United States Environmental Protection Agency

National Clean Diesel Campaign

Innovative Strategies for Cleaner Air

2005 Progress Report

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"Working together we are going to make that black puff of smoke a thing of the past."

Stephen L. Johnson, EPA Administator

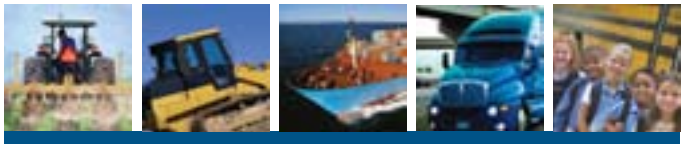
Introduction

Background

From the farm to the neighborhood grocery store, we find diesel engines in every corner of society. Diesel engines power the movement of goods across the nation, help construct the buildings in which we live and work, help build the roads on which we travel, and carry millions of children to school each day. While diesel engines provide mobility and are critical to the nation's economy, exhaust from diesel engines contains pollutants that negatively impact human health and the environment.

Diesel engines are a major source of pollution. Specifically, they emit particulate matter (PM), also known as soot; nitrogen oxides (NOx), which contribute to the production of ground-level ozone, or smog; hydrocarbons (HC); and air toxics. These pollutants contribute to poor air quality in many areas of the country and can cause serious health problems, especially for children, the elderly, and the chronically ill.

Fortunately, many cost-effective solutions are available today that can dramatically reduce pollutants from diesel exhaust. There are a variety of dependable, effective, and affordable technologies and measures—from exhaust filters to cleaner fuels to idle-reduction strategies—that will allow the nation to harness the power of diesel engines without compromising public health or the environment.



National Clean Diesel Campaign

What Is the National Clean Diesel Campaign?

The U.S. Environmental Protection Agency (EPA) established the National Clean Diesel Campaign (NCDC) to promote diesel emission reduction strategies. NCDC includes regulatory programs to address new diesel engines as well as voluntary programs to address the millions of diesel engines already in use.

NCDC's Regulatory Programs for New Diesel Engines

EPA has finalized two sets of clean fuel and vehicle emission standards that will lead to dramatic emission reductions in new diesel-powered engines.

The *2007 Heavy-Duty Highway Engine Rule* will cut harmful pollutants from highway engines by more than 90 percent, resulting in annual reductions of 2.6 million tons of NOx and 110,000 tons of PM when fully implemented.

The *Clean Air Nonroad Diesel Rule* will cut emissions from new construction and agricultural and industrial engines by more than 90 percent, resulting in annual reductions of 738,000 tons of NOx and 120,000 tons of PM annually when fully implemented.

NCDC's Voluntary Strategies

More than 11 million diesel engines in operation today do not meet EPA's new clean diesel standards, yet these engines can continue to operate for 20 to 30 years. EPA established voluntary programs to accelerate emission reductions from older diesel engines to provide more immediate air quality benefits. The goal of EPA's voluntary programs is to address in-use diesel engines in five

Diesel Emissions and Public Health

Reducing diesel engine emissions is one of the most important public health challenges facing the country. Emissions from these engines, especially particulate matter (PM), contribute to health problems. PM has been associated with an increased risk of premature mortality, hospital admissions for heart and lung disease, and increased respiratory symptoms. Long-term exposure to diesel exhaust is likely to pose a lung cancer hazard.

In addition, nitrogen oxides (NOx) contribute to ozone, which can aggravate asthma and other respiratory diseases, leading to more asthma attacks, the use of additional medication, more severe symptoms that require a doctor's attention, more visits to the emergency room, and increased hospitalizations. Ozone can inflame and damage the lining of the lungs, which can lead to permanent changes in lung tissue, irreversible reductions in lung function if the inflammation occurs repeatedly over a long time period, and a lower quality of life. Children, outdoor workers, people with heart and lung disease, and the elderly are most at risk.

The emissions in diesel exhaust contribute to poor air quality in many areas of the country. Areas designated as "nonattainment" do not meet the health-based National Ambient Air Quality Standards. About 159 million Americans live in areas that are designated as nonattainment with the 8-hour ozone standard. Nearly 90 million people live in areas that do not meet the PM standard. EPA and states are working aggressively to reduce air pollution in these areas to protect the health of all Americans. Reducing diesel emissions is necessary to accomplish this task.

Diesel Emissions and the Environment

In addition to public health impacts, diesel exhaust can also contribute to environmental problems. The NOx in diesel exhaust can contribute to the formation of ozone (smog), which can make plants more susceptible to disease, pests, damage from other pollutants, and harsh weather conditions. The NOx and sulfur in diesel emissions contribute to acid rain, which can negatively impact bodies of water and damage the building blocks of aquatic ecosystems. Fine particulates from diesel engines can also be a source of haze, which affects people's ability to see long distances and to enjoy scenic vistas in recreational areas such as national parks. In addition, PM, NOx, and ozone can all contribute to crop damage.

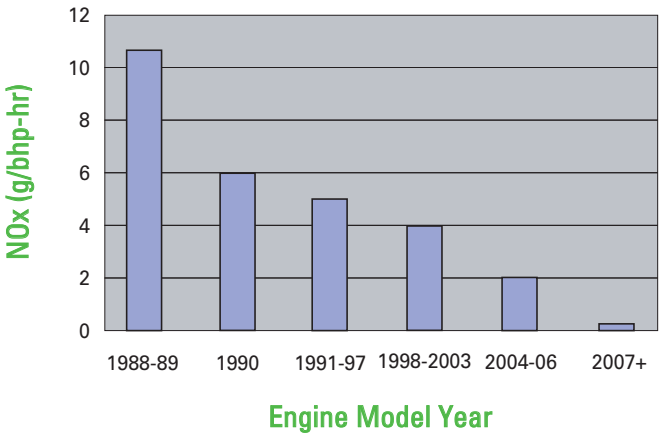
key sectors—freight, construction, agriculture, ports, and school buses—by promoting a variety of cost-effective and innovative emission reduction strategies, including switching to cleaner fuels; retrofitting, repairing, repowering, and replacing equipment; and reducing idling. EPA has made significant progress toward this goal by engaging in partnerships, fostering innovative technologies, and providing grants to accelerate the introduction of clean diesel technologies.

Summary of Key Accomplishments, 2004-2005

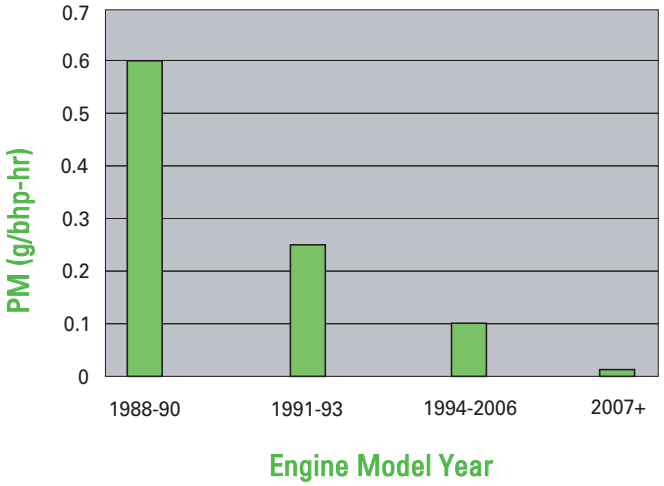
Regulations Driving Cleaner Engines

Through landmark regulations, EPA has dramatically reduced and will continue to reduce the amount of PM and NOx emitted from the tailpipes of new diesel engines. Current highway trucks and buses emit about one-sixth of the PM and less than 80 percent of the NOx of a 20-year old truck. In 2007, new heavy-duty diesel engines will become even cleaner, and all highway diesel engines will be powered with cleaner diesel fuel. In 2008, nonroad engines in construction, agriculture, and industrial equipment will become 90 percent cleaner than they were just over a decade ago.

Highway Heavy-duty Diesel Engines NOx Emission Standards



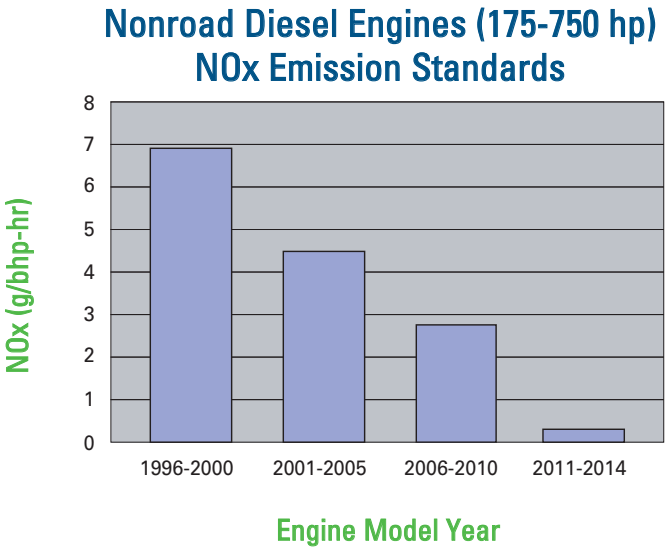
Highway Heavy-duty Diesel Engines PM Emission Standards

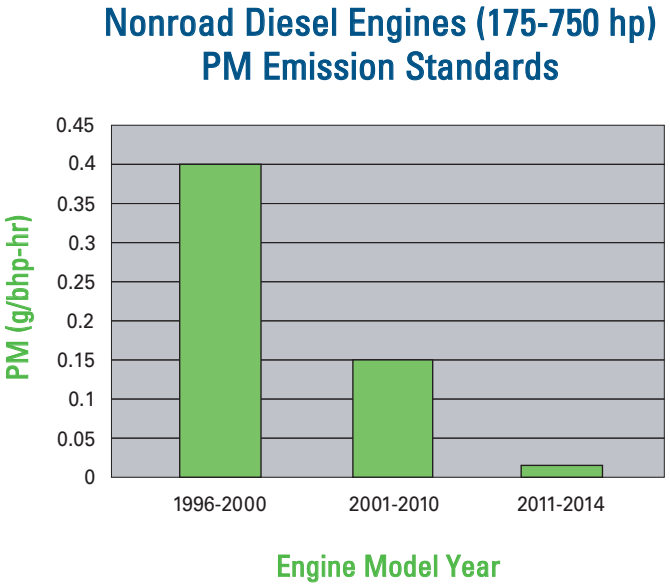


Through the *2007 Heavy-Duty Highway Engine Rule*, EPA estimates that emission reductions will prevent:

- 8,300 premature deaths
- More than 9,500 hospitalizations
- 1.5 million lost work days annually

The total health benefits from the rule are expected to be more than 17 times the compliance costs.





In addition, the *Clean Air Nonroad Diesel Rule* is expected to prevent:

- 12,000 premature deaths
- 8,900 hospitalizations
- 1 million lost work days annually

The total benefits from this rule are expected to be 40 times the compliance costs.

Voluntary Programs Yielding Results

While EPA regulations are making new diesel engines cleaner, EPA has been reducing the amount of pollution emitted from nearly 200,000 diesel engines in operation today through NCDC's voluntary programs. The voluntary programs' estimated lifetime PM reduction of 20,000 tons is equivalent to removing more than 1,000 heavy-duty trucks from the nation's roads. The NOx lifetime reduction of more than 110,000 tons is comparable to removing almost 115,000 large diesel trucks from the road.

Clean diesel retrofit programs currently under way will provide approximately $4 to $5 billion in health benefits from PM reductions over the life of the programs (in year 2000 dollars), including avoiding:

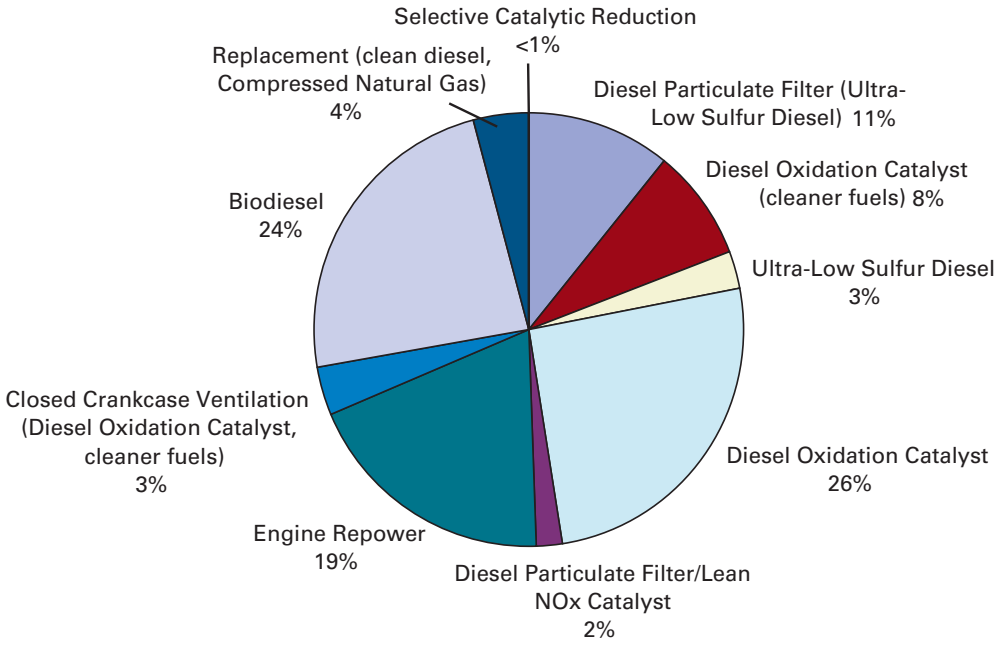
- Approximately 1,000 cases of premature deaths.
- Approximately 2,000 chronic illnesses, such as chronic bronchitis and non-fatal heart attacks.
- Nearly 40,000 respiratory symptoms in children.
- About 27,000 asthma exacerbations, 1,000 of which would be serious enough to send a patient to the emergency room.
- Hundreds of thousands of minor restricted activity days.

This health benefit estimate, from clean diesel retrofit programs currently underway, does not take into account other impacts from diesel emissions such as ozone-related health effects, visibility effects, and air toxic effects, such as cancer risks.

Fostering Technology

NCDC voluntary programs are creating demand for emission reduction technologies. To date, EPA has verified emissions benefits for 17 emission control technologies through extensive and statistically rigorous testing. In addition, 20 states and Washington, D.C., are using ultra-low sulfur diesel well ahead of EPA's mandates. This cleaner diesel fuel directly reduces emissions from engines and enables the use of some of the most effective emission control devices to date. Clean diesel partners are using a wide variety of technologies to reduce emissions.

Diverse Technologies Reduce Diesel Emissions



Clean diesel projects currently underway employ a wide range of strategies to achieve reductions in diesel emissions. This chart illustrates the percentage of vehicles/engines that use a particular technology to reduce diesel emissions.

Broad-based Support

Through NCDC, EPA has collaborated with more than 500 partners to reduce the health effects of diesel emissions across the nation. These diverse and committed partners include state and local governments that have created incentive programs to reduce emissions from both public and private fleets; businesses and industry groups that have provided technical assistance and devoted millions of dollars to retrofit diesel engines; and environmental or community groups that have successfully advocated for and managed effective projects to help reduce the public health impacts from diesel emissions.

Partnerships have resulted in more than one million children in 150 school districts riding more than 20,000 cleaner buses; freight collaborations have created more than 50 idle-reduction projects along major interstate corridors; and more than 200 shipping and trucking companies have committed to reducing emissions from roughly 300,000 trucks.

EPA recently showcased the results of its collective efforts and expanded the partnership base at the NCDC Policy Leaders Summit, which was co-sponsored by the Diesel Technology Forum and the Manufacturers of Emission Controls Association. Approximately 300 government, industry, and environmental leaders converged in Washington, D.C., to share lessons learned from successful programs and to explore innovative options for accelerating diesel emission reductions. At the conference, EPA welcomed several new organizations into the campaign and fostered new opportunities for collaboration and partnership.

Funding Projects

EPA has funded many successful projects across the country through NCDC. The campaign's Clean School Bus USA program has provided approximately 80 grants, which have led to approximately 10,000 school bus retrofits. EPA has also provided NCDC funding toward 28 projects that will reduce emissions from more than 1,000 diesel vehicles and equipment used in construction, ports, agriculture, transit, and municipal fleets. SmartWay Transport grants have created more than 1,000 electrified parking spaces that reduce emissions by eliminating engine idling.

More than 300 clean diesel projects nationwide are resulting in significant emission reductions (in lifetime tons) including:

- **110,000 NOx**
- **20,000 PM**
- **35,000 HC**
- **125,000 carbon monoxide (CO)**

EPA's clean diesel grants leverage more than $2 for every federal dollar invested. Demand for NCDC grant funds has exceeded available resources by 10 times, illustrating great support for reducing diesel emissions. In addition to EPA's clean diesel funds, several state and local programs are providing financial support for clean diesel strategies. For example, California's Carl Moyer Program has granted more than $150 million in clean diesel projects since 1998, and the program expects to grant more than $140 million annually until 2015. The Texas Emissions Reduction Plan has granted more than $180 million since 2001.

EPA Funded Retrofit Projects (as of 2/22/2006)

Program Activities

EPA launched NCDC in 2004 to mitigate the impact of diesel emissions on public health and the environment. NCDC is a comprehensive initiative to reduce pollution from diesel engines across the country by implementing varied control strategies and proactively involving national, state, and local partners. NCDC comprises regulatory programs to address new engines and voluntary programs to address the millions of diesel engines already in use.

Regulatory Strategies for the Future

The Clean Air Nonroad Diesel Rule and the 2007 Heavy-Duty Highway Engine Rule set stringent standards on new diesel engines and diesel fuel. The Nonroad Rule will cut emission levels from new construction, agriculture, and industrial diesel engines by more than 90 percent. Clean ultra-low sulfur diesel (ULSD) fuel will be required for use in highway diesel engines starting in 2006 and nonroad machines in 2010. In addition to directly reducing emissions from the diesel fleet, these clean fuels will enable the use of advanced aftertreatment technologies. Technologies, like particulate filters, capable of emission reductions of 90 percent or more will be required under new standards that will be phased in for the highway sector in 2007 and the nonroad sector in 2008.

Both rules will yield enormous long-term benefits for public health and the environment. By 2030, when the full effect of these rules are realized, PM and NOx will

Benefits from the Clean Air Nonroad Rule

The long-term annual health benefits from this important program include the prevention of approximately:

- 6,000 children's asthma-related ER visits.
- 8,900 hospitalizations.
- 12,000 premature deaths.
- 15,000 heart attacks.
- 280,000 cases of respiratory symptoms in children.
- 1 million workdays lost.

When fully implemented, the annual monetized health benefits of this program will exceed $80 billion, compared to implementation costs of $2 billion.

Benefits from the 2007 Heavy-Duty Highway Rule

EPA's new emission and fuel standards for heavy-duty highway vehicles will result in large reductions in ozone and PM. In 2030, these reductions will prevent approximately:

- 8,300 premature deaths.
- More than 9,500 hospitalizations.
- 1.5 million workdays lost.

The total health benefits are worth more than $70 billion each year, with costs of only $4 billion.

be reduced by 250,000 tons per year and four million tons per year, respectively. These reductions will result in annual public health benefits of more than $150 billion, at a cost of approximately $7 billion.

New highway and nonroad standards are the critical foundation of EPA's diesel emission control programs. EPA is fully committed to the successful implementation of the Clean Air Nonroad Diesel Rule and the 2007 Heavy-Duty Highway Engine Rule. The Agency is working with industry to ensure that new engines meet the required standards throughout their useful life. To that end, EPA certifies and tests engines with the latest emission testing technologies.

EPA is also bringing clean diesel to the rail and marine sectors by developing new emission requirements for locomotives and marine engines. Without these regulations, locomotive and marine sources are expected to contribute 45 percent of diesel PM and 27 percent of NOx from mobile sources in 2030. Through the use of cleaner fuels and engines, EPA can reduce the impact of locomotive and marine engines.

Voluntary Strategies for Cleaning Up the Legacy Fleet

The more stringent diesel engine emission standards are set to take effect over the next decade, but the full effect of new regulations will not be realized for some time. Through NCDC's voluntary programs, EPA seeks to reduce emissions from millions of diesel engines in use today. NCDC is built on an impressive portfolio of EPA's voluntary projects. Today there are more than 300 projects in 44 states and more than 500 partners across the country. More than 20 states are using ultra-low sulfur diesel fuel well ahead of EPA's regulatory schedule.

EPA is committed to reducing the emissions from the existing fleet of diesel engines through collaboration and a variety of cost-effective voluntary strategies. States and local agencies are developing clean air implementation plans that rely on cost-effective solutions to reduce air pollutants that contribute to nonattainment of the health-based National Ambient Air Quality Standards. To assist these governments, EPA has created peer-reviewed emission models and provided State Implementation Plan guidance to state air partners. EPA has also created productive partnerships with diverse groups—from environmentalists to industry

to state and federal representatives—to work toward a shared goal of cleaning up diesel emissions. For example, EPA has worked with the National Conference of State Legislatures to pass a resolution in support of clean diesel efforts. In addition, EPA has engaged its stakeholders to work together with dozens of organizations and groups through a Federal Advisory Committee Act workgroup.

Clean Diesel Solutions

There is a wide range of emission reduction strategies available for any diesel vehicle or equipment application, including:

- Using cleaner fuels.
- Replacing older equipment.
- Reducing idling.

- Retrofitting engines with verified technologies.
- Repowering (replacing an old engine with a new, cleaner engine).
- Properly maintaining equipment.
- Gaining operational efficiencies.

Retrofit technologies are advancing at a rapid pace. The use of established technologies, such as diesel oxidation catalysts (DOCs) and diesel particulate filters (DPFs), continues to grow exponentially, while new, emerging technologies, such as lean NOx catalysts (LNC), are steadily improving. Retrofit technologies often vary in the type of pollutant reduced. DOCs and DPFs remove PM from the exhaust. DOCs or DPFs can be combined with a NOx reduction strategy, such as using a cleaner fuel, to enhance the emission reduction benefits.

While retrofit technologies are one option for reducing diesel emissions, other options include cleaner fuels such as compressed natural gas and the replacement of older engines and equipment. Cleaner fuels are becoming more prevalent throughout the country. The switch to ULSD fuel for highway engines enables advanced emission reduction technologies (e.g., DPFs) to operate effectively. Another option that can be applied to any vehicle or equipment is to reduce idling. Simply turning off the engine when the vehicle or machine is not in use can reduce emissions as well as save fuel and minimize wear and tear on the engine.

Verifying Emission Reductions from Retrofit Technologies

To evaluate the effectiveness of retrofit technologies, EPA created the Retrofit Technology Verification Program. Through this program, EPA helps to ensure users of retrofit technologies that the actual emissions benefits from retrofit technologies match those advertised by the manufacturer. The verification process includes evaluations of the emission reduction performance of retrofit technologies—including the durability of the technologies—and identification of engine operating criteria and other conditions that must exist for these approved technologies to achieve the verified level of reductions.

Summary of Available Options for Reducing Diesel Emissions

EMISSION CONTROL TECHNOLOGY	DESCRIPTION	PERCENT EMISSION REDUCTION*			
		PM	NOx	HC	CO
Diesel Particulate Filter (DPF)	DPFs are honeycomb or mesh devices that filter, or trap PM from the exhaust. Exhaust temperature, duty cycle, and fuel type are critical elements to evaluate prior to selecting a DPF.	Up to 90+	—	60-90	60-90
Diesel Oxidation Catalyst (DOC)	DOCs reduce harmful pollutants by catalytically converting pollutants to water and carbon dioxide (CO_2). Inside the canister is a honeycomb substrate that is coated with a small amount of precious metals where the reaction occurs.	20-50	—	60-90	60-90
Lean NOx Catalyst (with a DPF)	LNCs are catalysts that promote the reduction of NOx by using hydrocarbons as a reducing agent. Often an LNC is combined with a DPF.	Up to 90+	25	60-90	60-90
Exhaust Gas Recirculation (with a DPF)	EGR technology recirculates a portion of engine exhaust back into the engine. This recirculation cools peak combustion temperatures and dilutes the oxygen content of the fuel-air mixture, thus reducing NOx. EGR can be coupled with a DPF to reduce even more PM.	Up to 90+	Up to 50 (60-90 with DPF)	60-90	60-90
Selective Catalytic Reduction	SCR technology injects urea (or some form of ammonia) into the exhaust stream which reacts over a catalyst to reduce NOx emissions.	30-50	Up to 90+	50-90	50-90
Closed Crankcase Ventilation systems	CCV systems are designed to return crankcase blow-by gases to the engine intake for subsequent combustion during the engine combustion process.	10-25	—	30-40	30-35
Ultra-Low Sulfur Diesel	ULSD fuel has a sulfur content of 15 parts per million (PPM) or less.	5-10	—	—	—
Biodiesel	Renewable fuel (meeting ASTM spec 6751) that can be manufactured from vegetable oils or animal fats.	varies	varies	varies	varies
Additives	Chemicals added to the fuel in very small amounts to improve one or more properties of the base fuel.	—	Up to 5	—	—
Emulsions	Water and additives mixed with fuel to lower combustion temperatures.	16-60	10-25	varies	varies
Repowering	Replacing an older engine with a newer, cleaner engine or replacing a diesel engine with one that can use alternative fuels.	varies	varies	varies	varies
Replacement	Replacing older vehicles and equipment with ones that are newer and cleaner.	varies	varies	varies	varies

*Percent emision reduction of the following pollutants:
PM - Particulate Matter HC - Hydrocarbons
NOx - Nitrogen Oxides CO - Carbon Monoxide

EPA compiles this information for each of these technologies and posts it on EPA's Verified Technology List (see Appendix).

EPA evaluates each technology using a specific fuel, on a specific engine, and under specific loading cycles. Depending on the manufacturer and/or the technology, an independent laboratory may be used to conduct the majority of verification testing.

The California Air Resources Board (CARB) has a verification process similar to EPA's verification process. EPA signed a Memorandum of Agreement (MOA) with CARB for the Coordination and Reciprocity in Diesel Retrofit Device Verification. The MOA establishes reciprocity in verifications of hardware or device-based retrofits, and further reinforces EPA's and CARB's commitment to cooperate on the evaluation of retrofit technologies. This agreement commits EPA and CARB to work toward accepting PM and NOx verification levels assigned by the other's verification programs.

"Retrofits have been a high priority, and . . . they will continue to be a high priority for my office and the Agency."

Bill Wehrum, EPA Assistant Administrator

Additionally, as retrofit manufacturers initiate and conduct in-use testing, EPA and CARB have agreed to coordinate this testing so that the data manufacturers generate satisfy the requirements of each program. This MOA is intended to expedite the verification and introduction of innovative emission reduction technologies, by reducing the effort needed for retrofit technology manufacturers to complete verification. In addition to the Verified Technology List, EPA recognizes and accepts retrofit hardware strategies or device-based systems that have been verified by CARB.

Regional Clean Diesel Collaboratives

Collaborations and Partnerships

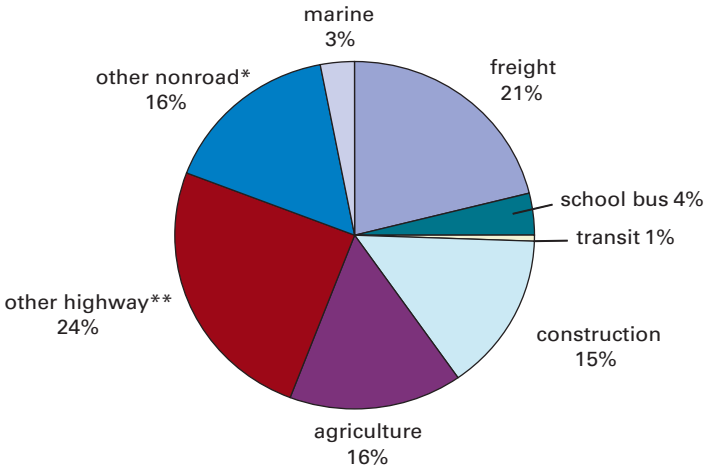
EPA works collaboratively with businesses and industry representatives, government, environmental and community organizations, and others to achieve immediate and significant environmental results. EPA engaged its stakeholder community to form a work group under the auspices of the Clean Air Act Advisory Committee to gain a consensus among all members on how to best address emission reductions from the existing fleet of diesel vehicles and equipment. Through this effort, EPA has developed a broad, diverse coalition of stakeholders that is working toward a shared vision of innovative strategies and incentives for reducing diesel emissions from public and private fleets.

At the regional level, several clean diesel collaboratives have formed across the country and are employing proactive, incentive-based approaches to achieve regional environmental improvement. Members of these regional initiatives have agreed collectively to secure additional funds for projects and to take a more localized approach to diesel emission mitigation.

EPA Regions 9 and 10 formed the West Coast Collaborative. The Collaborative is the first regional initiative under NCDC, charged with reducing air pollution emissions from diesel engines along the west coast. This joint effort includes EPA, the U.S. Department of Agriculture/Natural Resource Conservation Service, the U.S. Department of Energy, the U.S. Department of Transportation (DOT), the governments of Canada and Mexico, as well as state, local, non-profit, and private sector partners from California, Alaska, Washington, Oregon, Idaho, and Hawaii. Members of the collaborative work across sector workgroups for agriculture, construction, locomotives and rail, marine vessels and ports, and trucking to identify, fund, and implement regional diesel emission reduction projects.

Six other regional collaboratives have also been initiated around the country (see map, page 12). The Midwest Diesel Initiative, formed by EPA Region 5, is a cooperative, public/private effort to reduce diesel emissions along major transportation corridors and Midwest cities. The Midwest Initiative is focused on trucking, rail, ports, agriculture, and U.S.-Canada border areas. For the Northeast Diesel Collaborative, EPA Regions 1 and 2 work with eight northeastern states in partnership with the Northeast States for Coordinated Air Use Management to reduce exposure to diesel emissions. The newly developed Mid-Atlantic Diesel Collaborative in EPA Region 3 promotes the reduction of diesel emissions by leveraging resources, raising awareness, sharing information and expertise, and implementing projects.

2004 Diesel Emissions Inventory by Sector



Note: Port data is unavailable.
*Examples of other nonroad include nonroad equipment used at industrial sites and airports.
**Other highway refers to smaller trucks and vehicles (LD to Class 5).

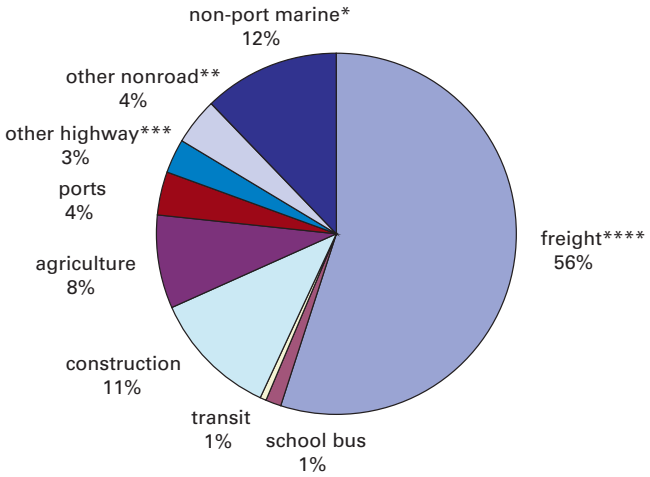
NCDC's Sector Focus

EPA chose to focus its voluntary efforts on five key sectors: school buses, ports, construction, freight, and agriculture. These sectors represent a diverse array of diesel engines in use today and provide the best opportunities to obtain emission reductions that can significantly protect public health.

The five sectors were chosen for many important reasons:

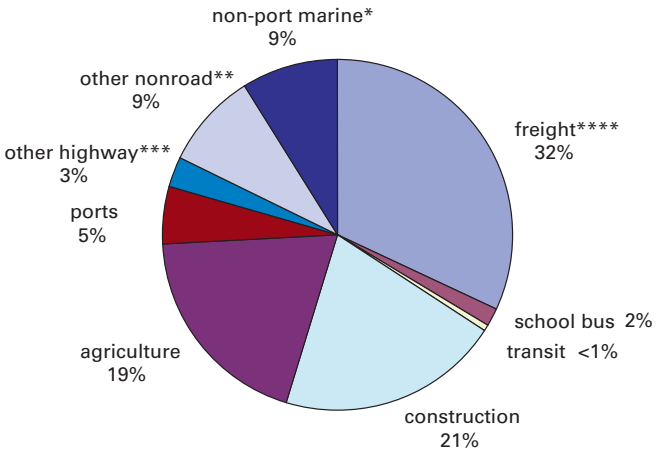
- *Each sector has a significant impact on public health and is present in areas with poor air quality or near susceptible populations.* Under the Clean School Bus USA Program, for example, EPA targets its resources to ensure that children, who are especially susceptible to diesel pollution,

2004 NOx Emissions by Mobile Diesel Sector



*Non-port marine includes recreational vessels and a fraction of C1, C2 and C3 marine.
**Examples of other nonroad include equipment used at industrial sites and airports.
***Other highway refers to smaller trucks and vehicles (LD through Class 5).
****Freight includes heavy-duty trucks and some nonroad rail.

2004 $PM_{2.5}$ Emissions Mobile Diesel Sectors



*Non-port marine includes recreational vessels and a fraction of C1, C2 and C3 marine.
**Examples of other nonroad include equipment used at industrial sites and airports.
***Other highway refers to smaller trucks and vehicles (LD through Class 5).
****Freight includes heavy-duty trucks and some nonroad rail.

can breathe cleaner air while being safely transported to school.

- *The five sectors combined represent roughly 80 percent of all diesel NOx and PM emissions from the mobile sector.* The freight sector alone accounts for approximately 30 percent of all mobile source diesel PM emissions.
- *Cost-effective strategies exist for each sector.* Diesel retrofit strategies are some of the most cost-effective measures for PM emission control. Nonroad equipment found in the construction, agricultural, and port sectors is often powered by older diesel engines that comply with much less stringent emission standards than today's standards. For comparable model years and engine sizes, older nonroad equipment can emit as much as 70 to 100 percent more pollution than today's engines. Thus, cleaning up nonroad equipment can be particularly cost-effective and important for public health.
- *Support for the sector programs has been overwhelming.* Industries in the five sectors are voluntarily acting to reduce diesel exhaust. Some federal funding solicitations are met with demand that is 10 times greater than available resources. Grant recipients have attracted additional resources, averaging two to four times the amount of the original grant.
- *Rapid growth in marine ports and construction.* Seaports are expanding and vessel size is increasing in response to the nation's increased global trade. According to DOT estimates, the volume of foreign trade moving through U.S. ports will more than double 1996 tonnage levels by 2020, significantly impacting our coastal and Great Lakes ports. In addition, the Bureau of Labor Statistics projects that construction employment will increase 15 percent from 2002 to 2012, making it the only goods-producing sector expected to grow.

SmartWay℠ Transport Partnership
U.S. Environmental Protection Agency

The Freight Sector: SmartWay Transport®

The freight transport sector is a pivotal component of the United States' economic strength, but it also presents environmental health and air quality challenges. In 2004, the freight sector emitted approximately one-third of all fine particulates and more than half the amount of NOx of all mobile diesel sources. In addition, trucks and locomotives burn 35 billion gallons of diesel fuel each year, representing 20 percent of the fuel used in the entire transportation sector.

"Like others in the transportation industry, we need to operate efficiently and ensure that we reduce the impact our company has on the environment. By becoming a member of SmartWay, our company, as a whole, is challenged to improve our operations for the betterment of all."

Joe Chapman, Operations Manager
Triple S Trucking

To address the impact of the freight system in the United States, including the legacy trucking fleet, EPA developed SmartWay Transport. SmartWay Transport is a voluntary public-private initiative designed to improve the environmental performance of the freight delivery system in the United States through money-saving, market-based approaches. The goal of the program is to reduce emissions by promoting cost-effective strategies that reduce fuel consumption and air pollution, by eliminating unnecessary idling, installing emission control devices, and improving freight logistics. By 2012, EPA expects to reduce more than 200,000 tons of NOx annually, as well as 33 million tons each year of carbon dioxide (CO_2), a greenhouse gas created from the combustion of fossil fuels, in addition to significant PM reductions.

There are four components of SmartWay Transport: the SmartWay Transport Partnership, National Idle-Free Corridors Program, SmartWay Capitalization and Upgrade Kits, and the SmartWay Technologies Program.

The sections that follow describe how the components work and achievements to date.

The SmartWay Transport Partnership: The Partnership involves voluntary collaboration between EPA and the freight industry. When a company, such as a freight shipper, carrier, or logistics company, joins the SmartWay Transport Partnership, it commits to (1) assess the environmental performance of its current operations using EPA's Freight Logistics Environmental and Energy Tracking (FLEET) Performance Models; (2) identify a goal to improve its environmental performance; (3) develop a plan detailing how the goal will be achieved; and (4) report its progress annually to EPA. Companies that join the partnership improve their environmental performance by adopting fuel efficiency technologies (e.g., trailer aerodynamics, wide-based tires, auxiliary heating and cooling units) and policies (e.g., no-idling zones at loading docks and speed policies) that increase fuel efficiency of freight transport— saving money while significantly reducing greenhouse gases and air pollution.

Since its inception in 2004, more than 260 shipping and trucking companies, representing more than 300,000 diesel trucks, have joined the SmartWay Transport® Partnership. From partner commitments during the first year, SmartWay Transport Partnership projects annual reductions of 3.1 million tons of CO_2, 777 tons of PM, and 22,096 tons of NOx. This amounts to an annual fuel saving of 283 million gallons of diesel fuel—worth $807 million dollars per year to the industry.[1]

National Idle-Free Corridors Program: To address unnecessary idling, EPA has developed the National Idle-Free Corridors Program. The program targets infrastructure modifications at truck stops, travel centers, ports,

[1] Fuel data is based on the November 10, 2005, diesel price of $2.85 per gallon.

loading docks, terminals, and along the side of the road. Over the last two years, the Agency has awarded 14 grants to states and non-profit organizations totaling approximately $6 million for the deployment of idle-reduction technologies around the country.

SmartWay Capitalization and Upgrade Kits: In an effort to make cleaner technologies more accessible to companies, EPA has created a unique technology deployment system called the "SmartWay Upgrade Kit" which allows companies to integrate fuel-saving and emission control strategies into their operations. SmartWay upgrade kits generally consist of idling control equipment, improved tire technology, improved tractor and trailer aerodynamics, and a PM emission control device. Together, these items create a more fuel-efficient and lower emission truck, and benefits are realized in cost savings to the truck driver. The SmartWay Upgrade Kit can be customized to fit a variety of trucking operations.

To date, EPA has partnered with two states, Minnesota and Arkansas, to offer small business loans that can be used for the purchase of SmartWay Upgrade Kits. These loans are being provided at below-market interest rates and have flexible terms. EPA is working to develop similar financing options for SmartWay Upgrade Kits with other states and private institutions.

SmartWay Technologies Program: The Agency strives to help freight companies employ the most fuel-efficient, environmentally beneficial, and cost-efficient strategies and technologies for their fleets. To this end, EPA provides a methodology that the industry can use to quantify the environmental benefits of new and emerging products and helps accelerate the market deployment of innovative freight technologies. As a first step toward developing protocols, EPA performed preliminary tests using aerodynamic and rolling drag reduction equipment on Class 8 trucks. This preliminary testing demonstrated a strong correlation between saving fuel and reducing NOx emissions due to reduced engine load. A report is expected to be released in 2006.

Clean Construction USA

Roughly two million pieces of construction equipment are used throughout the nation every day. In 2005, construction equipment generated more than 30 percent of NOx and PM of all land-based, nonroad sources, according to EPA's nonroad model. Therefore, cleaning up construction equipment has important public health benefits.

Clean Construction USA is a voluntary program that promotes the reduction of diesel exhaust emissions from construction equipment and vehicles. The program's goal is to retrofit, rebuild, or replace approximately two million diesel engines in the construction sector by 2014. In the early stages of the construction program, more than 7,000 machines were retrofitted, and almost $200 million was committed to make construction engines cleaner.

A typical bulldozer emits as much PM as 500 cars.

Under the Clean Construction USA program, EPA works with key stakeholders through collaborative efforts to advance the use of construction retrofits. The program has partnered with the Associated General Contractors of America (AGC) and others to help contractors, owners, and operators of construction equipment to properly maintain their equipment, retrofit and/or replace older diesel engines with verified or certified technologies, and use cleaner fuels. This year, representatives of the campaign spoke at several conferences, including the largest conference for the construction community, AGC's ConExpo.

EPA also works with states and local governments to implement clean diesel construction programs. A number of large-scale construction retrofit projects are in progress across the nation. Through state grant

programs like the Texas Emission Reduction Plan and California's Carl Moyer program, hundreds of pieces of equipment have been retrofitted or replaced to significantly improve the quality of air in those states and across the country. The Massachusetts Turnpike Authority alleviated the effects of diesel emissions near sensitive receptors such as residential communities and hospitals by retrofitting hundreds of construction machines and by establishing an idle-reduction policy for The Central Artery/Tunnel Project (The Big Dig) in Massachusetts. EPA assists these efforts by providing technical assistance, verifying technologies, and providing education and outreach materials to showcase model projects throughout the country.

"Programs like EPA's National Clean Diesel Campaign, the Texas Emission Reduction Plan, and California's Carl Moyer Program have been great in achieving emission reductions while recognizing the needs of businesses, which can be seen in the overall positive attitude of contractors."

Bob Lanham, Vice President
William Brothers Construction

Through Clean Construction USA, EPA has funded several demonstration projects aimed at fostering the use of new technologies for nonroad equipment. In 2004, the Agency funded retrofit construction programs in Colorado, Massachusetts, and Illinois that have enabled hospital patients, university students, and local communities to breathe cleaner air. This November, EPA announced nine new construction retrofit demonstration grants totaling almost $1 million. These grants will exhibit a wide variety of technologies including cleaner fuels, retrofit technologies such as catalysts and filters, and engine replacement, while improving air quality and serving as valuable models for future clean construction projects.

Under the Clean Construction USA program, EPA expects to launch many more clean construction projects throughout the country in the coming years. EPA will issue additional funding assistance in 2006 and will expand the number of tools available for clean construction projects. For example, EPA's new National Mobile Inventory Model has a retrofit calculator that can assess nonroad emission reductions from projects. EPA will release guidance on how to attain credits for these reductions in air quality plans. In addition, Congress passed a suite of provisions in the Energy Policy Act of 2005 and the Transportation Act of 2005, which would provide funding and other incentives for clean construction projects throughout the country. For example, Congress made retrofits, including nonroad retrofits for highway construction equipment, a priority for funding available through DOT's Congestion Mitigation and Air Quality (CMAQ) Improvement Program. EPA will be working with DOT to provide guidance for establishing CMAQ-funded retrofit projects.

Clean Agriculture USA

Diesel-powered engines help make American farmers among the most productive in the world. Roughly two-thirds of all agricultural equipment is diesel powered, according to the Diesel Technology Forum. The agricultural sector accounts for nearly one-quarter of NOx and one-third of PM of all land-based nonroad diesel emissions. With more than two million diesel engines, reducing emissions voluntarily from agricultural equipment can have significant public health benefits for rural and suburban areas.

Clean Agriculture USA is the campaign's newest voluntary, incentive-based program. Through this program, EPA will seek to achieve significant diesel emission reductions from agricultural engines over the next 10 years. Through partnerships and demonstration projects, the Agency is identifying cost-effective solutions to reduce diesel emissions from farms and is working collaboratively with the agricultural community to implement diesel emission reduction projects.

EPA grants have provided the foundation for helping curb agricultural emissions through several groundbreaking projects. The Agency provided funding assistance to place catalysts on agricultural equipment, retrofit or replace agricultural pumps, test fuel additives in biodiesel, and reduce equipment use through no-till/direct seeding techniques.

In addition, EPA is working to address agricultural emissions through partnerships with the U.S. Department of Agriculture and various farm organizations and agricultural businesses. The campaign's regional clean diesel initiatives play a critical role in working at the local and regional level to offer guidance and coordinate efforts to reduce diesel emissions in agricultural operations. For example, the Midwest Diesel Collaborative works to reduce emissions from the transport of agricultural goods to market, while the West Coast Collaborative works with organizations regionally to identify funding assistance, establish programs, and share lessons from clean diesel projects.

In the coming year, EPA expects to expand its stakeholder network, showcase more successful clean diesel projects, and release new outreach materials under the Clean Agriculture program.

Clean Ports USA

Ports on coasts and inland waterways accommodate more than 95 percent, by weight, and 75 percent, by value, of all U.S. overseas trade. In addition, the U.S. port industry directly and indirectly impacts approximately $1.5 trillion in business sales for goods and services. Over the past 30 years, port industry impacts on the gross domestic product have increased from 13 percent to 30 percent. The ships, vessels, cargo handling equipment, trucks, and rail used in and around ports rely heavily on diesel engines.

Solutions for mitigating the effects of diesel engines differ from one port to another, so EPA's Clean Ports USA program offers a wide selection of technology options and emission reduction strategies to fit individual port's needs. EPA works with port authorities, marine terminal operators, and other partners to overcome barriers to reducing diesel emissions in this sector.

In its first year, Clean Ports USA has been successful in reducing emissions at many major ports across the country. For example, EPA awarded grants to the Port of Houston, Port of Tacoma, and Massachusetts Port Authority to establish new projects that demonstrate innovative emission control technologies. The Agency also awarded a grant to the Port of Long Beach, which is a recognized leader in retrofitting cargo-handling equipment. These ports are retrofitting some of their trucks,

yard equipment, straddle carriers, and rubber-tired gantry cranes with retrofit technologies and cleaner fuels to reduce pollution in their local area.

EPA is also partnering with the American Association of Port Authorities (AAPA), the National Association of Waterfront Employers, and other entities to develop cost-effective methods to improve ports' environmental performance. For example, in partnership with AAPA, ports, and terminal operators around the country, EPA hosted a series of clean diesel workshops to discuss the successes and challenges of reducing emissions at ports. In this type of venue, ports can share information and brainstorm solutions to their concerns about enhancing environmental performance, while meeting business needs.

Several ports have already taken measures to reduce diesel emissions and can serve as role models for other ports. For example, the Port Authority of New York and New Jersey led a tenant engine replacement program for tenants expanding their fleets. Through this program, terminal operators were advised to substitute highway engines built to stricter emission standards in place of older nonroad engines in yard trucks. After these changes were implemented, operations at the port increased by 25 percent, while fuel consumption dropped by almost 20 percent. These engine replacements also resulted in reductions of NOx emissions by 31 percent and PM by 32 percent. Additional benefits to using newer, highway engines in yard trucks include improved reliability, better warranty coverage, and lower maintenance costs.

The Georgia Port Authority responded to its customers' needs and overarching security concerns by introducing a Web Access Gate System. The system reduces emissions while improving efficiency by 84 percent and increasing gate transactions from 38 manual transactions per hour to 240 per hour. Processing time for entering trucks was cut from 22 to six minutes. More than 3,000 gallons of fuel are saved each day and the reduction in truck idling reduces a half-ton of NOx and 33 tons of CO_2 per day.

In the coming year, EPA will continue to provide technical assistance, support demonstration projects, and showcase results. EPA expects to provide a best practices report for port emission inventories in 2006 and will provide additional outreach materials for the program.

Clean School Bus USA

Each school day, about 24 million children spend an average of one-and-a-half hours in a school bus on their way to and from school. School buses have been shown to be the safest way for children to get to school. However, children are especially sensitive to diesel emissions compared to healthy adults because they have a faster breathing rate and their respiratory systems are still developing.

Through the Clean School Bus USA program, EPA is working to retrofit or replace the approximately 400,000 diesel school buses in the United States over the next several years. The initiative is a partnership of educators, industry and corporate partners, transportation experts, public health officials, and other community leaders who are committed to protecting children's health and modernizing America's school bus fleet.

Because of Clean School Bus USA, more than one million children ride to school in cleaner buses each day. The Agency works with more than 150 school districts operating 20,000 school buses to reduce diesel emissions. More than 15 million people live in communities with cleaner buses and are breathing better air.
As the program moves forward, emission reductions from retrofits alone will lead to 20,000 fewer respiratory symptoms and 14,000 fewer asthma exacerbations in children.

A key component of the program is the promotion of idle-reduction policies in the nation's 15,000 school districts. EPA assists school districts in developing programs to encourage bus drivers to turn off their buses when they arrive at loading or unloading areas. The Agency has developed an idle-reduction pledge card program that helps school districts recognize drivers who successfully reduce idling.

More than one million children now ride cleaner school buses as a result of the Clean School Bus USA program.

Under the Clean School Bus USA program, EPA also promotes local and state action to reduce school bus emissions. For example, the state of Washington is working to retrofit bus fleets throughout the state, reducing emissions by 50 to 90 percent. The Washington State Clean School Bus Program affects approximately 5,000 of more than 9,000 school buses throughout the state—the largest voluntary school bus retrofit program in the country. Retrofits for buses involve either installing PM filters or diesel oxidation catalysts on school bus exhaust systems, depending on the age of the bus and the regional availability of ultra-low sulfur diesel fuel.

Portland, Maine, provides another example of a community developing a diesel emission reduction program for its school bus fleets. This program focuses on idle-reduction and fuel conservation, route management to assign the cleanest buses to the longest routes, and investing in newer, cleaner buses overall. In a partnership among the Portland School Transportation Department, the Maine Departments of Education and Environmental Protection, the Asthma Regional Council, and NCDC, the Portland School District has replaced 90 percent of its school bus fleet with newer, cleaner buses.

EPA has developed a variety of public outreach and awareness materials for use with school districts, transportation officials, and the public, including a general brochure, a technical fact sheet, a short video for bus drivers on idling reduction, bookmarks and pencils for children, and an extensive Web site. An array of materials that can be used to promote idling reduction and other Clean School Bus USA projects nationwide are being developed.

Looking Ahead

While NCDC has facilitated significant emission reductions from diesel engines, a tremendous amount of work remains, and substantial investments are needed. EPA will continue to work aggressively to reduce pollution from diesel engines across the country by partnering with key stakeholders to promote clean diesel strategies.

In the upcoming year, EPA will be strengthening and enhancing NCDC through many efforts. They include:

Collaborations and Partnerships

- EPA will expand the reach of NCDC voluntary programs across the nation through targeted partnerships with stakeholders from states, localities, the construction and emission control industries, and environmental groups.
- EPA will strengthen existing regional diesel collaboratives and initiate new regional diesel reduction initiatives.
- EPA will work closely with industry to ensure that stringent standards for new engines will meet or exceed regulation deadlines.
- EPA will also work with stakeholders on a clean diesel incentives report that will be submitted to the Clean Air Act Advisory Committee in 2006.

New Clean Diesel Tools

- EPA will provide new resources to assist state and local governments in developing their own clean diesel programs. In 2006, EPA will release guidance on incorporating retrofit projects into clean air plans. This guidance will supplement the Agency's work with DOT on providing guidance for using CMAQ funds for retrofit projects.
- EPA will expand the clean diesel toolbox by promoting the verification of innovative technologies. EPA will examine ways to improve the verification process and will begin to confirm the emission performance of verified technologies in the field. Through in-use testing, the implementation of in-use testing protocols for verified technologies will provide important information to states that depend on the field performance of retrofit technologies in their air quality plans.

Funding

- EPA expects to announce more than 25 new Clean School Bus USA demonstration grants totaling $7.5 million in early 2006.
- EPA plans to achieve immediate reductions in diesel emissions through $12 million in grant funds to establish new clean diesel projects in the highway, nonroad, and school bus sectors.
- EPA will work with DOT on guidance for utilizing CMAQ funds administered through DOT. CMAQ has a total funding level of $8.6 billion through 2009.
- EPA will continue to promote existing state programs—like California's Carl Moyer Program and the Texas Emissions Reduction Plan—to help develop new and innovative financial incentive programs with other states and local governments.

Education and Outreach

- For each NCDC sector program, EPA will develop new and useful educational materials and will continue to build awareness by participating in key events. For example, the Clean Ports USA program is planning additional terminal operator workshops across the country to educate equipment owners and operators about ways to reduce their emissions. The Clean School Bus USA program will continue to support children's health by conducting several idle-reduction events throughout the country and launching an informational publication targeted to children.
- EPA will target current PM nonattainment areas where diesel retrofits and replacements will have the greatest public health impact. EPA will also help states and localities employ diesel reduction strategies to prepare for a newly proposed PM national air quality standard.

Regulations

- EPA will ensure the smooth implementation of the 2007 highway engine standards and ultra-low sulfur fuel requirements.
- EPA will work with manufacturers to prepare for the first wave of nonroad diesel engine standards in 2008.
- EPA will develop new emission standards for locomotive and large marine diesel engines.
- EPA will implement the diesel emissions reduction provisions of the Energy Policy Act of 2005.

Technology

- EPA will demonstrate the significant emission benefits from new, innovative retrofit technologies, and bring new technologies to the market.

Diesel engines will continue to play a vital role in our economy, and EPA's NCDC can help to minimize their impact on public health. Through NCDC's programs, EPA has made significant progress toward cleaning up diesel engines, and the Agency will continue to work hard at this task. We look forward to reporting on new accomplishments and opportunities in the next progress report.

Appendix: Verified Retrofit Technologies

Manufacturer	Technology	Applicability	Reductions (%)			
			Particulate Matter (PM)	Carbon Monoxide (CO)	Nitrous Oxides (NOx)	Hydro-carbons (HC)
Caterpillar, Inc.	Catalyzed Converter/Muffler	Highway, heavy-heavy and medium-heavy-duty, 4-cycle, non-EGR, model year 1998-2003, turbocharged or naturally aspirated	20	20	N/A	40
Caterpillar, Inc.	Diesel Particulate Filter	Nonroad, 4-cycle, non-EGR equipped, model year 1996-2005, turbocharged engines with power ratings 130 ≤ KiloWatts < 225 (174.2 ≤Horsepower < 301.5)	89	90	N/A	93
Clean Diesel Technologies, Inc.	Platinum Plus Purifier System (Fuel Borne Catalyst plus DOC)	Highway, medium-heavy and heavy-heavy-duty, 4-cycle, model year 1988 -2003, turbocharged or naturally aspirated	25 to 50	16 to 50	0 to 5	40 to 50
Clean Diesel Technologies, Inc.	Platinum Plus Fuel Borne Catalyst/Catalyzed Wire Mesh Filter System	Highway, medium-heavy duty, 4 cycle, model year 1991-2003, non-EGR, turbocharged or naturally aspirated	55 to 76	50 to 66	0 to 9	75 to 89
Donaldson	Series 6000 DOC & Spiracle (closed crankcase filtration system)	Highway, heavy-heavy- and medium-heavy-duty, 4-cycle, non-EGR, model year 1991-2003, turbocharged or naturally aspirated	25 to 33	13 to 23	N/A	50 to 52
Donaldson	Series 6100 DOC	Highway, heavy-heavy and medium-heavy-duty, 4 cycle, non-EGR, model year 1991-2003, turbocharged or naturally aspirated	20 to 26	38 to 41	N/A	49 to 66
Donaldson	Series 6100 DOC & Spiracle (closed crankcase filtration system)	Highway, heavy-heavy- and medium-heavy-duty, 4-cycle, non-EGR, model year 1991-2003, turbocharged or naturally aspirated	28 to 32	31 to 34	N/A	42
Engelhard	DPX Catalyzed Diesel Particulate Filter	Highway, heavy-duty, 4-cycle, model year 1994-2002, turbocharged or naturally aspirated	60	60	N/A	60
Engelhard	CMX Catalyst Muffler	Heavy-duty, highway, 2-cycle engines	20	40	N/A	50
Engelhard	CMX Catalyst Muffler	Heavy-duty, highway, 4-cycle engines	20	40	N/A	50
International Truck & Engine Corp.	Green Diesel Technology-Low NOx Calibration plus DOC with Ultra-Low Sulfur Diesel	Highway light heavy-duty, 4-cycle, Navistar/International engines, model years 1999-2003 in the following families: XNVXH0444ANA YNVXH0444ANB 1NVXH0444ANB 2NVXH0444ANB 3NVXH0444ANB	0 to 10	10 to 20	25	50

Appendix: Verified Retrofit Technologies (continued)

Manufacturer	Technology	Applicability	Reductions (%)			
			PM	CO	NOx	HC
Johnson Matthey	Catalyzed Continuously Regenerating Technology Particulate Filter	Highway, heavy-heavy, medium-heavy, light-heavy-duty, urban bus, 4-cycle, non-EGR model year 1994-2003, turbocharged or naturally aspirated engines	60	60	N/A	60
Johnson Matthey	Continuously Regenerating Technology Particulate Filter	Heavy-duty, highway, 2- & 4-cycle, model year 1994-2002, turbocharged or naturally aspirated engines	60	60	N/A	60
Johnson Matthey	CEM™ Catalytic Exhaust Muffler and/or DCC™ Catalytic Converter	Highway, heavy-heavy, medium-heavy, light-heavy-duty, non-urban bus, 4-cycle, non-EGR model year 1991-2003, turbocharged or naturally aspirated engines	20	40	N/A	50
Johnson Matthey	CEM Catalyst Muffler	Heavy-duty, highway, 2-cycle engines	20	40	N/A	50
Lubrizol	PuriNOxWater emulsion fuel	Heavy-duty, highway & nonroad, 2- & 4-cycle	16 to 58	-35 to 33	9 to 20	-30 to -120
Lubrizol Engine Control Systems	Purifilter - Diesel Particulate Filter	Highway heavy-heavy-duty, medium heavy-duty; urban bus; 4-cycle; model years 1994-2003; turbocharged or naturally aspirated; non-EGR engines	90	75	N/A	85
Lubrizol Engine Control Systems	AZ Purimuffler or AZ Purifier DOC with Low-Sulfur Diesel Fuel (30 ppm S max)	Highway medium heavy-duty, 4-cycle, model years 1991-2003 Cummins and Navistar/International engines originally manufactured without any aftertreatment which are turbocharged or naturally aspirated, non-EGR engines	40	40	N/A	70
Lubrizol Engine Control Systems	AZ Purimuffler or AZ Purifier DOC with Low-Sulfur Diesel Fuel (30 ppm S max)	Highway heavy-heavy-duty, 4-cycle, model years 1991-1993 Cummins engines originally manufactured without exhaust aftertreatment which are turbocharged or naturally aspirated, non-EGR engines	35	40	N/A	70
Lubrizol Engine Control Systems	AZ Purimuffler AZ Purifier	Heavy-duty, highway, 2-cycle engines	20	40	N/A	50
Lubrizol Engine Control Systems	AZ Purimuffler AZ Purifier	Heavy-duty, highway, 4-cycle engines	20	40	N/A	50
Various	Biodiesel (1 to 100%)	Heavy-duty, highway, 2- & 4- cycle	0 to 47	0 to 47	0 to -10	0 to 67
Various	Cetane Enhancers	Heavy-duty, highway, 4-cycle, non-EGR-equipped	N/A	N/A	0 to 5	N/A

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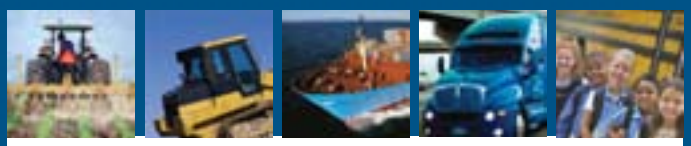

National Clean Diesel Campaign