

# Revisions to the Primary National Ambient Air Quality Standard, Monitoring Network and Data Reporting Requirements for Sulfur Dioxide (SO<sub>2</sub>)



## General Overview

Office of Air and Radiation  
Office of Air Quality Planning and Standards  
June 2010

# Overview

- On June 2, 2010 EPA strengthened the primary National Ambient Air Quality Standards (NAAQS) for sulfur dioxide (SO<sub>2</sub>) to improve public health protection
- Specifically, EPA replaced the existing annual and 24-hour primary SO<sub>2</sub> standards with a new 1-hour SO<sub>2</sub> standard set at 75 parts per billion (ppb) to better protect public health by reducing people's exposure to high short-term (5-minutes to 24 hours) concentrations of SO<sub>2</sub>
- This final standard is consistent with the recommendations of the Clean Air Scientific Advisory Committee (CASAC)
- This final rule does not cover the secondary SO<sub>2</sub> standard, which EPA is reviewing separately as part of a joint review of the welfare effects associated with deposition of SO<sub>2</sub> and NO<sub>2</sub> (to be completed in 2012)

# Overview (cont.)

- EPA is revising the ambient air monitoring requirements for SO<sub>2</sub>. States must make necessary adjustments to their monitoring network to meet the new requirements by January 1, 2013.
- EPA is also describing our planned hybrid approach for implementing the new 1-hour SO<sub>2</sub> standard. The approach would rely on air dispersion modeling of SO<sub>2</sub> sources and ambient monitoring to determine compliance with the new standard.
- This final rule also changes the Air Quality Index to include the revised SO<sub>2</sub> standard.
- For more information, <http://www.epa.gov/air/sulfurdioxide/>

# Regulating Sulfur Dioxide Pollution

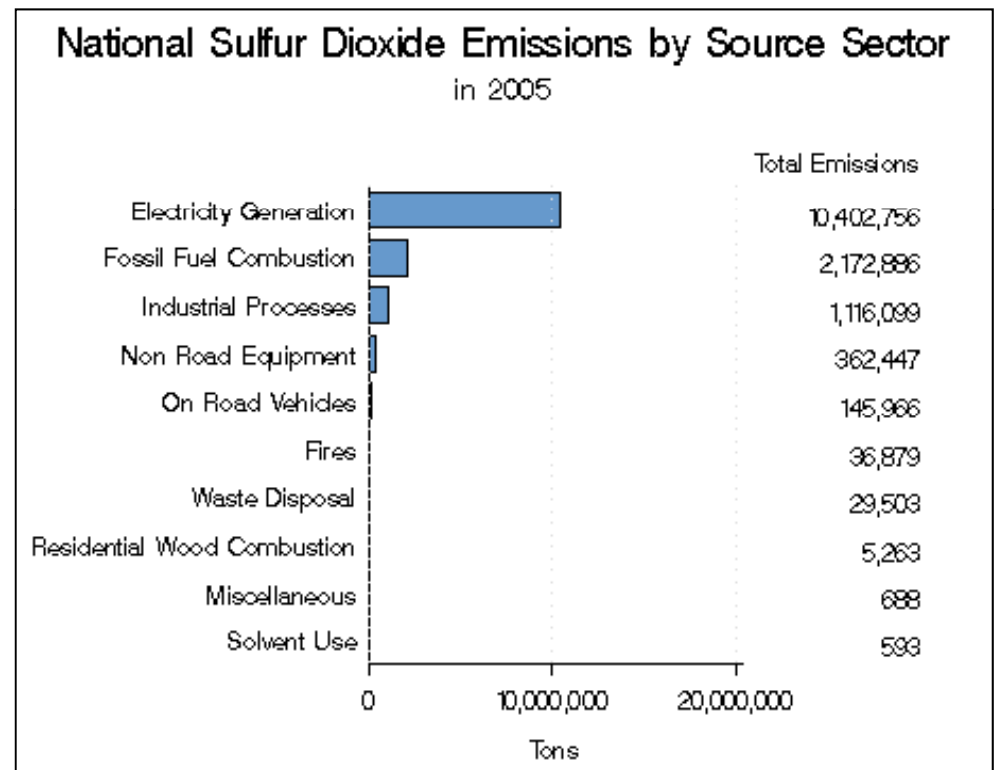
- The Clean Air Act requires EPA to set two types of national ambient air quality standards (NAAQS) for ‘criteria’ air pollutants:
  - *Primary standards* to protect public health with an adequate margin of safety, and
  - *Secondary standards* to protect public welfare and the environment (including 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), and
  - **Achieving NAAQS:** account for cost, technical feasibility, time needed to attain.

## SO<sub>2</sub>-Related Health Effects

- Exposure to SO<sub>2</sub> is associated with an array of adverse respiratory effects, including:
  - Narrowing of the airways leading to difficulty breathing (bronchoconstriction), especially during exercise,
  - Increased asthma symptoms, especially during exercise, and
  - Increased emergency-department visits and hospital admissions for all respiratory illnesses and asthma.
- Children, the elderly and people with asthma are among the most at-risk populations.

# Sources of SO<sub>2</sub> Pollution

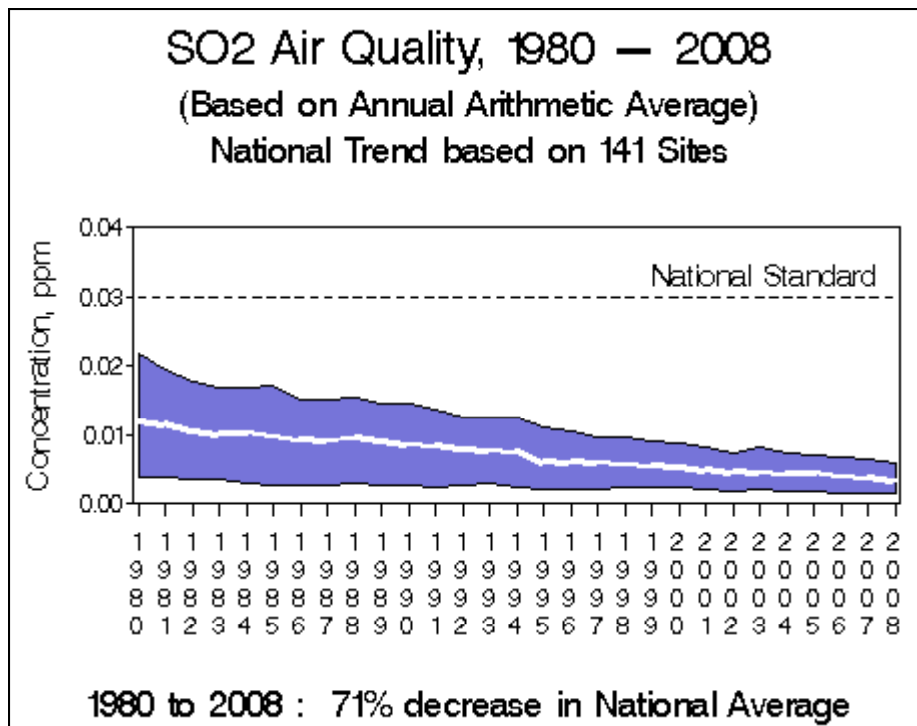
- Fossil fuel combustion at power plants (73%) and other industrial facilities (20%) are the main sources of SO<sub>2</sub> emissions.
- Other sources include industrial processes such as extracting metal from ore, and the burning of high sulfur fuels by locomotives, large ships, and non-road equipment.



## Sulfur Oxides Also Contribute to the Formation of Fine Particle Pollution

- $\text{SO}_2$  is generally co-emitted with other oxides of sulfur ( $\text{SO}_x$ ), 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 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 SO<sub>2</sub> 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 SO<sub>2</sub> 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 Primary SO<sub>2</sub> Standards

- The existing primary SO<sub>2</sub> 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 SO<sub>2</sub> standards, completed in 1996, EPA considered, but did not set, a five-minute primary SO<sub>2</sub> NAAQS to protect asthmatics at elevated ventilation rates from bronchoconstriction and other respiratory symptoms associated with 5-10 minute peak concentrations of SO<sub>2</sub>.
  - 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 SO<sub>2</sub> 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 for link between short-term SO<sub>2</sub> 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 associated with adverse respiratory responses.
- Epidemiologic studies show an association between short-term SO<sub>2</sub> exposure (mostly 1-hour and 24-hour) 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 SO<sub>2</sub> concentrations below current standards, including a few large multi-city studies
  - Many of these studies show effects generally occurring independently of the presence of co-pollutants, including particulate matter

# Final SO<sub>2</sub> Primary Standard

- EPA is establishing a new 1-hour standard SO<sub>2</sub> standard at a level of 75 parts per billion (ppb).
- The 1-hour standard of 75 ppb is below levels measured in many US locations where epidemiologic studies have associated exposure to SO<sub>2</sub> with increased emergency department visits and/or hospitalizations.
- The new 1-hour standard provides substantial protection from high, 5 – 10 minute concentrations of concern.
  - Clinical studies reported that five minute SO<sub>2</sub> exposures  $\geq$  200 ppb can result in respiratory problems such as narrowing of the airways which can cause difficulty breathing and increased asthma symptoms.
- This final standard is consistent with the recommendations of the Clean Air Scientific Advisory Committee (CASAC).

# Hybrid Monitoring/Modeling Approach to Assess Compliance with the New Standard

- EPA plans to use a combination of monitoring and modeling to assess compliance with the 1-hour standard
  - More technically appropriate and efficient to model medium to larger sources and to rely on monitoring for groups of smaller sources and sources not as conducive to modeling.
- Basis for revising monitoring-focused proposal to hybrid approach that includes modeling:
  - Address comments that increasing monitoring was insufficient and too burdensome, and
  - Consistent with historic approach to SO<sub>2</sub> compliance that used both monitoring and modeling to make determinations.

## Hybrid Monitoring/Modeling Approach to Assess Compliance with the New Standard (cont.)

- For sources or groups of sources that have the potential to cause or contribute to a violation of the standard, EPA anticipates using refined source-oriented dispersion modeling to:
  - identify violations, and
  - determine compliance.
- EPA plans to develop modelling and implementation guidance for the states addressing a variety of issues including how to:
  - Appropriately compare the model results to the new SO<sub>2</sub> standard, and
  - Identify and appropriately assess the air quality impacts of smaller SO<sub>2</sub> sources that may potentially cause or contribute to a violation of the new SO<sub>2</sub> standard.
- EPA will provide an opportunity for public comment on the guidance before issuing it in final form.

# Final SO<sub>2</sub> Monitoring Network Requirements

- EPA is setting specific minimum requirements for where states must place SO<sub>2</sub> monitors.
- At least 163 SO<sub>2</sub> monitoring sites nationwide are required by this rulemaking.
- The final monitoring regulations require monitors to be placed in Core Based Statistical Areas (CBSAs) based on a population weighted emissions index for the area . The final rule requires:
  - 3 monitors in CBSAs with index values of 1,000,000 or more;
  - 2 monitors in CBSAs with index values less than 1,000,000 but greater than 100,000; and
  - 1 monitor in CBSAs with index values greater than 5,000.
- All required SO<sub>2</sub> monitors must be operational by January 1, 2013.
- EPA Regional Administrators have the authority to require additional monitoring in certain circumstances.

# Final SO<sub>2</sub> Data Reporting Requirements

- EPA also finalized changes to data reporting requirements. State and local agencies are required to report two data values for every hour of monitoring conducted:
  - The 1-hour average SO<sub>2</sub> concentration; and
  - The maximum 5-minute block average SO<sub>2</sub> concentration for each hour.

## Designations & Potential Hybrid Monitoring/Modeling Approach

- Initial designations in 2012 will be based on data from existing monitors and, where provided by states, appropriate modeling.
- EPA's planned designation approach is:
  - Any area that has monitoring data (or refined modeling results) showing a violation would be designated “nonattainment”.
  - Any area that has both monitoring and refined modeling results showing no violations would be designated “attainment”.
  - All other areas would initially be designated “unclassifiable”.
  - County would be the presumptive nonattainment boundary unless state demonstrates otherwise in recommendations to EPA.



# Attainment Plans & Potential Hybrid Monitoring/Modeling Approach

- States with monitored or modeled air quality violations are required to submit “nonattainment” state implementation plans (SIPs).
  - Due February 2014
  - Must demonstrate that the area will attain the standard by August 2017
  
- For all other areas, maintenance SIPs required by the Clean Air Act would be due in June 2013. These plans would:
  - Demonstrate, through refined air quality modeling, that all sources contributing to monitored and modeled violations of the new standard, or that have the potential to cause or contribute to a violation, will be sufficiently controlled to ensure timely attainment and maintenance of the new SO<sub>2</sub> standard; and
  - Include, where needed, enforceable emissions limitations, timetables for compliance, and appropriate testing/reporting to assure compliance.

## Attainment Plans & Potential Hybrid Monitoring/Modeling Approach (cont.)

- The modeling to support these “maintenance” plans should reflect SO<sub>2</sub> reductions EPA expects from national and regional emissions standards, including rules for industrial boilers and power plants.
- EPA believes that “unclassifiable” areas should plan to demonstrate attainment and maintenance of the standard as expeditiously as possible, but no later than August 2017, the date nonattainment areas must meet the standard.

## Anticipated Approach & Timeline for Implementation

Deadline	Milestone
June 2010	EPA sets new primary SO <sub>2</sub> standard
June 2011	States submit designation recommendations, based on available monitoring data and any modeling they choose to perform in advance of submitting their state implementation plans
June 2012	EPA issues initial designations: <ul style="list-style-type: none"> <li>➤ “nonattainment” = monitored <u>or</u> modeled violations</li> <li>➤ “attainment” = monitored <u>and</u> modeled evidence of no violations</li> <li>➤ “unclassifiable” = all other areas</li> </ul>
January 2013	New monitoring network operational
June 2013	State plans for basic requirements to implement the revised standards (including appropriate state regulations to carry out monitoring etc.) due to EPA Attainment and unclassifiable area state implementation plans, modeling attainment of the new standard by August 2017, due to EPA.
February 2014	Nonattainment area plans due to EPA
August 2017	All areas attain the standard

## Regulatory Impact Analysis (RIA)

- EPA estimates that the revised SO<sub>2</sub> primary standards would yield annual health benefits valued between \$13 billion and \$33 billion in 2020.
  - These estimates reflect a range of potential benefits depending on the specific study used as the basis for calculating mortality benefits
  - The benefits 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<sub>x</sub>, which account for the vast majority of benefits
- The estimated cost in 2020 to fully implement this standard is approximately \$1.5 billion.
- EPA did not use this analysis in selecting the proposed SO<sub>2</sub> 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 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 SO<sub>2</sub> 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 in 2020\*

Chronic bronchitis	1,600
Work loss days	290,000
Asthma exacerbation	54,000
Nonfatal heart attacks	3,900
Emergency room visits (respiratory)	2,500
Avoided premature mortality	2,300 to 5,900

\*Includes benefits of reduced fine particle concentrations associated with illustrative SO<sub>x</sub> controls applied for purposes of meeting the SO<sub>2</sub> primary NAAQS. Fine particle concentrations due to controls on SO<sub>x</sub> account for the vast majority of benefits.