DOCKETED	
Docket Number:	19-BSTD-03
Project Title:	2022 Energy Code Pre-Rulemaking
TN #:	234934-2
Document Title:	Appendix A to RMI, Redwood Energy, Guttmann and Blaevoet, Mothers Out Front, NRDC, Sierra Club Comments
Description:	Appendix A to Rocky Mountain Institute (RMI), Redwood Energy, Guttmann & Blaevoet Consulting Engineers, Mothers Out Front, Natural Resources Defense Council (NRDC), and Sierra Club Response to SoCalGas's Comments on Indoor Air Quality
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Organization:	Rocky Mountain Institute
Submitter Role:	Public
Submission Date:	9/28/2020 4:39:37 PM
Docketed Date:	9/28/2020

June 12, 2020

Statewide Codes and Standards Enhancement (CASE) Program
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Re: Comments on Draft Report: Multifamily Indoor Air Quality (2022 Cycle)

Dear Statewide CASE team:

The draft CASE report makes important recommendations to the California Energy Commission (CEC), providing tangible pathways to improve indoor air through building code updates. As a group of scientists, health professionals, experts, and researchers we commend your work in addressing ventilation requirements for range hoods, particularly in setting capture efficiency standards for the first time. In order to achieve health-protective indoor air, more can be done:

1) the committee should utilize more stringent benchmarks for modeling indoor air quality, including calling for a workshop of experts to advise on indoor thresholds; and

2) the final report should recommend additional steps to ensure ventilation is used when cooking: by emphasizing education on the health risks, including provisions for automatic ventilation, and developing requirements for noise levels.

Ventilation Standards Should Apply the Most Protective Air Quality Guidelines

Multiple health studies over the past forty years have investigated the relationship between nitrogen dioxide (NO_2) emissions and health risks. The scientific link has only become stronger in recent years. In 2016, the EPA identified a causal relationship between short term exposures to NO_2 and respiratory effects (as did Canada). Due to this new health evidence of short-term NO_2 exposures, Canada strengthened outdoor NO_2 standards and residential indoor guidelines. The key evidence that NO_2 exposure can exacerbate asthma is from controlled human exposure studies, which found that in adults with asthma, airway responsiveness was identified following NO_2 exposures of 100 ppb for one hour (the same value used in the report's modeling).[1]

It is well-known that children are more susceptible to air pollution and though there are no controlled exposure studies on children, the threshold for health effects may be even lower. A 2013 study of children with asthma in suburban and urban homes measuring month-long averages of indoor NO_2 found that as NO_2 levels increased, so did the severity of asthma.[2] For every 5-ppb increase in NO_2 above a threshold of 6 ppb, the risk of wheeze and the need for medication increased. The study concluded that asthmatic children are at higher risk for more severe asthma symptoms at low levels of NO_2 and the risk rises as NO_2 rises.[3] Gas stoves are a major source of indoor NO_2. The EPA found that homes with gas stoves have 50 – 400% higher concentrations of NO_2 than homes with electric stoves.[4]

One in eight Californians—5 million people—have asthma.[5] Asthma rates are even higher in low-income communities and communities of color; consequently, these communities may be at higher risk of harms resulting from exposure to pollution from gas stoves, as some of the most susceptible populations are those with existing asthma.[6] Additionally, lower income homes may be at a higher risk of exposure to gas stove pollution in the first place, as factors that contribute to higher levels of NO_2 in homes are more common in low-income multifamily housing. These factors include smaller unit size, more people per home, and inadequate ventilation.[7]

Another pollutant of concern is carbon monoxide (CO). While fatal at high doses, CO can cause health effects at low-level exposure, particularly for people with coronary heart disease.[8] In homes without gas stoves, average CO levels are between 0.5 and 5 parts per million (ppm). Homes with gas stoves that are properly adjusted are often between 5 and 15 ppm whereas levels near poorly adjusted stoves can be twice as high: 30 ppm or higher.[9] A 2011–2013 study of 316 California homes that measured CO in homes found that approximately 5 percent had short-term levels that exceed California's ambient air quality standard of 20 ppm over a one-hour period or 9 ppm over an eight-hour period.[10]

The air quality guidelines that the draft CASE report relies upon for range hood capture efficiency requirements are outdated. There is reason to believe that these guidelines may not sufficiently protect the public, especially sensitive communities. After not having updated its indoor air quality guidelines for NOx emissions since 1994,[11] the California Air Resources Board ("CARB") recently began a process to revise those guidelines.[12] The draft CASE report[13] applies the U.S. Environmental Protection Agency's ("EPA") 2010 one-hour outdoor nitrogen dioxide ("NO_2") standards for use indoors.[i,14]

Numerous scientific studies have found this standard is not sufficiently protective of health indoors (or outdoors), especially for the most sensitive populations. As a result, the below table shows that government officials in Canada and the World Health Organization (WHO) have adopted more stringent guidelines for indoor and outdoor thresholds for NO_2 and CO than the EPA.[15]

[i] The draft CASE report (p. 46) states that 100 ppb is a CARB 2016 guideline, however this may be an error and refer instead to the EPA's 2010 100 ppb standard. CARB's one-hour standard is 180 ppb.

Air Pollution Standards and Guidelines for CO and NO_2

Combustion pollutant	Measurement period	Outdoor Air Standards[16]			Indoor Guidelines		Most protective standard or guideline
		CARB	US EPA	Canada[17]	WHO[18]	Canada[19]	
Carbon monoxide	24 hours				6 ppm	10 ppm	6 ppm
	8 hours	9 ppm	9 ppm		9 ppm		9 ppm
	1 hour	20 ppm	35 ppm		30 ppm	25 ppm	20 ppm
	15 min				87 ppm		87 ppm
Nitrogen dioxide	Annual	30 ppb	53 ppb	17 ppb	21 ppb		17 ppb[ii]
	24 hours					11 ppb	11 ppb
	1 hour	180 ppb	**100 ppb**	60 ppb	106 ppb	90 ppb	60 ppb

In other modeling, the CASE team has used a standard other than the EPA standard when it is more protective of health. In the case of particulate matter ($PM_{2.5}$), the CASE team sensibly applied the WHO's more protective guideline for a 24-hour average (25 $\mu g/m^3$) rather than the less protective U.S. EPA outdoor standard (35 $\mu g/m^3$).[20,21] Similarly, in order to protect public health, the CASE team should apply the most protective indoor air guidelines for NO_2 and CO issued by the WHO and Canada.

In order to best protect the health of Californians, the CASE team should:

- Apply the most protective available health guidelines for NO_2: 60 ppb (one-hour) and 11 ppb (long-term) to ensure that in modeling capture efficiency of range hoods, safer indoor levels are met.
- The report is unclear as to whether CO capture rates have been considered and at what level. The final report should model capture rates of CO at the most protective standards: 6 ppm (24 hours), 9 ppm (8 hours), 20 ppm (1 hour), 87 ppb (15 minutes).
- Call for a workshop of leading experts in the field to advise on indoor air quality thresholds for NO_2 and CO to better inform ventilation requirements.

Recommendations Should Better Ensure Ventilation Is Used When Cooking

The draft CASE report finds that occupants used range hoods less than one third of the time while cooking.[22] The number one response why occupants did not use hoods all the time was that they did not feel that ventilation was needed. This is concerning, as two pollutants with known health effects are invisible and odorless: NO_2 and CO. These pollutants produce no smoke and thus many building occupants may not know that ventilation must be used during all cooking events. Considering the strong indoor air and health case for source ventilation (vs. whole house), residents must be educated about the risk of not using range hoods. A range hood is

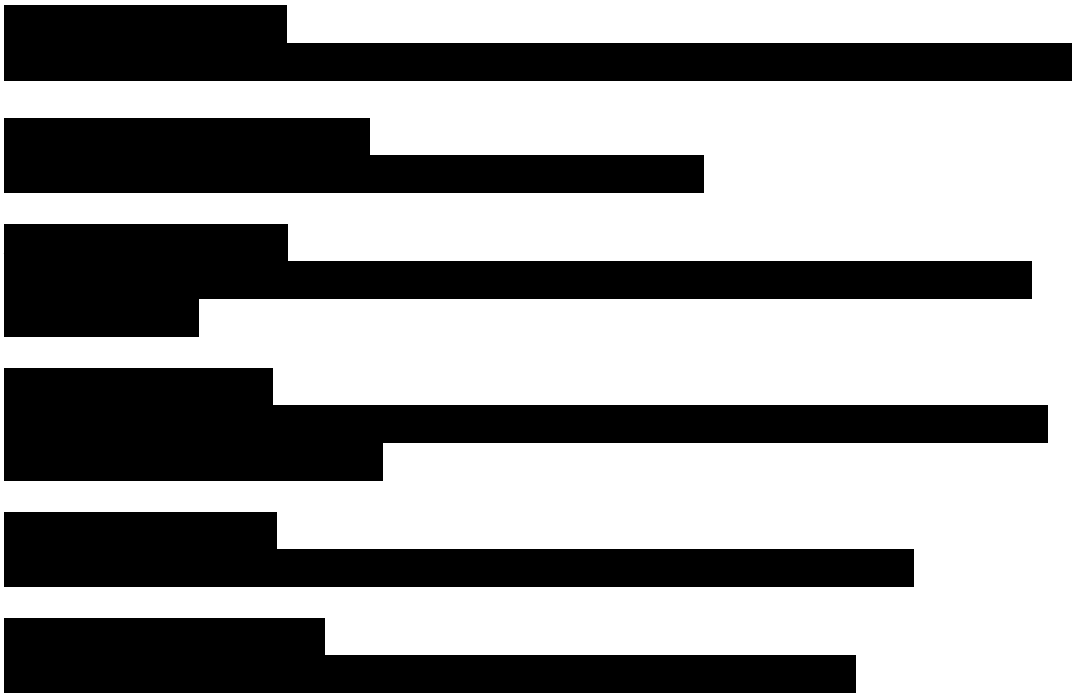
[ii] The lowest value across this row is 17 ppb. However, the 24-hour most protective exposure level is 11 ppb, lower than 17 ppb; to be health-protective, one could apply the lower level, 11 ppb.

only effective when used. To better ensure building occupants are breathing healthy levels of indoor air, the final report should provide provisions or requirements for:

- Automatic ventilation during all cooking events and until the time that pollutant concentrations are reduced to within safe threshold levels.
- Education on the health risk of not using range hoods whenever stoves are on, including warning labels for nitrogen dioxide on gas stoves.
- Development of maximum-sone-level standards to address the noisiness of range hoods, which is a known deterrent to use.[23]

Buildings in California will likely last centuries. These buildings can either work for Californians by promoting healthy indoor air, or work against public health by creating more polluted spaces than the outdoors. The proposed code revisions in the *Multifamily Indoor Air Quality* report take important steps to improve the health in buildings, but currently fall short with respect to NO_2 and CO pollution. To ensure health benefits today and for future generations, the CASE team should benchmark against health-protective standards and recommend additional measures such as automatic ventilation and education to ensure ventilation is employed.

Respectfully submitted,



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[1]1 Integrated Science Assessment (ISA) For Oxides of Nitrogen – Health Criteria (Final Report, 2016). US Environmental Protection Agency, Washington DC, EPA/600/R-15/068, p. 1-18, 2016. https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=310879.

[2] Kathleen Belanger et al, "Household levels of nitrogen dioxide and pediatric asthma severity", Epidemiology 24(2), March 2013, 320-330, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3686297/

[3] Ibid.

[4] Integrated Science Assessment (ISA) For Oxides of Nitrogen – Health Criteria (Final Report, 2016). US Environmental Protection Agency, Washington DC, EPA/600/R-15/068, p. 2-38, 2016. https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=310879.

[5] California Dep't of Public Health, Asthma's Impact on California: Recent Data from the California Breathing Asthma Program (2013), https://www.cdph.ca.gov/Programs/CCDPHP/DEODC/EHIB/CPE/CDPH%20Document%20Library/AsthmaImpactFactSheet.pdf.

[6] *See, e.g.*, Michael Guarnieri & John R. Balmes, *Outdoor Air Pollution and Asthma*, 383 LANCET 1581 (2014), *available at* https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4465283; Christina M. Pacheco et al., *Homes of Low-Income Minority Families with Asthmatic Children Have Increased Condition Issues*, 35 Allergy and Asthma Proceedings 467 (2014), *available at* https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4210655/#!po=78.0000; Cheryl Katz, *People in Poor Neighborhoods Breathe More Hazardous Particles*, Scientific American (Nov. 2012), https://www.scientificamerican.com/article/people-poor-neighborhoods-breate-more-hazardous-particles; Hatice S. Zahran et al., Vital Signs: Asthma in Children – United States, 2001 – 2016, Centers for Disease Control and Prevention Morbidity and Mortality Weekly Report (Feb. 9, 2018), http://dx.doi.org/10.15585/mmwr.mm6705e1; Centers for Disease Control and Prevention, Summary Health Statistics: National Health Interview Survey: 2015 at tbl. C-1 (2017), http://www.cdc.gov/nchs/nhis/shs/tables.htm.

[7] Gary Adamkiewicz et al., *Moving Environmental Justice Indoors: Understanding Structural Influences on Residential Exposure Patterns in Low-Income Communities*, 101 Am. J. Public Health S238 (2011), *available at* https://www.ncbi.nlm.nih.gov/pubmed/21836112#.

[8] Integrated Science Assessment for Carbon Monoxide (CO), p. 2–10, https://www.epa.gov/isa/integrated-science-assessment-isa-carbon-monoxide.

[9] Carbon Monoxide's Impact on Indoor Air Quality, US Environmental Protection Agency, https://www.epa.gov/indoor-air-quality-iaq/carbon-monoxides-impact-indoor-air-quality

[10] Nasim A. Mullen, Jina Li, and Brett C. Singer, Participant Assisted Data Collection Methods in the California Healthy Homes Indoor Air Quality Study of 2011-13, August 2013, Ernest Orlando Lawrence Berkeley National Laboratory, p. 237, https://eta-publications.lbl.gov/sites/default/files/participant_assisted_data_collection_lbnl-6374e_2.pdf

[11] California Air Resources Board, Combustion Pollutants in Your Home (1994), *available at* https://ww3.arb.ca.gov/research/indoor/combustf.htm; see California Air Resources Board, Report to the California Legislature: Indoor Air Pollution in California 136-37, 144 (2005), *available at* https://ww2.arb.ca.gov/sites/default/files/classic//research/apr/reports/l3041.pdf.

[12] Emily C. Dooley, *California Wants to See How Cooking With Gas Affects Indoor Air*, Bloomberg Green (May 8, 2020), https://www.bloomberg.com/news/articles/2020-05-08/california-wants-to-see-how-cooking-with-gas-affects-indoor-air.

[13] Codes and Standards Enhancement ("CASE") Initiative team on Multifamily Indoor Air Quality, https://title24stakeholders.com/measures/cycle-2022/multifamily-indoor-air-quality/.

[14] Marian Goebes et al., 2022 California Energy Code (Title 24, Part 6), Multifamily Indoor Air Quality – Kitchen Range Hood Capture Efficiency Requirement (Mar. 23, 2020), *available at* https://title24stakeholders.com/wp-content/uploads/2020/01/T24-2022-Submeasure-Summary_KITCHENRANGEHOOD.pdf; Codes and Standards Enhancement (CASE) Initiative 2022 California Energy Code, Multifamily Indoor Air Quality Draft CASE Report, 2022-MF-IAQ-D (May 2020), https://title24stakeholders.com/wp-content/uploads/2018/10/MF-IAQ_Draft-CASE-Report_Statewide-CASE-Team.pdf.

[15] *See* Health Canada, Residential Indoor Air Quality Guideline: Nitrogen Dioxide (2015), *available at* https://www.canada.ca/en/health-canada/services/publications/healthy-living/residential-indoor-air-quality-guideline-nitrogen-dioxide.html; World Health Organization (Regional Office for Europe), WHO Guidelines for Indoor Air Quality: Selected Pollutants (2010), *available at* https://apps.who.int/iris/handle/10665/260127. *Compare* U.S. EPA, NAAQS Table, https://www.epa.gov/criteria-air-pollutants/naaqs-table (Apr. 10, 2020).

[16] CARB, Ambient air quality standard. https://ww3.arb.ca.gov/research/aaqs/aaqs2.pdf?_ga=2.234597526.924500990.1586297281-173368984.1561935623

[17] Canadian ambient air quality standard. http://airquality-qualitedelair.ccme.ca/en/

[18] WHO Indoor Air Quality Guidelines: Household Fuel Combustion, 2014. https://www.who.int/airpollution/guidelines/household-fuel-combustion/IAQ_HHFC_guidelines.pdf

[19] Health Canada, Residential indoor air quality guidelines, 2018. https://www.canada.ca/en/health-canada/services/air-quality/residential-indoor-air-quality-guidelines.html#a1

[20] Codes and Standards Enhancement (CASE) Initiative 2022 California Energy Code, Multifamily Indoor Air Quality Draft CASE Report, 2022-MF-IAQ-D (May 2020), p. 46, https://title24stakeholders.com/wp-content/uploads/2018/10/MF-IAQ_Draft-CASE-Report_Statewide-CASE-Team.pdf.

[21] Environmental Protection Agency, NAAQS Table, https://www.epa.gov/criteria-air-pollutants/naaqs-table

[22] Codes and Standards Enhancement (CASE) Initiative 2022 California Energy Code, Multifamily Indoor Air Quality Draft CASE Report, 2022-MF-IAQ-D (May 2020), p. 53, https://title24stakeholders.com/wp-content/uploads/2018/10/MF-IAQ_Draft-CASE-Report_Statewide-CASE-Team.pdf.

[23] Codes and Standards Enhancement (CASE) Initiative 2022 California Energy Code, Multifamily Indoor Air Quality Draft CASE Report, 2022-MF-IAQ-D (May 2020), p. 54, https://title24stakeholders.com/wp-content/uploads/2018/10/MF-IAQ_Draft-CASE-Report_Statewide-CASE-Team.pdf.