Special Act 05-07
Connecticut Clean Diesel Plan
School Bus Sector Report

I. Introduction

Diesel engines emit fine particulate matter ($PM_{2.5}$) which, when inhaled, can lodge deep in the lungs, aggravating existing heart and lung diseases to cause cardiovascular symptoms, arrhythmias, chronic obstructive pulmonary disease, heart attacks, asthma attacks and bronchitis. In Connecticut nearly 387,000 children ride approximately 6,500 school buses each day. Approximately 90% of the state school bus fleet is diesel fueled. The amount of time a child spends on the bus every day varies from 20 minutes to several hours per day. Collectively, Connecticut children spend 50 million hours on buses each year. Because the health issues associated with diesel exhaust are exacerbated in children, the Department of Environmental Protection (DEP) has made the reduction of diesel emissions from school buses a priority.

DEP's initial diesel reduction efforts began with an aggressive anti-idling campaign developed in partnership with the Connecticut School Transportation Association (COSTA) in 2000. COSTA and DEP entered into a voluntary Memorandum of Understanding (MOU) designed to eliminate all necessary idling. The MOU and associated training became a model for other states in the region and still an important model for reducing diesel emissions in the school environment.

DEP's anti-idling efforts have also been coupled with retrofit projects designed to achieve reductions through the application of diesel reduction technology. DEP's retrofit efforts prioritized projects based on the health risks posed by diesel exhaust air quality monitoring data and available funding sources. Application of these criteria elevates Connecticut's urban centers in order of priority. In 2002 DEP completed the first full-fleet school bus retrofit project in Norwich, CT to serve as a program model. From the experience gained in the Norwich project DEP initiated projects in New Haven, Hartford and Bridgeport. DEP efforts to date have provided a solid foundation to pursue additional emission reductions and public health benefits from the school bus sector. These efforts provide a foundation for expanding efforts to achieve additional reductions of diesel emissions, especially in urban communities, as envisioned by Special Act 05-07 (the Act).

The School Bus Subcommittee is one of four subcommittees formed to explore and develop information to meet the goals of the Connecticut clean diesel plan required by the Act. The action items assigned to the school bus subcommittee are:

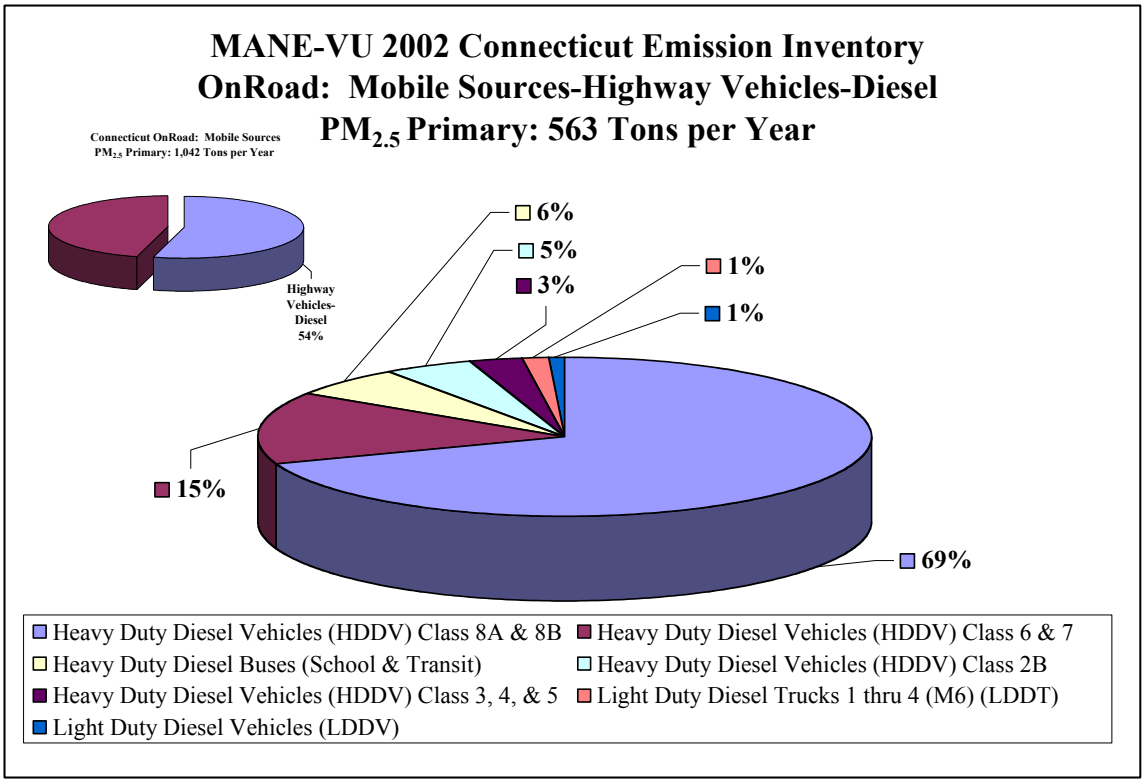
- Number of school buses state-wide;
- Fleet retrofit, (Implementing crank case controls), replacement, and retirement options;
- Clean fuel options;
- Anti-idling efforts;
- Model Contract Language;

- Case studies / pilot projects; and
- Other Items identified by the subcommittee.

The School Bus Subcommittee consists of members from government, private industry, public health and environmental organizations. Representatives from organizations involved in the operations of school buses also participate in the subcommittee, such as: COSTA; Connecticut Association of School Business Officials (CASBO); school district representatives and representatives from companies servicing district's school transportation needs. The committee met on three occasions apart from the general diesel plan meetings and informational forums. Material related to the subcommittee's efforts have been posted on DEP's website.

Figure 1 represents the emissions of $PM_{2.5}$ from on-road diesel-powered vehicles in Connecticut in 2002. The Mid-Atlantic/Northeast Visibility Union (MANE-VU) 2002 Emission Inventory estimates on-road diesel highway vehicles as contributing 563 tons per year of $PM_{2.5}$ in Connecticut. School and transit buses comprise six percent of PM2.5 emissions or 33.78 tons per year. It is estimated that school buses may be responsible for as much as 30 tons of $PM_{2.5}$ emissions per year from mobile source diesel engines in Connecticut.

Figure 1[1]



[1] The Mid-Atlantic/Northeast Visibility Union (MANE-VU) was formed by the Mid-Atlantic and Northeastern states, tribes, and federal agencies in 2001 to coordinate regional haze planning activities for the region. MANE-VU provides technical assessments and assistance to its members.

II. School Bus Report

A. State-wide School Bus Inventory

The statewide school bus inventory is compiled from registration information from the Department of Motor Vehicles' (DMV).[2] Inventory information for this report reflects vehicles registered for operation in the 2004 – 2005 school year. The total number of vehicles registered in the State of Connecticut as school bus transportation vehicles is 7,727. This total includes personal passenger vehicles registered to transport pupils to school.

The total number of common school buses, Type I and Type II school buses (herein after the fleet), in Connecticut is about 7,030. Analysis of the school bus inventory of Type I/II school buses reveals that 6,310, or approximately 90%, of the buses are powered by diesel fuel (gasoline about 7%, and other fuels power the remaining 3% of the fleet).

Historically, the focus of retrofit projects has been on diesel-fueled Type I buses. Type I buses are the typical large yellow buses with a gross vehicle weight rating greater than ten thousand pounds. Type I buses generally seat twenty to ninety passengers and comprise approximately 78% (5,486 buses) of the fleet; of this total, approximately 4,929 (70% of the total) are diesel fueled vehicles. For planning purposes the committee and the DEP evaluated diesel emission reduction options for the diesel-fueled Type I buses.

The other 22% (1,544 buses) are Type II buses, smaller buses under ten thousand pounds gross vehicle weight, which usually seat up to twenty passengers. A breakdown of Type I/II school buses by model year (MY) is provided in Table 1.

Connecticut has about 139 school districts that contract out school bus services and 14 municipally owned school bus fleets. Some of these contracts have clauses that require buses to be no older than 5 or 7 years, with two districts tolerating buses as old as 10 or 12 years. Because of this variation, the average fleet turnover period in Connecticut is about six and one-half years.

Table 1:

Type I and Type II School Buses Registered For the 2004 – 2005 School Year

Model Year	Vehicle Count
2006	**47**
2005	**306**
2004	**410**
2003	**426**
2002	**735**
2001	**621**
2000	**719**
1999	**656**
1998	**515**
1997	**537**
1996	**439**
1995	**719**
1994	**183**
1993	**321**
1992	**132**
1991	**127**
1990	**64**
1989	**22**
1988	**21**
1987	**22**
1986	**2**
1985	**3**
1984	**3**
Total	7,030

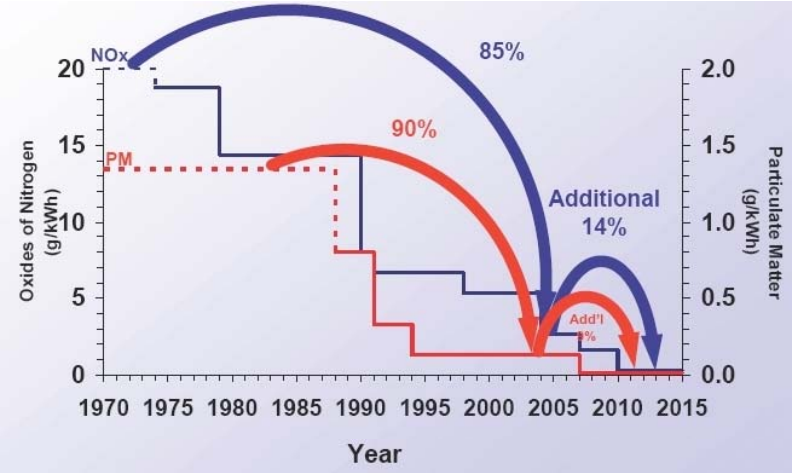
The contracts covering 139 districts comprise an estimated 85% (COSTA to verify) of the fleet of Type I school buses. Recommendations for diesel reduction efforts will be

[2] The DMV conducts vehicle inspections annually. All vehicles must have DMV inspectors' approval before new registration or registration renewal can be granted. All vehicles must be registered by August 31st of any year in order to operate in that following school year.

most effective when designed within this contractual framework. An analysis of the Connecticut school bus inventory along with EPA applicable heavy-duty engine standards (HDDEs)[3] provides a snapshot of air pollution from school buses. From a PM perspective 90% of the current fleet meets the 1994 standards,[4] which will be effective until 2007. Emissions of NO_X, an ozone precursor, are also important to consider in light of ozone nonattainment. EPA tightened the standards for NO_X in 1998[5]; and in 2004, EPA combined the NO_X standards with the hydrocarbon (HC, another ozone precursor)[6]. Only 11% of the fleet meets the 2004 standards for NO_X + HC. Based on the age of the fleet, fleet rollover strategies will yield the greatest reductions in NO_X.

Figure 2[7]

U.S. On-Highway Emission Standards



B. Fleet Retrofit, Replacement and Retirement Options

The Connecticut diesel emissions reduction strategy required by The Act, states the following, Section 1 subsection (b)(3), pertaining to school buses:

> *An implementation strategy, and an estimate regarding the cost and benefits to the state or municipalities of implementing such strategy, to maximize, not later than December 31, 2010, diesel particulate matter emission reductions from school buses and to prevent by said date diesel particulate matter engine emissions from entering the passenger cabin of the buses;*[8]

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[3] The standards can be accessed through EPA's website at: http://www.epa.gov/otaq/retrofit/overoh-all.htm

[4] The 1994 standards for PM are 0.10 g/bhp-hr (grams per brake horsepower hour) for regular engines and 0.07 g/bhp-hr for urban buses.

[5] The 1998 standard for NO_X is 4.0 g/bhp-hr.

[6] The 2004 NO_X + HC standard is 2.5g/bhp-hr; HC contribution cannot exceed 0.5 g/bhp-hr.

[7] Joe Suchecki, Director of Public Affairs, Engine Manufacturers Association, DEP Technology Forum, August 17, 2005.

[8] See Attachment A, Special Act 05-07, *An Act Establishing A Connecticut Clean Diesel Plan.*

According to DMV's inventory data, the Connecticut school bus fleet is comprised of relatively new buses. Based on survey information compiled by DEP and the CASBO, conditions in existing school bus contracts between school districts and transportation providers will insure that the whole fleet will be comprised of buses meeting the federal 2007 engine standards via the natural process of fleet turnover by 2019. Implementing a mandatory strategy involving both retrofits and replacement will move the achievement date forward to 2010, increasing capital costs, but decreasing the health costs resulting from the additional years of PM exposure. Existing contracts that contain clauses allowing for renegotiation of terms and conditions can accelerate replacement or retrofits; and providing financial incentives enhances this option for reducing emissions on a shorter schedule. These options have different timetables; in general a premium is paid for more rapid reductions but those increased capital costs should be weighed against the increased health costs resulting from the longer implementation periods. The three options are discussed in more detail below.

- **Option 1: Mandatory Retrofit and Replacement**

  Due to the implementation of federal on-highway HDDE standards for 2007 and later MY buses,[9] a combined retrofit and replacement strategy will focus on the retrofit of 2006 and earlier MY school buses while replacing retired vehicles with 2007 compliant school buses.

  All 2007 and later MY front engine school buses will come equipped with emission reduction technologies designed to achieve significant reductions of $PM_{2.5}$ in the exhaust stream and will prevent emissions from entering the passenger cabin of the buses by the use of crankcase controls.[10] Therefore, retrofits utilizing closed crankcase technology should be an option reserved for pre-2007 MY front-engine[11] school buses that cannot accept more efficient $PM_{2.5}$ emissions reduction controls.

  The following technologies for reducing $PM_{2.5}$ emissions were reviewed:

  - **Diesel Oxidation Catalyst:** DOCs are devices that use a chemical process to break down pollutants in the exhaust stream into less harmful components. Diesel oxidation catalysts can reduce emissions of PM by 20-26 percent, HC by 50 percent and CO by approximately 40 percent. Oxidation catalysts cost about $1,000 to $2,000, can be installed on any diesel engine, and run on regular diesel fuel. Although installation time can vary, field experience suggests it takes about 1 to 3 hours to install an oxidation catalyst.[12]

[9] 40 CFR 86.007-11
[10] http://www.dieselnet.com/standards/us/hd.html#y2007
[11] DEP research of available literature illustrates very little in-cabin PM emissions from rear engine school buses. Therefore, installation of crankcase controls on rear engine school buses is not the most beneficial investment for targeting PM emission reductions and in-cabin exposure to diesel exhaust.
[12] Source: EPA.

- **Diesel Particulate Filter:** DPFs are ceramic devices that collect the particulate matter in the exhaust stream The high temperature of the exhaust heats the ceramic structure and allows the particles inside to break down (or oxidize) into less harmful components. They can be installed on new and used buses, but must be used in conjunction with ULSD fuel. Costs can range from $5,000 to $12,000 installed. The combination of PM filters and ULSD, however, can reduce emissions of PM, HC, and CO by 60 to 90 percent.[13]
  - **DPF Maintenance Costs:** DPFs must be periodically "regenerated" to remove the collected particulate matter. Special ovens are used to bake off the accumulated soot at high temperatures. The cost of annually regenerating a filter, including labor, is currently estimated to be $500 per engine or $2.5 million annually for the Type I fleet. These filters must also be replaced, generally every five years, at an additional cost to the operators, currently estimated to be $7,500 per vehicle. Assuming that one fifth of the fleet will require new filters every year at a cost of $7.4 million, the total maintenance budget for the state fleet will be increased by $9.9 million. These costs will be phased in as 2007-compliant buses make their way into the fleet.
  - **Suitability:** While highly attractive from the standpoint of PM emissions reduction, DPFs require data-logging and customized engineering for installation on many school bus engines and they cannot be used at all on the oldest buses in the state fleet. DPFs will be factory-installed on the 2007-compliant buses. DPFs are not suitable as an emissions reduction technology for general application due to the case-by-case review required. A more detailed statewide inventory of school bus engine (make, model, year) and an assessment of duty-cycles are also important elements in a case-by-case review.

- **Closed Crankcase Filtration System**: A small but significant amount of exhaust gas leaks out from around the seals of the moving pistons in the engine and is conventionally vented to the atmosphere through the crankcase. These vapors, which contain PM, water and traces of oil, can make their way into passenger compartments of trucks and buses. Closed crankcase systems include condensation filters to remove the oil and particulates, pressure regulators to protect the engine and ductwork to route the filtered gases back through the engine instead of to the atmosphere. When the closed crankcase is used in a system with a DOC, PM emissions can be reduced by 30% (as opposed to 20% with the DOC alone).

[13] Source: EPA and CARB

The option of a mandatory retrofit/replacement strategy, as submitted by one stakeholder group,[14] would require that 100% of Type I school buses to be replaced (with an engine model year 2007 or newer) or retrofitted with emissions control devices verified by either the US Environmental Protection Agency (EPA) or the California Air Resources Board (CARB) by September 1, 2010. This option is based on the following assumptions:

- 1,200 older Type I diesel school buses would be replaced with 2007-compliant buses under current fleet turnover schedules, and 372 Type I buses are currently being retrofitted; this leaves about 3,400 buses to be retrofitted.[15]
- Buses will be retrofitted with DOCs and closed crankcase systems at a cost of $1,900[16] per bus, installed.[17]
- The DOC/closed crankcase system can decrease PM emissions by approximately 30%.
- It is possible to perform 3,400 retrofits in a five-year period.
- Existing contracts can be renegotiated to accommodate the retrofits by December 31, 2010.

This option leads to a project cost of about $6.5 million, a tailpipe emissions reduction of 9 tons per year[18] and near total elimination of crankcase emissions of in-cabin $PM_{2.5}$. With installation occurring over a five-year period, to be complete by the end of 2010, the cost effectiveness in the last year of installation is roughly $144,000 per ton of $PM_{2.5}$ emissions reductions in 2010. This would require 680 installations per year, most likely an unrealistic schedule from an operational standpoint. Even if operationally feasible, this would likely yield still higher installation costs that those estimated.

Any option that seeks to mandate emissions controls and/or replacement would have to take into account existing contracts between school districts and school bus operators in the majority of districts in Connecticut. From DEP's limited survey, it appears that there would be considerable obstacles to overcome related to contract renegotiation. Experience with the few district contracts indicates that the process will require participation and support from the local superintendent, the mayor or town manager, parent/teacher organizations, the school transportation provider and the public. Development of a contract renegotiation track along with complementary compliance schedules will require significant administrative oversight and would likely result in a lengthy timeframe for implementation.

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[14] See Attachment B: Environment Northeast, "*School Bus Options Menu Memo, Option #2.*"
[15] DMV's inventory does not include a breakdown by engine type. The number of front engine buses from the 3,400 buses would need to be determined.
[16] ENE's original proposal used $1,000, the cost of the uninstalled DOC.
[17] This figure represents capitol cost of the installed retrofits only. Operating costs of filter maintenance and replacement are not included.
[18] This represents 30% reduction from DOC times 30 tons per year from school buses; see page 1.

Without renegotiating the contracts, compliance schedules and deadlines would have to be adjusted to be consistent with contract renewal dates. Because so many Connecticut school districts contract out their student transportation services, the goal of maximizing emissions reductions by September 1, 2010 may not be achievable under a mandated emissions control strategy.

Enforcement responsibilities were not outlined in this proposal, however if DEP oversight is intended, this option will incur additional administrative costs that would need to be quantified.

ENE, as part of the Clean Diesel Coalition, submitted a subsequent proposal that refines the mandatory retrofit/replacement option.[19] It contains some creative financing incentives that are discussed in Option 3 of this report and a table of retrofit and replacement scenarios that could be a valuable reference for fleet owners. However, this proposal contains two "requirements" that may render it legally untenable.

- *By September 1, 2007, no school bus with an engine model year of 1993 or older may be used to transport school children in Connecticut; and*
- *School districts and school bus owners must permit existing contracts to be reopened to negotiate compliance with requirements.*

As was discussed above, unless the existing contracts include clauses allowing them to be reopened, there is no clear method to compel renegotiation. A mandatory provision constituting a flat ban of school buses based upon model year may encounter significant legal hurdles in adoption, either in statute or through regulation, and may not justifiable under these circumstances.

- **Option 2: Implementation of EPA's 2007 Standards for Connecticut School Buses**

Federal regulations, currently in place, set revised standards for on-highway heavy-duty diesel engines beginning with the 2007 MY.[20] All on-highway heavy-duty diesel engines, 2007 and later model years are required to meet revised emission standards that include nitrogen oxides (NO_X) as well as $PM_{2.5}$.[21] Therefore, the phase-in of model year 2007 and later engines will assist greatly in meeting the goals of the Act to reduce $PM_{2.5}$ emissions from school buses and will help Connecticut in reducing emissions of NO_X, an important precursor to ozone formation.

The average school bus in Connecticut is about 6 years old. In comparison to other states such as California, the Connecticut school bus fleet is relatively clean. Assuming that natural fleet turnover continues and there is not a dramatic increase

[19] See Attachment C.
[20] http://www.epa.gov/otaq/retrofit/overoh-all.htm
[21] 40 CFR 86.007-11.

in the acquisition of school buses prior to the implementation of 2007 standards, the average school bus will be 2007 compliant by 2013. The oldest school buses in Connecticut are in a few districts that have set the contractual age limit for school buses at 12 years. Therefore, by 2019 the entire Connecticut school bus fleet under contract will be 2007-compliant[22].

At the time of this writing, the engine manufacturers are still developing vehicles that meet the 2007 standards, however, it is estimated that each vehicle will cost $5,000 to $6,000 more than new school buses purchased in 2006. Turning over the entire fleet of diesel-fueled Type I school buses will ultimately add as much as $25-30 million to the budget for new buses in Connecticut. Cost effectiveness is an annual figure, dependant upon the turnover schedule. Distributing the capital cost evenly across the twelve year period between 2007 and 2019, and including the 85% $PM_{2.5}$ emissions reduction from DPF technology, the cost effectiveness of the capital investment in the last year of the turnover would be about $82,000-$98,000 per ton of $PM_{2.5}$ emissions reduced. This does not include the increased cost of maintaining and replacing the filters on the 2007-compliant buses.

Compressed Natural Gas (CNG)-powered buses emit 70-90% less PM than diesel -powered buses. Three CNG school buses are included in the Norwich fleet. However, these vehicles can run as much as four times the cost of diesel-powered buses or $25,000 to $40,000 per vehicle. The cost effectiveness of replacing all the Type 1 diesel-powered buses with CNG vehicles would be $25-$40 million per ton of $PM_{2.5}$ emissions reduced in the last year of the turnover. Additionally, CNG vehicles require special refueling facilities as well as special maintenance facilities, both of which are expensive.

- **Option 3: Model Contract Language and Fleet Retrofit/Replacement Incentives:**

  Option 3 focuses on a variety of strategies that could be considered within the context of existing contracts and as elements that could be included for future contracts. This option relies on a collaborative approach that includes a wide range of stakeholders including: the mayor or town manager, the superintendent's office (transportation director and/or the business manager), corporation counsel, parent/teacher organizations (PTOs), citizens and the transportation provider. Facilitated discussions will help to identify common goals and potential obstacles and ensure a public and transparent decision-making process.

  - **Model Contract Language**: In an effort to develop model contract language, the DEP collaborated with CASBO to structure a survey for CASBO members requesting information on contract terms and conditions, including age limits and information on plans to update each

[22] Additional research needs to be done to fully evaluate the 14 municipally owned fleets.

fleet.[23] Existing contracts that allow for renegotiation could be revised to incorporate one of the following options to affect fleet age and turnover:

- Age Limits: Several contracts specify that no bus will be older than a certain age; 10 years is the most common example, some are as high as 12 years. These could be modified to set a 5-year age limit.
- Average Age of Fleet: Where this clause is present, the average age specified is usually 7 years; sometimes this is used in conjunction with age limits. Such contracts could be modified to require an average age of 5-years.
- Replacement Quotas: Some districts specify that a certain number of buses be replaced or upgraded each year; one example requires that the two oldest Type I buses be replaced by two new Type I buses. The replacement quota could be doubled, with continued emphasis on replacing the oldest Type I buses in the fleet.
- Emissions Controls: One contract specifies that new buses have the "greenest" technology available; this could be modified to require purchase of school buses that meet EPA 2007 emissions standards as specified in 40 CFR 86.007-11.

- **Fleet Retrofit/Replacement Incentives:** Another available option, based on recommendations made by the school bus subcommittee, is to provide incentives to accelerate the replacement of pre-2007 MY school buses. The sales tax and the increased cost for the purchase of a 2007 bus are the only costs directly affiliated with the school bus purchase. ENE's straw proposal asserts that waiving the sales tax on new buses will result in a reduced cost of $4,000 per vehicle, helping to defray the costs of new school buses and encouraging districts to move forward in making decisions to replace older buses with a cleaner fleet.

  Incentive grants can be designed to fund retrofits as well as contributing toward the increased cost of 2007-compliant buses. Suggested incentives include up to $250 for the installation of a closed crankcase system and $1,000 to $3,000, depending upon the level of PM reductions, for CARB/EPA verified emission control retrofit devices. These incentive grants would be available for a limited time with sunset dates established to promote more rapid action to improve the emission controls on the fleet. This would assist all fleet owners and encourage action by school districts that own their fleets. Unresolved issues related to this option include determining whether this would be a grant evenly distributed among districts or whether preference would be given to communities with older school buses.

C. Clean Fuel Options

[23] See Attachment D, CASBO Survey Results.

Federal regulations also limit the sulfur content in on-highway diesel fuel to 15 parts per million (ppm) and refiners are to start producing 15 ppm sulfur fuel (designated Ultra Low Sulfur Diesel, or ULSD) beginning June 1, 2006. To meet emission standards for 2007, buses will need to run on ULSD fuel as it is needed by sulfur-intolerant emission control technologies available on 2007 and later MY school buses. The change to ULSD can account for a small but significant reduction in $PM_{2.5}$ emissions.

Alternative fuels and fuel additives can improve the reduction of $PM_{2.5}$ and other harmful pollutants. However, alternative fuels and fuel additives generally do not reduce $PM_{2.5}$ emissions in quantities achieved by retrofit technologies such as DPFs. $PM_{2.5}$ emission reductions witnessed from a natural gas vehicle are comparable to that attained by DPFs, however at an installed cost of up to four times that of a DPF, per unit.

Alternative fuels can be used in conjunction with diesel emissions control technology, but emissions control technology manufacturers have limited information on equipment efficiency with the use of alternative fuels. Utilizing a blend of ULSD with up to 5% biodiesel in the fleet could improve the lubricity of the ULSD. Biodiesel is a renewable energy source that promotes energy independence. School districts and operators can receive Energy Policy Act credit for utilizing biodiesel in their fleets. Engine manufacturers and retrofit technology manufacturers must accept the use of an alternative fuel, in order not to void warranties.[24]

CNG is being used to power three school buses in Norwich and could be considered as an option for replaced buses. A domestic product that helps to decrease our dependence on foreign oil, CNG is a mixture of hydrocarbons, mainly methane, and is produced either from gas wells or in conjunction with crude oil production. Vehicles powered by CNG perform just like vehicles powered by diesel fuel. CNG buses can reduce emissions of PM by about 70 to 90 percent if they meet Clean Fueled Fleet (on-road) requirements or have catalysts. The cost of CNG varies, but generally is comparable to the cost of regular diesel fuel. However, the cost of a new CNG vehicle can be $25,000 to $40,000 higher than a comparable diesel vehicle. Additionally, CNG vehicles require special refueling facilities as well as special maintenance facilities, both of which are expensive.

D. Anti-Idling Provisions

Buses that idle on school grounds or upon discharging or picking up passengers produce unnecessary emissions and expose children to harmful pollutants. Educating drivers and enforcing existing anti-idling regulations can increase the benefits resulting from improved emissions control technology under The Act. Anti-idling measures will also save fuel, reduce noise and reduce engine wear.

Connecticut's regulations regarding idling are found in Section 22a-174-18(b)(3) of the Regulations of Connecticut State Agencies[25]. In general, buses that are stopped must be

[24] For more information on alternative fuels see: http://www.dep.state.ct.us/air2/diesel/techforum17aug05.htm.
[25] See Attachment E, Regulations of Connecticut State Agencies, Sec. 22a-174-18(b).

turned off after three minutes of idling. Exceptions exist for passenger safety and comfort in cold or hot weather, under heavy traffic conditions and in cases of mechanical difficulties. Local law enforcement officers have the authority to issue tickets for school bus anti-idling violations. The violations are issued directly to the individual school bus drivers. The State of Connecticut DEP has developed signs that can be posted at bus stops and school grounds to increase public awareness while reminding drivers of the anti-idling policy.

E. Overview of Case Studies and Pilot Projects

There are numerous school bus retrofit projects taking place in Connecticut and throughout the Northeast United States. Connecticut has completed projects in Norwich, CT and New Haven, CT. Funding is at hand for the retrofitting of the fleets in the cities of Bridgeport, CT and Hartford, CT. Retrofit project planning is underway in Bridgeport and Hartford.

- The retrofit project in **Norwich, CT** was completed in 2002 with 42 school buses being retrofitted with DPFs. Buses that did not exhibit duty cycle exhaust temperatures suitable for the use of DPFs, were accommodated by insulating exhaust pipes to attain DPF temperature criteria. The insulation of exhaust streams is not common practice but has been employed in the Norwich retrofit project for buses that did not meet the necessary criteria by a few percents. The option of insulating the exhaust line is not recommended because of the extra costs and questionable effectiveness associated with the insulation process. Norwich has no reported problems with the retrofitted buses. The entire Norwich school bus fleet runs on ULSD fuel.

- **The City of New Have**n carried out a retrofit project in the summer of 2005. The New Haven bus fleet was retrofitted with a combination of diesel emission reduction technologies. The technologies were the Donaldson Spiracle (closed-crankcase filtration systems) units and Diesel Oxidation Catalysts. New Haven exhibits a perfect example of Best Available Control Technology (BACT) implementation, reducing in cabin PM emissions where exhaust PM emission controls could not be applied. New Haven also has no reported problems with retrofitted buses.

III. Diesel Plan School Bus Subcommittee Recommendations

A. Option 1: Mandatory Retrofit and Replacement

This option is designed to maximize reductions of fine particulate on the most aggressive schedule. The focus of retrofits of older buses will be to select emission reduction technologies that will maximize the reduction of diesel particulate exhaust emissions. DOCs and crankcase control technologies are preferred for this purpose with priority given to front engine (FE) buses of the fleet, since crankcase controls, which reduce

exhaust exposure in school bus cabins, are much more effective on FE buses. However, significant implementation issues as discussed previously limit the viability of this option as presented.

Table 2: Implementation Costs for Special Act 05-07:
School Bus Option 1: Mandatory Retrofit/Replacement

Projected Capital Cost of Retrofits (includes installation)	$6.5 million
Cost Effectiveness for PM Reduction (per ton per year)	$144,000

To assist school districts in evaluating technology options and purchasing at a competitive cost, DEP and the Department of Administrative Services are developing a state wide bid specification for retrofit technologies. This will enable school districts to purchase retrofit equipment off a state contract taking advantage of volume purchasing.

Most projects require retrofitted vehicles to remain in use for a few years in order to assure that it was a beneficial investment. A common obstacle encountered by districts that hire contractors to provide school transportation needs, is dealing with existing contracts that are not approaching expiration. Because it is necessary to work within existing contractual frameworks, the timeline associated with this option is difficult, if not impossible to achieve.

B. Option 2: Implementation of EPA's 2007 Standards for Connecticut's School Buses

Engine manufacturers report that 2007-compliant buses will not be available until late 2006 or early 2007. One option for meeting the goals of The Act in the state school bus fleet is to allow the natural fleet turnover to take place after the implementation of the 2007 HDDE standards. With current fleet turnover rates, this would be accomplished by 2019. New buses would have factory-installed DPFs and emissions controls for the ozone precursor, NO_X. Table 3 represents the costs and benefits associated with replacing the entire fleet with 2007-compliant vehicles. Cost effectiveness is based on capital costs.

Table 3: Implementation Costs for Special Act 05-07:
School Bus Option 2: Natural Fleet Turnover

Projected Capital Cost Increase for 2007-Compliant Buses	$25-30 million
Projected Maintenance Cost Increase at Full Replacement	$9.9 million per year
Cost Effectiveness for PM Reduction (per ton per year)	$82,000-$98,000

C. Option 3: Model Contract Language and Fleet Retrofit/Replacement Incentives:

Option 3 focuses on a variety of strategies that could be considered within the context of existing contracts and as elements that could be included for future contracts. Existing contracts that allow for renegotiation could be revised to incorporate one of several options to affect fleet age and turnover. Model language could be developed to assist in future contract negotiations.

To maximize $PM_{2.5}$ emissions reductions, the school bus subcommittee recommended incentives for districts seeking bids to replace their fleets, as rapidly as possible, with 2007 compliant school buses. Passing legislation to waive the sales tax on the purchase of 2007 compliant buses over the next three to four years would provide a strong incentive. Waiving the sales tax on new buses will have a great impact on districts making a decision to replace older buses with a cleaner fleet.

Another suggestion is to provide an incentive grant for the purchase of new buses, which contributes toward the increased cost of a 2007 bus (further discussions are necessary to determine whether this would be a grant evenly distributed among districts or preference given to communities with older school buses or high ambient air pollution).

D. Other Clean Diesel Recommendations

- **Clean Fuel**

The availability of ultra low sulfur diesel fuel has been raised as a potential problem. There are currently no shortages in the supply of ULSD in the State of Connecticut. Once a school bus has been retrofitted with any kind of sulfur-intolerant emissions control technology, availability of ULSD is imperative. Back-up buses should be available in the event that ULSD supply becomes an issue or equipment emission control equipment malfunctions. A contract age exemption for back-up buses is a cost-effective suggestion for districts to retain some older buses in the fleet, for this purpose. Strict annual mileage limits would be required for back-up designation.

- **Anti-Idling**

In the continued anti-idling efforts of the State of Connecticut DEP, it is a recommendation of the school bus subcommittee to continue outreach and education. Outreach and education must be deployed to community members and parents of children that ride school buses, school bus drivers and maintainers in order to overcome urban legends stalling anti-idling efforts. Anti-idling practices must take place in bus yards just as they do on school grounds.

One recommendation to achieve this is to place a sticker in the school bus cabin or on the school bus reminding the school bus drivers and operators of anti-idling measures. Sticker distribution can be incorporated at the time of registration of the school bus. Approval process will need to occur in order to place anything on a school bus.

Newer school bus engine technology makes it possible for a bus to operate properly with a shorter warm up time. As the fleet turnover process occurs, replacement of an older bus with a newer bus will assist anti-idling efforts.

- **Inspection and Maintenance**

School buses undergo annual safety inspections prior to registration for operation in a forthcoming school year. Previous efforts to establish an inspection and maintenance program for school buses have been futile. One recommendation is to incorporate emissions testing into the annual safety inspection. Emissions testing of school buses would require a statutory change to Section 14-164c of Connecticut General Statutes. If DMV inspectors were to conduct emissions testing, the only testing that can be done is an opacity test, since it is the only equipment that can be easily transported onto a fleet site by an inspector. The other option is for fleets to establish a self-inspection program and inspectors to verify that such an inspection has taken place. Section 14-164i-10 of the Regulations of Connecticut State Agencies provides information about the "Licensed dealer and repairer diesel emission inspection program". Adoption of such a program by the school bus fleet in the State of Connecticut will have great benefits in the reduction of PM emissions.

- **Post Retrofit Testing**

Another issue raised is the lack of post-retrofit emissions testing and temperature data logging. It needs to be confirmed that retrofitted buses are experiencing the expected emission reductions. Where the retrofit involved installation of a DPF, inspection of filter availability is possible. Temperature data logging would assure that the buses are meeting temperatures required for the filters to work properly. Currently other states in the Northeast have programs to assure the proper operation of retrofit equipment. New Jersey DEP conducts post-retrofit testing of retrofitted equipment in the state. New York conducts annual inspections to assure proper function of retrofit equipment. In New York equipment not meeting the specified emission reduction levels are subject to a fine that ranges between $1,000 and $10,000.

- **Funding**

DEP remains committed to working with school districts to develop proposals for federal funding. Over the past several years the availability of federal funding has increased rapidly. If Congress appropriates federal funding at the levels authorized under the Diesel Emissions Reduction Act, a significant amount of funding will be available to states. Connecticut has pursued these opportunities very aggressively and should continue to develop viable diesel reduction proposals that can be submitted for future funding opportunities.

IV. Conclusions

Concluding statement on how to move forward with the recommendations and options presented above.

Attachment A

Senate Bill No. 920

Special Act No. 05-7

AN ACT ESTABLISHING A CONNECTICUT CLEAN DIESEL PLAN.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Section 1. (*Effective from passage*) (a) The Commissioner of Environmental Protection shall, in accordance with the provisions of this section, develop a Connecticut diesel emission reduction strategy.

(b) The Connecticut diesel emission reduction strategy shall recommend programs, policies and legislation for achieving reductions of diesel particulate matter consistent with reduction targets for diesel particulate matter indicated in the Connecticut Climate Change Action Plan 2005. The strategy shall provide the following:

(1) A description of the sources of diesel particulate matter emissions in the state and recommendations for maximizing diesel particulate matter emission reductions from identified sources;

(2) An implementation strategy, and an estimate regarding the cost and benefits to the state or municipalities of implementing such strategy, to reduce, not later than December 31, 2010, the level of diesel particulate matter emissions from motor buses, as defined in section 14-1 of the general statutes, that are publicly owned and funded, have an engine model year of 2006 or older, and are not less than twenty-nine feet in length, by (A) retrofitting the engines of such motor buses with diesel particulate filters in order to achieve a reduction of diesel particulate matter by not less than eighty-five per cent, or (B) using alternative fuels or alternative engine technology in order to achieve a reduction of diesel particulate matter by not less than eighty-five per cent;

(3) An implementation strategy, and an estimate regarding the cost and benefits to the state or municipalities of implementing such strategy, to maximize, not later than December 31, 2010, diesel particulate matter emission reductions from school buses and to prevent by said date diesel particulate matter engine emissions from entering the passenger cabin of the buses;

(4) An implementation strategy, to be phased in not later than July 1, 2006, on projects valued at more than five million dollars, to maximize particulate matter emissions reductions from construction

equipment servicing state construction projects, and an estimate regarding the cost and benefits to the state or municipalities of implementing such strategy;

(5) Recommendations for technical assistance resources to be developed by the commissioner to support the implementation of diesel particulate matter reduction strategies by municipalities and other diesel fleet owners and operators;

(6) A strategy for securing and leveraging federal funds and funds from other sources to defray the costs of meeting the goals set forth in subdivisions (1) to (5), inclusive, of this subsection; and

(7) Recommendations for programs and policies to raise awareness about the health risks and climate impacts associated with diesel particulate matter pollution and the solutions available for reducing emissions of diesel particulate matter.

(c) In developing the report, the commissioner shall make draft recommendations available to the public on an Internet web site, provide opportunity for public comment, at times and locations to maximize public participation, and provide a forum for ongoing written public comment on the strategy.

(d) Not later than January 15, 2006, the commissioner shall submit, in accordance with the provisions of section 11-4a of the general statutes, a report containing the strategy to the joint standing committee of the General Assembly having cognizance of matters relating to the environment, and recommendations for legislation to implement such strategy. The strategy shall contain an addendum of all public comments received by the commissioner. The commissioner shall post a copy of the strategy and the addendum on an Internet web site.

Approved June 24, 2005

Attachment B

MEMO

To: School Bus Subcommittee
From: Madeleine Weil, Environment Northeast
Date: September 27, 2005
Re: School Bus Options Menu

Contents

Introduction

More than 387,000 children ride the bus to school each day in Connecticut. The length of time spent on buses varies from 20 minutes per day to several hours. A child with a 30 minute trip to and from school each day spends 180 hours on a school bus each school year. Cumulatively, Connecticut school children spend more than 50 million hours on school buses each year, (EHHI, Children's Exposure to Diesel Exhaust on School Buses).

Beginning with MY2007, federal law requires that all new school buses will come equipped with diesel particulate filters and closed crankcase ventilation systems, and will meet an OEM PM emission standard of 0.01 g/bhp-hr. This is the most stringent level of protection from emissions possible with today's diesel technology, comparing favorably even with alternative fuels like compressed natural gas.

Over time, Connecticut's school bus fleet will become cleaner as older school buses are phased out and replaced by buses compliant with the MY2007 emission standard. Typically, Connecticut school buses are less than 10 years old, with older outliers in less affluent districts such as Hartford. The Hartford school bus fleet, for instance, currently includes buses up to 14 years old (MY1991). Given these trends, under a business-as-usual scenario, it will be 2012-2014 before the majority of Connecticut school children are protected from diesel pollution to

the full extent possible with today's technology. Children in districts with older buses may not be protected until 2020 or after.

A large body of scientific and medical research has conclusively demonstrated that a) diesel pollution causes serious health problems, b) children are exposed to high levels of diesel pollution on school buses, and c) children are particularly susceptible to health impacts from diesel pollution. With these things in mind, the CT Legislature passed Special Act 05-7, instructing the DEP to develop a diesel emission reduction strategy. The Act specifies that the strategy must contain:

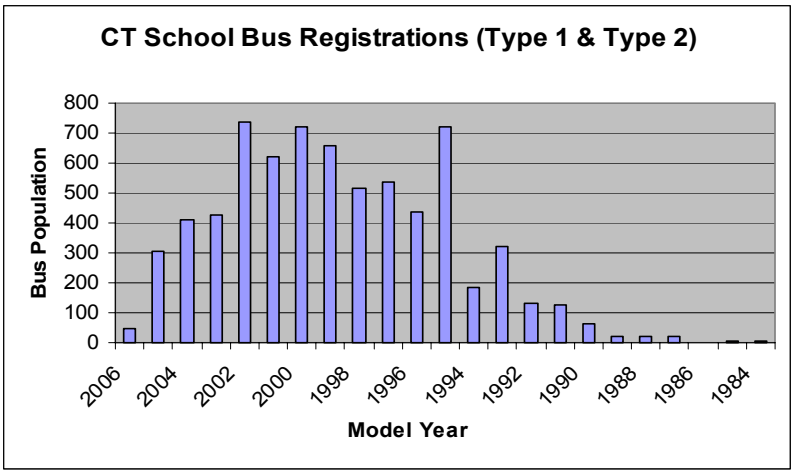
"An implementation strategy, and an estimate regarding the cost and benefits to the state or municipalities of implementing such strategy, to maximize, not later than December 31, 2010, diesel particulate matter emission reductions from school buses and to prevent by said date diesel particulate matter engine emissions from entering the passenger cabin of the buses;"

This Act essentially speeds up the timeframe for achieving the PM reductions that would eventually happen through a business-as-usual fleet turnover schedule under EPA regulations, essentially ensuring that by 2010, all Connecticut school buses will have stringent pollution control technology.

Connecticut's School Bus Fleet

Currently, 5486 Type 1 (full size) and 1544 Type 2 (half-size) school buses are registered to transport students in Connecticut according to the Connecticut Department of Motor Vehicles. All of the Type 1 buses and approximately 35% (535) of the Type 2 buses use diesel fuel. 90% are owned by private bus companies and contracted out for student transport by school districts and the remainder are owned by municipalities or school districts. The Connecticut School Transportation Industry Association has 92 member bus companies that do business in the state of Connecticut (including municipal members).

The age profile for the Connecticut school bus fleet is below (Source: CT DMV, July 2005):



Scope of School Bus Clean Up

Under a business-as-usual scenario, assuming that the age of the Connecticut school bus fleet remains constant, by 2010, approximately 1,924 buses will have been replaced by MY2007 or newer engines. Approximately 5106 buses will remain in the fleet with pre-2007 emission standards. Of that number, approximately 1100 are Type 2 (half-size) buses. These smaller buses are not addressed directly in this options menu. If past trends hold true, by 2010, an estimated 4000 Type 1 buses will require active clean up.

Current School Bus Registrations (Ariel Garcia, CTDEP)

Model Year	Quantity
2006	47
2005	306
2004	410
2003	426
2002	735
2001	621
2000	719
1999	656
1998	515
1997	537
1996	439
1995	719
1994	183
1993	321
1992	132
1991	127
1990	64
1989	22
1988	21
1987	22
1986	2
1985	3
1984	3

Option #1: New York City School Bus Law

Summary
NYC Local Law No. 428-A requires the use of ultra low sulfur diesel fuel and best available retrofit technology for all pre-2007 school buses.

Timing - ULSD
(1) Beginning July 1, 2006, any diesel fuel-powered school bus that is operated by a person who fuels such school bus at any facility at which **ultra low sulfur diesel fuel** is available, or of which such person has the exclusive use and control, or at which such person has the ability to specify the fuel to be made available, shall be powered by ultra low sulfur diesel fuel;
(2) Beginning September 1, 2006, any diesel fuel-powered school bus to which paragraph one of this subdivision does not apply shall be powered by ultra low sulfur diesel fuel.

Timing - BART
Diesel fuel-powered school buses shall utilize the best available retrofit technology in accordance with the following schedule:
i. 50% of school buses used to fulfill each school bus contract by September 1, 2006;
ii. 100% of school buses used to fulfill each school bus contract by September 1, 2007.

BART Definition
"Best available retrofit technology" means technology, verified by the United States environmental protection agency or the California air resources board, for reducing the emission of pollutants that achieves reductions in particulate matter emissions at the highest classification level for diesel emission control strategies, as set forth in **subdivision e** of this section, that is applicable to the particular engine and application. Such technology shall also, at a reasonable cost, achieve the greatest reduction in emissions of nitrogen oxides at such particulate matter reduction level and shall in no event result in a net increase in the emissions of either particulate matter or nitrogen oxides.

BART Determinations
The commissioner shall make determinations, and shall publish a list containing such determinations, as to the best available retrofit technology to be used for each type of diesel fuel-powered school bus to which this section applies. Each such determination shall be reviewed and revised, as needed, on a regular basis, but in no event less often than once every six months.

Subdivision E: BART Classifications
The classification levels for diesel emission control strategies are as follows, with Level 4 being the highest classification level:

i. Level 4 – reduces tailpipe diesel particulate matter emissions by 85 percent or greater or reduces engine emissions to less than or equal to 0.01 grams diesel particulate matter per brake horsepower-hour;
ii. Level 3 – reduces tailpipe diesel particulate matter emissions by between 50 and 84%;
iii. Level 2 – reduces tailpipe diesel particulate matter emissions by between 25 and 49%;
iv. Level 1 – reduces tailpipe diesel particulate matter emissions by between 20 and 24%.

Option #2: Significant emission reductions for all CT school buses, and preventing crankcase emissions from entering the cabins of school buses.

Summary

- By no later than September 1, 2010, all school buses that transport children in Connecticut may be no more than 10 years old. Unless extended, this provision could sunset in 2017 (when all CT school buses will meet 2007 emission standards).
- By no later than September 1, 2010, 100% of Type 1 school buses serving a Connecticut school district must:
    1. Have an engine model year of 2007 or newer; OR
    2. Be retrofit with a CARB/EPA-verified emissions control device certified to reduce PM emissions by at least 25% and a closed crank-case ventilation system; OR
    3. Use an alternative fuel that achieves equivalent or greater PM benefits to option (b) above, or use in combination with options (a) or (b) above.

Minimum Compliance Scenario

This scenario assumes that of approximately 5500 Type 1 buses in Connecticut:

- Approximately 1200 will have turned over to MY2007 or newer engines by 2010 through business-as-usual turnover schedule;
- 4300 will have to be actively cleaned up. This is a conservative estimate, including a 300 bus cushion beyond expectations from past trends to account for potential variation due to the anticipated additional cost of buses meeting MY2007 emission requirements, (see Introduction).

Alternative routes to compliance (with additional emission reduction benefits) include early replacement of school buses with MY2007 or later engines, or retrofitting engines with more sophisticated tailpipe emission control equipment such as a catalyzed wire mesh filter or a diesel particulate filter.

Minimum compliance cost/benefit scenario

Diesel oxidation catalysts + closed-crankcase filters on all 4300 buses
Cost[26] = $1,200 per bus * 4300 buses = $5,160,000
Benefit = 35% tailpipe PM reductions

[26] Cost of DOC + Spiracle Kit for 2004 New Haven School Bus Retrofit Project, (Source: Tracy Babbidge, CTDEP)

Annual Avoided Emissions[27] = 5 tons tailpipe + virtual elimination of crankcase emissions (in-cabin PM2.5)

Implementation

Questions for discussion:

- How would this policy be integrated in to the school bus contracting process?
  - Build requirements into bid specification?
  - Change orders?
  - Which party is responsible for assuring compliance, school district or contractor?
- How the above decisions influence costs and implementation schedule?
- How are costs covered?
  - Absorbed by school districts and bus contractors through contracting process and market competition?
  - Full or part reimbursement from state fund? State matching funds to encourage local investment?
  - Other incentives?

Reporting and Compliance

Under current law, school buses have to register annually with the Connecticut Department of Motor Vehicles, and prior to each school year, each bus must undergo a mandatory safety inspection. We recommend amending the reporting requirements associated with the proposed program to the existing registration requirements. School districts would provide the DMV with documentation of compliance (including engine model, model year, and type of retrofit, date installed, etc.) as a supplemental to the currently-required registration paperwork. Furthermore, the mandatory annual safety inspection would be supplemented by an emissions compliance inspection.

Enforcement

The policy should provide for some form of enforcement provision to compel districts and school bus owners/operators to comply in a timely manner. One example that Connecticut could consider is New York City law which imposes civil penalties on school bus operators or owners who violate the requirements. In New York, owner/operators are liable for a civil penalty between $1,000 and $10,000 in addition to twice the amount of money saved by their failure to comply. An additional civil penalty of $20,000 must be paid in the event that an owner or operator has made a false claim.

Option #2.1: Priority Communities Provision

Summary

- Implement "Best Available Emissions Control" in priority communities, where children are already at risk from elevated levels of PM2.5, as determined by the CT DEP.

[27] Calculated using emission rates in NESCAUM analysis of projected emission reductions for 2004 New Haven School Bus Retrofit Project

- This option is proposed as a supplementary component of Option #2.

Creating incentives for Best Available Emission Control (BAEC)
"Best Available Emissions Control" for school buses results in closed crankcase ventilation and a particulate matter emissions rate of 0.01 g/bhp-hr, the original engine manufacturer (OEM) emissions standard for all new, on-road, heavy-duty diesel engines beginning with MY2007. Retrofitting pre-2007 school bus engines with diesel particulate filters and closed crankcase ventilation systems also results in this standard being met. Using an alternative fuel such as natural gas could also achieve this standard.

Justification
Some Connecticut communities have high levels of ambient air pollution and high incidence of childhood respiratory impacts. For these communities, a higher standard of school bus emission control can and should be sought. A supplemental incentive program should be established to cover some or all of the incremental costs of achieving BAEC in school districts of designated "Priority Communities." This additional incentive would provide support to school districts in priority communities for procuring buses with MY2007 or newer engines, or purchasing/installing diesel particulate filters with closed crankcase ventilation systems. Compared to a minimum compliance scenario (35% PM reductions), BAEC would yield at least 85% PM reductions. These additional benefits would accrue directly to children in overburdened communities, who are particularly vulnerable to the harmful effects of diesel particulate matter.

Implementation
Model contract language for procuring BAEC buses should be designed by DEP and the Department of Administrative Services (DAS). DEP and DAS staff should provide outreach and assistance to designated priority communities so that each is prepared to submit an alternate bid for BAEC buses, in addition to a business-as-usual bid. The increment of cost between the regular bid price and the BAEC bid price could be reimbursed in part or in full through a state incentive program. The school districts should be responsible for providing documentation of school bus procurement, including the business-as-usual bid price and the BAEC price. For school districts that own their own school buses, a model bid specification for purchasing MY2007-compliant buses or BAEC retrofits should be developed and disseminated. Documentation of bid price should be provided to DEP. Provisions for preventing price inflation should be established.

Identification of "Priority Communities"
The Department of Environmental Protection should be responsible for identifying "Priority Communities." In its proposal for school bus retrofit funding from the VEPCO settlement in 2003, the CTDEP utilized statewide air-monitoring data to prioritize school districts based on the overall quality of local air. From CTDEP's 2003 VEPCO plan (http://www.dep.state.ct.us/air2/diesel/docs/vep.pdf):

> "While the emission reduction goals from diesel school bus retrofit projects are focused on reducing the localized exposure risks of school

> children being transported by school buses, the health of children may already be at risk in areas that have elevated levels of particulate matter and ozone pollution. In certain areas of the State, the existing regional air quality can present respiratory and other health problems for children. Priority has been given to districts that are located in areas that face the most serious regional air pollution concerns and would benefit from diesel reduction strategies."

The following Connecticut communities are highlighted in the DEP's plan because they have 3-year annual average particulate concentrations of greater[28] than 12 ug/m^3: Bridgeport, Danbury, Hartford, New Haven, Norwalk, Stamford, Waterbury, Westport. Connecticut's urban areas are disproportionately overburdened by a variety of sources of environmental pollution. Residents tend, on the whole, to suffer disproportionate health impacts associated with pollution (such as asthma). The VEPCO plan also cites methods for prioritizing communities through an environmental justice screen, including identifying "distressed cities" as designated by the DEP's Environmental Equity Program, and "high need urban area" as designated by the Department of Education.

Option #3: Average fleet-age requirement with alternative compliance through emissions reductions

(a) Phase-out of oldest bus engines. Beginning January 1, 2006, no public school district in Connecticut shall enter into a contract for any Type 1 bus with an engine model year older than X years. Beginning September 1, 2010, no public school district shall transport school children in any Type 1 school bus with an engine model year older than X years.

(b) Mitigate crank-case emissions. In order to minimize seepage of emissions into the cabin, all buses must have closed crankcase ventilation systems installed. The terms of this subsection shall apply to all public school buses operated in Connecticut by September 1, 2008.

(c) Phase-in of younger buses. Beginning September 1, 2006, no public school district in Connecticut shall contract for a school bus fleet with an average engine emissions age for full-sized school buses of greater than four years. By September 1, 2010, the average engine emissions age for full-sized school bus fleets operated or contracted by public school districts in Connecticut, based on engine model year, shall be no greater than four years old. Buses with an engine model year that is the same year in which a calculation is being made shall be counted as zero years old. Buses of MY 2007 or later shall be counted as zero years old. The engine emissions age for all other buses shall be counted in whole numbers by subtracting the model year of the bus engine from year in which the calculation is being made.

[28] 12 ug/m^3 is the level to which EPA staff scientists have recommended lowering the federal annual standard for PM2.5 to adequately protect public health. The State of California adopted this standard in 2002 based on extensive review of health-based scientific literature.

(d) Alternative compliance.

a. A bus engine retrofit with an emission control device or using an alternative fuel verified by CARB/EPA to achieve Level 3 PM reductions (≥85%) shall be counted as zero years old;
b. A bus engine retrofit with an emission control device or using an alternative fuel verified by CARB/EPA to achieve Level 2 PM reductions (≥50%) shall be counted as two years old;
a. A bus engine retrofit with an emission control device or using an alternative fuel verified by CARB/EPA to achieve Level 1 PM reductions (≥25%) shall be counted as four years old;

(e) Reporting and Conditions of Registration.

(1) The Department of Motor Vehicles shall establish reporting forms and procedures for public school districts of Connecticut to record their annual progress in complying with the provisions of this section, including information regarding the model year, crank case emissions mitigation system, or alternative compliance system relevant to each Type 1 bus. Reports shall be submitted to the Department of Motor Vehicles with the Student Transportation Vehicle Inspection Report no later than August 31 of each year. The Department of Motor Vehicles shall also provide an annual report to the Department of Environmental Protection no later than December 31, 2006 and each December 31 thereafter on progress in reducing emissions from public school buses until there are no longer any Type 1 school buses older than model year 2007 operating in the state or in the year 20XX, whichever comes first.

(2) The Department of Motor Vehicles shall not re-register any in-use Type 1 school bus that:

A. is not accounted for in a school district's progress report, or
B. is part of a school bus fleet that has failed to demonstrate full compliance with any provision of this section.

(3) Any inconsistencies found during an inspection between actual state of the vehicle and the information contained in the annual progress report regarding the model year, crank case emission mitigation system, or alternative compliance system shall constitute an infraction and prohibit the issuance of an inspection sticker.

(f) Sunset. The requirements of sub-sections (c) and (d) of this section shall expire when there are no longer any Type 1 school buses older than model year 2007 operating in the state or in the year 20XX, whichever comes first.

Attachment C

MEMO

To: CT Department of Environmental Protection
From: Environment Northeast, Clean Water Action, Connecticut Coalition for Environmental Justice, Connecticut Fund for the Environment
Date: November 10, 2005
Re: School Bus Emissions Reduction Straw Proposal

Through Special Act 05-7, the Connecticut General Assembly directed the Connecticut Department of Environmental Protection to develop a diesel emission reduction plan containing:

"An implementation strategy, and an estimate regarding the cost and benefits to the state or municipalities of implementing such strategy, to maximize, not later than December 31, 2010, diesel particulate matter emission reductions from school buses and to prevent by said date diesel particulate matter engine emissions from entering the passenger cabin of the buses;"

To this end, we offer the following policy recommendation to the CT DEP for consideration.

Proposed Policy Summary:

- Establish a minimum "floor" level of emission reductions for all full-sized school buses operating in Connecticut; and
- Create incentives for school districts to go beyond required minimum emission reductions by introducing newer, cleaner engines, advanced diesel retrofit technology, or cleaner fuels.

Element #1 – Requirements[29]:

- By September 1, 2007, no school bus with an engine model year 1993 or older may be used to transport school children in Connecticut;
- By September 1, 2008, all front-engine school bus engines of model year 2006 or older must be retrofit with a closed crankcase filtration system;
- By September 1, 2010, all full-sized school buses transporting children in Connecticut must either:
  - Be equipped with a Level 1, Level 2, or Level 3[30] CARB/EPA verified emission control technology; OR

[29] Requirements presume that by late 2006, all on-road diesel fuel will be ULSD (per federal law).

- Be equipped with an engine from MY2007 or newer; OR
- Use an alternative fuel verified by CARB/EPA to reduce particulate matter (PM) emissions by at least 25% (equivalent to a Level 1 emission control technology).
- School districts and school bus owners must permit existing contracts to be re-opened to negotiate compliance with requirements.

Element #2 – Implementation and Outreach:
CT DEP and CT DAS develop state procurement contracts for a) the purchase of new buses compliant with MY2007 emission standards, b) tailpipe emission control retrofits, and c) closed crankcase filtration systems.

  - Contracts must be available to municipalities and private school bus operators, provided they can demonstrate that the affected school bus is/will be in service in Connecticut;
  - Contracts must be available through CT DAS's e-Procurement website, in a category that clearly identifies the product to municipalities and private school bus operators;
  - At least one contract must be developed for each CARB emission control device verification level: Level 1, Level 2, and Level 3;
  - At least one contract must be developed for a closed crankcase filtration system.
- CT DEP and CT DAS develop an outreach plan and materials for educating school districts and bus companies about the new requirements and paths to compliance.

Element #3 – Financing and Incentives:

- Effective immediately, the state offers a sales tax on new bus purchases up to $4,000 per bus, but only for model years 2007-2010, natural gas or diesel. Waiver sunsets September 1, 2010;
- Effective immediately, for school bus model years 1994-2005, the state provides incentive to school bus owners for the purchase and installation of closed crankcase filtration system (CCFS) retrofit device. The per-unit incentive shall not exceed $250. Incentive sunsets September 1, 2008.
- Effective immediately, for school bus model years 1994-2005 only, the state provides incentive to school bus owners for the purchase and installation of any CARB/EPA-verified emission control retrofit device. In 2006-2007, the per-unit incentive shall not exceed $1000 for a Level 1 device, $2000 for a Level 2 device, and $3000 for a Level 3 device. Incentive levels may be re-evaluated annually, with the goal of maintaining competition in the market for retrofit devices. Incentives sunset September 1, 2010.
- To receive incentive from the state, school bus owners must submit a form to the authorized state agency containing the bus model and year, engine model and year, VIN number, receipt for the retrofit device, and date installed for every

[30] California Air Resources Board, Diesel Emission Control Strategies Verification: Level 1 ≥ 25% reduction PM, Level 2 ≥ 50% reduction PM, Level 3 ≥ 85% reduction PM.

eligible bus. Bus owners must also certify that newly purchased or retrofitted buses will operate in the state of Connecticut for a minimum of four years.
- Potential incentive funding streams may include but are not limited to tax credits, appropriations, and Special Transportation Fund revenues and should be available to both private and public school bus owners.

Element #4 – Reporting, Compliance, and Enforcement:
- Reporting requirements should be amended as a supplemental to existing annual registration requirements due to CT DMV prior to each school year. Documentation of compliance should include bus model and year, engine model and year, type of retrofit, date installed, date and amount of state rebate received. For school buses complying with the use of a clean fuel (at least Level 1 CARB/EPA-verified) documentation must include clean fuel receipts (each delivery);
- Supplement mandatory annual safety inspection with emission control compliance inspection;
- Establish civil penalties for non-compliance and additional penalties for making false claims. Penalty money should be directed into a CT Diesel Risk Mitigation Fund.

Element #5 – Priority Community Provision:
- When penalty funds, state SEP funds, federal funds, or funds from other state or non-state sources become available, these should be first allocated toward further offsetting costs of achieving "best available" emissions control in "priority communities."
    - The "best available" standard is attained by all new buses (MY2007 and newer) and by diesel buses retrofit with Level 3-verified diesel particulate filters and closed crankcase filtration systems. A clean alternative fuel (such as natural gas) could also achieve this standard;
    - "Priority communities" (to be identified by the CT DEP) are CT communities that have high levels of ambient air pollution and high incidence of childhood respiratory impacts.

Estimated Potential Costs and Benefits to State:
- Costs/Benefits depend on the compliance decisions made. The following chart outlines 6 potential scenarios, with varying selection rates of the lowest cost and lowest benefit option (Level 1 DOC + CCFS retrofit) and the highest cost and highest benefit option (new bus, MY2007 and beyond). Costs and benefits of actual implementation scenarios that may include Level 2 and Level 3 retrofit selections will fall within the range below. Assumptions:
    - 5500 full-sized diesel school buses[31]

[31] DMV inventory, provided by Ariel Garcia, DEP (9/7/05).

- Average annual bus mileage = 18,000 miles[32]
- Cost to state of Diesel Oxidation Catalyst (DOC) incentive = $1000
- Cost to state of Closed Crankcase Filtration System (CCFS) incentive = $250
- Cost to state of New Bus incentive = $4000 (lost state sales tax revenue)
- Uncontrolled bus PM emission rate = 0.17 g/mi[33]
- Bus with DOC + CCFS retrofit PM emission rate = 0.1105 g/mi (35% reduction)
- New bus, MY2007 and beyond, emission rate = 0.017 g/mi (90% reduction)

	L1 retrofit (DOC/CCFS) selection	New bus selection	DOC Cost	CCFS Cost	New Bus Cost	**Total Program Cost**	**Annual PM Benefit (tons/year)**
Scenario 1	100%	0%	$5,500,000	$1,375,000	$0	**$6,875,000**	**6.49**
Scenario 2	80%	20%	$4,400,000	$1,100,000	$4,400,000	**$9,900,000**	**8.53**
Scenario 3	60%	40%	$3,300,000	$825,000	$8,800,000	**$12,925,000**	**10.57**
Scenario 4	40%	60%	$2,200,000	$550,000	$13,200,000	**$15,950,000**	**12.62**
Scenario 5	20%	80%	$1,100,000	$275,000	$17,600,000	**$18,975,000**	**14.66**
Scenario 6	0%	100%	$0	$0	$22,000,000	**$22,000,000**	**16.7**

- The primary beneficiaries of this projected 6.49-16.7 ton annual PM reduction would be school children and bus drivers. Several studies have found that fine particulate matter levels inside school buses is significantly higher than outside (5-10 times higher). Cumulatively, Connecticut children spend more than 50 million hours on school buses per year. Expected benefits included avoided health impacts, avoided health care costs, and avoided school absences. [34]

[32] COSTA, *Safety Gram*, (http://www.epa.gov/ne/eco/diesel/assets/pdfs/costa_safetygram.pdf). States average daily mileage for Connecticut school buses = about 100 miles. 100 miles per day * 180 school days per year = 18,000 miles per year. This may underestimate total annual mileage because it does not include summer-time travel.

[33] 0.17 g/mi is the EPA Mobile6 emission factor for 1994 school bus. EPA staff is currently reviewing the accuracy of this emission factor – they believe it underestimates emissions. In NESCAUM's "School Bus Emission Reductions" analysis, prepared for New Haven school bus retrofits in Dec. 2002, an emission factor of 0.25 g/mi was used. The more conservative number was selected for this analysis. Using the 0.25 g/mi factor would increase benefits to 9.55 tons (Scenario 1) to 24.55 tons (Scenario 6).

[34] EHHI, *Children's Exposure to Diesel Exhaust on School Buses,* 2002, http://www.ehhi.org/reports/diesel/, CATF, *A Multi-City Investigation of the Effectiveness of Retrofit Emissions Controls in Reducing Exposures to Particulate Matter in School Buses,* 2005, http://www.catf.us/publications/view/82, also CARB (2003), NRDC (2001).

Attachment D

CASBO SCHOOL BUS CONTRACT SURVEY

11/14/2005

District Name:	Contact Name:	# Buses in Fleet	Term of current contract?	Expiration Date (MM/YYYY):	Does your contract include a renegotiation clause.	Plans to update your fleet?	Provide Language from existing contract:	Briefly explain plans to update:
Ansonia	John Crist	15	5	Jun-10		No		
Bethel	Jay Hubelbank	22	5	Jun-09	No	Yes		12 year age limit.
Bolton	Chris Chemerka							
Branford	Tashie Rosen	34	5	Jun-10		No		
Bridgeport	Laidlaw	108 Type I, 70 Type II	5	Jun-10		No		Bridgeport has contract language that requires the 'greenest' technology available for new vehicles.
Bristol	William Smyth	104	5	Jun-09	No	Yes		Annual upgrade of 5 buses per year. Our oldest vehicle is 1996 vintage and most vehicles are 2000 vintage and up.
C.E.S.	Jim Carroll	25	3	Jun-08		No		
Canton	Tom Sullivan							
Cornwall	Sam Herrick	5	5	Jun-06	No	Yes		10yr age limit, may put averageage limit in future contracts.
Cromwell	Rick Mandeville	14	4	Jun-07	Yes		Several section exist	New contract will require new(er) busses
East Granby	Eve Spencer	9	5	Jun-10	No	Yes		The contract states that average age of bus can be no more than five years with no single bus older than ten years
East Haddam	Robert Carroll	13	5	Jun-09		No		Throughout the term of the contract, no bus shall be more than 10 yrs old.
East Hampton	Kevin M. Reich	21	5	Jun-10	Yes	No	This contract shall be effective from July 1,2005 to June 30 , 2010,unless terminated in accordance with the provisions of the contract.In the third year of the contract the Board will vote to consider a new four year agreement commencing July 1 ,2008.the	

CASBO SCHOOL BUS CONTRACT SURVEY

11/14/2005

District Name:	Contact Name:	# Buses in Fleet	Term of current contract?	Expiration Date (MM/YYYY):	Does your contract include a renegotiation clause.	Plans to update your fleet?	Provide Language from existing contract:	Briefly explain plans to update:
East Lyme	Don Meltabarger	22	5	Jun-08	Yes		Term of Contract: In addition, the board may extend contract beyond expiration date between contractor and Board upon mutual agreement	
East Windsor	Timothy Howes	15	3	Jun-06	No	No		
Education CT	Bert Hughes	60			Yes	No		
Granby	H. Traver	27	2 of 5	Jun-07	Yes			
Guilford	Andy Potochney	31	5	Jun-05	No			
Litchfield	Peg Perusse	14	5	Jun-08	Yes	No	This Agreement may be amended or modified at any time by mutual written agreement, which shall be signed by the duly authorized representatives of the Board and the contractor. Any such written amendment shall be attached.	
Madison	Arthur Sickle	47	5	Jun-09	Yes	Yes		Our contract requires a maximum average age of the fleet to be no older than 7 years old, with no single bus older than 10 years old.
Manchester	Patricia F. Brooks							
Mansfield	Jeff Smith	16	1	Jun-06		No		We have an average age in contract which means buses get purchased each year
Meriden	Corinne Eisenstein	58 Type I, 20 Type II	3 years with two one year options to renew	Jun-07		No		
Milford	Philip G. Russell	60	5	Jul-10	Yes		5 year contract period.	

CASBO SCHOOL BUS CONTRACT SURVEY

11/14/2005

District Name:	Contact Name:	# Buses in Fleet	Term of current contract?	Expiration Date (MM/YYYY):	Does your contract include a renegotiation clause.	Plans to update your fleet?	Provide Language from existing contract:	Briefly explain plans to update:
Monroe	Steven R DeVaux	30	5	Jun-10	Yes	No		
Monroe	Steven R DeVaux	33	5	Jun-10	Yes			
New Canaan	M. Lagas	60	5	Jun-07	Yes	Yes		More emission control equipment on vendor-provided vehicles
New Fairfield	Theresa Yonsky	21 large, 5 vans	4	Jun-06	No	Yes		Contract bids this year, some newer buses will be expected to be added to the fleet.
New Milford	T. Corbett	47	5 Years	Jun-08		Yes		Prior to the end of our contract we will be developing specifications for a new contract. Our existing fleet is 8 yrs old so we will be looking to update equipment.
North Stonington	Charles McCarthy	18	5	Sep-09	No	Yes		The new contract requires the bus company to replace a specified number of buses each year until the entire fleet is replaced.
Norwich	M. Picard							
Old Saybrook	M & J Bus Co.	12	5	Jun-05	Yes	Yes	Reopener: A successor contract may be negotiated in the 5th year of this current contract.	12 year age llimit.
Oxford	Richard E. Carmelich III	18	5	Jun-07	No	No		
Plymouth	Gerry Perusse	16	last year 2 year option	Jun-06	Yes			

CASBO SCHOOL BUS CONTRACT SURVEY

11/14/2005

District Name:	Contact Name:	# Buses in Fleet	Term of current contract?	Expiration Date (MM/YYYY):	Does your contract include a renegotiation clause.	Plans to update your fleet?	Provide Language from existing contract:	Briefly explain plans to update:
Putnam	Nancy T Cole	17	n/a own fleet	n/a				Buses are included in the town capital improvement plan; 2 each year
Region #10	Dave Lenihan	25	5	Jun-08		No		The contract calls for buses over 7 years old to be replaced
Region #4	Steve Spires	14	5	Jun-06	No	No		
Region #8	Bill Mazzara	18	5	Jun-08		No		
Regional #12	Bob Giesen	27	5	Jun-09	No	No		
Regional # 6	Jerry Domanico	11	5	Jun-09	No	Yes		Contract stipulates that: 'Contractor will add two new Type I vehicles and retire the two oldest Type I vehicles each subsequent year for the life on the contract.'
Regional #16	William Stowell	25	5	Jun-10		No		
Regional #18	Marilyn M. Warren	18	5	Jun-10		No	Basically it states that change orders have to be agreed to by both parties.	
Ridgefield	Gary Green	55	7	Jun-10		No		
Rocky Hill	Gregory Turansky	11	5	Jul-08	No	No		
Salem	Kim Gadaree	9	5	Jun-06	No	No		
Shelton	Al Cameron	54	5	Jun-08	No	Yes		Our last contract allowed the fleet operator to keep low milage vehicles up to 10 years on the road. Next contract we will require an all new fleet.
Simsbury	David P. Holden	30	5	Jun-10	No	Yes		Based upon attractiveness financially, we would retrofit buses. DEP needs to provide financial incentive.

CASBO SCHOOL BUS CONTRACT SURVEY

11/14/2005

District Name:	Contact Name:	# Buses in Fleet	Term of current contract?	Expiration Date (MM/YYYY):	Does your contract include a renegotiation clause.	Plans to update your fleet?	Provide Language from existing contract:	Briefly explain plans to update:
Somers	Bill Boutwell	15	6	Jun-07	Yes		The terms of this agreement may be modified in whole or in part by mutual agreement of both parties. Any such change shall be reduced to writing and signed by authorized representatives of both parties.	
Southington	Sherri DiNello	56	5	Jun-09	No	Yes		We require that buses used in our district are no more than 7 years old. So the contractor continues to purchase new buses.
Stafford	Jill Gregori	34	5	Jun-10	Yes	Yes	Previous to the opening of the new elementary school, either party may reopen the contract for the pur	Contract language: Vehicles will be no older than ten (10) yers at the beginning of each school year. The average age of the fleet utilized in any given contract year will not exceed seven (7) years at the beginning of each school year.
Suffield	Ed Basile	21	5	Jun-08	No	No		
Tolland	Jane A Regina	28	5	Jun-09		No		
Wethersfield	Karen Clancy	18	5	Jun-08	Yes	No	The contractor and the Board agree to negotiate the cost of any additional equipment that the Board may require that is not covered by laws, rules, regulations, policies and standards of the federal government, the State of Connecticut.	
Wethersfield	Gary Miller, Int Bus. Mgr.							
Windham	Jeff Nelson	26	5	Jun-09	No	No		
Windsor	S. Grobard	60	5	Jun-06	No	Yes		Our contract states buses must be no older than 10 years. the contractor purchases 10- 15 new buses each year.

Attachment E

Regulations of Connecticut State Agencies

Section 22a-174-18. Control of particulate matter and visible emissions.

EFFECTIVE APRIL 1, 2004

(b) Visible emission standards.

(1) Stationary sources without opacity CEM equipment. Except as provided in subsection (j) of this section, an owner or operator of any stationary source without opacity CEM equipment for which opacity is measured using visual observation shall not exceed the following visible emissions limits:
   (A) Twenty percent (20%) opacity during any six-minute block average as measured by 40 CFR 60, Appendix A, Reference Method 9; or
   (B) Forty percent (40%) opacity as measured by 40 CFR 60, Appendix A, Reference Method 9, reduced to a one-minute block average.

(2) Stationary sources with opacity CEM equipment. Except as provided in subsection (j) of this section, an owner or operator of a stationary source for which opacity is measured using opacity CEM equipment shall not exceed the following visible emissions limits:
   (A) Twenty percent (20%) opacity during any six-minute block average; or
   (B) Forty percent (40%) opacity during any one-minute block average.

(3) Mobile sources. Except as provided in subsection (j) of this section, no person shall cause or allow:
   (A) Any visible emissions from a gasoline powered mobile source for longer than five (5) consecutive seconds;
   (B) Visible emissions from a diesel powered mobile source of a shade or density equal to or darker than twenty percent (20%) opacity for more than ten (10) consecutive seconds, during which time the maximum shade or density shall be no darker than forty percent (40%) opacity; or
   (C) A mobile source to operate for more than three (3) consecutive minutes when such mobile source is not in motion, except as follows:
      (i) When a mobile source is forced to remain motionless because of traffic conditions or mechanical difficulties over which the operator has no control,
      (ii) When it is necessary to operate defrosting, heating or cooling equipment to ensure the safety or health of the driver or passengers,
      (iii) When it is necessary to operate auxiliary equipment that is located in or on the mobile source to accomplish the intended use of the mobile source,
      (iv) To bring the mobile source to the manufacturer's recommended operating temperature,
      (v) When the outdoor temperature is below twenty degrees Fahrenheit (20 degrees F),
      (vi) When the mobile source is undergoing maintenance that requires such mobile source be operated for more than three (3) consecutive minutes, or
      (vii) When a mobile source is in queue to be inspected by U.S. military personnel prior to gaining access to a U.S. military installation.