



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

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## Summary

On October 17, 2006, the Environmental Protection Agency (EPA) published its final revisions to the National Ambient Air Quality Standards (NAAQS) for particulate matter (particulates, or PM). Several states and industry, agriculture, business, and environmental and public health advocacy groups petitioned the U.S. Court of Appeals for the District of Columbia Circuit, challenging certain aspects of EPA's revisions. A February 24, 2009, decision by the D.C. Circuit granted the petitions in part, denying other challenges, and remanded the standards to EPA for further consideration but did not specifically vacate the 2006 PM standards. EPA initiated its next round of the periodic review of the PM NAAQS, in part, in response to the court's decision and on June 29, 2012, published a proposal to strengthen the standards. These actions, and the ongoing implementation of the 2006 PM NAAQS, have prompted renewed interest among Members of Congress.

Experiences and issues leading up to and following the promulgation of the 2006 PM<sub>2.5</sub> NAAQS could provide relevant insights as EPA proceeds with its current review. Although a tightening of the standards, the particulates NAAQS established in 2006 were 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.

EPA found that the evidence continued to support associations between exposure to particulates in ambient air and numerous health problems. Based on several analytical approaches, EPA estimated that compliance with the revised NAAQS would prevent 1,200 to 13,000 premature deaths annually, as well as substantial numbers of hospital admissions and missed work days due to illness. EPA revised the PM NAAQS by strengthening the 1997 standard for "fine" particulate matter 2.5 micrometers or less in diameter (PM<sub>2.5</sub>). Specifically, the agency lowered the allowable *daily* concentration averaged over 24-hour periods of PM<sub>2.5</sub> in the air from 65 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ) to 35  $\mu\text{g}/\text{m}^3$ . The *annual* PM<sub>2.5</sub> standard, which is set in addition to the daily standard to address human health effects from chronic exposures to the pollutants, was unchanged from the 1997 standard. The decision not to tighten the annual standard was overturned by the D.C. Circuit and remanded to EPA for consideration.

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<sub>10</sub>). EPA abandoned its proposal to replace the particle size indicator of PM<sub>10</sub> with a range of 10 to 2.5 micrometers (PM<sub>10-2.5</sub>). The D.C. Circuit's February 24, 2009, decision upheld EPA's decisions with regard to PM<sub>10</sub> NAAQS.

EPA's ongoing implementation of the 2006 NAAQS, including EPA's November 13, 2009, final designation of those geographical areas not in compliance (typically defined by counties or portions of counties), has been an area of debate among some Members of Congress, states, and other stakeholders. Although EPA did not require new nonattainment designations for PM<sub>10</sub>, the tightening of the PM<sub>2.5</sub> standard resulted in an increased number of areas in nonattainment compared to the designations for the 1997 PM NAAQS. EPA's November 2009 final designations for the 2006 PM NAAQS included 120 counties and portions of counties in 18 states as nonattainment areas based on 2006 through 2008 air quality monitoring data.

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## Introduction

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, 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>

EPA’s revised particulates NAAQS modified the standards established in 1987<sup>4</sup> that focused on particles smaller than 10 micrometers (PM<sub>10</sub>, or coarse particles), and standards for “fine” particles smaller than 2.5 micrometers<sup>5</sup> (PM<sub>2.5</sub>) introduced for the first time with the promulgation of the 1997 PM<sub>2.5</sub> NAAQS.<sup>6</sup> Specifically, the agency lowered the allowable *daily* concentration averaged over 24-hour periods of PM<sub>2.5</sub> in the air from 65 micrograms per cubic meter (µg/m<sup>3</sup>) to 35 µg/m<sup>3</sup>. The *annual* PM<sub>2.5</sub> standard, which is set in addition to the daily standard to address human health effects from chronic exposures to the pollutants, was unchanged. 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<sub>10</sub>).

The 2006 revisions to the particulates NAAQS were the culmination of EPA’s statutorily required periodic review,<sup>7</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. 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.

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>8</sup>) established by the CAA.<sup>9</sup> Conversely, some contended that

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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> A micrometer is 1/1000<sup>th</sup> of a millimeter; there are 25,400 micrometers in an inch.

<sup>6</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>7</sup> Section 109(d)(1) of the CAA. According to the statute, 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.

<sup>8</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>9</sup> Section 109(d)(2) of the Clean Air Act.

available data did not support the need for stricter standards or, in some cases, the standards as promulgated in 1997.

A February 24, 2009, decision by the U.S. Court of Appeals for the D.C. Circuit<sup>10</sup> to grant, in part, petitions challenging certain aspects of EPA's revised NAAQS generated renewed interest in the PM NAAQS. In December 2006, 13 states, the District of Columbia, and several state agencies had petitioned the U.S. Court of Appeals for the D.C. Circuit to review the 2006 particulates NAAQS.<sup>11</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, filed petitions with the D.C. Circuit challenging the 2006 NAAQS.<sup>12</sup> Petitioners, joined by several interveners and amici, challenged both the fine and coarse particulates standards.

The court's decision did not vacate the PM standards but remanded certain aspects of the annual PM<sub>2.5</sub> standard to EPA for reconsideration; the petitions did not challenge the tightening of the daily (24-hour) standard. Although implementation of the 2006 PM NAAQS continues,<sup>13</sup> EPA initiated its statutorily required review of the PM NAAQS, in part in response to the decision, not long after the 2006 promulgation of the PM NAAQS.<sup>14</sup> EPA staff reassessed scientific studies considered in setting the 2006 PM NAAQS revisions, reviewed and analyzed extensive subsequent research, and considered public comments and recommendations of the CASAC. Based on the scientific evidence considered, EPA Administrator Lisa P. Jackson signed the proposal that would tighten the current standard primarily by lowering the annual health-based ("primary") standard for PM<sub>2.5</sub>. The proposal includes options for new secondary standards to address visibility impacts in urban areas associated with PM<sub>2.5</sub>, but did not modify the standards for inhalable coarse particles smaller than 10 micrometers (PM<sub>10</sub>).<sup>15</sup> EPA is to finalize its decision regarding the PM NAAQS by December 14, 2012. For an overview of the proposed revisions to the PM NAAQS published June 29, 2012, see CRS Report R42671, *Air Quality: EPA's 2012 Proposed Changes to the Particulate Matter (PM) Standard*, by Robert Esworthy.

The range of issues raised prior to and shortly after the promulgation of the 2006 PM<sub>2.5</sub> NAAQS could provide relevant insights as EPA proceeds with finalizing its decisions with regard to revising particulates NAAQS. This CRS report provides an analysis of the agency's final 2006 revisions to the particulates NAAQS, and an overview of the estimated costs and benefits of the revised standards and of more stringent alternatives analyzed. The report highlights concerns and

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<sup>10</sup> American Farm Bureau Federation v. U.S. EPA, No. 06-1410 (D.C. Cir., February 24, 2009).

<sup>11</sup> Three amici states filed jointly with the 13 party states.

<sup>12</sup> Cases were consolidated with American Farm Bureau Federation v. U.S. EPA, 2009 Westlaw 437050, No. 06-1410 (D.C. Cir. 2006).

<sup>13</sup> For a more detailed discussion of the NAAQS implementation process for designating geographical nonattainment areas with respect to the tightening of the PM<sub>2.5</sub> standards under the 2006 particulates NAAQS, including comparisons with the final designations under the 1997 PM<sub>2.5</sub> NAAQS, see CRS Report R40096, *2006 National Ambient Air Quality Standards (NAAQS) for Fine Particulate Matter (PM<sub>2.5</sub>): Designating Nonattainment Areas*, by Robert Esworthy.

<sup>14</sup> The current review was initiated with EPA's June 2007 general call for information, U.S. EPA, "Integrated Science Assessment for Particulate Matter: Call for Information," 72 *Federal Register* 35462, June 28, 2007. See also EPA's *Policy Assessment for the Review of the Particulate Matter National Ambient Air Quality Standards*, pp. 1-10 through 1-12, U.S. EPA Office of Air Quality Planning and Standards, Health and Environmental Impacts Division, EPA 452/R-11-003, April 2011, <http://www.epa.gov/ttnnaqs/standards/pm/data/20110419pmpafinal.pdf>.

<sup>15</sup> See EPA's Fact Sheet "Overview of EPA's Proposal to Revise the Air Quality Standards for Particle Pollution (Particulate Matter)," <http://www.epa.gov/pm/2012/fsoverview.pdf>.

issues raised regarding the 2006 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 EPA set national ambient (outdoor) air quality standards for pollutants whose emissions "may reasonably be anticipated to endanger public health (primary standards) or welfare"<sup>16</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 reaffirm or modify previously established NAAQS.

### **The 2006 Particulates NAAQS**

EPA's review leading up to the 2006 promulgation of the revised PM NAAQS 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>17</sup> Further, 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  $\mu\text{g}/\text{m}^3$ ,

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<sup>16</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>17</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>.

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 µg/m<sup>3</sup>.

- **PM<sub>10</sub>**: retained the *daily* 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>18</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)
<b>PM<sub>2.5</sub> (Fine)</b>		
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>
<b>PM<sub>10</sub> (Coarse)</b>		
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 with information from EPA’s final particulates NAAQS (71 *Federal Register* 61 143-61233, October 17, 2006), and related technical documents, available at <http://www.epa.gov/air/particulates/actions.html>. EPA’s final PM staff paper and the CASAC review of the EPA staff paper 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).

EPA’s final revisions to the standards for fine particulates (PM<sub>2.5</sub>) were the same as those 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 EPA staff.

With regard to coarse particulates, 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 EPA’s final decisions are discussed later in this report.

<sup>18</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.



## Implementing the 2006 PM NAAQS<sup>19</sup>

Promulgation of NAAQS in 2006 set in motion a process under which the states and EPA first identified geographic nonattainment areas, those areas failing to comply with the NAAQS based on monitoring and analysis of relevant air quality data.<sup>20</sup> Within three years of issuance of a NAAQS, states were required to submit “infrastructure” plans demonstrating that they have the basic air quality management components necessary to implement the NAAQS.<sup>21</sup> Following EPA’s final designations of attainment and nonattainment areas, states submit their plans (State Implementation Plans, or SIPs) for how they will achieve and/or maintain attainment of the standards to EPA. 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 mobile sources, such as automobiles and trucks) and in the form of emission standards for new stationary sources (e.g., utilities, refineries).

The 2006 tightening of the PM<sub>2.5</sub> standards resulted in an increase in the number of areas (typically defined by counties or portions of counties) designated nonattainment. EPA did not require new nonattainment designations for PM<sub>10</sub> since the standards were not strengthened (see map in **Figure 1**, later in this report, depicting PM<sub>10</sub> nonattainment areas).

### 2006 PM<sub>2.5</sub> 24-Hour NAAQS Area Designations

On November 13, 2009, EPA published its designations of 31 areas in 18 states, comprising 120 counties (89 counties and portions of 31 additional counties) for nonattainment of the revised 2006 24-hour PM<sub>2.5</sub> standard.<sup>22</sup> The designations, based on 2006 through 2008 air quality monitoring data, included a few counties that were designated nonattainment for PM<sub>2.5</sub> for the first time, but the majority of the counties identified overlapped with EPA’s final nonattainment designations for the 1997 PM<sub>2.5</sub> NAAQS.<sup>23</sup> However, most of the 1997 PM<sub>2.5</sub> nonattainment areas were *only* exceeding the annual standard; thus, tightening the 24-hour standard resulted in an increased number of areas being designated nonattainment based on exceedances of both the 24-hour *and* the annual standard. The final nonattainment designation rule for the 2006 PM NAAQS became effective December 14, 2009 (30 days from the date of publication).<sup>24</sup> Publication of a

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<sup>19</sup> See CRS Report R40096, *2006 National Ambient Air Quality Standards (NAAQS) for Fine Particulate Matter (PM<sub>2.5</sub>): Designating Nonattainment Areas*, by Robert Esworthy.

<sup>20</sup> For a general overview of the NAAQS designations process, see EPA’s “Designations” website at <http://www.epa.gov/air/urbanair/designations.html>.

<sup>21</sup> Section 110(a)(2) of the Clean Air Act. For a general overview of the NAAQS implementation plans process, see EPA’s “State Implementation Plan Overview” website at <http://www.epa.gov/air/urbanair/sipstatus/overview.html>.

<sup>22</sup> 74 *Federal Register* 58688-58781; see also “Area Designations for 2006 24-Hour Fine Particulate (PM<sub>2.5</sub>) Standards—Regulatory Actions,” <http://www.epa.gov/pmdesignations/2006standards/regs.htm#4>.

<sup>23</sup> For detailed PM<sub>2.5</sub> state/county geographical designation recommendations by EPA and those from individual states and tribes, for the 1997 and for the 2006 PM<sub>2.5</sub> NAAQS, see <http://www.epa.gov/pmdesignations>.

<sup>24</sup> In addition, in the February 3, 2011, *Federal Register*, EPA published its final designations of three areas as “nonattainment” or “unclassifiable/attainment” for the 2006 24-hour PM<sub>2.5</sub> NAAQS that were deferred at the time of the agency’s November 13, 2009, promulgated designations. Designations were deferred so that EPA could evaluate measurements of high fine particle concentrations by violating monitors. EPA designated a portion of Pinal County, AZ, as nonattainment. Eight surrounding counties were designated unclassifiable/attainment, and Gila River Indian Community and the Ak-Chin Indian community designations were deferred pending completion of the formal consultation process. Plumas County, CA, and Shasta County, CA, as well as surrounding counties, were designated (continued...)

final area designation rule for the 2006 24-hour PM<sub>2.5</sub> NAAQS was delayed as a result of the incoming Administration's review of the final rule, along with several other agency proposed and final actions introduced toward the end of the previous Administration.<sup>25</sup>

## **State Implementation Plans (SIPs)**

Under the CAA, within three years of issuance of a NAAQS, all states are required to submit "infrastructure" plans demonstrating that they have the basic air quality management components necessary to implement the NAAQS.<sup>26</sup> Areas designated attainment/unclassifiable will not have to take steps to improve air quality, but under the statute they must take steps to prevent air quality from deteriorating to unhealthy levels. For those areas designated nonattainment, state, local, and tribal governments must outline detailed control requirements in plans demonstrating how they will meet the 2006 24-hour PM<sub>2.5</sub> NAAQS. These plans, defined as state implementation plans and referred to as SIPs (TIPs for tribal implementation plans), were to be submitted to EPA three years after the December 14, 2009, effective date of the agency's final designations.<sup>27</sup> If states failed to develop an adequate implementation plan, EPA can impose one. Under CAA, states are required to meet the 2006 PM<sub>2.5</sub> standard "as expeditiously as practicable," but no later than five years from the effective date of designation—December 14, 2014, according to EPA's timeline—unless an extension (up to five additional years) allowed under the CAA is granted.<sup>28</sup>

For a discussion of the status of states' infrastructure, and nonattainment area SIPs for the 2006 PM<sub>2.5</sub> NAAQS, see CRS Report R40096, *2006 National Ambient Air Quality Standards (NAAQS) for Fine Particulate Matter (PM2.5): Designating Nonattainment Areas*, by Robert Esworthy.

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(...continued)

unclassifiable/attainment.

<sup>25</sup> The review of these regulations was initiated, in part, in response to a White House January 20, 2009, memorandum, Memorandum to Heads and Acting Heads of Executive Departments and Agencies from Rahm Emanuel, Assistant to the President and Chief of Staff, regarding Regulatory Review, January 20, 2009, *74 Federal Register* 4435, January 26, 2009; the memorandum is also available at [http://www.whitehouse.gov/sites/default/files/omb/assets/information\\_and\\_regulatory\\_affairs/regulatory\\_review\\_012009.pdf](http://www.whitehouse.gov/sites/default/files/omb/assets/information_and_regulatory_affairs/regulatory_review_012009.pdf). Also see Office of Management and Budget website, "Regulatory Matters"—OIRA Policies and Practices, at [http://www.whitehouse.gov/omb/international\\_regulatory\\_cooperation](http://www.whitehouse.gov/omb/international_regulatory_cooperation), and the Office of Management and Budget's subsequent January 21, 2009, memorandum regarding regulatory review, Memorandum to Heads and Acting Heads of Executive Departments and Agencies from Peter R. Orszag, Director, Office of Management and Budget, regarding Implementation of Memorandum Concerning Regulatory Review, January 21, 2009; see Office of Management and Budget website, "Regulatory Matters"—OIRA Policies and Practices, at [http://www.whitehouse.gov/omb/international\\_regulatory\\_cooperation](http://www.whitehouse.gov/omb/international_regulatory_cooperation).

<sup>26</sup> Section 110(a)(2) of the Clean Air Act. For a general overview of the NAAQS implementation plans process, see EPA's "State Implementation Plan Overview" at <http://www.epa.gov/air/urbanair/sipstatus/overview.html>.

<sup>27</sup> Section 172 of the Clean Air Act. See EPA's "State Implementation Plan Overview" at <http://www.epa.gov/air/urbanair/sipstatus/overview.html>.

<sup>28</sup> Under Section 172(a)(2)(A) of the CAA, 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."

## National Regulations

EPA expected that in many cases implementing national strategies—including the 1999 visibility protection regulations (Regional Haze Rule);<sup>29</sup> voluntary diesel engine retrofit programs; and federal emission standards for cars, light trucks, heavy-duty, and nonroad diesel engines—would provide a framework for achieving attainment with the PM<sub>2.5</sub> NAAQS. A key federal regulation designed to control emissions of air pollution that causes air quality problems in downwind states, EPA’s May 2005 Clean Air Interstate Rule (CAIR),<sup>30</sup> was vacated in a July 11, 2008, decision (*North Carolina v. EPA*), by the U.S. Court of Appeals for the D.C. Circuit.<sup>31</sup>

On August 8, 2011, EPA published a final rule replacing CAIR, the Cross-State Air Pollution Rule (hereinafter the “Cross-State Rule” or CSAPR).<sup>32</sup> The Cross-State Rule left the CAIR Phase 1 limits in place and set new limits replacing CAIR’s second phase in 2012 and 2014, up to three years earlier than CAIR would have. The CSAPR covered 28 eastern, midwestern, and southern states (adding Oklahoma, Kansas, and Nebraska to the 28 covered by CAIR, but removing Connecticut, Delaware, and Massachusetts from the CAIR group) and the District of Columbia.

The CSAPR,<sup>33</sup> which was to have gone into effect in 2012, was stayed in December 2011, and then vacated on August 21, 2012, by the D.C. Circuit Court of Appeals.<sup>34</sup> The D.C. Circuit’s decisions regarding the CSAPR and CAIR have had a disruptive effect on certain aspects of initial implementation of the 2006 revised PM<sub>2.5</sub> NAAQS. On October 5, 2012, the U.S. Department of Justice filed a petition<sup>35</sup> seeking en banc rehearing of the D.C. Circuit’s August 21, 2012, decision regarding the CSAPR. The D.C. Circuit denied requests for both a panel and the en banc rehearing on January 24, 2013.<sup>36</sup> To date, EPA has not made a decision regarding its

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<sup>29</sup> 64 *Federal Register* 35714-35774, July 1, 1999. See CRS Report RL32483, *Visibility, Regional Haze, and the Clean Air Act: Status of Implementation*, by Larry Parker and John Blodgett, also CRS Report RL32927, *Clean Air Interstate Rule: Review and Analysis*, by Larry Parker.

<sup>30</sup> Promulgated under the CAA, 42 U.S.C. 7401 et seq., see U.S. EPA, “Ambient air quality standards, national—Fine particulate matter and ozone; interstate transport control measures,” 70 *Federal Register* 25162, May 12, 2005.

<sup>31</sup> *North Carolina v. EPA* 531 F.3d 896 (D.C. Cir. 2008), see CRS Report RL34589, *Clean Air After the CAIR Decision: Multi-Pollutant Approaches to Controlling Powerplant Emissions*, by James E. McCarthy, Larry Parker, and Robert Meltz; also see EPA’s Clean Air Interstate Rule website at <http://www.epa.gov/CAIR/index.html>.

<sup>32</sup> See U.S. EPA, “Federal Implementation Plans: Interstate Transport of Fine Particulate Matter and Ozone and Correction of SIP Approvals,” 76 *Federal Register* 48208-48483, August 8, 2011, <http://www.gpo.gov/fdsys/pkg/FR-2011-08-08/pdf/2011-17600.pdf>. EPA announced the release of the final rule on July 6, 2011. Explanatory and background material can be found on EPA’s website at <http://www.epa.gov/crossstaterule/actions.html>. When proposed in August 2010, the Cross-State Rule was referred to as the Clean Air Transport Rule. The name change to “Cross-State Rule” occurred late in the development of the final rule. As a result, many of the explanatory materials, including the final Regulatory Impact Analysis, refer to the “Transport Rule.”

<sup>33</sup> See U.S. EPA, “Federal Implementation Plans: Interstate Transport of Fine Particulate Matter and Ozone and Correction of SIP Approvals,” 76 *Federal Register* 48208-48483, August 8, 2011, <http://www.gpo.gov/fdsys/pkg/FR-2011-08-08/pdf/2011-17600.pdf>. Explanatory and background material can be found on EPA’s website at <http://www.epa.gov/crossstaterule/actions.html>.

<sup>34</sup> *EME Homer City Generation, L.P. v. Environmental Protection Agency*, D.C. Cir., No. 11-1302, August 21, 2012, [http://www.cadc.uscourts.gov/internet/opinions.nsf/19346B280C78405C85257A61004DC0E5/\\$file/11-1302-1390314.pdf](http://www.cadc.uscourts.gov/internet/opinions.nsf/19346B280C78405C85257A61004DC0E5/$file/11-1302-1390314.pdf). See also U.S. EPA’s website, “Cross-State Air Pollution Rule (CSAPR),” for this decision and other related documents.

<sup>35</sup> U.S. EPA, [http://epa.gov/crossstaterule/pdfs/Rehearing\\_Petition\\_617874.pdf](http://epa.gov/crossstaterule/pdfs/Rehearing_Petition_617874.pdf). For status of the petition see EPA’s website, “Cross-State Air Pollution Rule (CSAPR),” at <http://epa.gov/crossstaterule/>.

<sup>36</sup> *EME Homer City Generation, L.P. v. Environmental Protection Agency*, D.C. Cir., No. 11-1302, January 24, 2013, Orders. See U.S. EPA’s website, “Cross-State Air Pollution Rule (CSAPR),” <http://epa.gov/crossstaterule/>.

response to the Court's denial for a rehearing. The implications of the Cross-State Rule has generated considerable interest among states, industry, and other stakeholders, and have been the topic of further debate during the 112<sup>th</sup> Congress.<sup>37</sup>

## 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>38</sup> Costs and feasibility are generally taken into account in NAAQS implementation (a process that is primarily a state responsibility).

Nevertheless, EPA released a regulatory impact analysis (RIA) on October 6, 2006,<sup>39</sup> to meet its obligations under Executive Order 12866 and in compliance with guidance from the White House Office of Management and Budget.<sup>40</sup> The RIA only analyzed the benefits and costs of implementing the PM<sub>2.5</sub> NAAQS. Citing time, data, and modeling limitations, EPA did not analyze the benefits and costs of retaining the PM<sub>10</sub> standard.

EPA emphasized that the October 2006 RIA differed from typical RIAs in that it did not analyze the regulatory impact of a specific 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 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. 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, in particular the 2005 Clean Air Interstate Rule (CAIR).<sup>41</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>42</sup> As discussed earlier in this report, the U.S. Court

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<sup>37</sup> For example, see House Committee on Science, Space, and Technology, full-committee hearing, "Out of Thin Air: EPA's Cross-State Air Pollution Rule," September 15, 2011, <http://science.house.gov/hearing/full-committee-hearing-epas-cross-state-air-pollution-rule>.

<sup>38</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).

<sup>39</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 at <http://www.epa.gov/ttn/ecas/ria.html>.

<sup>40</sup> 58 *Federal Register* 51735, October 4, 1993. See the White House OMB website, *Regulatory Matters*, at [http://www.whitehouse.gov/omb/regulatory\\_affairs/default](http://www.whitehouse.gov/omb/regulatory_affairs/default).

<sup>41</sup> CAA, 42 U.S.C. 7401 et seq., 70 *Federal Register* 25162, May 12, 2005.

<sup>42</sup> Sulfur dioxide (SO<sub>2</sub>) is a precursor (a pollutant that is transformed in air to form another air pollutant) contributing to the formation of PM<sub>2.5</sub> concentrations, and NO<sub>x</sub> is a precursor 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 (continued...)

of Appeals for the D.C. Circuit initially vacated CAIR in its entirety in a July 11, 2008,<sup>43</sup> decision, and then modified its decision, allowing CAIR to remain in effect until a new rule is promulgated by EPA.<sup>44</sup> EPA subsequently published a final rule replacing CAIR, the Cross-State Air Pollution Rule (CSAPR), on August 8, 2011.<sup>45</sup> As discussed above, CSAPR was stayed in December 2011, and then vacated on August 21, 2012, by the D.C. Circuit Court of Appeals.<sup>46</sup> On October 5, 2012, the U.S. Department of Justice filed a petition<sup>47</sup> seeking en banc rehearing of the D.C. Circuit's August 21, 2012, decision regarding the CSAPR. Building on emission reductions attributed to CAIR phase I, the CSAPR was expected to result in relatively comparable benefits to those associated with CAIR in EPA's October 2006 RIA. The D.C. Circuit denied requests for both a panel and the en banc rehearing on January 24, 2013.<sup>48</sup> To date, EPA has not made a decision regarding its response to the Court's denial for a rehearing.

## **EPA's Monetized Benefits and Cost Estimates<sup>49</sup>**

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. 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, 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, EPA presented a variety of benefits estimates based on morbidity impacts derived from several published epidemiological studies,<sup>50</sup> and mortality impacts derived

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(...continued)

NAAQS (70 *Federal Register* 25162, May 12, 2005).

<sup>43</sup> 531 F.3d 896 (D.C. Cir. 2008). See CRS Report RL34589, *Clean Air After the CAIR Decision: Multi-Pollutant Approaches to Controlling Powerplant Emissions*, by James E. McCarthy, Larry Parker, and Robert Meltz.

<sup>44</sup> 550 F.3d 1176 (D.C. Cir. 2008).

<sup>45</sup> See U.S. EPA, "Federal Implementation Plans: Interstate Transport of Fine Particulate Matter and Ozone and Correction of SIP Approvals," 76 *Federal Register* 48208-48483, August 8, 2011, <http://www.gpo.gov/fdsys/pkg/FR-2011-08-08/pdf/2011-17600.pdf>. EPA announced the release of the final rule on July 6, 2011. Explanatory and background material can be found on EPA's website at <http://www.epa.gov/crossstaterule/actions.html>. When proposed in August 2010, the Cross-State Rule was referred to as the Clean Air Transport Rule. The name change to "Cross-State Rule" occurred late in the development of the final rule. As a result, many of the explanatory materials, including the final Regulatory Impact Analysis, refer to the "Transport Rule."

<sup>46</sup> See footnote 34.

<sup>47</sup> See footnote 35.

<sup>48</sup> *EME Homer City Generation, L.P. v. Environmental Protection Agency*, D.C. Cir., No. 11-1302, January 24, 2013, Orders. See U.S. EPA's website, "Cross-State Air Pollution Rule (CSAPR)," <http://epa.gov/crossstaterule/>.

<sup>49</sup> U.S. EPA, EPA's RIA of the 2006 NAAQS for Fine Particle Pollution (PM<sub>2.5</sub>), available at <http://www.epa.gov/ttn/ecas/ria.html>.

<sup>50</sup> The studies from which EPA health effect estimates are drawn are listed in Table 5-7 of the RIA for the 2006 PM<sub>2.5</sub> NAAQS.

from an American Cancer Society (ACS) Study<sup>51</sup> used in previous RIAs, the Harvard Six Cities Study,<sup>52</sup> and an expert elicitation study conducted by EPA in 2006.<sup>53</sup> **Table 2** below presents a range of EPA's estimated economic costs, monetized benefits, and net benefits associated with achieving the revised 2006 PM<sub>2.5</sub> NAAQS.

**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	Full Benefits		Cost	Net Benefits <sup>a</sup>	
<i>Benefits based on American Cancer Society Study Mortality Function and Published Scientific Literature Morbidity Functions</i>					
3%	\$17 confidence interval (\$4 - \$36)		\$5.4	\$12	
7%	\$14.5 confidence interval (\$3.5 - \$31)		\$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 lower bound (\$0.8 - \$42)	\$76 upper bound (\$19 - \$150)	\$5.4	\$3.5	\$70
7%	\$8 lower bound (\$0.8 - \$36)	\$64 upper bound (\$16 - \$130)	\$5.4	\$2.4	\$59

**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>); see Table ES-1, p. ES-7; Table ES-3, p. ES-9; Table 5-1, p. 5-3, Table 9-1, p. 9-2. <http://www.epa.gov/ttn/ecas/ria.html>. Estimates and results are as reported by EPA and have been rounded after calculation.

**Note:** Results are rounded to two significant digits after calculation for presentation and computation as reported by EPA. Estimates (costs and benefits) reflect full 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 EPA's *Guidelines for Preparing Economic Analyses (2000)* and OMB Circular A-4 (2003).

- a. For purposes of calculating net benefits, EPA uses the total social cost estimate, which is slightly higher than the engineering cost.

<sup>51</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>52</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. 1, <http://pubs.healtheffects.org/getfile.php?u=271>.

<sup>53</sup> See Chapter 5 of EPA's October 6, 2006, RIA <http://www.epa.gov/ttn/ecas/ria.html>.

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 epidemiology studies. Using the mortality function developed from the expert elicitation in conjunction with the morbidity function from the published studies, EPA's total annual benefits are estimated to range from \$8 billion to \$76 billion in 2020. EPA's estimated monetized benefits for 2020, like the cost estimates, were based on 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 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. The benefits ranged from \$2.4 billion to \$70 billion, based on derivation mortality from expert elicitation and morbidity from the epidemiology studies. The ranges of estimates are forecasted using discount rates of 3% and 7%.

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 national regulations addressing emissions from the power generation sector, including the CAIR,<sup>54</sup> as well as regulation of various mobile sources, that contribute to lowering PM<sub>2.5</sub> concentrations in future years.

In addition to the monetized health benefits estimates, EPA estimated the monetary benefits associated with improvements in visibility in selected Class I national parks and wilderness areas.<sup>55</sup> 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, 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>56</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 "Concerns and Issues" section of this report.

## **Potential Health Impacts**

The EPA health effects estimates were a primary component of its derivations of the monetized benefits discussed above. For purposes of illustration, **Table 3** summarizes 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, as reported in its RIA. The range of the estimated mean number of reductions in premature deaths is based on EPA's derivations using the ACS and the Harvard Six-Cities studies.

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<sup>54</sup> 70 *Federal Register* 25162, May 12, 2005.

<sup>55</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.

<sup>56</sup> See Appendix I in *Visibility Benefits Methodology* of EPA's October 6, 2006, RIA <http://www.epa.gov/ttn/ecas/ria.html>.

EPA's mean estimates for the remaining adverse health effects were based on various epidemiology studies.<sup>57</sup>

**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

**Source:** Prepared by the Congressional Research Service with data based on mortality and 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>)* October 6, 2006, and available on EPA's website at <http://www.epa.gov/ttn/ecas/ria.html>. Estimates are rounded by EPA.

- a. For consistency with the emissions and benefits modeling, 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 premature death estimates reflects the mean estimates derived from the American Cancer Society study and the Harvard Six-Cities Study, respectively.

EPA also 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 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, 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, 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>58</sup> The funding

<sup>57</sup> See Table 5-7 in Chapter 5 of EPA's October 6, 2006, RIA: <http://www.epa.gov/ttn/ecas/ria.html>.

<sup>58</sup> Congress increased EPA's appropriations for particulate matter research from \$18.8 million in FY1997 (H.Rept. 104- (continued...))



supported EPA intramural and extramural PM research projects and the establishment of five university-based PM research centers around the country.

According to the February 2010 EPA report entitled *Our Nation's Air: Status and Trends Through 2008*,<sup>59</sup> nationally, annual and 24-hour PM<sub>2.5</sub> concentrations were 17% and 19% lower, respectively, in 2008 compared to 2001. Based on a comparison of results from PM<sub>2.5</sub> monitoring locations (565 sites) for two three-year periods, 2001-2003 and 2006-2008, EPA reported that almost all sites showed a decline or little change in PM<sub>2.5</sub> concentrations.

Of the 565 monitoring sites, EPA reported that 16 sites in California, Illinois, Indiana, Michigan, Ohio, Utah, and West Virginia showed the greatest decreases in annual PM<sub>2.5</sub> concentrations, and five sites in California, Montana, Oregon, Pennsylvania, and Utah showed the greatest decrease in 24-hour PM<sub>2.5</sub> concentrations. Four monitoring sites located in Montana, Arizona, and Wisconsin showed the greatest increase in annual PM<sub>2.5</sub> concentrations, but none were above the annual PM<sub>2.5</sub> NAAQS standard for the most recent three-year period (2006-2008). Nineteen sites located throughout all regions of the United States showed an increase in 24-hour PM<sub>2.5</sub> concentrations. Seven of these sites are located in or near metropolitan areas in Arizona, California, Georgia, Montana, Virginia, and Washington were above the 24-hour PM<sub>2.5</sub> NAAQS standard for the most recent three-year period.

Most of the areas that showed the greatest improvement were the ones that generally had the highest concentrations in the earlier years. Despite the reported overall progress, in 2008 nearly 37 million people lived in counties with measured concentrations exceeding the annual and the 24-hour PM<sub>2.5</sub> national air quality standards, according to the EPA trends report.<sup>60</sup>

EPA's review leading up to the promulgation of the 2006 particulates NAAQS 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>61</sup> However, as referenced earlier, findings and policy options presented for consideration in EPA's staff assessments,<sup>62</sup> and associated recommendations by the Clean Air Scientific Advisory Committee (CASAC)<sup>63</sup> in support of EPA's June 2012 proposal to revise the particulates NAAQS, concluded, and the CASAC concurred, that the scientific evidence supported modifying the PM<sub>2.5</sub> primary standard and considering options for revising the secondary standard for reducing visibility impairment associated with PM. Recognizing certain limitations of the data, a range of alternatives were

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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>59</sup> EPA-454/R-09-002, February 2010 <http://www.epa.gov/airtrends/2010/index.html>.

<sup>60</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. Comparatively, the combined population residing in EPA's final nonattainment designation areas for the 1997 PM<sub>2.5</sub> NAAQS, consisting of 208 counties in 20 states and the District of Columbia, is almost 90 million.

<sup>61</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>62</sup> See footnote 15 and footnote 17.

<sup>63</sup> See footnote 17.

presented for consideration by the Administrator for modifying the current PM NAAQS. These recommendations were the basis for the Administrator's decision, taking into account other factors including public comments received, for proposing to strengthen the annual PM<sub>2.5</sub> primary standard.<sup>64</sup>

## **Concerns and Issues Associated with the Revisions of the Particulates NAAQS**

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 were held regarding implementation and review of the particulates NAAQS.<sup>65</sup> Well before 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. 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>66</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 standards.<sup>67</sup>

The Administrator is not required by statute to follow CASAC's recommendations; the CAA (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 the Administrator's 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

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<sup>64</sup> See 77 *Federal Register* 38900-38944, *Section III. Rationale for Proposed Decisions on Primary PM<sub>2.5</sub> Standards*, June 29, 2012.

<sup>65</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>66</sup> For a discussion of issues regarding the CASAC, see CRS Report RL33807, *Air Quality Standards and Sound Science: What Role for CASAC?*, by James E. McCarthy.

<sup>67</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).

Administrator's decisions and its description of the process as having failed to meet statutory and procedural requirements could play a role in the debate regarding EPA's reviews of NAAQS.

## **Petitions Challenging the 2006 PM NAAQS and the D.C. Circuit's February 24, 2009, Decision<sup>68</sup>**

In December 2006, a diverse mix of petitioners, including states and state agencies,<sup>69</sup> environmental and public health advocacy organizations, and groups representing various industry and agriculture interests, petitioned the U.S. Court of Appeals for the D.C. Circuit to review EPA's 2006 final rule revising the PM NAAQS. The court consolidated the cases.<sup>70</sup>

The petitioners, who challenged aspects of both the fine and coarse PM standards, were joined by various interveners and amici. Decisions regarding PM<sub>2.5</sub> standard focused primarily on the annual standard. Although the court's February 24, 2009, decision remanded aspects of EPA's decisions regarding the primary annual NAAQS for PM<sub>2.5</sub> to the agency for reconsideration, it did not vacate the annual standard, stating: "First, the EPA's failure adequately to explain itself is in principle a curable defect. Second, vacating a standard because it may be insufficiently protective would sacrifice such protection as it now provides, making the best an enemy of the good."<sup>71</sup>

Although aspects of the 2006 PM standard remanded to EPA for reconsideration by the court remain in effect and EPA's tightening of the 24-hour PM<sub>2.5</sub> standard was not affected, EPA's completion of its next round of periodic review and June 2012 proposed revisions to the PM standards has generated concerns with respect to the implementation process for the 2006 standards. EPA's eventual actions may have longer-term implications, particularly if the agency further tightens the primary or secondary annual standards as proposed. Such actions could require modifications to SIPs submitted by existing previously designated nonattainment areas.

The following sections summarize key areas of concern following the promulgation of the 2006 PM NAAQS and include brief discussions of the D.C. Circuit's February 24, 2009, decision as it pertains to the particular issue area.

### **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."<sup>72</sup> According to the CASAC:

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<sup>68</sup> See footnote 10.

<sup>69</sup> 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

<sup>70</sup> See footnote 12.

<sup>71</sup> See footnote 10.

<sup>72</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).

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 98<sup>th</sup> percentile form, in concert with an annual NAAQS in the range of 14 to 13 µg/m<sup>3</sup>.<sup>73</sup>

**Table 4** 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 4. 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 (98 <sup>th</sup> 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 EPA's final 2006 particulates NAAQS (71 *Federal Register* 61143-61233, October 17, 2006), EPA's proposed particulates NAAQS (71 *Federal Register* 2620, December 20, 2005), and related technical documents,<sup>74</sup> available at <http://www.epa.gov/air/particles/actions.html>.

In response to the discrepancies between the proposal and the CASAC recommendations, then 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>75</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>76</sup>

Many public comments received on 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>77</sup> argued for standards as stringent or

<sup>73</sup> See footnote 72.

<sup>74</sup> EPA's final PM staff paper and the CASAC review of the EPA staff paper (see references earlier in this report).

<sup>75</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>76</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>77</sup> CRS communication with Mr. William Becker, Executive Director, State and Territorial Air Pollution Program (continued...)

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>78</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>79</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,” 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>80</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 EPA’s final 2006 particulates NAAQS in its September 29, 2006, letter to Administrator Johnson.<sup>81</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>82</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 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>83</sup> (Italics in original.)

Petitions from several states and state agencies, as well as the American Lung Association, Environmental Defense, and the National Parks Conservation Association, challenged EPA’s decision not to strengthen the primary annual NAAQS standard for PM<sub>2.5</sub> (15µg/m<sup>3</sup>). Their challenges were based, in part, on the agency’s reliance primarily on long-term exposures and lack of consideration of vulnerable populations. The D.C. Circuit concluded that EPA failed

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(...continued)

Administrators/Association of Local Air Pollution Control Officials (STAPPA/ALAPCO), January 5, 2006.

<sup>78</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, at <http://epa.gov/pm/actions.html>.

<sup>79</sup> CRS communication with Mr. Frank Maisano, Media Contact for the Electric Reliability Coordinating Council, January 17, 2006.

<sup>80</sup> 71 *Federal Register* at 2651, January 17, 2006.

<sup>81</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). Italics in original.

<sup>82</sup> *Ibid.*

<sup>83</sup> *Ibid.*

adequately to explain why, in view of the risks posed by short-term exposures and the evidence of morbidity resulting from long-term exposures, its annual standard of  $15\mu\text{g}/\text{m}^3$  is “requisite to protect health [with] an adequate margin of safety,” including the health of vulnerable subpopulations.<sup>84</sup> In its February 24, 2009, decision, the court granted this part of the petition and remanded the standard to EPA for reconsideration, but did not vacate the standard. The court denied the same petitions with respect to review of the EPA analysis of long-term mortality studies, and its decision not to rely upon the quantitative risk assessment.

### **Potential Health Benefits of a More Stringent PM<sub>2.5</sub> Standard**

In its RIA, 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  $35\mu\text{g}/\text{m}^3$  daily (24-hour) standard and the unchanged  $15\mu\text{g}/\text{m}^3$  annual standard, and (2) an alternative standard similar to the least stringent of the CASAC recommendations that includes a tighter annual standard of  $14\mu\text{g}/\text{m}^3$  and the same  $35\mu\text{g}/\text{m}^3$  daily (24-hour) standard. As discussed previously, EPA presented a variety of benefits estimates based on several epidemiological studies,<sup>85</sup> the American Cancer Society (ACS) Study<sup>86</sup> used in previous RIAs, the Harvard Six-Cities Study,<sup>87</sup> and an expert elicitation study conducted by EPA in 2006.<sup>88</sup>

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 expert 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>89</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 5** below provides a comparison of EPA’s predicted reductions annually for the 2006 PM<sub>2.5</sub> NAAQS ( $15/35\mu\text{g}/\text{m}^3$ ) with a more stringent alternative analyzed ( $14/35\mu\text{g}/\text{m}^3$ ), based on premature mortality estimates derived from the ACS and Harvard Six-Cities studies, and morbidity derived from various epidemiology studies. As discussed previously, a key component of 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 PM<sub>2.5</sub> NAAQS.

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<sup>84</sup> See footnote 10.

<sup>85</sup> See footnote 57.

<sup>86</sup> See footnote 51.

<sup>87</sup> See footnote 52.

<sup>88</sup> See Chapter 5 of EPA’s October 6, 2006, RIA for more detail, <http://www.epa.gov/ttn/ecas/ria.html>.

<sup>89</sup> See Appendix in I *Visibility Benefits Methodology* of EPA’s October 6, 2006, RIA <http://www.epa.gov/ttn/ecas/ria.html>.

**Table 5. EPA's Predicted Reductions in Health Effects Annually in 2020 Associated with Meeting the 2006 PM<sub>2.5</sub> NAAQS and a More Stringent Alternative Annual Standard, Incremental to Attainment of the 1997 PM<sub>2.5</sub> Standards**

Adverse Health Effect	PM <sub>2.5</sub> NAAQS (15/35 µg/m <sup>3</sup> )	More Stringent Annual Std. (14/35 µg/m <sup>3</sup> )
	Predicted Reductions <sup>a</sup> (estimated mean)	
<b>Mortality</b>		
Premature deaths in individuals with preexisting cardiovascular and respiratory disease		
Based on American Cancer Society and Six Cities Studies	2,500 to 5,700 <sup>b</sup>	4,000 to 9,000 <sup>b</sup>
Based on Expert Elicitation Results (low and high mean)	1,200 to 13,000	2,200 to 24,000
<b>Morbidity</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 presented in Chapter 5 of EPA's Agency Regulatory Impact Analysis of the 2006 National Ambient Air Quality Standards for Fine Particle Pollution (PM<sub>2.5</sub>) October 6, 2006, and available on EPA's website at <http://www.epa.gov/ttn/ecas/ria.html>. Estimates are as rounded by EPA.

- a. For consistency with the emissions and benefits modeling, 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-Cities Study, respectively.

As discussed earlier, EPA also used expert elicitation to characterize the concentration response function for the relationship between fine PM and premature mortality. The estimates EPA derived using this approach 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 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.

EPA assessments<sup>90</sup> in support of the June 2012 proposal to revise the particulates NAAQS have further stimulated the debate and generated considerable comment with regard to further tightening of the annual  $\text{PM}_{2.5}$  standards. The assessments include findings that indicate that more stringent annual *and* 24-hour  $\text{PM}_{2.5}$  standards could potentially reduce mortality risk from long-term exposure, as well as provide protection from high peak concentrations. In its review of EPA's draft assessments, members of the CASAC supported the EPA staff's conclusion that "currently available information clearly calls into question the adequacy of the current standards" and that the staff's recommendation for consideration of a stricter  $\text{PM}_{2.5}$  standard are "supported by the epidemiological and toxicological evidence, as well as by other risk and air quality information" compiled by EPA in related scientific assessments.<sup>91</sup>

## **Coarse Particulate ( $\text{PM}_{10}$ ) Primary Standards**

### **Particle Size Indicator**

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  $\text{PM}_{10}$  measurements to support the annual standard, and that there was a specific need to address particles ranging in size from 2.5 to 10 micrometers.<sup>92</sup> EPA's January 17, 2006, proposal would have replaced the existing particle size indicator of 10 micrometers ( $\text{PM}_{10}$ ) with an indicator range of 10 to 2.5 micrometers ( $\text{PM}_{10-2.5}$ ), referred to as inhalable (or thoracic) coarse particles, and setting a  $\text{PM}_{10-2.5}$  *daily* standard of 70  $\mu\text{g}/\text{m}^3$  rather than the current  $\text{PM}_{10}$  daily standard of 150  $\mu\text{g}/\text{m}^3$ . At the time of its proposal, 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, EPA decided to maintain the  $\text{PM}_{10}$  indicator, citing the limited body of evidence on health effects associated with thoracic coarse particles from studies that use  $\text{PM}_{10-2.5}$  measurements. The agency also determined that the only studies of clear quantitative relevance to health effects most likely associated with thoracic coarse particles used  $\text{PM}_{10}$  measurements. The 2006 particulates NAAQS retained the  $\text{PM}_{10}$  indicator and the *daily* (24-hour) standard of 150  $\mu\text{g}/\text{m}^3$ .

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<sup>90</sup> See footnote 15 and footnote 16.

<sup>91</sup> See footnote 17.

<sup>92</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>.



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.

Included in the October 17, 2006, *Federal Register* Notice, EPA promulgated 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. EPA anticipated that the new FRM should provide a basis for gathering scientific data to support future reviews of the particulates NAAQS.<sup>93</sup>

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>94</sup> directing EPA to ensure that the standard did not duplicate the regulation of fine particles. The agency contended 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>95</sup>

In its February 24, 2009, decision,<sup>96</sup> the D.C. Circuit denied petitions by industry and agricultural groups for review of the primary daily standard for PM<sub>10</sub>. In their petition, the American Farm Bureau Federation, the National Pork Producers Council, the National Cattlemen’s Beef Association, and the Agricultural Retailers Association challenged EPA’s decision to retain a daily standard for PM<sub>10</sub> including that in nonurban areas. They also challenged the decision to retain the indicator particle size indicator of 10 micrometers (PM<sub>10</sub>), and the primary daily standard of 150 µg/m<sup>3</sup>. The court denied the petitions, finding EPA’s decision and explanation on all three issues to be reasonable.

Environmental groups petitioned for review of EPA’s decision to revoke the primary annual standard for PM<sub>10</sub>. The D.C. Circuit denied the petition finding EPA’s decision reasonable because the latest scientific evidence, as shown in the Criteria Document and the Staff Paper, do not indicate long-term exposure to coarse particles poses a health risk.

## **Rural PM<sub>10</sub> Sources**

In addition to the changes to the coarse particulates indicator, EPA had proposed focusing the PM<sub>10-2.5</sub> standard only 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, EPA proposed revoking the current 24-hour PM<sub>10</sub>

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<sup>93</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>94</sup> 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 EPA (*American Trucking Associations v. EPA*, 175 F.3d 1027, 1054-55 (D.C. Cir. 1999)).

<sup>95</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>96</sup> See footnote 10.

standards, except in areas that have (1) monitors indicating violation, 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>97</sup>

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 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 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>98</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>99</sup> In the final rule, 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).

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, 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, 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>100</sup> 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. EPA published a final rule amending its national air quality monitoring requirements in a separate Notice in the October 17,

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<sup>97</sup> 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).

<sup>98</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>99</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>100</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>.

2006, *Federal Register*.<sup>101</sup> Under the revised monitoring strategy, EPA and the states are adding measurement of “inhalable coarse particles,” (i.e. PM<sub>10-2.5</sub>) at the 75 multi-pollutant monitoring sites added per the rule. Many of the existing monitors across the country sampling levels of PM<sub>10</sub> remained in place, especially in areas that exceed the 24-hour standard. However, monitors in some states that are redundant or are measuring air quality concentrations well below the level of the 24-hour PM<sub>10</sub> standard have been shut down.

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>102</sup> remained 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. In its February 24, 2009, decision,<sup>103</sup> the D.C. Circuit found that EPA provided reasonable explanation for its decisions not to set separate urban and nonurban PM<sub>10</sub>, rejecting the petitioners challenge to the level of PM<sub>10</sub> standard.<sup>104</sup>

Because the PM<sub>10</sub> standard was not strengthened no new areas, including rural or non-urban areas, will be designated as nonattainment for PM<sub>10</sub>. To the contrary, some counties previously designated nonattainment have been determined by EPA to be in attainment since the 2006 revisions to the particulates NAAQS. 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. The map in **Figure 1** below shows the status of nonattainment of the PM<sub>10</sub> NAAQS as of March 8, 2013.

As depicted on the map, the majority of the United States is in attainment of the PM<sub>10</sub> NAAQS (including Hawaii, which is not shown on the map). Since 1990, EPA designated 88 areas as nonattainment with the PM<sub>10</sub> NAAQS.<sup>105</sup> As of March 8, 2013, 43 of the 88 PM<sub>10</sub> areas previously designated nonattainment have been redesignated to attainment. Of the remaining 45 nonattainment areas (38 counties with a population of about 25 million), 28 areas are currently not meeting the PM<sub>10</sub> standard or have insufficient data to determine attainment based on 2009-2011 air quality data (most recent three years available). The remaining 17 counties are meeting the PM<sub>10</sub> NAAQS but have not yet been formally redesignated to attainment.<sup>106</sup>

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<sup>101</sup> 71 *Federal Register* 61236-61328, October 17, 2006, at <http://epa.gov/pm/actions.html>.

<sup>102</sup> Some members of the House Committee on Agriculture expressed their concerns with EPA’s final actions with regard to the exemptions at a September 28, 2006, hearing regarding EPA’s pesticide programs. House Committee on Agriculture, Subcommittee on Conservation, Credit, Rural Development, and Research, *Review of the Environmental Protection Agency’s Pesticide Program*, September 28, 2006.

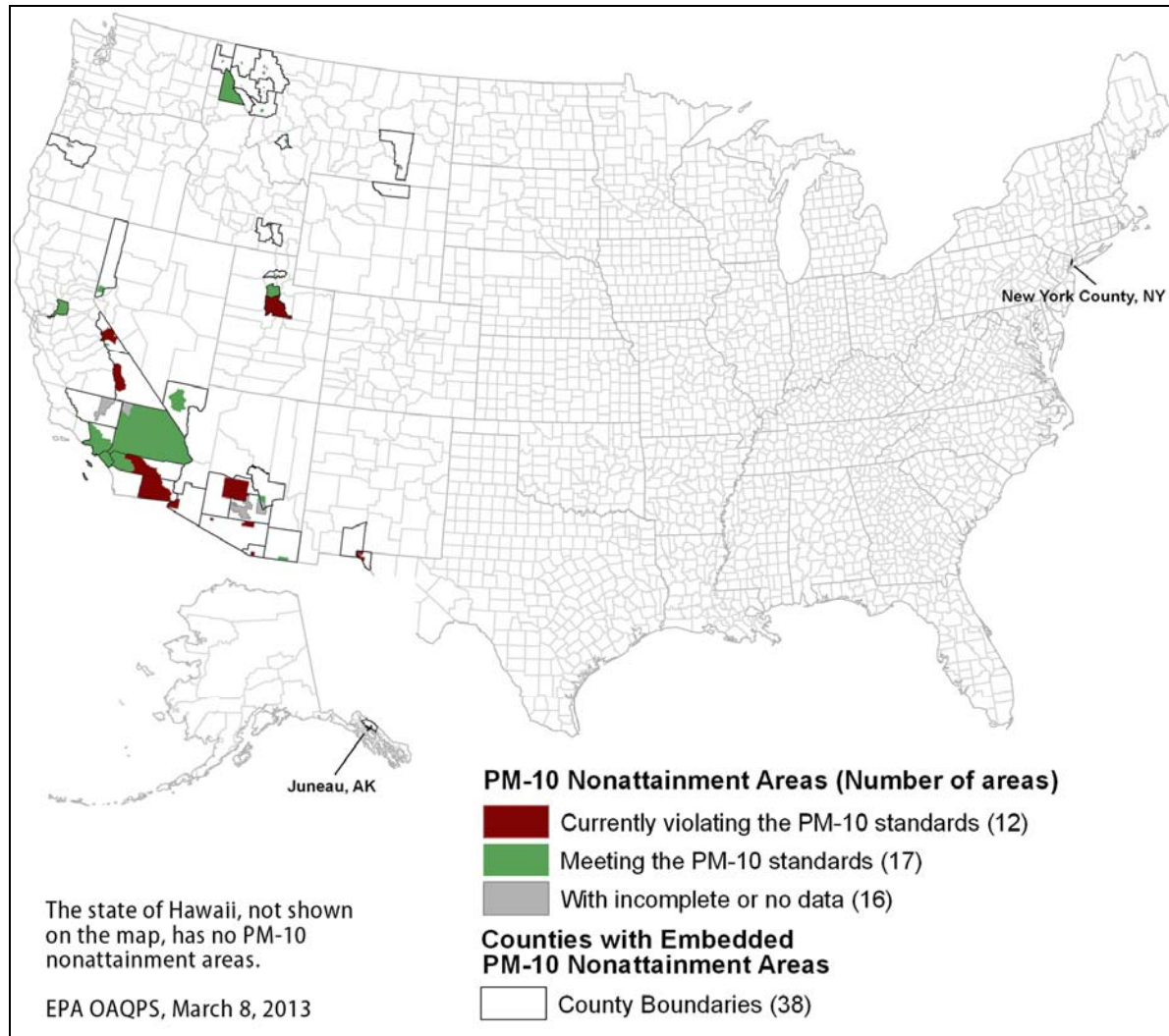
<sup>103</sup> See footnote 10.

<sup>104</sup> Part IV of the D.C. Circuit’s February 24, 2009, decision. The court also did not reach the question raised by the amicus National Association of Home Builders that EPA does not have the authority to set different NAAQS for urban areas or for different emissions sources.

<sup>105</sup> See EPA’s PM<sub>10</sub> designations at <http://www.epa.gov/air/oaqps/greenbk/pindex.html>.

<sup>106</sup> Information provided directly to CRS by the EPA Office of Air Quality Planning and Standards (OAQPS).

**Figure I. Status of Current PM<sub>10</sub> Nonattainment Areas, Based on 2009-2011 Air Quality Data**  
 (many areas are indicated on the map as only portions of counties)



**Source:** Updated map provided directly to CRS by EPA’s Office of Air Quality Planning and Standards, March 2013. Nonattainment area status as identified on the map is based on 2009-2011 air quality data, the most currently available three-year dataset at the time the determinations were made. Areas not highlighted on the map are designated attainment/unclassifiable. There are no PM<sub>10</sub> nonattainment areas in Hawaii, which was not included on the map as provided by EPA.

The agricultural community and some Members of Congress have expressed concerns with EPA's reviews of the PM NAAQS as they pertain particularly to the PM<sub>10</sub> standards,<sup>107</sup> and have weighed in on EPA's review and June 2012 proposal.<sup>108</sup> Thoracic coarse particles (PM<sub>10</sub>) are generally emitted as a result of mechanical processes that crush or grind larger particles or the resuspension of dusts.<sup>109</sup> While certain agricultural operations can contribute to emission of PM<sub>10</sub>, sometimes referred to as "farm dust," there are many sources of thoracic coarse particles—for example, unpaved and paved roads, traffic-related emissions such as tire and brake lining materials, direct emissions from industrial operations, construction and demolition activities, and mining operations.

Although the PM<sub>10</sub> standard would be unchanged in EPA's June 2012 proposal,<sup>110</sup> some stakeholders and some Members of Congress remain skeptical that the final revised NAAQS could be changed from the proposal. Congress continues to consider legislation that would delay EPA regulatory action with respect to revising the PM<sub>10</sub> NAAQS,<sup>111</sup> including the House-passed Farm Dust Regulation Prevention Act of 2011 (H.R. 1633), which awaits action in the Senate. A general provision was also included in FY2012 House-reported EPA appropriations language (H.R. 2584, Title IV, Section 454)<sup>112</sup> that would have restricted the use of FY2012 appropriations "... to modify the national primary ambient air quality standard or the national secondary ambient air quality standard applicable to coarse particulate matter (generally referred to as 'PM<sub>10</sub>')."<sup>113</sup> No comparable provision was retained in the Consolidated Appropriations Act, 2012 (P.L. 112-74), enacted December 23, 2011, which ultimately included EPA's FY2012 appropriation.

EPA has noted that atmospheric science and monitoring information indicate that exposures to PM<sub>10</sub> tend to be higher in urban areas than in nearby rural locations.<sup>114</sup> Urban or industrial ambient mixes of PM<sub>10</sub> dominated by high-density vehicular, industrial, and construction emissions have been the primary concern with respect to reducing the negative health effects. EPA continues to research the link between coarse particle composition and toxicity, including the toxicity of urban versus rural particles.

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<sup>107</sup> There was some concern regarding designations in rural areas for the 2006 PM<sub>2.5</sub> NAAQS. The designated nonattainment areas for the PM<sub>2.5</sub> are primarily concentrated in and around highly populated metropolitan areas.

<sup>108</sup> See CRS Report R41622, *Environmental Regulation and Agriculture*, coordinated by Megan Stubbs.

<sup>109</sup> U.S. Environmental Protection Agency, "National Ambient Air Quality Standards for Particulate Matter," 71 *Federal Register* 61146, October 17, 2006.

<sup>110</sup> See U.S. EPA, National Ambient Air Quality Standards for Particulate Matter, Proposed Rule, 77 *Federal Register* 38889-39055, June 29, 2012, EPA's Fact Sheet and other related documents regarding the proposal at <http://www.epa.gov/pm/actions.html#jun12>.

<sup>111</sup> For example, U.S. Congress, House Committee on Energy and Commerce, Subcommittee on Energy and Power, *Farm Dust Regulation Prevention Act of 2011*, hearing on H.R. 1633, 112<sup>th</sup> Cong., 1<sup>st</sup> sess., October 25, 2011, <http://energycommerce.house.gov/hearings/hearingdetail.aspx?NewsID=8999>.

<sup>112</sup> The Department of the Interior, Environment, and Related Agencies Appropriations Act, 2012 (H.R. 2584, Title IV Section 454) as reported by the House Committee on Appropriations on July 19, 2011. From July 25, 2011, to July 28, 2011, the House considered H.R. 2584 as reported July 19, 2011, but the House floor debate was suspended.

<sup>113</sup> See CRS Report R42332, *Environmental Protection Agency (EPA) FY2012 Appropriations*, by Robert Esworthy, and CRS Report R41979, *Environmental Protection Agency (EPA) FY2012 Appropriations: Overview of Provisions in H.R. 2584 as Reported*, by Robert Esworthy.

<sup>114</sup> U.S. EPA, "Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information," p. 2-36, OAQPS Staff Paper EPA-452/R-05-005a, December 2005, [http://www.epa.gov/ttn/naaqs/standards/pm/data/pmstaffpaper\\_20051221.pdf](http://www.epa.gov/ttn/naaqs/standards/pm/data/pmstaffpaper_20051221.pdf).

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

The EPA January 2006 proposal, and the final October 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 ultimately 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 EPA had proposed.

In its February 24, 2009, decision,<sup>115</sup> the D.C. Circuit granted in full a petition from environmental groups challenging EPA's decision to set the PM<sub>2.5</sub> secondary NAAQS for protecting public welfare at the same level as the primary NAAQS for protecting public health. The decision remanded the PM<sub>2.5</sub> secondary NAAQS to EPA for reconsideration. The court found that EPA unreasonably concluded that the NAAQS are adequate to protect public welfare from adverse effects on visibility.

In assessments in support of the next round of the agency's periodic review of the particulate NAAQS referenced earlier in this report, EPA staff recommends revising the secondary standards for PM<sub>2.5</sub> based on preliminary review of data.<sup>116</sup>

In the EPA June 2012 proposed revisions to the PM NAAQS, secondary standards that provide protection against welfare (non-health) effects, such as ecological effects and material deterioration, would be identical to the primary standards the same as in 2006, but the proposal included two options for a 24-hour PM<sub>2.5</sub> standard to improve visibility.<sup>117</sup>

## **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 studies) 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.

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<sup>115</sup> See footnote 10.

<sup>116</sup> See assessments referenced in footnote 15 and footnote 16. See also U.S. EPA, *Particulate Matter Urban-Focused Visibility Assessment - Second External Review Draft* (EPA 452/P-10-002, January 2010), available at [http://www.epa.gov/ttn/naaqs/standards/pm/s\\_pm\\_2007\\_risk.html](http://www.epa.gov/ttn/naaqs/standards/pm/s_pm_2007_risk.html).

<sup>117</sup> See CRS Report R42671, *Air Quality: EPA's 2012 Proposed Changes to the Particulate Matter (PM) Standard*, by Robert Esworthy.

At the time of the proposal, 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.<sup>118</sup> With the release of its final 2006 particulates NAAQS, 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>119</sup>

## Conclusions

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’s 2006 tightening of the fine particulates (PM<sub>2.5</sub>) NAAQS, additional areas were classified as nonattainment and needed to implement new controls on particulate matter in order to comply. States and local governments were 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 expected to result in fewer adverse health effects for the general population and particularly sensitive populations, such as children, asthmatics, and the elderly, with the estimated value of these benefits significantly outweighing the costs.

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 February 2009 decision regarding challenges to the 2006 PM NAAQS, delays in implementing the 2006 PM<sub>2.5</sub> NAAQS resulting from the Administration’s review of the final designations, and EPA’s next round of periodic review of the particulate NAAQS and subsequent June 2012 proposal to revise the standards, have prompted renewed interest in several of the issues associated with the promulgation of the 2006 PM NAAQS discussed throughout this report.

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<sup>118</sup> 71 *Federal Register* 2625, January 17, 2006, <http://epa.gov/pm/actions.html>.

<sup>119</sup> 71 *Federal Register* 61143-61233, October 17, 2006, <http://epa.gov/pm/actions.html>.