



U.S. Environmental Protection Agency's Integrated Science Assessment for Sulfur Oxides – Health Criteria Second External Review Draft

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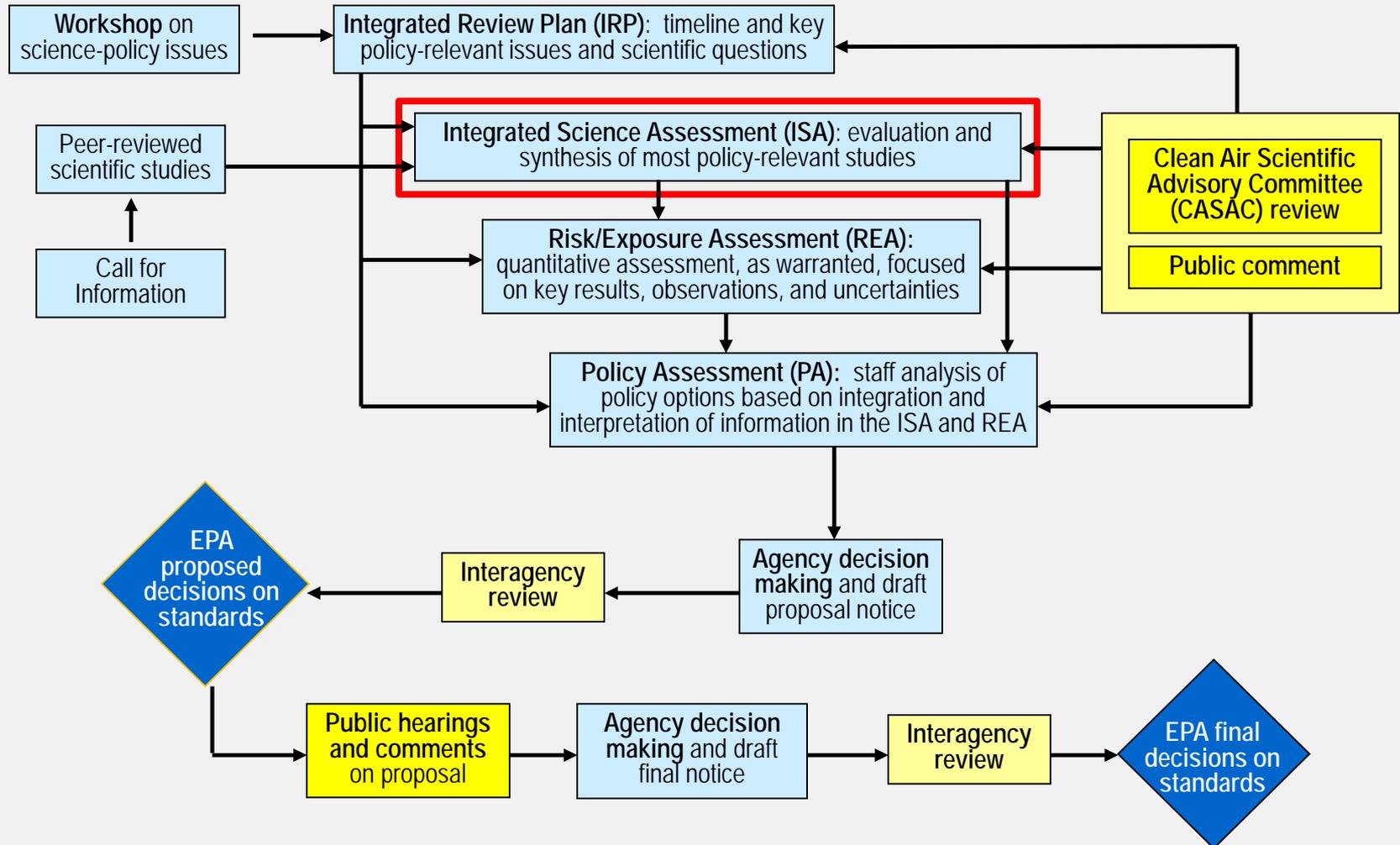
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Overview of the Process for Reviewing NAAQS



Anticipated Timeline for the SO_x ISA

Science and Policy Issue Workshop	June 12-13, 2013
Draft Integrated Review Plan (IRP)	March 2014
CASAC/public consultation on draft IRP	April 2014
Final IRP	October 2014
Peer Input Workshop	June 23-24, 2014
1 st Draft ISA	November 2015
CASAC/public Review of 1 st Draft ISA	January 2016
2 nd Draft ISA	December 2016
CASAC/public review of 2nd Draft ISA	March 20, 2017
Final ISA	December 2017

Executive Summary

- Revised language to make it more accessible for a nontechnical audience

Chapter 1

- Updated conclusions to reflect revisions elsewhere in the ISA

Chapter 2

- Reconciled source categories for consistency and clarified discussion of major sources
- Streamlined chemistry discussion to focus on urban context
- Updated the air quality analysis to incorporate 2013-2015 data

Chapter 3

- Reorganized the discussion to distinguish exposure issues relevant to all criteria pollutants from those specific to SO₂
- Expanded conceptual discussion of SO₂ exposure metrics and added section defining exposure terminology

Main Revisions in 2nd Draft SO_x ISA (continued)

Chapter 4

- Added material on respiratory tract structure and function as well as breathing rate and breathing habit by age, sex, and body weight

Chapter 5

- Revised causal determinations for short-term SO₂ exposure and cardiovascular effects as well as for long-term SO₂ exposure and total mortality, reproductive/developmental effects, and cancer from “suggestive” to “inadequate”

Chapter 6

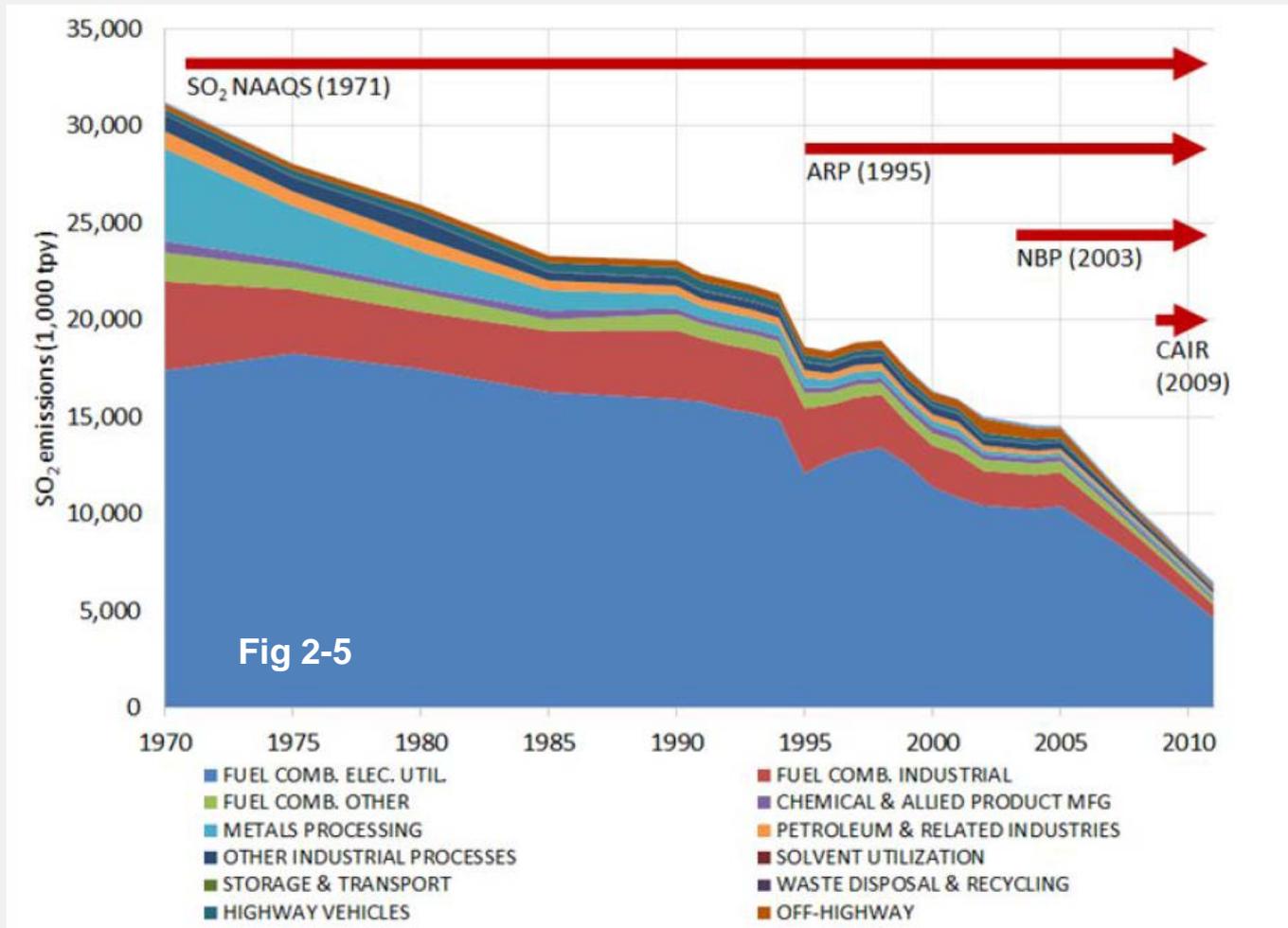
- Clarified the discussion of potentially at-risk populations
- Consistent with previous ISAs, at-risk discussion focused on health outcomes determined "likely to be causal" and "causal" (i.e., short-term exposure and respiratory effects)

Overall

- Added a small number of recent studies from the latest literature search (August 2016)

Sources of SO₂

- This figure and accompanying table and text have been revised to consistently use the same source categories
- Fossil fuel combustion is by far the largest source of SO₂



Ambient Concentrations

- U.S. mean 1-hr daily max concentration from 2013-15 was 5.4 ppb; 99th percentile was 64 ppb
- Between 1990-2015, 99th percentile 1-hr daily max SO₂ concentrations declined 76% (Fig 2-21)
- Median ratio of 5-min hourly max to 1-hr avg concentration was 1.3, although higher ratios were observed at some sites (Fig 2-26)

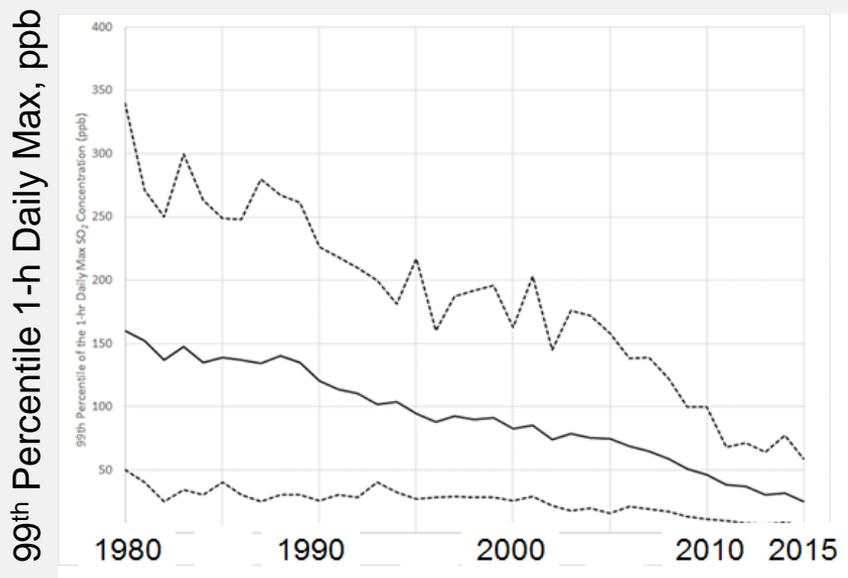


Fig 2-21

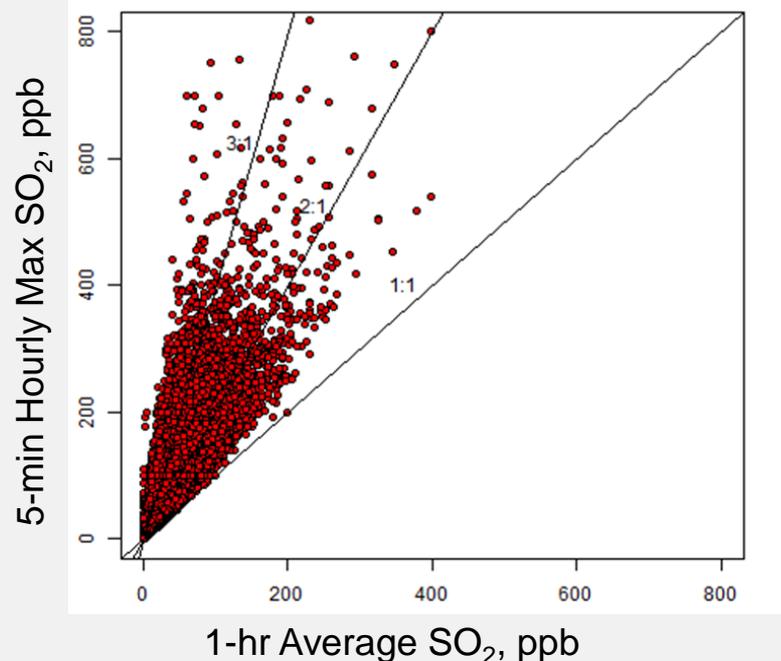


Fig 2-26

Exposure

- Expanded conceptual overview of exposure across pollutants to define exposure metrics and terms
- Moved copollutant correlation discussion from Chapter 2 to Chapter 3
 - Median correlations between SO₂ and other criteria pollutants are all below 0.4, although some sites have negative or strongly positive correlations
 - Where correlations are higher, the potential for copollutant confounding exists in epidemiologic studies discussed in Chapter 5
- Exposure considerations specific to SO₂ include:
 - Point source emissions contribute to elevated local exposures and high spatial variability
 - Dispersion and oxidation of SO₂ plumes contribute to spatial variability
 - Temporal variability is inconsistent across urban areas for daily and seasonal time scales

Health Effects of SO₂

- Revised causal determinations for short-term SO₂ exposure and cardiovascular effects as well as for long-term SO₂ exposure and total mortality, reproductive/developmental effects, and cancer from “suggestive” to “inadequate”
 - Conclusions of “suggestive” in 1st draft ISA were based on the large body of new evidence for these outcome categories since the 2008 SO_x ISA, with some studies showing evidence of an association with SO₂
 - However, the evidence shows a lack of coherence across lines of evidence or related outcomes within a category, and the new studies did not adequately address previous uncertainties regarding exposure measurement error, copollutant confounding, and potential modes of action, leading to a revised causal determination of “inadequate”
 - These conclusions are consistent with the 2008 SO_x ISA

Health Effects of SO₂ (continued)

- Added material on the structure and function of the respiratory tract
- Breathing rates normalized to body weight are greater in normal-weight children relative to normal-weight adults
 - Overweight/obese individuals have increased ventilation rates across age groups
- Increased fraction of oral breathing is observed in children (possibly even more in obese children), in males (all ages), and in individuals with allergies or upper respiratory infections
- Addressed CASAC comments on mode of action material

Health Effects of SO₂ (continued)

Health Effect Category and Exposure Duration	Causal Determination	
	1 st Draft ISA	2 nd Draft ISA
Respiratory effects – Short-term exposure	Causal	Causal
Respiratory effects – Long-term exposure	Suggestive	Suggestive
Cardiovascular effects – Short-term exposure	Suggestive	Inadequate
Cardiovascular effects – Long-term exposure	Inadequate	Inadequate
Reproductive and developmental effects	Suggestive	Inadequate
Total mortality – Short-term exposure	Suggestive	Suggestive
Total mortality – Long-term exposure	Suggestive	Inadequate
Cancer – Long-term exposure	Suggestive	Inadequate

- Information was brought forward from the Preamble to clarify and characterize the potential intrinsic and extrinsic factors (including increased exposure/dose) that may modify risk for certain populations and lifestages
- At-risk characterizations were focused on respiratory effects (the only health outcome determined to be causal or likely to be causal)
 - Consideration was also given to the potential of increased risk for other health effects observed only in certain populations and lifestages (e.g., older adults)

At-Risk Populations and Lifestages (continued)

- Consistent with the 2008 SO_x ISA and the 1st draft ISA, there is **adequate evidence** to conclude that **people with asthma** are at increased risk for SO₂-related health effects
- Evidence is suggestive of increased risk for SO₂-related health effects for children and older adults
- Evidence was inadequate to determine whether other factors result in increased risk, including genetic background, sex, socioeconomic status, race/ethnicity, obesity, cardiovascular disease, and diabetes

Next Steps for the SO_x ISA

CASAC/public review of draft ISA

Mar 20, 2017

Revise ISA in response to comments

Summer/Fall 2017

Release Final ISA

December 2017*

*EPA is currently being sued for missing the statutory deadlines for this review, and we anticipate that this action will be subject to a court-ordered deadline. Notice of a proposed consent decree to resolve this litigation was published in the Federal Register on January 17, 2017.