



CARB Indoor NO₂ Guidelines Workshop #2

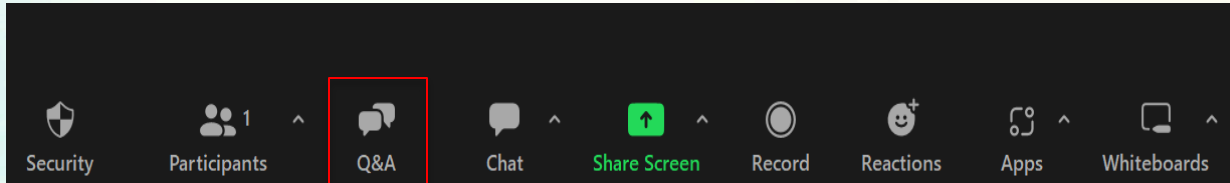
May 30, 2024

Housekeeping Items

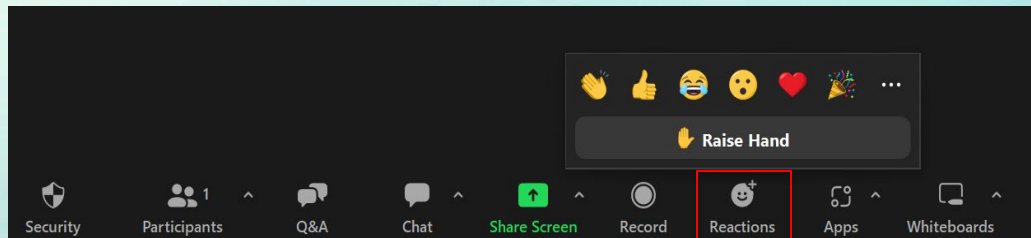
- We ask that you keep any comments to under 2 minutes. You can also submit comments at this link: <https://ww2.arb.ca.gov/public-comments/public-workshop-2-updating-indoor-air-quality-guidelines-nitrogen-dioxide-submit>
- If we are unable to get to your question during the Q/A session, or if you would like to submit additional information, you are welcome to email us at IAQGuidelines@arb.ca.gov and we will respond to you.
- If you are having any technical difficulties during the workshop, please email Aussma Ali at aussma.ali@arb.ca.gov.
- This meeting will be recorded, and the presentations posted to our webpage at <https://ww2.arb.ca.gov/our-work/programs/indoor-air-quality/indoor-no2-guidelines-update>
- We will send registered participants an email when the posting is completed.

Housekeeping Items

- If you have a written question, please enter it into the Q&A using the icon at the bottom of the screen.



- If you wish to ask a question verbally, raise your hand using the reactions icon. We will unmute you during the Q/A sessions at the end of the panel.
- When called on, please identify yourself and your affiliation, and whether you have a question or comment.



CARB Participants in IAQ Workshop

- Elizabeth Scheehle – Chief, Research Division
- Bonnie Holmes-Gen – Branch Chief, Health and Exposure Assessment Branch
- Pat Wong, Ph.D. – Manager, Building and Indoor Environments Section (BIES)
- Jeff Williams, Ph.D. – Lead for IAQ Guidelines, BIES
- Zoe Zhang, Ph.D. – Technical staff lead, BIES

Agenda

- 1) Welcome
- 2) Housekeeping
- 3) Presentation
 - a) Background and health effects
 - b) Timeline and review of workshop #1
 - c) Approaches for guidelines update
- 4) Public comment and discussion of questions
- 5) Summary and next steps
- 6) Adjourn

The need to update NO₂ guidelines

CARB's last published indoor guidelines in 2005

Health Canada and WHO have adopted more health protective guidelines

Community research and calls for action

Provide guidance to inform state/local policies, appliance standards, future building codes, etc

Identify Gaps and Needs for research into indoor air pollutants

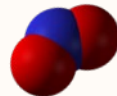
Provide input for updated IAQ report

How are the Indoor Air Quality Guidelines different from Air Quality Standards?

- Indoor Air Quality Guidelines are voluntary health- or risk- based benchmarks for safe concentration thresholds for indoor air pollutants.
- Air Quality Standards are enforceable maximum concentration levels in outdoor air set by CARB or USEPA. These mandatory standards are based on agency assessment of the maximum amount of a pollutant (averaged over a specific period) that can be present in outdoor air without any harmful effects on people or the environment.

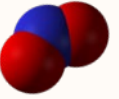


NO₂ in the Indoor Environment



- People spend most of their time indoors
 - NO₂ levels indoors can regularly exceed the levels of the National Ambient Air Quality Standards
 - Rule of 1,000 – Prof. Kirk Smith
- Sources include combustion appliances
 - Ventilation helps but does not fully address concerns
- NO₂ emissions released indoors affects both indoor and outdoor air quality

NO₂ Exposure and Health Effects



- Causal short-term effects^{1,2}
- Long-term effects – asthma and increased mortality^{8,9}
- Epidemiological studies of NO₂ –pulmonary inflammation, asthma exacerbation, particularly in children^{3,4,5}
- Gas and propane stoves contribute to long-term NO₂ exposure and estimated ~50,000 cases of pediatric asthma¹⁰

Exposure to Indoor NO₂ Sources

- Asthmatic children exposed to NO₂ indoors are at risk for increased asthma morbidity. ^{4,6,7}
 - Risks are not confined to inner-city children, but occur at NO₂ concentrations common in urban and suburban homes ⁴
- Increased NO₂ exposure = increase in risk of higher asthma severity score ⁴
- 12.7% of current childhood asthma in the US attributable to stove use. 20% for California ¹¹
- Indigenous and Black, Hispanic/Latino households experience 60 and 20% more NO₂ exposure respectively ¹⁰

Other IAQ Guideline Efforts

- Federal/States
 - CEC – Funding significant research on IAQ, appliances, ventilation, and gas vs electric cooking
 - EPA – In the process of developing PM2.5 IAQ guidelines
 - CDPH – Exploring the development of IAQ guidelines, starting with PM2.5
 - CPSC – Independent joint task force on IAQ and gas ranges.
 - Air Quality Guidelines working group recommended adopting Health Canada Guideline.

CEC Research on Appliance Impacts

- Current and Future Research
 - EPC-21-033 – Cooking Electrification and Ventilation Improvements for Children’s Asthma (CEVICA)
 - GFO-23-501 – Quantifying Exposures to Indoor Air Pollutants in Multifamily Homes that Cook with Gas or Alternatives
- Selected Past Research
 - CEC-500-2020-023 – Ventilation and Air Quality in New California Homes with Gas Appliances and Mechanical Ventilation
 - CEC-500-2021-005 – Effective Kitchen Ventilation for Healthy Zero Net Energy Homes with Natural Gas

Indoor Air Guidelines History

CARB's most recently published IAQ guidelines
1-hr NO₂: 250 ppb

CARB lowered AAQS 1-hr NO₂:
180 ppb

Health Canada lowered IAQ guideline
1-hr NO₂: 90 ppb

CARB IAQ guidelines update

2005

2007

2010

2015

2021

Now

US EPA lowered AAQS 1-hr NO₂:
100 ppb

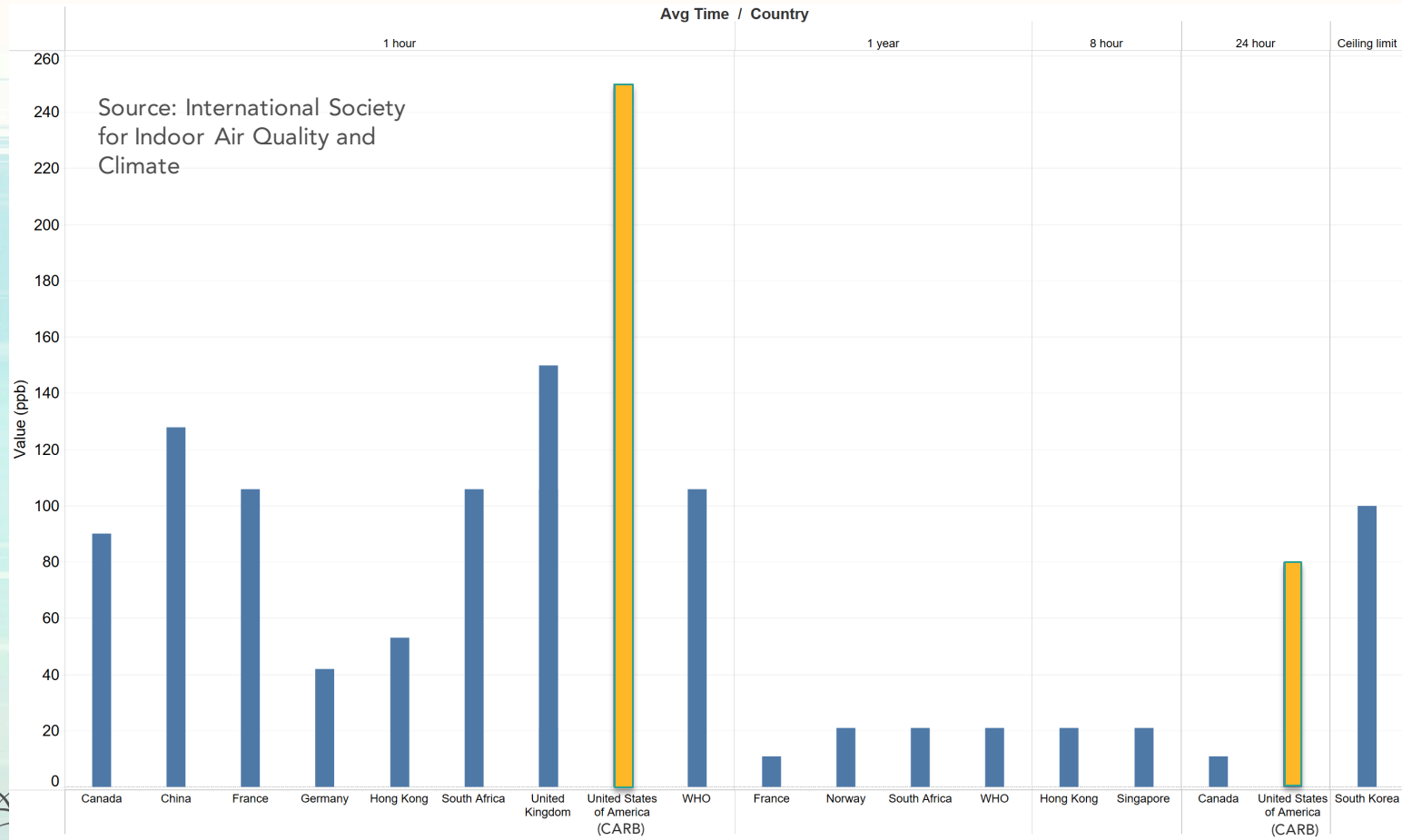
WHO set IAQ guidelines
1-hr NO₂: 106 ppb

WHO set annual IAQ guideline of 5 ppb (with higher interim targets)

Current Indoor NO₂ Guidelines/Standards

Guideline	Methodology - Target Value	Agency - NO ₂ Concentration (year)
1-hour indoor guidelines	Indoor level at 1 hour	Canada ----- 90 ppb (2015) California --- 250 ppb (2005) US EPA ----- N/A* WHO ----- 106 ppb (2010)
24-hour indoor guidelines	Indoor level at 24 hours (or more)	Canada ----- 11 ppb (2015) California -- 80 ppb (2005) WHO ----- 5 ppb annual (2021) 21,16,10 ppb (Interim target values)

Global Indoor NO₂ Guidelines



Key Milestones - Indoor Air Quality Guidelines for NO₂

Winter
2022

CARB pre-workshop research, internal briefings

Consultations: international and state agencies, academia

Workshop #1
May 16, 2023
Panels and Public Comments

Develop alternative approaches for IAQ Guidelines

Spring
2024

Workshop #2
Present alternative approaches, public comments

Draft IAQ Guidelines document development

2025

Workshop #3
Review draft IAQ guidelines and public comment

Final document for public release.

Workshop # 1 Review

Participants

- International health agencies: WHO, Health Canada
- State agencies: CDPH, OEHHA, CEC
- CBOs: WeACT, PSR and CCAC
- Technical experts: Academia, Pediatric Environmental Health Specialty Units, Livermore Berkeley National Laboratory

Topics

- Literature on health impacts of indoor air quality
- Research on NO₂ emissions, exposures, health effects
- Science and process of setting guidelines
- How current guidelines used
- Indoor air quality impacts in EJ communities

WHO, Health Canada and State Agencies

- Now is an excellent time to update guidelines
 - New studies on health effects of NO₂
 - Better knowledge of sources and controls
 - Indoor NO₂ regularly exceeds ambient standards
- Guidelines based on adequate margin for protection of health
- Source reduction and ventilation are key to reducing NO₂ indoors
- Extensive review process used in development
 - Comprehensive literature and scientific review spanned several years
 - WHO – excluded indoor air studies in assessment
 - Health Canada – considered feasibility when setting level

CBO's and Academia/Health

- NY households that switched from gas to induction saw 35% reduction in daily NO₂
- Low-income communities = older housing, structural deficiencies.
- Cooking can raise NO₂ well above healthy levels
- Systemic issues impacting low-income communities (e.g. redlining, hwy act).
- Need community involvement, better tenant protections, codes, guidelines
- Main sources of NO₂ in Calif homes - gas burners and infiltration from outdoors
- Ventilation (range hood) can help reduce exposure. Challenge is getting people to use them

Considerations for Guideline Approaches

- High level of health protection
- Build on previous foundation of solid research
- Consider approaches that streamline development timeline
- Take into consideration the feasibility of implementing new guidelines
- Promote benefits in impacted communities

Approach #1: Adopt Existing Guideline Level(s) Representing Maximum Health Protection

APPROACH	METHOD	BENEFITS	CHALLENGES	1-hr (ppb)	24-hr (ppb)
Maximum Health Protection for Sensitive Populations: Adopt Health Canada's 2015 Reference Concentration (RfC) from the SAD for NO ₂	Extensive literature reviews. Determined a Lowest Observed Adverse Effects Level (LOAEL) then divided by uncertainty factor(s) to obtain RfC Very similar to OEHHA's methodology already used for REL development in CA.	Most health protective for the most sensitive groups and environmental justice communities	Requires electrification to achieve these levels; highest challenges for existing homes/businesses Outdoor NO ₂ intrusion may make this difficult to achieve 24-hr value	27	5
<i>For Reference: Existing CARB guidelines</i>	<i>1-hr from 2005 state outdoor value. 24-hr from 1987 WHO indoor value.</i>	<i>Outdated. The 2005 report values were carried forward from CARB's 1994 report on combustion pollutants in the home.</i>		250	80

Approach #2: Adopt Existing Guideline Level(s) based on Risk Reduction

APPROACH	METHOD	BENEFITS	CHALLENGES	1-hr (ppb)	24-hr (ppb)
Guideline Levels with Risk Reduction Approach: Adopt Health Canada Residential Indoor Air Quality Guideline (RIAQG)	For 1-hr: based on what is expected to be attainable in 75% of homes with gas stoves and moderately effective stovetop ventilation. For 24hr: level considered attainable in most Canadian homes	Would reduce NO ₂ exposures and health effects, and more achievable. Most CA homes should be able to reach the 24-hr levels with source reduction and ventilation	May not as strongly support CARB electrification/exposure reduction goals as with a more protective guideline	90	11
For Reference: Existing CARB guidelines	1-hr from 2005 state outdoor value. 24-hr from 1987 WHO indoor value.	Outdated. The 2005 report values were carried forward from CARB's 1994 report on combustion pollutants in the home.		250	80

Approach #3: Develop New Guideline Level(s)

APPROACH	METHOD	BENEFITS	CHALLENGES	1-hr (ppb)	24-hr (ppb)
Develop new guidelines (CARB and OEHHA)	CARB/OEHHA would conduct literature reviews. Determine a Lowest Observed Adverse Effects Level (LOAEL) and divide by a composite uncertainty factor, including literature since 2015	Can be tailored to CA population. Will be completed with partner agencies and familiar process	Will likely produce same result as Health Canada but could take up to 3 years. Key decision would be to determine feasibility	TBD	TBD
<i>For Reference: Existing CARB guidelines</i>	<i>1-hr from 2005 state outdoor value. 24-hr from 1987 WHO indoor value.</i>	<i>Outdated. The 2005 report values were carried forward from CARB's 1994 report on combustion pollutants in the home.</i>		250	80

Implications

- Approach #1 (Health-based)
 - Maximum health benefit
 - Source reduction (electrification) with induction cooking to meet levels (WEACT study)
 - Improved home ventilation and range ventilation will be additional benefit
- Approach #2 (Risk-reduction)
 - Factors in feasibility of meeting guideline levels
 - Assumes some electrification, but improved (CEC) ventilation could be primary means to meet levels

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References - Cont

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Questions and Comments

Bonnie Holmes-Gen, moderator



Primary Questions



What do you view as the greatest health benefits for the respective approaches?



What are the equity implications and barriers for low and middle income communities?



What are the biggest challenges to achieving guideline NO₂ levels?



What are the potential costs to communities?



What technologies and practices will best help achieve reductions of NO₂?
Suggested research for review?



How can we improve our outreach efforts to maximize the benefits of new guidelines?

Thank You!

Email us

IAQguidelines@arb.ca.gov

NO₂ Guidelines Web Page

<https://ww2.arb.ca.gov/our-work/programs/indoor-air-quality/indoor-no2-guidelines-update>

Comments

<https://ww2.arb.ca.gov/public-comments/public-workshop-2-updating-indoor-air-quality-guidelines-nitrogen-dioxide-submit>

Programs Incentivizing Electrification

