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.

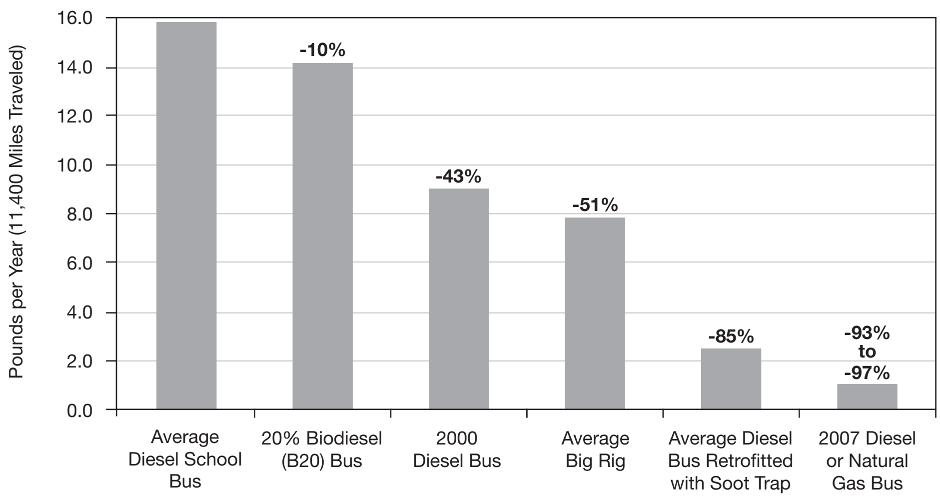
- **Replacing the oldest school buses and retrofitting more recent models will require substantial investment by states and the federal government.** Equipping all school buses built after 1993 with particulate traps and closed crankcase filtration controls would cost approximately $2.6 billion.[2] Replacing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