Air Quality: EPA's 2006 Changes to the Particulate Matter (PM) Standards

(name redacted)
Specialist in Environmental Policy

(name redacted)
Specialist in Environmental Policy

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Summary

On October 17, 2006, the EPA published its final revisions to the National Ambient Air Quality Standards (NAAQS) for particulate matter (particulates, or PM). The EPA reviewed more than 2,000 scientific studies and found that the evidence continued to support associations between exposure to particulates in ambient air and numerous significant health problems, including aggravated asthma, chronic bronchitis, reduced lung function, heart attacks, and premature death in people with heart or lung disease. Based on several analytical approaches, the EPA estimated that compliance with the new NAAQS will prevent 1,200 to 13,000 premature deaths annually, as well as substantial numbers of hospital admissions and missed work or school days due to illness. Although a tightening of the standards, the new 2006 particulates NAAQS are not as stringent as recommended by EPA staff or the independent scientific advisory committee (Clean Air Scientific Advisory Committee, or CASAC) mandated under the Clean Air Act.

The new 2006 particulates NAAQS strengthen the pre-existing (1997) standard for "fine" particulate matter 2.5 micrometers or less in diameter ($PM_{2.5}$) by lowering the allowable *daily* concentration of $PM_{2.5}$ in the air. The new daily standard averaged over 24-hour periods is reduced from 65 micrograms per cubic meter ($\mu g/m^3$) to 35 $\mu g/m^3$. However, the *annual* $PM_{2.5}$ standard, which is set in addition to the daily standard to address human health effects from chronic exposures to the pollutants, is unchanged from the 1997 standard of 15 µg/m3, although the CASAC had recommended a tighter annual standard in the range of 13 to 14 $\mu g/m^3$. Nearly 90 million people live in the 208 counties designated as "nonattainment" areas for the 1997 $PM_{2.5}$ NAAQS.

The 2006 particulates NAAQS also retain the 24-hour standard and revoke the annual standard for slightly larger, but still inhalable, particles less than or equal to 10 micrometers (PM_{10}). The EPA abandoned its proposal to replace the particle size indicator of PM_{10} with a range of 10 to 2.5 micrometers ($PM_{10-2.5}$), and did not follow through on its proposal to exclude any mix of particles "dominated by rural windblown dust and soils and PM generated by agricultural and mining sources."

The divergence from the CASAC's recommendation has proved controversial, as have several other elements of the 2006 particulates NAAQS, including the decision not to exclude rural sources from the coarse particle standard. Some have also questioned the EPA's strengthening of the standard for *all* fine particles, without distinguishing their source or chemical composition. In December 2006, several states and industry, agriculture, business, and public advocacy groups petitioned the U.S. Court of Appeals for the District of Columbia (D.C.) Circuit to review the new 2006 particulates NAAQS. All briefs from petitioners, EPA, and supporters were filed with the court by March 7, 2008, but the date for oral argument has not yet been scheduled. EPA anticipates a decision in late 2008. Congress may conduct oversight of the new 2006 particulates NAAQS, given the potential public health and economic impacts, and concerns regarding the role of CASAC in NAAQS reviews.

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Introduction

The EPA has identified and promulgated National Ambient Air Quality Standards (NAAQS) under the Clean Air Act (CAA)[1] for six principal pollutants classified by the agency as "criteria pollutants": particulate matter (PM), ozone (O_3, a key measure of smog), nitrogen dioxide (NO_2, or, inclusively, nitrogen oxides,[2] NOx), sulfur oxides (SOx, or, specifically, SO_2), carbon monoxide (CO), and lead (Pb). On October 17, 2006,[3] the EPA published its revisions to the NAAQS for particulates to provide protection against potential health effects associated with short- and long-term exposure to particulate matter (including chronic respiratory disease and premature mortality).

The EPA's newly promulgated particulates NAAQS modify the standards established in 1987[4] that focused on particles smaller than 10 microns (PM_{10}, or coarse particles) and standards for "fine" particles smaller than 2.5 microns ($PM_{2.5}$) introduced for the first time with the promulgation of the 1997 $PM_{2.5}$ NAAQS.[5] The 2006 revisions to the particulates NAAQS are the culmination of the EPA's most recent statutorily required periodic review,[6] based on its evaluation and analysis of more than 2,000 scientific studies available between 1997 and 2002, and on determinations made by the Administrator. Prior to this, the most recent changes to any NAAQS, a strengthening of the particulate matter and ozone standards, were promulgated jointly in 1997. The EPA's most recently completed review of the particulates NAAQS and of the scientific criteria for setting the standards was initiated not long after the 1997 promulgation.

The 2006 particulates NAAQS are expected to continue to generate national interest and debate, and possibly oversight in Congress, as did the previous changes to the particulates standards promulgated in 1997. While the new 2006 particulates NAAQS generally tightened the air quality standards for particulate matter, the action has caused considerable controversy, including concerns that the standards are outside the range recommended by both EPA staff and by the scientific advisory panel (Clean Air Scientific Advisory Committee, or CASAC [7]) established by the Clean Air Act (CAA).[8] Conversely, some continue to contend that available data do not support the need for stricter standards or, in some cases, the standards as promulgated in 1997. In December 2006, 13 states and the District of Columbia petitioned the U.S. Court of Appeals for the District of Columbia (D.C.) Circuit to review the new 2006 particulates NAAQS. In addition, several groups representing various industry and agriculture interests (including coal, iron, steel, and corn refiners, oilseed processors, farmers, and cattle and pork producers), as well as environmental and public health organizations, also filed petitions to the D.C. Circuit challenging

[1] Sections 108-109 of the Clean Air Act.

[2] The NAAQS is for NO_2; nitrogen gases that are ozone precursors are referred to as NOx.

[3] 71 *Federal Register* 61143-61233, October 17, 2006. See also EPA's PM Regulatory Actions website at http://epa.gov/pm/actions.html.

[4] 52 *Federal Register* 24634-24715, July 1, 1987.

[5] 62 *Federal Register* 38652-38896, July 18, 1997.

[6] Section 109(d)(1) of the CAA. According to the statute, the EPA is required to review the latest scientific studies and either reaffirm or modify the NAAQS every five years.

[7] For information regarding the CASAC PM review panel and its activities and reports, see http://yosemite.epa.gov/sab/sabpeople.nsf/WebCommittees/CASAC.

[8] Section 109(d)(2)of the Clean Air Act.

the new 2006 NAAQS.[9] Briefs from petitioners, EPA, and supporters were filed with the court by March 7, 2008, but the date for oral argument had not yet been scheduled as of the updating of this report. EPA anticipates a decision in late 2008.

The completion of the 2006 PM NAAQS review was followed by an EPA announcement, on December 7, 2006, that it would modify the process for setting and reviewing NAAQS. Among other changes, the CASAC would no longer have a role in approving the policy staff paper with its recommendations to the Administrator. CASAC would be relegated to commenting on the policy paper after it appears in the Federal Register, during a public comment period. The Senate Environment and Public Works Committee included the EPA's changes to the NAAQS review process among the topics it considered February 6, 2007, in a hearing on "Oversight of Recent EPA Decisions."[10] Seven Democratic members of the committee wrote EPA Administrator Johnson on December 21, 2006, to express their strong opposition to the changes and to ask him to "abandon" them.[11]

In order to better understand EPA's actions, this report provides an analysis of the agency's final 2006 revisions to the particulates NAAQS, and the estimated costs and benefits of the new standards and of more stringent alternatives analyzed. The report concludes by highlighting concerns and issues raised regarding the revisions to the particulates standards, including those of the science advisory committee (CASAC), and actions in Congress.

EPA's 2006 Changes to the Particulates NAAQS

Establishing NAAQS does not directly limit emissions; rather, it represents the EPA Administrator's formal judgment regarding the level of ambient pollution that will protect public health with an *adequate margin of safety*. Under Sections 108-109 of the CAA, Congress mandated that the EPA set national ambient (outdoor) air quality standards for pollutants whose emissions "may reasonably be anticipated to endanger public health (primary standards) or welfare[12] (secondary)" and "the presence of which in the ambient air results from numerous or diverse mobile or stationary sources." The statute further requires that every five years EPA review the latest scientific studies and either reaffirm or modify previously established NAAQS.

The CAA is quite specific about certain steps for establishing and reviewing NAAQS, particularly with regard to the preparation of a "criteria document" that summarizes the scientific information and resulting criteria that the EPA Administrator will use to determine the final standard and the procedural process for promulgating the standard. The act also established the Clean Air Scientific Advisory Committee to review criteria and standards, and to advise the Administrator. The CASAC augments its own resources by creating a review panel of scientists with expertise

[9] Cases have been consolidated with American Farm Bureau Federation v. U.S. EPA, No. 06-1410 (D.C. Cir. 2006).

[10] http://epw.senate.gov/public/index.cfm?FuseAction=Hearings.Home.

[11] Office of Senator Barbara Boxer, "Democratic Members of Senate EPW Committee Warn EPA on Air Rollbacks," Press Release, December 21, 2006, at http://boxer.senate.gov/news/releases/record.cfm?id=267092. For a discussion of issues regarding the CASAC, focusing on the statutory and historical role of CASAC and various proposals for change, see CRS Report RL33807, *Air Quality Standards and Sound Science: What Role for CASAC?*, by (name redacted).

[12] The use of public welfare in the CAA "includes, but is not limited to, effects on soils, water, crops, vegetation, manmade materials, animals, wildlife, weather, visibility, and climate, damage to and deterioration of property, and hazards to transportation, as well as effects on economic values and on personal comfort and well-being, whether caused by transformation, conversion, or combination with other air pollutants" (42 U.S.C. 7602(h)).

specific to the pollutant in question. The PM review panel consisted of 22 national experts, primarily academics and independent researchers.[13] In addition to the CAA requirements, the EPA has chosen to add the preparation of a "staff paper" that summarizes the criteria document and lays out policy options. Traditionally, the CASAC has also formally reviewed the EPA staff paper.[14]

The EPA's most recent review found that the scientific evidence since 1997 reinforced the associations between exposure to particulates and numerous cardiovascular and respiratory health problems, including aggravated asthma, chronic bronchitis, reduced lung function, irregular heartbeat, nonfatal heart attacks, and premature death. The CASAC found that the numerous epidemiological studies EPA reviewed "have shown statistically significant associations between the concentrations of ambient air $PM_{2.5}$ and PM_{10} (including levels that are lower than the 1997 particulates NAAQS) and excess mortality and morbidity."[15] Further, the EPA concluded, and most of the CASAC panel concurred, that the scientific evidence supported modifying the particulates standards.

The primary NAAQS for both $PM_{2.5}$ and PM_{10} include an *annual* and a *daily* (24-hour) limit. To attain the annual standard, the three-year average of the weighted annual arithmetic mean PM concentration at each monitor within an area must not exceed the maximum limit set by the agency. The 24-hour standards are a concentration-based percentile form, indicating the percentage of the time that a monitoring station can exceed the standard. For example, a 98th percentile 24-hour standard indicates that a monitoring station can exceed the standard 2% of the days during the year.

As modified and published in the October 17, 2006, *Federal Register* Notice, the primary $PM_{2.5}$ and PM_{10} standards are as follows:

- **$PM_{2.5}$:** strengthens the *daily* (24-hour) standard, which currently allows no more than 65 micrograms per cubic meter ($\mu g/m^3$), by setting a new limit of 35 $\mu g/m^3$, based on the three-year average of the 98th percentile of 24-hour $PM_{2.5}$ concentrations; retains the *annual* standard at 15 $\mu g/m^3$.
- **PM_{10}:** retains the *daily* (24-hour) standard at 150 $\mu g/m^3$ but changes from the 99th percentile to no more than one exceedance per year on average over three years; eliminates the *annual* maximum concentration (50 $\mu g/m^3$) standard for PM_{10}.[16]

[13] For information regarding the CASAC PM review panel, see http://yosemite.epa.gov/sab/sabpeople.nsf/WebCommittees/CASAC.

[14] The EPA October 2004 criteria document and December 2005 staff paper, the CASAC reviews, and related information supporting the 2006 revisions to the particulates NAAQS are available at http://www.epa.gov/ttn/naaqs/standards/pm/s_pm_index.html.

[15] CASAC Particulate Matter (PM) review of EPA's *Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information (Second Draft PM Staff Paper, January 2005*, EPA-SAB-CASAC-05-007, June 6, 2005), available on the EPA CASAC website, see "Final Reports by Fiscal Year" at http://yosemite.epa.gov/sab/sabproduct.nsf/WebReportsbyYearCASAC.

[16] Based on the findings in the EPA PM criteria document and staff paper, and the CASAC's concurrence, that the studies reviewed do not provide sufficient evidence regarding *long-term* exposure to warrant continuation of an annual standard, see 71 *Federal Register* 2653, *Section III. Rationale for Proposed Decision on Primary PM_{10} Standards*, January 17, 2006.

For $PM_{2.5}$ and PM_{10}, the secondary (welfare) NAAQS are the same as the primary standards. **Table 1** below provides a comparison of the newly revised primary NAAQS with those previously promulgated for both $PM_{2.5}$ and PM_{10}.

Table 1. Primary (Health) NAAQS for $PM_{2.5}$ and PM_{10}: Final Revisions (2006), and Previously Promulgated

	Previous NAAQS	EPA Final Rule (2006)
	$PM_{2.5}$ (Fine)	
24-Hour Primary Standard	65 µg/m³	35 µg/m³
Annual Primary Standard	15 µg/m³	15 µg/m³
	PM_{10} (Coarse)	
24-Hour Primary Standard	150 µg/m³	150 µg/m³
Annual Primary Standard	50 µg/m³	Revoked

Source: Prepared by the Congressional Research Service (CRS), with information from the EPA's final particulates NAAQS (71 *Federal Register* 61143-61233, Oct. 17, 2006), and related technical documents,[17] available at http://www.epa.gov/air/particles/actions.html.

EPA's final revisions to the standards for fine particulates ($PM_{2.5}$) are the same as the agency had proposed in January 2006. However, the final 2006 EPA revisions to the $PM_{2.5}$ NAAQS, while tightening the standards, are not as stringent as those recommended by the CASAC and by the EPA staff. With regard to coarse particulates, the EPA had proposed replacing the current particle size indicator of PM_{10} with a range of 10 to 2.5 micrometers ($PM_{10-2.5}$), referred to as inhalable (or thoracic) coarse particles, and setting a $PM_{10-2.5}$ *daily* standard of 70 µg/m^3 rather than the current PM_{10} daily standard of 150 µg/m^3. The proposal also included narrowing the focus of the $PM_{10-2.5}$ standard to "urban and industrial" sources and excluding particles typical to rural areas, including "windblown dust and soils and particulates generated by agricultural and mining sources." The range of alternative standards considered and proposed and issues associated with the EPA's final decisions are discussed later in this report.

Promulgation of NAAQS sets in motion a process under which the states and the EPA first identify geographic nonattainment areas, those areas failing to comply with the NAAQS based on monitoring and analysis of relevant air quality data. The 2006 tightening of the $PM_{2.5}$ standards is expected to increase the number of areas (typically defined by counties or portions of counties) in nonattainment. EPA expects to finalize the nonattainment designations (based on 2005-2007 monitoring data) for the new 2006 PM NAAQs by the end of 2008 with an effective date of April 2009.[18] Following formal designation, the states have three years (until April 2012) to submit State Implementation Plans (SIPs), which identify specific regulations and emission control requirements that will bring an area into compliance.

[17] EPA's final PM staff paper and the CASAC review of the EPA staff paper http://www.epa.gov/ttn/naaqs/standards/pm/s_pm_index.html.

[18] See EPA's guidance on its website "Area Designations for 2006 24-Hour $PM_{2.5}$ NAAQS - Technical Information," http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html.

The EPA is not requiring new nonattainment designations for PM_{10} and it does not anticipate any significant incremental cost impacts of this action. A discussion of the potential benefits and cost impacts associated with implementation of the new particulates NAAQS follows.

Potential Impacts of the 2006 Particulates NAAQS

As discussed above, in setting and revising the NAAQS, the CAA directs the EPA Administrator to protect public health *with an adequate margin of safety*. This language has been interpreted, both by the agency and by the courts, as requiring standards based on a review of the health impacts, without consideration of the costs, technological feasibility, or other non-health criteria.[19] This being the case, costs and benefits were not to play a central role in setting the particulates NAAQS. Costs and feasibility are generally taken into account in NAAQS implementation (a process that is primarily a state responsibility).

Nevertheless, the EPA released a regulatory impact analysis (RIA) on October 6, 2006,[20] to meet its obligations under Executive Order 12866 and in compliance with guidance from the White House Office of Management and Budget.[21] The RIA only analyzed the benefits and costs of implementing the $PM_{2.5}$ NAAQS. Citing time, data, and modeling limitations, the EPA did not analyze the benefits and costs of retaining the PM_{10} standard. [22]

The EPA emphasized that the October 2006 RIA differs from typical RIAs in that it does not analyze the regulatory impact of an action and that it is primarily for illustrative purposes. The basis for the benefits calculations are reductions in ambient concentrations of $PM_{2.5}$ resulting from a reasonable, but speculative, array of cost-effective state implementation strategies selected by the EPA for purposes of analysis. The analysis does not model the specific actions that each state will undertake in implementing the new $PM_{2.5}$ NAAQS. The EPA includes a detailed discussion of the limitations and uncertainties associated with the analyses.

EPA's Monetized Benefits and Cost Estimates[23]

The EPA estimated incremental costs of attaining the new $PM_{2.5}$ standard based on a set of assumptions and extrapolations regarding currently designated nonattainment areas, likely control strategies and technologies and their associated engineering costs, emissions inventories and sources, and regional variability. The EPA emphasizes that the technologies and control strategies selected for analysis only illustrate one way for nonattainment areas to reach attainment, and that states will compile and evaluate a variety of programs and adopt those attainment strategies best

[19] With regard to the non-relevance of cost considerations, see generally Whitman v. American Trucking Associations, 531 U.S. 457, 465-472, 475-76 (2001).

[20] EPA's Regulatory Impact Analysis (RIA) of the 2006 National Ambient Air Quality Standards for Fine Particle Pollution ($PM_{2.5}$), available on EPA's website at http://www.epa.gov/ttn/ecas/ria.html.

[21] 58 *Federal Register* 51735, October 4, 1993. See the White House OMB website, *Regulatory Matters* at http://www.whitehouse.gov/omb/inforeg/regpol.html#rr.

[22] The EPA did not release an RIA assessing the costs and benefits at the time of its January 17, 2006, proposal, but conducted interim and "provisional" analyses regarding certain aspects of potential risk reductions in specific locations associated with an array of $PM_{2.5}$ standards. http://www.epa.gov/air/particlepollution/actions.html.

[23] EPA's Regulatory Impact Analysis (RIA) of the 2006 National Ambient Air Quality Standards for Fine Particle Pollution ($PM_{2.5}$), available on EPA's website at http://www.epa.gov/ttn/ecas/ria.html.

suited for their specific local conditions. For purposes of comparing costs with monetized benefits, the EPA estimated that the total annual mean social cost of attainment of the new $PM_{2.5}$ NAAQS incremental to attainment of the 1997 standards would be $5.4 billion in 2020.

EPA's estimates of the monetized benefits of complying with the new $PM_{2.5}$ standard reflect the valuation associated with predicted reductions in the incidence of certain health and social welfare effects. In the RIA, the EPA presents a variety of benefits estimates based on several published epidemiological studies, including an American Cancer Society (ACS) Study[24] used in previous RIAs, and the Harvard Six Cities Study,[25] as well as an expert elicitation study conducted by the EPA in 2006.[26] The EPA estimated the total annual monetized benefits of attaining the new $PM_{2.5}$ NAAQS would range from $15 billion to $17 billion based on the mortality function from the ACS study and morbidity function from the published studies. Using the mortality function developed using the expert elicitation in conjunction with the morbidity function from the published studies, the EPA's total annual benefits are estimated to range from $8 billion to $76 billion in 2020. The EPA's estimated monetized benefits for 2020, like the cost estimates, are based on the EPA's projected compliance schedule and are incremental to compliance with the 1997 $PM_{2.5}$ NAAQS by 2015.

According to the October 6, 2006, RIA, the estimated total annual health and welfare net benefits (subtracting social costs from the monetized benefits) in 2020 of attaining the new $PM_{2.5}$ NAAQS range from $9 billion to $12 billion, based on modeling of morbidity and mortality using published epidemiology studies, and from $2.4 billion to $70 billion, based on derivation from expert elicitation.

The EPA's benefits and cost estimates are in terms of 1999 dollars and are incremental to the agency's modeled attainment strategy for the 1997 $PM_{2.5}$ NAAQS by 2015. The baseline case incorporates expected impacts associated with implementation of recent national regulations addressing emissions from the power generation sector (e.g., the Clean Air Interstate Rule [CAIR][27]), as well as various mobile sources, that contribute to lowering $PM_{2.5}$ concentrations in future years. below presents a range of the EPA's cost and monetized benefits estimates.

[24] Pope, C. Arden, III, et al. "Particulate Air Pollution as a Predictor of Mortality in a Prospective Study of U.S. Adults." *American Journal of Respiratory and Critical Care Medicine* 151 (1995): 669-674.

[25] Dockery, Douglas W. et al. "An Association Between Air Pollution and Mortality in Six U.S. Cities." *New England Journal of Medicine* 329 (1993): 1753-1759. See also the Health Effects Institute, "Statement: Synopsis of the Particle Epidemiology Reanalysis Project." *Reanalysis of the Harvard Six Cities Study and the American Cancer Society Study of Particulate Air Pollution and Mortality*, July 2000 (includes November 1, 2001 errata sheet), p. I. (http://pubs.healtheffects.org/getfile.php?u=271).

[26] See Chapter 5 of the EPA's October 6, 2006, RIA http://www.epa.gov/ttn/ecas/ria.html.

[27] 70 *Federal Register* 25162, May 12, 2005.

Table 2. EPA's Estimated Total Annual Monetized Benefits and Costs of Attaining Alternative $PM_{2.5}$ NAAQS in 2020

(1999 $ billions)

2006 $PM_{2.5}$ NAAQS (15/35 µg/m³)					
Discount Rate[a]	**Benefits**		**Cost**	**Net Benefits**	
Benefits based on American Cancer Society Study Mortality Function and Published Scientific Literature Morbidity Functions					
3%	$17		$5.4	$12	
7%	$15		$5.4	$9	
Benefits Range based on Expert Elicitation Derived Mortality Function and Published Scientific Literature Morbidity Functions					
	Low Mean	High Mean		Low Mean	High Mean
3%	$9	$76	$5.4	$3.5	$70
7%	$8	$54	$5.4	$2.4	$59

Source: Prepared by the Congressional Research Service from the Environmental Protection Agency's *Regulatory Impact Analysis (RIA) of the 2006 National Ambient Air Quality Standards for Fine Particle Pollution (PM2.5),* Table ES-1, p. ES-7, available on the EPA's website at http://www.epa.gov/ttn/ecas/ria.html. Estimates and results have been rounded.

Note: Estimates (costs and benefits) reflect attainment in 2020, which includes implementation of several national programs and are incremental to compliance with the 1997 PM2.5 NAAQS.

a. The discount rates are as recommended in the EPA's *Guidelines for Preparing Economic Analyses (2000)* and OMB Circular A-4 (2003).

In addition to the monetized health benefits estimates, the EPA estimated the monetary benefits associated with improvements in visibility in selected Class I national parks and wilderness areas.[28] The EPA primarily used a stated preference approach which estimates values based on sampling surveys asking people what amount of compensation would be equivalent to a defined improvement in environmental quality. Extrapolating the results of a study based on a 1988 survey on recreational visibility value, the EPA estimated visibility "willingness to pay" benefits to be $530 million in 2020 with attainment of the new PM2.5 NAAQS.[29]

EPA estimated the cost and benefits of a more stringent alternative PM2.5 for purposes of comparative analysis. The comparative results are discussed in the "Potential Concerns and Issues" section of this report.

Potential Health Impacts

According to the January 2008 EPA report entitled, *Latest Findings on National Air Quality Status and Trends Through 2006*,[30] nationally, annual PM2.5 concentrations declined by 14% between 2000 and 2006. Between 1990 and 2006, nationally, PM10 concentrations declined by 30%. For PM2.5 the areas that showed the greatest improvement were the ones that had the

[28] Defined as areas of the country such as national parks, national wilderness areas, and national monuments that have been set aside under Section 162(a) of the Clean Air Act to receive the most stringent degree of air quality protection.

[29] See Appendix I *Visibility Benefits Methodology* of the EPA's October 6, 2006, RIA http://www.epa.gov/ttn/ecas/ria.html.

[30] EPA-454/R-07-007, January 2008 http://www.epa.gov/air/airtrends/2007/.

highest concentrations in the earlier years. Decreasing concentrations in southern California were largely the result of decreasing levels of nitrate particles; organic carbon levels remained relatively unchanged and have been the largest component of PM2.5 in southern California. The Southeast had little change in PM2.5. The industrial Midwest and the Northeast showed decreasing concentrations, mostly due to reductions in nitrates and sulfates. Despite this progress, in 2006 nearly 67 million people lived in counties with measured concentrations exceeding the annual PM2.5 national air quality standard (based on one-year metric, not the three-year average).[31]

A report released by the American Lung Association (ALA) in April 2007 indicated higher average concentration levels of year-round PM2.5 in densely populated areas of the eastern United States during 2003-2005, compared with 2002-2004. The report noted that outside of the eastern United States, particle levels continued to drop during the same time period, even in areas that the ALA has historically ranked as high in particle pollution.[32]

For purposes of illustration, **Table 3** summarizes the EPA's predicted reductions in the incidence of a range of adverse health effects annually in 2020 for the new PM2.5 NAAQS (15/35 µg/m3), as reported in its RIA. The range of the estimated mean number of reductions in premature deaths is based on the EPA's derivations using the ACS and the Harvard Six-City studies. EPA's mean estimates for the remaining adverse health effects are based on various epidemiology studies. The EPA health effects estimates were a primary component of its derivations of the monetized benefits discussed above.

[31] Refers to trends in the measured $PM_{2.5}$ concentrations relative to their air quality standards in those areas where monitors are located across the country, and does reflect all designated nonattainment areas. The combined population residing in EPA's final $PM_{2.5}$ nonattainment designation areas, consisting of 208 counties in 20 states and the District of Columbia, is almost 90 million.

[32] Estimates are based on air quality data obtained from the U.S. Environmental Protection Agency's Air Quality System, formerly called Aerometric Information Retrieval System (AIRS). American Lung Association, *State of the Air: 2007*, released April 2007, http://lungaction.org/reports/stateoftheair2007.html.

Table 3. EPA's Predicted Reductions in Adverse Health Effects Annually in 2020 Associated with Meeting the New $PM_{2.5}$ NAAQS

Adverse Health Effect	Predicted Reductions[a] (estimated mean)
Premature deaths in individuals with preexisting cardiovascular and respiratory disease	2,500 to 5,700[b]
Cases of chronic bronchitis (age >25)	2,600
Cases of acute bronchitis (age 8-12)	7,300
Nonfatal heart attacks (age >71)	5,000
Hospital admissions for cardiovascular or respiratory symptoms (age >17)	1,630
Emergency room visits for asthma (age <19)	1,200
Cases of aggravated asthma (asthmatics age 6-18)	51,000
Cases of upper and lower respiratory symptoms (asthmatics age 6-18)	97,000
Days when individuals miss work (age 18-75)	350,000
Days when individuals must restrict their activities because of symptoms related to particle pollution (age 18-65)	2,000,000

Source: Prepared by the Congressional Research Service with data based on epidemiology studies presented in Chapter 5 of the Environmental Protection Agency *Regulatory Impact Analysis of the 2006 National Ambient Air Quality Standards for Fine Particle Pollution ($PM_{2.5}$)* Oct. 6, 2006, and available on the EPA's website at http://www.epa.gov/ttn/ecas/ria.html. Estimates are rounded by EPA to two significant digits.

a. For consistency with the emissions and benefits modeling, the EPA used national population estimates based on the U.S. Census Bureau projections. U.S. Bureau of Census. 2000. Population Projections of the United States by Age, Sex, Race, Hispanic Origin and Nativity: 1999 to 2100. Population Projections Program, Population Division, U.S. Census Bureau, Available at http://www.census.gov/population/projections/nation/summary/np-t.txt.

b. The range of estimates reflects the mean estimates derived from the American Cancer Society study and the Harvard Six-City Study, respectively.

In addition to the expected improved health benefits based on the epidemiology studies, the EPA estimated reductions in premature mortality based on the expert elicitation approach discussed above. The estimates were variable from expert to expert, ranging from a mean of 1,200 to 13,000 avoided premature deaths annually in 2020 resulting from attainment of the new standards (15/35 $\mu g/m^3$) incremental to the EPA's baseline strategy for the 1997 $PM_{2.5}$ NAAQS (15/65 $\mu g/m^3$).

When promulgating the 1997 $PM_{2.5}$ NAAQS, the EPA estimated that compliance would result in the annual prevention of 15,000 premature deaths, 75,000 cases of chronic bronchitis, and 10,000 hospital admissions for respiratory and cardiovascular disease, as well as other benefits. These estimates have been the subject of significant debate and re-analysis. Since 1998, with dedicated funding from Congress, the EPA accelerated its research and re-analysis on $PM_{2.5}$ to better understand the potential associated health effects and to develop ways to reduce risks.[33] The

[33] Congress increased EPA's appropriations for particulate matter research from $18.8 million in FY1997 (H.Rept. 104-812) to $49.6 million in FY1998 (H.Rept. 105-297). PM research appropriations averaged more than $60 million per year from FY1999 through FY2004, and Congress provided $60.5 million for FY2005. Congress did not identify PM research funding in EPA's FY2006 appropriation but included $66.8 million for NAAQS research (H.Rept. 109-465).

funding supported EPA intramural and extramural PM research projects and the establishment of five university-based PM research centers around the country. The EPA's most recent review has increased its confidence in earlier findings associating exposure to $PM_{2.5}$ with increases in respiratory health problems, hospitalizations for heart and lung disease, and premature death, particularly for children, the elderly, and those with preexisting heart and lung disease.[34]

Geographical Nonattainment Areas: Potential Impacts

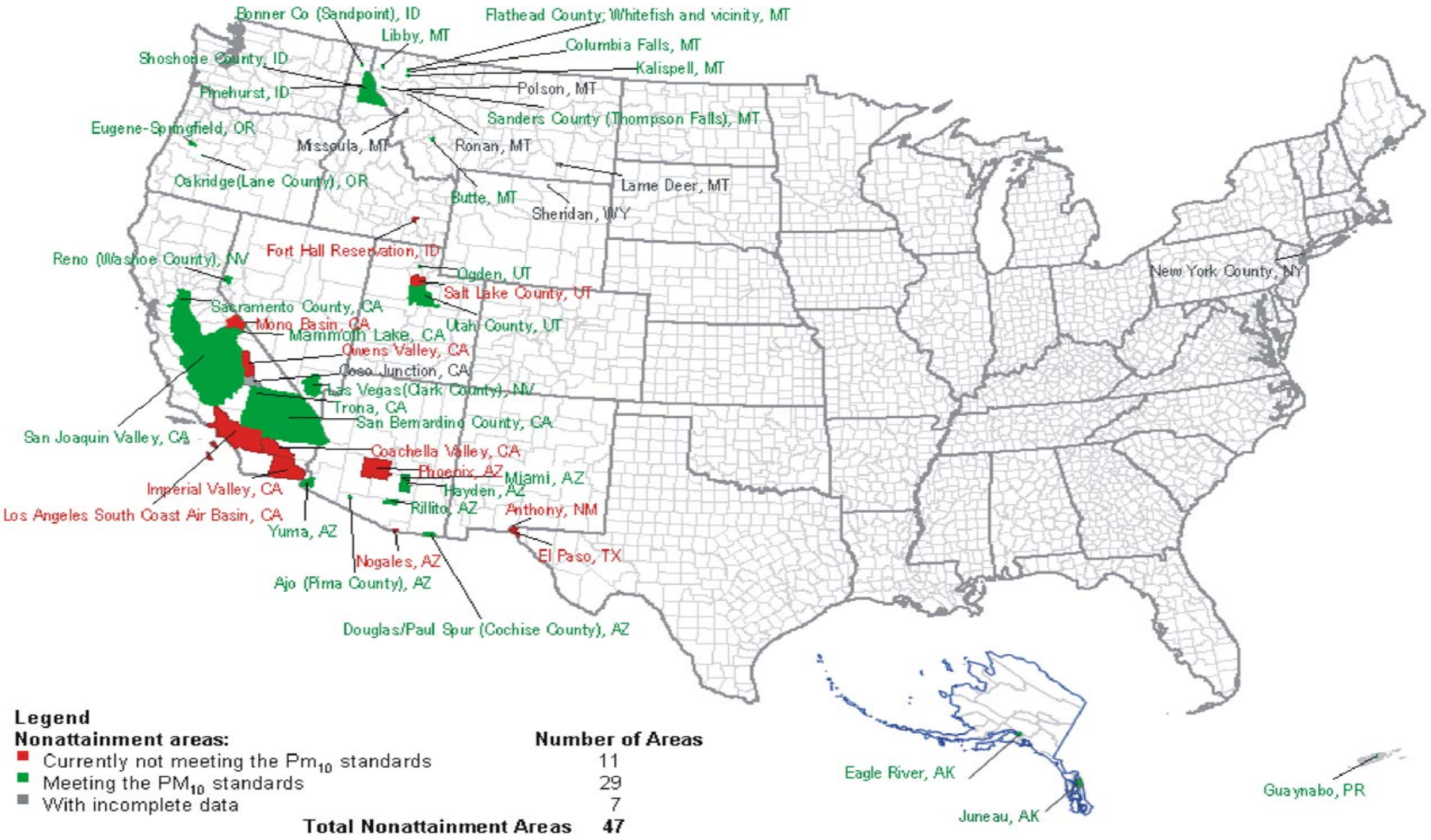
As described earlier, the Clean Air Act has been interpreted to exclude consideration of the costs, technological feasibility, and other non-health criteria when setting and revising the NAAQS. Nevertheless, costs and feasibility associated with the NAAQS implementation (primarily a state responsibility) are key elements of the debate regarding the new 2006 particulates NAAQS. The proposed tightening of the $PM_{2.5}$ standards is expected to increase the number of areas (typically defined by counties or portions of counties) in nonattainment, and subsequently result in increased costs to achieve compliance.

The current PM_{10} daily (24-hour) standard has been retained at the 1987 level and the annual standard revoked. The EPA is not requiring new nonattainment designations for PM_{10}, and it does not anticipate any significant incremental cost impacts of this action. The Agency has designated 87 areas as nonattainment with the PM_{10} NAAQS since 1990. As of March 2008, 40 of the original 87 PM_{10} areas have been redesignated to attainment. Of the remaining 47 nonattainment areas (46 counties with a population of 28.5 million), 18 areas are currently not meeting the 1987 standard based on 2004-2006 data. The remaining counties have submitted the required SIPs for PM_{10} but have not yet been formally redesignated to attainment. **Figure 1**, below, shows the status of nonattainment of the 1987 PM_{10} NAAQS.[35]

[34] EPA criteria and technical documents in support of the October 17, 2006, final particulates NAAQS, the December 20, 2005, proposal, and the 1997 NAAQS, are available at http://www.epa.gov/ttn/naaqs/standards/pm/s_pm_index.html.

[35] See EPA's PM_{10} designations at http://www.epa.gov/air/oaqps/greenbk/pindex.html.

Figure 1. Status of Current PM_{10} Nonattainment Areas, Based on 2004-2006 Air Quality



Source: U.S. EPA http://www.epa.gov/particles/pdfs/20061025_graphsmaps.pdf.

Designation of geographical areas and the associated impacts on specific areas would be speculative at best, because implementation of the 2006 revised PM NAAQS is several years off. The tightening of the $PM_{2.5}$ standards[36] is expected to increase the number of areas (typically defined by counties or portions of counties) in nonattainment. States provided recommendations to EPA in December 2007 for nonattainment boundaries for the 2006 $PM_{2.5}$ standards based on 2004-2006 monitoring data. EPA expects to finalize these nonattainment designations (based on 2005-2007 monitoring data) by the end of 2008 with an effective date of April 2009, and state implementation plans (SIPs) would be due three years later in April of 2012.[37] SIPs identify specific regulations and emission control requirements that will bring an area into compliance. If new or revised SIPs for attainment establish or revise a transportation-related emissions allowance ("budget"), or add or delete transportation control measures (TCMs), they will trigger "conformity" determinations. Transportation conformity is required by the CAA, Section 176(c),[38] to prohibit federal funding and approval for highway and transit projects unless they are consistent with ("conform to") the air quality goals established by a SIP, and will not cause new air quality violations, worsen existing violations, or delay timely attainment of the national ambient air quality standards.

Under the Clean Air Act, states are required to meet the new 2006 $PM_{2.5}$ standard "as expeditiously as practicable," but no later than five years from the date of designation—April 2014. An extension of one to five years may be obtained if a state demonstrates severe air quality conditions prevent achieving attainment within the five years after designation.[39]

With regard to the 1997 $PM_{2.5}$ NAAQS, States are required to submit their SIPs for how the designated nonattainment areas will meet the 1997 $PM_{2.5}$ NAAQS by April 2008. EPA expects that about half of the 58 SIPs (there are 39 areas but some have multiple states submitting individual SIPs) to be submitted before July 2008, and the remainder to be submitted in the following months.[40] States with nonattainment areas must be in compliance with the 1997 $PM_{2.5}$ NAAQS by April 5, 2010, unless they are granted a five-year extension.[41] The EPA published its final "$PM_{2.5}$ implementation" rule on April 25, 2007, which describes the requirements that states and tribes must meet in their implementation plans to achieve and maintain attainment of the 1997 $PM_{2.5}$ NAAQS.[42] The rule also provides guidance and procedures for establishing controls

[36] The new daily standard averaged over 24-hour periods is reduced from 65 micrograms per cubic meter ($\mu g/m^3$) to 35 $\mu g/m^3$ (71 *Federal Register* 61143-61233, October 17, 2006).

[37] See EPA's guidance on its website"Area Designations for 2006 24-Hour PM2.5 NAAQS—Technical Information," http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html.

[38] 42 U.S.C. 7506(c).

[39] Under section 172(a)(2)(A) of the CAA, the EPA may grant an area an extension of the initial attainment date for one to five years (in no case later than 10 years after the designation date for the area). A state requesting an extension must submit an implementation plan (SIP) by the required deadline that includes, among other things, sufficient information demonstrating that attainment by the initial attainment date is "impracticable."

[40] U.S. EPA Office of Air Quality Planning and Standards (OAQPS) based on information received from the EPA Regions regarding expected SIP submittal dates.

[41] Under section 172(a)(2)(A) of the CAA, the EPA may grant an area an extension of the initial attainment date for one to five years (in no case later than 10 years after the designation date for the area). A state requesting an extension must submit an implementation plan (SIP) by the required deadline that includes, among other things, sufficient information demonstrating that attainment by the initial attainment date is "impracticable."

[42] The rule addresses attainment demonstration and modeling; local emission reduction measures, including reasonably available control technology (RACT), reasonably available control measures (RACM), and reasonable further progress (RFP); regional emission reduction strategies; innovative program guidance; emission inventory requirements; transportation conformity; and stationary source test methods.

to achieve and maintain attainment. Six petitions for review of EPA's implementation rule have been filed with the U.S. Court of Appeals for the District of Columbia (D.C.) Circuit,[43] and two petitions for reconsideration have been filed with EPA.[44]

Implementation of the 1997 $PM_{2.5}$ NAAQS—delayed several years by litigation, the lack of monitoring capability, and other factors—is ongoing. The EPA's final designation of 39 geographical areas, composed of 208 counties in 20 states and the District of Columbia, in nonattainment with the 1997 $PM_{2.5}$ NAAQS (those areas with or contributing to air quality levels exceeding the annual and 24-hour standards) became effective on April 5, 2005. A direct national comparison of nonattainment areas for the 1997 $PM_{2.5}$ NAAQS and the 2006 revised $PM_{2.5}$ NAAQS is not currently available. However, using 2003-2005 monitoring data, the EPA identified 143 of those counties with monitors that exceed the new $PM_{2.5}$ NAAQS. Although the actual nonattainment designations would be based on monitoring data[45] from later years (EPA expects to use 2005-2007 monitoring data,[46] comparatively the counties identified reflect an increase from 73 counties with monitors within the total 208 counties that were designated by EPA as in nonattainment (exceeding) the 1997 $PM_{2.5}$ NAAQS. presents the geographic distribution of counties with monitors exceeding new 2006 $PM_{2.5}$ NAAQS identified by EPA, and those exceeding the 1997 $PM_{2.5}$ NAAQS.

[43] The six petitions are: Earthjustice on behalf of American Lung Association, National Resources Defense Council, Sierra Club and Medical Advocates for Healthy Air (American Lung Association v. EPA, No. 07-1233 (D.C. Cir. June 26, 2007); National Environmental Development Association's Clean Air Project; National Petrochemical & Refiners Association; State of New York; State of New Jersey; National Cattlemen's Beef Association.

[44] Earthjustice, Petition for Reconsideration, *Final Clean Air Fine Particle Implementation*, filed before the Administrator of the U.S. Environmental Protection Agency, June 25, 2007, (Docket #EPA-HQ-OAR-2003-0062-0256 available at http://www.regulations.gov); and petition by the National Cattlemen's Beef Association (based on information received by CRS from EPA's Office of Air Quality Planning and Standards, March 19, 2008).

[45] Revisions to Ambient Air Monitoring Regulations, final rule, 71 *Federal Register* 61235-61328, October 17, 2006. In a separate but related action, EPA amended its national air quality monitoring requirements, including those for monitoring particle pollution, to help federal, state, and local air quality agencies "improve public health protection and inform the public about air quality in their communities" by taking advantage of improvements in monitoring technology. Information on the changes is available at http://www.epa.gov/air/particlepollution/actions.html.

[46] See EPA's guidance on its website "Area Designations for 2006 24-Hour PM2.5 NAAQS—Technical Information," http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html.

Table 4. Counties with Monitors Identified by EPA To Be in Nonattainment for the 1997 and the New (2006) $Pm_{2.5}$ NAAQS

	$PM_{2.5}$ NAAQS (annual/24-hour µg/m³)					
	1997 Standard 15/65 µg/m³			New 2006 Standard 15/35 µg/m³		
	National	West	East	National	West	East
	Number of counties with monitors					
Total exceeding the standard	73	9	64	143	32	111
Exceeding the 24-hour and annual standards	1	0	1	56	9	47
Exceeding the 24-hour standard only	0	0	0	70	23	47
Exceeding the annual standard only	72	9	63	17	0	17

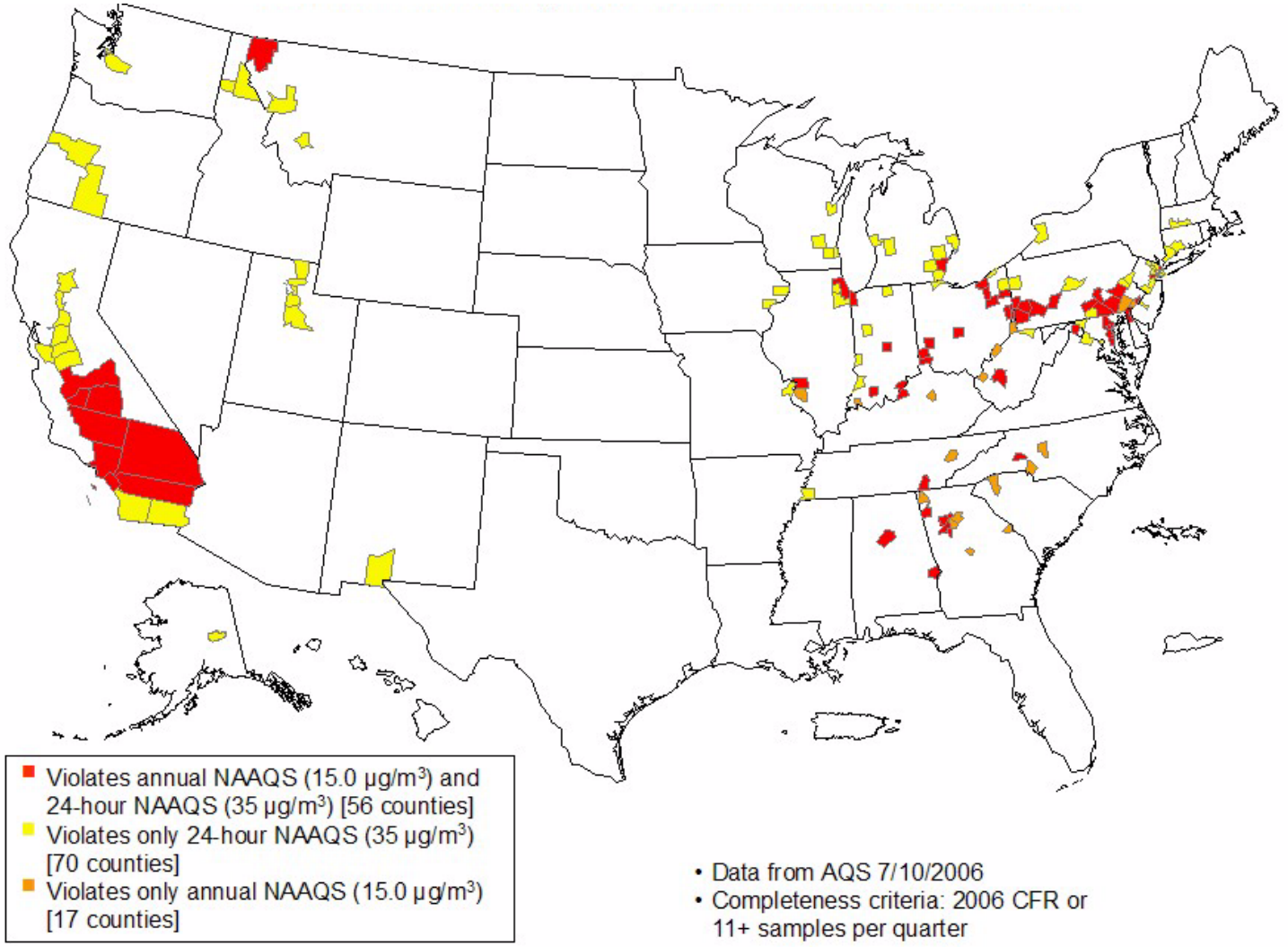
Source: Prepared by the Congressional Research Service with data provided by EPA Office of Air Quality Planning and Standards, Office of Air and Radiation.

Note: By December 2007, EPA received States recommendations for nonattainment area boundaries for the 2006 PM2.5 NAAQS based on 2004-2006 monitoring data. EPA expects to finalize the nonattainment area designations for the 2006 PM2.5 NAAQS in December 2008 based on 2005-2007 monitoring data, with an effective date in April 2009.[47]

Observed on the map in **Figure 2** below, the identified areas can seem small compared with the approximately 3,000 counties in the United States. However, taking into account those areas without monitors but contributing to air quality levels exceeding the new 2006 PM2.5 and other factors considered by the agency when determining the designations, the total number of counties in nonattainment, and the potential impacts with the new PM2.5 NAAQS, is likely to be even larger. The number of counties where emissions will need to be controlled may be two or three times the number of those exceeding the standard, because "nonattainment areas" include both counties where pollutant concentrations exceed the standard and those that contribute to exceedance of the standard in adjoining counties. Entire metropolitan areas tend to be designated nonattainment, even if only one county in the area has readings worse than the standard. In addition, the nonattainment counties tend to have larger populations than those in attainment: nearly 90 million people (about 30% of the U.S. population) live in the 208 counties designated nonattainment for the current standard. The new standard may affect an even larger percentage of the population.

[47] Ibid.

Figure 2. Counties Exceeding Revised PM2.5 Standards, Based on 2003-2005 Monitoring Data



Source: U.S. EPA http://www.epa.gov/particles/pdfs/20061025_graphsmaps.pdf

Potential Concerns and Issues

Congress and a wide variety of stakeholders have closely followed the development of the new 2006 particulates NAAQS since EPA's review began nearly 10 years ago. During the 109th Congress the Senate Committee on Environment and Public Works and the committee's Subcommittee on Clean Air, Climate Change, and Nuclear Safety held hearings regarding implementation and review of the particulates NAAQS.[48] Well before the EPA formally proposed revising the particulates NAAQS, stakeholders were providing evidence and arguments at public hearings and other forums for their preferred recommendations. In general, business and industry oppose more stringent standards, and public health and environmental interest groups advocate tighter standards. The EPA received thousands of comments during various stages of development of the particulates criteria document and in response to drafts of the EPA particulates staff paper. The agency reported receiving more than 120,000 comments in response to the January 2006 particulates NAAQS proposal.

The Administrator's proposed and final decisions represent the first time in CASAC's nearly 30-year history that the promulgated standards fall outside of the range of the scientific panel's recommendations.[49] In letters dated March 21, 2006, and September 29, 2006, the CASAC raised its concerns and objections regarding both PM_{10} and $PM_{2.5}$ proposed standards.[50] The Administrator is not required by statute to follow CASAC's recommendations; the act (in Section 307(d)(3)) requires only that the Administrator set forth any pertinent findings, recommendations, and comments by CASAC and the National Academy of Sciences, and, if his proposal differs in an important respect from any of their recommendations, provide an explanation of the reasons for such differences. Courts, in reviewing EPA regulations, also generally defer to the Administrator's judgment on scientific matters, focusing more on issues of procedure, jurisdiction, and standing. Nevertheless, CASAC's detailed objections to the Administrator's decisions and its description of the process as having failed to meet statutory and procedural requirements could play a role litigation challenging the standards.

At the time of its January 2006 proposal, the agency solicited comment regarding its supporting analysis and a variety of alternative particulates NAAQS. In addition to soliciting written comments, the EPA held public hearings in early March 2006 in Philadelphia, Chicago, and San Francisco. As presented in its rationale for the final standards throughout the preamble of the final rule, in some cases the EPA has revised elements of its proposal based on certain comments; in

[48] U.S. Senate Committee on Environment and Public Works, full Committee, *The Science and Risk Assessment Behind the EPA's Proposed Revisions to the Particulate Matter Air Quality Standards*, July 19, 2006; Subcommittee on Clean Air, Climate Change, and Nuclear Safety, *EPA's Proposed Revisions to the Particulate Matter Air Quality Standards*, July 13, 2006, and *Implementation of the Existing Particulate Matter and Ozone Air Quality Standards*, November 10, 2005.

[49] For a discussion of recent issues regarding the CASAC, focusing on the statutory and historical role of CASAC and various proposals for change, see CRS Report RL33807, *Air Quality Standards and Sound Science: What Role for CASAC?*, by (name redacted).

[50] Letter of Dr. Rogene Henderson, Chair, Clean Air Scientific Advisory Committee, to the Hon. Stephen Johnson, Administrator, U.S. EPA, March 21, 2006, EPA-CASAC-LTR-06-002, available at http://yosemite.epa.gov/sab/sabproduct.nsf/CD706C976DAC62B3852571390081CC21/$File/casac-ltr-06-002.pdf; and letter of Dr. Rogene Henderson, Chair of the Clean Air Scientific Advisory Committee, et al. to Hon. Stephen L. Johnson, EPA Administrator, September 29, 2006, EPA-CASAC-LTR-06-003, available at http://yosemite.epa.gov/sab/sabproduct.nsf/1C69E987731CB775852571FC00499A10/$File/casac-ltr-06-003.pdf.

other cases the EPA lays out its reasoning for disagreeing. EPA's final modifications to the existing particulates NAAQS have sparked interest and conflicting concerns among a diverse array of stakeholders and in Congress. The following sections highlight several areas of interest.

Fine Particulate ($PM_{2.5}$) Primary (Health) Standards

The final 2006 revised $PM_{2.5}$ NAAQS, which are the same as proposed, are not as stringent as the levels recommended by the independent CASAC and those recommended by EPA professional staff, as noted above. EPA staff and CASAC recommendations for $PM_{2.5}$ included a range of levels more stringent than those proposed in January and finalized September of 2006. In particular, the majority of the CASAC panel "*did not endorse the option of keeping the annual standard at its present value*." According to the CASAC:

> Of the options presented by EPA staff for lowering the level of the PM standard, based on the above considerations and the predicted reductions in health impacts derived from the risk analyses, most Panel members favored the option of setting a 24-hour $PM_{2.5}$ NAAQS at concentrations in the range of 35 to 30 $\mu g/m^3$ with the 98th percentile form, in concert with an annual NAAQS in the range of 14 to 13 $\mu g/m^3$. [51]

Table 5 below compares the CASAC and EPA staff recommendations for $PM_{2.5}$ primary standards, the 1997 standards, and 2006 standards as proposed and promulgated.

Table 5. $PM_{2.5}$ Primary (Health) NAAQS: Final (2006), Proposed and Alternatives, and as Promulgated in 1997

$PM_{2.5}$ NAAQS Options	24-hour Primary (98th percentile)	Annual Primary (arithmetic mean)
1997 NAAQS	65 $\mu g/m^3$	15 $\mu g/m^3$
EPA staff paper (December 2005)	mid to lower range of 35-25 $\mu g/m^3$	15 $\mu g/m^3$
	or	
	mid to lower range of 40-30 $\mu g/m^3$	14-12 $\mu g/m^3$
CASAC (December 2005)	35-30 $\mu g/m^3$	14-13 $\mu g/m^3$
EPA Proposed Rule (January 2006)	35 $\mu g/m^3$	15 $\mu g/m^3$
EPA Final Rule (October 2006)	35 $\mu g/m^3$	15 $\mu g/m^3$

Source: Prepared by the Congressional Research Service (CRS), with information from the EPA's final 2006 particulates NAAQS (71 *Federal Register* 61143-61233, Oct. 17, 2006), the EPA's proposed particulates NAAQS (71 *Federal Register* 2620, Dec. 20, 2005), and related technical documents,[52] available at http://www.epa.gov/air/particles/actions.html.

In response to the discrepancies between the proposal and the CASAC recommendations, EPA Administrator Stephen Johnson indicated that his decision required consideration of a number of factors and "judgment based upon an interpretation of the evidence." The Administrator relied on the evidence of long-term exposure studies as the principal basis for retaining the annual PM2.5

[51] CASAC PM Review Panel report, p. 7, June 2005 http://www.epa.gov/ttn/naaqs/standards/pm/s_pm_index.html.

[52] EPA's final PM staff paper and the CASAC review of the EPA staff paper (see references earlier in this report).

standard.[53] CASAC strongly disagreed with the Administrator's decision regarding the $PM_{2.5}$ annual standard and took the unprecedented step of urging reconsideration of the proposal.[54]

Many public comments received on the EPA's proposed revisions to the $PM_{2.5}$ standards, most frequently from environmental and public health organizations, medical doctors and researchers, and the association representing state air quality regulators,[55] argue for standards as stringent or more stringent than those recommended by CASAC. In contrast, another group of commenters, generally representing industry associations and businesses, opposed revising the 1997 $PM_{2.5}$ standards, in some cases highlighting different aspects of the same research cited by the CASAC and others supporting tighter standards.[56] Some who opposed more stringent particulates NAAQS called attention to more recent studies of health effects attributable to particulates that demonstrate risk estimates are lower and less statistically significant than they were in 1997, when the last standard was set.[57]

In Section II of the preamble of the final October 2006 revisions, "Rationale for Final Decisions on Primary $PM_{2.5}$ Standards," the EPA discusses its final decision with respect to the CASAC recommendations regarding the $PM_{2.5}$ annual standard. The Administrator differs with the CASAC with regard to the level of uncertainty associated with the agency's quantitative risk assessment and whether the results appropriately serve as a primary basis for a decision on the level of the annual $PM_{2.5}$ standard. The Administrator further stressed the emphasis placed on the long-term means of the levels associated with mortality effects in the two key long-term studies[58] in determining the level of the annual standard. CASAC considered the evidence from specific short-term exposure studies as part of the basis for its recommendation for a lower annual standard level. As noted above, the CASAC expressed its objections to the EPA's final 2006 particulates NAAQS in its September 29, 2006, letter to Administrator Johnson.[59]

With regard to $PM_{2.5}$, the letter stated: "CASAC is concerned that the EPA did not accept our finding that the annual $PM_{2.5}$ standard was not protective of human health and did not follow our recommendation for a change in that standard."[60] The letter noted that "*there is clear and convincing scientific evidence that significant adverse human-health effects occur in response to*

[53] For the EPA Administrator's rationale for proposing to retain the current level for the annual $PM_{2.5}$ standard and recognition of the CASAC's recommendation not endorsing this approach, see 71 *Federal Register* 2650-2653, January 17, 2006.

[54] Letter of Dr. Rogene Henderson, Chair, Clean Air Scientific Advisory Committee, to the Hon. Stephen Johnson, Administrator, U.S. EPA, March 21, 2006, EPA-CASAC-LTR-06-002, available at http://yosemite.epa.gov/sab/sabproduct.nsf/CD706C976DAC62B3852571390081CC21/$File/casac-ltr-06-002.pdf; or from the federal docket for the proposed rule Docket ID No. EPA-HQ-OAR-2001-0017, on the Federal Docket website http://www.regulations.gov.

[55] CRS communication with Mr. William Becker, Executive Director, State and Territorial Air Pollution Program Administrators/Association of Local Air Pollution Control Officials (STAPPA/ALAPCO), January 5, 2006.

[56] For EPA's discussion and response to several of these comments, see 71 *Federal Register* 61143-61233, October 17, 2006, Part II *Rationale for Final Decisions on Primary $PM_{2.5}$ Standards*, Sections B and F, on EPA's website at http://epa.gov/pm/actions.html.

[57] Communication with Mr. Frank Maisano, Media Contact for the Electric Reliability Coordinating Council, January 17, 2006.

[58] 71 *Federal Register* at 2651, January 17, 2006.

[59] Letter of Dr. Rogene Henderson, Chair of the Clean Air Scientific Advisory Committee, et al. to Hon. Stephen L. Johnson, EPA Administrator, September 29, 2006, available at http://yosemite.epa.gov/sab/sabproduct.nsf/1C69E987731CB775852571FC00499A10/$File/casac-ltr-06-003.pdf.

[60] Ibid.

short-term and chronic particulate matter exposures at and below 15 µg/m^3," and noted that 20 of the 22 Particulate Matter Review Panel members, including all seven members of the statutory committee were in "complete agreement" regarding the recommended reduction. "*It is the CASAC's consensus scientific opinion that the decision to retain without change the annual $PM_{2.5}$ standard does not provide an adequate margin of safety … requisite to protect the public health' (as required by the Clean Air Act)....*"[61]

Potential Health Benefits of a More Stringent $PM_{2.5}$ Standard

In its RIA, the EPA estimated the nationwide monetized human health and welfare benefits of attaining two suites of $PM_{2.5}$ NAAQS: (1) the newly revised $PM_{2.5}$ NAAQS, which include the new 35 µg/m^3 daily (24-hour) standard and the unchanged 15 µg/m^3 annual standard, and (2) an alternative standard similar to the least stringent of the CASAC recommendations that includes a tighter annual standard of 14 µg/m^3 and the same 35 µg/m^3 daily (24-hour) standard. As discussed previously, the EPA presented a variety of benefits estimates based on several epidemiological studies, the American Cancer Society (ACS) Study[62] used in previous RIAs, the Harvard Six-Cities Study,[63] and expert elicitation study conducted by the EPA in 2006.[64]

The EPA estimated that attainment of the more stringent alternative $PM_{2.5}$ NAAQS would result in $26 billion to $30 billion of total annual benefits in 2020, based on the ACS mortality function. This compares to a range of $15 billion to $17 billion estimated for compliance with the newly promulgated $PM_{2.5}$ NAAQS (see **Table 2** and discussion earlier in this report). EPA's estimate of annual benefits derived using the expert elicitation ranged from $15 billion to $140 billion for the more stringent alternative, compared to the agency's estimates of $8 billion to $76 billion for compliance with the new standard. EPA also estimated the monetary benefits ("willingness to pay") associated with improvements in visibility in selected Class I national parks and wilderness areas would be $1.2 billion in 2020 with attainment of the more stringent alternative $PM_{2.5}$ standard analyzed, compared to $530 million with attainment of the newly revised $PM_{2.5}$ NAAQS.[65] EPA estimated the total annual cost associated with attainment of the alternative $PM_{2.5}$ NAAQS analyzed would be $7.9 billion in 2020, compared to $5.4 billion.

As discussed previously, a key component of the EPA's monetized benefits estimates are the agency's predicted reductions in the incidence of premature deaths and a range of adverse health effects annually in 2020 associated with compliance of the new 2006 $PM_{2.5}$ NAAQS. For example, for the more stringent attainment strategy analyzed (14/35 µg/m^3), the EPA estimated 2,200 to 24,000 fewer premature deaths based on the expert elicitation. For purposes of illustration, **Table 5** provides a comparison of EPA's predicted reductions annually for the new

[61] Ibid.

[62] Pope, C. Arden, III, et al. "Particulate Air Pollution as a Predictor of Mortality in a Prospective Study of U.S. Adults." *American Journal of Respiratory and Critical Care Medicine* 151 (1995): 669-674.

[63]Dockery, Douglas W. et al. "An Association Between Air Pollution and Mortality in Six U.S. Cities." *New England Journal of Medicine* 329 (1993): 1753-1759. See also the Health Effects Institute, "Statement: Synopsis of the Particle Epidemiology Reanalysis Project." *Reanalysis of the Harvard Six Cities Study and the American Cancer Society Study of Particulate Air Pollution and Mortality*, July 2000 (includes November 1, 2001 errata sheet), p. I. (http://pubs.healtheffects.org/getfile.php?u=271).

[64] See Chapter 5 of the EPA's October 6, 2006, RIA for more detail http://www.epa.gov/ttn/ecas/ria.html.

[65] See Appendix I *Visibility Benefits Methodology* of the EPA's October 6, 2006, RIA http://www.epa.gov/ttn/ecas/ria.html.

$PM_{2.5}$ NAAQS (15/35 µg/m^3) with a more stringent alternative analyzed (14/35 µg/m^3), based on data from the ACS and Harvard Six-City studies, and various epidemiology studies.

Table 6. EPA's Predicted Reductions in Adverse Health Effects Annually in 2020 Associated with Meeting the New $PM_{2.5}$ NAAQS and a More Stringent Alternative

Adverse Health Effect	Predicted Reductions[a] (estimated mean)	
	PM2.5 NAAQS (15/35 µg/m3)	More Stringent Alternative (14/35 µg/m3)
Premature deaths in individuals with preexisting cardiovascular and respiratory disease	2,500 to 5,700	4,000 to 9,000[b]
Cases of chronic bronchitis (age >25)	2,600	4,600
Cases of acute bronchitis (age 8-12)	7,300	13,000
Nonfatal heart attacks (age >71)	5,000	8,700
Hospital admissions for cardiovascular or respiratory symptoms (age >17)	1,630	3,080
Emergency room visits for asthma (age <19)	1,200	3,200
Cases of aggravated asthma (asthmatics age 6-18)	51,000	79,000
Cases of upper and lower respiratory symptoms (asthmatics age 6-18)	97,000	153,000
Days when individuals miss work (age 18-75)	350,000	550,000
Days when individuals must restrict their activities because of symptoms related to particle pollution (age 18-65)	2,000,000	3,300,000

Source: Prepared by the Congressional Research Service with data based on epidemiology studies presented in Chapter 5 of the Environmental Protection Agency *Regulatory Impact Analysis of the 2006 National Ambient Air Quality Standards for Fine Particle Pollution (PM2.5)* Oct. 6, 2006, and available on the EPA's website at http://www.epa.gov/ttn/ecas/ria.html. Estimates are rounded by EPA to two significant digits.

a. For consistency with the emissions and benefits modeling, the EPA used national population estimates based on the U.S. Census Bureau projections. U.S. Bureau of Census. 2000. Population Projections of the United States by Age, Sex, Race, Hispanic Origin and Nativity: 1999 to 2100. Population Projections Program, Population Division, U.S. Census Bureau, Available at http://www.census.gov/population/projections/nation/summary/np-t.txt.

b. The range of reductions in premature deaths estimates reflect the mean estimates derived from the American Cancer Society study and the Harvard Six-City Study, respectively.

Particle Size Indicator

The EPA and most of the CASAC panel members concluded that there was a lack of evidence (often a lack of studies) on long-term adverse health effects of specific PM_{10} measurements to support the annual standard, and that there was a specific need to address particles ranging in size from 2.5 to 10 microns.[66] EPA's January 17, 2006, proposal would have replaced the existing

[66] Clean Air Scientific Advisory Committee (CASAC) Review of the EPA Staff Recommendations Concerning a Potential Thoracic Coarse PM Standard in the *Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information* (Final PM OAQPS Staff Paper, EPA-452/R-05-005, June 2005), September 15, 2005, EPA-SAB-CASAC-05-007, available on the EPA CASAC website at (continued...)

particle size indicator of 10 micrometers (PM_{10}) with an indicator range of 10 to 2.5 micrometers ($PM_{10-2.5}$), referred to as inhalable (or thoracic) coarse particles, and setting a $PM_{10-2.5}$ *daily* standard of 70 $\mu g/m^3$ rather than the current PM_{10} daily standard of 150 $\mu g/m^3$. At the time of its proposal, the EPA concluded that the scientific evidence supported the standard based on short-term exposure to certain coarse particles, particularly in urban and industrial areas.

In the final 2006 particulates NAAQS, the EPA decided to maintain the PM_{10}, citing the limited body of evidence on health effects associated with thoracic coarse particles from studies that use $PM_{10-2.5}$ measurements. The agency also determined that the only studies of clear quantitative relevance to health effects most likely associated with thoracic coarse particles used PM_{10}. The new 2006 particulates NAAQS retain the PM_{10} indicator and the *daily* (24-hour) standard of 150 $\mu g/m^3$.

In its September 29, 2006, letter, the CASAC said it was "completely surprised" at the decision to revert to the use of PM_{10} as the indicator for coarse particles, noting that the option of retaining the existing daily PM_{10} standard was not discussed during the advisory process and that CASAC views this decision as "highly-problematic since PM_{10} includes both fine and coarse particulate matter." The CASAC did agree that having a standard for PM_{10} was better than no standard.

The EPA indicated that it is promulgating a new federal reference method (FRM) for measurement of mass concentrations of $PM_{10-2.5}$ in the atmosphere as the standard of reference for measurements of $PM_{10-2.5}$ concentrations in ambient air. The EPA anticipates that the new FRM should provide a basis for gathering scientific data to support future reviews of the particulates NAAQS.[67] According to the EPA, these monitors will employ the latest in speciation technology to advance the science, enabling future regulation to provide more targeted protection.

The EPA's January 17, 2006, proposal to change the indicator of the standard for coarse particles was in response to a 1999 U.S. Court of Appeals for the DC Circuit decision[68] directing the EPA to ensure that the standard did not duplicate the regulation of fine particles. The EPA's standard for PM_{10}, as modified by the 1997 changes to the particulates NAAQS, was challenged shortly after promulgation. Concluding that PM_{10} was a "poorly matched indicator" for thoracic coarse particles because it included the smaller $PM_{2.5}$ category as well as the larger particles, the D.C. Circuit remanded the standard to the EPA. The agency contends that it has addressed the concerns raised by the court regarding PM_{10} as an indicator for inhalable coarse particulate matter in its rationale in the final 2006 particulates NAAQS, announced September 21, 2006.[69] This is an issue that could potentially be challenged in further litigation.

Rural PM_{10} Sources

In addition to the changes to the coarse particulates indicator, the EPA had proposed narrowing the focus of the $PM_{10-2.5}$ standard on "urban and industrial" sources—particles typical to rural

(...continued)

http://yosemite.epa.gov/sab/sabproduct.nsf/WebReportsbyYearCASAC.

[67] 71 *Federal Register* 61143-61233, October 17, 2006, *Section VI. Reference Methods for the Determination of Particulate Matter as $PM_{10-2.5}$ and $PM_{2.5}$* http://epa.gov/pm/actions.html.

[68] American Trucking Associations v. EPA, 175 F.3d 1027, 1054-55 (D.C. Cir. 1999).

[69] 71 *Federal Register* 61143-61233, October 17, 2006, Section III.C.3. *Decision Not to Revise PM_{10} Indicator*, available at http://epa.gov/pm/actions.html.

areas including "*windblown dust and soils and PM generated by agricultural and mining sources*" would *not* be subject to this standard. Additionally, the EPA proposed revoking the current 24-hour PM_{10} standards, except in areas that have 1) violating monitors, and 2) a population of 100,000 or more. The emphasis on urban and industrial areas in the January 2006 proposal was based on the findings reported in the Criteria Document, the PM staff paper, and the CASAC conclusion that "the evidence for the toxicity of $PM_{10-2.5}$ comes from studies conducted primarily in urban areas and is related, in large part, to the re-entrainment of urban and suburban road dusts, as well as primary combustion products."[70]

The EPA's proposal to exclude any ambient mix of $PM_{10-2.5}$ that is dominated by rural windblown dust and soils and particulates generated by agricultural and mining sources, and how the EPA would distinguish the sources during its implementation, raised a number of questions and resulted in numerous comments. In response to the proposal, in its March 21, 2006, letter to the EPA Administrator, the CASAC stated that while it had recognized the scarcity of information on the toxicity of rural dust, it "neither foresaw nor endorsed a standard that specifically exempts all agricultural and mining sources, and offers no protection against episodes of urban-industrial $PM_{10-2.5}$ in areas of populations less than 100,000." The committee strongly recommended "expansion of our knowledge of the toxicity of $PM_{10-2.5}$ dusts rather than exempting specific industries (e.g., mining, agriculture)."[71]

Several Members of the House Committee on Agriculture submitted a letter to EPA Administrator Stephen Johnson in July 2006 conveying support for the agency to maintain its provision to exclude agriculture and mining dust and similar sources of coarse particulates in the particulates NAAQS, as had been proposed.[72] The EPA indicated that with the exception of representatives of those sources that would have been excluded under the proposal (e.g., agriculture and mining), most commenters opposed the exclusion. Those opposed included environmental and public health groups, state and local agencies, and industries not excluded from the proposed indicator (e.g., transportation and construction).

The EPA did not exclude any areas or the types of particle in the final 2006 particulates NAAQS revisions, based on further consideration of the data and in response to comments. In its rationale for the final PM_{10} standard, the EPA continued to acknowledge that there is far more evidence concerning health effects associated with thoracic coarse particles in urban areas than in non-urban areas. However, the EPA also stated that "the existing evidence is inconclusive with regard to whether or not community-level exposures to thoracic coarse particles are associated with adverse health effects in non-urban areas."[73] The EPA indicated that it is expanding its research and monitoring programs to collect additional evidence on the differences between coarse particles typically found in urban areas and those typically found in rural areas. The EPA

[70] CASAC review. CASAC reviews, the PM criteria document, staff paper, and related information, are available at http://www.epa.gov/ttn/naaqs/standards/pm/s_pm_index.html.

[71] Letter of Dr. Rogene Henderson, Chair, Clean Air Scientific Advisory Committee, to the Hon. Stephen Johnson, Administrator, U.S. EPA, March 21, 2006, EPA-CASAC-LTR-06-002, available at http://yosemite.epa.gov/sab/sabproduct.nsf/CD706C976DAC62B3852571390081CC21/$File/casac-ltr-06-002.pdf, or from the federal docket for the proposed rule Docket ID No. EPA-HQ-OAR-2001-0017, on the Federal Docket website http://www.regulations.gov.

[72] Letter to EPA Administrator Stephen L. Johnson, from the Chairman, the Ranking Member, and other Members of the House Committee on Agriculture, July 27, 2006.

[73] 71 *Federal Register* 61143-61233, October 17, 2006, Section III.C.3. *Decision Not to Revise PM_{10} Indicator*, available at http://epa.gov/pm/actions.html.

announced the release of a final rule amending its national air quality monitoring requirements on September 27, 2006.[74]

In contrast to objections regarding other aspects of EPA's final 2006 particulates NAAQS revisions, the CASAC agreed with the EPA decision against including exemptions in its September 29, 2006, letter to the EPA Administrator. However, a number of those representing agriculture interests, including some Members of Congress, remain concerned that EPA's decision not to include the exclusions in the final 2006 particulates NAAQS will result in unnecessary burdens on the agricultural community. During the 109th Congress, some Members of the House Committee on Agriculture expressed their concerns with the EPA's final actions with regard to the exemptions at a September 28, 2006, hearing regarding the EPA's pesticide programs.[75]

Secondary $PM_{2.5}$ and PM_{10} Standards

The EPA proposal, and the final 2006 particulates NAAQS, set the secondary standard for PM_{10} and for $PM_{2.5}$ at the same level as their primary standard. The PM staff paper and the CASAC both recommended secondary standards at levels different from the primary in order to be more protective of visibility, and the CASAC reiterated the recommendations in its March 21, 2006, and September 29, 2006, letters to the EPA Administrator. For $PM_{2.5}$, the EPA PM staff paper and most of CASAC panel recommended consideration of a sub-daily standard with a level in the range of 20 to 30 $\mu g/m^3$ for a four- to eight-hour midday time period, with a 92nd to 98th percentile form, as opposed to the primary daily standard at 35 $\mu g/m^3$, based on the current three-year average of the 98th percentile of 24-hour $PM_{2.5}$ concentrations. Although the CASAC agreed with setting a secondary standard at the same level as the primary standard based on the coarse particulates indicator $PM_{10-2.5}$, the committee recommended that the standard not be limited to urban areas, as the EPA had proposed.

Exclusion of More Recent Research

A number of stakeholders commented that EPA should have considered certain studies that were published too recently to have been included in the 2004 criteria document that, they argued, increased the uncertainty about possible health risks associated with exposure to particulates. Others contend that there are new studies (some of them the same) in support of their arguments for a lower (more stringent) level to protect health. Some commenting on the January 17, 2006, proposal who opposed more stringent standards, argued that the agency should have delayed its decision regarding the PM NAAQS to take into consideration several of these studies.

At the time of the proposal the EPA declared its intention to review and evaluate significant new studies developed since 2002, and those published since the close of the criteria document, during the comment period.[76] With the release of its final 2006 particulates NAAQS, the EPA acknowledged that these studies provided expansion of the science and some insights regarding particulates exposure and related health effects, but determined that the new data "do not

[74] 71 *Federal Register* 61236-61328, October 17, 2006, at http://epa.gov/pm/actions.html.

[75] House Committee on Agriculture, Subcommittee on Conservation, Credit, Rural Development, and Research, *Review of the Environmental Protection Agency's Pesticide Program*, September 28, 2006.

[76] 71 *Federal Register* 2625, January 17, 2006 (http://epa.gov/pm/actions.html).

materially change any of the broad scientific conclusions regarding the health effects of PM exposure made in the 2004 PM Air Quality Criteria Document."[77]

Synopses of Stakeholder Reaction to the New 2006 Particulates NAAQS

Based on the EPA's references to the comments in the preamble to the final 2006 particulates NAAQS revisions published October 17, 2006; a review of several comments in the Federal Docket for the January 17, 2006, proposal; and several media articles and available press releases, views of proponents and critics of stricter standards are summarized below.

Proponents of more stringent particulates standards generally assert that

- the standards should be at least as stringent as the more stringent combined daily and annual levels recommended in the EPA PM staff paper and those recommended by the CASAC, based on its review of the criteria and the EPA staff analysis;
- scientific evidence of adverse health effects is more compelling than when the standards were revised in 1997;
- exclusion of rural sources from the coarse particle (PM_{10}) standard would not be sufficiently protective of human health and would be difficult to distinguish and implement;
- more stringent standards ensure continued progress toward protection of public health with an adequate margin of safety as required by the CAA, in addition to avoidance of other adverse health effects; and
- welfare effects, such as visibility, crop yield, and forest health, will be enhanced.

Critics of more stringent particulates standards contend that

- more stringent standards (and in some cases even the 1997 standards) are not justified by the scientific evidence; the proposal did not take into account hundreds of studies completed since the 2002 cut-off;
- requiring the same level of stringency for all fine particles without distinguishing sources is unfounded;
- costs and adverse impacts on regions and sectors of the economy are excessive; some commenters identified as "urban" sources contend exemption of rural particles may result in a disproportional compliance burden;
- those identified as "rural" sources contend exemption of rural particles is warranted by the lack of evidence regarding adverse effects associated with emission sources in these areas, and that not excluding these areas and sources creates an unnecessary burden;

[77] 71 *Federal Register* 61143-61233, October 17, 2006 (http://epa.gov/pm/actions.html).

- revising the standards could impede implementation of the existing particulates NAAQS and the process of bringing areas into compliance, given the current status of this process; revisions could also impede efforts to meet air quality regulations promulgated in 2004 and 2005, such as the Clean Air Interstate Rule (CAIR) and Clean Air Nonroad Diesel Rule;[78] and
- the benefits (and costs) associated with implementation of the 1997 $PM_{2.5}$ NAAQS, as well as compliance with recent EPA air quality regulations, have not yet been realized.

In late December 2006, thirteen states (New York, California, Connecticut, Delaware, Illinois, Maine, New Hampshire, New Jersey, New Mexico, Oregon, Pennsylvania, Rhode Island, Vermont), the District of Columbia, and the South Coast Air Quality Management District petitioned the U.S. Court of Appeals for the District of Columbia (D.C.) Circuit to review the new 2006 particulates NAAQS.[79] In addition, several groups representing various industry and agriculture interests (including coal, iron, steel, and corn refiners; oilseed processors; farmers; and cattle and pork producers), as well as environmental and public health organizations also filed petitions to the D.C. Circuit challenging the new 2006 NAAQS. The court consolidated the cases and ordered submission of briefs from petitioners, EPA, and supporters for October 2007 through February 2008, with final briefs due by March 2008.[80] Briefs from petitioners, EPA, and supporters were filed with the court by March 7, 2008, but the date for oral argument had not yet been scheduled at the time this report was updated. Parties are to be notified of the schedule for oral arguments by a separate order. EPA anticipates a decision in late 2008.

Conclusions

The EPA's October 17, 2006, promulgation of the final modifications to the existing particulates NAAQS following completion of its statutorily required review has sparked interest and conflicting concerns among a diverse array of stakeholders, and in Congress.

Tightening the particulates NAAQS will result in more areas classified as nonattainment and needing to implement new controls on particulate matter. States and local governments will be required to develop and implement new plans for addressing emissions in those areas that do not meet the new standards. A stricter standard means increased costs for the transportation and industrial sectors most likely to be affected by particulate matter controls, including utilities, refineries, and the trucking industry. In terms of public health, a stricter standard is estimated to result in fewer adverse health effects for the general population and particularly sensitive populations, such as children, asthmatics, and the elderly.

Because of health and cost implications, NAAQS decisions have been the source of significant concern to some in Congress for quite some time. The evolution and development of the particulates NAAQS, in particular, have been the subject of extensive oversight. When the 1997 particulates NAAQS were promulgated, Congress held 28 days of hearings on the EPA rule.

[78] 70 *Federal Register* 25162, May 12, 2005, and 69 *Federal Register* 38958, June 29, 2004. See also EPA's website at http://www.epa.gov/cleanair2004/.

[79] Pursuant to Rule 15 of the Federal Rules of Appellate Procedure and §307(b) of the Clean Air Act, 42 U.S.C. §7607(b).

[80] American Farm Bureau Federation v. U.S. EPA, No. 06-1410 (D.C. Cir. 2006).

Congress enacted legislation specifying deadlines for implementation of the 1997 $PM_{2.5}$ NAAQS, funding for monitoring and research of potential health effects, and the coordination of the particulates (and ozone) standard with other air quality regulations.

In December 2006, several states and industry, agriculture, business, environmental, and public health groups petitioned the Court of Appeals for the D.C. Circuit to review the new 2006 particulates NAAQS. The EPA's previous review and establishment of particulates NAAQS were the subject of litigation and challenges, including a Supreme Court decision in 2001.[81] The EPA's 1997 promulgation of standards for both coarse and fine particulate matter prompted critics to charge the EPA with overregulation and spurred environmental groups to claim that the EPA had not gone far enough. More than 100 plaintiffs petitioned the court to overturn the standard.

Several elements of the EPA's most recent action, including the level of stringency of the new 2006 particulates NAAQS, the objections of the CASAC, the agency's decision not to modify the particle size indicator for coarse particulates, and not excluding rural sources from the coarse standard as proposed have already generated debate and controversy. Thus, the final form of the current efforts to revise PM NAAQS may not be known for some time.

Author Contact Information

(name redacted)
Specialist in Environmental Policy
[redacted]@crs.loc.gov, 7-....

(name redacted)
Specialist in Environmental Policy
[redacted]@crs.loc.gov, 7-....

[81] American Trucking Associations v. EPA, 175 F.3d 1027, 1055-56 (D.C. Cir. 1999), rehearing granted in part and denied in part, 195 F.3d 4 (D.C. Cir. 1999), affirmed in part and reversed in part, Whitman v. American Trucking Associations, 531 U.S. 457 (2001). In March 2002, the Court of Appeals rejected all remaining challenges to the standards, American Trucking Associations v. EPA, 283 F. 3d 355, 369-72 (D.C. Cir. 2002).

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