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Ozone and Particulate Matter Air Standards: EPA Review

The Clean Air Act (CAA) requires the U.S. Environmental Protection Agency (EPA) to review standards for national ambient air quality every five years. In 2018, EPA announced strategies to expedite the National Ambient Air Quality Standard (NAAQS) review while concurrently disbanding a pollutant-specific scientific review panel that has historically advised agency staff during their reviews. Although the CAA allows the EPA Administrator to specify the procedures for review of the NAAQS, past EPA reviews and revisions have garnered considerable congressional oversight. In December 2020, EPA completed the particulate matter (PM) NAAQS review and retained the standards. This In Focus discusses the recently completed PM NAAQS review and the ongoing ozone review.

Background on Ozone and Particulate Matter

Ozone and PM are two of six principal pollutants referred to as “criteria pollutants” for which EPA has promulgated NAAQS under the CAA (42 U.S.C. § 7408(a)(1)).

Ground-level ozone, the primary component of smog, is formed when nitrogen oxides (NO_x) react with volatile organic compounds (VOCs) in sunlight. Ground-level ozone is associated with health effects, such as aggravated asthma, chronic bronchitis, heart attacks, and premature death. EPA has identified natural and anthropogenic sources of ozone and ozone precursors (e.g., NO_x and VOCs), including factories, lightning, power plants, vegetation, vehicles, volatile chemical products (e.g., paints and solvents), and wildfires.

PM refers to a mixture of solid particles and liquid droplets in the atmosphere. PM components may include acids, organic chemicals, metals, and soil or dust particles. The size of PM varies, ranging from tiny particles that can be seen only through a high-power microscope to larger particles (e.g., soot). Exposure to PM has been associated with adverse health effects (e.g., aggravated asthma, chronic bronchitis, and premature death). PM has also been linked with haze formation and other ecological effects.

Typical sources of fine PM (PM_{2.5})—measured at 2.5 micrometers or less in diameter—include emissions from vehicles, smokestacks, and fires. Coarse PM (PM₁₀)—generally measuring 10 micrometers or less in diameter—is often associated with dust from paved and unpaved roads, construction and demolition operations, certain industrial processes and agriculture operations, and biomass burning. In addition, precursor emissions (e.g., sulfur oxides, NO_x, and VOCs) contribute to the formation of “secondary PM.” PM_{2.5} contains a much greater portion of secondary particles than PM₁₀ does.

Notwithstanding air quality progress since 1970, ozone and PM concentrations currently exceed the NAAQS in some areas (“nonattainment areas”). **Table 1** lists these NAAQS and the estimated population in nonattainment areas.

Table 1. Selected NAAQS and the Estimated U.S. Population in Corresponding Nonattainment Areas

NAAQS	Primary Standard	Estimated U.S. Population in Nonattainment Areas
2015 Ozone	70 ppb (8-hour)	122 million
2012 Fine PM	12.0 µg/m ³ (Annual)	21 million
1987 Coarse PM	150 µg/m ³ (24-hour)	6 million

Source: CRS, as adapted from EPA Green Book (May 31, 2020), which lists nonattainment areas (<https://www.epa.gov/green-book>). Estimated population based on 2010, rounded to nearest million.

Notes: Units of measure are parts per billion (ppb) and micrograms per cubic meter of air (µg/m³). See 40 C.F.R. Part 50 for detailed NAAQS. Table presents the most recent PM and ozone NAAQS.

NAAQS Statutory Requirements

NAAQS do not directly limit emissions. Rather, NAAQS are concentration-based standards for ambient (outdoor) pollution. Under the CAA, Congress mandated that EPA establish two types of NAAQS for each criteria pollutant—a primary NAAQS, which must protect public health with an “adequate margin of safety,” and a secondary NAAQS, which must “protect public welfare from any known or anticipated adverse effects” (42 U.S.C. § 7409(b)). Public welfare includes damage to crops, vegetation, property, building materials, and climate (42 U.S.C. § 7602(h)).

The CAA establishes a framework for EPA to set NAAQS based on the “latest scientific knowledge” through a notice-and-comment rulemaking process (42 U.S.C. §§ 7408, 7409). The CAA requires EPA to review the NAAQS and the science upon which they are based every five years and then revise the NAAQS if necessary. The CAA also requires EPA to appoint an independent scientific review committee composed of seven members, which has become the Clean Air Scientific Advisory Committee (CASAC). The act directs CASAC to review the NAAQS every five years and recommend to the EPA Administrator “any new national ambient air quality standards and revisions ... as may be appropriate” (42 U.S.C. § 7409(d)(2)).

EPA’s Review of the NAAQS

Beyond the aforementioned CAA requirements, procedural aspects of the NAAQS review are generally at the discretion of the EPA Administrator. Historically, the agency has undertaken a multi-step process to review each NAAQS. Each NAAQS review typically begins with a planning phase in which EPA seeks public input and develops an Integrated Review Plan (IRP). The IRP maps

out the schedule and process for the review and identifies policy-relevant science issues to guide the review.

EPA reviews the relevant scientific literature published since the last NAAQS revision, summarizing it in a report currently known as the Integrated Science Assessment (ISA). The ISA compiles information about sources of the pollutant, exposure pathways, empirical evidence regarding the causality link between exposure and adverse health effects, and other topics. The ISA is intended as the scientific foundation for the EPA Administrator's assessment of whether the NAAQS sufficiently protect public health and welfare. In the past, EPA solicited public comment and multiple CASAC reviews before finalizing. The final ISA informs EPA's preparation of the Risk and Exposure Assessment (REA), which estimates exposures and health risks under defined air quality scenarios.

Subsequently, EPA prepares a Policy Assessment (PA), which summarizes information from the ISA and REA and provides the Administrator with options regarding the indicators, averaging times, statistical form, and numerical level (concentration) of the NAAQS. EPA solicits comment on the PA from CASAC and the public, then finalizes a decision on the NAAQS standard through the rulemaking process. The agency proposes a decision—to retain or to revise the standard—after considering information in the ISA, REA, and PA and the advice of CASAC.

EPA Restructuring of the NAAQS Reviews

The NAAQS review process has evolved over time, with multiple Administrations introducing procedural modifications intended to streamline the process, improve transparency, or strengthen the scientific basis. In 2018, EPA announced plans to streamline NAAQS reviews by, for example, releasing some documents for CASAC review concurrently and folding REA-related analyses into the PA rather than developing a new REA. EPA also planned to seek CASAC advice about background pollution and potential adverse effects from NAAQS compliance strategies and changed the CASAC subcommittees.

Under its CASAC charter, EPA may form subcommittees or workgroups, such as pollutant-specific panels, to serve under CASAC. Past panels, which included individuals with expertise in specific pollutants, assisted with the NAAQS reviews. In 2018, EPA disbanded the Particulate Matter Review Panel formed in 2015, directing the seven-member CASAC to assist EPA with reviews for the 2012 PM and 2015 ozone NAAQS on an expedited timeline. Some have expressed concerns about the lack of pollutant specific panels, and in its review of PM, CASAC recommended EPA either reappoint the CASAC PM panel or appoint a new panel with similar expertise. CASAC stated that the “breadth and diversity of evidence to be considered exceeds the expertise of the statutory CASAC members” (letter from CASAC to EPA, April 11, 2019).

CASAC also recommended “substantial revisions” to the draft PM ISA, finding that it did “not provide a sufficiently comprehensive, systematic assessment of the available science.” CASAC members did not reach consensus as to “whether there is robust and convincing evidence to support the EPA's conclusion that there is a causal relationship between PM_{2.5} exposure and mortality” (CASAC letter).

EPA's causality assessment is consequential, as it factors into the Administrator's decision about whether to revise the NAAQS.

EPA replied that it would make “necessary adjustments” to the PM ISA while finishing the PA and reaffirmed its goal to complete the PM review by 2020 (EPA letter to CASAC, July 25, 2019). EPA did not form a new PM panel or convene an ozone panel. In September 2019, EPA announced the availability of 12 subject matter experts to assist CASAC with technical questions. Incorporating elements of CASAC's review, EPA finalized its PM PA in early 2020, concluding that available scientific evidence, air quality analyses, and risk assessments call “into question the adequacy of the public health protection afforded” by the current PM_{2.5} standards. The final PA further recognizes that contrasting conclusions might be reached dependent on judgment of the weight of various types of scientific evidence considered (Final PM PA, January 2020, EPA-452/P-19-001). After consideration of the scientific reviews, and information from five public meetings and a reported 60,000 comments, the EPA Administrator decided to retain the existing PM standards. The final decision, the same as proposed, was based partly on the Administrator's conclusion that there are “important uncertainties in the evidence for adverse health effects below the current” PM_{2.5} standards (85 *Federal Register* 82685, December 18, 2020).

EPA began the current ozone review in 2018 and structured it to last roughly two-and-a-half years. The previous ozone review lasted about seven years. EPA compressed the current review schedule partly by releasing the draft ISA and draft PA nearly concurrently requesting simultaneous review by the CASAC. This approach differs from previously completed reviews in which EPA considered CASAC input and public comments on the ISA as EPA developed the PA. CASAC found that the draft ISA did not provide a “comprehensive, systematic assessment” and recommended that EPA “consider restoring a traditional interactive discussion process in which the CASAC can interact directly with external expert panels” (CASAC, EPA-CASAC-20-002). CASAC did not reach consensus regarding the draft PA's recommendation that the Administrator consider retaining the primary ozone standard. EPA has since finalized the ISA and the PA, which recommends retaining the primary ozone standard.

Issues for Consideration

Congress may consider if EPA's revised approach meets the CAA objectives to review the NAAQS and the science upon which they are based in a timely manner. EPA's modifications to the NAAQS review process underscore the tension between competing concerns. Some stakeholders, interest groups, and Members of Congress have criticized the timeliness of past NAAQS reviews, which routinely have not been completed within the five-year review cycle. Others question whether expedited NAAQS decisions are able to reflect the latest science and if the scientific basis is rigorous and unbiased.

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