1. INTRODUCTION

Diesel engines are an important part of transportation and industry throughout the industrialized world, and their use may expand because of increased pressures for fuel efficiency. For example, in addition to their widespread use in heavy-duty trucks and in many nonroad applications (such as construction and agriculture), there is increased use of diesel engines in light/medium duty trucks. Also, new technologies, such as hybrid vehicles powered by advanced diesel engines, and the potential for increased use of light-duty diesel engines in the sport utility market could fuel this expansion. In both the United States and Europe (where diesel passenger vehicles are much more common than in the United States), decisions are being made about how to regulate diesel engine and diesel fuel emissions; these decisions need to be based on sound scientific foundations.

EPA's Office of Mobile Sources (OMS) has traditionally regulated diesel engine emissions through Clean Air Act (CAA) provisions, based on diesel engines' contribution to nonattainment of the PM-10 and ozone National Ambient Air Quality Standards (NAAQS). In particular, diesel engines are a significant source of particulate and nitrogen oxide (NO_x) emissions. Since the passage of the first CAA in 1977, great strides have been made in controlling particulate matter and NO_x emissions (including NO and NO_2, both of which contribute to ozone formation) from highway and nonroad diesel engines. Heavy-duty urban bus diesel engine particulate certification standards decreased by approximately 90% between 1988 and 1996, and heavy-duty highway diesel engine particulate certification standards decreased by approximately 80% in the same period. NO_x emissions standards have also been reduced, resulting in significant control of these emissions over the years. Manufacturers have reduced particulate NO_x emissions by a variety of control technologies, such as altered combustion chamber design, better fuel injection technology such as high-pressure injection, and oxidation-type catalysts in some cases. EPA has also implemented initial regulations controlling emissions (NO_x) from nonroad diesel engines. In addition, EPA has regulated diesel fuel quality by limiting the sulfur content of diesel fuel, thereby reducing particulate emissions.

New authority granted to OMS under the CAA Amendments of 1990 allows for further regulation of nonroad diesel engines. Particulate and NO_x emission standards have been or will be established for diesel engines used to power nonroad equipment such as construction equipment, marine vessels, and locomotives.

As mentioned previously, EPA has taken action to control diesel engine particulate matter emissions in order to facilitate attainment with the PM-10 NAAQS as a direct result of the adoption of a new NAAQS for particulate matter less than 2.5 µm in diameter. On the basis of current health research, it is this fraction of the PM that is implicated in both the cancer and

noncancer effects observed from diesel particulate emissions exposure. PM 2.5 data indicate that diesel engines contribute significantly to the national particulate emission inventories. Further regulation of diesel engine particulate emissions will require sound scientific evidence from the NAAQS effort as well as continuing research related to particulate effects on public health.

EPA has never prepared a comprehensive health assessment document focused on the possible health hazards from direct exposure to diesel exhaust emissions. Piecemeal health assessment work was done at various times in the 1980s, as was EPA-sponsored health research, with most of the attention focused on the possible carcinogenicity of DE exposure. The purpose of this assessment is to capture the key data relating to toxicity and to assess that body of evidence in order to produce a risk characterization describing the human health hazards of DE exposure. Companion comprehensive characterizations of human exposure, diesel engine emission factors, postemission DE pollutant transformation, and transport in the ambient air are not included in the assessment, though some overview information is provided so that the health assessment findings can be placed in a context with related issues.

In Chapters 2 through 11 of this assessment, key human and animal toxicity topics, as well as overview topics, are reviewed and conclusions drawn as appropriate. Chapter 12 integrates the various findings about the potential for health hazards and risk and additionally provides a risk characterization.

The health assessment findings from this assessment will be advisory to EPA's Office of Mobile Sources by providing health impact information that can be used to characterize residual health hazards and risk.