

# CRS Report for Congress

## The National Ambient Air Quality Standard for Particulate Matter (PM): EPA's 2006 Revisions and Associated Issues

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**Prepared for Members and  
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## Summary

Following its review of more than 2,000 scientific studies, 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 U.S. Court of Appeals for the District of Columbia Circuit's pending decision regarding challenges to the 2006 PM NAAQS by several states and industry, agriculture, business, and public advocacy groups, may prompt renewed interest in Congress. All briefs from petitioners, EPA, and supporters were filed with the court by March 7, 2008, and oral argument occurred September 15, 2008.

Although a tightening of the standards, the 2006 particulates NAAQS are not as stringent as recommended by EPA staff or the independent scientific advisory committee mandated under the Clean Air Act (Clean Air Scientific Advisory Committee, or CASAC). The divergence from the CASAC's recommendations proved controversial, as did 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.

The EPA 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, heart attacks, and premature death. Based on several analytical approaches, the EPA estimated that compliance with the revised 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. Based on these findings, EPA revised the PM NAAQS by strengthening 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 averaged over 24-hour periods of  $PM_{2.5}$  in the air. 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.

The 2006 particulates NAAQS also retained the 24-hour standard and revoked 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 ( $PM_{10-2.5}$ ).

The forthcoming implementation of the 2006 NAAQS, which includes designating areas (typically defined by counties or portions of counties) as not attaining the standard and adopting measures to achieve compliance, may generate interest in Congress. Although EPA is not requiring new nonattainment designations for  $PM_{10}$ , the tightening of the  $PM_{2.5}$  standard will increase the number of areas in nonattainment. In its preliminary recommendations submitted to states and tribes in August 2008, EPA identified 215 counties as nonattainment for the 2006 NAAQS.

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# The National Ambient Air Quality Standard for Particulate Matter (PM): EPA's 2006 Revisions and Associated Issues

## Introduction

The EPA has identified and promulgated National Ambient Air Quality Standards (NAAQS) under the Clean Air Act (CAA)<sup>1</sup> for six principal pollutants commonly referred to as “criteria pollutants”: particulate matter (PM), ozone (O<sub>3</sub>, a key measure of smog), nitrogen dioxide (NO<sub>2</sub>, or, inclusively, nitrogen oxides,<sup>2</sup> NO<sub>x</sub>), sulfur oxides (SO<sub>x</sub>, or, specifically, SO<sub>2</sub>), carbon monoxide (CO), and lead (Pb). On October 17, 2006, 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).<sup>3</sup>

The EPA's revised particulates NAAQS modified the standards established in 1987<sup>4</sup> that focused on particles smaller than 10 microns (PM<sub>10</sub>, or coarse particles), and standards for “fine” particles smaller than 2.5 microns (PM<sub>2.5</sub>) introduced for the first time with the promulgation of the 1997 PM<sub>2.5</sub> NAAQS.<sup>5</sup> The 2006 revisions to the particulates NAAQS were the culmination of the EPA's statutorily required periodic review,<sup>6</sup> 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. The EPA's review of the particulates NAAQS and of the scientific criteria for setting the standards completed in 2006 was initiated not long after the 1997 promulgation.

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<sup>1</sup> Sections 108-109 of the Clean Air Act.

<sup>2</sup> The NAAQS is for NO<sub>2</sub>; nitrogen gases that are ozone precursors are referred to as NO<sub>x</sub>.

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

<sup>4</sup> 52 *Federal Register* 24634-24715, July 1, 1987.

<sup>5</sup> 62 *Federal Register* 38652-38896, July 18, 1997. See CRS Report RL32431, *Particulate Matter (PM<sub>2.5</sub>): Implementation of the 1997 National Ambient Air Quality Standards (NAAQS)*, by Robert Esworthy.

<sup>6</sup> 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, however EPA has rarely met this requirement and in some cases has been forced to comply through litigation.

The 2006 particulates NAAQS generated national interest and debate, and oversight in Congress, as did the previous changes to the particulates standards promulgated in 1997. While the 2006 particulates NAAQS generally tightened the air quality standards for fine particulate matter, the action caused considerable controversy, including concerns that the standards were outside the range recommended by both EPA staff and by the scientific advisory panel (Clean Air Scientific Advisory Committee, or CASAC<sup>7</sup>) established by the Clean Air Act (CAA).<sup>8</sup> Conversely, some contended that available data did 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 D.C. Circuit to review the 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 the 2006 NAAQS.<sup>9</sup> Briefs from petitioners, EPA, and supporters were filed with the court by March 7, 2008, and oral argument occurred September 15, 2008.<sup>10</sup> Relatedly, the D.C. Circuit Court's July 2008 decision to vacate EPA's 2005 Clean Air Interstate Rule (CAIR) has implications for implementing the 1997 and the 2006 NAAQS, and has garnered attention in Congress.<sup>11</sup>

This report provides an analysis of the agency's final 2006 revisions to the particulates NAAQS, and the estimated costs and benefits of the revised standards and of more stringent alternatives analyzed. The report highlights 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

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

<sup>8</sup> Section 109(d)(2) of the Clean Air Act.

<sup>9</sup> Cases have been consolidated with *American Farm Bureau Federation v. U.S. EPA*, No. 06-1410 (D.C. Cir. 2006).

<sup>10</sup> *American Farm Bureau Federation v. U.S. EPA*, No. 06-1410 (D.C. Cir. , oral argument September 15, 2008).

<sup>11</sup> For a more detailed discussion of the court's decision and its implications, see CRS Report RL34589, *Clean Air After the CAIR Decision: Back to Square One?*, by James E. McCarthy, Larry Parker and Robert Meltz; also see related discussion in CRS Report RL32431, *Particulate Matter (PM<sub>2.5</sub>): Implementation of the 1997 National Ambient Air Quality Standards (NAAQS)*, by Robert Esworthy.

quality standards for pollutants whose emissions “may reasonably be anticipated to endanger public health (primary standards) or welfare<sup>12</sup> (secondary standards)” and “the presence of which in the ambient air results from numerous or diverse mobile or stationary sources.” The statute also requires that every five years EPA review the latest scientific studies and either reaffirm or modify previously established NAAQS.

## The 2006 Particulates NAAQS

The EPA’s review of PM 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<sub>2.5</sub> and PM<sub>10</sub> (including levels that are lower than the 1997 particulates NAAQS) and excess mortality and morbidity.”<sup>13</sup> Further, the EPA concluded, and most of the CASAC panel concurred, that the scientific evidence supported modifying the particulates standards.

The 1997 primary NAAQS for both PM<sub>2.5</sub> and PM<sub>10</sub> included 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 were a concentration-based percentile form, indicating the percentage of the time that a monitoring station can exceed the standard. For example, a 98<sup>th</sup> 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<sub>2.5</sub> and PM<sub>10</sub> standards are as follows:

- **PM<sub>2.5</sub>:** strengthened the *daily* (24-hour) standard, which had allowed no more than 65 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ), by setting a new limit of 35  $\mu\text{g}/\text{m}^3$ , based on the three-year average of the 98<sup>th</sup> percentile of 24-hour PM<sub>2.5</sub> concentrations; retained the *annual* standard at 15  $\mu\text{g}/\text{m}^3$ .

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<sup>12</sup> 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)).

<sup>13</sup> 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>].

- **PM<sub>10</sub>**: retained the *daily* (24-hour) standard at 150 µg/m<sup>3</sup> but changes from the 99<sup>th</sup> percentile to no more than one exceedance per year on average over three years; eliminated the *annual* maximum concentration (50 µg/m<sup>3</sup>) standard for PM<sub>10</sub>.<sup>14</sup>

For PM<sub>2.5</sub> and PM<sub>10</sub>, the secondary (welfare) NAAQS are the same as the primary standards. **Table 1** below provides a comparison of the revised primary NAAQS with those previously promulgated for both PM<sub>2.5</sub> and PM<sub>10</sub>.

**Table 1. Primary (Health) NAAQS for PM<sub>2.5</sub> and PM<sub>10</sub>: Final Revisions (2006), and Previously Promulgated**

	Previous NAAQS	EPA Final Rule (2006)
<i>PM<sub>2.5</sub> (Fine)</i>		
24-Hour Primary Standard	65 µg/m <sup>3</sup>	35 µg/m <sup>3</sup>
Annual Primary Standard	15 µg/m <sup>3</sup>	15 µg/m <sup>3</sup>
<i>PM<sub>10</sub> (Coarse)</i>		
24-Hour Primary Standard	150 µg/m <sup>3</sup>	150 µg/m <sup>3</sup>
Annual Primary Standard	50 µg/m <sup>3</sup>	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,<sup>15</sup> available at [<http://www.epa.gov/air/particles/actions.html>].

EPA's final revisions to the standards for fine particulates (PM<sub>2.5</sub>) were the same as the agency had proposed in January 2006. However, the 2006 EPA revisions to the PM<sub>2.5</sub> NAAQS, while tightening the standards, were 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<sub>10</sub> with a range of 10 to 2.5 micrometers (PM<sub>10-2.5</sub>), referred to as inhalable (or thoracic) coarse particles, and setting a PM<sub>10-2.5</sub> *daily* standard of 70 µg/m<sup>3</sup> rather than the current PM<sub>10</sub> daily standard of 150 µg/m<sup>3</sup>. The proposal also included narrowing the focus of the PM<sub>10-2.5</sub> 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.

<sup>14</sup> 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<sub>10</sub> Standards*, January 17, 2006.

<sup>15</sup> 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](http://www.epa.gov/ttn/naaqs/standards/pm/s_pm_index.html)].

## Implementing the 2006 PM NAAQS

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 EPA is not requiring new nonattainment designations for PM<sub>10</sub> (see **Figure 1** in **Appendix** depicting PM<sub>10</sub> nonattainment areas). However, the 2006 tightening of the PM<sub>2.5</sub> standards is expected to increase the number of areas (typically defined by counties or portions of counties) in nonattainment.

In response to recommendations submitted by states, in August 2008, EPA identified 169 counties and portions of 46 additional counties for designation as nonattainment *only* for the revised 2006 24-hour PM<sub>2.5</sub> standard. While many of these counties identified for consideration overlap with the final nonattainment designations for the 1997 PM<sub>2.5</sub> NAAQS, most designations for the 1997 NAAQS were based on nonattainment *only* for the *annual* standard. EPA expects to finalize the nonattainment designations (based on 2005-2007 monitoring data) for the 2006 PM NAAQS by the end of 2008 with an effective date of April 2009.<sup>16</sup>

Following formal designation, the states have three years (until April 2012 based on the current schedule) to submit State Implementation Plans (SIPs), which identify specific regulations and emission control requirements that will bring an area into compliance. In addition to requiring states to submit implementation plans, EPA acts to control NAAQS pollutants through national standards. These may be in the form of regulations of products that might emit the pollutants (particularly fuels) and in the form of emission standards for new stationary sources (e.g., utilities, refineries). States would be required to meet the 2006 PM<sub>2.5</sub> standard no later than five years from the effective date of designations (or no later than 10 years if qualified for an extension).

## 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.<sup>17</sup> Costs and feasibility are generally taken into account in NAAQS implementation (a process that is primarily a state responsibility).

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<sup>16</sup> See EPA's guidance on its website "Area Designations for 2006 24-Hour PM<sub>2.5</sub> NAAQS - Technical Information," [[http://www.epa.gov/ttn/naaqs/pm/pm25\\_2006\\_techinfo.html](http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html)].

<sup>17</sup> 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).



Nevertheless, the EPA released a regulatory impact analysis (RIA) on October 6, 2006,<sup>18</sup> to meet its obligations under Executive Order 12866 and in compliance with guidance from the White House Office of Management and Budget.<sup>19</sup> The RIA only analyzed the benefits and costs of implementing the PM<sub>2.5</sub> NAAQS. Citing time, data, and modeling limitations, the EPA did not analyze the benefits and costs of retaining the PM<sub>10</sub> standard.

The EPA emphasized that the October 2006 RIA differed from typical RIAs in that it did 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<sub>2.5</sub> 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 2006 PM<sub>2.5</sub> NAAQS. The EPA includes a detailed discussion of the limitations and uncertainties associated with the analysis.

In its impact analysis, EPA's estimated baseline case incorporated expected impacts of other national regulations that contribute to lowering PM<sub>2.5</sub> concentrations in future years. These other regulations included those addressing emissions from the power generation sector, namely the 2005 Clean Air Interstate Rule (CAIR).<sup>20</sup> However, in a July 11, 2008 decision (*North Carolina v. EPA*), the U.S. Court of Appeals for the D.C. Circuit vacated CAIR in its entirety.<sup>21</sup> CAIR was expected to serve as the primary tool to assist downwind states in meeting the PM<sub>2.5</sub> (and 8-hour ozone) NAAQS by mitigating interstate transport of sulfur dioxide (SO<sub>2</sub>) and nitrogen oxide (NO<sub>x</sub>) emissions from electric generating units that contribute to the formation of PM<sub>2.5</sub>.<sup>22</sup>

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<sup>18</sup> EPA's Regulatory Impact Analysis (RIA) of the 2006 National Ambient Air Quality Standards for Fine Particle Pollution (PM<sub>2.5</sub>), available on EPA's website at [<http://www.epa.gov/ttn/ecas/ria.html>].

<sup>19</sup> 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>].

<sup>20</sup> CAA, 42 U.S.C. 7401 et seq., 70 *Federal Register* 25162, May 12, 2005.

<sup>21</sup> No. 05-1244, 2008 WL 2698180 (D.C. Cir. July 11, 2008). See CRS Report RL34589, *Clean Air After the CAIR Decision: Back to Square One?*, by James E. McCarthy, Larry Parker, and Robert Meltz.

<sup>22</sup> Sulfur dioxide (SO<sub>2</sub>) is a precursor contributing to the formation of PM<sub>2.5</sub> concentrations, and NO<sub>x</sub> is a precursor (a pollutant that is transformed in air to form another air pollutant) contributing to the formation of both ozone and PM<sub>2.5</sub> concentrations. EPA has concluded that SO<sub>2</sub> and NO<sub>x</sub> emissions, through the phenomenon of air pollution transport, contribute significantly to downwind nonattainment, or interfere with maintenance, of the PM<sub>2.5</sub> and 8-hour ozone NAAQS (70 *Federal Register* 25162, May 12, 2005).

## EPA's Monetized Benefits and Cost Estimates<sup>23</sup>

The EPA estimated incremental costs of attaining the revised PM<sub>2.5</sub> 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 emphasized 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 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 revised PM<sub>2.5</sub> 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 revised PM<sub>2.5</sub> standard reflect the valuation associated with predicted reductions in the incidence of certain health and social welfare effects. In the RIA, the EPA presented a variety of benefits estimates based on several published epidemiological studies, including an American Cancer Society (ACS) Study<sup>24</sup> used in previous RIAs, and the Harvard Six Cities Study,<sup>25</sup> as well as an expert elicitation study conducted by the EPA in 2006.<sup>26</sup> The EPA estimated the total annual monetized benefits of attaining the revised PM<sub>2.5</sub> 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 from 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, were based on the EPA's projected compliance schedule and are incremental to compliance with the 1997 PM<sub>2.5</sub> 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 2006 PM<sub>2.5</sub> NAAQS ranged from \$9 billion to \$12 billion, based on modeling of morbidity and mortality using published epidemiology studies, and from

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<sup>23</sup> EPA's RIA of the 2006 NAAQS for Fine Particle Pollution (PM<sub>2.5</sub>), available on EPA's website at [<http://www.epa.gov/ttn/ecas/ria.html>].

<sup>24</sup> 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.

<sup>25</sup> 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>]).

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

\$2.4 billion to \$70 billion, based on derivation from expert elicitation. **Table 2** below presents a range of the EPA's cost and monetized benefits estimates.

**Table 2. EPA's Estimated Total Annual Monetized Benefits and Costs of Attaining Alternative PM<sub>2.5</sub> NAAQS in 2020**  
(1999 \$ in billions)

2006 PM <sub>2.5</sub> NAAQS (15/35 µg/m <sup>3</sup> )					
Discount Rate	Benefits		Cost	Net Benefits	
<i>Benefits based on American Cancer Society Study Mortality Function and Published Scientific Literature Morbidity Functions</i>					
3%	\$17		\$5.4	\$12	
7%	\$15		\$5.4	\$9	
<i>Benefits Range based on Expert Elicitation Derived Mortality Function and Published Scientific Literature Morbidity Functions</i>					
	Low Mean	High Mean		Low Mean	High Mean
3%	\$9	\$76	\$5.4	\$3.5	\$70
7%	\$8	\$54	\$5.4	\$2.4	\$59

**Note:** Estimates (costs and benefits) reflect attainment in 2020, which includes implementation of several national programs and are incremental to compliance with the 1997 PM<sub>2.5</sub> NAAQS. The discount rates are as recommended in the EPA's *Guidelines for Preparing Economic Analyses (2000)* and OMB Circular A-4 (2003).

**Source:** Prepared by the Congressional Research Service using data from the Environmental Protection Agency's *Regulatory Impact Analysis (RIA) of the 2006 National Ambient Air Quality Standards for Fine Particle Pollution (PM<sub>2.5</sub>)*, 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.

The EPA's benefits and cost estimates were in terms of 1999 dollars and were incremental to the agency's modeled attainment strategy for the 1997 PM<sub>2.5</sub> NAAQS by 2015. The baseline case incorporated expected impacts associated with implementation of recent national regulations addressing emissions from the power generation sector, including the CAIR,<sup>27</sup> as well as various mobile sources, that contribute to lowering PM<sub>2.5</sub> concentrations in future years.

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.<sup>28</sup> 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

<sup>27</sup> 70 *Federal Register* 25162, May 12, 2005.

<sup>28</sup> 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.

on recreational visibility value, the EPA estimated visibility “willingness to pay” benefits to be \$530 million in 2020 with attainment of the 2006 PM<sub>2.5</sub> NAAQS.<sup>29</sup>

EPA estimated the cost and benefits of a more stringent alternative PM<sub>2.5</sub> 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*,<sup>30</sup> nationally, annual PM<sub>2.5</sub> concentrations declined by 14% between 2000 and 2006. For PM<sub>2.5</sub> the areas that showed the greatest improvement were the ones that had the 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 PM<sub>2.5</sub> in southern California. The Southeast had little change in PM<sub>2.5</sub>. 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 PM<sub>2.5</sub> national air quality standard (based on one-year metric, not the three-year average).<sup>31</sup>

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 2006 PM<sub>2.5</sub> NAAQS (15/35 µg/m<sup>3</sup>), 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 were based on various epidemiology studies. The EPA health effects estimates were a primary component of its derivations of the monetized benefits discussed above.

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

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

<sup>31</sup> Refers to trends in the measured PM<sub>2.5</sub> concentrations relative to their air quality standards in those areas where monitors are located across the country, and does not reflect all designated nonattainment areas. The combined population residing in EPA’s final PM<sub>2.5</sub> nonattainment designation areas, consisting of 208 counties in 20 states and the District of Columbia, is almost 90 million.

**Table 3. EPA's Predicted Reductions in Adverse Health Effects Annually in 2020 Associated with Meeting the 2006 PM<sub>2.5</sub> NAAQS**

Adverse Health Effect	Predicted Reductions <sup>a</sup> (estimated mean)
Premature deaths in individuals with preexisting cardiovascular and respiratory disease	2,500 to 5,700 <sup>b</sup>
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

- 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.

**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<sub>2.5</sub>)* 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.

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 2006 standards (15/35 µg/m<sup>3</sup>) incremental to the EPA's baseline strategy for the 1997 PM<sub>2.5</sub> NAAQS (15/65 µg/m<sup>3</sup>).

When promulgating the 1997 PM<sub>2.5</sub> 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<sub>2.5</sub> to better understand the potential associated health effects and to develop ways to reduce risks.<sup>32</sup> The 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<sub>2.5</sub> 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.<sup>33</sup>

## Potential Concerns and Issues

Congress and a wide variety of stakeholders closely followed the development of the 2006 particulates NAAQS since EPA's review began nearly 10 years ago. Congressional hearings have been held regarding implementation and review of the particulates NAAQS.<sup>34</sup> 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 opposed more stringent standards, and public health and environmental interest groups advocated 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 represented the first time in the nearly 30-year history of the Clean Air Scientific Advisory Committee (CASAC) that the promulgated standards fell outside of the range of the scientific panel's recommendations.<sup>35</sup> In letters dated March 21, 2006, and September 29, 2006, the CASAC raised its concerns and objections regarding both PM<sub>10</sub> and PM<sub>2.5</sub> proposed

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<sup>32</sup> 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 has not identified PM research funding since FY2005.

<sup>33</sup> 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](http://www.epa.gov/ttn/naaqs/standards/pm/s_pm_index.html)].

<sup>34</sup> 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.

<sup>35</sup> For a discussion of recent issues regarding the CASAC, see CRS Report RL33807, *Air Quality Standards and Sound Science: What Role for CASAC?* by James E. McCarthy.

standards.<sup>36</sup> 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 in 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 some cases the EPA revised elements of its proposal based on certain comments; in other cases the EPA laid out its reasoning for disagreeing. EPA's final modifications to the existing particulates NAAQS 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<sub>2.5</sub>) Primary (Health) Standards**

The final 2006 revised PM<sub>2.5</sub> NAAQS, were 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<sub>2.5</sub> included a range of levels more stringent than those proposed in January and finalized in 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<sub>2.5</sub> NAAQS at concentrations in the range of 35 to 30 µg/m<sup>3</sup> with the 98th percentile form, in concert with an annual NAAQS in the range of 14 to 13 µg/m<sup>3</sup>.<sup>37</sup>

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<sup>36</sup> 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](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](http://yosemite.epa.gov/sab/sabproduct.nsf/1C69E987731CB775852571FC00499A10/$File/casac-ltr-06-003.pdf)].

<sup>37</sup> CASAC PM Review Panel report, p. 7, June 2005 [[http://www.epa.gov/ttn/naaqs/standards/pm/s\\_pm\\_index.html](http://www.epa.gov/ttn/naaqs/standards/pm/s_pm_index.html)].

**Table 5** below compares the CASAC and EPA staff recommendations for PM<sub>2.5</sub> primary standards, the 1997 standards, and 2006 standards as proposed and promulgated.

**Table 5. PM<sub>2.5</sub> Primary (Health) NAAQS: Final (2006), Proposed and Alternatives, and as Promulgated in 1997**

PM <sub>2.5</sub> NAAQS Options	24-hour Primary (98th percentile)	Annual Primary (arithmetic mean)
1997 NAAQS	65 µg/m <sup>3</sup>	15 µg/m <sup>3</sup>
EPA staff paper (December 2005)	mid to lower range of 35-25 µg/m <sup>3</sup>	15 µg/m <sup>3</sup>
	or	
	mid to lower range of 40-30 µg/m <sup>3</sup>	14-12 µg/m <sup>3</sup>
CASAC (December 2005)	35-30 µg/m <sup>3</sup>	14-13 µg/m <sup>3</sup>
EPA Proposed Rule (January 2006)	35 µg/m <sup>3</sup>	15 µg/m <sup>3</sup>
EPA Final Rule (October 2006)	35 µg/m <sup>3</sup>	15 µg/m <sup>3</sup>

**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,<sup>38</sup> 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 PM<sub>2.5</sub> standard.<sup>39</sup> CASAC strongly disagreed with the Administrator's decision regarding the PM<sub>2.5</sub> annual standard and took the unprecedented step of urging reconsideration of the proposal.<sup>40</sup>

<sup>38</sup> EPA's final PM staff paper and the CASAC review of the EPA staff paper (see references earlier in this report).

<sup>39</sup> For the EPA Administrator's rationale for proposing to retain the current level for the annual PM<sub>2.5</sub> standard and recognition of the CASAC's recommendation not endorsing this approach, see 71 *Federal Register* 2650-2653, January 17, 2006.

<sup>40</sup> 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](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>].



Many public comments received on the EPA's proposed revisions to the PM<sub>2.5</sub> standards, most frequently from environmental and public health organizations, medical doctors and researchers, and the association representing state air quality regulators,<sup>41</sup> argued 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<sub>2.5</sub> standards, in some cases highlighting different aspects of the same research cited by the CASAC and others supporting tighter standards.<sup>42</sup> 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.<sup>43</sup>

In Section II of the preamble of the final October 2006 revisions, "Rationale for Final Decisions on Primary PM<sub>2.5</sub> Standards," the EPA discussed its final decision with respect to the CASAC recommendations regarding the PM<sub>2.5</sub> annual standard. The Administrator differed with the CASAC with regard to the level of uncertainty associated with the agency's quantitative risk assessment and whether the results appropriately served as a primary basis for a decision on the level of the annual PM<sub>2.5</sub> 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<sup>44</sup> 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.<sup>45</sup>

With regard to PM<sub>2.5</sub>, the letter stated: "CASAC is concerned that the EPA did not accept our finding that the annual PM<sub>2.5</sub> standard was not protective of human health and did not follow our recommendation for a change in that standard."<sup>46</sup> The letter noted that "*there is clear and convincing scientific evidence that significant adverse human-health effects occur in response to short-term and chronic particulate matter exposures at and below 15 µg/m<sup>3</sup>,*" and noted that 20 of the 22 Particulate Matter Review Panel members, including all seven members of the statutory

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<sup>41</sup> 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.

<sup>42</sup> 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<sub>2.5</sub> Standards*, Sections B and F, on EPA's website at [<http://epa.gov/pm/actions.html>].

<sup>43</sup> Communication with Mr. Frank Maisano, Media Contact for the Electric Reliability Coordinating Council, January 17, 2006.

<sup>44</sup> 71 *Federal Register* at 2651, January 17, 2006.

<sup>45</sup> 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](http://yosemite.epa.gov/sab/sabproduct.nsf/1C69E987731CB775852571FC00499A10/$File/casac-ltr-06-003.pdf)].

<sup>46</sup> *Ibid.*

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<sub>2.5</sub> standard does not provide an adequate margin of safety ... requisite to protect the public health’ (as required by the Clean Air Act)...*”<sup>47</sup>

**Potential Health Benefits of a More Stringent PM<sub>2.5</sub> Standard.** In its RIA, the EPA estimated the nationwide monetized human health and welfare benefits of attaining two suites of PM<sub>2.5</sub> NAAQS: (1) the revised PM<sub>2.5</sub> NAAQS, which include the 35 µg/m<sup>3</sup> daily (24-hour) standard and the unchanged 15 µg/m<sup>3</sup> 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<sup>3</sup> and the same 35 µg/m<sup>3</sup> 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<sup>48</sup> used in previous RIAs, the Harvard Six-Cities Study,<sup>49</sup> and an expert elicitation study conducted by the EPA in 2006.<sup>50</sup>

The EPA estimated that attainment of the more stringent alternative PM<sub>2.5</sub> 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 2006 PM<sub>2.5</sub> 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 2006 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<sub>2.5</sub> standard analyzed, compared to \$530 million with attainment of the revised PM<sub>2.5</sub> NAAQS.<sup>51</sup> EPA estimated the total annual cost associated with attainment of the alternative PM<sub>2.5</sub> NAAQS analyzed would be \$7.9 billion in 2020, compared to \$5.4 billion.

For purposes of illustration, **Table 6** below provides a comparison of EPA’s predicted reductions annually for the 2006 PM<sub>2.5</sub> NAAQS (15/35 µg/m<sup>3</sup>) with a more

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<sup>47</sup> Ibid.

<sup>48</sup> 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.

<sup>49</sup> 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>]).

<sup>50</sup> See Chapter 5 of the EPA’s October 6, 2006, RIA for more detail [<http://www.epa.gov/ttn/ecas/ria.html>].

<sup>51</sup> See Appendix in I *Visibility Benefits Methodology* of the EPA’s October 6, 2006, RIA [<http://www.epa.gov/ttn/ecas/ria.html>].

stringent alternative analyzed (14/35  $\mu\text{g}/\text{m}^3$ ), based on data from the ACS and Harvard Six-City studies, and epidemiology studies. 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 2006  $\text{PM}_{2.5}$  NAAQS. For example, for the more stringent attainment strategy analyzed (14/35  $\mu\text{g}/\text{m}^3$ ), the EPA estimated 2,200 to 24,000 fewer premature deaths based on the expert elicitation.

**Table 6. EPA's Predicted Reductions in Adverse Health Effects Annually in 2020 Associated with Meeting the 2006  $\text{PM}_{2.5}$  NAAQS and a More Stringent Alternative**

Adverse Health Effect	Predicted Reductions <sup>a</sup> (estimated mean)	
	$\text{PM}_{2.5}$ NAAQS (15/35 $\mu\text{g}/\text{m}^3$ )	More Stringent Alternative (14/35 $\mu\text{g}/\text{m}^3$ )
Premature deaths in individuals with preexisting cardiovascular and respiratory disease	2,500 to 5,700 <sup>b</sup>	4,000 to 9,000 <sup>b</sup>
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 presented in Chapter 5 of EPA's *Agency Regulatory Impact Analysis of the 2006 National Ambient Air Quality Standards for Fine Particle Pollution ( $\text{PM}_{2.5}$ )* 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 reductions in premature deaths estimates reflect the mean estimates derived from the American Cancer Society study and the Harvard Six-City Study, respectively.

The estimates EPA derived from an expert elicitation approach were only for mortality. The results were variable from expert to expert, ranging from a mean of 2,200 to 24,000 avoided premature deaths annually in 2020 resulting from attainment of the more stringent alternative standard (14/35  $\mu\text{g}/\text{m}^3$ ) incremental to the EPA's baseline strategy for the 1997 NAAQS (15/65  $\mu\text{g}/\text{m}^3$ ). For attainment of the 2006 standards (15/35  $\mu\text{g}/\text{m}^3$ ), EPA estimated 1,200 to 13,000 fewer premature deaths based on the expert elicitation.

## Coarse Particulate (PM<sub>10</sub>) Primary Standards

**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<sub>10</sub> 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.<sup>52</sup> EPA's January 17, 2006, proposal would have replaced the existing particle size indicator of 10 micrometers (PM<sub>10</sub>) with an indicator range of 10 to 2.5 micrometers (PM<sub>10-2.5</sub>), referred to as inhalable (or thoracic) coarse particles, and setting a PM<sub>10-2.5</sub> *daily* standard of 70  $\mu\text{g}/\text{m}^3$  rather than the current PM<sub>10</sub> daily standard of 150  $\mu\text{g}/\text{m}^3$ . 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<sub>10</sub> indicator, citing the limited body of evidence on health effects associated with thoracic coarse particles from studies that use PM<sub>10-2.5</sub> 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<sub>10</sub> measurements. The 2006 particulates NAAQS retained the PM<sub>10</sub> indicator and the *daily* (24-hour) standard of 150  $\mu\text{g}/\text{m}^3$ .

In its September 29, 2006, letter, the CASAC said it was "completely surprised" at the decision to revert to the use of PM<sub>10</sub> as the indicator for coarse particles, noting that the option of retaining the existing daily PM<sub>10</sub> standard was not discussed during the advisory process and that CASAC views this decision as "highly-problematic since PM<sub>10</sub> includes both fine and coarse particulate matter." The CASAC did agree that having a standard for PM<sub>10</sub> 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<sub>10-2.5</sub> in the atmosphere as the standard of reference for measurements of PM<sub>10-2.5</sub> concentrations in ambient air. The EPA anticipates that the new FRM should provide a basis for gathering scientific

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<sup>52</sup> 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 [<http://yosemite.epa.gov/sab/sabproduct.nsf/WebReportsbyYearCASAC>].

data to support future reviews of the particulates NAAQS.<sup>53</sup> 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<sup>54</sup> directing the EPA to ensure that the standard did not duplicate the regulation of fine particles. The agency contends that it addressed the concerns raised by the court regarding PM<sub>10</sub> as an indicator for inhalable coarse particulate matter in its rationale in the final 2006 particulates NAAQS, announced September 21, 2006.<sup>55</sup>

**Rural PM<sub>10</sub> Sources.** In addition to the changes to the coarse particulates indicator, the EPA had proposed narrowing the focus of the PM<sub>10-2.5</sub> standard on "urban and industrial" sources. Particles typical to rural areas including "*windblown dust and soils and PM generated by agricultural and mining sources*" would *not* have been subject to this standard. Additionally, the EPA proposed revoking the current 24-hour PM<sub>10</sub> 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<sub>10-2.5</sub> 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."<sup>56</sup>

The EPA's proposal to exclude any ambient mix of PM<sub>10-2.5</sub> 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<sub>10-2.5</sub> in areas of populations less than 100,000." The

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<sup>53</sup> 71 *Federal Register* 61143-61233, October 17, 2006, *Section VI. Reference Methods for the Determination of Particulate Matter as PM<sub>10-2.5</sub> and PM<sub>2.5</sub>* [<http://epa.gov/pm/actions.html>].

<sup>54</sup> The EPA's standard for PM<sub>10</sub>, as modified by the 1997 changes to the particulates NAAQS, was challenged shortly after promulgation. Concluding that PM<sub>10</sub> was a "poorly matched indicator" for thoracic coarse particles because it included the smaller PM<sub>2.5</sub> category as well as the larger particles, the D.C. Circuit remanded the standard to the EPA (*American Trucking Associations v. EPA*, 175 F.3d 1027, 1054-55 (D.C. Cir. 1999)).

<sup>55</sup> 71 *Federal Register* 61143-61233, October 17, 2006, *Section III.C.3. Decision Not to Revise PM<sub>10</sub> Indicator*, available at [<http://epa.gov/pm/actions.html>].

<sup>56</sup> 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](http://www.epa.gov/ttn/naaqs/standards/pm/s_pm_index.html)].

committee strongly recommended “expansion of our knowledge of the toxicity of PM<sub>10-2.5</sub> dusts rather than exempting specific industries (e.g., mining, agriculture).”<sup>57</sup>

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.<sup>58</sup> 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 types of particles 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<sub>10</sub> 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.”<sup>59</sup> The EPA indicated that it would be 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 announced the release of a final rule amending its national air quality monitoring requirements on September 27, 2006.<sup>60</sup>

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,<sup>61</sup> remained concerned that EPA’s decision not to include the exclusions in

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<sup>57</sup> 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](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>].

<sup>58</sup> 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.

<sup>59</sup> 71 *Federal Register* 61143-61233, October 17, 2006, Section III.C.3. *Decision Not to Revise PM<sub>10</sub> Indicator*, available at [<http://epa.gov/pm/actions.html>].

<sup>60</sup> 71 *Federal Register* 61236-61328, October 17, 2006, at [<http://epa.gov/pm/actions.html>].

<sup>61</sup> 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. House Committee on Agriculture, Subcommittee on Conservation, Credit, Rural Development, and Research, *Review of the Environmental* (continued...)

the final 2006 particulates NAAQS will result in unnecessary burdens on the agricultural community.

Since the PM<sub>10</sub> standard was not strengthened (in fact the 2006 PM NAAQS eliminated the *annual* maximum concentration (50 µg/m<sup>3</sup>) standard for PM<sub>10</sub>) no new areas, including rural or non urban areas, will be designated as nonattainment for PM<sub>10</sub>. To the contrary, a few counties previously designated nonattainment have been determined by EPA to be in attainment since the 2006 revisions to the particulates NAAQS (see **Figure 1** in **Appendix** depicting PM<sub>10</sub> nonattainment areas). Additionally, states' nonattainment recommendations for the 2006 PM<sub>2.5</sub> NAAQS and EPA's August 2008 proposed modifications to these recommendations, do not include new rural or non-urban areas.

## Secondary PM<sub>2.5</sub> and PM<sub>10</sub> Standards

The EPA proposal, and the final 2006 particulates NAAQS, set the secondary standard for PM<sub>10</sub> and for PM<sub>2.5</sub> 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<sub>2.5</sub>, the EPA PM staff paper and most of the CASAC panel recommended consideration of a sub-daily standard with a level in the range of 20 to 30 µg/m<sup>3</sup> for a four- to eight-hour midday time period, with a 92<sup>nd</sup> to 98<sup>th</sup> percentile form, as opposed to the primary daily standard at 35 µg/m<sup>3</sup>, based on the current three-year average of the 98<sup>th</sup> percentile of 24-hour PM<sub>2.5</sub> 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<sub>10-2.5</sub>, 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 contended 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 who opposed more stringent standards, commented 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

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<sup>61</sup> (...continued)

*Protection Agency's Pesticide Program*, September 28, 2006.

the criteria document, during the comment period.<sup>62</sup> 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 materially change any of the broad scientific conclusions regarding the health effects of PM exposure made in the 2004 PM Air Quality Criteria Document.”<sup>63</sup>

## **Synopses of Stakeholder Reaction to the 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 asserted 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<sub>10</sub>) 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 contended 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;

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<sup>62</sup> 71 *Federal Register* 2625, January 17, 2006 ([<http://epa.gov/pm/actions.html>]).

<sup>63</sup> 71 *Federal Register* 61143-61233, October 17, 2006 ([<http://epa.gov/pm/actions.html>]).



- requiring the same level of stringency for all fine particles without distinguishing sources is unfounded;
- those representing “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; and
- the benefits (and costs) associated with implementation of the 1997 PM<sub>2.5</sub> NAAQS, as well as compliance with recent EPA air quality regulations, have not yet been realized.

In 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 D.C. Circuit to review the 2006 particulates NAAQS.<sup>64</sup> 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 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.<sup>65</sup> Briefs from petitioners, EPA, and supporters were filed with the court by March 7, 2008, and oral argument occurred September 15, 2008.<sup>66</sup>

Further delays in implementing 1997 PM<sub>2.5</sub> NAAQS will likely have direct implications for implementing the 2006 PM<sub>2.5</sub> NAAQS. A number of events, most notably the D.C. Circuit Court’s July 2008 decision to vacate EPA’s 2005 Clean Air Interstate Rule (CAIR), are directly affecting the timely implementation of the 1997 PM<sub>2.5</sub> NAAQS. The D.C. Circuit’s decision regarding the CAIR could result in significant delays, and has garnered attention in Congress.<sup>67</sup>

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<sup>64</sup> 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).

<sup>65</sup> American Farm Bureau Federation v. U.S. EPA, No. 06-1410 (D.C. Cir. 2006).

<sup>66</sup> American Farm Bureau Federation v. U.S. EPA, No. 06-1410 (D.C. Cir. , oral argument September 15, 2008).

<sup>67</sup> For a more detailed discussion of the court’s decision and its implications, see CRS Report RL34589, *Clean Air After the CAIR Decision: Back to Square One?*, by James E. McCarthy, Larry Parker and Robert Meltz; also see related discussion in CRS Report RL32431, *Particulate Matter (PM<sub>2.5</sub>): Implementation of the 1997 National Ambient Air Quality Standards (NAAQS)*, by Robert Esworthy.

## Conclusions

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

As a result of EPA tightening the fine particulates ( $PM_{2.5}$ ) NAAQS, more areas will be classified as nonattainment and needing to implement new controls on particulate matter in order to comply. States and local governments will be required to develop and implement new or modified plans for addressing emissions in those areas that do not meet the 2006 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. The evolution and development of the particulates NAAQS, in particular, have been the subject of extensive oversight. As a result, the D.C. Circuit's decision regarding challenges to the 2006 PM NAAQS may prompt renewed interest in the issues discussed throughout this report.

## Appendix. PM<sub>10</sub> NAAQS Geographic Nonattainment Areas

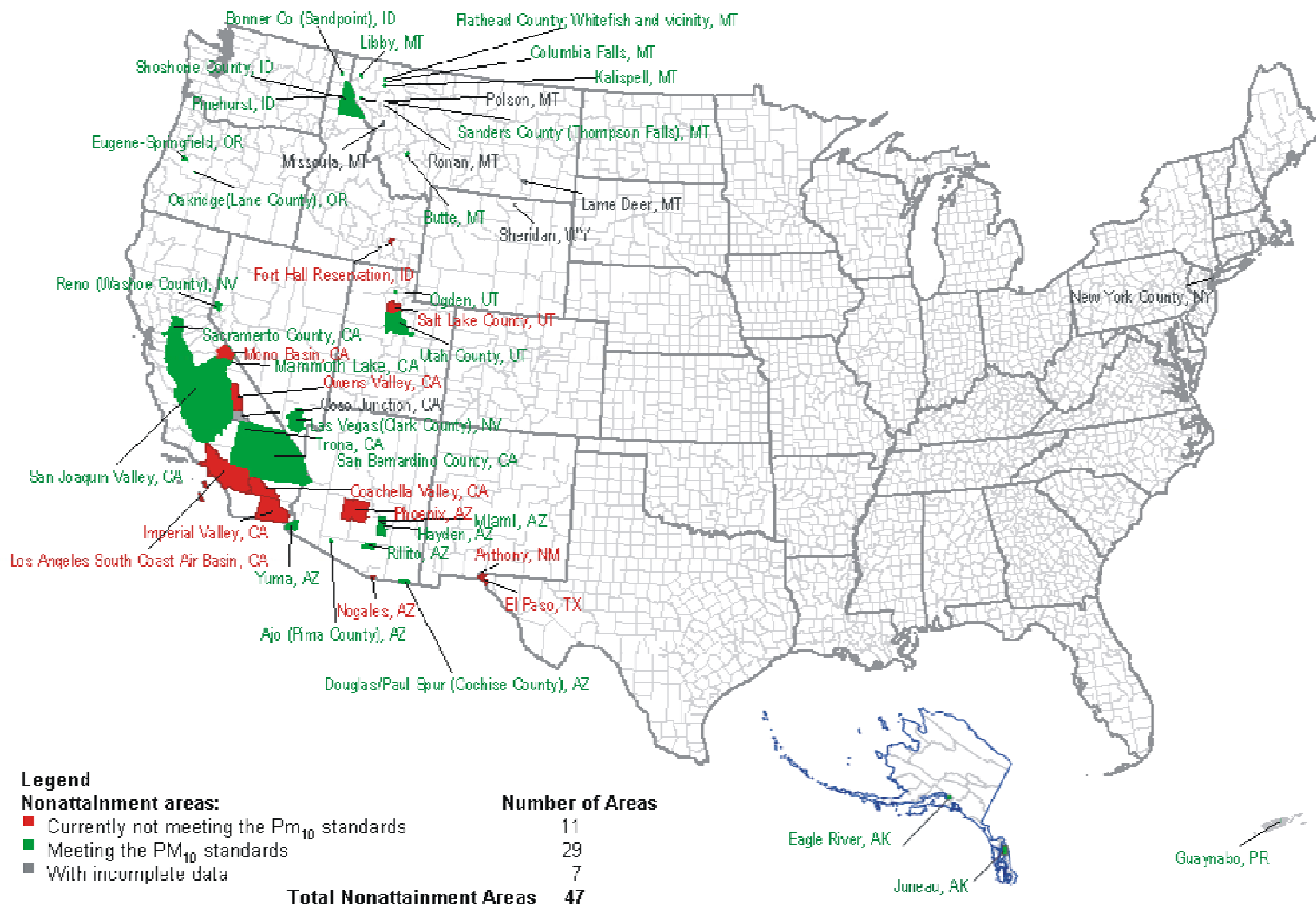
Since 1990, EPA designated 87 areas as nonattainment with the PM<sub>10</sub> NAAQS.<sup>68</sup> As of November 2008, 40 of the original 87 PM<sub>10</sub> areas have been redesignated to attainment. Of the remaining 47 nonattainment areas (46 counties with a population of 28.5 million), 26 areas are currently not meeting the PM<sub>10</sub> standard or have insufficient data to determine attainment based on 2005-2007 data. The remaining counties have submitted the required SIPs for PM<sub>10</sub> but have not yet been formally redesignated to attainment.<sup>69</sup> **Figure 1** shows the status of nonattainment of the PM<sub>10</sub> NAAQS. As depicted on the map, the majority of the U.S. is in attainment of the PM<sub>10</sub> NAAQS (including Hawaii which is not shown on the map as provided by EPA).

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<sup>68</sup> See EPA's PM<sub>10</sub> designations at [<http://www.epa.gov/air/oaqps/greenbk/pindex.html>].

<sup>69</sup> Information provided directly to CRS by the EPA Office of Air Quality Planning and Standards (OAQPS).

**Figure 1. Status of Current PM<sub>10</sub> Nonattainment Areas, Based on 2004-2006 Air Quality**



**Source:** Updated map provided directly to CRS by the EPA Office of Air Quality Planning and Standards (OAQPS), March 19, 2008. There are no PM<sub>10</sub> nonattainment areas in Hawaii which was not included on the EPA map.