The Health Effects From Gas Stoves

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California Building Decarbonization Coalition

AGENDA

1. Introductions
2. Overview of recent report
3. Outdoor air quality: a few words
4. Zoom in on California
5. Upcoming work
6. Questions & Discussion

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MOTHERS OUT FRONT
MOBILIZING FOR A LIVABLE CLIMATE

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SIERRA CLUB

HEALTH EFFECTS FROM GAS STOVE POLLUTION

PUBLISHED MAY 5, 2020

Report Summary

Synthesizes 8 key findings:

1. Indoor air unregulated
2. Gas stoves emit numerous pollutants
3. Indoor air pollution can reach levels that would be illegal outdoors
4. Well-documented health risks
5. Children particularly at risk
6. Lower-income households may be at higher risk
7. Ventilation important but not sole strategy
8. Electric cooking is cleaner option

Spotlights 4 case studies of action:

- Canada sets health-based standards & guidelines
- California all-electric movement
- Massachusetts Medical Society commits to issue
- Prioritization of environmental justice communities

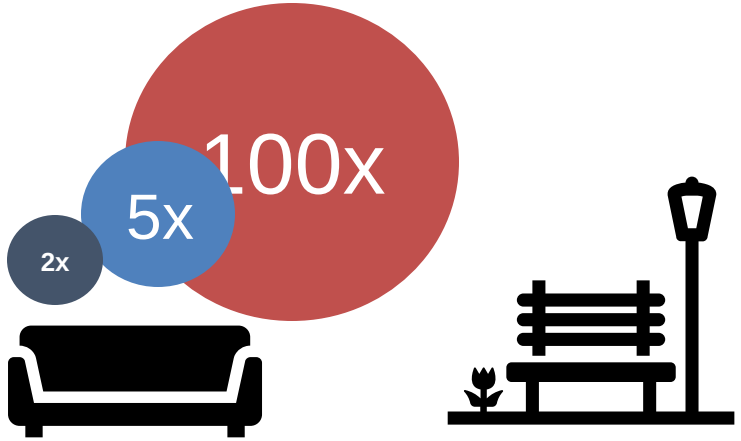
Provides practical recommendations for:

- Policymakers
- Individuals
- Healthcare professionals
- Researchers & funders

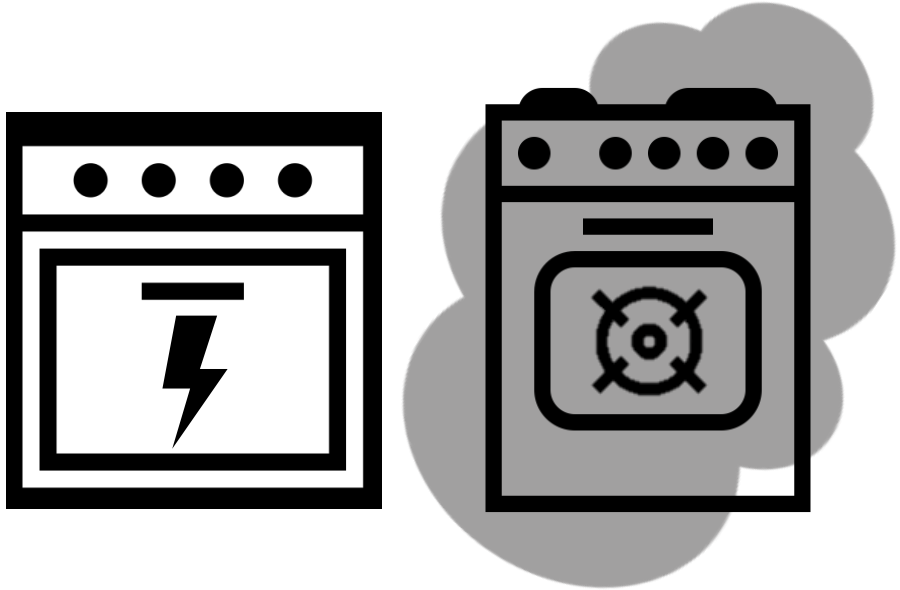
Indoor Air Quality is Often Worse than Outdoor Air Quality

We spend up to **90%** of our time indoors

EPA states indoor pollutant levels may be **2 to 5** and as much as **100 times** higher indoors than outdoors



Homes with gas stoves have **50 - 400%** higher NO_2 emissions than homes with electric stoves



https://rmi.org/insight/gas-stoves-pollution-health/

Differentiating Pollutants from Cooking Food vs. Gas Fuel

Pollutants Generated from Cooking Food (regardless of stove type)
Particulate Matter (PM_{10}) Small particles with a diameter less than 10 micrometers. Commonly measured in cooking activities like frying or broiling with the highest emissions levels found during the oven self-cleaning cycle.[17]
Particulate Matter ($PM_{2.5}$) Small particles with a diameter less than 2.5 micrometers. $PM_{2.5}$ can penetrate deep into the lungs and even enter the bloodstream.[19] Stove tests show emissions are dependent on a number of factors such as the type of food cooked, cooking temperature, type of oil used, and type of fuel/stove used.[20]
Ultrafine Particles (UFP) These tiny particles are less than 100 nanometers (nm) in diameter and are hazardous to health. Cooking is the main source of UFP in homes, particularly those with gas stoves.[25] Gas stoves and electric coil resistance stoves emit high quantities of UFP, particularly smaller than 10 nm in diameter.[26]

Pollutants Associated With Gas Stoves
Particulate Matter ($PM_{2.5}$) Unlike electric stoves, gas stoves emit $PM_{2.5}$ in the absence of cooking food (i.e., from the flames). Although cooking food emits $PM_{2.5}$, tests show $PM_{2.5}$ emissions from gas stoves can be two times higher than from electric stoves.[18]
Nitrogen Oxides (NO_x) When nitrogen and oxygen react to each other, especially at high temperatures, they produce several toxic gases. NO_2 and NO are the principal gases associated with combustion sources (collectively known as NO_x).[21,22] *A 2001 laboratory study showed no rise in NO_x when using an electric stove.[23] *A study published in 2016 showed that after subtracting outdoor contribution, all-electric homes had NO_x levels close to zero.[24]
Nitrogen Dioxide (NO_2) Nitric Oxide is oxidized in the air to form NO_2. More data exists on NO_2 than NO. NO_2 is regulated by the EPA and thus is the component most studied and considered by the EPA in terms of health effects.[27]
Nitric Oxide (NO) A primary gas associated with combustion; NO is also a precursor to NO_2. *A 2001 major study found NO concentrations on electric stoves were insignificant compared to gas stoves.[28]
Carbon Monoxide (CO) An odorless, colorless gas. A 2011–2013 study found that gas stoves can substantially increase the risk of elevated CO in the home.[29]
Formaldehyde (CH_2O or HCHO) A known human carcinogen. Exposures at levels that occur in homes have been associated with human health impacts such as lower respiratory infections.[30,31] A new test of one gas stove shows that simmering on low heat for multiple hours can produce significant exposure levels if ventilation is not used.[32]
Other Emissions from cooking also include various volatile organic compounds (VOCs) such as benzene and acrolein as well as polycyclic aromatic hydrocarbons (PAH).[33]

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Indoor NO2 Emissions from Gas Stoves Often Exceed Outdoor Standards

Outdoor Standards for NO_2	1-hr average (ppb)
US National Standard (EPA)	100
Canadian National Standard	60
California State Standard	180
Indoor Guidelines for NO_2	**1-hr average (ppb)**
Canada	90
World Health Organization	106

Measured NO_2 Emissions from Gas Stoves	Peak (ppb)
Baking cake in oven	230
Roasting meat in oven	296
Frying bacon	104
Boiling water	184
Gas cooktop - no food	82–300
Gas oven - no food	130–546

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3 Main Factors Why Children are More Susceptible to Illnesses Associated with Air Pollution than Adults

Higher **breathing rates** and greater levels of **physical activity**

Higher lung surface to body weight ratios and smaller bodies

Immature respiratory and immune systems

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Health Effects of NO2 in Children May Include:

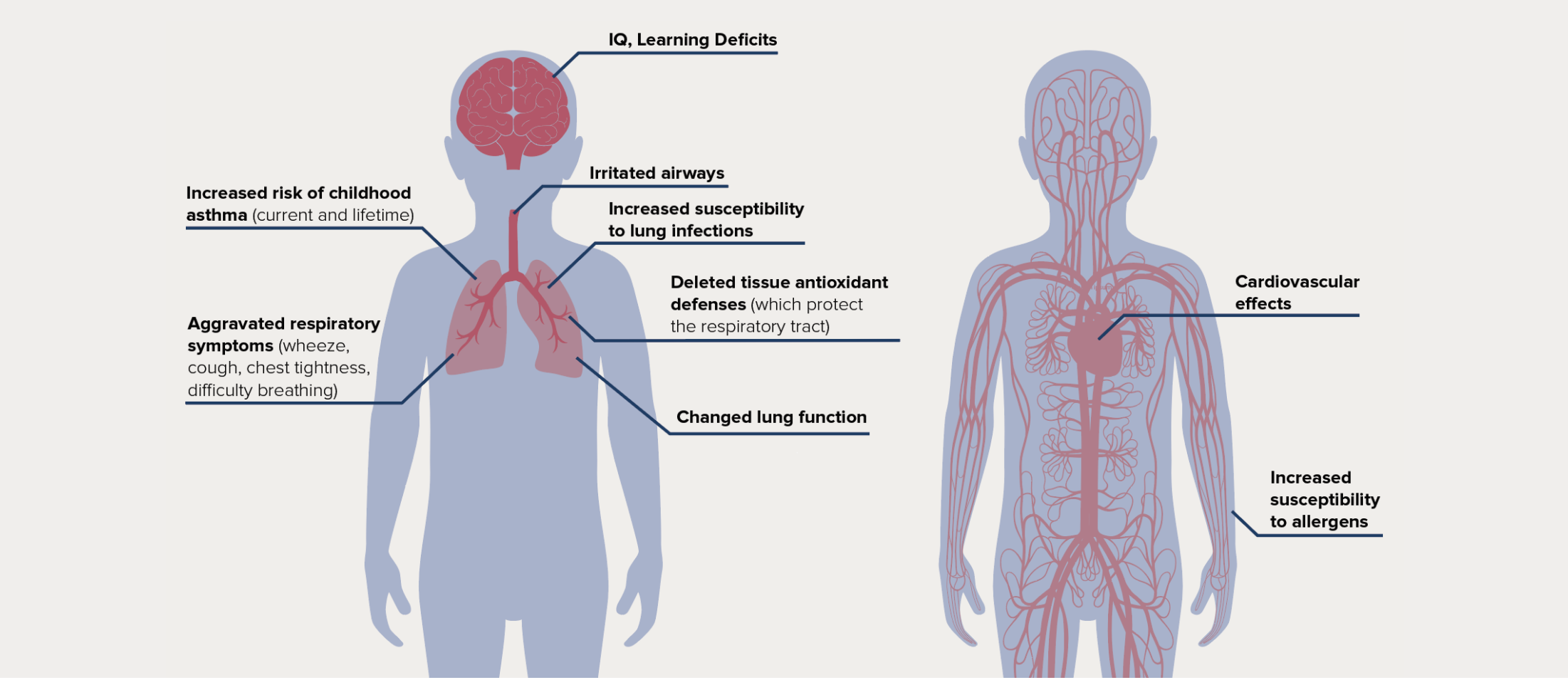

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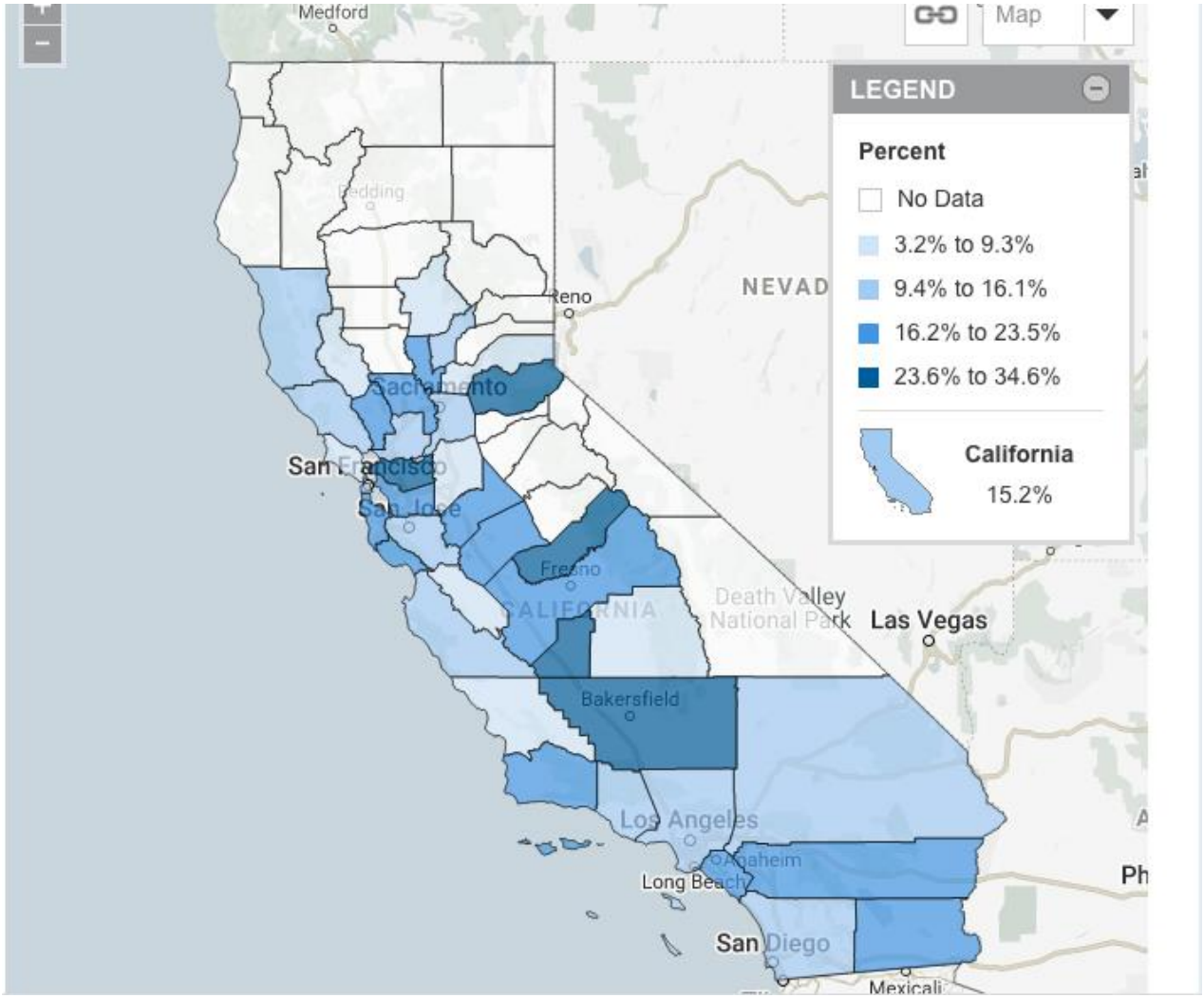
Table ES-1 Causal determinations for relationships between nitrogen dioxide exposure and health effects from the 2008 and 2016 Integrated Science Assessment for Oxides of Nitrogen.

Exposure Duration and Health Effects Category[a]	Causal Determination[b]	
	2008 Integrated Science Assessment	2016 Integrated Science Assessment
Short-Term Nitrogen Dioxide Exposure (minutes up to 1 month)		
Respiratory effects Section 5.2, Table 5-39	Sufficient to infer a likely causal relationship	Causal relationship
Cardiovascular effects Section 5.3, Table 5-52	Inadequate to infer the presence or absence of a causal relationship	Suggestive of, but not sufficient to infer, a causal relationship
Total mortality Section 5.4, Table 5-57	Suggestive of, but not sufficient to infer, a causal relationship	Suggestive of, but not sufficient to infer, a causal relationship
Long-Term Nitrogen Dioxide Exposure (more than 1 month to years)		
Respiratory effects Section 6.2, Table 6-5	Suggestive of, but not sufficient to infer, a causal relationship	Likely to be a causal relationship
Cardiovascular effects and diabetes[c] Section 6.3, Table 6-11	Inadequate to infer the presence or absence of a causal relationship	Suggestive of, but not sufficient to infer, a causal relationship
Reproductive and developmental effects[c] Sections 6.4.2, 6.4.3, and 6.4.4, Table 6-14	Inadequate to infer the presence or absence of a causal relationship	Fertility, reproduction, and pregnancy: Inadequate to infer a causal relationship
		Birth outcomes: Suggestive of, but not sufficient to infer, a causal relationship
		Postnatal development: Inadequate to infer a causal relationship
Total mortality Section 6.5, Table 6-18	Inadequate to infer the presence or absence of a causal relationship	Suggestive of, but not sufficient to infer, a causal relationship
Cancer Section 6.6, Table 6-20	Inadequate to infer the presence or absence of a causal relationship	Suggestive of, but not sufficient to infer, a causal relationship

Asthma is the number one chronic disease in children

- More than **1** in **7** children in California have an asthma diagnosis
- In some CA counties **1** in **4** kids have asthma



- U.S. EPA. Integrated Science Assessment (ISA) For Oxides of Nitrogen – Health Criteria (Final Report, 2016). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-15/068, 2016

Health Effects of Carbon Monoxide by CO Levels & Alarm Thresholds

CO Level	UL 2034 Alarm Thresholds[46]	Health Effects[47]
30 ppm or less	No alarm until after 30 days[48]	Most healthy people will not experience symptoms from prolonged exposure to 1–70 ppm. Some people with heart problems may experience more chest pain.
70 ppm	Alarm after 1–4 hours (but not less than 1 hour)	
		At levels above 70 ppm, symptoms become more noticeable and can include headache, fatigue, and nausea.
150 ppm	Alarm after 10–50 minutes	Sustained concentrations above 150 to 200 ppm can lead to disorientation, unconsciousness, and death.
400 ppm	Alarm after 4–15 minutes	

https://rmi.org/insight/gas-stoves-pollution-health/

Lower-income Households May be at a Higher Risk of Exposure to Gas Stove Pollution

FACTORS CONTRIBUTING TO HIGHER LEVELS OF NO2 IN HOMES:

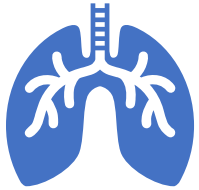
Smaller unit size

More people per home

Older homes, inadequate ventilation

Using the stove/ oven for supplemental heat

Higher exposure to outdoor pollution



Greater asthma burden

https://rmi.org/insight/gas-stoves-pollution-health/

Transitioning to Electric Options Can Yield Health Benefits

A study of two public housing apartment buildings found improved health impacts when moving to "green" housing.

Switching from gas to electric stoves could be a contributor to the evidenced reductions, which they cite is supported by the fact that cooking times did not change.

NO_2 levels decreased by 65%

https://rmi.org/insight/gas-stoves-pollution-health/

Recommendations for Individuals

TO REDUCE OR ELIMINATE EXPOSURE TO GAS STOVE POLLUTION

Install & maintain a CO detector

If available, run your exhaust hood while cooking

Open a window while cooking

Cook on the back burners

Use other electric appliances like toaster oven or kettle.

Try a plug-in induction stove ($50)

Switch to an electric/ induction stove

https://rmi.org/insight/gas-stoves-pollution-health/

Recommendations for Policymakers

Indoor Air Quality Guidelines	Regulators and building commissions adopt health-based guidelines that protects the most sensitive populations
Building Codes	Must require adequate ventilation & other protections (such as low-level CO detectors, automatic ventilation)
Warning Labels	Regulators require manufacturers to warn consumers about the dangers of gas stove pollution
Incentives	Financial incentives, such as tax credits or rebates, should be made available (plug-in induction cooktop or for switching to electric)
Public Buildings & Funds	Eliminate gas stove pollution as soon as practical (including in schools & low-income housing). Funds should not be used to purchase/install appliances that could pose a health risk.
Landlords	Require landlords to provide notice to tenants about the gas stove pollution risk. (include options: induction cooktops, stove replacement, ventilation to outdoors.

https://rmi.org/insight/gas-stoves-pollution-health/

MEDIA HITS

FEATURED IN 150+ ORIGINAL ARTICLES & REPRINTED STORIES INCLUDING HIGH-PROFILE COVERAGE

Daily Mail

Gas stoves are 'exposing millions of Americans to dangerous pollutants and give children a 42% higher risk of developing asthma'

A report by RMI warns against the dangers of using a gas stove for cooking at home as it can expose people to indoor air pollution and expose children to a higher risk of developing asthma.

Vox

Gas stoves may routinely generate unsafe levels of indoor air pollution

Recent research has shown that indoor air pollutants pose more of a threat than previously believed. RMI's latest report finds that gas stoves could be exposing tens of millions to

Bloomberg Law

Post-crisis infrastructure must be built with low carbon materials

The Louisiana House of Representatives approved a bill that would ban local governments from prohibiting utility connections, including natural gas hookups. However, natural gas hookups do raise some health concerns as pointed out in

Bloomberg Green

California wants to see how cooking with gas affects indoor air

California air regulators are looking at indoor air quality which includes the differences between natural gas and electric stoves. Brady Seals comments on how studys like this have been going on for the past 40 years and we are now looking at new urgency to an old problem.

The Guardian

Gas stoves making indoor air up to five times dirtier than outdoor air, report finds

A new report by RMI finds that gas stoves expose millions of people to indoor air pollution levels that would be illegal is they were outside.

FOX 35

Gas stoves may be harmful to respiratory health, report suggests

A recent report from RMI warns of the danger of cooking with gas stoves, which is a source of harmful indoor pollution.

SA

Coronavirus Lockdowns May Raise Exposure to Indoor Air Pollution

With more people staying at home outdoor air quality has improved dramatically. However, according to a new report from RMI, homes with gas stoves face higher amounts of air pollution which can lead to a variety of lung and heart

POLITICO

In Politico's Morning Energy report, RMI's latest report on indoor air pollution from gas stoves. Homes with gas stoves have approximately 50% to 400% higher than average nitrogen dioxide concentrations.

Mother Jones

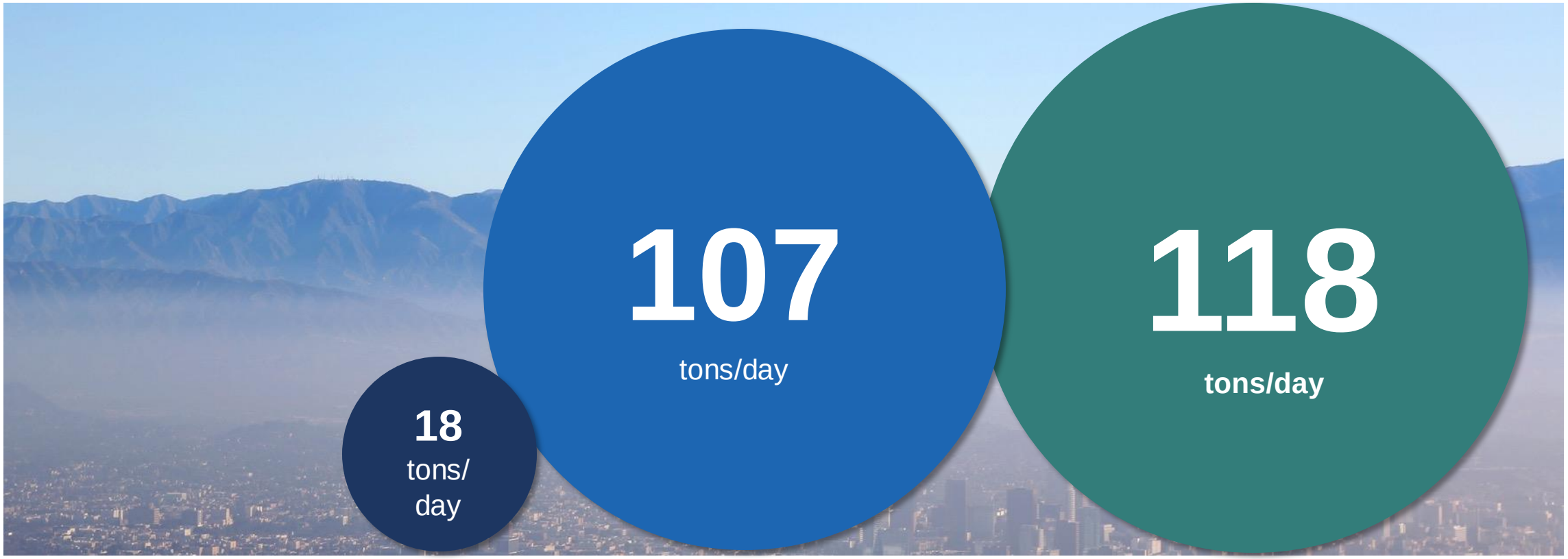
The Gas Industry Is Paying Instagram Influencers to Gush Over Gas Stoves

Not pictured: toxic fumes.

A FEW WORDS ON OUTDOOR AIR POLLUTION

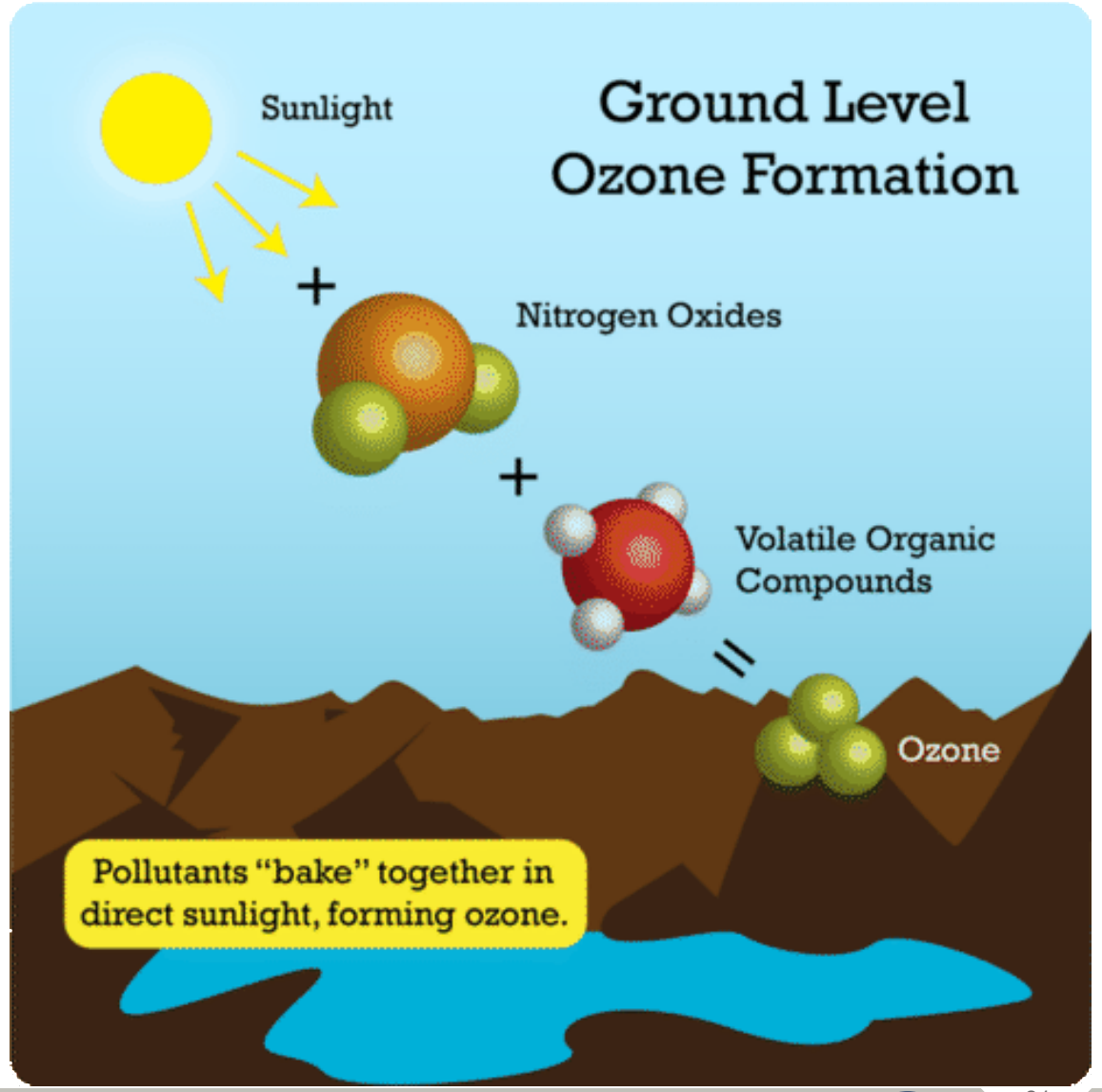
In CALIFORNIA, burning fossil fuels in buildings generates nearly as much NOx as light-duty passenger vehicles and more than five times as much as NOx as power plants

Nitrogen Oxides (NO_X) in California



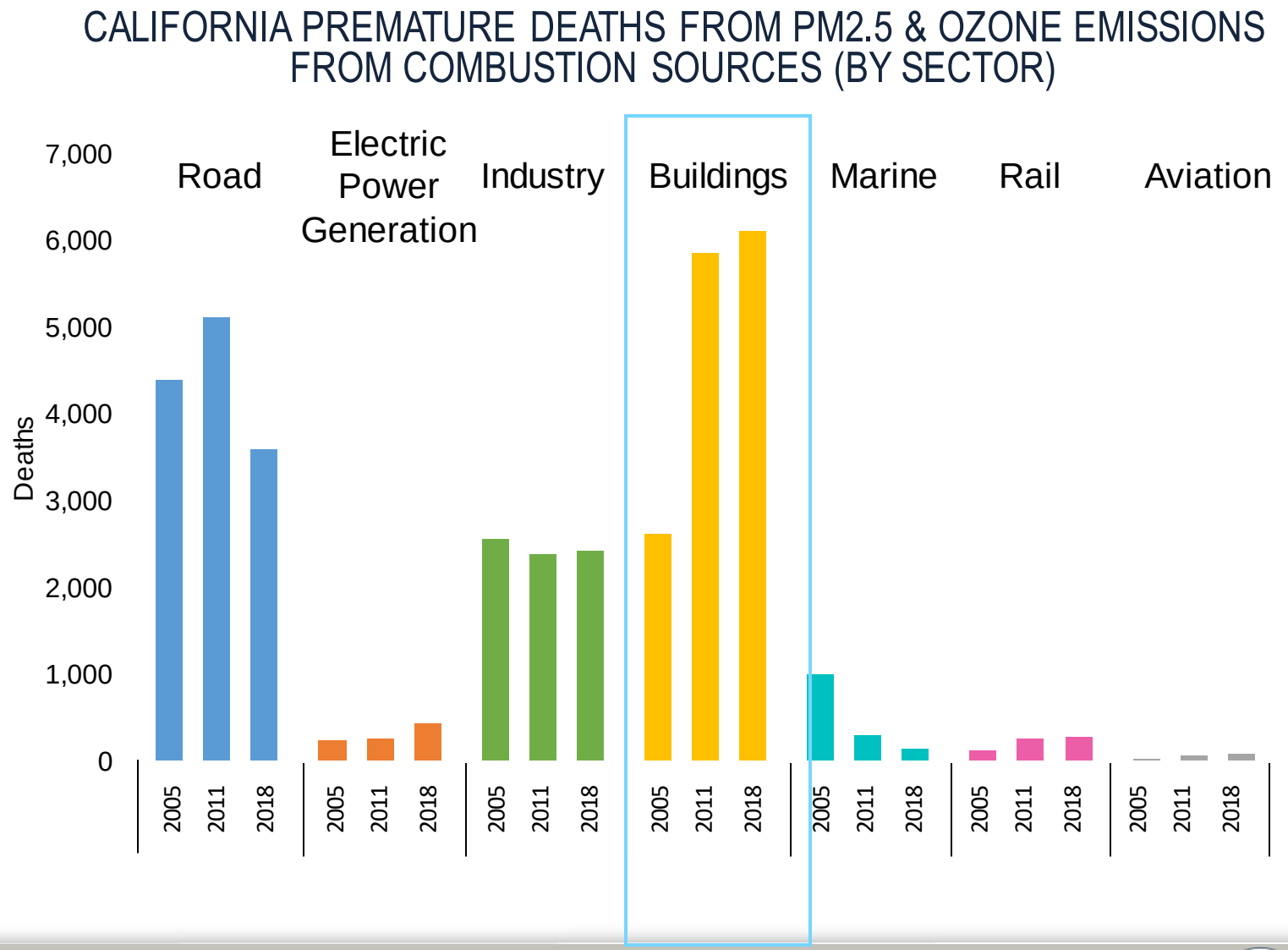
Source: CARB

NOx ARE PRECURSOR EMISSIONS TO BOTH OZONE & SECONDARY PM2.5

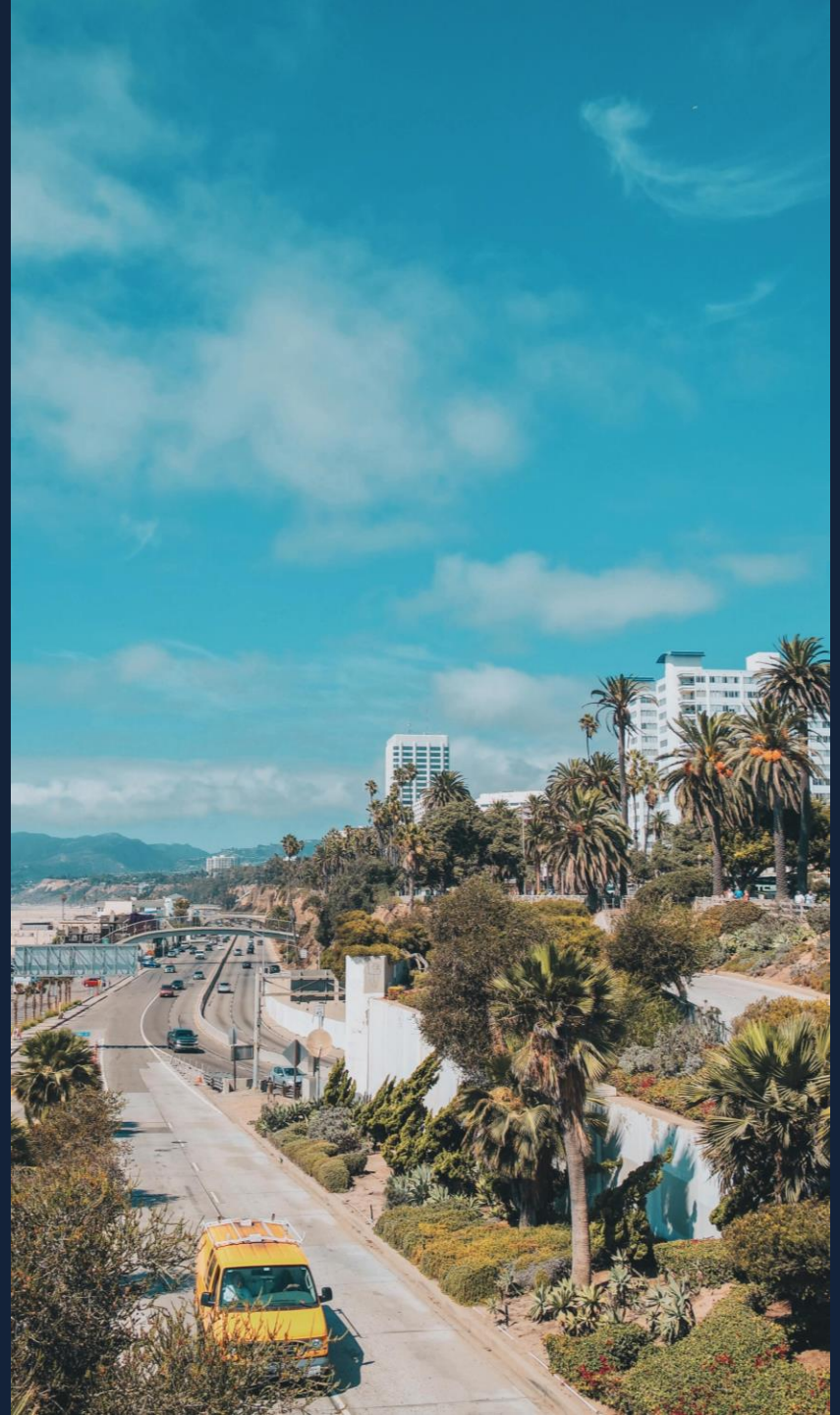


http://www.clearairbc.ca/visibility/Pages/Emission-Sources.aspx & https://www.ck12.org/book/ck-12-earth-science-for-middle-school/section/22.1/

Buildings are the #1 Source of Pollution-Related Premature Deaths



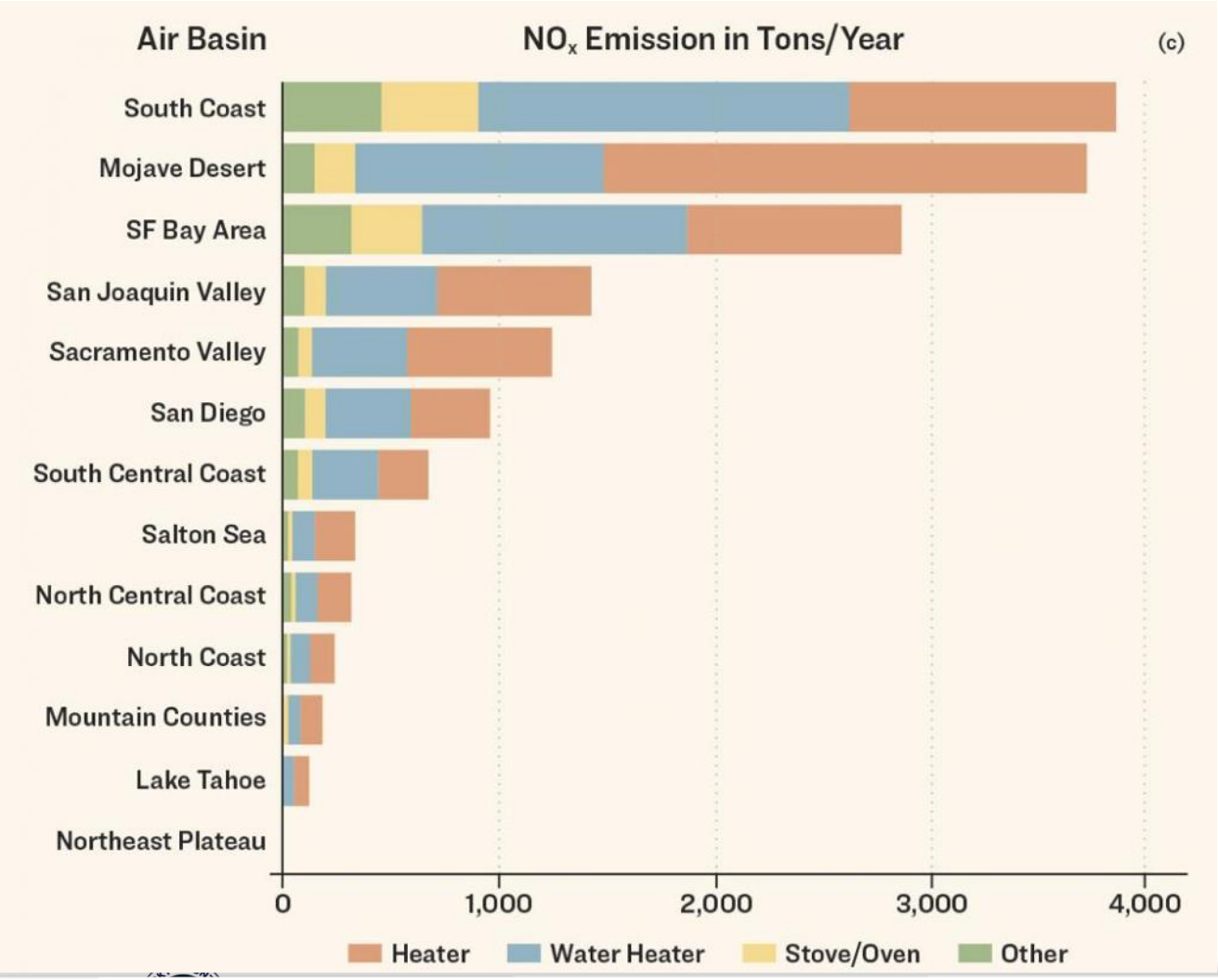
Source: Dedoussi et al., Nature Feb 2020 (MIT study- supplemental material). Graph depicts in-state and cross-state pollution.
**all combustion emission sources include gas, wood, oil, propane, etc. from the commercial and residential building sector.*

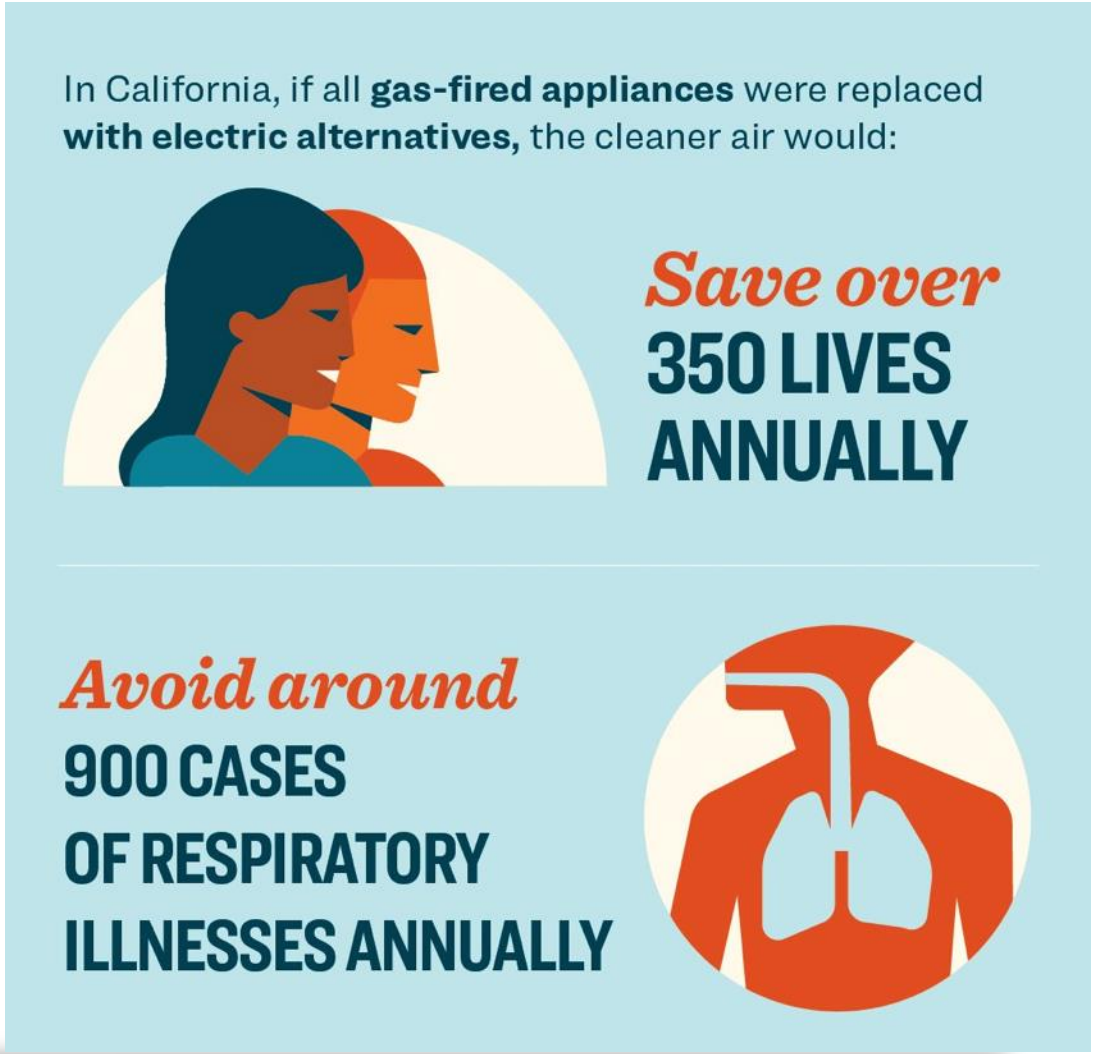


CALIFORNIA

A recent UCLA report modeled the emissions & health impacts of gas in buildings

Gas appliances release nearly 16,000 tons/year of NOx outdoors – reducing these emissions would result in health benefits





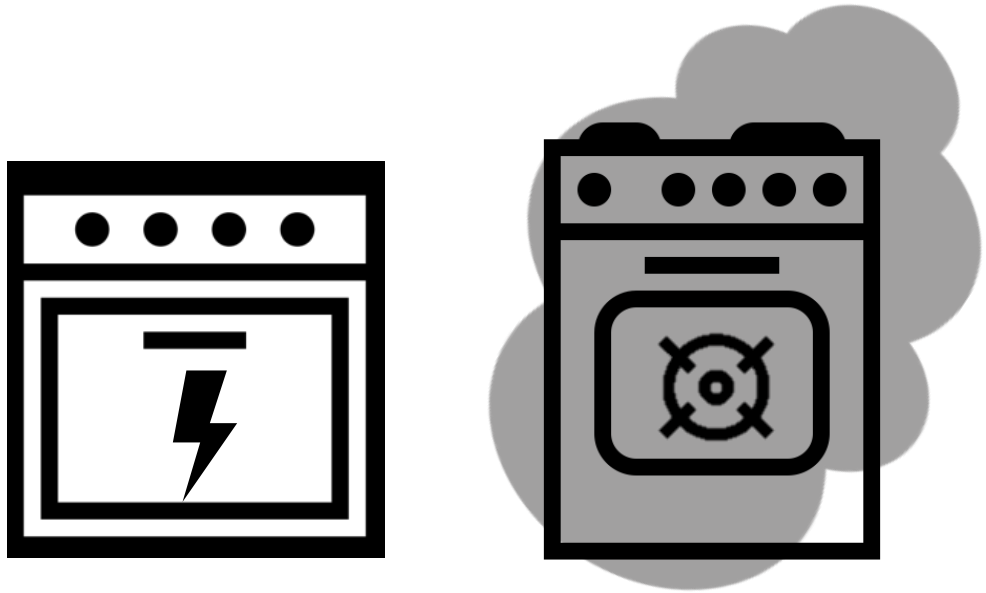
*2018 scenario modeled from from nitrogen oxides (NOX) and primary PM2.5
Source: Dr. Yifang Zhu et al., UCLA (2020)

CARB's NO_2 Indoor Air Quality Guidelines are Outdated/Unenforced

Indoor Guidelines		
	Short-term (1-hour) ppb	Long-term (annual) ppb
WHO	100	20
Canada	90	11

Outdoor Standards (Indoor Benchmark)		
	Short-term (1-hour) ppb	Long-term (annual) ppb
California	180	30
US (EPA)	100	53
Canada	60	17
Australia (current)	120	30
Australia (requested)	72	9

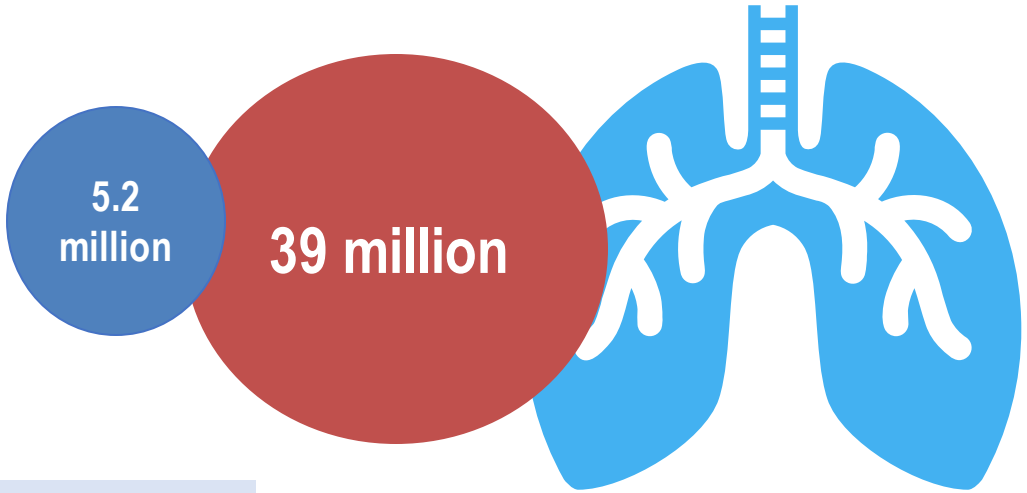
Homes with gas stoves have **50 - 400%** higher NO_2 emissions than homes with electric stoves

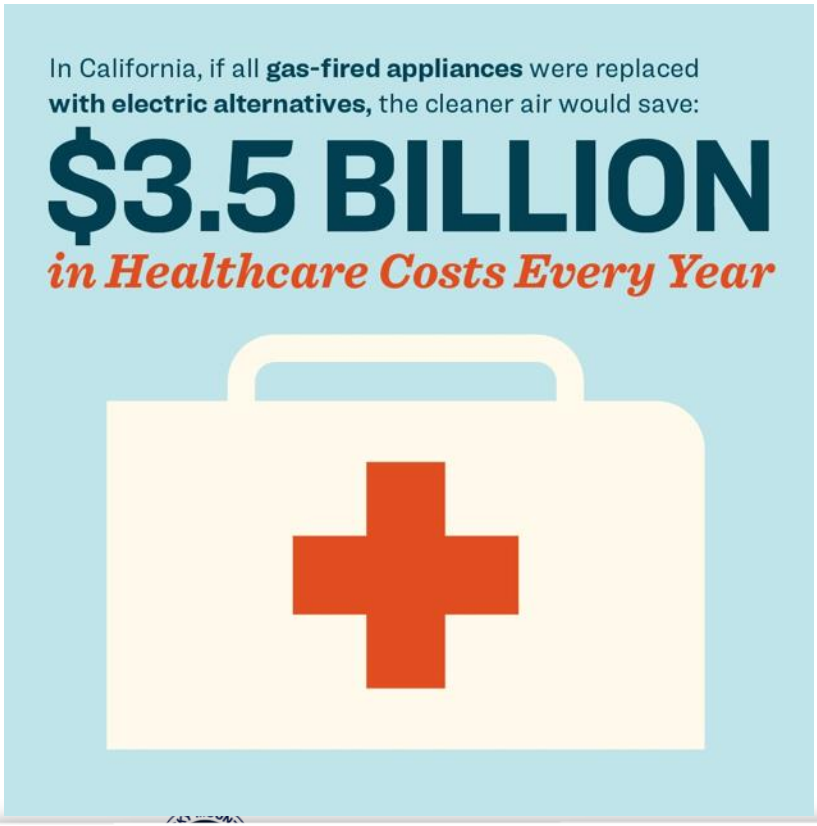


Sources: US EPA, World Health Organization, CARB, Health Canada, Lung Foundation Australia

What is the health cost of gas appliances? It is not zero.

Approximately **5.2 million** Californians have asthma. Annual statewide cost of asthma $11B.





In 2018, an Australian study found that **12.3%** of the childhood asthma burden is attributable to exposure to **gas stove pollution**.

Average cost of each asthma hospitalization:
$33,000 (2010)

Cost of an electric stove:
$500-$1,000

Sources: California Department of Public Health (2015-17 data), CARB, Knibbs et al., Medical Journal of Australia (2018), UCLA (2020)

UPCOMING WORK

- **Harvard study: Health cost of building vs. coal emissions**
  - (Sept 2020, peer-reviewed)
- **California revision to indoor air quality guidelines**
  - (early stages)

THANKS
&
QUESTIONS?