

trillion dollars between 2007 and 2030. By the year 2030, this proposed rule would be expected to prevent approximately 9,600 deaths per year from premature mortality, and 16,000 nonfatal heart attacks. It is estimated to also prevent 14,000 acute bronchitis attacks in children, 260,000 respiratory symptoms in children, and nearly 1 million lost work days in 2030. The reductions will also improve visibility.

In the remainder of this section we will describe in more detail the air pollution problems associated with emissions from nonroad diesel engines, and the emission and air quality benefits we expect to realize from the fuel and engine controls in this proposal.

#### A. Overview

The emissions from nonroad engines that are being directly controlled by the standards in this rulemaking are NO<sub>x</sub>, PM and NMHC, and to a lesser extent, CO. Gaseous air toxics from nonroad diesels will also be reduced as a consequence of the proposed standards. In addition there will be a substantial reduction in SO<sub>x</sub> emissions resulting from the proposed reduction in sulfur level in diesel fuel.

From a public health perspective, we are primarily concerned with nonroad engine contributions to atmospheric levels of particulate matter in general, diesel PM in particular and various gaseous air toxics emitted by diesel engines, and ozone.<sup>9</sup> We will first review important public health effects linked to these pollutants, briefly describing the human health effects and the current and expected future ambient levels of direct or indirectly caused pollution. Our presentation will show that substantial further reductions of these pollutants, and the underlying emissions from nonroad diesel engines, are needed to protect public health.

Following discussion of health effects, we will discuss a number of welfare effects associated with emissions from diesel engines. These effects include atmospheric visibility impairment, ecological and property damage caused by acid deposition, eutrophication and nitrification of surface waters, environmental threats posed by polycyclic organic matter (POM) deposition, and plant and crop damage from ozone. Once again, the information available to us indicates a continuing

need for further nonroad emission reductions to bring about improvements in air quality.

Next, we will describe our understanding of the engine emission inventories for the primary pollutants affected by the proposal. As noted above, these include PM, NO<sub>x</sub>, SO<sub>x</sub>, Air Toxics and HC. We will present current and projected future levels of emissions for the base case, including anticipated reductions from control programs already adopted by EPA and the States, but without the controls proposed today. Then we will identify expected emission reductions from nonroad engines. These reductions will make important contributions to controlling the health and welfare problems associated with ambient PM and ozone levels and with diesel related air toxics.

While the material we will present in this section will describe our understanding of the need for control of nonroad engine emissions and the air quality improvements we expect to realize, this section is not an exhaustive treatment of these issues. For a fuller understanding of the topics treated here, you should refer to the extended presentations in the Draft Regulatory Impact Analysis accompanying this proposal.

#### B. Public Health Impacts

##### 1. Particulate Matter

Particulate matter (PM) represents a broad class of chemically and physically diverse substances. It can be principally characterized as discrete particles that exist in the condensed (liquid or solid) phase spanning several orders of magnitude in size. PM<sub>10</sub> refers to particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers. Fine particles refer to those particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers (also known as PM<sub>2.5</sub>), and coarse fraction particles are those particles with an aerodynamic diameter greater than 2.5 microns, but less than or equal to a nominal 10 micrometers. Ultrafine PM refers to particles with diameters of less than 100 nanometers (0.1 micrometers). The health and environmental effects of PM are associated with fine PM fraction and, in some cases, to the size of the particles. Specifically, larger particles (>10 μm) tend to be removed by the respiratory clearance mechanisms whereas smaller particles are deposited deeper in the lungs. Also, particles scatter light obstructing visibility.

The emission sources, formation processes, chemical composition, atmospheric residence times, transport

distances and other parameters of fine and coarse particles are distinct. Fine particles are directly emitted from combustion sources and are formed secondarily from gaseous precursors such as sulfur dioxide (SO<sub>x</sub>), oxides of nitrogen (NO<sub>x</sub>), or organic compounds. Fine particles are generally composed of sulfate, nitrate, chloride, ammonium compounds, organic carbon, elemental carbon, and metals. Nonroad diesels currently emit high levels of NO<sub>x</sub> which react in the atmosphere to form secondary PM<sub>2.5</sub> (namely ammonium nitrate). Nonroad diesel engines also emit SO<sub>2</sub> and HC which react in the atmosphere to form secondary PM<sub>2.5</sub> (namely sulfates and organic carbonaceous PM<sub>2.5</sub>). Combustion of coal, oil, diesel, gasoline, and wood, as well as high temperature process sources such as smelters and steel mills, produce emissions that contribute to fine particle formation. In contrast, coarse particles are typically mechanically generated by crushing or grinding. They include resuspended dusts and crustal material from paved roads, unpaved roads, construction, farming, and mining activities. These coarse particles can be either natural in source such as road dust or anthropogenic. Fine particles can remain in the atmosphere for days to weeks and travel through the atmosphere hundreds to thousands of kilometers, while coarse particles deposit to the earth within minutes to hours and within tens of kilometers from the emission source.

The relative contribution of various chemical components to PM<sub>2.5</sub> varies by region of the country. Data on PM<sub>2.5</sub> composition are available from the EPA Speciation Trends Network in 2001 and the Interagency Monitoring of PROtected Visual Environments (IMPROVE) network in 1999 covering both urban and rural areas in numerous regions of the U.S. These data show that carbonaceous PM<sub>2.5</sub> makes up the major component for PM<sub>2.5</sub> in both urban and rural areas in the western U.S. Carbonaceous PM<sub>2.5</sub> includes both elemental and organic carbon. Nitrates formed from NO<sub>x</sub> also play a major role in the western U.S., especially in the California area where it is responsible for about a quarter of the ambient PM<sub>2.5</sub> concentrations. Sulfate plays a lesser role in these regions. For the eastern and mid U.S., these data show that both sulfates and carbonaceous PM<sub>2.5</sub> are major contributors to ambient PM<sub>2.5</sub> in both urban and rural areas. In some eastern areas, carbonaceous PM<sub>2.5</sub> is responsible for up to half of ambient PM<sub>2.5</sub> concentrations. Sulfate is also a

<sup>9</sup> Ambient particulate matter from nonroad diesel engine is associated with the direct emission of diesel particulate matter, and with particulate matter formed indirectly in the atmosphere by NO<sub>x</sub> and SO<sub>x</sub> emissions (and to a lesser extent NMHC emissions). Both NO<sub>x</sub> and NMHC participate in the atmospheric chemical reactions that produce ozone.