School Bus Pollution Report Card 2006

Grading the States

Union of Concerned Scientists

Citizens and Scientists for Environmental Solutions

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Union of Concerned Scientists
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Patricia Monahan is a senior analyst in the Union of Concerned Scientists Clean Vehicles Program.

The Union of Concerned Scientists is a nonprofit partnership of scientists and citizens combining rigorous scientific analysis, innovative policy development, and effective citizen advocacy to achieve practical environmental solutions.

The Union of Concerned Scientists Clean Vehicles Program develops and promotes strategies to reduce the adverse environmental impact of the U.S. transportation system.

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This report represents a compilation of hundreds of interviews with school bus transportation directors, state environmental agencies, the U.S. Environmental Protection Agency (EPA), state and local nonprofit organizations, and researchers at the California Air Resources Board (CARB).

I would particularly like to acknowledge the contribution of the state directors of pupil transportation, who are not only charged with providing safe and reliable transportation for students, but now also face the added challenge of reducing school bus pollution. These officials willingly provided data on the composition of their fleets and activities to reduce pollution. Our goal in publishing this report is to support their mission by highlighting the need for increased funding for school bus replacements and retrofits.

I would also like to acknowledge the contributions of many state environmental departments and EPA regional offices whose staff willingly shared data they have collected on school bus retrofit and clean-fuel activities. Many dedicated individuals are engaged in state activities to reduce school bus pollution, and we applaud their efforts.

Several individuals from the EPA and CARB deserve special acknowledgment. At the EPA, Megan Beardsley provided technical assistance on emission factors, and Jennifer Keller and Trish Koman reviewed and commented on our draft report. At CARB, Ben Hancock, Renee Marshall, and Dilip Patel provided helpful assistance on emission factors for particulates from school buses and tractor-trailer trucks.

Here at the Union of Concerned Scientists, I am grateful to Jennifer Boynton for her invaluable assistance with data collection, analysis and summaries of in-bus pollution studies, and report editing. I am also indebted to Jason Mark for his technical assistance with data analysis and moral support throughout the process. Thanks also to Eli Hopson and Michelle Robinson for their helpful comments, Bryan Wadsworth for his copyediting, and David Gerratt for his design and layout.

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Preface

AUTHOR: John Froines, Ph.D.
Director, Southern California Particle Center

Today, we have a better scientific understanding than ever before of the harmful impacts of air pollution on children's health. Compared with adults, children may have heightened sensitivity to air pollution due to physiological differences and higher activity levels. Their developing physiology has a limited range of defense mechanisms that can protect against harmful exposures.

Air pollution has been shown to cause deficits in lung growth similar to that from secondhand cigarette smoke exposure. Children in communities where air pollution levels are high suffer from respiratory symptoms, asthma exacerbations, and asthma hospitalizations due to air pollution, even when breathing air that meets current air quality standards. New research indicates that air pollution may actually cause asthma in otherwise healthy children.

There is growing evidence that tiny particles in vehicle exhaust are harmful. The closer you are to a major roadway, the greater your exposure to these particles. Diesel exhaust contains small particles, vapors, and other toxic contaminants that can be inhaled and produce a range of health effects. Recent studies also indicate that children may face elevated exposures to diesel exhaust while riding buses to and from school. In our studies we have seen the greatest toxic potency (including inflammatory responses) from the small particles associated with diesel exhaust exposures. Exposure to diesel particles appears to play a role in respiratory and allergic diseases, and may have long-term chronic effects.

There is a compelling need to reduce children's exposure to air pollution. We also need to ensure that current air quality standards are sufficiently protective of children and other vulnerable populations. Cleaner air will help all of us breathe easier and improve our health.

Dr. Froines is a professor at the University of California, Los Angeles (UCLA) School of Public Health, and is the principal investigator of the Southern California Particle Center. The center's research program characterizes airborne particulate matter formation and composition in the Los Angeles air basin and conducts investigations on the impact and mechanism of health effects from particle exposure. Of particular importance to the center are particles emitted from mobile sources, which constitute by far the major source of air pollution in the Los Angeles basin.

Executive Summary

School buses are the safest form of transportation for children. Compared with cars or transit buses, school buses are involved in significantly fewer accidents, injuries, and fatalities. However, the pollution from older school buses may pose risks to children's health that tarnish the image of the familiar yellow school bus.

The exhaust from diesel fuel, which powers about 95 percent of the more than 505,000 school buses on U.S. roads today, is linked with asthma, heart disease, cancer, and even premature death. Recent studies have found that pollution can concentrate inside school buses, leading to even higher exposures for children who ride buses. Luckily, today's cleaner fuels and pollution controls for diesel vehicles can dramatically cut pollution from school buses. Many states have made progress in reducing pollution, but we are still a long way from ensuring that our children are riding in "clean" school buses.

SCHOOL BUSES AND CHILDREN'S HEALTH

School buses release particulate matter (soot), toxic air contaminants, and smog-forming pollution from the tailpipe and leaky crankcases. While all of today's school buses pollute, conventional diesel buses—particularly older models—release anywhere from 10 to more than 100 times as much soot as cleaner alternatives available today.

Fine soot particles can evade the body's normal defense mechanisms and lodge deep within the lungs. These particles have been shown to cause or exacerbate serious respiratory and cardiovascular illnesses, even leading to premature death in adults. Diesel exhaust can also contain more than 40 toxic air contaminants, including many known or suspected cancer-causing substances. Along with increased cancer risk, these toxic air contaminants are linked with immune system disorders and reproductive problems. And because particulate matter and toxic air contaminants can remain in the general vicinity of the emission source, children in or near high-emitting school buses are exposed to more of these pollutants.

Children may be more vulnerable than adults to the harmful effects of air pollution. They breathe more rapidly, taking in more air (and pollution) per unit of body weight, and their developing bodies do not have the full range of defense mechanisms that can protect against harmful exposures. Our polluted air has unfortunately provided researchers with ample evidence that children's health is harmed by exposure to air pollution; recent studies have linked current levels of air pollution with deficits in lung growth, asthma exacerbations and hospitalizations, and even the possible development of asthma in healthy children.

GRADING STATE FLEETS

Across the country, the pollution performance of state school buses varies widely depending on fleet age, fuel choice, and investments in retrofits and cleaner fuels. This report analyzes the amount of pollution released from the average state school bus. Each state received a letter grade (A B, C, or D) for estimated tailpipe emissions of soot, which warrants the most concern because of its potential to cause toxic "hot spots"—areas of higher exposure for children in or near buses. The emission performance of a diesel bus equipped with a diesel particulate filter (DPF, or "soot trap") established the baseline for our highest grade (A), which no states came close to achieving. We distributed the remaining grades on a curve.

We also evaluated state performance in two secondary categories: school bus cleanup programs and tailpipe emissions of smog-forming pollution. In comparing cleanup programs, we calculated the percent of school bus soot reduced through pollution control retrofits and use of cleaner fuels such as natural gas and biodiesel, and assigned each state a rank of Good, Above Average, Average, or Poor. States that failed to conduct any cleanup activities received a score of Incomplete. We also calculated smog-forming tailpipe emissions from the average state school bus and used a curve to assign each state a rank of Above Average, Average, or Poor. See Table 1 (p. 6) for state scores in each category.

Our key findings are:

- **School buses are some of the oldest vehicles on the road.** The average school bus is nine years old and emits nearly twice as much pollution per mile as a tractor-trailer truck (or "big rig").[1] Thirty-seven percent of U.S. school buses are more than a decade old, and 1 in 12 do not have to meet any soot pollution standards.
- **Pollution performance varies widely across the country.** The average school buses in the states with the dirtiest fleets, South Carolina and South Dakota, emit nearly three times more soot than the average bus in Delaware, which has the cleanest fleet. Only Alaska, Connecticut, Maine, Nevada, and New York scored above the national average in all three categories we evaluated.
- **Clean school bus programs have made significant strides.** Nationally, soot pollution from school buses has been reduced more than two percent through local, state, and federal actions. Most of these cleanup actions have occurred in the last three years. California and Washington State lead the country in cleanup programs, with school bus soot reduced more than seven percent through retrofits and cleaner fuels. Thirteen other states scored above the national average, with active cleanup programs reducing school bus soot between 2.5 and 7 percent.
- **Many states are ignoring the problem of school bus pollution.** Nine states and the District of Columbia did not appear to have taken any action to clean up school buses in 2005. Thirteen states have small programs achieving less than a one percent reduction in school bus soot.
- **All states need to increase investments in cleaner buses.** The average bus in the cleanest state fleet emitted 20 percent more soot per mile than the average big rig, and emissions could be reduced by a factor of 10 using technologies and fuels available today. Even the states receiving our highest marks for school bus cleanup programs continue to have high-emitting buses, with Washington receiving a D and California a C for soot pollution.

1 The California Air Resources Board (2006a) supplied the average per-mile emissions of a big rig in California. We applied CARB's fuel correction factor (California Air Resources Board n.d.) to estimate national average emissions from a big rig.

- **Replacing the oldest school buses and retrofitting more recent models will require substantial investment by states and the federal government.** Equipping all school buses built after 1993 with particulate traps and closed crankcase filtration controls would cost approximately $2.6 billion.[2] Replacing all buses built before 1994 with new low-emission buses would cost approximately $13.4 billion.[3]

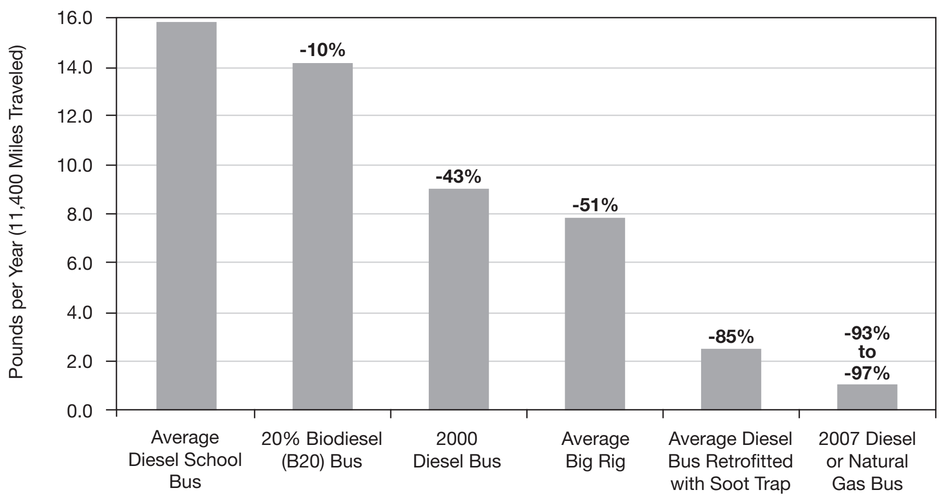
- **Concerned parents should not take their children off of school buses.** Buses are still the safest way to transport children to school. Parents should work with school administrators to explore pollution control retrofits, cleaner fuels, and bus replacement.

CLEANUP STRATEGIES

A variety of retrofit and cleaner-fuel technologies are available today and expected tomorrow for reducing pollution from school buses (Figure 1). These technologies play a key role in the cleanup strategies we refer to as "the five Rs:" retrofitting, refueling, replacement, repair, and reduced idling.

- **Retrofitting.** Diesel pollution control technologies are evolving rapidly and have the potential to cut toxic soot from the tailpipe 85 percent or more while also reducing on-board pollution (i.e., soot that enters the bus). The most effective tailpipe control is the particulate trap, but even advanced tailpipe controls need to be supplemented with effective crankcase filtration controls to protect

Figure 1 **Potential Annual Reduction in Soot Compared with the Average U.S. School Bus**



NOTE:
All model year 2007 and newer buses will probably be equipped with particulate traps in order to meet more stringent tailpipe standards.

SOURCES:
Based on interviews with state officials, we assume school buses travel 11,400 miles per year. Tailpipe emissions of diesel soot are based on emission factors from the California Air Resources Board EMFAC model. We rely on in-use testing data from the U.S. Department of Energy and other sources to estimate soot emissions from buses fueled by natural gas. We only evaluate running losses from the tailpipe and do not consider stops and starts, idling, or crankcase emissions. All emissions occurred in 2005, with the exception of the model year 2007 diesel bus. Additional information on emission calculations is available in the Technical Support Document for this report (available at *www.ucsusa.org*).

2 We assume a passive particulate trap with closed crankcase filtration costs $7,000.

3 We assume a new trap-equipped diesel school bus costs $100,000.

Table 1 **National School Bus Report Card**

State	Soot Pollution Grade	Cleanup Program Rank	Smog-forming Pollution Rank
Alabama	B	Poor	Above Average
Alaska	B	Above Average	Above Average
Arizona	D	Above Average	Poor
Arkansas	D	Poor	Poor
California	C	Good	Poor
Colorado	D	Above Average	Poor
Connecticut	B	Above Average	Above Average
Delaware	B	Incomplete	Above Average
District of Columbia	B	Incomplete	Above Average
Florida	C	Poor	Average
Georgia	C	Above Average	Average
Hawaii	D	Incomplete	Poor
Idaho	C	Incomplete	Average
Illinois	C	Average	Average
Indiana	B	Average	Above Average
Iowa	C	Above Average	Above Average
Kansas	C	Incomplete	Average
Kentucky	C	Poor	Average
Louisiana	D	Incomplete	Poor
Maine	B	Above Average	Above Average
Maryland	B	Poor	Above Average
Massachusetts	B	Average	Above Average
Michigan	C	Poor	Average
Minnesota	D	Average	Poor
Mississippi	C	Average	Poor
Missouri	B	Average	Above Average
Montana	D	Poor	Poor
Nebraska	D	Average	Poor
Nevada	B	Above Average	Above Average
New Hampshire	C	Poor	Average
New Jersey	B	Poor	Above Average
New Mexico	C	Poor	Average
New York	B	Above Average	Above Average
North Carolina	C	Above Average	Average
North Dakota	C	Poor	Poor
Ohio	C	Average	Average

Table 1 **National School Bus Report Card** continued

State	Soot Pollution Grade	Cleanup Program Rank	Smog-forming Pollution Rank
Oklahoma	D	Incomplete	Poor
Oregon	C	Above Average	Average
Pennsylvania	B	Average	Above Average
Rhode Island	C	Average	Average
South Carolina	D	Above Average	Poor
South Dakota	D	Incomplete	Poor
Tennessee	B	Average	Above Average
Texas	C	Above Average	Average
Utah	D	Poor	Poor
Vermont	C	Incomplete	Average
Virginia	C	Average	Average
Washington	D	Good	Poor
West Virginia	C	Poor	Average
Wisconsin	C	Average	Average
Wyoming	B	Incomplete	Above Average

children riding buses. Recent research indicates that leaky crankcases may be a major source of onboard pollution, and closed crankcase filtration controls may be effective in reducing such pollution.

- **Refueling.** Diesel pollution can be reduced by switching to buses using cleaner-burning fuels such as natural gas—the cleanest option commercially available today. A new natural gas bus,[4] for example, releases over 90 percent less soot than a model year 2005 conventional diesel school bus. Biodiesel is starting to be used more widely in school bus fleets across the country. It is often blended with conventional diesel fuel and at low percentages requires no engine modifications. The most common blend is 20 percent biodiesel (B20), which reduces soot emissions about 10 percent and generally requires no vehicle modifications, particularly for newer engines.

- **Replacement.** It should not come as a surprise that the oldest diesel school buses release the highest levels of pollution. Replacing a bus built in 1988 with a trap-equipped diesel bus can reduce soot pollution by 95 percent.

- **Repair.** Emissions gradually increase over the life of an engine. Performing routine maintenance and periodic engine rebuilds can keep an engine cleaner over its lifetime.

4 We assume the natural gas bus is equipped with an oxidation catalyst.

- **Reduced idling.** Idling school buses not only waste fuel and money, but can also unnecessarily expose children to harmful pollution. Many states have voluntary anti-idling measures while others have mandatory policies.

POLICY RECOMMENDATIONS

1. Minimize exposure.

The federal government should set a goal of reducing children's exposure to school bus pollution to the lowest reasonable level. Through the five "Rs," emissions can be reduced 85 percent or more over the next five years. The U.S. Environmental Protection Agency's (EPA) current goal of retrofitting or replacing all school buses by 2010 is an important step, but only provides a fraction of the benefits that current emission control technology can achieve.

2. Increase federal funding.

The EPA, through its enforcement actions and funding initiatives, is responsible for about one of every three school bus cleanup efforts in this country. Its Clean School Bus USA program in particular has been a resounding success, but the program's annual budget remains small—ranging between five million and 7.5 million dollars since its inception in 2003. The average annual investment is roughly equal to the capital cost of 75 new conventional school buses.

These efforts will be complemented by a national Clean School Bus Grant Program established by Congress in 2005 and authorized at $55 million a year for fiscal 2006 and 2007. School buses are also eligible for cleanup under the Diesel Emissions Reduction Act, a comprehensive national cleanup program authorized by Congress at $200 million a year for five years. However, because authorization amounts do not ensure actual funding, it is vital that these programs receive robust budget and appropriations support from both the White House and Congress over the next few years to ensure real progress.

3. Build state programs.

States should follow the models used by California and Washington to reduce school bus pollution. California has reduced its soot pollution nearly nine percent through its Lower-Emission School Bus Program, which has installed particulate traps on more than 10 percent of the state's fleet and retired hundreds of older buses since 2000. In addition, about 1 in 20 school buses on California's roads are powered by natural gas.

Washington has reduced its soot pollution more than seven percent through its Clean Buses, Healthy Kids Retrofit Project, which has retrofitted 38 percent of the state's fleet with diesel oxidation catalysts (DOCs) over the last several years. Washington's ultimate goal is to retrofit every one of its school buses.

4. Improve federal standards.

Children are experiencing health problems related to particulate and ozone pollution even in areas that meet the National Ambient Air Quality Standards. Strengthening these standards is critical to protecting children's health and will provide added incentive for states to reduce soot emissions from all diesel engines.

The current soot standards essentially treat all particles within specific size ranges as equivalent in terms of their potential to harm human health. But recent research indicates that the public health consequences of soot pollution vary with particle size, toxicity, and composition. Further research is needed to evaluate whether mass-based standards are sufficient for protecting public health. Specifically, the EPA should explore whether its tailpipe standards ought to include limits based on particle size, number, and toxicity. In addition, the current certification process for new engines should be supplemented with robust in-use performance tests.

5. Support new technologies.

More research is needed into the sources of pollution inside buses and strategies for reducing children's exposure to it. Additionally, all diesel trucks and buses should be subject to inspection and maintenance programs that will ensure pollution controls remain effective in the real world over the two-, three-, and even four-decade lifetime of the vehicles.

Finally, school buses should, like the most advanced passenger cars and trucks, come equipped with the cutting-edge technologies that will power our future. The welfare of our children should drive investments in school buses that meet 2010 standards today, hybrid and plug-in buses, and (over the long term) pollution-free buses powered by hydrogen fuel cells.

Chapter 1
School Buses and Children's Health

A growing body of evidence suggests children are particularly vulnerable to the harmful effects of air pollution. Recent studies have linked air pollution with deficits in lung growth, asthma exacerbations and hospitalizations, and even the possible development of asthma in healthy children (see American Academy of Pediatrics 2005 for a summary of these studies).

Children riding on school buses or playing near idling buses may be exposed to high levels of fine particles and toxic pollutants. So, while school buses have a stellar safety record—about eight times safer than passenger cars (National Highway Traffic Safety Administration 2002)—the pollution from conventional school buses represents a danger that must be addressed.

THE U.S. SCHOOL BUS FLEET

America's school buses carried more than 25 million children to and from school in 2005, logging about 5.8 billion miles[5] (Table 2). These buses come in all sizes, from vans to mass transit-style buses, accommodating as few as 10 children and as many as 80 or more.[6]

While gasoline used to be the fuel of choice for school buses, most are now powered by diesel. Our state survey found that only five percent of fleets rely on gasoline, with 94 percent of buses powered by diesel.[7] A small but growing share of buses use alternative fuels such as propane and natural gas, and biodiesel is also growing in popularity—nearly two percent of the U.S. fleet relies on B20 (a diesel blend containing 20 percent biodiesel).[8]

Although school buses are only responsible for a small share of total U.S. vehicle emissions, they routinely expose children and communities to hazardous particulate matter (soot), toxic air contaminants, and smog-forming pollutants. On average, a school bus emits nearly twice as much soot per mile as a tractor-trailer truck (or "big rig").[9] School buses are also some of the oldest vehicles on the road: the average U.S. school bus is nine years old, and more than 30 percent are older than 10 years. Cleaning up this "legacy" fleet will require a combination of retirement and sophisticated pollution controls that can simultaneously cut tailpipe emissions and onboard pollution (i.e., soot that enters the bus).

Across the country, states have partnered with the U.S. Environmental Protection Agency (EPA), local school districts, and school bus

5 Twenty-three states, comprising about 36 percent of the nation's school bus fleet, provided annual mileage data. On average, these buses traveled 11,400 miles per year and we assume this reflects the national average.

6 The average school bus has a gross vehicle weight between 19,501 and 33,000 pounds and is considered a "medium heavy-duty vehicle" by the Environmental Protection Agency.

7 Twenty-one states, comprising 40 percent of the nation's school bus fleet, provided fuel choice data. On average, five percent of these buses rely on gasoline. For states that did not provide fuel-use data, we assumed five percent of the fleet runs on gasoline and 95 percent on diesel.

8 Biodiesel is commonly blended with conventional diesel to reduce costs and minimize engine compatibility issues. Blends can vary from one percent biodiesel to 50 percent or more, but the most common blend is 20 percent biodiesel, or B20.

9 The California Air Resources Board (2006a) provided the average per-mile particulate emissions for a "heavy heavy-duty" truck.

Table 2 **The U.S. School Bus Fleet**

Fleet Characteristics	
Total fleet	505,000 buses
Children transported	25.4 million
Fleet mileage	5.8 billion miles per year
Individual bus mileage	11,400 miles per year
Fuel of Choice	
Diesel	94%
Gasoline	5%
Alternative fuels	1%
Average Yearly Emissions (entire fleet)	
Particulate matter (soot)	3,700 tons
Smog-forming pollutants*	101,000 tons
Average Yearly Emissions (per bus)	
Particulate matter (soot)	14.7 pounds
Smog-forming pollutants*	402 pounds
Reduction in Particulate Matter as a Result of:	
Retrofits	1.6%
Biodiesel	0.2%
Alternative fuels	0.4%
Total	**2.2%**

*Smog-forming pollutants include nitrogen oxides (NOx) and non-methane hydrocarbons (NMHC).

SOURCES:
Data on number of buses, age distribution, and fuel choice come from state interviews and R.L. Polk & Company (2005). Number of children transported represents 2003 data from *www.schoolbusfleet.com* (Bobit Business Media n.d.).

Tailpipe emissions of diesel soot are based on emission factors from the California Air Resources Board EMFAC model. We assume gasoline soot emissions are one-tenth the level of diesel soot emissions based on light-duty data. We rely on in-use testing data from the U.S. Department of Energy to estimate soot emissions from buses fueled by natural gas. Tailpipe emissions of smog-forming pollution are based on the EPA's MOBILE6 model. We only evaluate running losses from the tailpipe and do not consider stops and starts, idling, or crankcase emissions. Additional information on emission calculations is available in the Technical Support Document for this report (available at *www.ucsusa.org*).

Table 3 **Size Categories for Particulate Matter**

	Diameter in Microns
PM_{10}	Less than 10
Fine ($PM_{2.5}$)	Less than 2.5
Ultrafine	Less than 0.1
Nanoparticles	Less than 0.05

NOTE:
A human hair is about 70 microns in diameter.

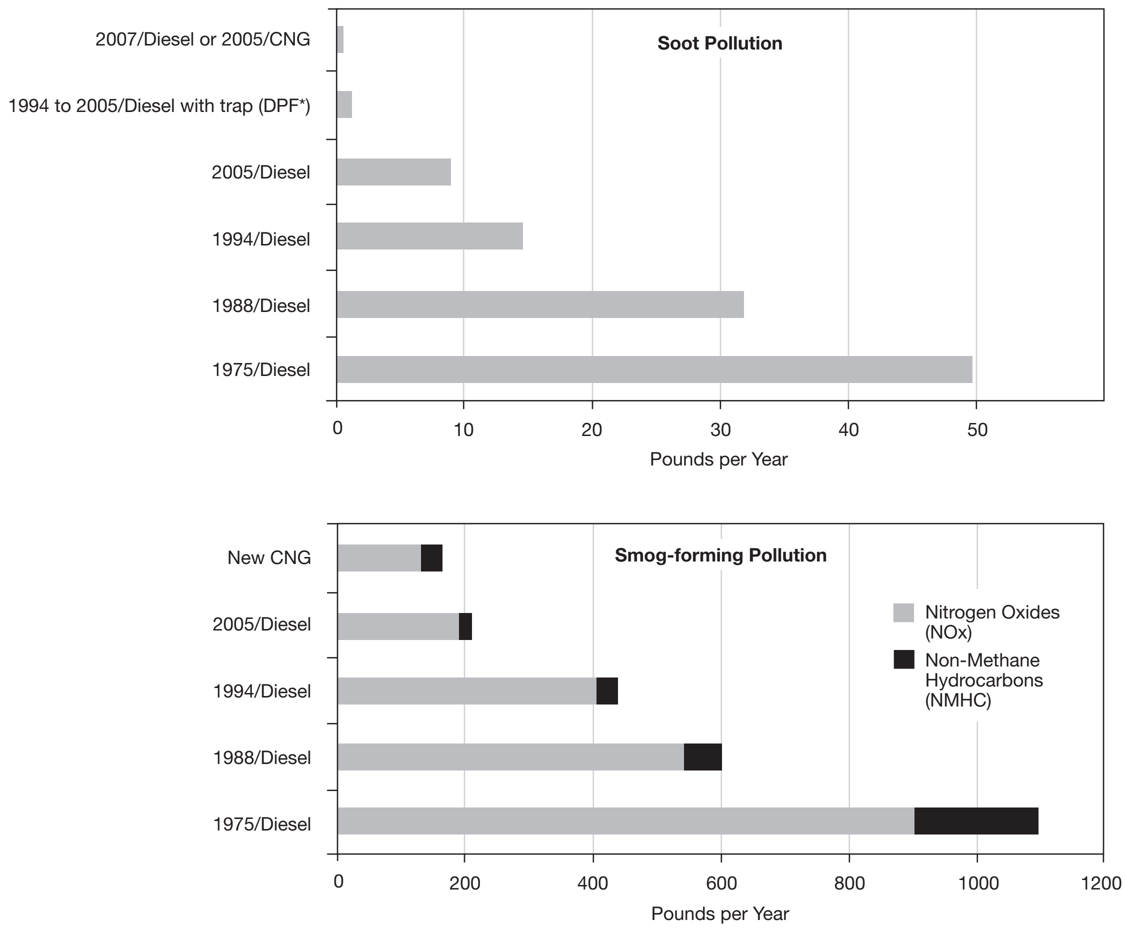
contractors to reduce school bus pollution. Over the last several years, school bus soot emissions have been lowered more than two percent through retrofits and cleaner fuels. Retrofitting school buses with pollution controls has been the key cleanup strategy: the installations of some 6,600 diesel particulate filters (DPFs, or "soot traps") and 18,000 diesel oxidation catalysts (DOCs) have reduced soot pollution 1.6 percent. But we are still a long way from ensuring that our children are traveling on "clean" school buses.

SCHOOL BUS POLLUTION

School buses release soot, toxic air contaminants, and smog-forming pollution. Diesel soot is a complex mix of carbon, sulfate particles, ash, and hydrocarbons (the exact composition varies depending on engine technology, test conditions, and sulfur content of the fuel). Soot particles are released directly from tailpipes and leaky crankcases, or they can form as nitrogen oxides, sulfur oxides, and hydrocarbons react in the atmosphere. Toxic air contaminants can be adsorbed onto these particles, more than 90 percent of which measure less than 2.5 microns in diameter (categorized as "fine" or $PM_{2.5}$; see Table 3)—small enough to be inhaled deep into the lungs. And, in contrast to smog-forming pollutants that disperse across air basins, soot and toxic air contaminants can remain in the general vicinity of the emission source, creating the potential for higher exposure in children riding school buses or playing nearby.

All of today's school buses—whether powered by diesel, gasoline, natural gas, or other alternative fuels—release toxic soot and smog-forming pollutants into the atmosphere. But conventional diesel school buses, particularly older models,

Figure 2 **Average Tailpipe Pollution: Comparing Model Years and Fuels**



*DPF stands for diesel particulate filter. We assume these pollution control retrofit devices are installed on buses from model year 1994 through 2005 and reduce soot emissions by 85 percent.

SOURCES:
We estimate school buses travel 11,400 miles per year, based on interviews with state officials. Tailpipe emissions of diesel soot are based on the California Air Resources Board EMFAC model. Estimated emissions of soot from buses fueled by compressed natural gas are based on in-use testing data from the U.S. Department of Energy. Tailpipe emissions of smog-forming pollution are based on the EPA's MOBILE6 model and California engine certification data. We only evaluate running losses from the tailpipe and do not consider stops and starts, idling, or crankcase emissions. Additional information on emission calculations is available in the Technical Support Document for this report (available at *www.ucsusa.org*).

release higher levels of pollution (Figure 2). A school bus built in 1975 releases up to 100 times more soot than a new bus powered by compressed natural gas (CNG) or a model year 2007 diesel school bus. Replacing a bus built in 1988 with a 2005 diesel bus can reduce soot pollution by 75 percent, and a 2005 trap-equipped diesel school bus can cut soot pollution by 95 percent.

Older buses pollute more than newer vehicles because engine performance degrades over time while tailpipe standards have been strengthened over time (Figure 3). Before 1988, there were no soot standards for diesel buses, but the EPA has recognized the dangers of diesel pollution by passing increasingly stringent emission standards for new diesel trucks and buses. Its 2007 soot standard, for example, will be 10 times more stringent than the current standard and 60 times more stringent than the 1990 standard. By 2010, new trucks and buses will emit 95 percent less smog-forming pollution compared with model year 2006 vehicles. Unfortunately, these cleaner buses will be sharing the road with older diesel buses, which can continue to release high levels of soot and smog-forming pollution.

Exposure to Onboard Pollution

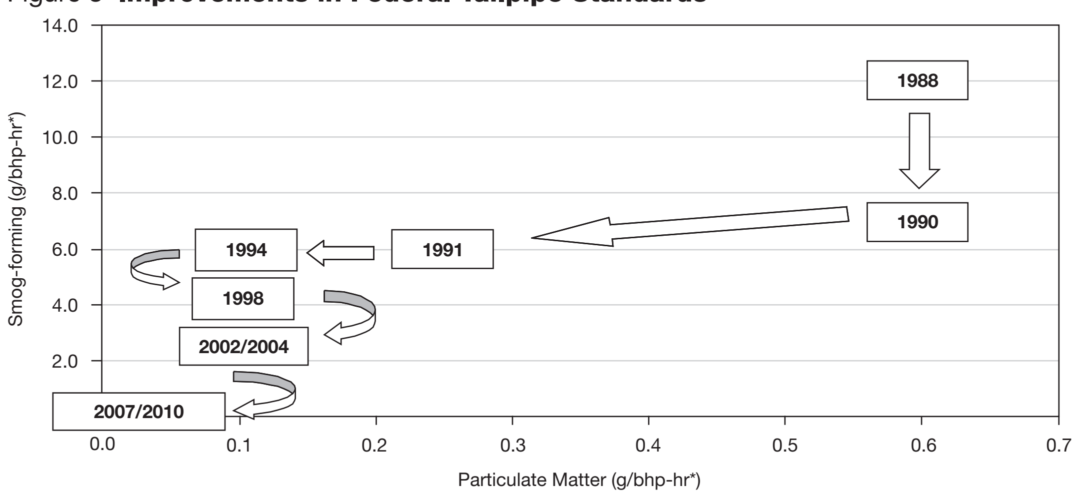
Several recent studies have found that children riding buses to and from school are exposed to high levels of diesel exhaust and soot (Hill et al. 2005; Fitz et al. 2003; Wargo 2002). The studies have also consistently found higher levels of pollution inside buses than in the ambient air.

In one such study, particulate monitors measured children's exposure to soot throughout the school day, including the commute to and from school (Wargo 2002).[10] The study found that children riding buses were exposed to concentrations of fine particles 5 to 15 times higher than in the ambient air.

Another study evaluated the range of children's exposures during school bus commutes in the Los Angeles area (Fitz et al. 2003).[11] The study measured onboard pollution in conventional diesel buses, a trap-equipped bus, and a CNG bus, and compared the results with pollution monitors in the community. On average, the levels of fine particles inside buses were two times higher than in the ambient air. Measured concentrations of air toxics such as polycyclic aromatic hydrocarbons (PAH) averaged five times higher inside buses than in the ambient air.

Most pollutant levels were higher inside the conventional diesel buses than the cleaner versions;

Figure 3 **Improvements in Federal Tailpipe Standards**



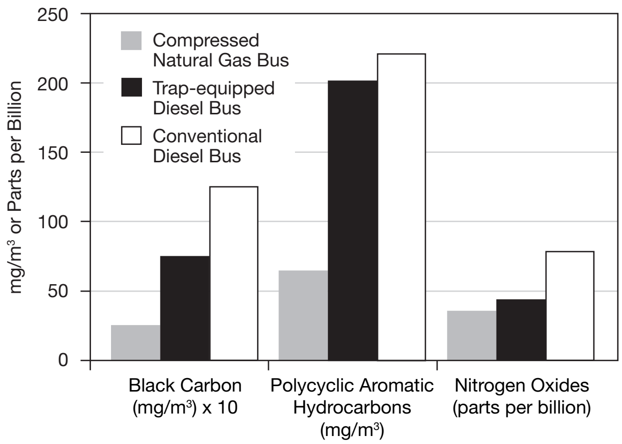
*Emission standards are expressed as grams of pollution per brake horsepower-hour (g/bhp-hr).

NOTES:
These emission standards apply to all heavy-duty diesel vehicles. Smog-forming pollution is composed of non-methane hydrocarbons and nitrogen oxides. Due to a settlement between diesel engine manufacturers, the EPA, and the California Air Resources Board, the 2004 federal standards for smog-forming pollution already applied to most heavy-duty vehicles by late 2002. The final soot standards will take effect by 2007, while the compliance date for the final smog-forming pollutant standards is 2010.

10 Fifteen children wore personal monitors to measure their exposure to $PM_{2.5}$ and PM_{10}. Onboard particulate levels were measured on eight bus runs per day for four days.

11 The study used five conventional diesel buses from model years 1975 to 1993, a model year 1998 diesel bus equipped with a particulate trap, and a model year 2002 CNG bus, and consisted of 36 bus runs in both urban and suburban settings.

Figure 4 **Comparing Onboard Pollution by Fuel (with Windows Closed)**



SOURCE:
Fitz et al. 2003.

the CNG bus had the lowest levels (Figure 4). However, bus-to-bus variations were high and the study sample relatively small, indicating that individual buses may not follow these emission patterns. The greatest exposures for children occurred while they were riding the bus rather than waiting at bus stops or during bus loading and unloading.

In both studies, onboard concentrations of fine particles skyrocketed during brief periods of the testing. Wargo found a maximum $PM_{2.5}$ concentration of more than 200 μg/m^3 and Fitz et al. found a maximum of 227 μg/m^3—three times higher than the EPA's current 24-hour particle standard and about six times higher than the proposed standard of 35 μg/m^3.[12] EPA standards average pollutant concentrations over a 24-hour period, with no maximum limits for short-term spikes.

Based on the results obtained by Fitz et al., the California Air Resources Board (CARB) estimated that children traveling two hours per school day from kindergarten through high school experience a five percent increase in lifetime cancer risk (California Air Resources Board 2003).

Sources of Onboard Pollution

Pollution inside a school bus can come from the bus itself ("self-pollution"), other vehicles on the road, and background concentrations of natural and human-produced pollution. Self-pollution is generally the result of emissions from tailpipes and leaky crankcases entering through doors, windows, and cracks in the vehicle body.

One study found that the crankcase may be the dominant source of fine particulate pollution on buses (Hill et al. 2005). In the diesel buses evaluated, crankcase exhaust vented near the front door of the bus and contained an extremely high concentration of $PM_{2.5}$ (12,000 μg/m^3). When the researchers installed closed crankcase filtration controls on the bus, the fine particle mass fell to ambient conditions.[13]

Particulate levels in buses vary with window position (open or closed), traffic conditions, weather, engine condition, and, most notably, vehicle age. From the limited research available, closing windows or using older and high-emitting buses generally results in higher amounts of onboard pollution (Hill et al. 2005; Fitz et al. 2003).[14] Traveling in high-traffic areas with other diesel-powered vehicles also tends to increase onboard pollution, while high winds disperse particles, leading to lower onboard pollution. The limited number of onboard tests and the variability in results from bus to bus call for increased research to better evaluate the sources of onboard

12 Average exposures to $PM_{2.5}$ in Wargo (2002) ranged from 10 to 40 μg/m^3 (including time away from the bus), and in Fitz et al. (2003), average concentrations of $PM_{2.5}$ ranged from 15 to 127 μg/m^3.

13 The closed crankcase filter did not affect the levels of black carbon, PAH, or "ultrafine" particulate matter.

14 In the study by Fitz et al., opening the windows on the CNG bus resulted in slightly higher onboard levels of black carbon, PAH, and nitrogen dioxide.

pollution and develop the most effective mitigation strategies.

AIR POLLUTION AND CHILDREN'S HEALTH

Compared with adults, children may have heightened sensitivity to air pollution due to physiological differences, higher activity levels, and greater exposure to outdoor pollution (American Academy of Pediatrics 2005; Wiley et al. 2001; Thurston 2000). Their developing bodies do not have the full range of defense mechanisms that can protect against harmful exposures; they breathe more rapidly than adults, taking in more air and pollutants per unit of body weight; and they often play outdoors where air pollution levels are higher. While playing certain sports, children may take up to 17 times more air into their lungs than they do when resting.

Our polluted air has unfortunately provided researchers with ample evidence that human health is harmed by exposure to air pollution, especially soot, ozone, and air toxics. Studies of adult populations have linked particulate matter with premature death (Pope et al. 1995; Dockery et al. 1993), but research has only recently begun to focus on children. These recent studies evaluated lung function growth and asthma incidences and hospitalizations in children breathing polluted air.

The Impact of Ozone and Soot

A study of more than 3,000 school-age children in Southern California found that those living in polluted areas experienced a decrease in lung function growth of three to five percent compared with children living in less-polluted areas (Gauderman et al. 2000). This reduction in lung function growth is more than four times that experienced by children exposed to secondhand cigarette smoke, suggesting that young lungs may be more likely to suffer permanent damage from exposure to air pollution. A follow-up study found that by the age of 18, subjects living in polluted areas were five times more likely to experience deficits in lung function growth than were young adults living in cleaner areas (Gauderman 2004).

Many studies have linked air pollution with an increase in asthma symptoms and hospitalizations (Gauderman 2005; Gent et al. 2003; Tolbert et al. 2000). Now there is evidence that air pollution may actually cause asthma in otherwise healthy children (McConnell et al. 2002). Researchers recruited more than 3,500 children with no history of asthma and tracked new cases over a five-year period. The study found that children playing three or more sports in high-ozone areas developed asthma at a rate three to four times higher than children living in less-polluted areas.

According to the Centers for Disease Control and Prevention (CDC 2005), 12 percent of U.S. children suffer from asthma, making it the leading chronic illness for this population. Nine million children under the age of 18 have been diagnosed with asthma and more than four million children experienced an asthma attack in the last 12 months. The CDC also found that children in poor families were more likely to be diagnosed with asthma, and non-Hispanic African-American children had the highest asthma rates.

A study of the economic costs of asthma in children found that children with asthma incurred 2.8 times more health care expenditures than children without asthma (Lozano et al. 1999). In addition, asthmatic children were more than twice as likely to visit the emergency room and 3.5 times more likely to be hospitalized.

The Impact of Toxic Air Contaminants

While soot and ozone can cause immediate health problems, air toxics are more likely to cause subtle cellular damage or disrupt cellular communication in ways that may take years for

Table 4 **Toxic Air Contaminants in Diesel Exhaust**

acetaldehyde	hexane
acrolein	inorganic lead
aniline	manganese compounds
antimony compounds	mercury compounds
arsenic	methanol
benzene	methyl ethyl ketone
beryllium compounds	naphthalene
biphenyl	nickel
bis[2-ehtylhexyl]phthalate	4-nitrobiphenyl
1,3-butadiene	phenol
cadmium	phosphorus
chlorine	POM, including PAHs
chlorobenzene	and their derivatives
chromium compounds	propionaldehyde
cobalt compounds	selenium compounds
cresol isomers	styrene
cyanide compounds	toluene
dioxins and dibenzofurans	xylene isomers and mixtures
dibutylphthalate	o-xylenes
ethyl benzene	m-xylenes
formaldehyde	p-xylenes

SOURCE:
California Air Resources Board 1998.

the damage to become apparent. The effects of air toxics on children's health are not well established, but in adults, the toxic components of diesel exhaust have been linked with increased cancer risk, serious immune system disorders, and reproductive problems. The California Air Resources Board has identified diesel exhaust, as well as more than 40 of its constituents, as toxic air contaminants (Table 4).

Findings from more than 30 epidemiological studies show that people who are routinely exposed to diesel exhaust through their work on railroads, docks, trucks, or buses have a 40 percent greater risk of lung cancer than people in other occupations (California Air Resources Board 1998). Based on these studies, CARB has estimated that diesel exhaust is responsible for 70 percent of the state's airborne cancer risk from toxic pollution. This translates to 540 additional cancers per million people exposed to current outdoor levels of diesel pollution over a 70-year lifetime. A similar analysis of the U.S. population estimated that diesel pollution could cause 350 additional cancers per million people—350 times the level considered acceptable by the EPA (Clean Air Task Force 2005).

The composition of diesel exhaust has changed over time, and it is not clear whether soot emitted by new diesel vehicles poses the same risk as soot emitted by older diesel engines. More research into the current composition of diesel exhaust is needed to accurately assess the toxicity of soot from both older engines and engines meeting the new tailpipe standards taking effect between 2007 and 2010.

Do Federal Standards Fail to Protect Children?

The EPA is responsible for setting emission standards for toxic air contaminants, but has yet to establish requirements for air toxics emitted by vehicles.[15] This is particularly troubling in light of the EPA's recently issued National Air Toxics Assessment, which estimated the cancer risk from 133 toxic air pollutants to be 42 times the one-in-a-million risk the agency considers safe. According to the assessment, "diesel exhaust is among the substances that the national-scale assessment

15 The EPA has the authority to establish emission standards for new vehicles and to set specific requirements for rebuilt engines, but its authority to require retrofits is unclear.

suggests pose the greatest relative risk" (U.S. Environmental Protection Agency 2006a).

The EPA is also responsible for establishing National Ambient Air Quality Standards for ozone and soot. The goal of these standards is to protect public health (including children's health) regardless of the costs of attainment.[16] However, in 2005 the EPA proposed lowering its standard for the daily average of $PM_{2.5}$ from 65 $\mu g/m^3$ to 35 $\mu g/m^3$—despite the consensus among the medical, scientific, and public health communities that the proposed standard would not sufficiently protect public health. The EPA's proposal disregarded recommendations by its own Clean Air Scientific Advisory Committee (U.S. Environmental Protection Agency 2005a) and Children's Health Protection Advisory Committee (U.S. Environmental Protection Agency 2005b).

Investigators have found increased coughing and bronchitis and decreased lung function in children living where long-term fine particle concentrations met the current standard (Gauderman et al. 2004; McConnell et al. 2002). Even concentrations below the current standard have been associated with premature death from heart and lung disease in adults (Pope et al. 2002; Krewski et al. 2000). In fact, studies have shown increased health risks down to the lowest levels investigated, suggesting that an annual average standard of 12 $\mu g/m^3$ (like the one adopted by California in 2002) or below is warranted.

Current soot standards essentially treat all particles within specific size ranges as equivalent in terms of their potential ability to affect public health. But recent research indicates that the consequences of soot pollution vary with particle size, toxicity, and composition. Fine and ultrafine particles, for example, are small enough to penetrate deep into the lungs, while larger particles are more easily trapped by the body's respiratory defenses. Several European studies indicate that decreases in lung function are more closely associated with particle number and size than mass.[17] More research is therefore needed to evaluate whether mass-based standards adequately protect public health.

CONCLUSION

School buses contribute a small fraction of this country's total pollution from cars, trucks, and buses, but they may be a significant source of particulate exposure for children. And for those children who ride on buses every school day, the exact level of particulate exposure can make a world of difference. Each dirty bus means one busload of children facing increased risks of asthma, cancer, and other significant health problems.

16 The current standards for ozone and soot were established in 1997, but legal challenges by the U.S. Chamber of Commerce, the American Trucking Association, and other business groups put the standards on hold for seven years. The U.S. Supreme Court upheld the standards in 2004, and they are finally being implemented.

17 According to the EPA's draft criteria for soot pollution (U.S. Environmental Protection Agency 2004).

Chapter 2
Grading State Fleets

The pollution performance of state school buses varies widely depending on fleet age, fuel choice, and investments in retrofits and cleaner fuels. This report analyzes the amount of pollution released from the average state school bus.[18] Each state received a letter grade (A, B, C, or D) for modeled tailpipe soot pollution; we also evaluated tailpipe emissions of smog-forming pollution and state programs for cleaning up school buses, assigning each state a rank of Good, Above Average, Average, or Poor for its performance in these secondary categories.

DATA COLLECTION AND EVALUATION

We contacted each state's director of pupil transportation to collect information on the age distribution and fuel choice of the state's school bus fleet. If the director was not responsible for maintaining this information, we contacted the agency responsible for overseeing school bus safety (such as the state police) or for collecting vehicle information (such as the transportation department).

Thirty states and the District of Columbia provided data on the age distribution of their school buses.[19] Some of the states only had data on buses transporting public school students, while other states also included data for private schools. Where we could not locate reliable state data, we used a national database prepared by R.L. Polk (2005) that culled model year data from each state's motor vehicles department. In addition, we contacted state environmental agencies to discuss ongoing or planned school bus cleanup programs, and often spoke with local agencies and schools to gather project-specific data. For a list of data sources, see the appendix.

Fuel Choice and Annual Mileage

Twenty-three states, comprising about 36 percent of the nation's school bus fleet, provided annual mileage data. These buses traveled an average of 11,400 miles per year—15 percent higher than the value in the EPA's MOBILE6 vehicle emission model. We assume the higher value reported by states represents the national average.

Twenty-one states, comprising 40 percent of the nation's school bus fleet, provided fuel choice data. On average, five percent of the fleet in these states is powered by gasoline, so, for states that did not provide fuel-use data, we assume five percent of the fleet is gasoline and 95 percent is diesel.[20] This assumption is supported anecdotally by many state directors of transportation.

Calculating Emissions

We evaluated the pollution performance of school buses for both soot and smog-forming nitrogen oxides (NOx) and non-methane hydrocarbons

18 This report card for state school bus fleets is based on the format of an analysis we conducted four years ago. We have since modified several key variables to reflect an improved understanding of fleet composition (including fuel choice), annual miles traveled, and tailpipe emission factors for diesel and gasoline school buses. We have also changed our grading criteria to focus primarily on soot pollution and children's health, and have expanded our analysis to include state programs for reducing soot through retrofits and cleaner fuels. As a result of these updated assumptions and grading criteria, it is not possible to compare a state's performance in our original analysis with the grades presented in this report.

19 New Hampshire provided data on microfiche, but we were unable to extract the model year information.

20 In our original *Pollution Report Card*, we relied largely on data from R.L. Polk to estimate that diesel buses comprised about 85 percent of the U.S. fleet.

(NMHC). To calculate total emissions, we first evaluated base emissions, then accounted for reductions from retrofits and cleaner fuels. A basic description of our evaluation is described below; for more details, consult the Technical Support Document for this report (available at *www.ucsusa.org*).

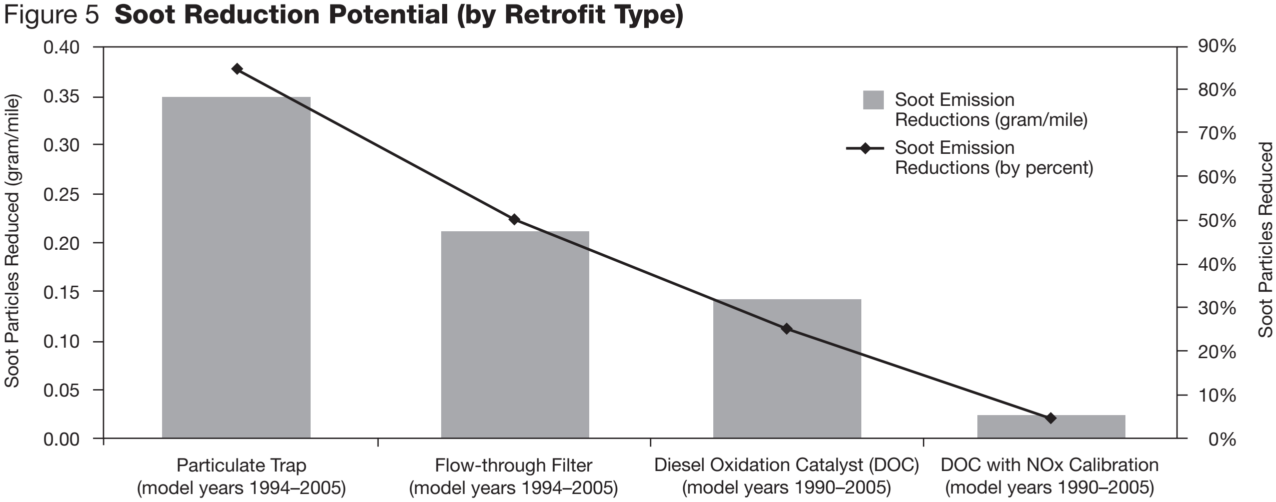
Base emissions. For each state, we compiled an inventory of diesel, gasoline, and alternative-fuel school buses by model year. We integrated this inventory with emission factors for soot particles and smog-forming pollutants to calculate base emissions. We do not include stop and start, idling, or tire emissions in our analysis.

To evaluate soot pollution, we used tailpipe emission factors for diesel school buses based on the medium-duty emission factors used in CARB's EMFAC model (which relies on chassis dynamometer data for more than 70 trucks following an urban driving schedule). EMFAC also incorporates deterioration factors that account for the effects of tampering and poor vehicle maintenance. For gasoline school buses, we estimate particle emissions to be one-tenth that of their diesel counterparts, based on the light-duty vehicle emission gap between the fuels. Older diesel cars, for instance, emit 10 to 40 times more soot than their gasoline counterparts (UCS analysis of data from Knapp et al. 2000 and Norbeck et al. 1998). Our estimate of natural gas emissions is based on chassis dynamometer test data from the U.S. Department of Energy's Alternative Fuels Data Center and other in-use data.

To evaluate smog-forming pollution for diesel and gasoline school buses, we relied on emission factors from the EPA's MOBILE6 model. For natural gas buses, we integrated the EPA's model with certification data from CARB.

Reductions from retrofits and cleaner fuels. We evaluated the impact that state school bus cleanup activities (such as pollution-control retrofits) and fuels such as biodiesel could have on soot pollution. Figure 5 shows potential emission reductions from various retrofits based on verification data from CARB and the EPA. We discuss each of these cleanup strategies in Chapter 3.

Figure 5 **Soot Reduction Potential (by Retrofit Type)**



SOURCES:
UCS estimate based on verification data from the U.S. Environmental Protection Agency (2006b) and California Air Resources Board (2006b).

It should be noted that we do not quantitatively evaluate emission reductions from anti-idling policies and regulations. While anti-idling efforts can significantly cut pollution, evaluating the wide variety of such programs in place across the country was beyond the scope of this study.

Grading Criteria

In our evaluation, states received letter grades for soot pollution based on average bus emissions.[21] Our report card emphasizes soot pollution because of its potential to cause toxic "hot spots"—areas of higher exposure for children riding in or playing near buses (see Chapter 1). We assigned soot grades using a bell curve distribution, reserving the highest grade (A) for states whose average school bus matches the emissions of a trap-equipped diesel bus or a new DOC-equipped bus fueled by natural gas (Figure 6). The lowest-scoring states received a D.

We also evaluated state performance in two secondary categories: school bus cleanup programs and tailpipe emissions of smog-forming pollution (Table 5). In comparing cleanup programs, we calculated the percent of school bus soot reduced through pollution control retrofits and use of cleaner fuels such as natural gas and biodiesel, and assigned each state a rank of Good, Above Average, Average, or Poor. States that failed to conduct any cleanup activities received a score of Incomplete. We also calculated smog-forming tailpipe emissions from the average state school bus and used a curve to assign each state a rank of Above Average, Average, or Poor.

Figure 6 **State Grading Criteria: Soot Pollution**

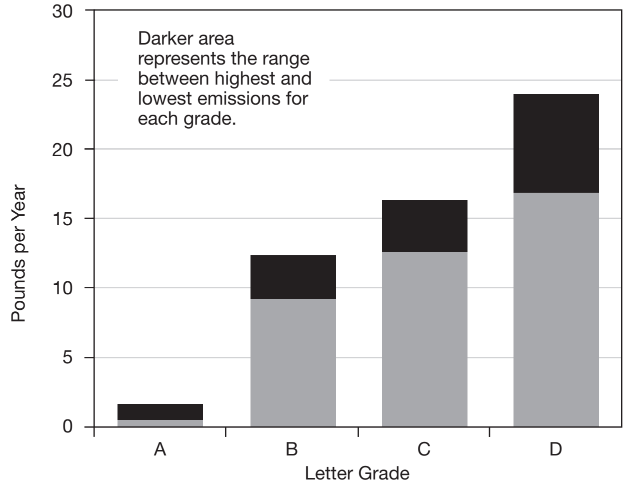


Table 5 **State Ranking Criteria: Cleanup Program and Smog-forming Pollution**

Rank	Cleanup Program Criteria (% of soot reduced through retrofits and cleaner fuels)	Smog-forming Pollution Criteria (grams/mile)
Good	Greater than 7.0%	N/A
Above Average	Greater than 2.5% to less than or equal to 7.0%	Less than 380
Average	Greater than 1.0% to less than or equal to 2.5%	380 to 421
Poor	Less than or equal to 1.0%	Greater than 421
Incomplete	0%	N/A

21 In our original *Pollution Report Card*, we issued grades for soot, smog-forming pollution, global warming pollution, and an overall grade representing the average of the category-specific grades. In other words, we weighted the pollution categories equally, despite the fact that their impact on human health and the environment differs. Our evaluation of global warming pollution, for example, did not take into account the growing body of research that indicates black carbon soot may be responsible for 15 to 30 percent of global warming—second only to carbon dioxide (Jacobson 2001).

RESULTS

Our key findings are:

1. **School buses are some of the oldest vehicles on the road.**
   - Thirty-seven percent of the U.S. fleet was built more than 10 years ago.
   - One in 12 school buses do not have to meet any soot pollution standards, and about one in five only have to meet weak tailpipe standards.[22]
   - The average school bus releases nearly two times more soot pollution per mile than a big rig.
2. **Pollution performance varies widely across the country.**
   - School buses in the state with the dirtiest fleets, South Carolina and South Dakota, release nearly three times more soot than the average bus in Delaware, which has the cleanest fleet.
   - Only Alaska, Connecticut, Maine, Nevada, and New York scored above the national average in all three categories.
   - Arkansas, Hawaii, Louisiana, Montana, Oklahoma, South Dakota, and Utah received a D for soot pollution and Poor marks for cleanup programs and smog-forming pollution.
3. **Clean school bus programs have made significant strides.**
   - Nationally, soot pollution from school buses has been reduced more than two percent through local, state, and federal actions. Most of these cleanup actions have occurred in the last several years.
   - California and Washington State lead the country in cleanup programs, with school bus soot pollution reduced by nine and seven percent, respectively, through retrofits and cleaner fuels.
   - Twelve other states received Above Average scores, with active cleanup programs reducing school bus pollution between 2.5 and 7 percent.
4. **Many states are ignoring the problem of school bus pollution.**
   - Thirteen states have small cleanup programs achieving less than a one percent reduction in school bus soot.
   - Nine states and the District of Columbia did not appear to have any cleanup activities in 2005.
5. **All states need to increase investments in cleaner buses.**
   - The average bus in the cleanest state fleet emitted 20 percent more soot per mile than the average big rig, and six times more than a trap-equipped diesel bus.
   - Even the states earning the highest marks for cleanup programs continue to have high-emitting buses, with Washington receiving a D and California a C for soot pollution.

22 These buses, which were built between 1988 and 1993, are allowed under current EPA emission standards to emit 2.5 to 6 times more soot than buses built between 1994 and 2006.

Table 6 **National School Bus Report Card**

State	Soot Pollution Grade	Soot Pollution (pounds per bus in 2005)	Cleanup Program Rank	Percent of School Bus Soot Reduced through Cleanup Programs as of 2005	Smog-forming Pollution Rank	Smog-forming Pollution (pounds per bus in 2005)
Alabama	B	12.0	Poor	0.3%	Above Average	369
Alaska	B	10.9	Above Average	2.5%	Above Average	376
Arizona	D	17.4	Above Average	3.2%	Poor	434
Arkansas	D	22.3	Poor	0.2%	Poor	492
California	C	13.7	Good	8.7%	Poor	463
Colorado	D	22.4	Above Average	3.3%	Poor	497
Connecticut	B	11.4	Above Average	3.0%	Above Average	379
Delaware	B	9.2	Incomplete	0.0%	Above Average	326
District of Columbia	B	9.2	Incomplete	0.0%	Above Average	348
Florida	C	13.7	Poor	0.2%	Average	389
Georgia	C	14.8	Above Average	2.6%	Average	403
Hawaii	D	21.9	Incomplete	0.0%	Poor	466
Idaho	C	15.1	Incomplete	0.0%	Average	402
Illinois	C	14.8	Average	1.6%	Average	392
Indiana	B	10.8	Average	1.4%	Above Average	349
Iowa	C	13.9	Above Average	3.1%	Above Average	378
Kansas	C	17.0	Incomplete	0.0%	Average	429
Kentucky	C	14.9	Poor	0.8%	Average	391
Louisiana	D	20.7	Incomplete	0.0%	Poor	455
Maine	B	12.2	Above Average	3.8%	Above Average	359
Maryland	B	12.4	Poor	0.6%	Above Average	367
Massachusetts	B	11.6	Average	2.3%	Above Average	367
Michigan	C	15.9	Poor	0.5%	Average	411
Minnesota	D	19.1	Average	1.4%	Poor	446
Mississippi	C	17.1	Average	1.8%	Poor	432
Missouri	B	12.6	Average	1.6%	Above Average	375
Montana	D	18.3	Poor	0.0%	Poor	432
Nebraska	D	17.9	Average	1.0%	Poor	439
Nevada	B	12.5	Above Average	6.0%	Above Average	355
New Hampshire	C	16.6	Poor	0.5%	Average	423
New Jersey	B	11.7	Poor	0.3%	Above Average	364
New Mexico	C	16.0	Poor	0.3%	Average	396
New York	B	12.4	Above Average	2.5%	Above Average	369
North Carolina	C	14.4	Above Average	2.9%	Average	394
North Dakota	C	16.9	Poor	0.1%	Poor	432

Table 6 **National School Bus Report Card** continued

State	Soot Pollution Grade	Soot Pollution (pounds per bus in 2005)	Cleanup Program Rank	Percent of School Bus Soot Reduced through Cleanup Programs as of 2005	Smog-forming Pollution Rank	Smog-forming Pollution (pounds per bus in 2005)
Ohio	C	14.9	Average	1.2%	Average	400
Oklahoma	D	18.8	Incomplete	0.0%	Poor	445
Oregon	C	15.3	Above Average	2.8%	Average	409
Pennsylvania	B	11.9	Average	1.2%	Above Average	367
Rhode Island	C	14.8	Average	1.2%	Average	413
South Carolina	D	24.5	Above Average	3.0%	Poor	531
South Dakota	D	23.7	Incomplete	0.0%	Poor	512
Tennessee	B	11.8	Average	1.2%	Above Average	357
Texas	C	16.2	Above Average	3.3%	Average	417
Utah	D	19.6	Poor	0.5%	Poor	450
Vermont	C	15.4	Incomplete	0.0%	Average	402
Virginia	C	16.2	Average	2.3%	Average	398
Washington	D	17.6	Good	7.3%	Poor	440
West Virginia	C	13.8	Poor	1.0%	Average	397
Wisconsin	C	16.9	Average	1.6%	Average	421
Wyoming	B	12.6	Incomplete	0.0%	Above Average	365
National Average		**14.7**		**2.2%**		**402**

6. **Replacing the oldest school buses and retrofitting more recent models will require substantial investment by states and the federal government.**
   - Retrofitting all school buses built after 1993 with particulate traps and closed crankcase filtration systems would cost approximately $2.6 billion.[23]
   - Replacing all buses built before 1994 with new low-emission buses would cost approximately $13.4 billion.[24]

Soot Pollution Grades

Soot performance varied greatly from state to state—an average school bus in South Carolina or South Dakota (the states with the dirtiest fleets) released nearly three times more soot than the average bus in the state with the cleanest fleet, Delaware.

Good marks. No state earned an A for its soot performance, but 15 states and the District of Columbia did receive a B. These states have younger fleets, with an average bus age of five

23 We assume a passive particulate trap with crankcase filtration control costs $7,000.

24 We assume a trap-equipped diesel school bus costs $100,000.

to eight years, and many have progressive replacement policies that fully fund new buses.

The top state is Delaware, with the lowest per-mile pollution in the country. Because public school buses in Delaware must be retired after 12 years, the average age of the state's buses is five years. The District of Columbia also boasts quick vehicle turnover; its oldest bus was built in 1997 and its average bus is six years old. Alabama, Connecticut, Indiana, Maryland, Massachusetts, New Jersey, Nevada, Pennsylvania, Tennessee, and Wyoming have good retirement policies or funding for replacements that result in an average school bus age of seven years.

Unfortunately, these states represent the exception rather than the rule. The majority of states do not have adequate funding for school bus replacement and allow buses to remain in operation as long as they can keep the engines running and pass annual safety inspections.

Average performers. Twenty-two states received a C for soot pollution. These states did not have effective school bus replacement policies, though many do have cleanup programs in place. Between 30 and 53 percent of the buses in these fleets are older than 10 years, with the average bus between 8 and 12 years old.

Poor marks. Thirteen states received a D for soot pollution. These states maintain school buses that are among the oldest in the country. Between 48 and 87 percent of the buses in these fleets are older than 10 years, with the average bus between 11 and 14 years old.

Cleanup Program Rankings

Good marks. Two of the lowest-performing states in our original *Pollution Report Card*, California and Washington, have emerged as leaders in school bus cleanup efforts. Since 2000, California has reduced its school bus soot nearly nine percent through its Lower-Emission School Bus Program, which pays for particulate traps and the replacement of older buses with new alternative-fuel buses or lower-emission diesel buses. As a result, more than 10 percent of California's school buses now have particulate traps installed. In addition, five percent of the state fleet is powered by natural gas.

Washington has reduced its school bus soot more than seven percent over the last several years through its Clean Buses, Healthy Kids Retrofit Project. The goal of the program is to retrofit all of the state's school buses, and the legislature has committed to providing five million dollars per year for the next five years to achieve this goal. The state has thus far retrofitted 38 percent of its fleet with DOCs that reduce soot between 20 and 40 percent.

Above Average marks. Thirteen states received a rank of Above Average for reducing school bus soot pollution between 2.5 and 7 percent.

Many states have chosen cleaner fuels (e.g., biodiesel, CNG, propane) as a strategy to reduce pollution. In Nevada, Clark County's 1,200 school buses, which comprise more than half of the state fleet, run entirely on B20. As a result, statewide soot emissions from school buses have fallen about 6.3 percent.

New York has embraced a variety of strategies. New York City, for example, passed a law in April 2005 that requires all of its 6,200 school buses to be equipped with the best available pollution controls. Half of these retrofits must be completed by the beginning of the 2006 school year, and the remaining buses must be retrofitted by the start of the next school year. In addition, the state department of education has included a requirement in its private-operator contracts that effectively sets a mandatory bus retirement age of

20 years. The contract also requires that at least 75 percent of the buses in any contractor's fleet must have been built in 1990 or later. The New York State Energy Research and Development Authority and the New York Power Authority have been actively supporting and funding retrofits using DOCs and particulate traps. While New York has reduced school bus soot pollution 2.5 percent from retrofits and cleaner fuels to date, these latest measures should result in significant soot reductions over the next two years.

Other states deserving commendation include Alaska, Arizona, Colorado, Connecticut, Georgia, Iowa, Maine, North Carolina, Oregon, South Carolina, and Texas. These states all have active cleanup programs that have cut their fleets' soot pollution by more than 2.5 percent.

Average performers. Thirteen states received Average scores for reducing school bus soot pollution between 1 and 2.5 percent.

Virginia deserves a special commendation for its cleanup program, which has installed nearly 2,000 DOCs on buses. Ohio also merits recognition for a new grant program that will provide about $350,000 per year for retrofits. As this program is implemented over the next several years, Ohio's grade will likely improve.

Poor marks. Thirteen states received Poor scores for reducing school bus soot pollution by less than one percent. These states have not prioritized retrofits and cleaner fuels, and often lack the resources to develop effective programs.

New Jersey's poor ranking will likely improve over the next several years as the state implements new legislation that requires crankcase filtration systems on all school buses and authorizes the state Department of Environmental Protection to investigate whether further controls are needed to reduce onboard pollution.

Incomplete marks. Nine states and the District of Columbia did not appear to have any active cleanup programs and therefore received a score of Incomplete.[25] It is important to note that although Delaware, Wyoming, and the District of Columbia lack any cleanup program, they each received a B for soot pollution because of their relatively new bus fleets. Emissions from buses in these states could be reduced tenfold through particulate trap retrofits.

Smog-forming Pollution Rankings

The amount of smog-forming pollution emitted by school buses in 2005 varied from about 325 to 530 pounds per bus. In general, the older the fleet, the greater the amount of smog-forming pollution emitted.

Extra Credit: Crankcase Filtration Controls

To reduce pollution inside buses, closed crankcase filtration controls can be installed alone or in conjunction with tailpipe controls. As of 2005, nearly 3,000 school buses had such controls. New Jersey receives extra credit in this category—by 2006, an additional 16,000 of the state's public school buses should have crankcase filtration controls.

CONCLUSION

In the past several years, many states have developed clean school bus programs and provided funding for replacements, retrofits, and cleaner

25 It is possible that some school buses in these states are using biodiesel blends, but neither the state director of pupil transportation nor the state environmental office had any knowledge of such practice.

fuels. The EPA has also supported cleaner school buses by providing millions of dollars from enforcement actions and $25 million from its Clean School Bus USA program over the last four years. Yet these laudable efforts have only succeeded in reducing soot pollution from school buses by two percent.

The vast majority of school districts do not have funds specifically allocated for bus replacement or retrofitting. Instead, such funds are often deducted from the district's general funds, potentially reducing the amount of monies available for educational expenses. As long as school districts face a trade-off between books and buses, children's health may suffer.

Chapter 3

Cleanup Strategies

A variety of cleaner fuels and retrofit technologies are available today and expected tomorrow for reducing pollution from school buses. Biodiesel is starting to be used more widely in school bus fleets across the country, and is particularly useful in reducing emissions from older buses. Buses powered by alternative fuels such as natural gas are the cleanest option commercially available today, but by 2010, pollution control technologies may enable diesel to rival the emission profile of natural gas.

These technologies have the potential to cut toxic soot from the tailpipe 85 percent or more while also reducing onboard pollution. Many require ultra-low sulfur diesel (which will be required in the United States as of this fall) to fulfill their potential, and their effectiveness must be demonstrated over the two-, three-, and even four-decade lifetime of school buses.

Just around the corner are hybrid technologies that can improve fuel economy and reduce harmful pollution simultaneously by supplementing diesel or alternative fuels with electric power. In the longer term, buses powered by hydrogen fuel cells offer the potential for pollution-free transportation for children.

RETROFITS

More than 25,000 school buses have been retrofitted with pollution controls, reducing soot by 59 tons in 2005 (Figure 7 and Table 7, p. 28). Nearly all of these retrofits were installed in the last three to five years. Controls in use today include particulate traps, DOCs, low NOx calibration, and crankcase filtration controls. Technologies available today but not yet employed on school buses include lean NOx catalysts and selective catalytic reduction. In the future, there may be new controls or strategies for reducing children's exposure to toxic onboard pollution. Table 8 (p. 28) lists retrofit technologies currently verified by CARB or the EPA.

Figure 7 **Soot Reduced in 2005 by Type of Cleanup Program**

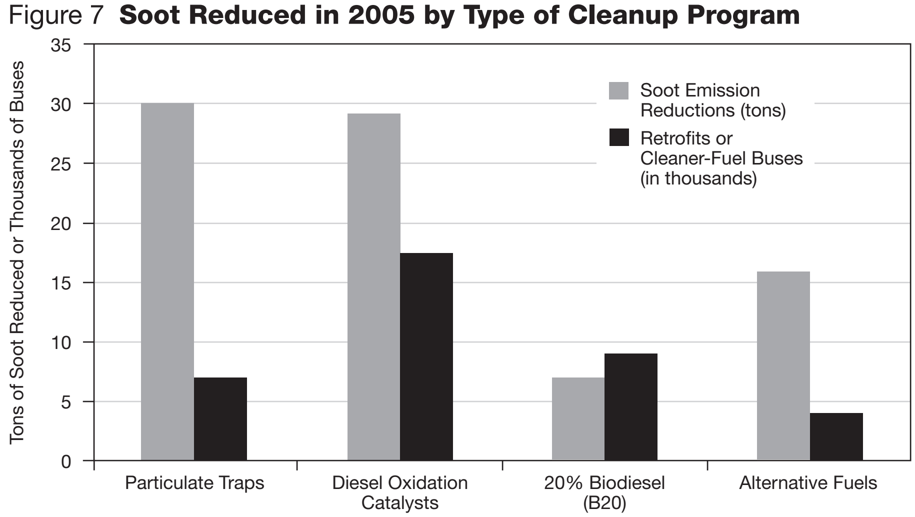


Table 7 **School Bus Retrofits (as of 2005)**

Pollution Control Device	
Diesel particulate filters (DPFs)	6,827
Diesel oxidation catalysts (DOCs)	14,397
DOCs with crankcase controls	2,541
DOCs with low nitrogen oxide (NOx) calibration	899
DOCs with low NOx calibration and crankcase controls	258
Crankcase controls*	168
Total	**25,090**

*An additional 16,000 crankcase filtration controls will be installed on New Jersey school buses in 2006.

Soot Controls

Diesel particulate filters (DPFs, or "soot traps"). The most effective retrofit device for reducing tailpipe emissions of soot, particulate traps can cut soot pollution 60 to 85 percent or more. The nearly 7,000 traps already installed on school buses eliminated about 30 tons of soot in 2005, accounting for approximately 37 percent of the total reductions from retrofits and cleaner fuels. Starting in model year 2007, all new school buses will probably be equipped with traps in order to meet stricter tailpipe standards.

As of 2005, traps installed on school buses all employed **passive regeneration**, meaning no additional energy is needed to oxidize or "burn off" soot particles, which normally burn at 500 degrees Celsius—far higher than the typical temperature range of diesel exhaust. Passive traps use a catalyst that lowers the temperature required to burn soot particles.[26] In order to function properly, passive

Table 8 **Verified Diesel Retrofit Technologies (as of February 2006)**

	Verified Emission Reduction (%)				
Technology	**Soot**	**Nitrogen Oxides**	**Hydrocarbons**	**Application**	**Agency**
Active diesel particulate filter (DPF)	85	0	N/A	Highway	CARB
Passive DPF	60 to 90	0	60 to 93	Highway & off-road	EPA and CARB
Passive DPF + exhaust gas recirculation	85	40	N/A	Highway	CARB
Passive DPF + lean nitrogen oxide (NOx) catalyst	85	25	N/A	Highway	CARB
Flow-through filter	50	N/A	N/A	Highway	CARB
Flow-through filter + fuel-borne catalyst	55 to 76	0 to 9	75 to 89	Highway	EPA
Diesel oxidation catalyst (DOC)	20 to 40	0	42 to 70	Highway & off-road	EPA and CARB
DOC + closed crankcase	25 to 32	N/A	42 to 52	Highway & off-road	EPA and CARB
DOC + emulsified diesel fuel	50	20	N/A	Off-road	CARB
DOC + fuel-borne catalyst	25 to 50	0 to 5	40 to 50	Highway	EPA
DOC + selective catalytic reduction	25	80	N/A	Off-road	CARB
DOC + low NOx calibration	0 to 10	25	50	Highway	EPA
Biodiesel	0 to 47	0 to -10	0 to 67	Highway	EPA
Emulsified diesel fuel	16 to 58	9 to 20	-30 to -120	Highway	EPA and CARB

SOURCES:
U.S Environmental Protection Agency (2006b) and California Air Resources Board (2006b).

26 Use of passive traps results in higher emissions of nitrogen dioxide, a respiratory irritant. New electrically regenerated traps do not create nitrogen dioxide, adding an additional layer of health protection for children.

traps must be used in conjunction with ultra-low sulfur diesel fuel, which will be required for all highway diesel vehicles starting in late 2006. Passive traps are generally restricted to buses built in 1994 or later, and some school bus duty cycles do not generate the temperatures necessary for passive regeneration, further limiting the applicability of this technology.

Particulate traps that feature **active regeneration**, on the other hand, can be employed on school buses of all ages and potentially all duty cycles. In active regeneration, soot particles are heated to the temperature needed for ignition. One active trap featuring electric regeneration has been verified for school buses. Another type of trap, the **flow-through filter**, reduces soot by about 50 percent and can also be used on older buses.

Diesel oxidation catalysts (DOCs). These devices can reduce tailpipe emissions of soot between 20 and 40 percent, and the more than 14,000 DOCs that have already been installed on school buses cut soot pollution from these vehicles by about 29 tons in 2005. As exhaust passes through this device, its precious-metal catalyst oxidizes carbon monoxide, gaseous hydrocarbons, and liquid hydrocarbons adsorbed onto carbon molecules, forming carbon dioxide in the process. DOC efficiency can be enhanced by injecting fuel-borne catalysts into the exhaust stream.

NOx Controls

Low NOx calibration with a DOC. More than 1,000 school buses have employed this technology, which is capable of reducing NOx by 25 percent, soot between zero and 10 percent, and hydrocarbons by 50 percent. As of 2005, only one manufacturer was offering this technology.

Selective catalytic reduction (SCR). Though not currently used on school buses, this technology has been verified to reduce NOx by 80 percent for certain off-road applications. It is also considered one of the key strategies for meeting the stricter NOx standards that will take full effect in 2010. SCR uses a reductant such as urea or ammonia to convert NOx into gaseous nitrogen and water vapor, reducing hydrocarbons and soot in the process as well.

This technology is sensitive to the timing and amount of reductant, variations in exhaust temperature, exhaust gas flow, and concentration of NOx in the exhaust. The vehicle's owner or operator must periodically replenish the reductant, and toxic pollution in the form of ammonium nitrate and ammonia can result if the reductant is injected at the wrong time or in the wrong amount. Proper compliance with the maintenance regime is therefore critical to system performance.

Lean NOx traps. These devices, which use hydrocarbons to convert NOx into nitrogen gas, carbon dioxide, and water, are currently verified to reduce NOx 25 percent for a limited number of highway vehicles.

NOx adsorbers. These devices, which have the potential to reduce NOx 80 percent or more, use a catalyst washcoat to capture NOx during oxygen-rich driving conditions. A reductant such as hydrocarbons must be periodically injected. This technology is not yet available for retrofits, but is one of the strategies being considered for compliance with the 2010 NOx standard.

Onboard Pollution Controls

Recent studies indicate that tailpipe pollution controls may be insufficient for protecting children on school buses from harmful pollutants (Hill et al. 2005; Fitz et al. 2003). Even buses with sophisticated traps can permit surprisingly high concentrations of onboard pollution.

Table 9 **Cleaner-Fuel Buses by State (as of January 2006)**

State	20% Biodiesel (B20)	Natural Gas or Propane
Alaska		5
Arizona	560	281
Arkansas	149	
California		1,363
Colorado	1,067	8
Florida		2
Illinois	1,400	
Iowa	67	187
Kentucky	410	
Maryland		3
Maine	20	3
Michigan	18	
Minnesota	1,049	
Mississippi		240
Montana	8	
Nebraska	50	
Nevada	1,200	8
North Carolina	630	12
North Dakota		4
Ohio	74	
Oregon		280
Pennsylvania		65
Rhode Island	72	
South Carolina	1,220	
Texas		1,646
Utah		27
Virginia	189	11
Washington	450	
Total	**8,632**	**4,145**

NOTE:
The total number of buses running on biodiesel is greater than the B20 equivalent in our study. Fleets running on lower-percentage blends were discounted at a rate comparable to the percentage of biodiesel in the fuel. For example, a fleet of 100 B2 buses is counted as 10 B20-equivalent buses.

However, Hill et al. found that closed crankcase filtration controls can be very effective at reducing this type of exposure, particularly when used in conjunction with traps. Crankcase filtration controls alone are not verified by the EPA or CARB, since verification procedures require reductions in tailpipe emissions. However, many DOCs are now verified in conjunction with crankcase filtration controls.

No other technologies have been demonstrated to improve onboard air quality, but researchers are exploring strategies such as blowers that would funnel polluted air out of buses and cleaner air onto the vehicles. None of these experimental technologies are currently available for commercial use.

CLEANER FUELS

Nearly 13,000 school buses are currently running on biodiesel or cleaner alternative fuels such as natural gas and propane, cutting soot pollution by 23 tons in 2005 (Table 9). Hybrid school buses are expected on the market during the next several years, and fuel cells—already being used by some transit agencies—may ultimately offer the highest level of protection for schoolchildren.

Biodiesel

The most common cleaner fuel, biodiesel, was used in approximately 8,600 B20-equivalent school buses in 2005, reducing soot pollution by seven tons. In most cases, biodiesel is mixed with conventional diesel to cut costs, reduce engine compatibility issues, and minimize cold-weather operating concerns; common blends are B20 (20 percent biodiesel) and B2 (two percent biodiesel). Biodiesel's environmental benefits increase in proportion to the percent of actual biodiesel in the blend. On average, B20 achieves about a

10 percent reduction in soot, but it can increase NOx pollution slightly.[27] High-percentage blends of biodiesel can also affect fuel hoses and pump seals, particularly in older vehicles.

The fact that buses can easily switch between biodiesel and conventional diesel as prices fluctuate makes this approach attractive to many school districts, but it also means that biodiesel is only effective at reducing emissions when it is actually used. In contrast, alternative-fuel buses and pollution control retrofits continuously reduce emissions over their lifetime. States can guarantee the long-term effectiveness of biodiesel by requiring that all diesel contain some percentage of biodiesel; in Minnesota, for example, all diesel sold in the state must contain two percent biodiesel starting in 2006.

Emulsified Diesel

This fuel mixture, which contains water and other additives, is currently verified to reduce soot as much as 58 percent and NOx as much as 20 percent—without any mechanical modifications.[28] Emulsions usually need to be used within a fixed period of time to maintain fuel quality. As of 2005, only some 50 school buses were using emulsified diesel.

Natural Gas and Propane

There are approximately 4,150 alternative-fuel school buses in the nation. Texas has the most (about 1,650 buses fueled primarily by propane) and California has the second most (about 1,360 buses fueled by natural gas). Altogether, alternative-fuel school buses cut soot pollution by some 16 tons in 2005.

Along with natural gas and propane, alternative fuels include ethanol, methanol, electricity, liquids from natural gas, and hydrogen. The cleanest fuel currently available for use in school buses is natural gas, most often in its compressed form. Compared with a 2005 conventional diesel bus, a new bus powered by natural gas can cut soot pollution more than 90 percent and smog-forming pollution by about one-third.

The advent of sophisticated tailpipe controls such as particulate traps, however, has helped diesel become more competitive with natural gas in terms of soot and air toxics. Several studies found that trap-equipped diesel buses could achieve superior emission performance and lower toxicity compared with conventional natural gas buses, indicating that natural gas buses may require tailpipe pollution control retrofits (Ayala et al. 2002; Ahlvik and Brandberg 2000). CARB (2002) compared emissions from a DOC-equipped natural gas school bus with emissions from a trap-equipped diesel bus and found that toxicity and soot emissions were comparable, though the natural gas bus continued to outperform the diesel bus in terms of smog-forming pollution.

The capital cost for today's natural gas school buses is about 40 percent more than a comparable diesel bus. But a recent study found that natural gas vehicles could be highly competitive with diesel buses that meet 2010 emission requirements (TIAX 2005). In fact, the capital and operating costs of natural gas transit buses, refuse

27 Government researchers and biodiesel producers appear close to solving the NOx pollution problem. A study for the National Renewable Energy Laboratory (McCormick et al. 2003) found that a base fuel containing 25.8 percent aromatics would produce a NOx-neutral B20, and that biodiesel containing certain cetane enhancers would also emit less NOx.

28 Use of emulsified diesel can double hydrocarbon emissions. However, since diesel engines have inherently low hydrocarbon emissions, emulsified diesel still reduces smog-forming pollution.

29 The study found that when oil prices are greater than $31 per barrel (in 2005 dollars), natural gas vehicles have lower life cycle costs than comparable diesel vehicles.

haulers, and short-haul trucks may even be lower than diesel vehicles under certain conditions.[29] This study did not, however, take infrastructure costs for natural gas into account.

Natural gas represents a stepping-stone to another gaseous fuel—hydrogen—and the eventual market penetration of zero-emission fuel cells. Most commercial hydrogen today is reformed from natural gas, which is currently the lowest-cost source of hydrogen fuel. Building a national infrastructure for natural gas would therefore support the longer-term development of hydrogen fuel cells.

Electricity

Hybrid-electric transit buses that combine the advantages of diesel or alternative fuels with electricity are already in use across the country, and school buses may soon follow. A hybrid drivetrain can deliver higher fuel economy as long as the increased power it provides is used to improve fuel economy rather than supplement horsepower or vehicle amenities. Preliminary results from on-road testing conducted by the National Renewable Energy Laboratory (NREL) indicate hybrid transit buses can achieve a 25 to 50 percent increase in fuel economy.[30]

Theoretically, hybrid buses can also reduce tailpipe pollution, but a recent study suggests not all hybrids are cleaner than conventional diesel buses (Connecticut Academy of Science and Engineering 2005). In measuring soot emissions from two hybrid transit buses and two conventional diesel buses, the researchers found no reduction in soot from the hybrids. In addition, the hybrids provided only a 10 percent improvement in fuel economy over the baseline diesel bus.

Hybrids have the potential to cut pollution while improving fuel economy, but only if they are engineered to achieve both goals. A project to put 20 "plug-in" hybrid school buses on U.S. roads is already under way (Advanced Energy 2006). Plug-in hybrids can be recharged through an electrical outlet and have larger batteries than standard hybrids, allowing buses to travel a longer distance on electric power but also increasing the up-front cost.

Hybrids can also help ease the transition to another electricity-based technology: hydrogen fuel cells.

Hydrogen

Fuel cells produce energy through a chemical reaction between hydrogen and oxygen rather than through combustion. Not only is this process more efficient, but it also produces no tailpipe emissions. What's more, the hydrogen needed to power fuel cells can be derived from renewable sources such as solar energy as well as from traditional feedstocks such as gasoline, methanol, and natural gas—the least expensive source at the moment.

The promise of pollution-free, cost-effective transportation is driving research into fuel cells, and transit buses equipped with the technology are already being used in demonstration projects across the country. School buses would be a natural fit for fuel cells.

30 UCS analysis of NREL data (available at *http://www.nrel.gov/vehiclesandfuels/fleettest/avta.html*).

Chapter 4
Policy Recommendations

Federal funding for state cleanup programs is critical to cash-strapped states such as Louisiana and Mississippi that can ill afford to invest in clean school buses on their own. In fact, federal funding may be the only near-term solution for reducing children's exposure to diesel pollution. While some states have managed to develop their own school bus cleanup programs and funding streams, most states lack the funding to replace their oldest and dirtiest buses, and all states continue to rely on high-polluting buses.

EPA FUNDING

The EPA has helped expand awareness of the problems associated with diesel pollution and played a key role in clean school bus projects across the country. Through its Clean School Bus USA program, enforcement actions, and other funding activities, the agency is responsible for about one of every three school bus retrofits (Table 10, p. 34).

Clean School Bus USA works with communities to significantly reduce children's exposure to diesel exhaust. By 2010, the program aims to retrofit all model year 1991 and newer school buses with pollution controls, replace all older buses with newer vehicles, and reduce idling in the U.S. fleet.

So far, the retrofit and replacement program has only addressed about 4,400 buses—less than one percent of the U.S. fleet.[31] The EPA allocated $17.5 million for Clean School Bus USA grants between 2003 and 2005, and newly announced funding for 2006 has been held at seven million dollars—slightly less than the 2005 investment. Without a significant increase in funding, the agency will not come close to meeting its ambitious goal.

EPA enforcement actions have provided the bulk of funding for state cleanup projects. For example, 37 percent of all particulate trap retrofits in the country have been funded as part of settlements between the EPA and non-compliant companies. Several large settlements involving companies such as Toyota and Virginia Electric Power have resulted in significant emission reductions in school buses across the country. However, the EPA has indicated that federal enforcement funds may no longer be available for reducing school bus pollution, making it even less likely that the agency will achieve its goal of retrofitting or replacing every school bus on the road.

OTHER FEDERAL SOURCES

The Department of Energy's Clean Cities program has funded the incremental costs of biodiesel and alternative fuels, as well as new alternative-fuel school buses. Clean Cities supports projects that displace petroleum and promote U.S. energy and environmental security, and has been a major funding source for new natural gas and propane school buses. Other federal funding sources for cleaner fuels and retrofits include the Transportation Equity Act for the 21st Century and the Congestion Mitigation and Air Quality program.

31 Three out of four Clean School Bus USA-funded retrofits took the form of a DOC, which reduces soot between 20 and 40 percent.

Table 10 **EPA-funded Buses, Retrofits, and Cleaner Fuels (as of 2005)**

	Clean School Bus USA Program	Enforcement Actions	Other EPA Funding	Total
New diesel buses	192	4	3	199
New CNG buses	34	0	0	34
Diesel particulate filters (DPFs)	446	2,470	0	2,916
Diesel oxidation catalysts (DOCs)	2,849	1,359	451	4,659
Crankcase controls	86	0	0	86
DOCs + crankcase controls	499	323	142	964
Buses using 20% biodiesel (B20) or emulsified diesel	312	0	0	312
Total	**4,418**	**4,156**	**596**	**9,170**

STATE PROGRAMS

Several states, including California, Ohio, and Washington, have cleanup programs of their own. California's Lower-Emission School Bus Program was the first of its kind and remains a model for the rest of the country. It has succeeded in installing particulate traps on about one of every 10 buses, and replacing hundreds of older buses with new CNG and trap-equipped diesel buses. Washington intends to retrofit all of its school buses, and has committed five million dollars per year to that end. Ohio's new cleanup program will draw funding from civil non-compliance penalties expected to generate between $300,000 and $400,000 per year.

Many states have used settlement funds from enforcement actions to pay for school bus retrofit and replacement programs. Other states such as North Carolina and Texas have state funds available for projects that promote attainment of national air quality standards. So, while not specific to school buses, the Texas Emission Reduction Program and North Carolina's Mobile Source Emissions Reduction Grants have funded cleaner school buses.

CONCLUSION

Despite investments by the federal government, states, and school districts, soot pollution from school buses has been reduced only two percent over the last several years. The average school bus emits nearly two times more soot per mile than a big rig, and early studies indicate that even advanced tailpipe controls are not enough to protect children inside buses. Reducing emissions from the crankcase and protecting the bus from outside air pollution may be needed to significantly improve onboard air quality.

School buses are the safest form of transportation for children, and they should also rank among the cleanest. Our children deserve to ride in buses equipped with sophisticated pollution controls and powered by cleaner fuels. The technology to cut soot pollution by 85 percent or more exists today, but as our analysis shows, today's school buses are highly polluting.

Without a major increase in funding for cleanup programs, school buses will continue to lag behind big rigs. Every state needs to make a stronger commitment to ensuring its children are exposed to no more pollution than its truckers.

Chapter 5

2006 State Report Cards

ALABAMA

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	B	Alabama received a B grade for soot pollution. The state has a relatively new fleet of buses, largely the result of the state's progressive policy for reimbursing school districts for bus services. School districts have financial incentive to replace their buses after 10 years. Good marks go to the Birmingham school district for its project to retrofit buses.	The state ranked Poor for cleanup, with soot reductions of just 0.3%. The average school bus emits 50% more pollution per mile than a big rig. Alabama needs funding to develop a clean school bus program to promote retrofits and cleaner fuels.
Cleanup Program Rank	Poor		
Smog-forming Pollution Rank	Above Average		
Background			
Number of School Buses*	8,519		
Average School Bus Age (years)	7		
% of Fleet Older than 10 Years	18%		
Average School Bus Soot (pounds in 2005)	12.0		
Average Ratio of School Bus to Big Rig Soot per Mile	1.5		
% of School Bus Soot Reduced through Cleanup	0.3%		
Extra Credit			
State Fleet Tracking	Good		
**Includes public school buses only*			

ALASKA

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	B	Alaska received a B for soot pollution, and Above Average scores for cleanup and smog-forming pollution. Alaska has a relatively new fleet of buses, resulting in lower soot pollution. The Anchorage school district has an active program for retrofitting school buses with diesel oxidation catalysts (DOCs) and has purchased compressed natural gas (CNG) buses.	The average school bus emits 40% more soot per mile than a big rig. School bus contractors, who operate about 90% of the state's fleet, need to become more engaged in cleaning up their fleets.
Cleanup Program Rank	Above Average		
Smog-forming Pollution Rank	Above Average		
Background			
Number of School Buses*	1,041		
Average School Bus Age (years)	8		
% of Fleet Older than 10 Years	19%		
Average School Bus Soot (pounds in 2005)	10.9		
Average Ratio of School Bus to Big Rig Soot per Mile	1.4		
% of School Bus Soot Reduced through Cleanup	3%		
Extra Credit			
State Fleet Tracking	Good		
**Includes public school buses only*			

ARIZONA

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	D	Arizona ranked Above Average for its cleanup program. High marks go to Tucson Unified School District, which has prioritized school bus cleanup and developed an aggressive program. High marks also go to Paradise Valley School District, a leader in alternative fuels. Good marks go to the Department of Environmental Quality's voluntary anti-idling program.	The state received a dismal D grade for soot and scored Poor for smog-forming pollution. The average school bus is 11 years old and releases 2.2 times more soot per mile than a big rig. Nearly half of the state's school buses are older than 10 years, and new bus replacement should be a priority. The state needs funding to expand its school bus cleanup activities and replace older buses.
Cleanup Program Rank	Above Average		
Smog-forming Pollution Rank	Poor		
Background			
Number of School Buses*	7,822		
Average School Bus Age (years)	11		
% of Fleet Older than 10 Years	49%		
Average School Bus Soot (pounds in 2005)	17.4		
Average Ratio of School Bus to Big Rig Soot per Mile	2.2		
% of School Bus Soot Reduced through Cleanup	3.2%		
Extra Credit			
State Fleet Tracking	Good		
**Includes public school buses only*			

ARKANSAS

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	D	The Arkansas Department of Economic Development has a fledgling Adopt a School Bus program that encourages school districts to use biodiesel.	The state scored a D for soot pollution, and ranked Poor for cleanup and smog-forming pollution. The average school bus is 13 years old and emits nearly three times more pollution than a big rig. Arkansas needs funding to replace older school buses and retrofit newer buses with pollution controls and cleaner fuels.
Cleanup Program Rank	Poor		
Smog-forming Pollution Rank	Poor		
Background			
Number of School Buses*	6,500		
Average School Bus Age (years)	13		
% of Fleet Older than 10 Years	65%		
Average School Bus Soot (pounds in 2005)	22.3		
Average Ratio of School Bus to Big Rig Soot per Mile	2.9		
% of School Bus Soot Reduced through Cleanup	0.2%		
Extra Credit			
State Fleet Tracking	Poor		
**Includes public school buses only*			

CALIFORNIA

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	C	The state received the highest marks in the country for cleanup. California's Lower-Emission School Bus program has been a resounding success and is a model for the rest of the country. Through the state program and with help from the EPA's Clean School Bus USA program, about 11% of the fleet has particulate traps and the state has about 1,400 CNG buses in operation, resulting in a drop in soot pollution of nearly 9%.	Despite the successful Lower-Emission School Bus program, California only achieves a C for soot pollution and ranks Poor for smog-forming pollution. The average school bus is 11 years old and emits 2 times more pollution than a big rig. California needs dedicated funding for the state's clean school bus program, with a focus first on replacing its oldest buses and retrofitting all public and private school buses with particulate traps.
Cleanup Program Rank	Good		
Smog-forming Pollution Rank	Poor		
Background			
Number of School Buses*	29,871		
Average School Bus Age (years)	11		
% of Fleet Older than 10 Years	47%		
Average School Bus Soot (pounds in 2005)	13.7		
Average Ratio of School Bus to Big Rig Soot per Mile	2.0		
% of School Bus Soot Reduced through Cleanup	8.7%		
Extra Credit			
State Fleet Tracking	Good		
**Includes private and public school buses*			

COLORADO

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	D	Good marks to the Clean Yellow Fleets for Blue Skies program, which has supported school bus retrofits including DOCs, engine preheaters, crankcase controls, and bio-diesel, with soot reduced more than 3%.	The state received a D for soot pollution and ranked Poor for smog-forming pollutants. The average school bus is 13 years old and emits nearly 3 times more soot pollution per mile than a big rig. Nearly 3 out of every 5 school buses are more than 10 years old, and replacement should be a priority. The state needs funding to expand its Clean Yellow Fleets program.
Cleanup Program Rank	Above Average		
Smog-forming Pollution Rank	Poor		
Background			
Number of School Buses*	6,403		
Average School Bus Age (years)	13		
% of Fleet Older than 10 Years	59%		
Average School Bus Soot (pounds in 2005)	22.4		
Average Ratio of School Bus to Big Rig Soot per Mile	2.9		
% of School Bus Soot Reduced through Cleanup	3.3%		
Extra Credit			
State Fleet Tracking	Poor		
**Includes public school buses only*			

CONNECTICUT

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	B	The state received high marks in all 3 categories. Its high degree of commitment to cleaner school buses resulted in a 3% reduction in soot pollution through a variety of cleanup strategies (including particulate traps, DOCs, and crankcase controls). In addition, the state has passed an anti-idling law.	The average school bus emits 50% more pollution per mile than a big rig, and nearly one-quarter of the state's fleet is more than 10 years old. The state needs funding to expand its clean school bus activities and develop a school bus replacement program for older vehicles.
Cleanup Program Rank	Above Average		
Smog-forming Pollution Rank	Above Average		
Background			
Number of School Buses*	7,030		
Average School Bus Age (years)	7		
% of Fleet Older than 10 Years	23%		
Average School Bus Soot (pounds in 2005)	11.4		
Average Ratio of School Bus to Big Rig Soot per Mile	1.5		
% of School Bus Soot Reduced through Cleanup	3.0%		
Extra Credit			
State Fleet Tracking	Good		
**Includes private and public school buses*			

DELAWARE

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	B	The state received a B for soot pollution and an Above Average grade for smog-forming pollutants. Delaware has the newest fleet of buses in the country as a result of its excellent retirement policies for public school buses (buses older than 12 years must be taken off the road).	The average school bus releases 20% more pollution per mile than a big rig. Delaware received an Incomplete for cleanup, with no projects ongoing in 2005. The state needs funding to develop a clean school bus program.
Cleanup Program Rank	Incomplete		
Smog-forming Pollution Rank	Above Average		
Background			
Number of School Buses*	1,569		
Average School Bus Age (years)	5		
% of Fleet Older than 10 Years	4%		
Average School Bus Soot (pounds in 2005)	9.2		
Average Ratio of School Bus to Big Rig Soot per Mile	1.2		
% of School Bus Soot Reduced through Cleanup	0.0%		
Extra Credit			
State Fleet Tracking	Good		
**Includes public school buses only*			

DISTRICT OF COLUMBIA

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	B	The state received a B for soot pollution and scored Above Average for smog-forming pollutants. The District of Columbia has a newer fleet of public school buses thanks to its excellent retirement policies—the oldest bus is from model year 1997.	The District of Columbia received an Incomplete for cleanup, with no projects ongoing in 2005. The average school bus releases 20% more pollution per mile than a big rig. In addition, there are many private school buses in the district, and data on those buses are not included in this analysis. The district needs funding to implement a clean school bus program.
Cleanup Program Rank	Incomplete		
Smog-forming Pollution Rank	Above Average		
Background			
Number of School Buses*	658		
Average School Bus Age (years)	6		
% of Fleet Older than 10 Years	0%		
Average School Bus Soot (pounds in 2005)	9.2		
Average Ratio of School Bus to Big Rig Soot per Mile	1.2		
% of School Bus Soot Reduced through Cleanup	0.0%		
Extra Credit			
State Fleet Tracking	Good		
**Includes public school buses only*			

FLORIDA

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	C	Good marks go to the Hillsborough County Environmental Protection Commission, which has installed DOCs through a grant from the U.S. EPA. Using enforcement funds, the state has implemented a few small projects to install DOCs on school buses.	Florida ranked Poor for its cleanup program that reduced school bus soot only 0.2%. The average school bus is 8 years old and releases 70% more pollution than a big rig. About 30% of the state's fleet is more than 10 years old, and replacing these buses should be a priority. The state needs funding for retrofits, cleaner fuels, and replacement.
Cleanup Program Rank	Poor		
Smog-forming Pollution Rank	Average		
Background			
Number of School Buses*	20,588		
Average School Bus Age (years)	8		
% of Fleet Older than 10 Years	30%		
Average School Bus Soot (pounds in 2005)	13.7		
Average Ratio of School Bus to Big Rig Soot per Mile	1.7		
% of School Bus Soot Reduced through Cleanup	0.2%		
Extra Credit			
State Fleet Tracking	Good		
**Includes public school buses only*			

GEORGIA

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	C	The state scored Above Average for cleanup. Good marks go to the Georgia Department of Natural Re-sources (DNR) and school districts, which have reduced soot pollution 2.6% through a variety of projects. The DNR has excellent policies for retro-fitting school buses, relying on particulate traps for newer vehicles and a combination of DOCs and crankcase controls for older buses.	The average school bus is 10 years old and emits nearly 2 times more soot per mile than a big rig. School bus replacement needs to be a priority, with 41% of the fleet older than 10 years. The state needs funding to expand its clean school bus activities and replace older, high-polluting buses.
Cleanup Program Rank	Above Average		
Smog-forming Pollution Rank	Average		
Background	**0**		
Number of School Buses*	17,087		
Average School Bus Age (years)	10		
% of Fleet Older than 10 Years	41%		
Average School Bus Soot (pounds in 2005)	14.8		
Average Ratio of School Bus to Big Rig Soot per Mile	1.9		
% of School Bus Soot Reduced through Cleanup	2.6%		
Extra Credit			
State Fleet Tracking	Good		
**Includes public school buses only*			

HAWAII

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	D	None	The average school bus is 13 years old and emits nearly 3 times more particulates per mile than a big rig. Hawaii scored a D for soot pollution, Poor for smog-forming pollu-tion, and an Incomplete for its failure to have any cleanup projects. The state contracts all of its buses, and it should follow the lead of New York City in requring its contrac-tors to use cleaner fleets.
Cleanup Program Rank	Incomplete		
Smog-forming Pollution Rank	Poor		
Background			
Number of School Buses*	900		
Average School Bus Age (years)	13		
% of Fleet Older than 10 Years	66%		
Average School Bus Soot (pounds in 2005)	21.9		
Average Ratio of School Bus to Big Rig Soot per Mile	2.8		
% of School Bus Soot Reduced through Cleanup	0%		
Extra Credit			
State Fleet Tracking	Poor		
**Includes public school buses only*			

IDAHO

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	C	The state Department of Environmental Quality has sought funding for clean school bus activities but has not been successful. There have been attempts by the University of Idaho to encourage biodiesel use. The Meridian school district experimented with biodiesel but had problems with fuel quality.	The average school bus is 9 years old and releases nearly 2 times more soot per mile than a big rig. The state received an Incomplete for cleanup due to its lack of progress. The state needs to develop and secure funding for a clean school bus program. Replacement needs to be a priority, with 2 out of every 5 buses in the fleet older than 10 years.
Cleanup Program Rank	Incomplete		
Smog-forming Pollution Rank	Average		
Background			
Number of School Buses*	2,829		
Average School Bus Age (years)	9		
% of Fleet Older than 10 Years	39%		
Average School Bus Soot (pounds in 2005)	15.1		
Average Ratio of School Bus to Big Rig Soot per Mile	1.9		
% of School Bus Soot Reduced through Cleanup	0%		
Extra Credit			
State Fleet Tracking	Good		
**Includes public school buses only*			

ILLINOIS

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	C	Cook Illinois School Corporation is using 20% biodiesel (B20) in about 1,400 school buses. The state started an Adopt a School Bus program to encourage corporate sponsorship of cleaner buses. The state has used enforcement actions to fund more than 300 DOCs, and the U.S. EPA funded retrofits in the Chicago area. In total, soot pollution has been reduced 1.6%.	The average school bus is 9 years old and emits nearly 2 times more soot per mile than a big rig. The Adopt a School Bus program has floundered due to lack of corporate sponsorship. The state should develop a new initiative to reduce pollution through retrofits and cleaner fuels. With 40% of the fleet more than 10 years old, the state should develop a plan for replacing its oldest school buses.
Cleanup Program Rank	Average		
Smog-forming Pollution Rank	Average		
Background			
Number of School Buses*	19,031		
Average School Bus Age (years)	9		
% of Fleet Older than 10 Years	40%		
Average School Bus Soot (pounds in 2005)	14.8		
Average Ratio of School Bus to Big Rig Soot per Mile	1.9		
% of School Bus Soot Reduced through Cleanup	1.6%		
Extra Credit			
State Fleet Tracking	Poor		
**Includes public school buses only*			

INDIANA

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	B	The state fleet of buses is relatively new, resulting in a B for soot pollution and an Above Average rank for smog-forming pollutants. Good marks go to the state Department of Environmental Management for appying for and gaining access to federal funds for DOC retrofits. Soot pollution has been reduced 1.4% through these efforts.	The average school bus is 7 years old and emits 40% more soot per mile than a big rig. One in 5 buses was built more than 10 years ago. Indiana should expand its retrofit program to include more sophisticated controls such as particulate traps, and should look for additional funding to support cleaner school buses.
Cleanup Program Rank	Average		
Smog-forming Pollution Rank	Above Average		
Background			
Number of School Buses*	13,809		
Average School Bus Age (years)	7		
% of Fleet Older than 10 Years	20%		
Average School Bus Soot (pounds in 2005)	10.8		
Average Ratio of School Bus to Big Rig Soot per Mile	1.4		
% of School Bus Soot Reduced through Cleanup	1.4%		
Extra Credit			
State Fleet Tracking	Good		
**Includes public school buses only*			

IOWA

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	C	Iowa scored Above Average for cleanup and smog-forming pollution. Its Bus Emission Education Program (BEEP) helps school districts better maintain vehicles to help lower emissions.The Department of Natural Resources has received grant funding from the U.S. EPA for 340 DOCs and biodiesel blends in 3 school districts. As a result, soot has been reduced more than 3%.	The average school bus is 10 years old and emits 80% more soot per mile than a big rig. With 42% of the fleet more than 10 years old, school bus replacement should be a priority. The state needs funding to expand its retrofit program to include more sophisticated controls such as particulate traps and to replace older, high-polluting buses.
Cleanup Program Rank	Above Average		
Smog-forming Pollution Rank	Above Average		
Background			
Number of School Buses*	6,228		
Average School Bus Age (years)	10		
% of Fleet Older than 10 Years	42%		
Average School Bus Soot (pounds in 2005)	13.9		
Average Ratio of School Bus to Big Rig Soot per Mile	1.8		
% of School Bus Soot Reduced through Cleanup	3.1%		
Extra Credit			
State Fleet Tracking	Good		
**Includes public school buses only*			

KANSAS

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	C	Kansas is exploring the possibility of using enforcement funds and federal funds for school bus retrofits. There are several school districts using 2% biodiesel (B2) on a pilot basis.	The average school bus is 11 years old and emits more than twice as much soot per mile as a big rig. Kansas received an Incomplete for cleanup, with no actions ongoing in 2005. The state needs funding to implement a clean school bus program focusing on cleaner fuels and retrofits. With 44% of the fleet more than 10 years old, the state also needs funding to replace older, high-polluting buses.
Cleanup Program Rank	Incomplete		
Smog-forming Pollution Rank	Average		
Background			
Number of School Buses*	5,587		
Average School Bus Age (years)	11		
% of Fleet Older than 10 Years	44%		
Average School Bus Soot (pounds in 2005)	17.0		
Average Ratio of School Bus to Big Rig Soot per Mile	2.2		
% of School Bus Soot Reduced through Cleanup	0%		
Extra Credit			
State Fleet Tracking	Poor		
**Includes public school buses only*			

KENTUCKY

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	C	The state received good marks for biodiesel use by school districts.	The average school bus is 9 years old and releases nearly twice as much soot per mile as a big rig. The state scored Poor for cleanup, and needs funding for retrofits and cleaner fuels. With 2 out of every 5 buses in the fleet older than 10 years, the state also needs funding for school bus replacement.
Cleanup Program Rank	Poor		
Smog-forming Pollution Rank	Average		
Background			
Number of School Buses*	9,733		
Average School Bus Age (years)	9		
% of Fleet Older than 10 Years	41%		
Average School Bus Soot (pounds in 2005)	14.9		
Average Ratio of School Bus to Big Rig Soot per Mile	1.9		
% of School Bus Soot Reduced through Cleanup	0.8%		
Extra Credit			
State Fleet Tracking	Good		
**Includes public school buses only*			

LOUISIANA

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	D	None	The average bus is 12 years old and emits 2.6 times more soot per mile than a big rig. Louisiana received a D for soot pollution, Poor for smog-forming pollution, and an Incomplete for its lack of cleanup. The state needs to implement a clean school bus program and develop a plan for replacing its older, high-polluting buses.
Cleanup Program Rank	Incomplete		
Smog-forming Pollution Rank	Poor		
Background			
Number of School Buses*	8,136		
Average School Bus Age (years)	12		
% of Fleet Older than 10 Years	61%		
Average School Bus Soot (pounds in 2005)	20.7		
Average Ratio of School Bus to Big Rig Soot per Mile	2.6		
% of School Bus Soot Reduced through Cleanup	0.0%		
Extra Credit			
State Fleet Tracking	Poor		
**Includes public school buses only*			

MAINE

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	B	Through school bus cleanup and a relatively young fleet of buses, Maine scored a B for soot and ranked Above Average for cleanup and smog-forming pollution. High marks go to the Maine clean school bus program and the high level of participation by the state's director of pupil transportation. Maine school buses have been retrofitted with traps, hundreds of DOCs, crankcase controls, and biodiesel, reducing soot pollution by nearly 4%.	The average state school bus is 8 years old and emits 60% more soot per mile than a big rig. With 30% of its fleet older than 10 years, Maine should continue to expand its clean school bus activities.
Cleanup Program Rank	Above Average		
Smog-forming Pollution Rank	Above Average		
Background			
Number of School Buses*	2,709		
Average School Bus Age (years)	8		
% of Fleet Older than 10 Years	30%		
Average School Bus Soot (pounds in 2005)	12.2		
Average Ratio of School Bus to Big Rig Soot per Mile	1.6		
% of School Bus Soot Reduced through Cleanup	3.8%		
Extra Credit			
State Fleet Tracking	Good		
**Includes public school buses only*			

MARYLAND

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	B	The state received a B for soot due to its relatively young fleet of buses. There are several school bus cleanup projects in the state to retrofit buses with particulate traps and DOCs, primarily funded though federal enforcement actions.	The average school bus is 7 years old and emits 60% more pollution per mile than a big rig. Maryland ranked Poor for its lack of cleanup. The state should develop and implement a clean school bus program focusing on replacement, retrofits, and cleaner fuels.
Cleanup Program Rank	Poor		
Smog-forming Pollution Rank	Above Average		
Background			
Number of School Buses*	10,196		
Average School Bus Age (years)	7		
% of Fleet Older than 10 Years	27%		
Average School Bus Soot (pounds in 2005)	12.4		
Average Ratio of School Bus to Big Rig Soot per Mile	1.6		
% of School Bus Soot Reduced through Cleanup	0.6%		
Extra Credit			
State Fleet Tracking	Good		
**Includes private and public school buses*			

MASSACHUSETTS

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	B	The state received a B for soot and ranked Above Average for smog-forming pollutants. Boston retrofitted 235 of its school buses with particulate traps through a federal enforcement action. In addition, the city of Medford has installed more than 50 DOCs and nearly 20 particulate traps on its buses through a grant from the U.S. EPA. Good marks go to the state for its anti-idling law.	The average school bus is 7 years old and emits 50% more pollution per mile than a big rig, and nearly 1 in 4 buses is more than 10 years old. The state has relied on federal funding for its school bus retrofits, but does not have an active state program promoting retrofits, replacements, and cleaner fuels.
Cleanup Program Rank	Average		
Smog-forming Pollution Rank	Above Average		
Background			
Number of School Buses*	9,000		
Average School Bus Age (years)	7		
% of Fleet Older than 10 Years	23%		
Average School Bus Soot (pounds in 2005)	11.6		
Average Ratio of School Bus to Big Rig Soot per Mile	1.5		
% of School Bus Soot Reduced through Cleanup	2.3%		
Extra Credit			
State Fleet Tracking	Poor		
**Includes private and public school buses*			

MICHIGAN

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	C	Good marks go to the retrofit projects in the Ann Arbor, Manchester, and Okemos public schools, resulting in nearly 200 DOC retrofits. The U.S. EPA provided funding for these projects. Also, good marks go to schools that installed 94 particulate traps funded through a federal enforcement action against Toyota.	The average state bus is a decade old and emits 2 times more soot per mile than a big rig. In addition, 40% of the fleet is older than 10 years. Michigan ranked Poor for its lack of cleanup activities. The state needs to develop and implement a clean school bus program focusing on retrofits, clean fuels, and replacement.
Cleanup Program Rank	Poor		
Smog-forming Pollution Rank	Average		
Background			
Number of School Buses*	18,688		
Average School Bus Age (years)	10		
% of Fleet Older than 10 Years	40%		
Average School Bus Soot (pounds in 2005)	15.9		
Average Ratio of School Bus to Big Rig Soot per Mile	2.0		
% of School Bus Soot Reduced through Cleanup	0.5%		
Extra Credit			
State Fleet Tracking	Poor		
**Includes public school buses only*			

MINNESOTA

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	D	Good marks go to the state for its Project Green Fleet, a new partnership of businesses, government, and nonprofits. The goal of the project is to retrofit 500 buses at a cost of $2 million, and the state has raised $400,000 thus far. Minnesota's Pollution Control Agency promotes anti-idling policies by schools and has used enforcement funds for DOC retrofits. In 2006, the law mandates B2 for all vehicles.	The average school bus is 12 years old and emits 2.4 times more soot per mile than a big rig. More than half the fleet is older than 10 years. The state received a D for soot pollution and ranked Poor for smog-forming pollution. The state needs funding to expand its retrofit and clean fuels programs, and to replace its oldest school buses.
Cleanup Program Rank	Average		
Smog-forming Pollution Rank	Poor		
Background			
Number of School Buses*	10,485		
Average School Bus Age (years)	12		
% of Fleet Older than 10 Years	55%		
Average School Bus Soot (pounds in 2005)	19.1		
Average Ratio of School Bus to Big Rig Soot per Mile	2.4		
% of School Bus Soot Reduced through Cleanup	1.4%		
Extra Credit			
State Fleet Tracking	Poor		
**Includes private and public school buses*			

MISSISSIPPI

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	C	Good marks go to Moss Point and Lowndes County schools, which installed DOCs on nearly 90 buses through funding from the U.S. EPA.	The average school bus is 10 years old and emits 2.2 times more soot per mile than a big rig, and about half of the state's school buses are older than 10 years. The state needs funding to implement an active retrofit, clean fuels, and replacement program.
Cleanup Program Rank	Average		
Smog-forming Pollution Rank	Poor		
Background			
Number of School Buses*	7,090		
Average School Bus Age (years)	11		
% of Fleet Older than 10 Years	50%		
Average School Bus Soot (pounds in 2005)	17.1		
Average Ratio of School Bus to Big Rig Soot per Mile	2.2		
% of School Bus Soot Reduced through Cleanup	1.8%		
Extra Credit			
State Fleet Tracking	Poor		
**Includes public school buses only*			

MISSOURI

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	B	The state's progressive school bus reimbursement policies have resulted in a younger fleet of buses, resulting in a B for soot pollution and an Above Average rank for smog-forming pollutants. A federal enforcement action resulted in the installation of 800 DOCs in the St. Louis area, cutting soot pollution about 1.6%.	The average school bus is 8 years old and releases 60% more soot per mile than a big rig. In addition, 30% of the fleet is older than 10 years. Now that funds from the federal enforcement action have been spent, the state is not planning additional cleanup actions. The state needs funding for school bus replacement as well as a clean school bus program promoting retrofits and cleaner fuels.
Cleanup Program Rank	Average		
Smog-forming Pollution Rank	Above Average		
Background			
Number of School Buses*	13,338		
Average School Bus Age (years)	8		
% of Fleet Older than 10 Years	30%		
Average School Bus Soot (pounds in 2005)	12.6		
Average Ratio of School Bus to Big Rig Soot per Mile	1.6		
% of School Bus Soot Reduced through Cleanup	1.6%		
Extra Credit			
State Fleet Tracking	Good		
**Includes private and public school buses*			

MONTANA

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	D	A clean fuels project has enabled 8 school buses to run on B20. The state's Department of Environmental Quality promotes no-idling in school zones. Good marks go to the tracking of school buses by the state's director of pupil transportation.	The average school bus is 11 years old and emits 2.3 times more soot per mile than a big rig. Montana received a D for soot and scored Poor for its lack of cleanup actions and its high smog-forming pollution. The state needs funding to replace older buses with cleaner alternatives and to retrofit buses with pollution controls and cleaner fuels.
Cleanup Program Rank	Poor		
Smog-forming Pollution Rank	Poor		
Background			
Number of School Buses*	2,608		
Average School Bus Age (years)	11		
% of Fleet Older than 10 Years	48%		
Average School Bus Soot (pounds in 2005)	18.3		
Average Ratio of School Bus to Big Rig Soot per Mile	2.3		
% of School Bus Soot Reduced through Cleanup	0.0%		
Extra Credit			
State Fleet Tracking	Good		
**Includes public school buses only*			

NEBRASKA

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	D	The Nebraska Soybean Board is working with 20 school districts on biodiesel projects. Lincoln public schools installed about 117 DOCs on school buses through a grant from the U.S. EPA.	The average state school bus is 11 years old and emits 2.3 times more soot pollution than a big rig. As a result, Nebraska scored a D for soot pollution and ranked Poor for smog-forming emissions. The state needs funding to replace older buses with cleaner alternatives and to retrofit buses with pollution controls and cleaner fuels.
Cleanup Program Rank	Average		
Smog-forming Pollution Rank	Poor		
Background			
Number of School Buses*	2,700		
Average School Bus Age (years)	11		
% of Fleet Older than 10 Years	51%		
Average School Bus Soot (pounds in 2005)	17.9		
Average Ratio of School Bus to Big Rig Soot per Mile	2.3		
% of School Bus Soot Reduced through Cleanup	1.0%		
Extra Credit			
State Fleet Tracking	Good		
**Includes public school buses only*			

NEVADA

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	B	High marks go to the Clark County School District, which uses B20 in all of its 1,200 school buses (representing more than half of the state's fleet). Soot pollution has been reduced 6% as a result. The state received a B for soot pollution and ranked Above Average for cleanup and smog-forming pollution.	The average school bus is 7 years old and emits 60% more soot per mile than a big rig. Only one school district has a clean fuels program and there are no retrofits currently in use. The state needs funding for a clean school bus retrofit program.
Cleanup Program Rank	Above Average		
Smog-forming Pollution Rank	Above Average		
Background			
Number of School Buses*	2,151		
Average School Bus Age (years)	7		
% of Fleet Older than 10 Years	28%		
Average School Bus Soot (pounds in 2005)	12.5		
Average Ratio of School Bus to Big Rig Soot per Mile	1.6		
% of School Bus Soot Reduced through Cleanup	6.0%		
Extra Credit			
State Fleet Tracking	Good		
**Includes public school buses only*			

NEW HAMPSHIRE

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	C	Good marks go to the state's Department of Environmental Services for its anti-idling law and its partnership with the New Hampshire Transportation Association to promote reduced idling. A grant from the U.S. EPA funded 70 DOCs with crankcase filters in the state's two largest cities (Manchester and Nashua).	The average school bus is 10 years old and emits more than twice as much soot per mile as a big rig. The state has only one retrofit project under way, and ranked Poor for its lack of cleanup actions. The state needs funding for school bus replacement and cleanup.
Cleanup Program Rank	Poor		
Smog-forming Pollution Rank	Average		
Background			
Number of School Buses*	2,800		
Average School Bus Age (years)	10		
% of Fleet Older than 10 Years	43%		
Average School Bus Soot (pounds in 2005)	16.6		
Average Ratio of School Bus to Big Rig Soot per Mile	2.1		
% of School Bus Soot Reduced through Cleanup	0.5%		
Extra Credit			
State Fleet Tracking	Poor		
**Includes private and public school buses*			

NEW JERSEY

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	B	The state scored a B for soot and ranked Above Average for smog-forming pollution. New Jersey requires larger buses to be retired after 12 years, leading to a younger and cleaner fleet. High marks go to the state for requiring crankcase controls on all school buses starting in 2006, and good marks go to New Jersey's Department of Environmental Protection for its anti-idling and retrofit efforts. Nearly 200 buses currently have DOCs and 46 buses have flow-through filters as a result.	The average school bus is 7 years old and emits 50% more soot per mile than a big rig. As of 2005, New Jersey has reduced soot pollution a paltry 0.3% and the state ranked Poor for its cleanup program. Its Department of Environmental Protection should quickly provide the state legislature with a study on whether tailpipe emissions are affecting air quality inside school buses. New Jersey needs funding for tailpipe retrofits and cleaner fuels.
Cleanup Program Rank	Poor		
Smog-forming Pollution Rank	Above Average		
Background			
Number of School Buses*	23,326		
Average School Bus Age (years)	7		
% of Fleet Older than 10 Years	23%		
Average School Bus Soot (pounds in 2005)	11.7		
Average Ratio of School Bus to Big Rig Soot per Mile	1.5		
% of School Bus Soot Reduced through Cleanup	0.3%		
Extra Credit			
State Fleet Tracking	Poor		
**Includes model year 2005 public school buses only*			

NEW MEXICO

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	C	Good marks go to the state's Energy, Minerals and Natural Resources Department for its project to retrofit 50 buses with DOCs through funding from the U.S. EPA.	The average school bus is 10 years old and emits 2 times more soot per mile than a big rig. The state has only one retrofit project under way, resulting in a Poor ranking for cleanup. New Mexico needs funding for school bus replacement, pollution control retrofits, and cleaner fuels.
Cleanup Program Rank	Poor		
Smog-forming Pollution Rank	Average		
Background			
Number of School Buses*	3,292		
Average School Bus Age (years)	10		
% of Fleet Older than 10 Years	42%		
Average School Bus Soot (pounds in 2005)	16.0		
Average Ratio of School Bus to Big Rig Soot per Mile	2.0		
% of School Bus Soot Reduced through Cleanup	0.3%		
Extra Credit			
State Fleet Tracking	Poor		
**Includes model year 2005 public school buses only*			

NEW YORK

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	B	The state scored a B for soot and ranked Above Average for cleanup and smog-forming pollution. Among the state's many progressive actions: all 6,200 of New York City's school buses must be retro-fitted over the next few years; private contracts issued by the Department of Education include a school bus retirement age of 20 years; and both the Energy Authority and Power Authority have been actively supporting and funding retrofit projects (particularly in New York City).	The average state school bus is 8 years old and emits 60% more soot per mile than a big rig. With 30% of the state fleet older than 10 years, re-placement is a priority. New York needs funding not only for replacement but also con-tinued expansion of cleanup activities, particularly at public schools outside New York City and private schools across the state.
Cleanup Program Rank	Above Average		
Smog-forming Pollution Rank	Above Average		
Background			
Number of School Buses*	49,122		
Average School Bus Age (years)	8		
% of Fleet Older than 10 Years	30%		
Average School Bus Soot (pounds in 2005)	12.4		
Average Ratio of School Bus to Big Rig Soot per Mile	1.6		
% of School Bus Soot Reduced through Cleanup	2.5%		
Extra Credit			
State Fleet Tracking	Good		
**Includes model year 2005 private and public school buses*			

NORTH CAROLINA

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	C	North Carolina received an Above Average grade for cleanup, with many such pro-jects across the state. High marks go to the Department of the Environment and Natural Resources for its 20 projects resulting in about 1,300 DOCs, 600 buses running on B20, and 13 new CNG buses. Soot pollution has been reduced nearly 3%.	The average state school bus is 9 years old and releases 80% more soot per mile than a big rig. With 37% of the fleet older than 10 years, replace-ment is a priority. North Carolina should continue to make progress in reducing emissions through cleaner fuels and retrofits, and should expand its focus on DOCs to incorporate more sophisticated soot reduction technologies such as particulate traps.
Cleanup Program Rank	Above Average		
Smog-forming Pollution Rank	Average		
Background			
Number of School Buses*	13,529		
Average School Bus Age (years)	9		
% of Fleet Older than 10 Years	37%		
Average School Bus Soot (pounds in 2005)	14.4		
Average Ratio of School Bus to Big Rig Soot per Mile	1.8		
% of School Bus Soot Reduced through Cleanup	2.9%		
Extra Credit			
State Fleet Tracking	Good		
**Includes model year 2005 public school buses only*			

NORTH DAKOTA

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	C	Good marks go to the state's director of pupil transportation for collecting data on school bus age and fuel choice.	The average school bus is 12 years old and emits 2.2 times more soot per mile than a big rig. The state ranked Poor for cleanup, and has no retrofits on any school buses. With more than half the fleet older than 10 years, replacement is a priority. North Dakota needs funding for school bus replacement, pollution controls, and cleaner fuels.
Cleanup Program Rank	Poor		
Smog-forming Pollution Rank	Poor		
Background			
Number of School Buses*	1,935		
Average School Bus Age (years)	12		
% of Fleet Older than 10 Years	53%		
Average School Bus Soot (pounds in 2005)	16.9		
Average Ratio of School Bus to Big Rig Soot per Mile	2.2		
% of School Bus Soot Reduced through Cleanup	0.1%		
Extra Credit			
State Fleet Tracking	Good		
**Includes model year 2005 public school buses only*			

OHIO

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	C	High marks go to the state's Environmental Protection Agency for developing a new school bus retrofit program, with annual funding from enforcement actions expected to total approximately $350,000. Because this program begins in 2006, it was not included in our emissions evaluation. Good marks go to schools that installed 335 particulate traps (funded through a federal enforcement action against Toyota), and to retrofit efforts in Cleveland and Dayton.	The average school bus is 9 years old and emits nearly twice as much soot per mile as a big rig. With 1 in 3 buses in the fleet older than 10 years, replacement is a priority. The state should continue to expand its retrofit and clean fuels program.
Cleanup Program Rank	Average		
Smog-forming Pollution Rank	Average		
Background			
Number of School Buses*	20,398		
Average School Bus Age (years)	9		
% of Fleet Older than 10 Years	35%		
Average School Bus Soot (pounds in 2005)	14.9		
Average Ratio of School Bus to Big Rig Soot per Mile	1.9		
% of School Bus Soot Reduced through Cleanup	1.2%		
Extra Credit			
State Fleet Tracking	Good		
**Includes model year 2005 private and public school buses*			

OKLAHOMA

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	D	None	The average school bus is 11 years old and emits 2.4 times more soot per mile than a big rig. The state received a D for soot pollution, a Poor ranking for smog-forming pollution, and an Incomplete for its lack of cleanup activities. Oklahoma needs funding for a clean school bus program to invest in school bus retrofits, cleaner fuels, and replacement.
Cleanup Program Rank	Incomplete		
Smog-forming Pollution Rank	Poor		
Background			
Number of School Buses*	7,773		
Average School Bus Age (years)	11		
% of Fleet Older than 10 Years	48%		
Average School Bus Soot (pounds in 2005)	18.8		
Average Ratio of School Bus to Big Rig Soot per Mile	2.4		
% of School Bus Soot Reduced through Cleanup	0.0%		
Extra Credit			
State Fleet Tracking	Poor		
**Includes model year 2005 public school buses only*			

OREGON

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	C	Oregon ranked Above Average for its clean school bus program, which reduced soot by nearly 3%. The state has nearly 300 alternative-fuel buses that cut soot pollution more than 2.3%. Also, 2 retrofit projects have installed more than 50 particulate traps on school buses, reducing soot pollution an additional 0.5%.	The average school bus is 10 years old and emits 2 times more soot per mile than a big rig. In addition, 36% of the fleet is more than 10 years old, and 1 in 10 do not have to meet any soot standards. The state needs to expand its clean school bus program to promote replacements, retrofits, and cleaner fuels.
Cleanup Program Rank	Above Average		
Smog-forming Pollution Rank	Average		
Background			
Number of School Buses*	6,295		
Average School Bus Age (years)	10		
% of Fleet Older than 10 Years	36%		
Average School Bus Soot (pounds in 2005)	15.3		
Average Ratio of School Bus to Big Rig Soot per Mile	2.0		
% of School Bus Soot Reduced through Cleanup	2.8%		
Extra Credit			
State Fleet Tracking	Good		
**Includes model year 2005 private and public school buses*			

PENNSYLVANIA

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	B	Pennsylvania received a B for soot and ranked Above Average for smog-forming pollution due to its relatively new fleet of buses. Cleanup projects have resulted in the installation of about 280 particulate traps and 325 DOCs. Most of the funding has come from 3 federal enforcement actions and grants from the U.S. EPA, though smaller grants have also been funded by the state and a local health department.	The average public school bus is 7 years old and emits 50% more pollution than a big rig. Nearly 1 out of 5 is older than 10 years. The state needs funding for retrofits and cleaner fuels.
Cleanup Program Rank	Average		
Smog-forming Pollution Rank	Above Average		
Background			
Number of School Buses*	28,262		
Average School Bus Age (years)	7		
% of Fleet Older than 10 Years	18%		
Average School Bus Soot (pounds in 2005)	11.9		
Average Ratio of School Bus to Big Rig Soot per Mile	1.5		
% of School Bus Soot Reduced through Cleanup	1.2%		
Extra Credit			
State Fleet Tracking	Good		
**Includes public school buses only*			

RHODE ISLAND

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	C	Good marks go to Warwick public schools for retrofitting 50 buses with DOCs and fueling 72 buses with B20. The state's Office of Air Resources conducted a Breathe Better Rhode Island campaign to discourage school bus contractors from allowing engines to idle.	The average school bus is 9 years old and emits nearly twice as much soot per mile as a big rig. With 38% of the fleet older than 10 years, replacement is a priority. The state needs funding for pollution control retrofits, cleaner fuels, and replacement of the oldest, dirtiest buses.
Cleanup Program Rank	Average		
Smog-forming Pollution Rank	Average		
Background			
Number of School Buses*	1,646		
Average School Bus Age (years)	9		
% of Fleet Older than 10 Years	38%		
Average School Bus Soot (pounds in 2005)	14.8		
Average Ratio of School Bus to Big Rig Soot per Mile	1.9		
% of School Bus Soot Reduced through Cleanup	1.2%		
Extra Credit			
State Fleet Tracking	Poor		
**Includes public school buses only*			

SOUTH CAROLINA

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	D	The state ranked Above Average for its cleanup actions. Good marks go to the state's director of transportation and school districts for initiating a project to fuel 1,220 school buses with B20 and for aggressively seeking funds for retrofits. Good marks also go to the Department of Health and Environmental Control for its plans to install 140 particulate traps (using funds from an enforcement action) and its anti-idling education project.	The average school bus is 14 years old and emits more than 3 times as much soot per mile as a big rig. South Carolina received a D for soot and ranked Poor for smog-forming pollution. With one of the oldest fleets in the country (87% of buses are older than 10 years), the state desperately needs funding for school bus replacement as well as pollution control retrofits and cleaner fuels.
Cleanup Program Rank	Above Average		
Smog-forming Pollution Rank	Poor		
Background			
Number of School Buses*	5,702		
Average School Bus Age (years)	14		
% of Fleet Older than 10 Years	87%		
Average School Bus Soot (pounds in 2005)	24.5		
Average Ratio of School Bus to Big Rig Soot per Mile	3.1		
% of School Bus Soot Reduced through Cleanup	3.0%		
Extra Credit			
State Fleet Tracking	Good		
**Includes public school buses only*			

SOUTH DAKOTA

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	D	None	The average school bus is 14 years old and emits 3 times more soot per mile than a big rig. The state received a D for soot pollution and the lowest possible rankings for cleanup and smog-forming pollution. South Dakota needs funding for school bus pollution controls, cleaner fuels, and replacement.
Cleanup Program Rank	Incomplete		
Smog-forming Pollution Rank	Poor		
Background			
Number of School Buses*	1,670		
Average School Bus Age (years)	14		
% of Fleet Older than 10 Years	63%		
Average School Bus Soot (pounds in 2005)	23.7		
Average Ratio of School Bus to Big Rig Soot per Mile	3.0		
% of School Bus Soot Reduced through Cleanup	0.0%		
Extra Credit			
State Fleet Tracking	Poor		
**Includes public school buses only*			

TENNESSEE

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	B	Tennessee has a relatively young fleet of buses, with an average age of 7 years. As a result, the state received a B for soot and an Above Average grade for smog-forming pollution. Chattanooga Hamilton County Air Pollution Control and First Student installed more than 100 DOCs through a grant from the U.S. EPA. Good marks go to various schools for installing 94 particulate traps through funding from an enforcement action against Toyota.	The average public school bus is 7 years old and emits 50% more soot per mile than a big rig, and nearly 1 in 4 buses was built more than 10 years ago. The state needs funding for replacements, pollution control retrofits, and cleaner fuels.
Cleanup Program Rank	Average		
Smog-forming Pollution Rank	Above Average		
Background			
Number of School Buses*	8,258		
Average School Bus Age (years)	7		
% of Fleet Older than 10 Years	23%		
Average School Bus Soot (pounds in 2005)	11.8		
Average Ratio of School Bus to Big Rig Soot per Mile	1.5		
% of School Bus Soot Reduced through Cleanup	1.2%		
Extra Credit			
State Fleet Tracking	Good		
**Includes public school buses only*			

TEXAS

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	C	Texas ranked Above Average for its cleanup activities. Good marks go to various Councils of Government, the state's Energy Office, and its Railroad Commission for funding hundreds of retrofits and thousands of cleaner-fuel buses. Good marks also go to various schools for installing more than 500 particulate traps through funding from an enforcement action against Toyota.	The average public school bus is 10 years old and emits more than twice as much soot per mile as a big rig. With 36% of the fleet older than 10 years, Texas needs a plan for retiring and replacing buses. The state needs funding to expand its cleanup activities and replace older, high-polluting buses.
Cleanup Program Rank	Above Average		
Smog-forming Pollution Rank	Average		
Background			
Number of School Buses*	36,448		
Average School Bus Age (years)	10		
% of Fleet Older than 10 Years	36%		
Average School Bus Soot (pounds in 2005)	16.2		
Average Ratio of School Bus to Big Rig Soot per Mile	2.1		
% of School Bus Soot Reduced through Cleanup	3.3%		
Extra Credit			
State Fleet Tracking	Good		
**Includes public school buses only*			

UTAH

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	D	The Jordan School District has invested in 35 natural gas-powered school buses.	The average bus is 12 years old and emits 2.5 times more soot per mile than a big rig. The state received a D for soot pollution and the lowest rankings possible for cleanup and smog-forming pollution. Utah needs funding to develop a clean school bus program promoting retrofits and cleaner fuels. With more than half the fleet older than 10 years, the state also needs funding to retire and replace buses.
Cleanup Program Rank	Poor		
Smog-forming Pollution Rank	Poor		
Background			
Number of School Buses*	2,048		
Average School Bus Age (years)	12		
% of Fleet Older than 10 Years	53%		
Average School Bus Soot (pounds in 2005)	19.6		
Average Ratio of School Bus to Big Rig Soot per Mile	2.5		
% of School Bus Soot Reduced through Cleanup	0.5%		
Extra Credit			
State Fleet Tracking	Poor		
**Includes public school buses only*			

VERMONT

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	C	Good marks go to the Breathe Better Vermont anti-idling campaign, funded by the state's Department of Environmental Conservation.	The average school bus is 10 years old and emits 2 times more soot per mile than a big rig. Vermont failed to conduct any retrofit or clean-fuel projects, resulting in an Incomplete for cleanup. The state needs funding for school bus replacement, retrofits, and cleaner fuels.
Cleanup Program Rank	Incomplete		
Smog-forming Pollution Rank	Average		
Background			
Number of School Buses*	1,800		
Average School Bus Age (years)	10		
% of Fleet Older than 10 Years	43%		
Average School Bus Soot (pounds in 2005)	15.4		
Average Ratio of School Bus to Big Rig Soot per Mile	2.0		
% of School Bus Soot Reduced through Cleanup	0.0%		
Extra Credit			
State Fleet Tracking	Poor		
**Includes public school buses only*			

VIRGINIA

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	C	The state has an active clean school bus program that has cut soot pollution by 2.3%. About 1,900 DOCs (many with low nitrogen oxide calibration) have been installed on school buses, and nearly 200 run on B20.	The average school bus is 10 years old and emits 2.1 times more soot per mile than a big rig. Virginia needs additional funding to expand its clean school bus program and replace older buses.
Cleanup Program Rank	Average		
Smog-forming Pollution Rank	Average		
Background			
Number of School Buses*	13,204		
Average School Bus Age (years)	10		
% of Fleet Older than 10 Years	44%		
Average School Bus Soot (pounds in 2005)	16.2		
Average Ratio of School Bus to Big Rig Soot per Mile	2.1		
% of School Bus Soot Reduced through Cleanup	2.3%		
Extra Credit			
State Fleet Tracking	Poor		
**Includes model year 2005 public school buses only*			

WASHINGTON

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	D	Washington receives high marks for reducing soot pollution more than 7%—second only to California. More than 3,550 buses already have DOCs installed, and the state has committed to retrofitting all of its school buses with DOCs and particulate traps.	The average school bus is 11 years old and emits 2.3 times more soot per mile than a big rig. The state scored a D in soot pollution and needs to continue expanding its clean school bus program. With about half the fleet older than 10 years, the state needs funding to retire and replace its oldest buses. Washington also needs funding to retrofit school buses with more sophisticated technologies such as particulate traps and crankcase controls.
Cleanup Program Rank	Good		
Smog-forming Pollution Rank	Poor		
Background			
Number of School Buses*	9,613		
Average School Bus Age (years)	11		
% of Fleet Older than 10 Years	50%		
Average School Bus Soot (pounds in 2005)	17.6		
Average Ratio of School Bus to Big Rig Soot per Mile	2.3		
% of School Bus Soot Reduced through Cleanup	7.3%		
Extra Credit			
State Fleet Tracking	Good		
**Includes model year 2005 public school buses only*			

WEST VIRGINIA

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	C	Good marks go to school districts in Berkeley, Brooke, Jefferson, and Ohio Counties, which are installing DOCs on about 140 buses through funding from a federal enforcement action.	The average school bus is 8 years old and emits 80% more soot per mile than a big rig. West Virginia ranked Poor for cleanup. The state needs funding not only for a clean school bus program that promotes retrofits and cleaner fuels, but also to retire and replace its oldest buses (since about 30% of the fleet is older than 10 years).
Cleanup Program Rank	Poor		
Smog-forming Pollution Rank	Average		
Background			
Number of School Buses*	3,583		
Average School Bus Age (years)	8		
% of Fleet Older than 10 Years	29%		
Average School Bus Soot (pounds in 2005)	13.8		
Average Ratio of School Bus to Big Rig Soot per Mile	1.8		
% of School Bus Soot Reduced through Cleanup	1.0%		
Extra Credit			
State Fleet Tracking	Good		
**Includes public school buses only*			

WISCONSIN

	Results	Commendations	Areas for Improvement
Soot Pollution Grade	C	Good marks go to the Department of Natural Resources for working with school districts to install as many as 1,000 DOCs on school buses (using federal funds in the form of a Congestion Mitigation and Air Quality grant).	The average school bus is 11 years old and emits 2.2 times more soot per mile than a big rig. With about 47% of the fleet older than 10 years, replacement is a priority. The state needs funding for school bus replacements, retrofits, and cleaner fuels.
Cleanup Program Rank	Average		
Smog-forming Pollution Rank	Average		
Background			
Number of School Buses*	10,000		
Average School Bus Age (years)	11		
% of Fleet Older than 10 Years	47%		
Average School Bus Soot (pounds in 2005)	16.9		
Average Ratio of School Bus to Big Rig Soot per Mile	2.2		
% of School Bus Soot Reduced through Cleanup	1.6%		
Extra Credit			
State Fleet Tracking	Poor		
**Includes public school buses only*			
	Results	**Commendations**	**Areas for Improvement**

WYOMING

Soot Pollution Grade	B	Good state funding for new school buses has resulted in a younger fleet and lower soot pollution, earning the state a B for soot.	The average school bus is 7 years old and emits 60% more soot pollution per mile than a big rig. Wyoming failed to implement any cleanup actions, resulting in an Incomplete. With about 37% of the fleet older than 10 years, replacement is a priority. The state needs funding for a clean school bus program that promotes replacements, cleaner fuels, and retrofits.
Cleanup Program Rank	Incomplete		
Smog-forming Pollution Rank	Above Average		
Background			
Number of School Buses*	1,708		
Average School Bus Age (years)	7		
% of Fleet Older than 10 Years	26%		
Average School Bus Soot (pounds in 2005)	12.6		
Average Ratio of School Bus to Big Rig Soot per Mile	1.6		
% of School Bus Soot Reduced through Cleanup	0.0%		
Extra Credit			
State Fleet Tracking	Good		
**Includes model year 2005 public school buses only*			

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Appendix
Data Sources

State	Private Schools Included?	Source for Total Number of Buses	Source for Model Year Data	Source for Fuel Choice	Source for Policies/General	Source for Cleanup Program Data
Alabama	No	Joe Lightsey, Administrator of Pupil Transportation, Dept. of Education	Joe Lightsey, Administrator of Pupil Transportation, Dept. of Education	Joe Lightsey, Administrator of Pupil Transportation, Dept. of Education	Joe Lightsey, Administrator of Pupil Transportation, Dept. of Education	Ronnie Watkins, Chief, Program Development Unit, Dept. of Environmental Management
Alaska	Yes	Gary Wolske, Resurrection Auto	Gary Wolske, Resurrection Auto	Gary Wolske, Resurrection Auto	Eddy Jeans, School Finance Manager, Dept. of Education	Steve Calmus, Anchorage School District; Clint Farr, Dept. of Environmental Conservation
Arizona	No	Vickie Barnett and Shirley Willis, Dept. of Education	R.L. Polk	Shirley Willis, Dept. of Education	Vickie Barnett, Dept. of Education	Bill Ball, Tucson Unified School District; Jeff Cook, Paradise Valley Unified School District; Colleen Crowninshield, Clean Cities
Arkansas	No	Mike Simmons, Coordinator of School Transportation, Dept. of Education	R.L. Polk	National average	Mike Simmons, Coordinator of School Transportation, Dept. of Education	Jim McKenzie, Metroplan
California	Yes	Mike Ellis, Highway Patrol	Mike Ellis, Highway Patrol	Mike Ellis, Highway Patrol	None	Chris Acree, SJVAPCD; Freya Arick, SAPCD; Karen Chi, BAAQMD; Ranji George, SCAQMD; Cherie Rainforth, ARB; Chuck Spagnola, SDAPCD; Mike Trujillo, CEC
Colorado	No	Bruce Little, Senior Transportation Consultant, Dept. of Education	R.L. Polk	National average	Bruce Little, Senior Transportation Consultant, Dept. of Education	Steve McCannon, Regional Air Quality Council; Bob Young, Boulder Public Schools
Connecticut	Yes	Lt. David Maestrini, Commercial Vehicle Safety Division, Dept. of Motor Vehicles	Lt. David Maestrini, Commercial Vehicle Safety Division, Dept. of Motor Vehicles	National average	Lt. David Maestrini, Commercial Vehicle Safety Division, Dept. of Motor Vehicles	Tracy Babbidge, Dept. of the Environment
Delaware	No	Ronald Love, Supervisor of Pupil Transportation, Dept. of Education	Ronald Love, Supervisor of Pupil Transportation, Dept. of Education	Ronald Love, Supervisor of Pupil Transportation, Dept. of Education	Ronald Love, Supervisor of Pupil Transportation, Dept. of Education	Phil Wheeler, Air Quality Management Section, Dept. of Natural Resources and Environmental Control

State	Private Schools Included?	Source for Total Number of Buses	Source for Model Year Data	Source for Fuel Choice	Source for Policies/General	Source for Cleanup Program Data
District of Columbia	No	David Gilmore, DC Public Schools	David Gilmore, DC Public Schools	David Gilmore, DC Public Schools	David Gilmore, DC Public Schools	None
Florida	No	Terri Egler, Dept. of Education	Terri Egler, Dept. of Education	Terri Egler, Dept. of Education	Terri Egler, Dept. of Education	Martin Costello, Dept. of Environmental Protection
Georgia	No	Bill Simpson, Dept. of Education	Bill Simpson, Dept. of Education	Bill Simpson, Dept. of Education	Bill Simpson, Dept. of Education	Stacy Allman, Dept. of Natural Resources
Hawaii	No	Blanche Fontain, Student Transportation Services, Dept. of Education	R.L. Polk	National average	Blanche Fontain, Student Transportation Services, Dept. of Education	Willie Nagamine, Clean Air Branch, Dept. of Health
Idaho	No	Ray Merical, Pupil Transportation Dept., Dept. of Education	Ray Merical, Pupil Transportation Dept., Dept. of Education	National average	Ray Merical, Pupil Transportation Dept., Dept. of Education	Jorge Garcia, Dept. of Environmental Quality
Illinois	No	Estimate from historical growth	R.L. Polk	National average	Cinda Meneghetti, Div. of Funding & Disbursement Services, Board of Education	Mary Cruse, Illinois EPA
Indiana	No	Pete Baxter, Div. of School Traffic Safety, Dept. of Education	Pete Baxter, Div. of School Traffic Safety, Dept. of Education	National average	Pete Baxter, Div. of School Traffic Safety, Dept. of Education	Sean Seals, Dept. of Environmental Management
Iowa	No	Max Christensen, State Director of Pupil Transportation, Dept. of Education	Max Christensen, State Director of Pupil Transportation, Dept. of Education	Max Christensen, State Director of Pupil Transportation, Dept. of Education	Max Christensen, State Director of Pupil Transportation, Dept. of Education	Wendy Rains, Dept. of Natural Resources
Kansas	No	Larry Bluthardt, Director, School Bus Safety Education Unit, Dept. of Education	R.L. Polk	National average	Larry Bluthardt, Director, School Bus Safety Education Unit, Dept. of Education	Doug Watson, Dept. of Health and Environment
Kentucky	No	Tom Campbell, Director, Div. of Audit and Transportation Services, Dept. of Education	Tom Campbell, Director, Div. of Audit and Transportation Services, Dept. of Education	Tom Campbell, Director, Div. of Audit and Transportation Services, Dept. of Education	Tom Campbell, Director, Div. of Audit and Transportation Services, Dept. of Education	John Govins, Div. of Air Quality, Natural Resources and Environmental Protection
Louisiana	No	Jason Anthony, Dept. of Education; Larry Ourso, Director of Pupil Transportation, Dept. of Education	R.L. Polk	Jason Anthony, Dept. of Education; Larry Ourso, Director of Pupil Transportation, Dept. of Education	Jason Anthony, Dept. of Education; Larry Ourso, Director of Pupil Transportation, Dept. of Education	Barry Feldman, Joe Kordzi, and Clovis Steib, U.S. EPA Region 6

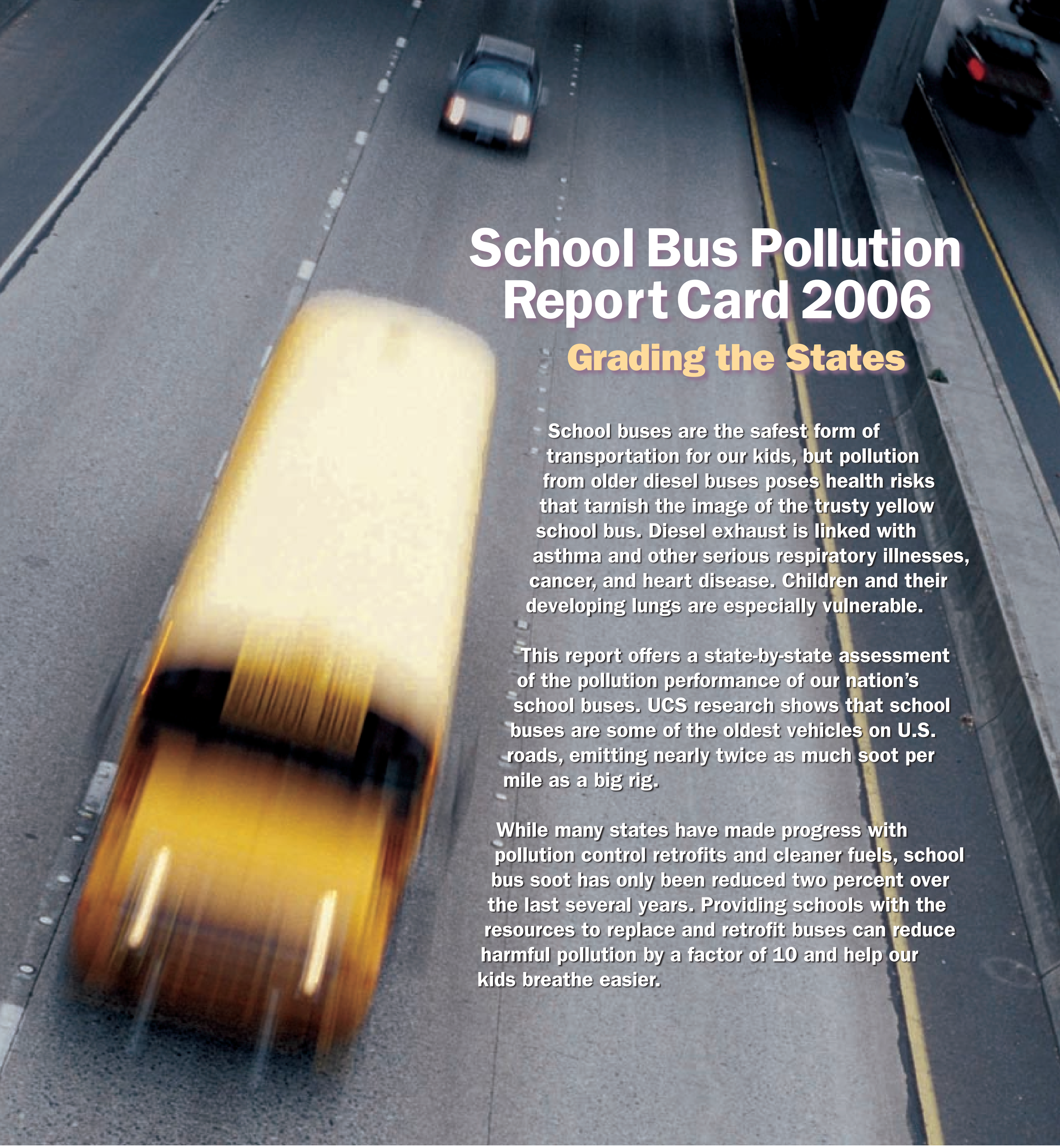
State	Private Schools Included?	Source for Total Number of Buses	Source for Model Year Data	Source for Fuel Choice	Source for Policies/General	Source for Cleanup Program Data
Maine	No	Harvey Boatman, Education Specialist, School Facilities & Transportation, Dept. of Education	Harvey Boatman, Education Specialist, School Facilities & Transportation, Dept. of Education	Harvey Boatman, Education Specialist, School Facilities & Transportation, Dept. of Education	Harvey Boatman, Education Specialist, School Facilities & Transportation, Dept. of Education	Lynn Cayting, Dept. of Environmental Protection
Maryland	No	Ed Beck, Pupil Transportation Director, Dept. of Education	Ed Beck, Pupil Transportation Director, Dept. of Education	Ed Beck, Pupil Transportation Director, Dept. of Education	Ed Beck, Pupil Transportation Director, Dept. of Education	Lonny Richmond, Dept. of the Environment
Massachusetts	No	Judith Dupille, Registry of Motor Vehicles	R.L. Polk	National average	None	Christine Kerby, Dept. of Environmental Protection; Ted LeClerc, First Student Bus Company
Michigan	No	Dwight Sinila, Dept. of Education	R.L. Polk	National average	Dwight Sinila, Dept. of Education	Bob Rusch, Dept. of Environmental Quality
Minnesota	Yes	Duane Bartels, State Patrol	R.L. Polk	National average	Duane Bartels and Ken Urquhart, State Patrol	Jeff Buss, Pollution Control Agency
Mississippi	No	Leonard Swilley, Office of Safe & Orderly Schools, Dept. of Education	R.L. Polk	National average	Leonard Swilley, Office of Safe & Orderly Schools, Dept. of Education	Keith Head, Dept. of Environmental Quality
Missouri	Yes	Brenda David, Motor Vehicle Inspection Analyst, DMV	Brenda David, Motor Vehicle Inspection Analyst, DMV	National average	Tom Quinn, Dept. of Elementary and Secondary Education	Haskins Hobsons, I/M Team Coordinator, Dept. of Natural Resources; Gina Ryan, St. Louis Community Project; Thomas Timbario, Emissions Advantage LLC
Montana	No	Maxine Mougeot, Pupil Transportation Director, Office of Public Instruction	Maxine Mougeot, Pupil Transportation Director, Office of Public Instruction	National average	Maxine Mougeot, Pupil Transportation Director, Office of Public Instruction	Brian Spangler, Dept. of Environmental Quality
Nebraska	No	Ron Mowrey, Programmer, Office of Public Instruction	Ron Mowrey, Programmer, Office of Public Instruction	National average	Russ Inbody, Director of Pupil Transportation, Office of Public Instruction	Victor Bohuslavsky, Nebraska Soybean Board; Marcus Rivas, U.S. EPA Region 7
Nevada	No	Diana Hollander, Pupil Transportation Program Manager, Dept. of Education	Diana Hollander, Pupil Transportation Program Manager, Dept. of Education	National average	Diana Hollander, Pupil Transportation Program Manager, Dept. of Education	Dan Hyde, City of Las Vegas; Sig Jaunarajs, Div. of Environmental Protection
New Hampshire	Yes	Officer Tarr, Div. of Motor Vehicles	R.L. Polk	National average	Officer Tarr, Div. of Motor Vehicles	Kathy Brockett, Dept. of Environmental Services

State	Private Schools Included?	Source for Total Number of Buses	Source for Model Year Data	Source for Fuel Choice	Source for Policies/General	Source for Cleanup Program Data
New Jersey	Yes	Bill Reed, Motor Vehicle Commission	Bill Reed, Motor Vehicle Commission (maximum age only)	National average	Dot Shelmet, Acting Director, Office of Student Transportation, Dept. of Education	Melinda Dower, Dept. of Environmental Protection
New Mexico	No	Estimate from historical growth	R.L. Polk	National average	Gilbert Perea, State Transportation Director, Dept. of Education	Barry Feldman, Joe Kordzi, and Clovis Steib, U.S. EPA Region 6
New York	Yes	Rusty Seastron, Div. of Public Safety, Dept. of Transportation	Rusty Seastron, Div. of Public Safety, Dept. of Transportation	Rusty Seastron, Div. of Public Safety, Dept. of Transportation	Rusty Seastron, Div. of Public Safety, Dept. of Transportation	Patrick Bolton, Energy Research and Development Authority; Kerry-Jane King, New York Power Authority
North Carolina	No	Derek Graham, Director, School Bus Transportation, Dept. of Public Instruction	Derek Graham, Director, School Bus Transportation, Dept. of Public Instruction	National average	Derek Graham, Director, School Bus Transportation, Dept. of Public Instruction	Vickie Chandler, Dept. of Environment and Natural Resources
North Dakota	No	Tom Decker, Director, School Bus Transportation, Dept. of Public Instruction	Tom Decker, Director, School Bus Transportation, Dept. of Public Instruction	Tom Decker, Director, School Bus Transportation, Dept. of Public Instruction	Tom Decker, Director, School Bus Transportation, Dept. of Public Instruction	Jeffrey Kimes, U.S. EPA Region 8
Ohio	Yes	Lt. Boster, Motor Vehicle Inspection Unit, State Patrol	Lt. Boster, Motor Vehicle Inspection Unit, State Patrol	National average	Pete Japiske, Director of Pupil Transportation, Div. of School Finance, Dept. of Education	Glenn Luksik, Ohio Environmental Protection Agency
Oklahoma	No	Randy McLerran, State Director of Pupil Transportation	R.L. Polk	National average	Randy McLerran, State Director of Pupil Transportation	Joe Kordzi and Clovis Steib, U.S. EPA Region 6
Oregon	Yes	Deborah Lincoln, Director of Pupil Transportation, Dept. of Transportation	Deborah Lincoln, Director of Pupil Transportation, Dept. of Transportation	National average	Kevin Downing, Dept. of Environmental Quality	Kevin Downing, Dept. of Environmental Quality
Pennsylvania	No	Chris Miller, Director, Pupil Transportation, Dept. of Education; data from Dept. of Transportation provided by Chris Trostle, Dept. of Environmental Protection	Chris Miller, Director, Pupil Transportation, Dept. of Education; data from Dept. of Transportation provided by Chris Trostle, Dept. of Environmental Protection	National average	Chris Miller, Director, Pupil Transportation, Dept. of Education	Chris Trostle, Dept. of Environmental Protection
Rhode Island	Yes	Estimate from historical growth	R.L. Polk	National average	Edward Parker, School Bus Safety, Registry of Motor Vehicles	Ron Marcaccio, Dept. of Environmental Management

State	Private Schools Included?	Source for Total Number of Buses	Source for Model Year Data	Source for Fuel Choice	Source for Policies/General	Source for Cleanup Program Data
South Carolina	No	Donald Tudor, Director of Transportation, Dept. of Education	Donald Tudor, Director of Transportation, Dept. of Education	Donald Tudor, Director of Transportation, Dept. of Education	Donald Tudor, Director of Transportation, Dept. of Education	Brian Barnes, Dept. of Health and Environmental Control
South Dakota	No	Estimate from historical growth	R.L. Polk	National average	Carol Uecker, Director of Pupil Transportation, Div. of Education	Jeffrey Kimes, U.S. EPA Region 8
Tennessee	No	Sam Cameron, Dept. of Education	Sam Cameron, Dept. of Education	National average	Sam Cameron, Dept. of Education	Marc Corrigan, Dept. of Environment and Conservation
Texas	No	Randy Boatman, Dept. of Education	Randy Boatman, Dept. of Education	National average	Charley Kennington, School Transportation, Dept. of Public Safety	Heather Ball, RR Commission; Hazel Barbour, Central Texas Adopt-A-School Program Manager; Dawn Martinez, SE Texas Regional Planning Commissions; Mindy Mize, North Central COG; Mary-Jo Rowan, Transportation Energy Program, Energy Conservation Office; Jason Salinas, Houston/Galveston COG; Betin Santos, Environmental Defense
Utah	No	Brent Huffman, Pupil Transportation Specialist, Office of Education	R.L. Polk; limited data from Brent Huffman, Pupil Transportation Specialist, Office of Education	Brent Huffman, Pupil Transportation Specialist, Office of Education	Brent Huffman, Pupil Transportation Specialist, Office of Education	Jim Hinkle, Jordan School District; Beverly Miller, Clean Cities; Joe Thomas, Dept. of Environmental Quality
Vermont	Yes	Ron Richter, Div. of Enforcement & Safety	R.L. Polk	National average	Ron Richter, Div. of Enforcement & Safety	David Love, Dept. of Environmental Conservation
Virginia	No	Estimate from historical growth	R.L. Polk	National average	June Eanes, Associate Director, Pupil Transportation, Dept. of Education	Doris McLeod, Dept. of Environmental Quality; Nic Van Vuurent, Clean Cities
Washington	No	Allan Jones, Pupil Transportation, Office of Superintendent of Public Instruction	Allan Jones, Pupil Transportation, Office of Superintendent of Public Instruction	Allan Jones, Pupil Transportation, Office of Superintendent of Public Instruction	Allan Jones, Pupil Transportation, Office of Superintendent of Public Instruction	Mike Boyer, Dept. of Ecology
West Virginia	No	Ben Shew, Executive Director, Office of School Transportation	Ben Shew, Executive Director, Office of School Transportation	Ben Shew, Executive Director, Office of School Transportation	Ben Shew, Executive Director, Office of School Transportation	Remy Chakrabarty, Dept. of Environmental Protection

State	Private Schools Included?	Source for Total Number of Buses	Source for Model Year Data	Source for Fuel Choice	Source for Policies/General	Source for Cleanup Program Data
Wisconsin	No	Bob Christian, Wisconsin School Bus Association, acting for Director of Pupil Transportation	R.L. Polk	National average	Bob Christian, Wisconsin School Bus Association, acting for Director of Pupil Transportation	Jessica Lawent, Dept. of Natural Resources
Wyoming	No	Leeds Pickering, Director of Pupil Transportation, Dept. of Education	Leeds Pickering, Director of Pupil Transportation, Dept. of Education	National average	Leeds Pickering, Director of Pupil Transportation, Dept. of Education	Jeffrey Kimes, U.S. EPA Region 8

NOTE:
All agencies referenced in this appendix are state agencies unless otherwise noted.



School Bus Pollution Report Card 2006

Grading the States

School buses are the safest form of transportation for our kids, but pollution from older diesel buses poses health risks that tarnish the image of the trusty yellow school bus. Diesel exhaust is linked with asthma and other serious respiratory illnesses, cancer, and heart disease. Children and their developing lungs are especially vulnerable.

This report offers a state-by-state assessment of the pollution performance of our nation's school buses. UCS research shows that school buses are some of the oldest vehicles on U.S. roads, emitting nearly twice as much soot per mile as a big rig.

While many states have made progress with pollution control retrofits and cleaner fuels, school bus soot has only been reduced two percent over the last several years. Providing schools with the resources to replace and retrofit buses can reduce harmful pollution by a factor of 10 and help our kids breathe easier.

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