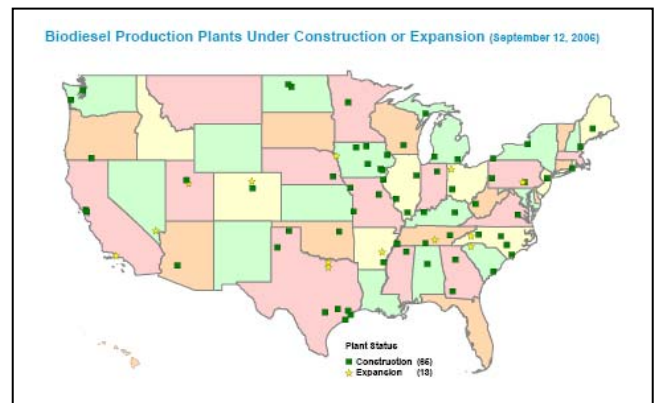
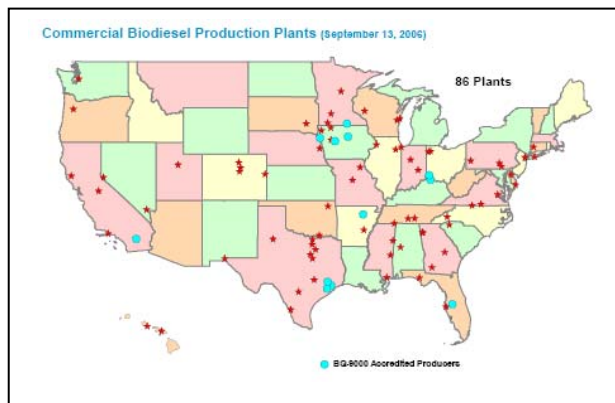
a) National Perspective

Spurred by energy and environmental concerns, as well as growing national interest in deployment of renewable fuels, biodiesel production has steadily increased. Significantly, biodiesel production from 2004 to 2005 jumped from 25 to 75 million gallons [1]:



Source: National Biodiesel Board.

This rapid increase in production stems from considerable biodiesel facilities construction in the US, with 86 facilities in current use and another 79 in the development and/or expansion stages [20, 22]:



b) New York Perspective

From the figure above, it is clear that biodiesel plant capacity is in place and increasing in the Northeast, favoring the availability of biodiesel in the area. From discussions with key New York and New England area users, it appears that availability is not an issue. The primary biodiesel provider in the New York Metropolitan Area, Sprague Energy, not only has an ample supply at competitive pricing, but is one of the very few BQ-9000 certified distributors in the country ensuring a steady supply of high-quality biodiesel (see Section 4 b, above).

For example, the New York City Department of Sanitation (DSNY) is just starting to institute a biodiesel program, initially at their Bronx #2 facility, then to their other Bronx facilities, and eventually throughout the fleet [35]. Components of the DSNY program include:

- Use of B5 at the Bronx #2 facility on about 50 pieces of equipment – both nonroad as well as on-highway refuse trucks.
- B5 use to extend to all of the Bronx and eventually the entire DSNY fleet over time (no definitive schedule has been set, yet). The DSNY fleet has approximately 6,000 refuse trucks and about 300 pieces of nonroad equipment, the latter mostly Daewoo and Case manufactured front end loaders.
- Use of B5, rather than B20, was a conservative-based decision to ensure that any perceived issues with B20 cold-weather handling and operation, would not surface.
- B5 use has just been initiated, but to-date, there have been no performance issues.

Similarly, New England fleets that order in bulk have experienced no issues with biodiesel supply even though there is evidence to suggest that supplies may be temporarily limited due to reallocation of delivery tanker trucks for ULSD which has just entered the commercial US marketplace [10].

Implementation

Emisstar recommends that NYMTC encourage the use of biodiesel for fleet and private users alike, in both on-highway and nonroad applications. This recommendation extends to those vehicles and pieces of equipment that do not employ aftertreatment (DPFs, DOCs, etc.) as well as those that have aftertreatment installed, either as part of the original “as delivered” specification, or when installed as a retrofit. All the data and engineering evaluation of biodiesel with DPFs points to trouble-free, effective PM emissions reductions with the concurrent use of these two technologies. Similarly, prior concerns regarding NOx increase with biodiesel use have largely been discounted and are in the process of being corroborated through ongoing, renewed testing. Finally, some fuel providers are using additives to further mitigate, if not altogether eliminate, any possibilities of NOx increase.

While biodiesel is higher in cost than conventional petrodiesel, federal subsidies, rapidly increasing production capacity and engine manufacturer acceptance of blends up to B20, even for vehicles equipped with DPFs, are all contributing to increased biodiesel use at lower cost.

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Section E

Funding for Reducing Emissions from Heavy Duty Diesel Vehicles

Introduction

While the identification of funding sources was not a prime objective of Emisstar's work, this section is provided as a reference of potential funding available to NYMTC. Most of the information on funding is reprinted from reports prepared by Diesel Technology Forum and referenced below.

In summary, Emisstar recommends that NYMTC pursue the following funding sources:

- Congestion Mitigation and Air Quality program (CMAQ). CMAQ provides significant flexibility to fund multiple types of retrofit projects.
- State supplemental environmental project (SEP) funds. (Federal SEPs are prevented from funding diesel retrofit projects.)
- New York Power Authority funds (to target electrification of engines, truck-stop electrification, and installation of plug-in active diesel particulate filters.)
- State Infrastructure Banks for loans to fund onboard idle reduction technologies and SmartWay fuel saving technologies.

Note: biodiesel already receives significant federal funding, which has reduced the price of the fuel to the point where its cost is acceptable by fleets.

Depending on the funding levels Congress sets, the Federal Diesel Emissions Reduction Program could potentially become a significant source of funds for diesel retrofits in 2008. In the meantime, Emisstar recommends that NYMTC maintain its primary focus on the funding sources listed above.

Diesel Emission Reduction Programs

In 2000, EPA announced a new voluntary initiative called the Diesel Retrofit Program to clean up older diesel engines in trucks, buses and construction equipment. This was followed by the creation of the Clean School Bus USA Partnership in 2003 with \$5 million in funding. In 2004, EPA launched the National Clean Diesel Campaign and provided both school bus and other demonstration retrofit grants, reaching a total appropriation of \$12 million in 2006. Beginning in FY2007, EPA's diesel retrofit funds will be administered under the Diesel Emissions Reduction Program (DERP) which was created through the Energy Policy Act of 2005. Under this program, EPA will establish a competitive grant and low-cost revolving loan program. Seventy percent of appropriated funds will be available for the national program administered by EPA and the other 30 percent will be available for similar programs operated by states.

The funding of EPA's DERP program initially authorized up to \$200 million annually for five years or a total of \$1 billion. EPA estimates that, if DERP is fully funded, it would reduce particulate matter emissions by 70,000 tons, generate nearly \$20 billion in economic benefit, and

return \$13 of benefit for every one dollar invested. However, each year's funding level will be determined by Congress during the annual appropriations process, with input from the President's annual budget request for EPA. Appropriations for 2007 are expected to be in the range of \$25 to \$30 million, however this level is still being determined by Congress. EPA will likely distribute DERA funds through a combination of national and regional awards with states handling funds provided to them either independently or working in conjunction with regional "diesel collaboratives," For more information about EPA funding and the regional diesel collaboratives, visit www.epa.gov/diesel/.

CMAQ Funding Congestion Mitigation and Air Quality Program

The other primary federal source of funding for diesel retrofit comes from the Federal Highway Administration (FHWA). In 1991, a year after Congress amended the Clean Air Act to accelerate efforts to achieve the National Ambient Air Quality Standards, the Congestion Mitigation and Air Quality program (CMAQ) was created as part of the Intermodal Surface Transportation Efficiency Act (ISTEA) to fund transportation projects that reduce emissions in non-attainment and maintenance areas. CMAQ funds require a 20 percent state or local match and must be distributed through a public sector partner. They are generally apportioned to state departments of transportation according to a formula based on air quality non-attainment status and population.

Although the Federal Highway Administration and the Federal Transportation Authority must approve all CMAQ-funded projects, there is no one system for identifying and approving projects at the state level. Metropolitan planning organizations (MPOs) have varying levels of authority over project selection, but are responsible for ensuring that projects are included in transportation improvement programs (TIP). Coordination between transportation and air quality officials at state and local planning agencies is critical to ensuring that TIPs conform with State Implementation Plans for obtaining NAAQS attainment, otherwise federal highway dollars could be jeopardized.

Diesel retrofit projects have previously been eligible for funding under the CMAQ program, but have traditionally represented a miniscule percentage of overall program expenditures, with transit and traffic flow improvement projects accounting for two-thirds to three-quarters of all program funds. This is expected to change as a result of the transportation authorization bill passed by Congress in 2005.¹¹

In October 2006, FHWA provide an interim program guidance document which includes many of the changes directed by the 2005 legislation. These changes include directing state departments of transportation to consider cost effectiveness in selecting projects, funding nonroad diesel retrofit projects, and providing language confirming that fleet modernization programs are eligible for CMAQ funding.

¹¹ The entire CMAQ introduction was copied from Diesel Technology Forum November 2006 report titled, *Retrofitting America's Diesel Engines: A Guide To Cleaner Air Through Cleaner Diesel* at http://www.dieselforum.org/fileadmin/templates/Resources/RetrofitMaterialsFactSheets/Retrofitting_America_s_Diesel_Engines_11-2006.pdf

State Infrastructure Banks

A State Infrastructure Bank (SIB) is a revolving fund that allows funds from federal surface transportation funding programs to be loaned to eligible federal-aid projects. The state then receives repayments over time that can be directed towards other transportation projects. A SIB, much like a private bank, can offer a range of loans and credit assistance enhancement products to public and private sponsors but may first need to be authorized by the State Legislature. SIBs require a 25 percent non-Federal match in cash to all Federal funding put in the account – although if a State has a sliding scale ratio, it may be applied. States also have the opportunity to contribute additional state or local funds beyond the required nonfederal match. SIB funds can be used to supplement or an alternative to CMAQ funding.

Thirty-two states, including New York, currently have SIBs, which are generally used to finance surface transportation projects such as highway and road construction. However, these funds are also eligible to be used to finance diesel retrofits or other emissions reduction programs if a state DOT chooses to commit funds to such a program.

To the best of Emisstar's knowledge, only one trucking/emissions reduction project has received assistance from a SIB loan to date (New York's SIB loaned the NY Thruway Authority funds for a stationary idle reduction center). Trucking firms and truck-related programs are eligible to apply.

In June of 2006, Oregon announced that it would commit \$3 million from its SIB and \$2 million from the state Department of Energy to capitalize an initiative to help finance of the purchase of EPA Smartway Upgrade Kits for trucks traveling along the I-5 corridor. Monthly fuel savings from the kit can exceed monthly loan payments, thereby increasing profits from the first day companies acquire the kits. More information on this program and Cascade Sierra Solutions, a non-profit which is distributing the kits is available at: www.cascadesierrasolutions.org. For more information on SIBs, please refer to the FHWA website at: www.fhwa.dot.gov/innovativefinance/sib.htm.¹²

¹² The information on the SIPs was copied from Diesel Technology Forum November 2006 report titled, *Retrofitting America's Diesel Engines: A Guide To Cleaner Air Through Cleaner Diesel* at http://www.dieselforum.org/fileadmin/templates/Resources/RetrofitMaterialsFactSheets/Retrofitting_America_s_Diesel_Engines_11-2006.pdf and a State Infrastructure Bank Factsheet at <http://www.westcoastdiesel.org/files/clearinghouse-truck/SIBfactsheet.pdf>