

Proposal to Revise the Primary National Ambient Air Quality Standards for Sulfur Dioxide (SO₂)



General Overview

Office of Air and Radiation
Office of Air Quality Planning and Standards
November 2009

Overview

- On November 16, 2009, EPA proposed to strengthen the primary National Ambient Air Quality Standards (NAAQS) for sulfur dioxide (SO₂) to improve public health protection
- Specifically, EPA has proposed to replace the existing annual and 24-hour primary SO₂ standards with a new 1-hour SO₂ standard set at a level between 50-100 ppb to better protect public health by reducing people's exposure to high short-term concentrations of SO₂
- EPA's proposal is consistent with the recommendations of the Clean Air Scientific Advisory Committee
- This proposal does not cover the secondary SO₂ standard, which EPA is reviewing separately as part of a joint review of the welfare effects associated with deposition of SO₂ and NO₂ (to be completed in 2012)
- Additional information:
 - A public hearing will be held on the proposed rule in Atlanta on January 5, 2010
 - The final rule will be signed no later than June 2, 2010
 - For more information, go to <http://www.epa.gov/air/urbanair/so2>

Regulating Sulfur Dioxide Pollution

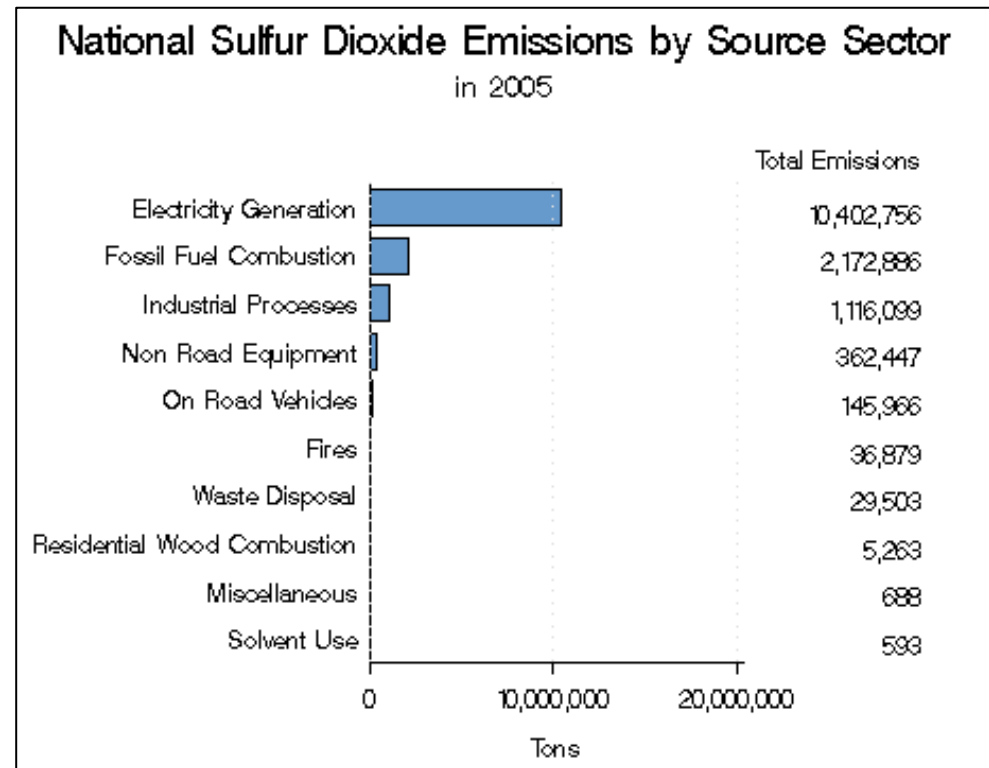
- The Clean Air Act requires EPA to set two types of national ambient air quality standards (NAAQS) for ‘criteria’ air pollutants
 - *Primary standards* to protect public health with an adequate margin of safety
 - *Secondary standards* to protect public welfare and the environment (including effects on soil, water, visibility, wildlife, crops, vegetation, national monuments and buildings)
- EPA has set NAAQS for 6 common air pollutants:
 - Nitrogen dioxide
 - Carbon monoxide
 - Lead
 - Particulate matter
 - Ground-level ozone (smog)
 - **Sulfur dioxide**
- The law requires EPA to review the scientific information and the standards for each pollutant every five years, and to obtain advice from the Clean Air Scientific Advisory Committee (CASAC) on each review
- Different considerations apply to setting NAAQS than to achieving them
 - **Setting NAAQS:** scientific information on health and/or environmental effects (not cost)
 - **Achieving NAAQS:** account for cost, technical feasibility, time needed to attain

SO₂-Related Health Effects

- Exposure to SO₂ is associated with an array of adverse respiratory effects, including:
 - Narrowing of the airways leading to difficulty breathing (bronchoconstriction)
 - Increased asthma symptoms, especially during exercise
 - Emergency-department visits and hospital admissions for respiratory illnesses
- Children, the elderly and asthmatics are among the most at-risk populations

Sources of SO₂ Pollution

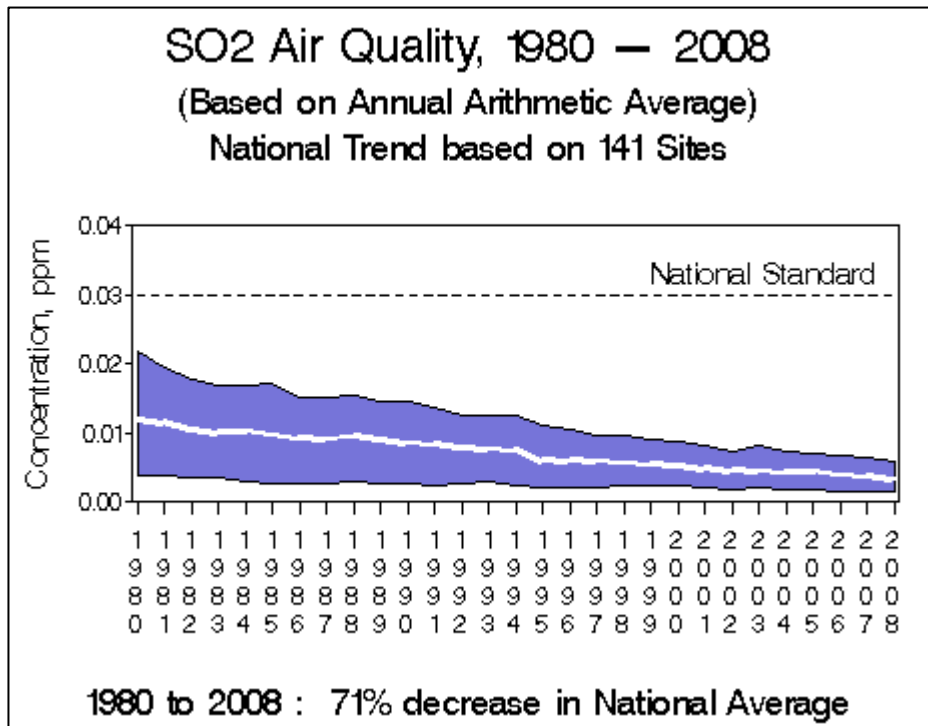
- Fossil fuel combustion at power plants (66%) and other industrial facilities (29%) are the main sources of SO₂ emissions
- Other sources include industrial processes such as extracting metal from ore, and the burning of high sulfur fuels by locomotives, large ships, and non-road equipment



Sulfur Oxides Also Contribute to the Formation of Fine Particle Pollution

- SO_2 is generally co-emitted with other oxides of sulfur (SO_x), which react with other compounds in the atmosphere to form fine particles ($\text{PM}_{2.5}$)
 - $\text{PM}_{2.5}$ penetrates deeply into sensitive parts of the lungs, where it can cause or worsen respiratory disease, such as emphysema and bronchitis, and can aggravate existing heart disease, leading to increased hospital admissions and premature death
- EPA has established a NAAQS for $\text{PM}_{2.5}$ to protect public health

Reducing Overall SO₂ Pollution in the U.S.



Note: These trends may not account for short-term levels in a given location

- Existing rules and programs have resulted in substantial reductions in SO₂ over the past 30 years
 - Acid Rain Program
 - Tier 2 Tailpipe and Fuel standards
 - Clean Air Interstate Rule
 - Diesel fuel sulfur standards for on-highway diesel engines (light-duty and heavy-duty) and nonroad diesel engines
 - Standards for marine diesel engines and fuels

EPA's Current Primary SO₂ Standards

- The current primary SO₂ standards were established in 1971, and include a 24-hour standard at a level of 140 parts per billion (ppb) and an annual average standard of 30 ppb
 - In the last review of the SO₂ standards, completed in 1996, EPA considered, but did not set, a five-minute primary SO₂ NAAQS to protect asthmatics at elevated ventilation rates from bronchoconstriction and other respiratory symptoms associated with 5-10 minute peak concentrations of SO₂
 - In 1998, the U.S. Court of Appeals for the District of Columbia Circuit remanded this decision back to EPA for further explanation
 - EPA's national-scale exposure analysis had estimated 68,000-166,000 asthmatics could be exposed annually to 5-minute peaks of concern; Court found that in deciding not to revise the NAAQS, EPA had not provided a reasoned explanation for its conclusion that 5-minute peaks of SO₂ do not pose a public health problem even though those peaks would likely cause adverse health impacts in a subset of asthmatics

New Health Evidence in this Review

- New scientific studies provide stronger evidence of link between short-term SO₂ exposures, ranging from 5 minutes to 24 hours, and adverse respiratory outcomes
- Controlled human exposure studies of exercising asthmatics indicate that 5-10 minute exposures are clearly associated with respiratory responses judged to be adverse
- Epidemiologic studies show an association between short-term SO₂ exposure and increased visits to emergency departments and hospital admissions for respiratory illnesses, particularly in at-risk populations including children, the elderly, and asthmatics
 - Over 50 U.S. and international studies, almost all new, since last review
 - Most conducted in locations with SO₂ concentrations below current standards, including a few large multi-city studies
 - Studies show effects generally occurring independently of the presence of co-pollutants, including particulate matter

CASAC Recommendations

- In a letter dated May 18, 2009, CASAC stated that the current standards are not adequate to protect public health and recommended a new 1-hour standard; supported consideration of range from 50 ppb to an upper limit of 150 ppb
 - 1-hour averaging time can protect against peak 5-minute exposures
 - Rationale “clearly sufficient” for range of levels beginning at 50 ppb
 - CASAC recognized that “An upper limit of 150 ppb ... could be justified under some interpretations of weight of evidence, uncertainties, and policy choices regarding margin of safety,” but provided no specific support for this upper limit
 - Noted importance of weighing uncertainties in considering an adequate margin of safety (e.g., severe asthmatics likely at greater risk)

- For a 1-hour standard within this range, CASAC stated that:
 - Annual standard no longer needed
 - The results of EPA’s risk and exposure analysis form appropriate basis for deciding whether to retain or revoke 24-hour standard, depending on the level proposed for the 1-hour standard

Proposed SO₂ Primary Standard

- EPA is proposing to replace the current annual and 24-hour SO₂ primary standards with a new 1-hour SO₂ standard set at a level between 50-100 ppb
 - A 1-hour standard would better protect public health by reducing people's exposure to high short-term (five-minute to 24-hour) concentrations of SO₂
 - EPA is proposing to revoke both the annual and 24-hour SO₂ standards because current evidence indicates that they would not offer any protection beyond that achieved by a 1-hour standard within the proposed range of 50-100 ppb
 - EPA is proposing two different options for the form of the standard, which is used to determine whether the ambient concentration measured at each monitor meets the standard: the 3-year average of either the 99th percentile concentration or the 4th highest daily maximum concentration in a year
- EPA is taking comment on alternative levels for the 1-hour standard up to 150 ppb. However, at this level, the Agency would retain the existing 24-hour primary standard and revoke only the annual standard

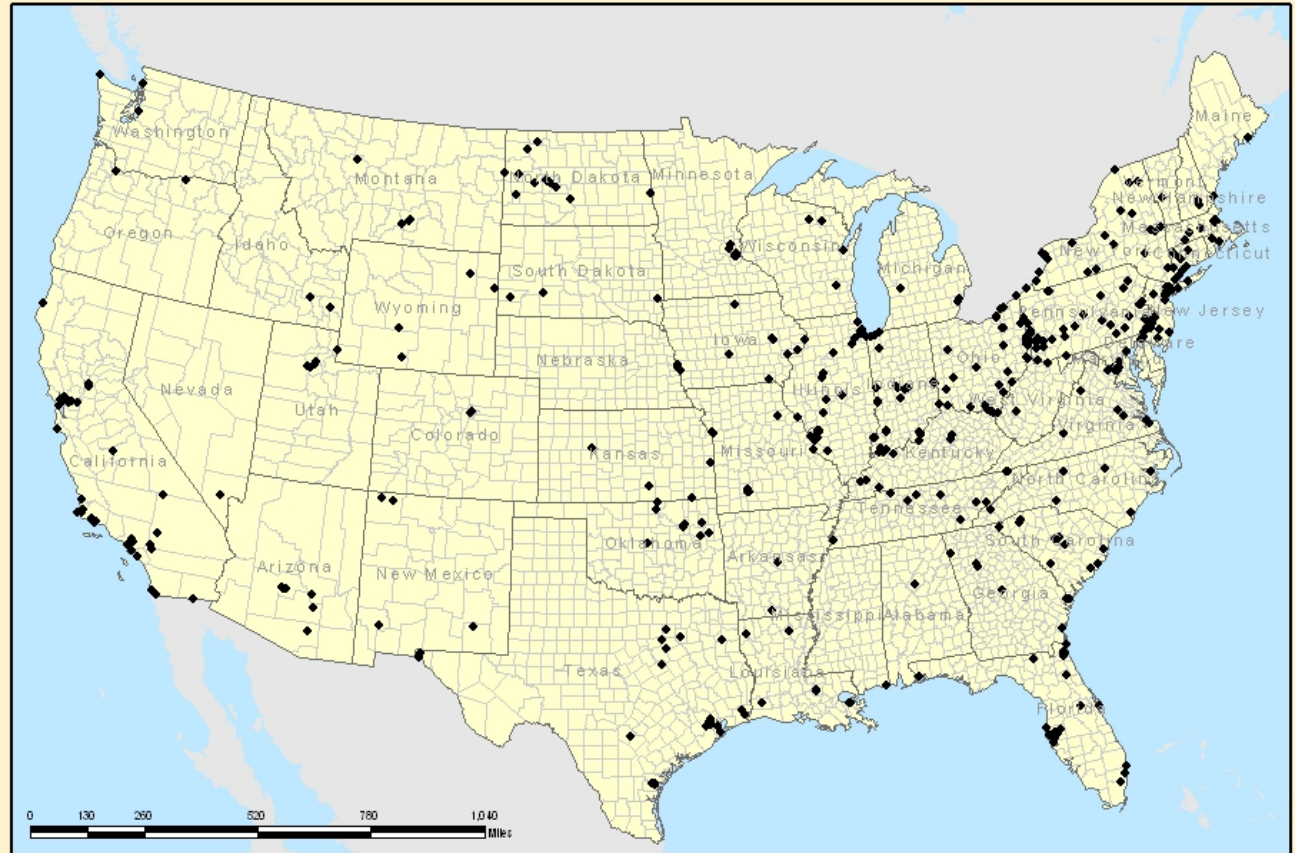
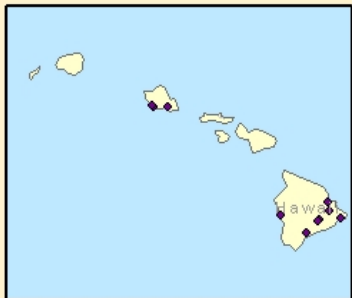
Proposed SO₂ Monitoring Network Design

- Current SO₂ network is not primarily configured to monitor locations of expected maximum short-term concentrations
 - Only ~1/3 of the 488 SO₂ monitors operating in 2008 were source-oriented or at high concentration sites
- To support the proposed 1-hour SO₂ NAAQS, EPA is proposing two categories of required monitors, with ALL sites required to be source-oriented and situated for maximum ground-level concentrations:
 - Monitors will be required in certain Core Based Statistical Areas (CBSAs) based on a combination of population and SO₂ emissions (~ 231 monitors in 131 CBSAs)
 - Additional monitors will be required within a state based on that state's contribution to national SO₂ emissions (~117 additional monitors). States will determine the specific location of these monitors within state boundaries
- EPA Regional Administrators would have the authority to require additional monitoring in certain circumstances, such as in areas impacted by major industrial point sources or a combination of sources that are not required to monitor under the other monitoring provisions
- Proposed SO₂ network would have ~348 sites nationwide
- EPA is proposing to require that all new SO₂ monitors be operational by Jan. 1, 2013

Alaska



Hawaii



Legend

- Active SO2 Sites (2008)

Current SO2 Monitoring (as of 2008)

EPA estimates that at least 1/3 of the SO2 monitors in the current network may satisfy the proposed siting requirements.

SO₂ NAAQS Implementation Timeline

<u>Milestone</u>	<u>Date</u>
Signature – Final Rule	June 2, 2010
State Designation Recommendations to EPA	June 2011
Final Designations	June 2012
SIPs Due	Winter 2014
Attainment Date	Summer 2017

Regulatory Impact Analysis (RIA)

- EPA estimates that the revised SO₂ primary standards would yield net health benefits valued between \$14 billion and \$94 billion
 - These estimates reflect a range of potential benefits between \$16-\$100 billion, and costs between \$1.8-\$6.8 billion, depending on the level of the standard evaluated and the specific study used as the basis for calculating mortality benefits
 - The benefits estimates are based on estimates of adverse health effects avoided, including reduced hospital admissions, emergency room visits, work days lost, cases of aggravated asthma and chronic bronchitis, and premature mortality
 - The benefits estimates also reflect air quality improvements associated with reductions in fine particle concentrations due to controls on SO_x, which account for the vast majority of benefits
- EPA did not use this analysis in selecting the proposed SO₂ standards.
 - The Clean Air Act bars EPA from considering costs in setting or revising any national air quality standard
 - EPA analyzes the benefits and costs of any major rule under requirements of Executive Order 12866 and according to guidelines from the White House Office of Management and Budget
- The illustrative control scenarios examined in the RIA are not intended to be precise predictions of control measures, costs, or benefits of implementing revised standards
- The RIA informs the public about the relative magnitude of the potential benefits and costs of reducing pollution to meet alternative SO₂ standards, by illustrating emissions control strategies States might consider adopting to meet the revised standards in an efficient and cost-effective manner

Estimated Number of Adverse Health Effects Avoided under Alternate Standard Levels in 2020*

	50 parts per billion	100 parts per billion
Chronic bronchitis	7,900	3,000
Work loss days	3.5 million	1.3 million
Asthma exacerbation	3.6 million	1.3 million
Nonfatal heart attacks	1,200	1,000
Emergency room visits (respiratory)	590,000	230,000
Avoided premature mortality	4,700 to 12,000	1,800 to 4,600

*Includes benefits of reduced fine particle concentrations associated with illustrative SO_x controls applied for purposes of meeting the SO₂ primary NAAQS