

# Backgrounder: EPA Review of the National Ambient Air Quality Standards for Sulfur Dioxide



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## ***In brief***

Sulfur dioxide (SO<sub>2</sub>) is a gaseous air pollutant emitted by many sources outdoors. The U.S. Environmental Protection Agency (EPA) is reviewing the national air quality standards for sulfur oxides, in particular, sulfur dioxide. The National Ambient Air Quality Standards (NAAQS) define what constitutes outdoor air that is safe to breathe and set enforceable goals for outdoor air pollution cleanup programs.

EPA has not updated the air quality standards for sulfur dioxide (SO<sub>2</sub>) since they were first set in 1971. The research over the past 35 years shows that the current standard fails to protect public health and that a short-term standard must be added to protect the health of people who have lung diseases like asthma, children and older adults. EPA is under a court order to propose revisions to the standards by November 16, 2009.<sup>1</sup>

## ***What is sulfur dioxide?***

Sulfur dioxide (SO<sub>2</sub>) is a gaseous air pollutant composed of sulfur and oxygen. SO<sub>2</sub> forms when sulfur-containing fuel such as coal, oil, or diesel is burned. Sulfur dioxide also converts in the atmosphere to sulfates, a prime component of fine particle pollution in the eastern U.S.

## ***What are the sources of sulfur dioxide emissions?***

Each year manmade sources in the U.S. emit 15 million tons of sulfur dioxide. The largest sources of sulfur dioxide emissions are electricity generation, industrial boilers, and other industrial processes such as petroleum refining and metal processing. Diesel engines are another major source, including old buses and trucks, locomotives, ships, and off-road diesel equipment.

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<sup>1</sup> *Center for Biological Diversity et al. v. Johnson* (D.D.C) Civ. No. 05-01814.

### ***Where and when do high SO<sub>2</sub> concentrations occur?***

Coal-fired power plants remain one of the biggest sources of sulfur dioxide in the U.S., particularly in the eastern states. The plume from a coal-fired power plant touches down at ground level (downwash) during high wind conditions or is trapped during atmospheric inversions, leaving high concentrations of SO<sub>2</sub> in the community near the plant. High concentrations may also occur during start-up, shutdown, upsets, and malfunctions of pollution control equipment. Ports, smelters, and other concentrated sources of sulfur dioxide also cause high concentrations of emissions nearby. SO<sub>2</sub> control programs that are based on trading schemes (such as the acid rain control program) do not protect against localized hotspots in the vicinity of power plants or other major sources.

### ***What are the health effects of sulfur dioxide air pollution?***

Sulfur dioxide causes a range of harmful effects on the lungs, as the EPA's most recent review of the science concluded<sup>2</sup>:

- Wheezing, shortness of breath and chest tightness and other problems, especially during exercise or physical activity.
- Continued exposure at high levels increases respiratory symptoms and reduces the ability of the lungs to function.
- Short exposures to peak levels of SO<sub>2</sub> in the air can make it difficult for people with asthma to breathe when they are active outdoors.
  - Rapid breathing during exercise helps SO<sub>2</sub> reach the lower respiratory tract, as does breathing through the mouth.
- Increased risk of hospital admissions or emergency room visits, especially among children, older adults and people with asthma.

### ***What evidence is there of effects below the current standards?***

EPA found evidence of such harm and summarized the findings in the Integrated Science Assessment, following extensive review by the Clean Air Scientific Advisory Committee. That assessment concludes:

“Collectively, the human clinical, epidemiologic, and animal toxicological data are sufficient to conclude that there is a causal relationship between respiratory morbidity and short-term exposure to

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<sup>2</sup> U.S. Environmental Protection Agency. Risk and Exposure Assessment to Support the Review of the SO<sub>2</sub> Primary National Ambient Air Quality Standards: Final Report. EPA-452/R-09-007, August 2009. Hereinafter REA.

SO<sub>2</sub>. Observed associations between SO<sub>2</sub> exposure and an array of respiratory outcomes, including respiratory symptoms, lung function, airway inflammation, AHR [airway hyperreactivity], and ED [emergency department] visits and hospitalizations from the human clinical, animal toxicological, and epidemiologic studies, in combination, provide clear and convincing evidence of consistency, specificity, temporal and biologic gradients, biological plausibility, and coherence.”<sup>3</sup>

- **Clinical studies** provide clear evidence for harm to people with asthma who breathed high levels of SO<sub>2</sub> while they were exercising. These studies found that these individuals suffered a decline in lung function and an increase in respiratory symptoms, even after only a 15-minute exposure of 200 ppb and greater.<sup>4</sup> People with asthma suffered increased airway resistance after several minutes of breathing SO<sub>2</sub> at concentrations of 100 ppb under conditions of exercise, when exposed to SO<sub>2</sub> via a facemask, which approximates mouth-breathing, such as occurs during exercise or with respiratory infections.<sup>5</sup>
- **Epidemiological studies** provide convincing evidence of increased respiratory symptoms in children at far lower concentrations than the clinical chamber studies. The community health studies find effects at current ambient concentrations, well below the level of the current 24-hour current NAAQS of 140 ppb.
  - A large multi-city study linked previous day SO<sub>2</sub> concentrations with morning respiratory symptoms in 8 urban areas where median 3-hour average SO<sub>2</sub> levels ranged from 17 ppb to 37 ppb.<sup>6</sup>
  - Inner city children with asthma suffer from declines in lung function following exposure to higher daily concentrations of sulfur dioxide.<sup>7</sup>

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<sup>3</sup> U.S. EPA. Integrated Science Assessment for Sulfur Oxides - Health Criteria. ISA: EPA/600/R-08/047F, September 2008, p. 5-10. Hereinafter ISA.

<sup>4</sup> ISA, p. 3-4.

<sup>5</sup> Sheppard D, Saisho A, Nadel JA, Boushey HA. Exercise increases sulfur dioxide-induced bronchoconstriction in asthmatic subjects. *Am Rev Respir Dis* 1981; 123: 486-491.

<sup>6</sup> Mortimer KM, Neas LM, Dockery DW, Redline S, Tager IB. The effect of air pollution on inner-city children with asthma. *Eur Respir J* 2002; 19: 699-705; Schwartz J, Dockery DW, Neas LM, Wypij D, Ware JH, Spengler JD, Koutrakis P, Speizer FE, Ferris BG Jr. Acute effects of summer air pollution on respiratory symptom reporting in children. *Am J Respir Crit Care Med* 1994; 150: 1234-1242.

<sup>7</sup> O'Connor GT, Neas L, Vaughn B, Katttan M, Mitchell H, Crain EF, Evans III R, Gruchalla R, Morgan W, Stout J, Adams GK, Lippmann M. Acute respiratory health effects of air pollution on children with asthma in US inner cities. *J Allergy Clin Immunol* 2008; Article in press doi: 10.1016/j.jaci.2008.02.020.

- Present day concentrations of SO<sub>2</sub> are also implicated in increased emergency department visits and hospitalizations for respiratory causes among children and older adults.<sup>8</sup>
- A study in Bronx, New York found that asthma hospitalizations in children climbed as hourly sulfur dioxide concentrations increased. Hospitalizations began to rise at hourly concentrations greater than 9 ppb, with a sharp increase at concentrations greater than 40 ppb.<sup>9</sup>
- Reducing SO<sub>2</sub> levels are linked to an immediate gain in life expectancy, according to evidence from a study that examined the health impact of drops in sulfur dioxide.<sup>10</sup>

### ***Who is at greatest risk?***

- Children
- Adults aged 65 and older
- People with heart or lung disease
- People with asthma who are active outdoors

These include millions of people. For example, there are an estimated 22.9 million people, including 6.7 million children with asthma in the U.S.<sup>11</sup>

### ***What's at stake?***

Millions of Americans are unprotected by the current standards. Kids with asthma should be able to play outside whenever and wherever they can, knowing that the air quality standards are set to protect them. Adults with asthma should be free to work outdoors or participate in outdoor recreation without fear that air pollution concentrations will trigger asthma exacerbations.

A stringent short-term SO<sub>2</sub> standard would trigger reductions in millions of tons per year in sulfur dioxide emissions, lowering health risks for millions of people with asthma.

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<sup>8</sup> ISA, Table 5-5. Effects of short-term SO<sub>2</sub> exposure on emergency department visits and hospital admissions for respiratory outcomes.

<sup>9</sup> Lin S, Hwang SA, Pantea C, Kielb C, Fitzgerald E. Childhood asthma hospitalizations and ambient air sulfur dioxide concentrations in Bronx County, New York. *Arch Environ Health* 2004; 59: 266-275.

<sup>10</sup> Hedley AJ, Wong CM, Thach TQ, Ma S, Lam TH, Anderson HR. Cardiorespiratory and all-cause mortality after restrictions on sulphur content of fuel in Hong Kong: an intervention study. *Lancet* 2002; 360: 1646-1652.

<sup>11</sup> Centers for Disease Control and Prevention. National Center for Health Statistics. National Health Interview Survey Raw Data, 2007. Analysis performed by American Lung Association Research and Program Services using SPSS and SUDAAN software.

### ***What are the current U.S. standards?***

The national ambient air quality standards (NAAQS) for health for SO<sub>2</sub> are:

- Annual average standard: 30 ppb
- 24-hour standard: 140 ppb (not to be exceeded more than once per year)

Other standard-setting bodies have set much tighter standards than the current EPA standards.

- The California Air Resources Board has established state air quality standards for sulfur dioxide that are more protective than the federal standards:
  - 24-hour standard: 40 ppb (not to be exceeded)
  - 1-hour standard: 250 ppb (not to be exceeded)
- The World Health Organization has recommended SO<sub>2</sub> standards as follows:
  - 24-hour standard: 7 ppb
  - 10-minute standard: 2 ppb

### ***What standards did the Clean Air Scientific Advisory Committee (CASAC) recommend?***

EPA's independent scientific advisory panel recommended establishment of a short-term standard for SO<sub>2</sub>, and generally supported a one-hour standard as protective of public health. The CASAC panel endorsed a range of 50 to 150 ppb for a 1-hour standard, based on its review of a draft Risk and Exposure Assessment document.<sup>12</sup>

### ***What standards did EPA staff scientists recommend?***

EPA staff scientists concluded that the health evidence, air quality, exposure and risk information most strongly support consideration of a 1-hour standard in the range of 50-75 ppb, 99<sup>th</sup> percentile, however, levels up to 150 ppb could be considered if significant weight were placed on uncertainties. The staff suggested that if a standard were adopted at the upper end of the range, that the current

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<sup>12</sup> Letter from Dr. Jonathan M. Samet, Chair, Clean Air Scientific Advisory Committee to The Honorable Lisa P. Jackson, Administrator, U.S. Environmental Protection Agency, "Clean Air Scientific Advisory Committee's (CASAC) Review of EPA's Risk and Exposure Assessment (REA) to Support the Review of the SO<sub>2</sub> Primary National Air Quality Standards: Second Draft." EPA-CASAC-09-007, May 18, 2009.

daily and annual average standards should be retained, but that they could be revoked if a standard were adopted at the lower end of the range.<sup>13</sup>

***What changes does the American Lung Association support?***

The Lung Association had advocated for establishment of a 5-minute standard, but believes that a 1-hour standard would be a major step forward toward protecting the health of the public. A stringent short-term standard is needed to protect the health of people with asthma. Therefore, the Lung Association supports an hourly standard at the lower end of the range -- 50 ppb, 99<sup>th</sup> percentile. The Lung Association opposes revocation of the current daily and annual average standards.

***What is the schedule for the review?***

EPA is on a court ordered schedule for the review of the SO<sub>2</sub> standard. The key milestones for the review of the health standard are:

- November 16, 2009: Proposed rule issued for public comment
- Approx. January 2010: Public hearings on proposed rule
- June 2, 2010: Final rule issued

***How can the public weigh in?***

The public can testify at the public hearings and write letters in support of tighter standards that protect the health of the public, especially the health of children with asthma.

Written comments may be submitted online at [www.regulations.gov](http://www.regulations.gov), Docket No.: EPA-HQ-OAR-2007-0352.

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<sup>13</sup> REA.