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Scientists

Diesel's Impact on Public Health

Emissions from construction equipment and other diesel vehicles are harmful to our health. Diesel exhaust contains several pollutants that can cause or exacerbate a wide range of serious health problems. These pollutants include:

- **Particulate matter (PM):** Also known as soot, these small particles (25 times smaller than the width of a human hair) are released directly from the tailpipe or formed indirectly from emissions of nitrogen oxides (NO_x) and sulfur oxides. Soot can penetrate deeply into the lungs, causing or aggravating a variety of respiratory and cardiovascular illnesses—and can even lead to premature death.
- **Smog-forming pollutants:** NO_x and hydrocarbons react in the presence of sunlight to form ozone, or smog. Smog can damage the respiratory tract, reduce lung function, exacerbate asthma, and aggravate chronic lung diseases. As much as 10 to 20 percent of all summertime respiratory hospital visits and admissions are associated with smog. More than 90 percent of Californians live in areas that do not comply with federal ozone standards.
- **Toxics:** The state of California has classified diesel exhaust and more than 40 compounds in diesel exhaust as toxic air contaminants.* Exposure to these chemicals can cause cancer, developmental harm to fetuses, and other serious health and reproductive problems. The California Air Resources Board has estimated that diesel exhaust is responsible for 70 percent of the state's risk of cancer from airborne toxics.

Children's Vulnerability

Children, who are outdoors more often and breathe at faster rates than adults, may experience greater exposure to harmful air pollutants. Children raised in heavily polluted areas have reduced lung capacity, prematurely aged lungs, and increased risk of bronchitis and asthma compared with peers living in less urbanized areas.

While numerous studies have found that air pollution exacerbates asthma in children, a study in Southern California suggests that air pollution may actually cause asthma in otherwise healthy children. In communities with the highest ozone levels, children who participated in sports were more than three times as likely to become asthmatic compared with less active children.



How Soot Causes Lung Damage

As soot particles from diesel exhaust travel through the air and are inhaled, the largest particles deposit in the nose, throat, and lungs and are ejected through sneezing and coughing. The finest particles are able to evade the body's natural defenses and travel deep into the lungs. Once there, these particles can cause inflammation and scarring of air passageways and lung tissue, resulting in reduced oxygen flow to the rest of the body. Symptoms can range from coughing and shortness of breath to severe and fatal asthma attacks.

* According to the California Health and Safety Code, a toxic air contaminant is "an air pollutant which may cause or contribute to an increase in mortality or in serious illness, or which may pose a present or potential hazard to human health."

State Cleanup Efforts on Slow Track

Both California and the federal government realize the seriousness of diesel pollution and have begun to take action to reduce emissions. But once again, efforts to clean up the construction sector have lagged behind.

Underfunded Incentive Programs

California: The Carl Moyer Program

This innovative incentive program, which began in 1998, helps accelerate diesel emission reductions by providing funds to cover the incremental cost of purchasing a cleaner engine or retrofitting an existing engine. UCS analysis finds that the modest costs of pollution cleanup through the Carl Moyer Program are more than offset by the health benefits, with a benefits-to-cost ratio of at least 10 to 1.

Funding levels for the Carl Moyer Program have varied widely from year to year, and the program has been constantly oversubscribed. In 2004, the California legislature and Governor Arnold Schwarzenegger approved a dedicated annual budget of \$140 million for the program. This is a big improvement, but the California Air

Resources Board estimates that a \$300 million annual investment is needed to adequately address California's air pollution crisis.

While construction equipment accounts for 30 percent of diesel PM emissions in California, less than five percent of the Moyer funding was allocated to this sector over the first four years of the program (when it focused on NOx reductions only).

Growing recognition of soot's impact on public health led the legislature to expand the program in 2004 to include PM, providing further opportunity for emission reductions.

National: The Voluntary Diesel Retrofit Program

This EPA program, which was launched in 2000, certifies diesel retrofit devices,



Bay Bridge Construction

provides educational outreach on pollution cleanup technology, and offers limited financial incentives for engine retrofits. This national program can help clean up today's existing diesel vehicles and equipment, but needs many millions of dollars more in funding (its current budget is a paltry \$800,000) to make a substantial impact.

Stalled Regulatory Efforts

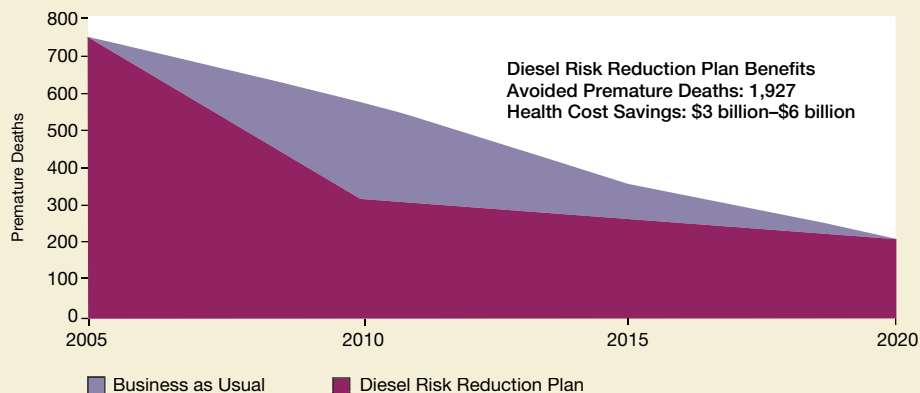
Regulations can be an extremely effective vehicle for cleaning up diesel equipment while maintaining an even playing field for businesses. California is in the process of adopting its Diesel Risk Reduction Plan, a series of

regulations requiring a 75 percent reduction in sector-wide diesel PM emissions from 2000 levels by 2010 and an 85 percent reduction by 2020. Unfortunately, rule development for the plan, which began in 2000, has been

delayed by industry opposition, regulatory gridlock, and other obstacles. Without emission reductions from construction equipment, it is highly unlikely California will be able to achieve its 2010 emission target.

The benefits of reaching California's goals in the construction equipment sector are significant. By 2020, more than 1,900 premature deaths could be avoided, saving the state between three billion and six billion dollars in health costs. Without concerted action by the governor, state legislature, Air Resources Board, and local air districts, these goals will not be achieved.

Premature Deaths from Construction Equipment Pollution



NOTE: Business as usual scenario includes reductions from federal emission standards adopted in 2004.

How to Reduce Diesel Emissions

There are a number of ways to cost-effectively reduce emissions from construction and other diesel off-road equipment, allowing for flexibility in meeting emission reduction targets.

- **Refuel.** Switching to cleaner fuels such as alternative diesel fuels or ultra-low-sulfur diesel fuel can achieve modest reductions in pollutants. These fuels can also facilitate the use of advanced retrofit technologies, resulting in even less pollution.
- **Repower.** The body or chassis of some equipment can last through many decades of use, beyond the life of the original engine. Installing a new low-emission engine in an older chassis can allow the machine to run for many more years.
- **Replace.** If equipment is old and near the end of its life, replacing it with a new lower-emission model ahead of schedule can result in substantial emission reductions.
- **Rebuild or repair.** Emissions gradually increase over the life of an engine. Performing routine maintenance and periodic engine rebuilds can keep emission rates at or near original levels.
- **Reduce idling.** Idling equipment is not only polluting, but also a waste of fuel. Limiting idle time can save money by reducing fuel usage and wear and tear on the engine.
- **Retrofit.** On equipment that still has some useful life left, engines can be retrofitted with an emission control

device. Retrofit technologies are available for a variety of applications.

Construction projects throughout the country and around the world are using retrofit technology to reduce pollution. The real-world examples described below demonstrate how controlling PM and NO_x emissions from construction equipment is feasible and affordable.

Boston

In an effort to reduce the risk to communities near Boston's Central Artery/Tunnel Project (better known as the "Big Dig"), the Massachusetts Turnpike Authority (MTA) retrofitted approximately 200 pieces of equipment with diesel oxidation catalysts. The MTA estimates these retrofits reduced three tons of diesel PM during each year of the project. There were no operational problems or added maintenance costs associated with these retrofit devices.

New York City

In 2002, New York required that all state construction projects in Lower Manhattan, including the World Trade Center site, use ultra-low-sulfur diesel fuel and install retrofit devices where possible. The following year, New York City's Local Law 77 expanded these clean construction requirements to apply to all city-funded construction projects. This ordinance provides a template for other cities and states to follow when cleaning up construction equipment.

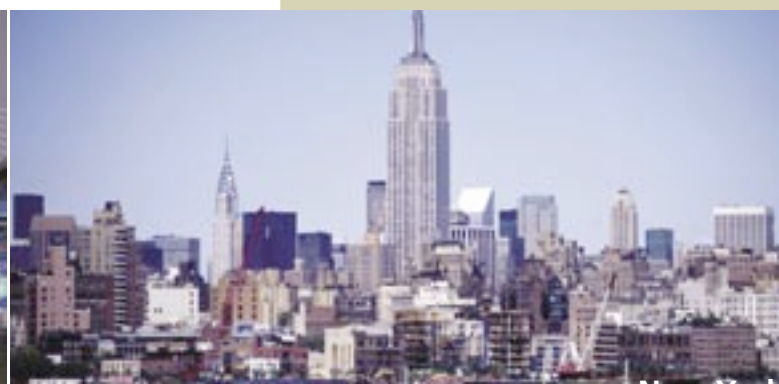


Retrofit technology (used on the wheeled loader at left) can help construction equipment generate far less pollution. (Photo: © NESCAUM)

Are Retrofits Worth the Cost?

Because diesel pollution has such a significant impact on public health, most retrofit technologies on the market today result in long-term benefits that far outweigh the initial cost of installation.

Consider, for example, a new wheeled loader that meets current diesel engine standards. Installing a particulate filter to reduce PM emissions by 85 percent costs \$7,000 to \$10,000 and increases the machine's annual maintenance cost by about \$500 (for filter cleaning). Over the filter's lifetime (seven years, on average), more than 350 pounds of diesel soot would be kept out of the atmosphere. The health benefits of reducing this amount of PM are 7 to 11 times greater than the installation and maintenance costs. Repowering or retrofitting older, dirtier equipment can be even more cost-effective, achieving benefits worth well over 10 times the initial cost.



Why Construction Equipment?

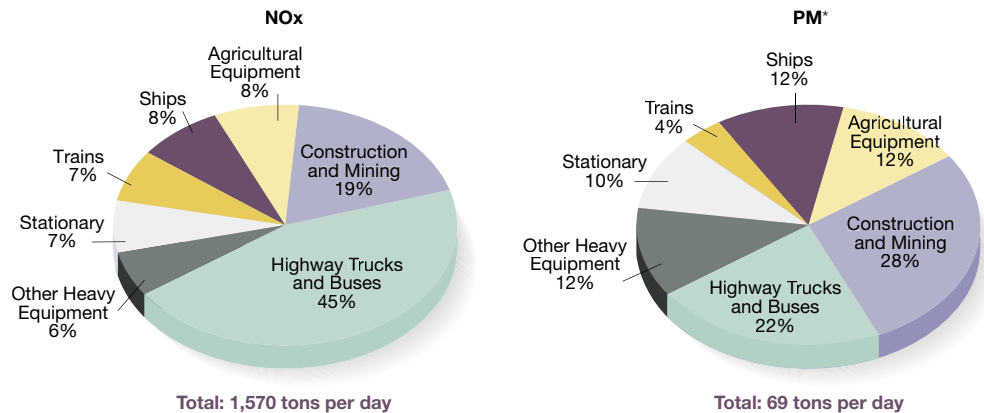
The construction sector (which includes mining) is the single largest source of diesel PM in the state, accounting for nearly 30 percent of diesel PM emissions. This is equivalent to 19 tons of soot being released into the air every day of the year. Construction equipment is second only to highway trucks and buses when it comes to NOx emissions, generating about the same amount of NOx as all light-duty passenger cars in the state.[†]

Lagging Engine Standards

Highway truck and bus engine manufacturers have had to meet stricter emission regulations since the late 1980s. Construction and other off-road equipment, however, did not face new PM emission standards until 1996, with some engines unregulated as late as 2003. The U.S. Environmental Protection Agency (EPA) finally adopted more stringent standards for off-road engines in spring 2004, requiring 90 percent reductions in NOx and PM for most engine sizes. These standards will phase in over a seven-year period starting in 2008.

Although these standards will result in a drastic reduction in pollutants from new engines, full benefits will not be realized until sometime after 2030, when the long-lasting equipment currently in use today is finally retired. There are technology options available to clean up these machines, but neither the EPA nor the state of California currently requires them. As a result, the construction sector will continue emitting high levels of toxic and smog-forming pollution for the next two to three decades.

California's 2005 Diesel Pollution



*Based on emission estimates for particulate matter less than 10 microns in diameter.
Source: California Air Resources Board Emission Inventory.

Annual Cost of California's Diesel Pollution (Construction Sector)

Health Endpoint	Estimated Mean Number of Incidences (2005)
Premature Mortality	751
Chronic Bronchitis	676
Hospital Visits	
Chronic Obstructive Pulmonary Disease	150
Cardiovascular Disease	441
Asthma Hospitalizations	79
Asthma Emergency Room Visits	436
Total Estimated Health Costs (2005\$)	\$5 billion

Based on UCS estimates of 2005 annual health incidences and the Final Regulatory Impact Analysis for the EPA's non-road diesel regulation (adopted in May 2004).

The Price of Diesel Pollution

Diesel pollution has a staggering impact on California's health and economy. UCS estimates that in 2005 alone, construction equipment emissions will cause more than 750 annual premature deaths, as well as hundreds of hospital visits for respiratory and

cardiovascular ailments. These health-related costs exceed five billion dollars annually—more than the entire estimated cost of rebuilding the Bay Bridge.

[†] Based on 2005 emission inventory estimates from the California Air Resources Board. Light-duty passenger cars do not include light trucks.



A Blueprint for Healthier Communities

Construction equipment emits more toxic soot than any other diesel sector, but solutions exist that are cost-effective and can prevent thousands of premature deaths over the next two decades. Not only will neighbors of construction sites benefit from less exposure to diesel exhaust, but construction workers will as well. UCS recommends the following actions to clean up construction equipment:

Legislation

The California legislature should require contractors on state projects to use the cleanest available equipment. This top-level leadership would set an example for other states and demonstrate that public health is a priority.



Regulations

Regulations can help achieve the greatest emission reductions over the long term by establishing minimum standards for construction equipment cleanup and creating demand for cleaner engines and advanced retrofit technology in the off-road

diesel market. California, with its unique authority under the Clean Air Act to regulate construction equipment, should:

- enact stringent emission reduction regulations with the goal of reducing diesel PM 75 percent from 2000 levels by 2010;
- phase out or retire the oldest, most polluting equipment;
- install the best available retrofit technology on more recent equipment; and
- require the strongest emission controls near sensitive communities such as schools, nursing homes, hospitals, and day care centers.

Incentive Programs

Incentives help lay the groundwork for enacting effective regulations and can even achieve emission reductions above and beyond minimum standards.

Financial incentives: California's Carl Moyer Program and the EPA's Voluntary Diesel Retrofit Program provide financial incentives for upgrading or retrofitting diesel engines. These programs are essential in reducing exposure to diesel exhaust and meeting state and federal air quality standards. The Carl Moyer Program has been especially successful in providing substantial and cost-effective diesel emission reductions in the state. Funding for both programs must remain a high priority. In addition, these programs should allocate more funds for cleaning up high-pollution construction equipment, particularly for projects in urban areas or near sensitive populations such as schoolchildren.



Contracting incentives: State and city governments, as well as private companies and individuals, can give preference to those contractors who use clean construction equipment for their projects. This creates a competitive advantage for companies that use lower-emission equipment and can help establish a "green" image for these companies. Specific requirements for clean construction equipment can also be included in construction contracts.

Green building incentives: To encourage the use of cleaner equipment during building-site preparation and construction, new criteria should be added to the Leadership in Energy and Environmental Design (LEED) rating system. This national standard, developed by the U.S. Green Building Council, recognizes progressive leadership in the construction industry by evaluating the environmental attributes of new and existing buildings.

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