

Health Impacts of Methane (aka “Natural”) Gas

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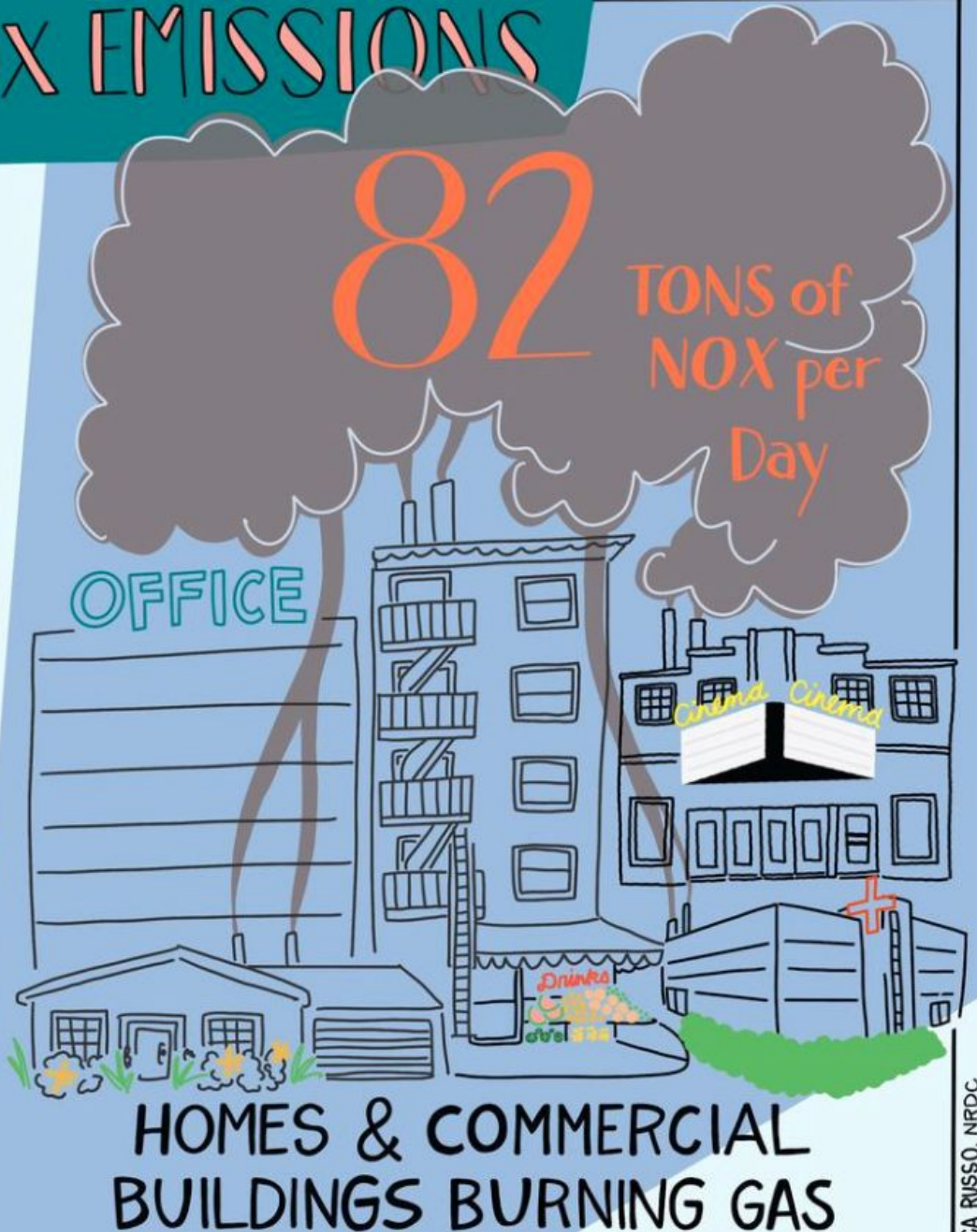








NOX EMISSIONS



SOURCE: CALIFORNIA AIR RESOURCES BOARD 2019 NO_x EMISSIONS ESTIMATES

JESSICA RUSSO, NRDC

Decreasing outdoor air pollution from gas furnaces etc saves lives and money

- California study: if all residential appliances were transitioned from gas to electric...
- There would be 354 fewer deaths per year
- It would save 3.5 million \$\$\$ in health costs per year



Pollutants Produced by Stoves and Ovens

Cooking with electricity:

- Particulate matter
(PM 2.5)

Cooking with gas:

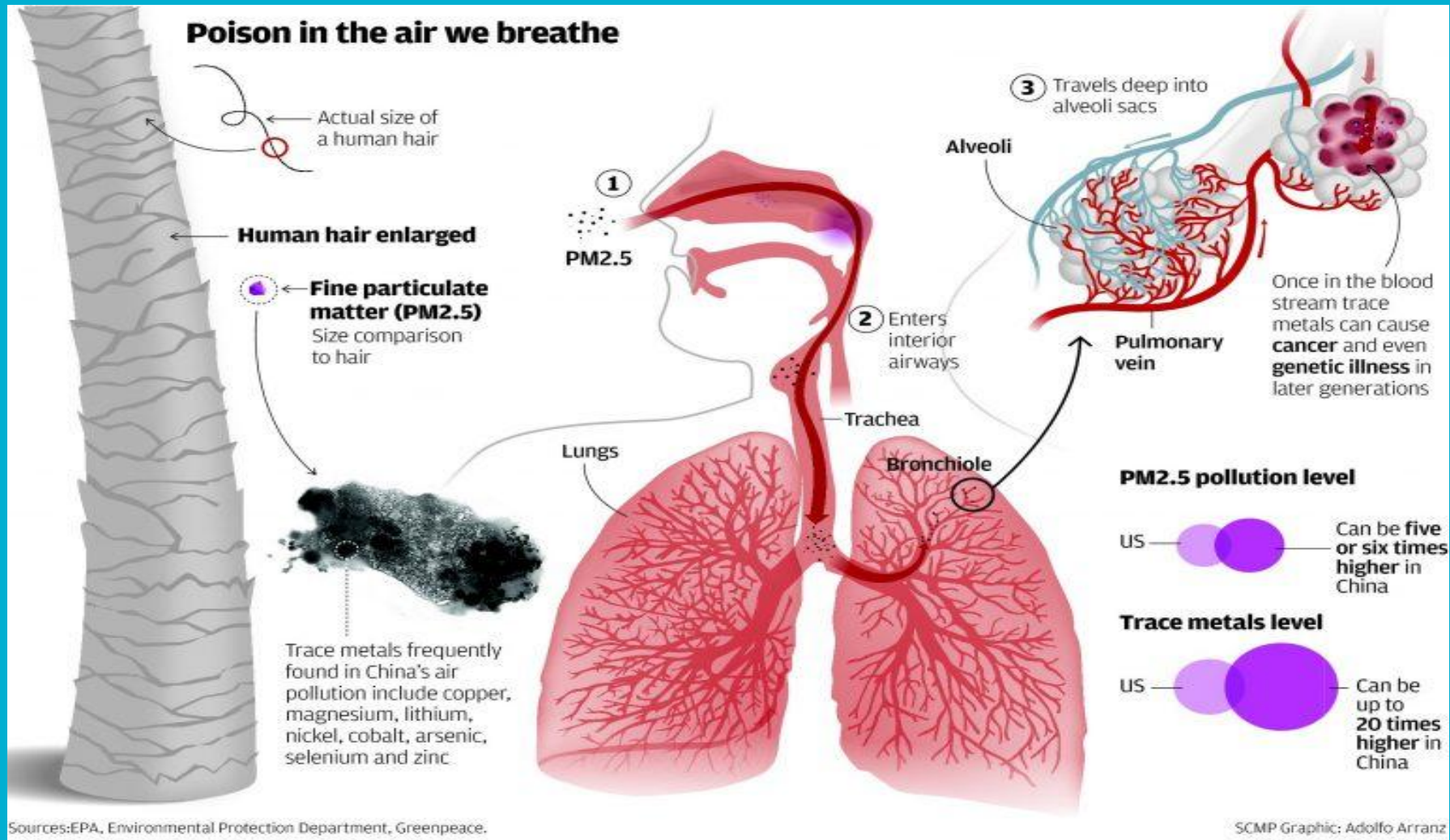
- Particulate matter
(PM 2.5) - twice as much
- Carbon monoxide (CO)
- Nitrogen dioxide (NO₂)
- Formaldehyde
- Benzene and other carcinogens
in unburned gas (leaks)

Car exhaust

- particulate matter (PM2.5)
- carbon monoxide (CO)
- nitrogen dioxide (NO₂)




Particulate Matter: The Silent Killer



Health Effects of Particulate Matter (PM2.5)

Gas stoves may emit twice as much PM 2.5 as electric stoves

- Acute exposure to PM  high blood pressure and risk of stroke
- Chronic exposure increases the risk of
 - Premature mortality
 - Asthma
 - Premature births and low birth weight babies

Carbon monoxide(CO)



- CO displaces Oxygen
- 393 people died in US (2015) from CO
- Heart and brain affected first
- Chronic low levels may also be harmful

Nitrogen dioxide: NO₂

- Outdoor standard is 100 PPB for an hour.
- No indoor standard for NO₂.
- On average, we spend 90% of our time indoors.
- Gas stoves emit levels of NO₂ that would be illegal outdoors.
- NO₂ levels are 50% to 400% higher in homes that cook with gas.
- Levels of NO₂ rise to this level in a few minutes.

Childhood Asthma and Gas stoves



Gas stoves and Childhood Asthma

- Asthma is the number one chronic disease in children.
- Meta-analysis: on average 42% increase in the risk of asthma symptoms in children living in homes with gas stoves, and a 24% increased risk for lifetime asthma.

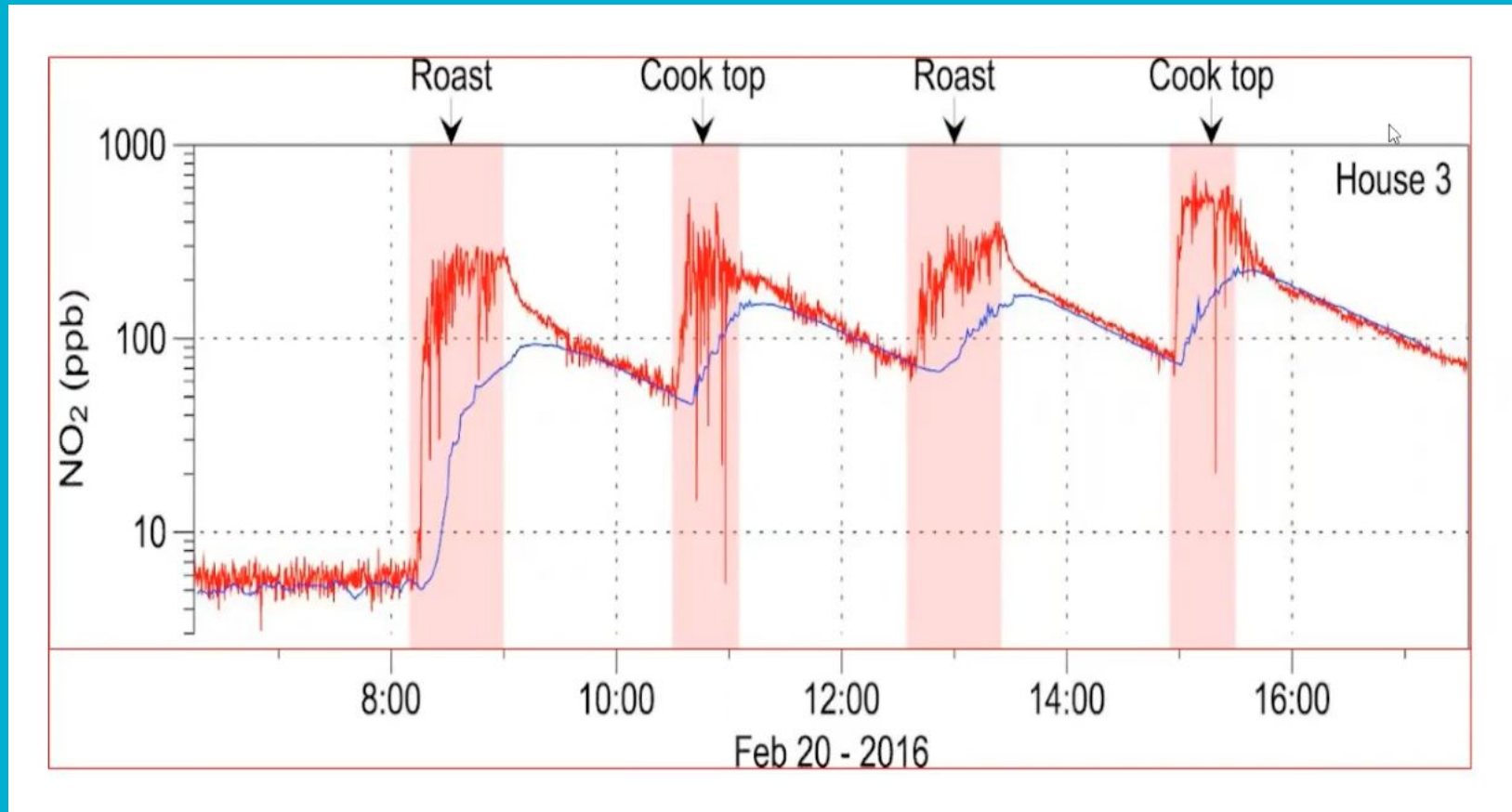
Weiwei Lin, Bert Brunekreef, Ulrike Gehring, Meta-analysis of the effects of indoor nitrogen dioxide and gas cooking on asthma and wheeze in children, *International Journal of Epidemiology*, Volume 42, Issue 6, December 2013, Pages 1724–1737, <https://doi.org/10.1093/ije/dyt150>

Children and Air Pollutants

- Higher respiratory rates, greater levels of physical activity
- More lung surface compared to their body weight
- Immature lung and immune systems



Nitrogen dioxide reaches levels in the bedroom (blue line) which would be illegal outdoors



From: Lawrence Berkely Laboratory

Childhood asthma and NO₂ levels – additional evidence

1. Kids with asthma age 5-10 – indoor NO₂ levels measured
Symptoms worse with NO₂ levels as low as 6 ppb
Dose response: worsening symptoms for each 5 ppb increment.
2. California – longitudinal study over 20 years
Outdoor NO₂ dropped with pollution controls on cars
Childhood asthma rates dropped in tandem with the lower levels

Belanger K, Holford TR, Gent JF, Hill ME, Kezik JM, Leaderer BP. Household levels of nitrogen dioxide and pediatric asthma severity. *Epidemiology*. 2013;24(2):320-330. doi:10.1097/EDE.0b013e318280e2ac

Garcia E, Berhane KT, Islam T, et al. Association of Changes in Air Quality With Incident Asthma in Children in California, 1993-2014. *JAMA*. 2019;321(19):1906–1915. doi:10.1001/jama.2019.5357

Other Health Effects of NO₂

NO₂ increases :

- All-cause mortality, especially in those with underlying conditions
- Lung and breast cancer
- Adverse pregnancy outcomes
- Exacerbation of chronic lung conditions
- Cognitive and learning deficits.
 - Air pollution has been associated with increased Alzheimer's, teenage depression and bad calls by umpires.

Science of The Total Environment volume 701, 20 January 2020, 134721

Archsmith and Hayes, University of Chicago

U.S. EPA. Integrated Science Assessment (ISA) for Oxides of Nitrogen – Health Criteria (Final Report, Jan 2016).

U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-15/068, 2016

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

Limitations of putting the burden on the user

“Use a range fan or exhaust hood that vents to the outside”

- Hood fans are noisy
- Many fans don't vent outside
- Needs to be used at highest speed, every time; back burners less convenient
- California survey: Fan use – max was 42% at dinner.
- Study from Baltimore – randomized trial to decrease NO₂
 - Hood – (no significant decrease at 3 months)
 - Carbon filter - (↓20% at 3 months)
 - Electric stove – (↓51% at 3 months)

<https://eta-publications.lbl.gov/sites/default/files/lbnl-5028e-cooking-appliance.pdf>

[Paulin LM, Diette GB, Scott M, McCormack MC, Matsui EC, Curtin-Brosnan J, Williams DL, Kidd-Taylor A, Shea M, Breyse PN, Hansel NN. Home interventions are effective at decreasing indoor nitrogen dioxide concentrations. Indoor Air. 2014 Aug;24\(4\):416-24.](#)

Continuous ventilation may not be as good at decreasing NO₂ as it is at decreasing other pollutants.

NCHH 2022

Contaminant	Health Effect of Improved Contaminant Levels	Study Group Level	Comparison Group Level	Measured Difference*	Guidance Level
		Geometric Mean			
Nitrogen dioxide (ppb)	Improved respiratory and cardiovascular health	25.6	25.3	No significant change observed	21 ^a
Particulate matter (PM _{2.5}) (µg/m ³)	Improved respiratory and cardiovascular health and decreased levels of mortality	13.3	17.7	20% improvement	12 (annual), 35 (daily) ^b
Carbon dioxide (ppm)	Improvement in cognition and reasoning	715	823	13% improvement	1,000 ^c
Carbon monoxide (15-minute maximum) (ppm)	Reduced risk of cardiovascular impairment	2.3	2.8	25% improvement (with continuous kitchen exhaust)	87 ^d
Formaldehyde (ppb)	Reduced risk of cancer	15.7	17.8	44% improvement (with continuous kitchen exhaust)	7-80 ^e

Gas stoves leak methane even when turned off.

- Three quarters of the leakage occurs when the stove is off
- Enough to be the GHG equivalent of 500,000 cars
- Methane itself may not harm your health, but it is contaminated by a number of substance known to cause cancer, like benzene.

January 28, 2022. Popular Science.

<https://www.popsci.com/environment/gas-stoves-harmful/>

June 28, 2022. NYT. Gas in homes contains benzene etc.

<https://www.nytimes.com/2022/06/28/climate/natural-gas-home-toxic-chemicals.html>

It's not just me....

Recommend educating patients about the risks of gas stoves:

- American Medical Association
- American Lung Association

- Summary: burning methane indoors is not a good idea.
- Affects those already health & pollution burdened.
- Electric stoves emit less pollution (Regular electric or induction) and solve the problem most effectively.
- Induction stoves are faster than gas, the safest for kids and elders. (Only the pot gets hot).

Possible downsides:

- Induction more expensive
- You may need an electrician to install a new circuit
- Cookware for induction - does a magnet stick to it? (Cast iron works great).



We all want clean and safe homes

If you are still cooking with methane gas:

- Use your fan hood - always!
- Cook more with electric appliances – microwave, electric kettle, instant pot
- Buy an inexpensive plug-in "single hob" induction burner (\$100-150 e.g. Duxtop 9600)
- Replace your gas stove with an electric or an induction stove

Heat pumps

- Much more efficient than gas furnaces
- Provide heating in the winter
- Less air pollution, no risk of CO poisoning.
- Provide cooling in the summer - needed these days



Getting off fossil fuels is not a sacrifice.
We can have healthier homes and better air quality.

