Evaluation of Public Health Risks from Diesel Engine Exhaust The public health risks associated with exposure to diesel engine exhaust were evaluated based on information on the physical and chemical characteristics of diesel engine exhaust, the transport of particles and gases in the atmosphere, and the potential health effects of diesel emissions. Health risks were stated in terms of the increased probability of persons living in congested urban areas developing chronic respiratory diseases or cancer. This risk evaluation is being used to focus related health effects research programs on areas where uncertainties remain about the effects of emissions from light-duty diesel vehicles.

History The attraction of diesels is largely that they achieve 10–25 percent higher fuel efficiencies than equivalent-sized gasoline engines and, thus, can make an important contribution to reducing U.S. dependence on foreign sources of oil. However, because current diesel engines emit more visible smoke and odors than gasoline engine vehicles, concern has been expressed that they may also involve new health risks. Indeed, particles emitted by diesel engines have been found to contain small amounts of known cancer-causing chemicals, which also have been shown to be mutagenic when tested in cell cultures. These particles are small enough to be inhaled by humans and deposited in the lungs. Although these are both signs of a potential health risk, epidemiological studies of workers who were exposed to high concentrations of emissions from diesel buses in garages showed no detectable increase in lung cancer incidence.

To understand this apparent anomaly, mathematical models were used to predict future air concentrations of diesel exhaust in congested urban areas. Relationships between exposure concentrations and health risks were developed by combining the results of short-term bioassay tests, whole-animal studies, and human epidemiological studies. Because human epidemiological studies of workers exposed to diesel exhausts were not sensitive enough to detect changes in cancer rates of the general population, the mathematical models used results of human epidemiological studies of populations exposed to coke-oven emissions, cigarette smoke, and urban soot. All of these represent exposures to the combustion products of fossil fuels that are similar to diesel emissions in their physical and chemical characteristics.

Overall, the health risk evaluation concluded that future diesel light-duty vehicles are not likely to increase significantly the risks of developing respiratory diseases or cancer over those already present from atmospheric pollution. The projected risks were also much less than those associated with cigarette smoking or exposure to levels of cigarette smoke that are commonly found indoors. The potential reductions in health risk that could be achieved with pollution controls on diesel vehicles were also evaluated.

Benefits The analysis performed for OHER is being used to (1) guide the development of research programs aimed at directly measuring the relationships between levels of exposure and risk, (2) identify populations that may be at greatest risk from future diesel emissions, and (3) formulate cost-effective emission control standards for future light-duty diesel vehicles. The health risk analysis was incorporated into the Environmental Protection Agency's (EPA's) summary publication *Toxicological Effects of Emissions from Diesel Engines* [J. Lewtas, *Developments in Toxicological and Environmental Science* 10, 1982 (Elsevier Science Publishing Company)].

The health risk analysis indicated that if 20 percent of the light-duty vehicles in the United States were to use diesel engines, fewer than 400 lung cancers/year would likely occur as a result of exposures to diesel engine exhaust—even if no further emission controls were applied to reduce particulate exhaust. Fewer than 200 lung cancers/year are projected if the proposed post-1985 emission standards reduce current particulate emissions by about 50 percent. This increased incidence would be a small fraction of the 100,000 lung cancers that already occur in the United States each year.

Thus, the research program developing risk analysis for the health effects of diesel engine exhaust has provided information that can serve as a basis for the cost-effective regulation of vehicle emissions.

Evaluation of Public Health Risks from Atmospheric Sulfates A probabilistic health-damage function that yielded a "best" estimate for increased mortality as a result of exposure to atmospheric sulfate particles, which included a confidence interval expressing the range of uncertainty of the estimate, was derived.

History Of the various pollutants produced in the combustion of fossil fuels, the chemically transformed products of sulfur dioxide and atmospheric sulfates have been of particular concern with respect to potential increases in human mortality. Numerous epidemiological studies have been conducted, generating a broad range of sometimes conflicting results. These studies were assessed for scientific validity and then aggregated into a single probabilistic function that expresses the uncertainty of the information available.

This probabilistic health-damage function has now become standard in the air pollution health impact literature, and the general methodology has been extended to a broad range of risk assessment and policy analysis applications. The function has served as an important tool in educating policymakers and the general public regarding the potential health impacts of future emissions. A recent state-of-the-art assessment of fossil fuel combustion stated that the probabilistic function might be regarded as the best available indication of the