

Visibility is also highly valued in significant natural areas such as national parks and wilderness areas, because of the special emphasis given to protecting these lands now and for future generations.

To quantify changes in visibility, we compute a light-extinction coefficient, which shows the total fraction of light that is decreased per unit distance. Visibility can be described in terms of visual range or light extinction and is reported using an indicator called deciview.⁷⁷ In addition to limiting the distance that one can see, the scattering and absorption of light caused by air pollution can also degrade the color, clarity, and contrast of scenes.

In addition, visibility impairment can be described by its impact over various periods of time, by its source, and the physical conditions in various regions of the country. Visibility impairment can be said to have a time dimension in that it might relate to short-term excursions or to longer periods (e.g., worst 20 percent of days and annual average levels). Anthropogenic contributions account for about one-third of the average extinction coefficient in the rural West and more than 80 percent in the rural East. In the Eastern U.S., reduced visibility is mainly attributable to secondarily formed particles, particularly those less than a few micrometers in diameter, such as sulfates. While secondarily formed particles still account for a significant amount in the West, primary emissions contribute a larger percentage of the total particulate load than in the East. Because of significant differences related to visibility conditions in the Eastern and Western U.S., we present information about visibility by region.

Furthermore, it is important to note that even in those areas with relatively low concentrations of anthropogenic fine particles, such as the Colorado Plateau, small increases in anthropogenic fine particulate concentrations can lead to significant decreases in visual range. This is one of the reasons mandatory Federal Class I

areas have been given special consideration under the Clean Air Act.⁷⁸

b. Visibility Impairment Where People Live, Work and Recreate

The secondary PM NAAQS is designed to protect against adverse welfare effects which includes visibility impairment. In 1997, EPA established the secondary PM_{2.5} NAAQS as equal to the primary (health-based) NAAQS of 15 $\mu\text{g}/\text{m}^3$ (based on a 3-year average of the annual mean) and 65 $\mu\text{g}/\text{m}^3$ (based on a 3-year average of the 98th percentile of the 24-hour average value) (62 FR 38669, July 18, 1997). EPA concluded that PM_{2.5} causes adverse effects on visibility in various locations, depending on PM concentrations and factors such as chemical composition and average relative humidity. In 1997, EPA demonstrated that visibility impairment is an important effect on public welfare and that unacceptable visibility impairment is experienced throughout the U.S., in multi-state regions, urban areas, and remote federal Class I areas. In many cities having annual mean PM_{2.5} concentrations exceeding annual standard, improvements in annual average visibility resulting from the attainment of the annual PM_{2.5} standard are expected to be perceptible to the general population. Based on annual mean monitored PM_{2.5} data, many cities in the Northeast, Midwest, and Southeast as well as Los Angeles would be expected to experience perceptible improvements in visibility if the PM_{2.5} annual standard were attained.

The updated monitoring data and air quality modeling, summarized above and presented in detail in the draft RIA, confirm that the visibility situation identified during the NAAQS review in 1997 is still likely to exist, and it will continue to persist when these proposed standards for nonroad diesel engines take effect. Thus, the determination in the NAAQS rulemaking about broad visibility impairment and related benefits from NAAQS compliance are still relevant.

Furthermore, in setting the PM_{2.5} NAAQS, EPA acknowledged that levels of fine particles below the NAAQS may also contribute to unacceptable visibility impairment and regional haze problems in some areas, and section 169 of the Act provides additional authorities to remedy existing impairment and prevent future impairment in the 156 national parks, forests and wilderness areas labeled as

mandatory Federal Class I areas (62 FR 38680–81, July 18, 1997).

In making determinations about the level of protection afforded by the secondary PM NAAQS, EPA considered how the section 169 regional haze program and the secondary NAAQS would function together.⁷⁹ Regional strategies are expected to improve visibility in many urban and non-Class I areas as well.

Fine particles may remain suspended for days or weeks and travel hundreds to thousands of kilometers, and thus fine particles emitted or created in one county may contribute to ambient concentrations in a neighboring region.⁸⁰

The 1999–2001 PM_{2.5} monitored values indicate that at least 74 million people live in areas where long-term ambient fine PM levels are at or above 15 $\mu\text{g}/\text{m}^3$.⁸¹ Thus, at least these populations (plus those who travel to those areas) are experiencing significant visibility impairment, and emissions of PM and its precursors from nonroad diesel engines contribute to this impairment.⁸²

Because of the importance of chemical composition and size to visibility, we used EPA's Regional Modeling System for Aerosols and Deposition (REMSAD)⁸³ model to project visibility conditions in 2020 and 2030 in terms of deciview, accounting for the chemical composition of the particles and transport of precursors. Our projections included anticipated emissions from the nonroad diesel engines subject to this proposed rule as well as all other sources.

Based on this modeling, we predict that in 2030, 85 million people (25

⁷⁹ U.S. EPA Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information OAQPS Staff Paper, EPA-452/R-96-013, 1996. Docket Number A-99-06, Documents Nos. II-A-18, 19, 20, and 23. The particulate matter air quality criteria documents are also available at <http://www.epa.gov/ncea/partmatt.htm>.

⁸⁰ Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment for Scientific and Technical Information, OAQPS Staff Paper, EPA-452/R-96-013, July, 1996, at IV-7. This document is available from Docket A-99-06, Document II-A-23.

⁸¹ U.S. EPA Air Quality Data Analysis 1999–2001. Technical Support Document for Regulatory Actions. March 2003.

⁸² These populations would also be exposed to PM concentrations associated with the adverse health impacts discussed above.

⁸³ Additional information about the Regional Modeling System for Aerosols and Deposition (REMSAD) and our modeling protocols can be found in our Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, document EPA420-R-00-026, December 2000. Docket No. A-2000-01, Document No. A-II-13. This document is also available at <http://www.epa.gov/otaq/disel.htm#documents>.

⁷⁷ Visual range can be defined as the maximum distance at which one can identify a black object against the horizon sky. It is typically described in miles or kilometers. Light extinction is the sum of light scattering and absorption by particles and gases in the atmosphere. It is typically expressed in terms of inverse megameters (Mm^{-1}), with larger values representing worse visibility. The deciview metric describes perceived visual changes in a linear fashion over its entire range, analogous to the decibel scale for sound. A deciview of 0 represents pristine conditions. Under many scenic conditions, a change of 1 deciview is considered perceptible by the average person.

⁷⁸ The Clean Air Act designates 156 national parks and wilderness areas as mandatory Federal Class I areas for visibility protection.