

Review of the O₃ NAAQS: Second Draft Policy Assessment

Clean Air Scientific Advisory Committee
Meeting

CASAC Ozone Panel

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Structure of 2nd Draft Policy Assessment

- Chapter 1: Introduction and overview of document; general approach to reviewing standards
- Chapter 2: Overview of O₃ monitoring and air quality, including characterization of background concentrations

Part I: Primary Standard

- Chapter 3: Adequacy of the current primary standard
- Chapter 4: Consideration of alternative primary standards

Part II: Secondary Standard

- Chapter 5: Adequacy of the current secondary standard
- Chapter 6: Consideration of alternative secondary standards



Overview of Updates from First Draft

- Updated and expanded discussion of the overall approach to reviewing the O₃ NAAQS (Chapter 1)
- Updated and expanded discussion of background O₃, including its potential role in the review process (Chapters 1, 2)
- New organization focuses on addressing key policy-relevant questions related to the current and potential alternative standards; serves to focus staff's considerations on the most policy-relevant scientific evidence and exposure/risk information (Chapters 3-6)
- Updated and expanded consideration of the health and welfare evidence and exposure/risk analyses (Chapters 3-6)
- Clarified the linkages between staff's preliminary conclusions and the aspects of the evidence and exposure/risk information, including associated uncertainties, that support those conclusions (Chapters 3-6)



Chapter 1: Introduction and Overview

- Legislative requirements for the NAAQS
- History of the O₃ NAAQS
- Expanded discussion of approaches to reviewing the current primary and secondary O₃ NAAQS
 - Focus on how the evidence and exposure/risk information are considered when reaching conclusions on the current and potential alternative standards
 - Includes discussion of how O₃ background concentrations have been considered in past O₃ NAAQS reviews



Chapter 2: Overview of O₃ Monitoring and Air Quality

- Air quality information is now provided in a separate Chapter 2 that includes discussion of the O₃ monitoring network, O₃ precursor emissions and atmospheric chemistry, O₃ air quality, and background O₃ concentrations.
- Summarizes key details from the ISA and includes results of recent EPA modeling of background O₃
 - Zero out and source apportionment modeling done for 2007 (details in Appendix 2A)
- Background O₃ modeling results suggest
 - Background can comprise a considerable fraction of total seasonal mean O₃ and W126, especially in Western U.S and at high elevations.
 - As daily ambient O₃ concentrations increase, the fraction attributable to background sources decreases
 - U.S. anthropogenic emissions are the dominant contributor to most exceedances of the NAAQS



Chapter 3: Adequacy of Current Primary Standard

- Chapter 3 integrates staff's consideration of the health evidence and exposure/risk information to reach preliminary conclusions on the adequacy of the current primary standard
- With regard to the health evidence from the ISA, focus is on health effects and at-risk populations for which evidence is strongest
 - Respiratory effects that ISA concludes are *caused by* short-term O₃ exposures and are *likely to be caused by* long-term O₃ exposures. New evidence supports and expands previous evidence.
 - New clinical studies provide evidence of respiratory effects in healthy adults at O₃ concentrations below 75 ppb
 - New epidemiologic studies strengthen evidence for associations between short-term O₃ exposure and respiratory hospital admissions, emergency department visits, mortality
 - New evidence for respiratory effects associated with long-term exposures
 - Total mortality and cardiovascular effects that ISA concludes are *likely to be caused by* short-term O₃ exposures
 - Strongest evidence of at-risk populations is for lifestages of children and older adults; people with asthma; outdoor workers; people with certain genetic variants; and people with reduced intake of certain nutrients
 - Experimental evidence for modes of action contributes to our understanding of the biological plausibility of adverse O₃-related health effects, including inter-individual variability
- New evidence strengthens conclusions from last review about health effects attributable to O₃ exposure; uncertainties have been reduced, especially with respect to the short-term exposure concentrations at which effects occur, respiratory effects from long-term exposures, total mortality from short-term exposures, and at-risk populations.



Chapter 3: Adequacy of Current Primary Standard (2)

- Chapter 3 considers the O₃ concentrations present in health studies, including an expanded analysis of health effect associations for air quality that would meet current standard.
 - Controlled human exposure studies: Focus on lung function decrements, airway inflammation, and respiratory symptoms in healthy adults at exposure concentrations below level of current standard
 - Panel studies: Focus on lung function decrements associated with on-site monitoring concentrations below level of current standard
 - Epidemiologic studies: Updated and expanded consideration of reported health effect associations for ambient O₃ concentrations that would have met the current standard
 - Additional studies considered as part of an expanded evaluation of confidence in health effect associations over distributions of ambient O₃ concentrations.
- Conclusion: The available evidence provides support for the occurrence of a range of adverse respiratory effects and mortality, under air quality conditions that would meet the current standard



Chapter 3: Adequacy of Current Primary Standard ⁽³⁾

- Chapter 3 includes updated and expanded consideration of the air quality, exposure, and risk analyses presented in the 2nd draft health REA
 - PA focus is on estimates of:
 - “Exposures of concern” ($\geq 60, 70, 80$ ppb), with emphasis on children
 - Lung function decrements ($\geq 10\%, 15\%, 20\%$), with emphasis on children
 - Mortality and morbidity risks, based on epidemiologic studies
 - Estimated risks for full distributions of ambient O₃ and for various portions of those distributions
 - Conclusion regarding REA analyses: Exposures and risks projected to remain upon just meeting the current standard are indicative of risks that can reasonably be judged to be important from a public health perspective
- Chapter 3 reaches the overall preliminary conclusion that while meeting the current standard will provide important improvements in public health protection, the available evidence and information call into question the adequacy of the protection provided by the current standard and revision should be considered



Chapter 4: Consideration of Potential Alternative Standards

- Chapter 4 integrates staff's consideration of the health evidence and exposure/risk information to reach preliminary conclusions about the range of potential alternative standards appropriate to consider
 - Alternatives considered in terms of indicator, averaging time, form, and level
- **Indicator:** Appropriate to consider retaining O₃ as the indicator
 - O₃ is the photochemical oxidant most widely studied and reductions in population exposures to O₃ can also be expected to lead to reductions in exposures to other photochemical oxidants
- **Averaging time:** Appropriate to consider retaining an 8-hour standard
 - Evidence is strongest for effects from short-term exposures
 - Analyses indicate that air quality adjustment to meet potential alternative 8-hour standards could also reduce longer-term O₃ concentrations
 - Seasonal averages of 1-hour daily max concentrations are reduced below those where evidence provides the greatest confidence in association between long-term O₃ and respiratory mortality
 - Compared to current standard, meeting alternative 8-hour standards reduces estimated respiratory mortality associated with "long-term" O₃
 - Majority of US population lives in locations where seasonal means of daily 8-hour O₃ concentrations would decrease in response to reductions in precursor emissions



Chapter 4: Consideration of Potential Alternative Standards (2)

- Form: Appropriate to consider retaining current 3-year average of 4th high form
 - In selecting a form, foremost consideration is the public health protection provided by the combination of form and level
- Level: For an 8-hour O₃ standard with the current form, it is appropriate to consider revising the level to within the range of 70 to 60 ppb
 - Compared to the current standard, a revised standard with a level in this range would be expected to more effectively limit the occurrence of:
 - O₃ exposure concentrations that result in respiratory effects
 - O₃-induced lung function decrements large enough to be adverse
 - O₃-associated mortality and morbidity, particularly that associated with upper portion of ambient distributions
- Staff's conclusions in final PA will reflect consideration of evidence, exposure/risk information, CASAC advice, and input from the public



Chapter 5: Adequacy of the Current Secondary Standard

- Chapter 5, in combination with Chapter 6, replaces the three chapters in the 1st draft PA in response to comments by CASAC. This chapter integrates staff's consideration of the welfare effects evidence, recent air quality, and exposure/risk information
- With regard to evidence from the ISA, focus is on vegetation and ecosystem effects, and their associated ecosystem services, for which evidence is strongest
 - ISA concludes that visible foliar injury, reduced vegetation growth, reduced productivity in terrestrial ecosystems, reduced yield and quality of agricultural crops, and alteration of below-ground biogeochemical cycles are caused by cumulative seasonal O₃ exposures
 - ISA also concludes that reduced carbon sequestration in terrestrial ecosystems, alteration of terrestrial ecosystem water cycling, and alteration of terrestrial community composition are likely to be caused by cumulative seasonal O₃ exposures
 - A cumulative, seasonal exposure index is the most biologically relevant way to relate O₃ exposure to plant growth response.
- New evidence strengthens conclusions from last review about vegetation effects attributable to O₃ exposure and the appropriateness of characterizing plant response in terms of cumulative, seasonal exposures; uncertainties have been reduced, especially with respect to the appropriateness of using existing concentration-response functions and the mechanisms underlying plant response



Chapter 5: Adequacy of the Current Secondary Standard (2)

- Chapter 5 includes updated and expanded consideration of the air quality, exposure/risk and ecosystem services assessed in the 2nd draft REA.
 - New consideration of crop effects evidence and exposure/risk information
 - Updated and expanded consideration of O₃ effects evidence and exposure/risk information on trees outside of Class I areas
 - Urban/other managed forests: Air pollution removal, carbon sequestration, timber production
 - Ecosystem impacts: Weighted relative biomass loss
 - Updated and expanded consideration of both quantitative and qualitative information on additional ecosystem services assessed in the REA (i.e. bark beetle, fire risk)
 - Updated and expanded consideration of the air quality analyses
- Chapter 5 reaches the overall preliminary conclusions that while meeting the current secondary O₃ standard will provide important improvements in public welfare protection, revision should be considered to increase protection against O₃ - attributable tree biomass loss, crop yield loss, and visible foliar injury and their associated ecosystem services, particularly for those effects associated with cumulative, seasonal exposures that occur in specially protected natural areas.



Chapter 6: Consideration of Potential Alternative Standards

- Chapter 6 integrates staff's consideration of the welfare effects evidence and exposure/risk information to reach preliminary conclusions about the range of potential alternative standards appropriate to consider for a secondary standard providing requisite public welfare protection against adverse effects
- **Indicator:** Appropriate to consider retaining O₃ as the indicator
 - O₃ is the photochemical oxidant most widely studied and it provides protection for public welfare from exposure to all photochemical oxidants
- **Form and Averaging Time:**
 - The W126 cumulative, seasonal exposure index is the most biologically relevant and appropriate metric for assessment of the evidence and exposure/risk information.
 - Because plants continue to grow and may be exposed to O₃ throughout their growing season, it is appropriate to consider summing hourly O₃ concentrations for 12 hour daylight period (8 am to 8 pm) over the maximum consecutive 3 month period within the growing season
 - Appropriate to consider averaging over 3 consecutive years
 - Given the high year-to-year variability, a multi-year evaluation period can provide stability in air quality management programs and thus provide greater public welfare protection
 - A form that averages across three years can also reduce individual year concentrations



Chapter 6: Consideration of Potential Alternative Standards (2)

- Level: Appropriate to consider range from somewhat above 15 ppm-hrs down to 7 ppm-hrs. Compared to the current standard, a revised standard with a W126 level in this range would be expected to:
 - Reduce biomass loss across studied tree species (e.g., median of 2 to 6%) and crop yield loss across studied crop species (e.g. median of approximately 5%)
 - Protect nearly half to more than half of individual tree and crop species from loss of >2% and >5%, respectively
 - Provide protection of >90% of studied Class I areas from weighted biomass loss >2%
 - Yield gains in carbon sequestration and pollutant removal, especially at lower levels
 - Potentially reduce prevalence of foliar injury
- Welfare considerations:
 - Large variability in sensitivity between species
 - Relationship between individual species effects and expected impacts on associated ecosystems and services
 - Consideration of the range of uncertainties inherent in the evidence and analyses
- Staff's conclusions in the final PA will reflect consideration of evidence, exposure/risk information, CASAC advice (based on review of draft PA), and input from the public.



O₃ NAAQS Review: Policy Assessment Team

Policy Assessment Team

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