Climate & Health Implications of Residential Gas Use & Electrification

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Building Electrification
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NACAA Climate Change Committee Call
September 29, 2020

AGENDA

1. Introductions
2. Why buildings?
3. State of play: decarbonization
4. Regulatory pathways
5. Roles for air regulators
6. Health co-benefits
    - Inside & outside
7. Questions & Discussion

Why Buildings?

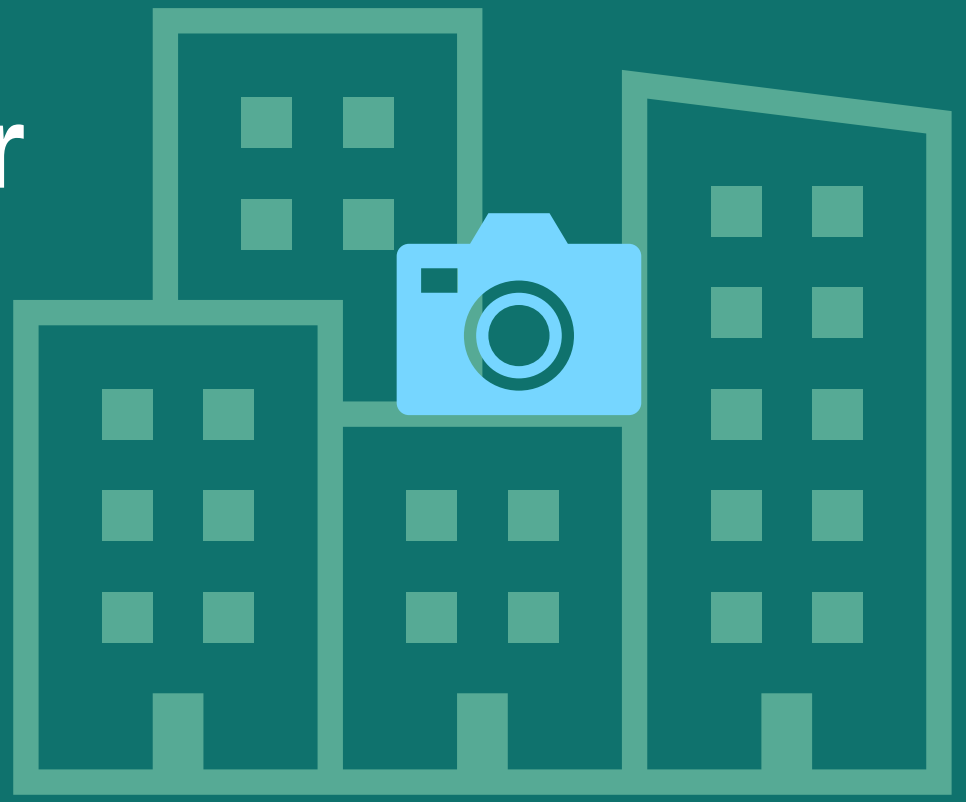
Buildings: largest contributor to **climate change**: 40% of emissions

Buildings: the biggest opportunity to **directly impact people**: 90% of our time spent inside buildings.

Co-Benefits: opportunity **to impact lives**: improve the comfort, health and productivity

Healthy buildings: critical to the **just transition** of our energy system

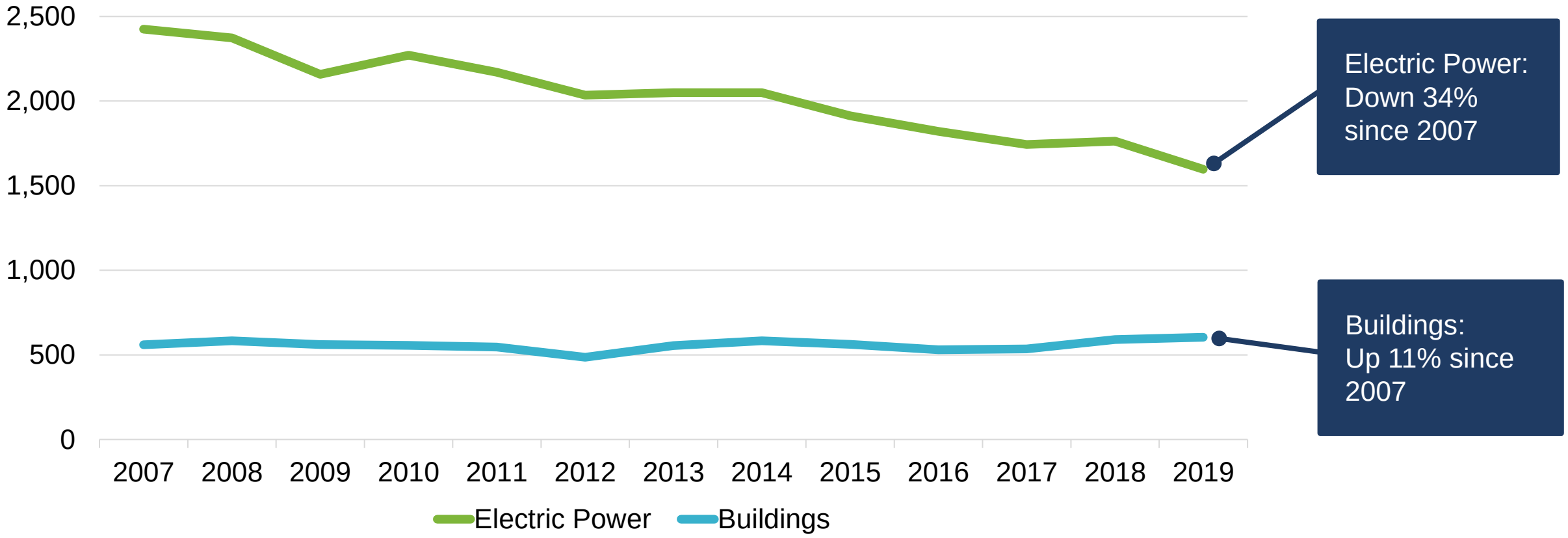
Building Sector Snapshot



The United States has reduced carbon emissions in the electricity sector, but not in the buildings sector

Annual CO_2 emissions from electric power and buildings sectors

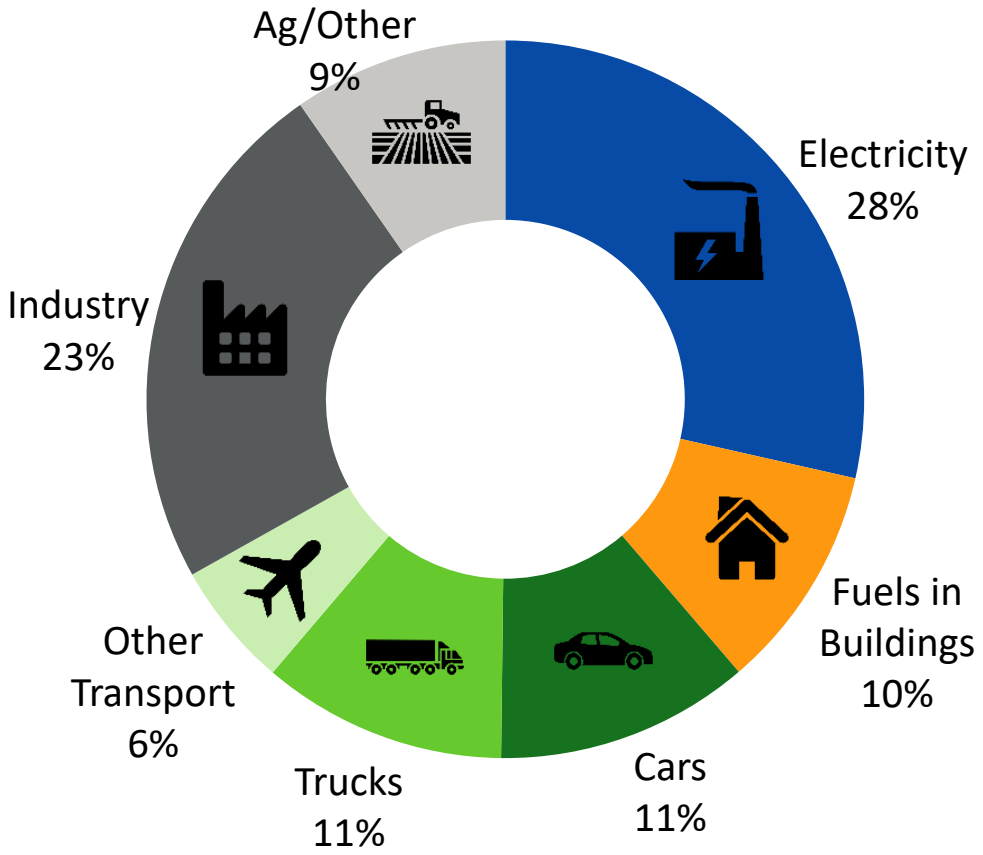
Million metric tons CO_2, US total, 2007–2019



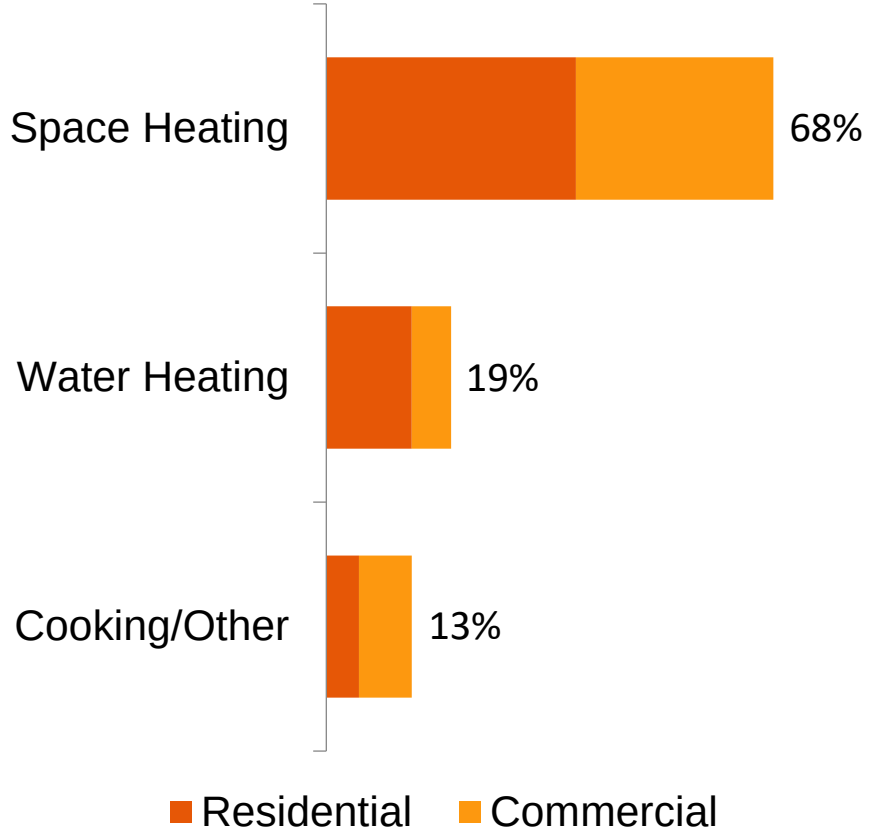
Source: EIA 2018; Rhodium Group (2019)

Fuels burned in 70 million homes and businesses account for 10% of US carbon emissions

Sources of US greenhouse gas emissions by share of total, 2017



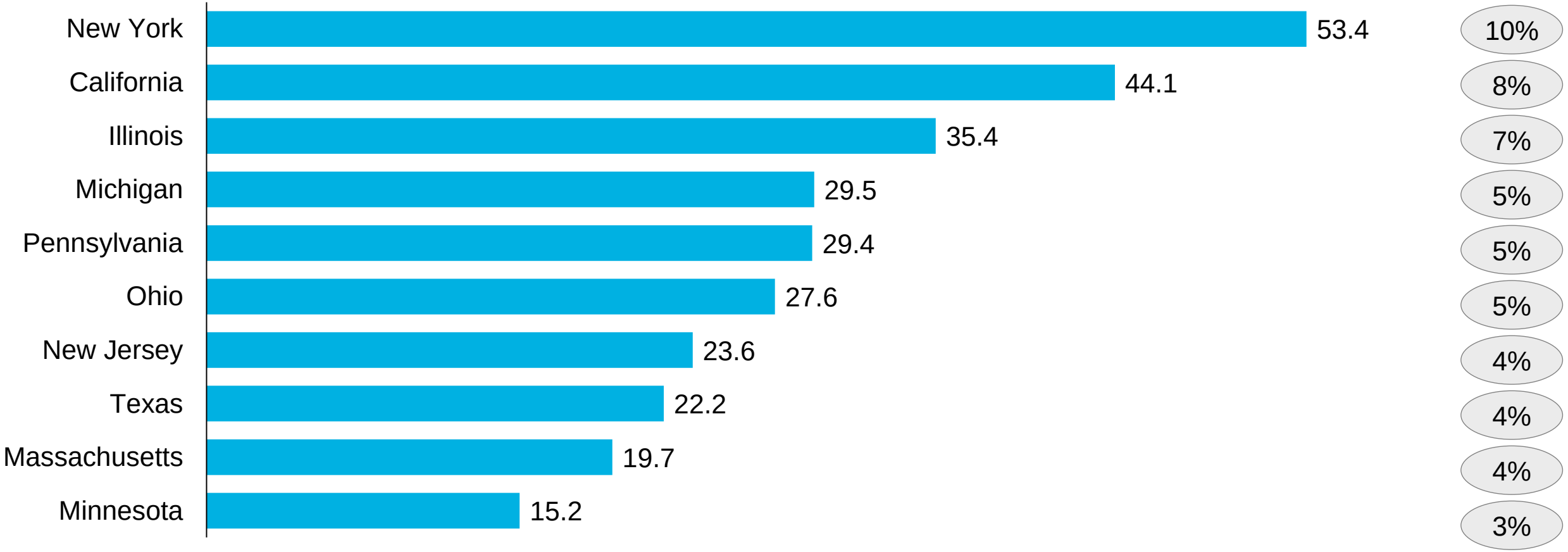
Breakdown of fuel emissions in buildings



Sources: EPA Greenhouse Gas Inventory, 2017 (excludes land use, land use change, and forestry);
EIA Residential Energy Consumption Survey (RECS), 2015

Ten states are responsible for 56% of direct building emissions nationally

Building greenhouse gas emissions by state
Million metric tons CO_2e, 2017

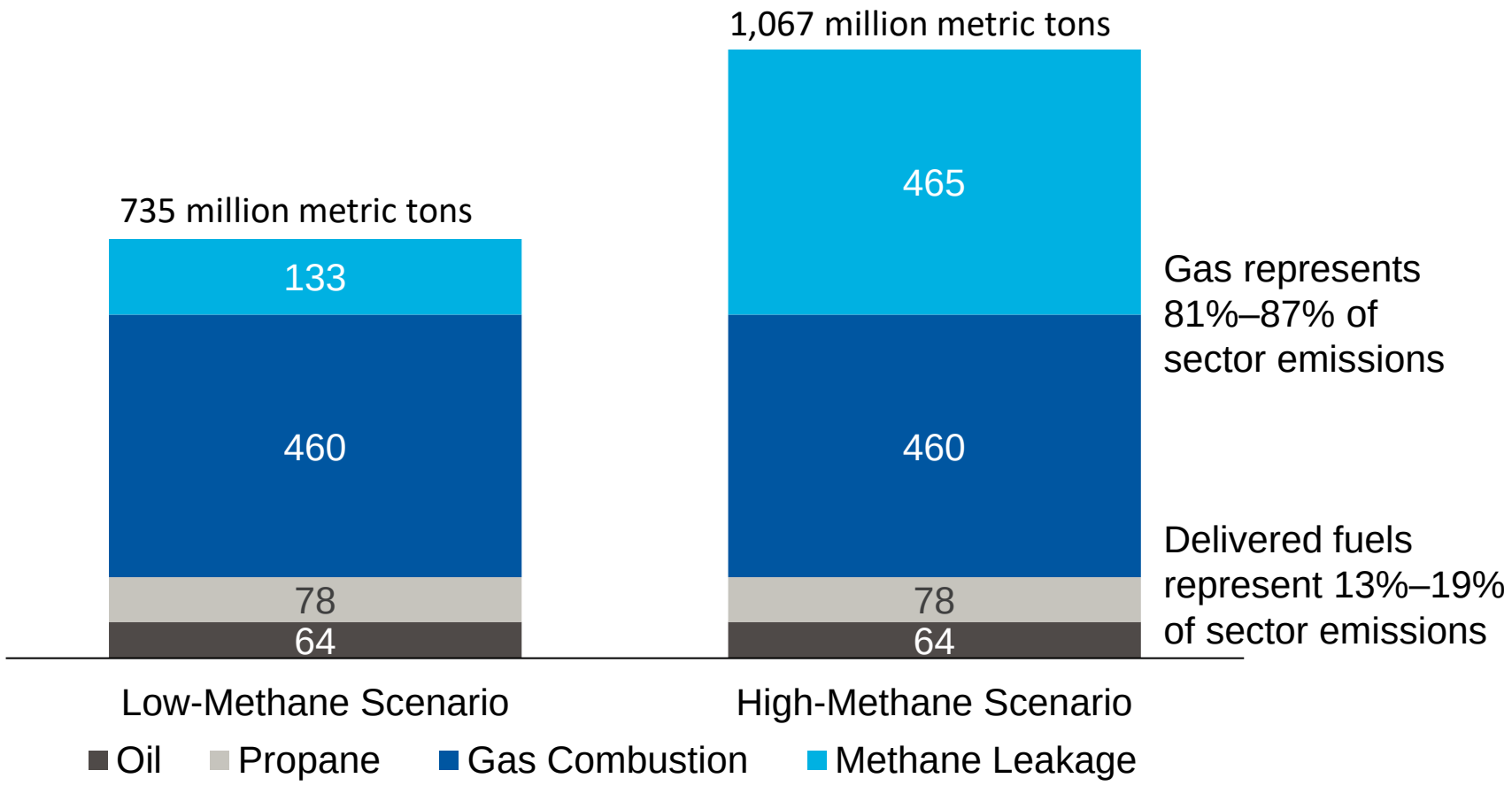


Source: EIA

*Does not include methane leakage

Gas is responsible for the majority of direct building emissions

Greenhouse gas emissions by building fuel
Residential and commercial sectors, US, 2018



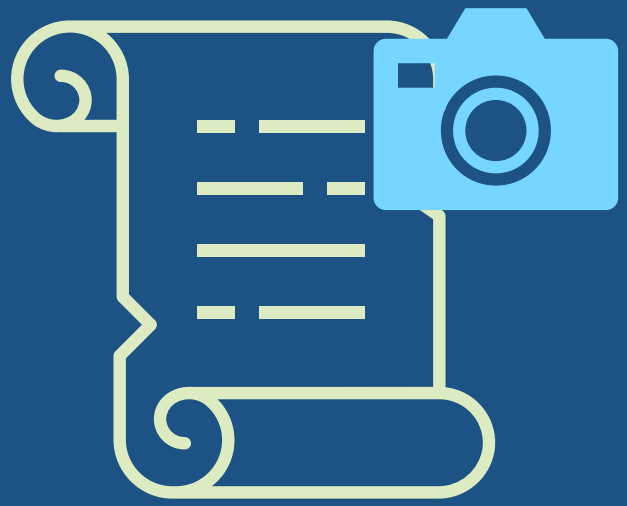
Methane leakage estimates vary by total percentage leakage and global warming potential (GWP).

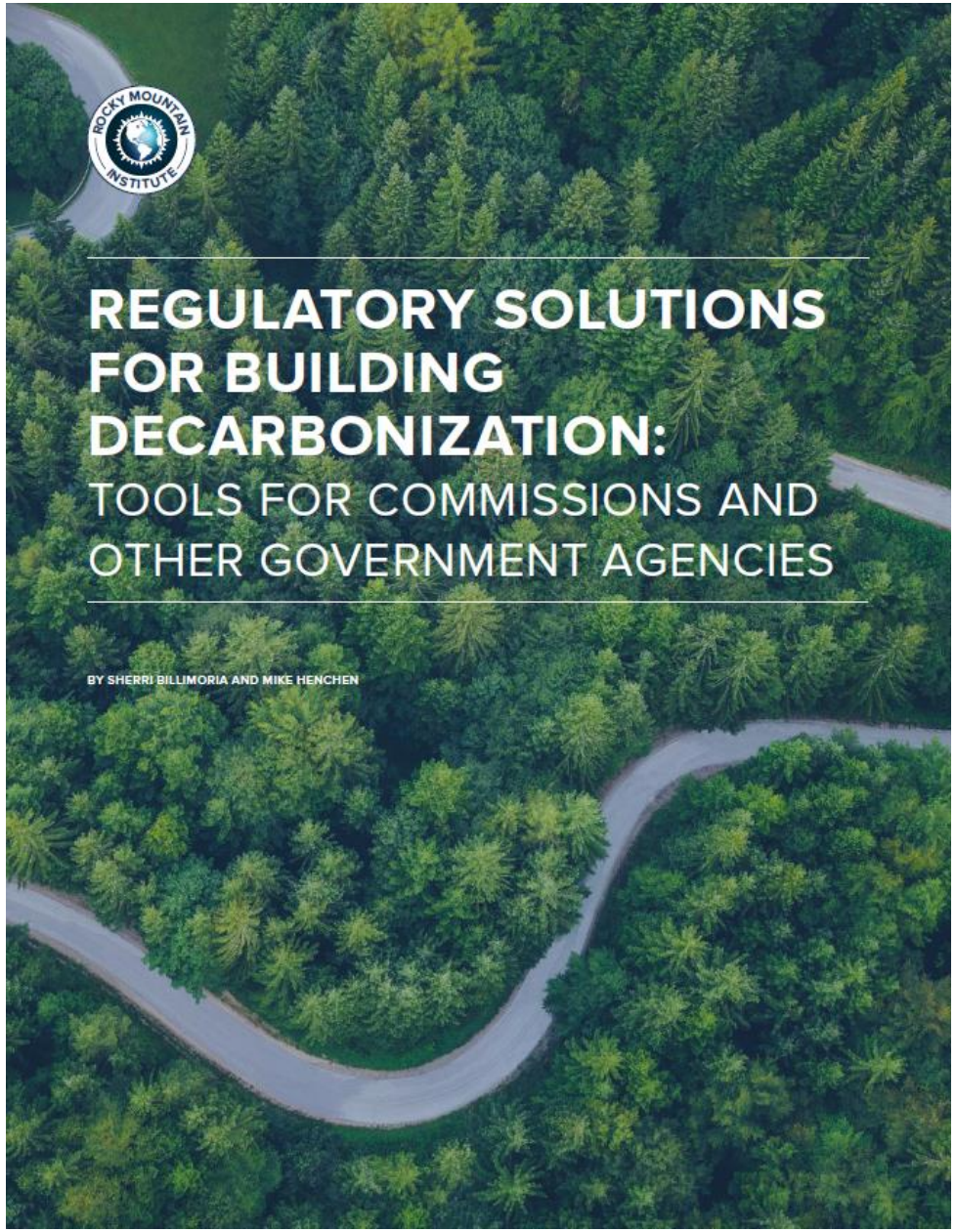
The total buildings-sector methane leakage may be 18% to 44% of buildings-sector climate impacts.

More information regarding these uncertainties is available later in these slides.

Note: "Direct" buildings-sector emissions refers to emissions from burning fuels, not those from electricity use.
Source: RMI analysis

Regulatory Solutions Snapshot





Resource Library available on the report website

"Regulatory Solutions for Building Decarbonization: Tools for Commissions and Other Government Agencies" outlines 10 key strategies to support building decarbonization. In this library, we share resources from commissions, nonprofits, and media that expand on the themes and strategies introduced in our report.

Holistic Approaches to Decarbonization | Near-Term Market Opportunities | Managing the Transition

Focus on Equity and Inclusion

Equity and inclusion must be considered throughout all the potential solutions in this framework; low- and moderate-income customers and disadvantaged communities cannot be an afterthought. Decision-making processes must meaningfully include the perspectives of multiple communities and programs must be designed to specifically support low-income and disadvantaged communities at risk of being left behind.

Equitable Building Electrification: A Framework for Powering Resilient Communities

Greenlining Institute and Energy Efficiency For All

Greenlining's Equitable Building Electrification Framework addresses the opportunities and challenges that electrification presents for low-income communities—70 percent of whom are renters. The framework finds that electrification can be a transformative force for low-income residents, and it explains the steps the state must take to ensure that electrification helps close the clean energy gap in California and provides relief to millions of residents facing energy insecurity in the current system.

This five-step framework presents a start-to-finish recipe for how the current goals of building electrification can be aligned with producing healthy homes, creating high-quality, local jobs that cannot be outsourced, and establishing stronger connections between everyday Californians and our climate change policies and goals.

Sacramento Wants to Electrify Its Homes, Low-Income Families Included

Justin Gerdes, Greentech Media

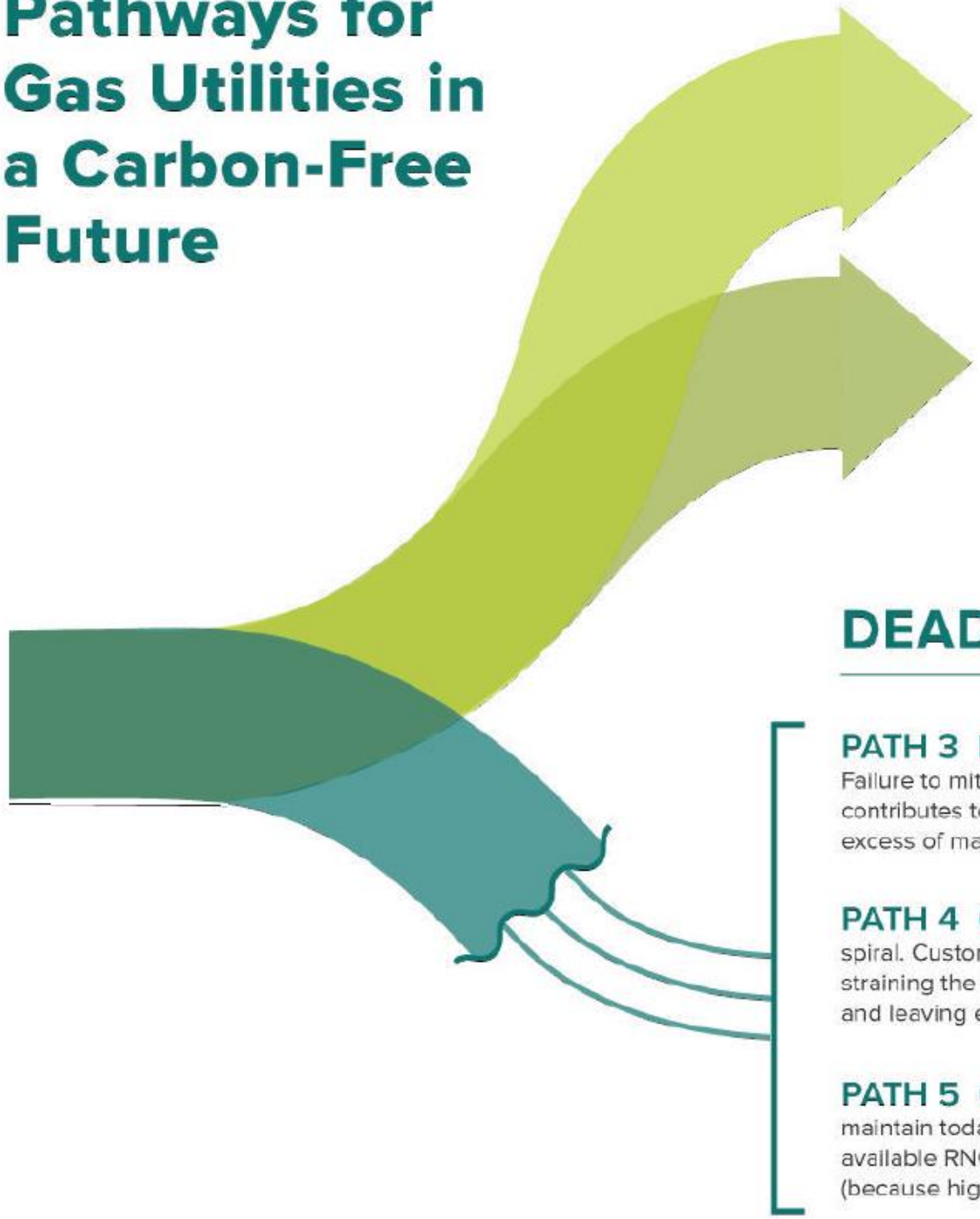
Sacramento Municipal Utility District (SMUD) attended Rocky Mountain Institute's eLab Accelerator to answer the question: how does a not-for-profit municipal utility that has committed to eliminate carbon from buildings ensure that its most disadvantaged customers aren't left behind during the transition? A guiding belief for SMUD was that low- and moderate-income households should be able to transition to gas-free electric appliances at the same rate as the rest of the population. The team saw potential benefits of that transition for building owners and tenants alike and developed a plan to integrate electrification into existing low-income efficiency efforts.

Framing what's needed

Focus on equity & inclusion

Align decarbonization regulatory work across state and local agencies

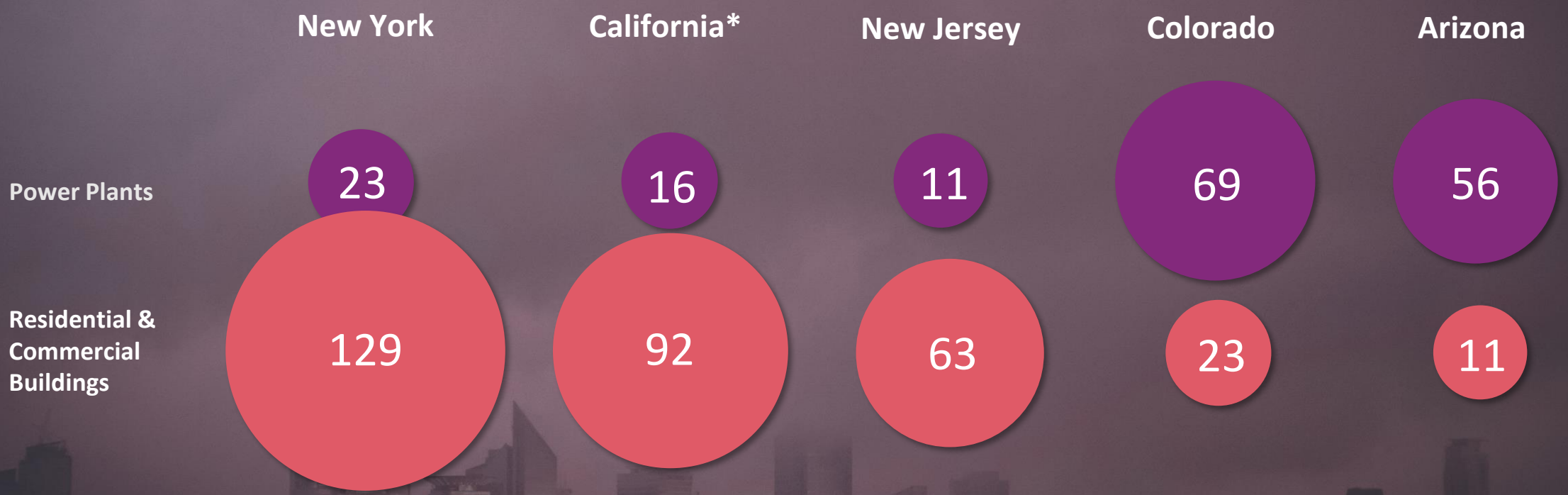
Modernize utility business models



Air Regulators

PLAY A CRITICAL ROLE

2017 NITROGEN OXIDES (NO_X) OUTDOOR EMISSIONS (TONS/DAY)

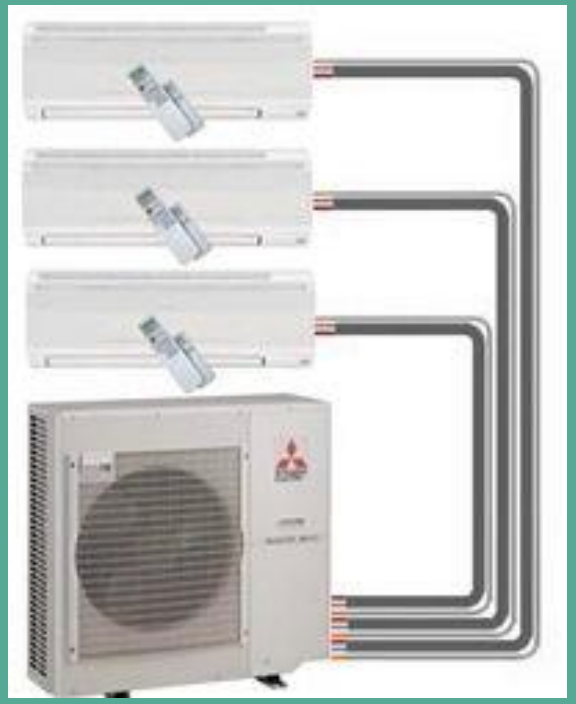


Source: *EPA, 2017 National Emissions Inventory (NEI)*

**Some states, such as California, classify emissions sources differently than the EPA, which may result in different emission allocations in state-level analyses.*

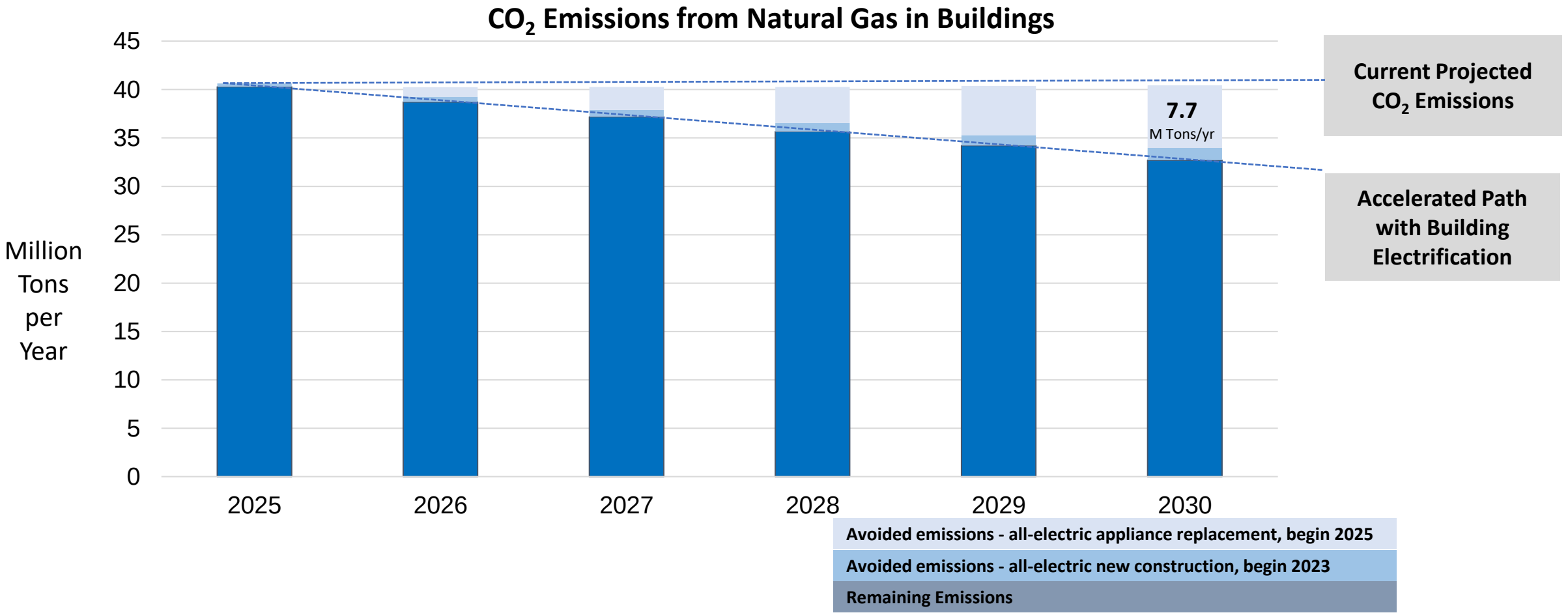
Electric Heat Pump Technology is Efficient and Available

Hot Water



Heating and Cooling

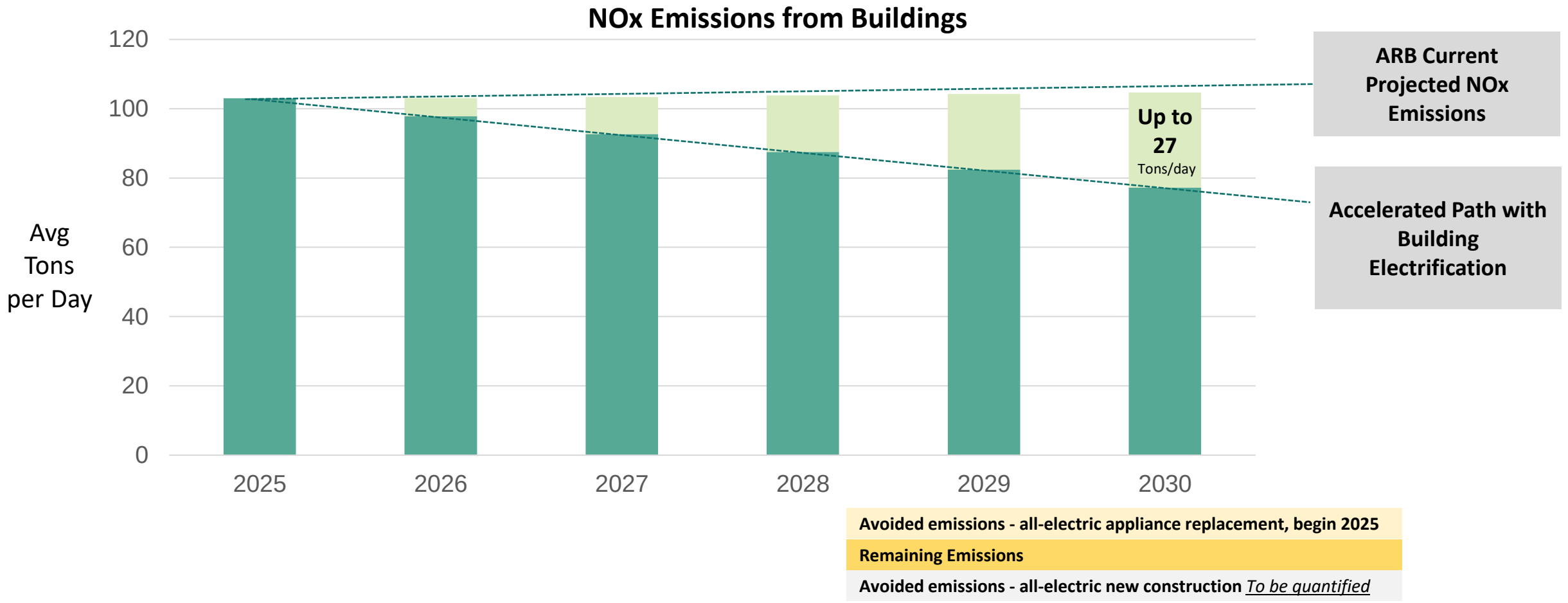
Introducing all-electric new construction by 2023 & all-electric appliance replacement by 2025 can reduce annual CO_2 emissions by ~20% in 2030



Sources: CARB, CEC 2019, Synapse Energy Economics 2018

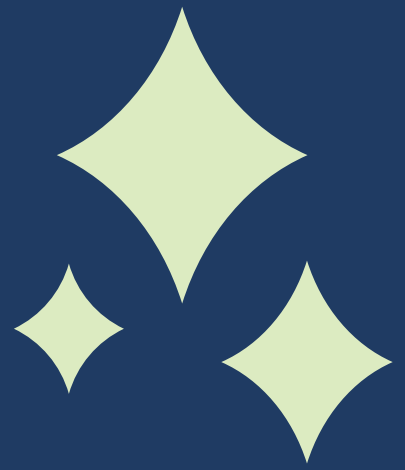
Assumptions:
--Leveraging Synapse report of net 7 MMT annual CO2e reduction by 2030, if 30% of stock goes electric
--Assume 30% of res/comm buildings electrified by 2030 (5% per year from 2025) and all-electric new construction

Introducing all-electric new construction by 2023 and all-electric appliance replacement by 2025 can reduce NOx emissions by ~27% in 2030



Source: CARB

Assumptions:
--Average 20 Year Appliance Life, 5% Stock Turnover per Year
--Above numbers reflect projected 'Residential' and 'Service & Commercial' NOx emissions.



Actions
To Reduce Building Emissions

Foundational steps: Set Indoor Air Quality Guidelines & Revisit Ambient Standards

Indoor Guidelines (NO_2)		
	Short-term (1-hour) ppb	Long-term (annual) ppb
WHO	100	20
Canada	90	11

Outdoor Standards (NO_2)		
	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

What agencies can set indoor air quality guidelines?

Start a process to review NO_2 standards based on the latest science

Other countries (Canada, Australia) have already started this process

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

Air regulators can address appliance emissions

Address outdoor air pollution

Water heaters, dryers, furnaces

1. States+Regions: Set a zero-NOx and/or zero-CO_2 emission standard
2. EPA (Clean Air Act):
   a) NSPS for NOx from appliances
   b) Cross-State Pollution
   c) Regional Haze

Address indoor air pollution

Stoves

1. Update indoor AQ guidelines for NO_2 & CO using latest science & quantify health costs
2. Set emission standards based on indoor AQ guidelines or venting to outdoors

Interagency coordination

Support building code regulators to:

a) adopt all-electric new construction code
b) eliminate gas stove pollution via ventilation standards

How air districts can help decarbonize buildings

Issue **zero-NOx appliance emission standards**

Include Building Decarbonization as **a key emissions reduction strategy** in future plans and align with climate targets

Create/update **indoor air quality guidelines** based on latest science,

Support energy agencies **in strengthening building code updates** including all-electric new construction and stronger ventilation requirements for kitchen appliances

Support and prioritize **building electrification incentives** in environmental justice communities

Health Co-Benefits

Why Air Quality & Health?

- Greatest environmental risk factor for early death
- Buildings are now the most important sector to address as other sectors have been regulated
- Electrifying buildings reduces emissions indoors and outdoors
- New opportunities for collaboration
- Policy driver: creates new avenues for regulation

Health Impacts from Indoor Air Pollution

ROCKY MOUNTAIN INSTITUTE

MOTHERS OUT FRONT
MOBILIZING FOR A LIVABLE CLIMATE

PSR
1985 NOBEL PEACE PRIZE
PHYSICIANS FOR SOCIAL RESPONSIBILITY

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
- California
- Massachusetts Medical Society
- Environmental justice communities

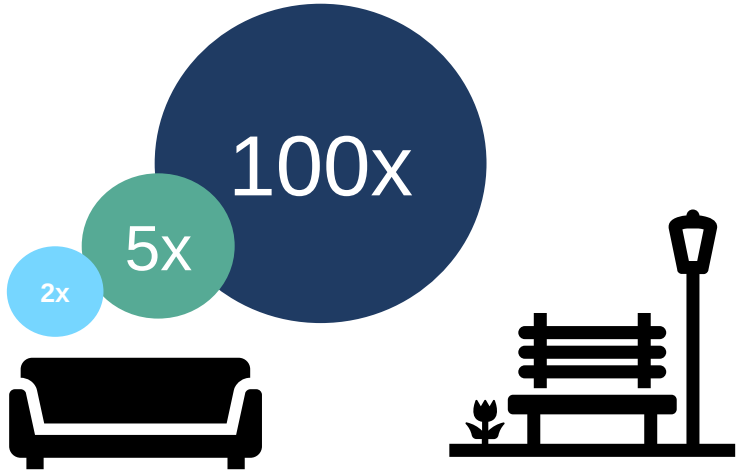
Provides practical recommendations for:

- Policymakers
- Individuals
- Healthcare professionals
- Researchers & funders

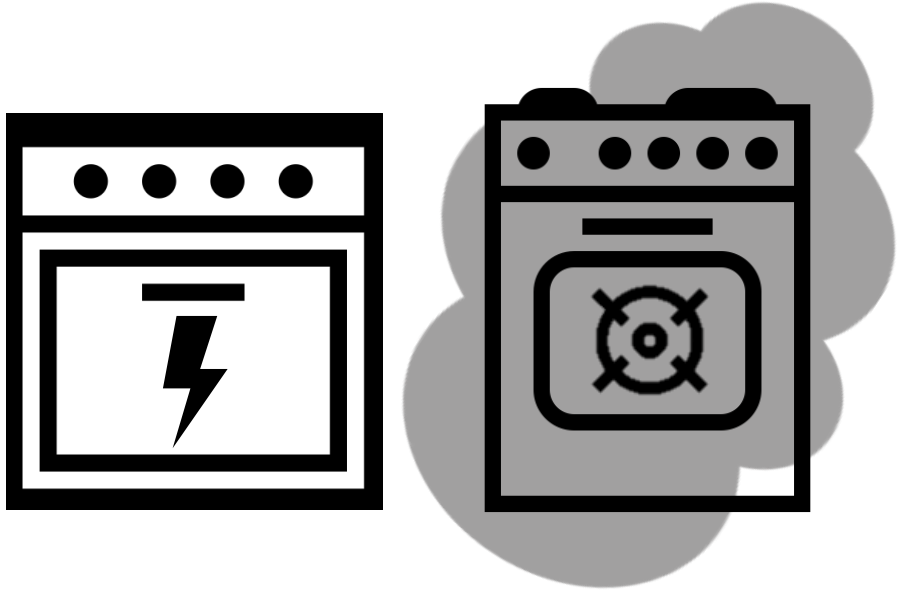
Indoor Air Quality is Often Worse than Outdoor Air Quality

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/

Indoor NO_2 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

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

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

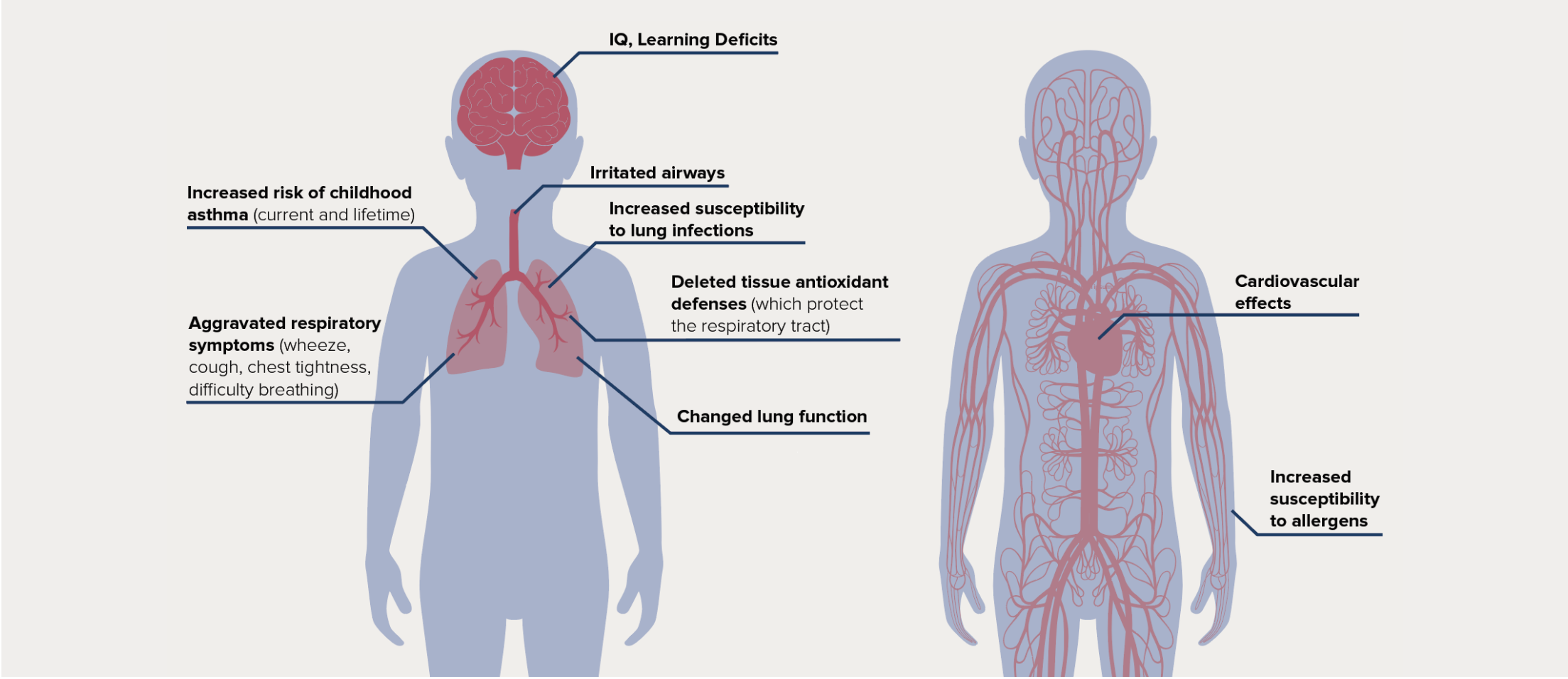
Higher **breathing rates** and greater levels of **physical activity**

Higher lung surface to body weight ratios and smaller bodies

Immature respiratory and immune systems

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

Health Effects of NO_2 in Children May Include:



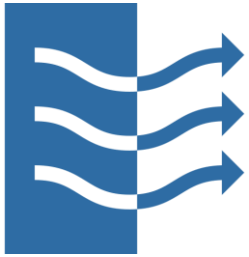
https://rmi.org/insight/gas-stoves-pollution-health/

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

FACTORS CONTRIBUTING TO HIGHER LEVELS OF NO_2 IN HOMES:

Smaller unit size

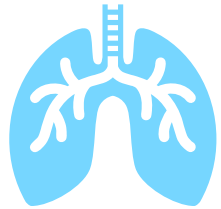
More people per home



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/

Recommendations for Individuals

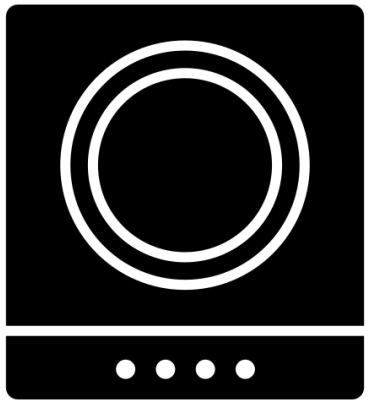
To reduce or eliminate exposure to gas stove pollution

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/

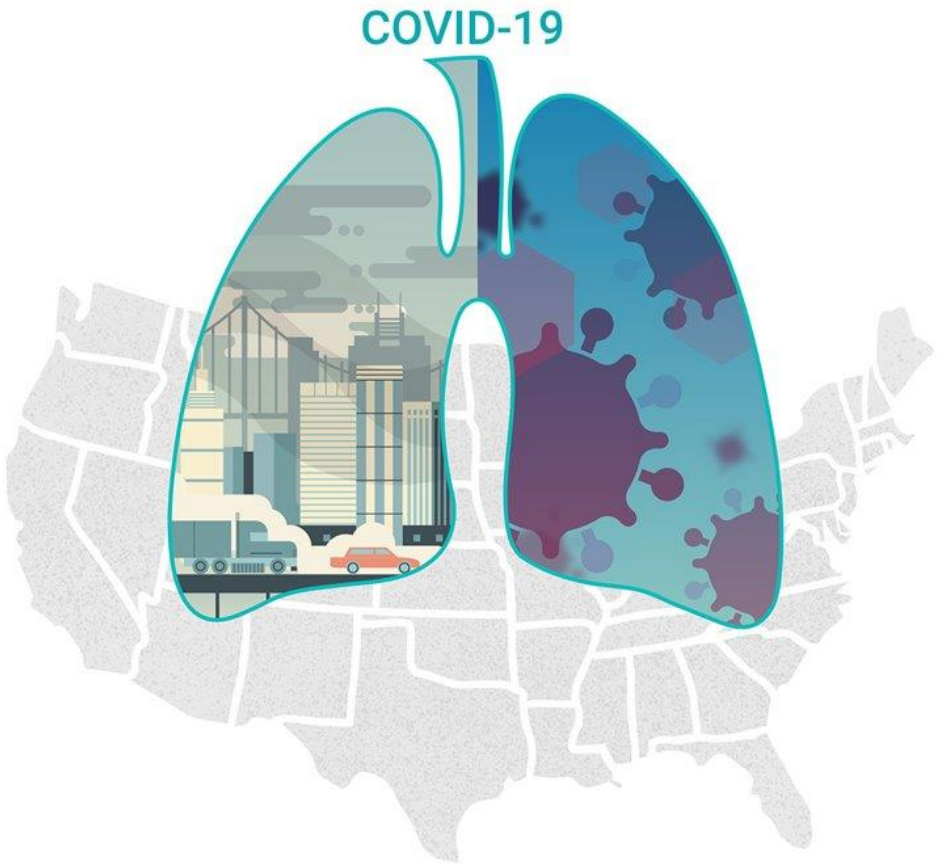
Recommendations for Policymakers

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.
Property Owners	Require property owners 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/

Health Impacts from Ambient Air Pollution

New study links COVID-19 to NO_2



Emory university peer-reviewed study published last week in The Innovation (Cell Press)

A **4.6 ppb reduction** in long-term exposure to NO_2 would have avoided **14,672 US deaths** among those who tested positive for the virus

= 44.7 avoided deaths per million US residents as of mid-July 2020

Upcoming study

Environmental Health Letters (peer-review)

HARVARD T.H. CHAN
SCHOOL OF PUBLIC HEALTH

C-CHANGE
CENTER FOR CLIMATE, HEALTH, AND THE GLOBAL ENVIRONMENT

- First ever inventory of stationary source emissions over last decade
- State-specific, county-level data
- Decline of coal, relative importance of other sectors
- Quantification of health impacts
  - Early deaths
  - Health burden ($Billions)

THANK YOU

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