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Testimony of

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On

Health Impacts of Exposure to Diesel Exhaust: Current Challenges and New Opportunities

Before the:

Senate Committee on Environment and Public Works
Subcommittee on Clean Air and Nuclear Safety

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Chairman Carper, Ranking Member Barrasso and members of the Committee, thank you for the opportunity to testify before you today on the health effects of exposure to diesel exhaust. I come before you as the Vice President of the Health Effects Institute, a non-profit, independent research institute funded jointly and equally by the US EPA and industry to provide high-quality, impartial science on the health effects of air pollution. For over two decades, we have conducted targeted research on the full range of emissions and health effects from sources in the environment, including extensive research on diesel exhaust, and I am pleased to summarize our understanding for you today.

I would like to briefly highlight three topics of direct relevance to the current discussion of Federal efforts to improve public health by reducing diesel emissions, they are:

- Sources of and exposure to diesel exhaust,
- Population health effects of diesel exhaust, and
- The remarkable improvements in new diesel technology and emissions.

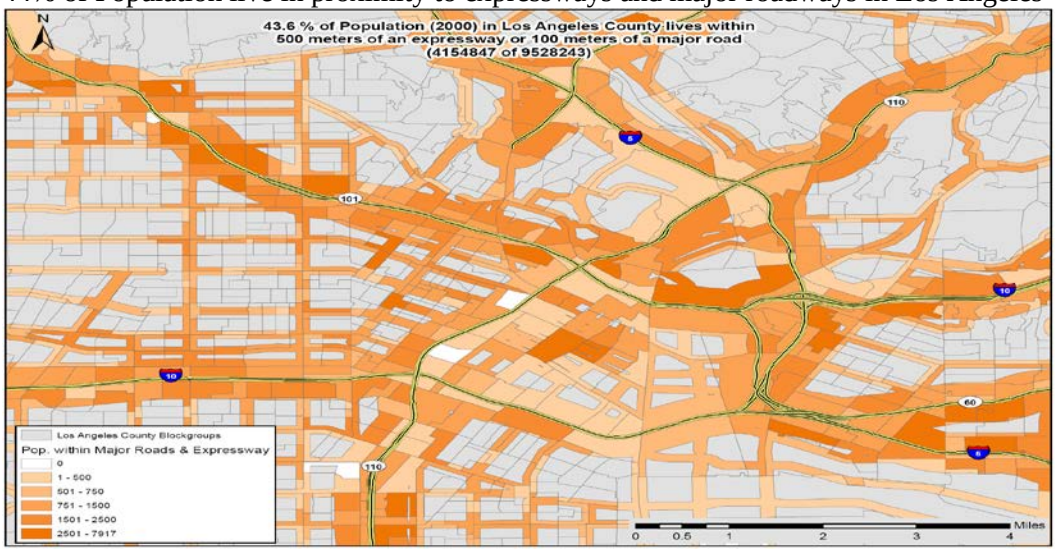
Sources and Exposure

Diesel engines are used extensively in transportation and construction in the United States, especially in heavy duty applications due to their power, durability and efficiency. Sources of diesel are pervasive in many parts of the country and include light duty and heavy duty trucks, busses, and a modest number of light duty vehicles all of which travel the nation's highways. There are also numerous off road vehicles used in agriculture and construction, as well as rail and shipping.

Given the numerous sources of diesel exhaust, population exposure can be widespread.

HEI's 2010 Review *Traffic Related Air Pollution: A Critical Review of the Literature on Emissions, Exposure and Health Effects* found that those living within 300-500 meters of a major roadway are most likely to be exposed to traffic related air pollution. The review assessed the percentage of the population living within this zone of likely exposure and found that between 38% and 45% of the population in cities studied in the US and Canada lived within this higher exposure zone. The following map illustrates Los Angeles, where population density and numerous major roadways result in a high exposure for 44% of the population. Urban industrial areas, including truck and bus depots, and some rail yards, ports and construction sites typically have higher concentrations.

44% of Population live in proximity to expressways and major roadways in Los Angeles



(Jerrett and Beckerman et al, HEI Review 2010)

Population Health Effects

Diesel exhaust from the older engines on the road today is a complex mixture of fine particles, including black carbon, and thousands of organic and inorganic components, some 40 of which have been identified as hazardous air pollutants by the USEPA. It has been associated with health effects including a range of respiratory symptoms, premature mortality from particulate matter, and designated as a likely human carcinogen by several prominent domestic and international governmental bodies. Today I will briefly touch on three examples.

Asthma Exacerbation

Diesel exhaust from older engines has been shown to exacerbate asthma in children and adults. HEI's study "Health Effects of Real-World Exposure to Diesel Exhaust in Persons with Asthma" led by Dr. Jim Zhang of the School of Medicine and Dentistry New Jersey, measured symptoms, airway function and cardiovascular responses of 60 study participants with asthma who walked on London's busy Oxford Street along which only predominantly diesel powered taxis and busses are allowed. The researchers then compared the responses of the same individuals after having them walk through nearby Hyde Park, where they were exposed to more general urban background air pollution. They found reductions in lung function that resulted from the short term exposure to the atmosphere on Oxford Street.

In an earlier study, a team led by HEI Review Committee member Bert Brunekreef found

that children attending schools near roads with heavy diesel truck traffic had significantly higher incidence of wheeze and other respiratory ailments. This and other evidence led HEI's Traffic Review expert panel to find a causal connection between exposure to traffic related air pollution and asthma exacerbation in children and adults.

Premature Mortality from PM
Diesel exhaust is a significant contributor to the mixture of fine particles (PM2.5) and black carbon in the ambient air, especially in heavily traveled urban areas. Epidemiological and other studies conducted over the last decade and earlier have reported associations between both long and short term exposure to PM and increases in illness and mortality. The most recent comprehensive study, HEI's *Extended Analysis of the American Cancer Society Study of Particulate Air Pollution and Mortality* (following a key population of over 360,000 Americans for 18 years), found continued associations of premature mortality, and especially associations of PM with much higher mortality from heart disease. This broad evidence led USEPA to conclude in the current Integrated Science Assessment for the PM National Ambient Air Quality Standard that PM2.5 is causally related to cardiovascular mortality and morbidity. Based on HEI studies, EPA estimated that over 20,000 annual premature deaths could be avoided by replacing older technology diesel on-road and non-road engines with new clean ones.

Lung Cancer
Diesel exhaust from older diesel engines and its possible association with cancer has been extensively studied in a range of toxicological, animal and human epidemiological studies. While study results have varied, HEI's *Diesel Exhaust: A Special Report* found a small but consistent increase in lung cancer risk for workers exposed to these older engines, and a number of national and international government agencies have concluded that diesel is likely carcinogenic in humans, though to varying degrees. These include:

- International Agency for Research on Cancer 1989: "*Probable human carcinogen"*
- National Toxicology Program 2005: "*Reasonably anticipated to be a human carcinogen"*
- USEPA 2002: "*Likely to be carcinogenic in humans"*

Thus there is an extensive body of literature suggesting that particle (including black carbon) and other exhaust from older technology diesel engines can have significant effects on the lung and heart. Having said that, with the advent of cleaner low sulfur fuels now required and dramatic advances in new clean diesel technology, especially the advent of the particle trap, the way forward for diesel is exceptionally promising.

Improvements in New Diesel Technology and Emissions

In response to the significant health concerns posed by exposure to diesel engines currently on the road, the U.S. Environmental Protection Agency promulgated the Heavy-Duty On-Highway Diesel Emissions Rule of 2001. This rule required significant reductions fuel sulfur (to 15 PPM) and companion reductions in two key pollutants, particles and nitrogen dioxide (also an important ozone precursor) in "on road" heavy duty engines. Subsequently, these rules were extended to apply to a host of non-road construction, and agricultural equipment as well.

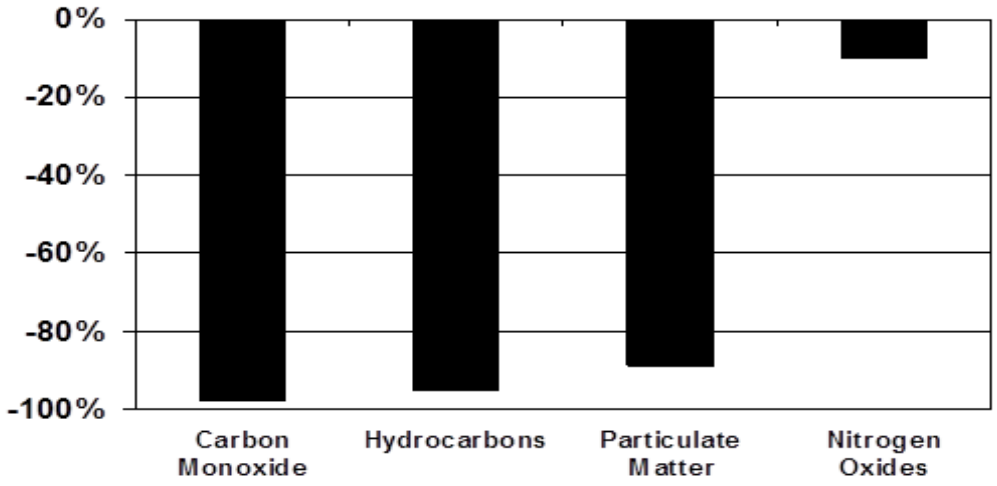
In order to comply with this new regulation, and as you will hear from others on this panel, industry developed advanced diesel engine and aftertreatment technology, including the use of new particle filters and NOx controls. At the same time, as part of a broader product stewardship initiative, government, including DOE, EPA and California, the diesel industry and

others came together to initiate at HEI and the Coordinating Research Council the Advanced Collaborative Emissions Study, the most rigorous emission testing ever done of new heavy duty engines - which power virtually every large truck and bus sold in the United States. The results of testing the emissions of these new diesel engines have been nothing short of dramatic.

The study, the comprehensive Phase 1 Report of ACES[1], found that emissions of fine particulate matter (PM) – a pollutant of significant public health concern – were approximately 99% lower than the PM emission levels allowed from 2004 technology heavy-duty diesel engines and nearly 90% lower than even the new 2007 national emissions standards for heavy-duty diesel vehicles (See Figure 1 below). This substantial over compliance with the stringent EPA standards is a remarkable achievement, and one that can be expected to make a significant contribution to improving the public health as the older engines are replaced.

Emissions of carbon monoxide, hydrocarbons, and a number of unregulated, so-called air toxics were also more than 90% lower than the 2004 levels and substantially below required levels. In addition, emissions of nitrogen oxides – which can have direct effects and contribute to the formation of smog – were approximately 70% lower than in the past and 10% below required levels. Another approximately 80% reduction in those emissions is required for engines sold after January 1, 2010.

Figure 1. Percent Below Required 2007 Levels



Unfinished Business

In summary, I have highlighted the negative health consequences of exposure to older technology diesel exhaust and the dramatic progress that has been made in producing new, cleaner diesel engines with particulate traps and advanced NOx controls that, over time, will

[1] The Phase 1 ACES study was conducted by the Southwest Research Institute in San Antonio, Texas under the oversight of the CRC. Investigators tested heavy duty diesel engines from the four major manufacturers of these engines, and subjected them to well-established federal test procedures, and to a much more rigorous 16 hour operation cycle designed especially for ACES. The engines were tested on multiple iterations of these cycles, and measurements of over 300 regulated and unregulated air pollutants were made in accordance with the highest laboratory standards.

penetrate the marketplace and result in cleaner air and improved health. As noted, diesel is also widely used in agricultural, construction, shipping and other enterprises and many of these (i.e. construction and farm equipment) will be subject to the new emission standards during the course of this decade. And the particle traps can and have been applied as retrofits to existing vehicles, with similar reductions in the mass of PM emitted.

There is a challenge however: diesel engines are exceptionally durable with a long life expectancy which will moderate the pace of fleet replacement and corresponding emissions reduction. Through natural replacement, US EPA did not expect full fleet turnover for heavy duty onroad engines until 2030; this will take even longer for nonroad engines. Given the evidence of effects from older diesel technology, and the fact that particle traps and companion technologies have been successfully applied as retrofits to existing vehicles, with similar reductions in PM mass, can action be taken to accelerate this transition? Such an acceleration will help protect the current generation of Americans from the emissions of the legacy fleet of older diesels that will continue to operate on the nation's highways, and in its fields and workplaces for years to come.

Clearly the technology to reduce emissions exists, and the public health benefits of those reductions, in terms of avoided mortality and respiratory health impacts can be expected to be significant.