UCLA

Indoor Air Quality in California: New Evidence and Environmental Justice

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UCLA

Outline

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Background

Cr. EnergyLogic

As required by Assembly Bill 1173, CARB staff compiled a comprehensive report in 2005 on indoor air pollution.

2002

Report preparation

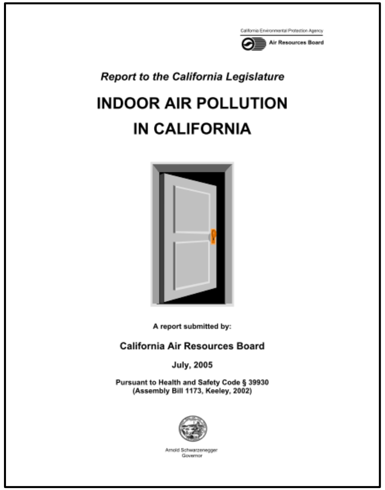
- Indoor air pollutants
- Existing regulations and practices
- Possible mitigation options

Externally scientific review

Kirk R. Smith, UC Berkeley
S. Katharine Hammond, UC Berkeley
William W. Nazaroff, UC Berkeley
Richard Sextro, LBNL

2005

Submission to the Legislature


California Environmental Protection Agency
Air Resources Board

Report to the California Legislature

INDOOR AIR POLLUTION IN CALIFORNIA

A report submitted by:
California Air Resources Board
July, 2005
Pursuant to Health and Safety Code § 39930
(Assembly Bill 1173, Keeley, 2002)

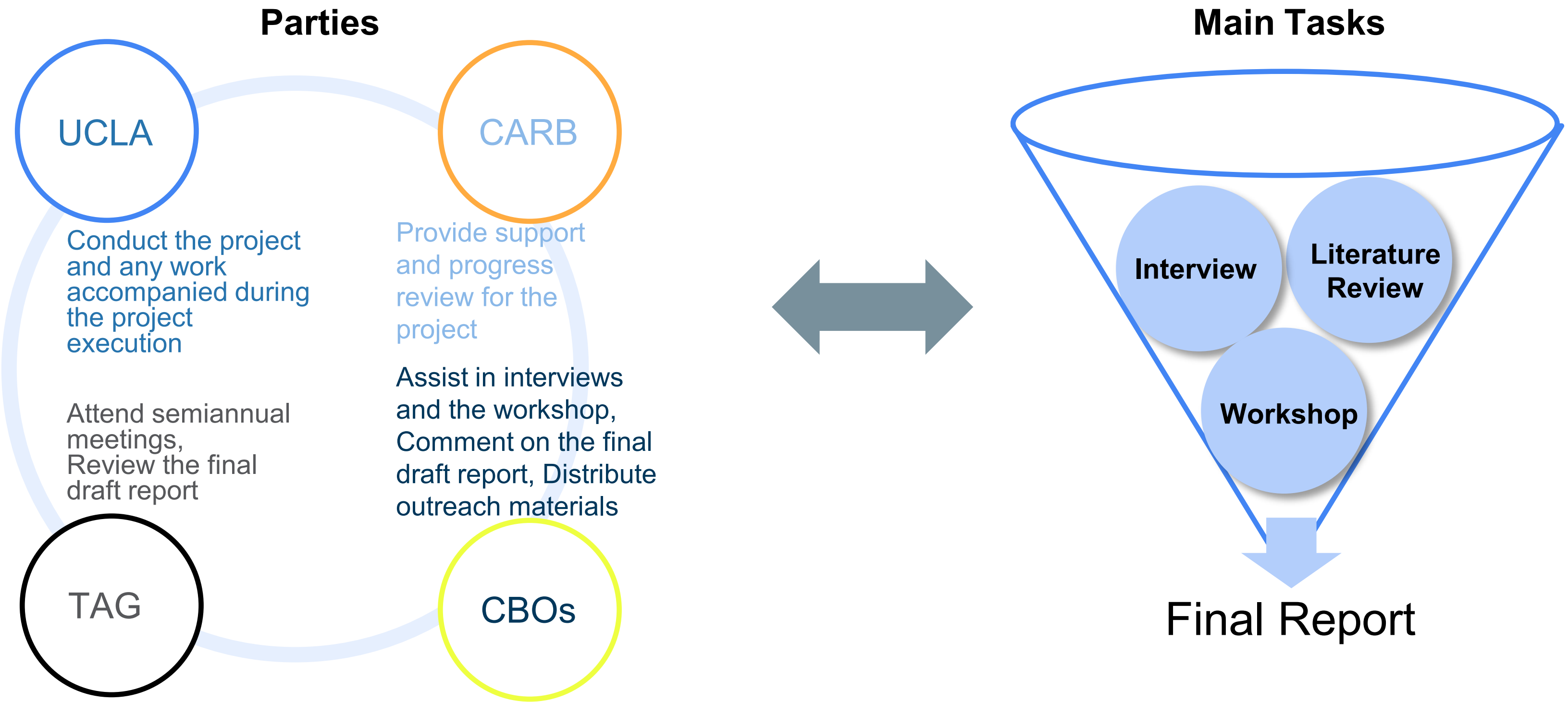
Arnold Schwarzenegger
Governor

2023?

Project Objectives

- ❑ What are the priority indoor air pollutants in California?
- ❑ How can exposures to these pollutants be mitigated to enhance human health protection?

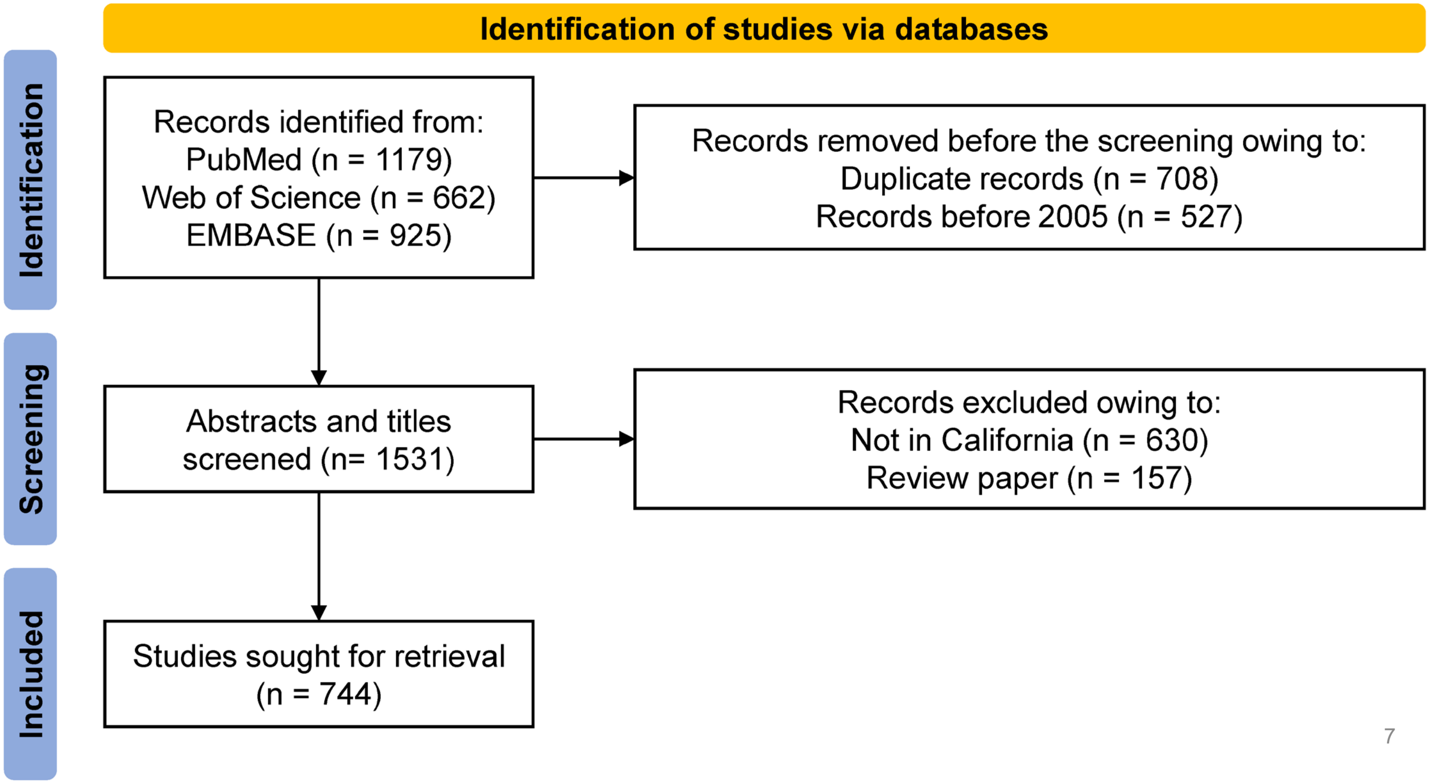
Project Approach



Literature Review

PRISMA Systematic Review

- ❑ Searched with terms: (‘indoor air pollution’ or ‘indoor air quality’ or ‘household air pollution’ or ‘household air quality’) and ‘California’
- ❑ Cut-off date 10/12/2023
- ❑ Post-cutoff wildfire studies included to reflect findings related to the 2025 Los Angeles Fires
- ❑ Post-cutoff regulatory and agency documents included to reflect most recent policies



Interviews

PHYSICIANS FOR SOCIAL RESPONSIBILITY
SAN FRANCISCO BAY CHAPTER

CCAC
Central California Asthma Collaborative

PSR-LA
Physicians for Social Responsibility Los Angeles

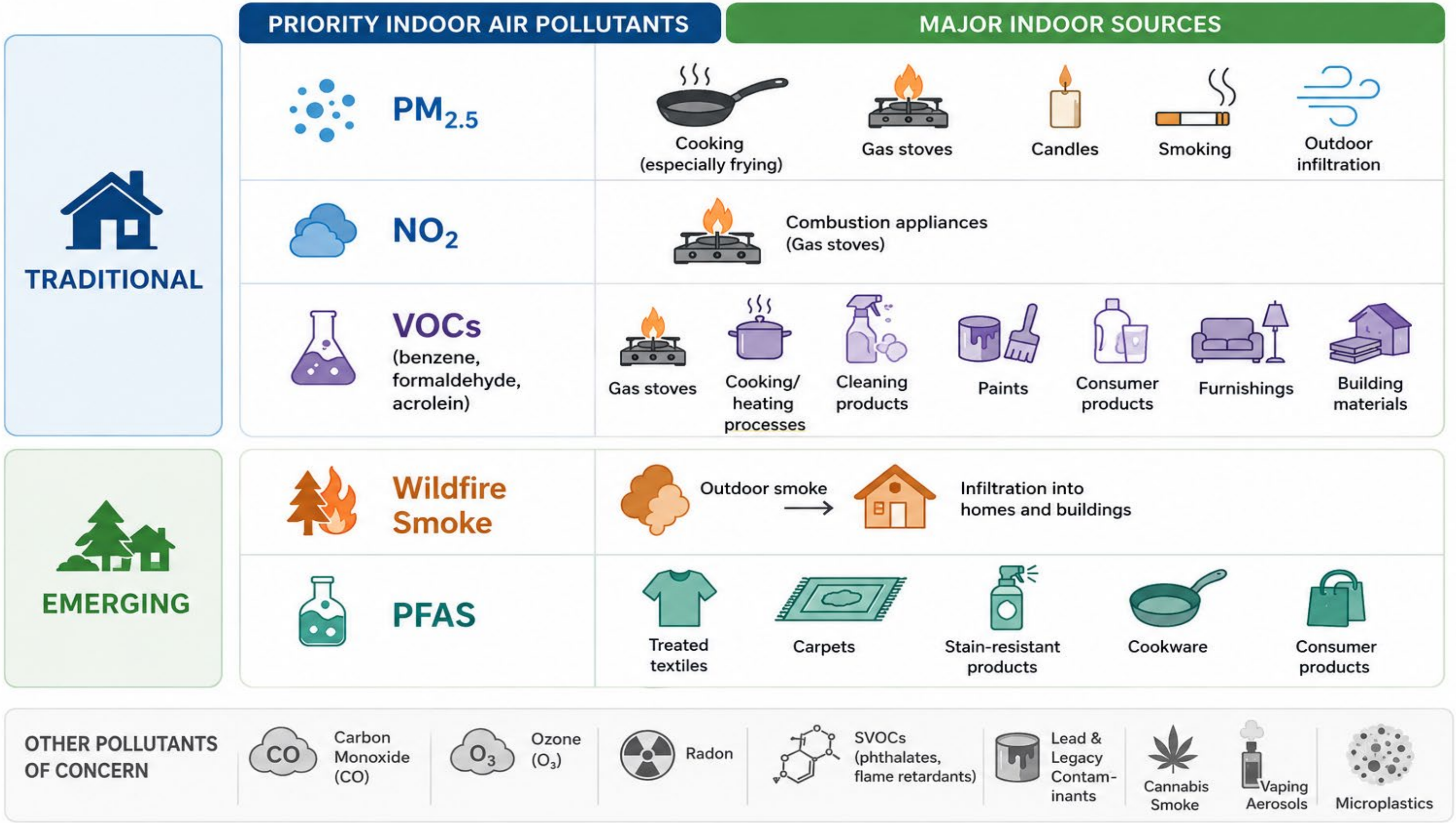
- 32 community members, 17 in English and 15 in Spanish.
- 10 interviewees from government agencies, academia, organizations, and manufacturers.

Indoor Air Pollutants of Concern and Sources

Indoor air quality is shaped by two dominant pathways:

🏠 **Indoor emissions**
gas appliances, cooking, consumer products, building materials, smoking/vaping

🌎 **Outdoor infiltration**
wildfire smoke, traffic pollution, ozone, ambient PM



$PM_{2.5}$

Indoor Levels in California

Residential settings	Schools and childcare facilities	Most commercial settings	Vape shops (highest observed)
~ 7–13 µg/m³	~ 18–19 µg/m³	~ 7–36 µg/m³	up to 276 µg/m³

Key Takeaway

Many California indoor environments exceed WHO recommendations.

Benchmarks ($PM_{2.5}$)

	World Health Organization (WHO)		U.S. EPA NAAQS	
	15 µg/m³	5 µg/m³	35 µg/m³	9 µg/m³
	24-hour	Annual	24-hour	Annual

Comparison with 2005 Report

$PM_{2.5}$ remains a **major indoor pollutant** of concern.

Cooking and **smoking/vaping** continue to be important indoor sources.

Infiltration of Outdoor $PM_{2.5}$

1 Typical Infiltration Factors

Infiltration factors reported in North America and Europe ranged from **0.2–0.8.**

Most California studies reported infiltration factors between **0.2** and **0.5.**

What is the Infiltration Factor (F_{inf})?

The infiltration factor is the fraction of outdoor $PM_{2.5}$ that infiltrates a building and remains indoors over a certain period, excluding contributions from indoor sources.

- Range: 0 to 1
- Accounts for both pollutant penetration through the building envelope and removal processes indoors (e.g., deposition or filtration).

2 Wildfire Smoke Can Infiltrate Indoors

Northern California homes showed different infiltration factors depending on wildfire conditions.

During Fire Days

0.23

Behavioral changes, such as closing windows, can lower infiltration of outdoor $PM_{2.5}$.

Non-Fire Days

0.42

Under typical conditions, higher infiltration allows more outdoor $PM_{2.5}$ to enter indoors.

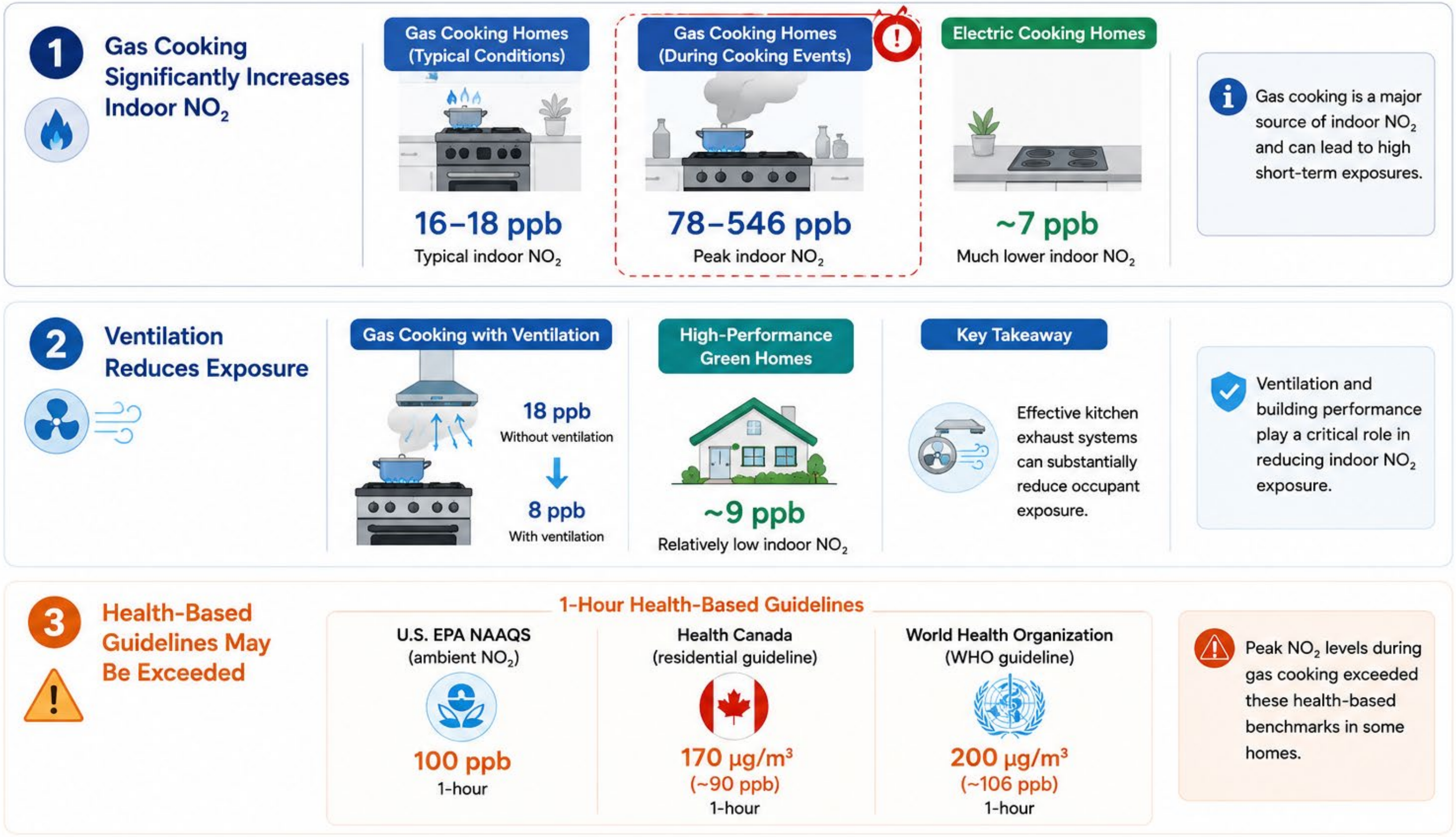
3 Building Characteristics Matter

Newer, tighter buildings generally have lower infiltration.

Effective Ventilation and High-Efficiency Filtration are Essential for Reducing Indoor $PM_{2.5}$

MERV 13 or higher filters can significantly lower indoor particle levels, with MERV 16 filters reducing $PM_{2.5}$ by up to 98% in supply ventilation systems.

NO_2


1
Gas Cooking Significantly Increases Indoor NO2
Gas Cooking Homes (Typical Conditions)
16–18 ppb
Typical indoor NO2
Gas Cooking Homes (During Cooking Events)
78–546 ppb
Peak indoor NO2
Electric Cooking Homes
~7 ppb
Much lower indoor NO2
Gas cooking is a major source of indoor NO2 and can lead to high short-term exposures.
2
Ventilation Reduces Exposure
Gas Cooking with Ventilation
18 ppb
Without ventilation
8 ppb
With ventilation
High-Performance Green Homes
~9 ppb
Relatively low indoor NO2
Key Takeaway
Effective kitchen exhaust systems can substantially reduce occupant exposure.
Ventilation and building performance play a critical role in reducing indoor NO2 exposure.
3
Health-Based Guidelines May Be Exceeded
1-Hour Health-Based Guidelines
U.S. EPA NAAQS (ambient NO2)
100 ppb
1-hour
Health Canada (residential guideline)
170 µg/m³
(~90 ppb)
1-hour
World Health Organization (WHO guideline)
200 µg/m³
(~106 ppb)
1-hour
Peak NO2 levels during gas cooking exceeded these health-based benchmarks in some homes.

VOCs

1. Indoor Levels in California

Formaldehyde	Benzene	Acrolein
5–68 µg/m³	0.2–5 µg/m³	0.2–5 µg/m³

Exceedances Reported?

- Formaldehyde: Yes
- Benzene: Occasionally
- Acrolein: Yes

2. Benchmarks (California OEHHA Chronic RELs*)

Formaldehyde	Benzene	Acrolein
California OEHHA Chronic REL	California OEHHA Chronic REL	California OEHHA Chronic REL
9 µg/m³	3 µg/m³	0.35 µg/m³

OEHHA Chronic RELs are health-based exposure guidelines designed to protect sensitive populations during long-term exposure.

3. Comparison with 2005 Report

VOCs remain important indoor pollutants of concern.

Building materials, consumer products, and combustion activities remain major sources.

Since 2005, California has strengthened formaldehyde controls and expanded VOC regulations to >130 consumer product categories.

Wildfire Smoke

WHY IT MATTERS

>7,400 wildfires annually in California (2020–2025), burning ~1.41 million acres/year.

In 2020, >4.5 million Californians were exposed to $PM_{2.5}$ >100 µg/m³ for **at least one day** (21-fold increase vs. 2010).

People spend ~90% of their time indoors, making indoor exposure a major concern.

DURING ACTIVE WILDFIRES

SMOKE COMPOSITION

- $PM_{2.5}$ (primary exposure indicator)
- VOCs and hazardous air pollutants
- Black carbon and organic aerosols
- Heavy metals
- Increasingly toxic emissions from WUI fires (homes, vehicles, and synthetic materials)

INDOOR EXPOSURE

- Smoke readily infiltrates buildings through ventilation, leaks, windows, and doors.
- Monitoring of >1,400 California buildings showed indoor $PM_{2.5}$ concentrations **tripled** during wildfire events.
- Portable HEPA filtration can reduce indoor $PM_{2.5}$ by **~50–80%.**

POST-FIRE INDOOR CONTAMINATION

Exposure may continue after visible smoke dissipates.

VOCs, PAHs, and metals can persist indoors on surfaces, in dust, and in building materials.

Important knowledge gaps remain:

- Indoor persistence and re-emission
- Long-term exposure pathways
- Effective cleanup and remediation strategies

Future policies should support indoor environmental assessment and recovery following wildfire events.

PFAS

1 Indoor Levels of PFAS in California and Other Settings

Setting Type (Study Location)	Sample	Mean Concentration Range* (Units)
California residential and commercial carpet life cycle	PFAS emissions to air during carpet use	0.5 – 4.6 ng/m²
	PFAS emissions to dust during carpet use	0.03 – 4.6 ng/m²
Residential homes in California (Northern and Central Valley)	Serum from children	4.46 – 6.28 ng/ml
	Serum from parents	1.86 – 4.73 ng/ml
	Serum from seniors	2.98 – 10.8 ng/ml
Clothing stores (California)	Air samples	30 – 200 ng/m³
Childcare facilities (California)	Air samples	2 – 600 ng/m³
Childcare facilities	Carpet fibers	7.29 – 69.9 ng/g
	Dust	28.0 – 88.2 ng/g
Residential homes (North Carolina)	Dust	6.44 – 1440 ng/g
Fire stations (U.S. and Canada)	Dust	216 – 760 ng/g

* Range reflect total PFAS unless otherwise noted.

2 Indoor Exposure Pathways

Inhalation
PFAS in indoor air and resuspended dust can be inhaled.

Ingestion
PFAS in indoor dust can be ingested hand-to-mouth.

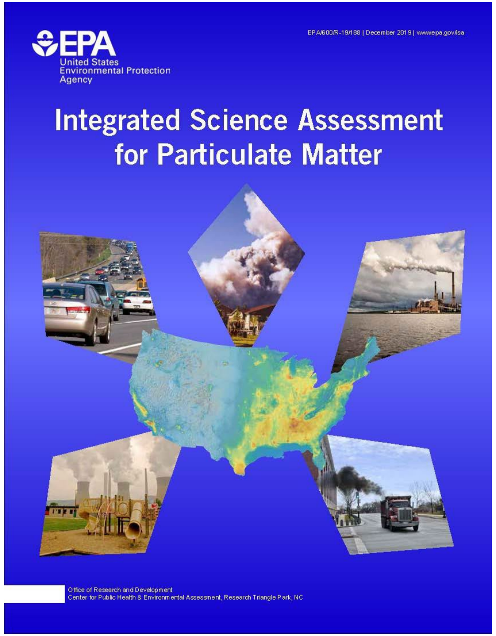
Dermal Contact
PFAS can transfer through skin contact with treated materials and dust.

PFAS exposure is widespread and can occur at low levels in everyday indoor environments.

3 Key Points

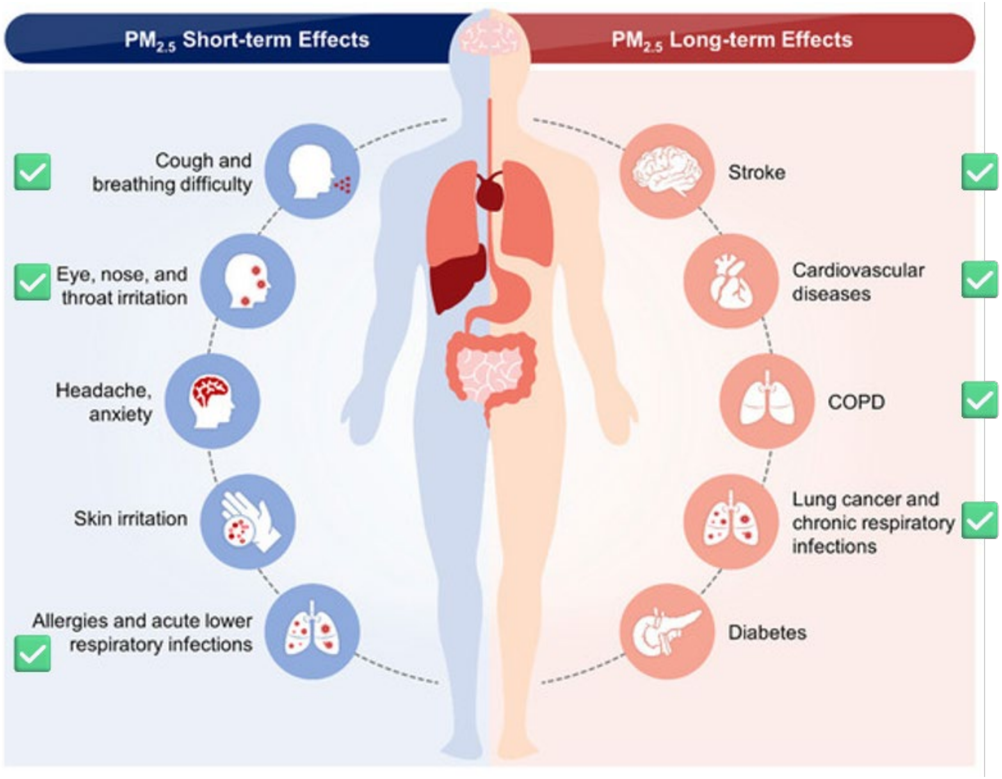
PFAS are detected in both indoor air and dust across a variety of indoor environments, including homes, schools, retail spaces, and workplaces.

The U.S. EPA's 2019 Integrated Science Assessment (ISA) for Particulate Matter Report



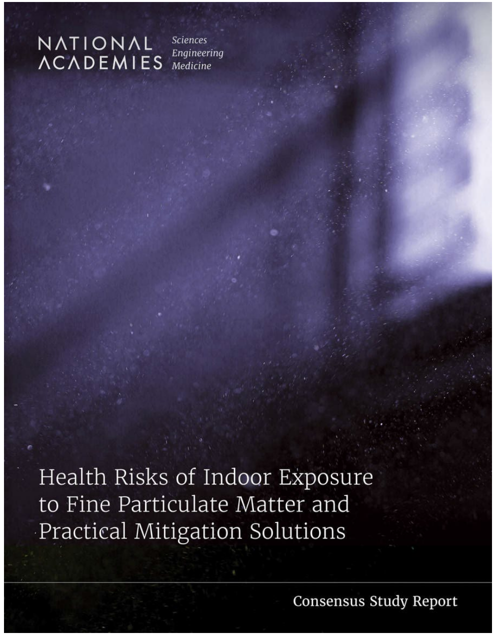
Causal or likely to be causal

Ambient $PM_{2.5}$



Basith et al., 2022, Nanomaterials, 12 (15)

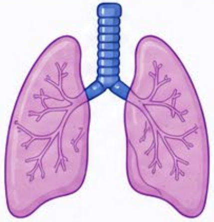
The 2024 National Academies of Sciences, Engineering, and Medicine (NASEM) Report



Indoor $PM_{2.5}$

Health Outcome	Evidence Strength
Respiratory effects (asthma, lung function decline, respiratory infection)	High
Cardiovascular effects (heart attack, cerebrovascular disease)	High
Neurological effects (cognitive decline, neurodevelopment)	Medium
Pregnancy & birth outcomes (preterm birth, low birth weight)	Medium
Cancer	Low

VOCs



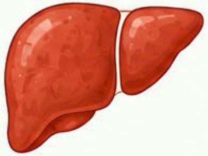
RESPIRATORY EFFECTS

Irritation, oxidative stress, and inflammation of the airways can lead to:

- Coughing, wheezing, chest tightness, shortness of breath
- Asthma onset or exacerbation
- More severe asthma symptoms

Associated VOCs:

Benzene, Toluene, p-Dichlorobenzene, o-Xylene, m,p-Xylene, Ethylbenzene



LIVER EFFECTS

Disruption of lipid metabolism and lipid homeostasis

- ↓ Triglycerides & diacylglycerol
- ↑ Phosphatidic acid & phosphatidylcholine
- Potential compromise of liver function with chronic exposure

Associated VOCs:

Mixtures from decorative paints

NEUROLOGICAL EFFECTS

Effects on the central nervous system can cause:

- Nausea
- Tremors
- Headaches
- Dizziness

Associated VOCs:

Benzene, Toluene, Butadiene, and other VOCs

CANCER & DEVELOPMENTAL EFFECTS

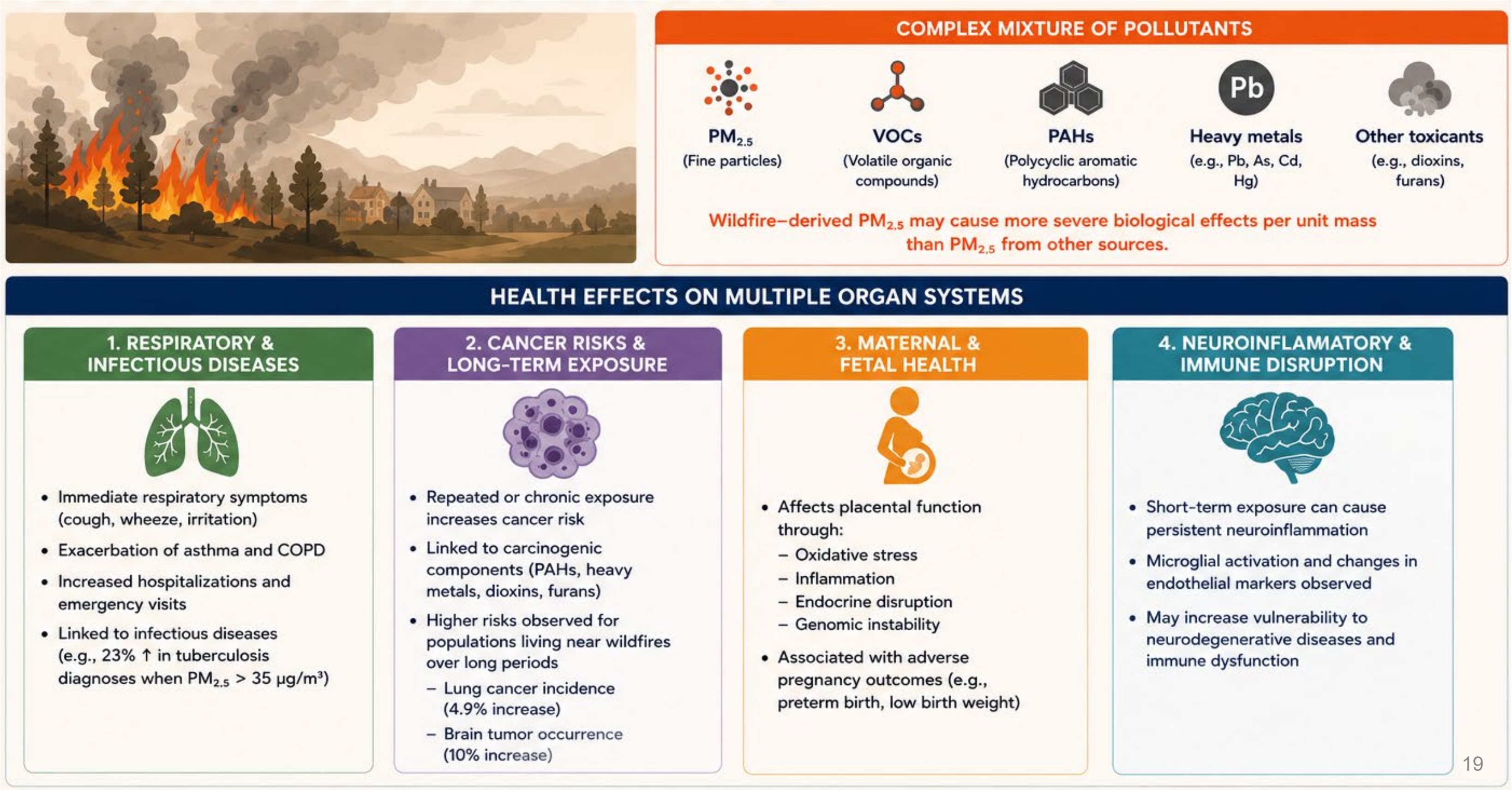
Linked to increased risks of:

- Leukemia (e.g., benzene, formaldehyde)
- Other cancers (e.g., nasopharyngeal cancer, squamous cell carcinoma, Hodgkin's lymphoma)
- Low birth weight from prenatal exposure

Associated VOCs:

Benzene, Butadiene, Formaldehyde, and other VOCs

Wildfire Smoke



Susceptible Groups at Higher Risk from Indoor Air Pollution

1 Infants and Children

- Developing organs and immune systems
- Higher breathing rates per body weight
- Greater exposure from floor-level activities and hand-to-mouth behaviors

2 Pregnant and Perinatal People

- Increased absorption and physiological sensitivity
- Exposure can affect placental function and fetal development

3 Elderly Populations

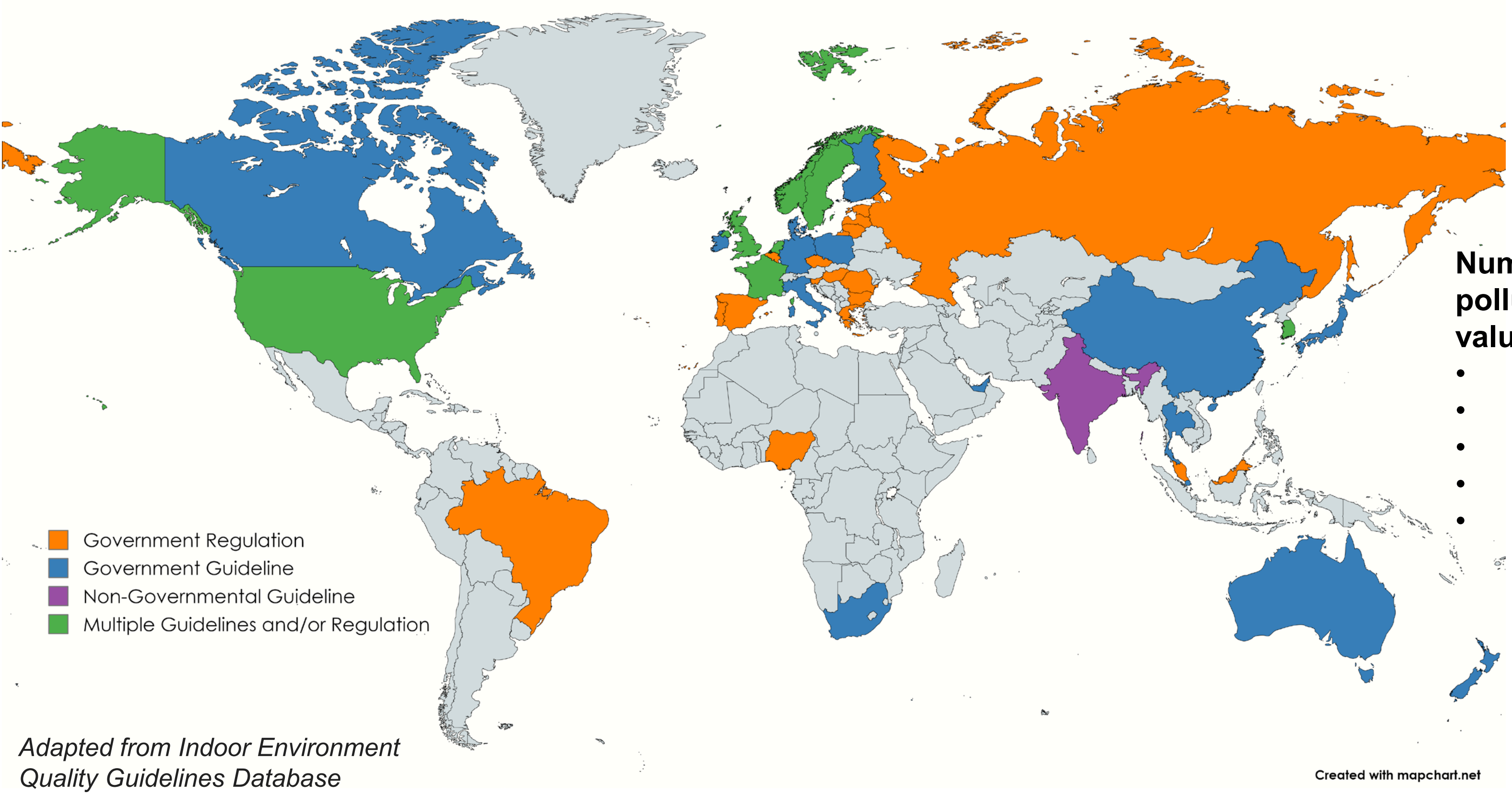
- Age-related decline in lung and immune function
- Higher prevalence of chronic diseases
- Increased sensitivity to toxic exposures

4 People with Preexisting Health Conditions

- Immune dysregulation or weakened defenses
- Greater vulnerability to infections and neuroinflammatory impacts
- Certain medications may increase susceptibility to air pollutants

Socioeconomic Drivers of Indoor Air Pollution Inequities

38 Countries Established IAQ Guidelines

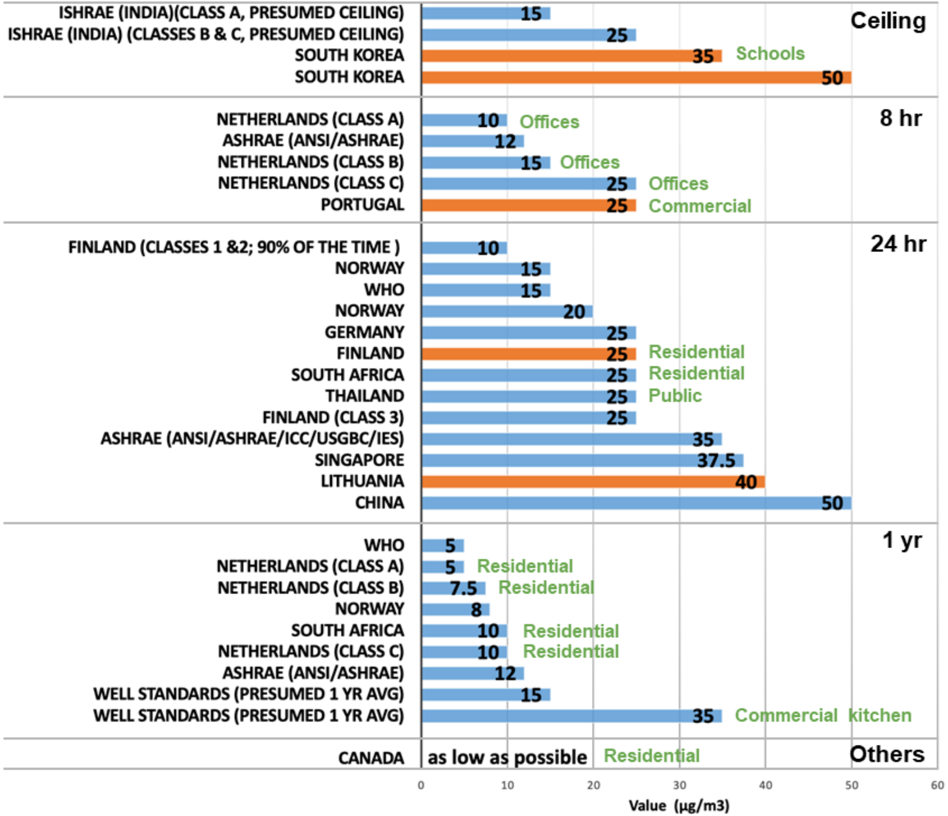


Adapted from Indoor Environment Quality Guidelines Database

Number of indoor air pollutants with guideline values (examples)

- Germany: **56**
- Canada: **30**
- China: **20**
- South Africa: **16**
- New Zealand: **1 (CO_2 only)**

Worldwide Indoor $PM_{2.5}$ Guideline Limits

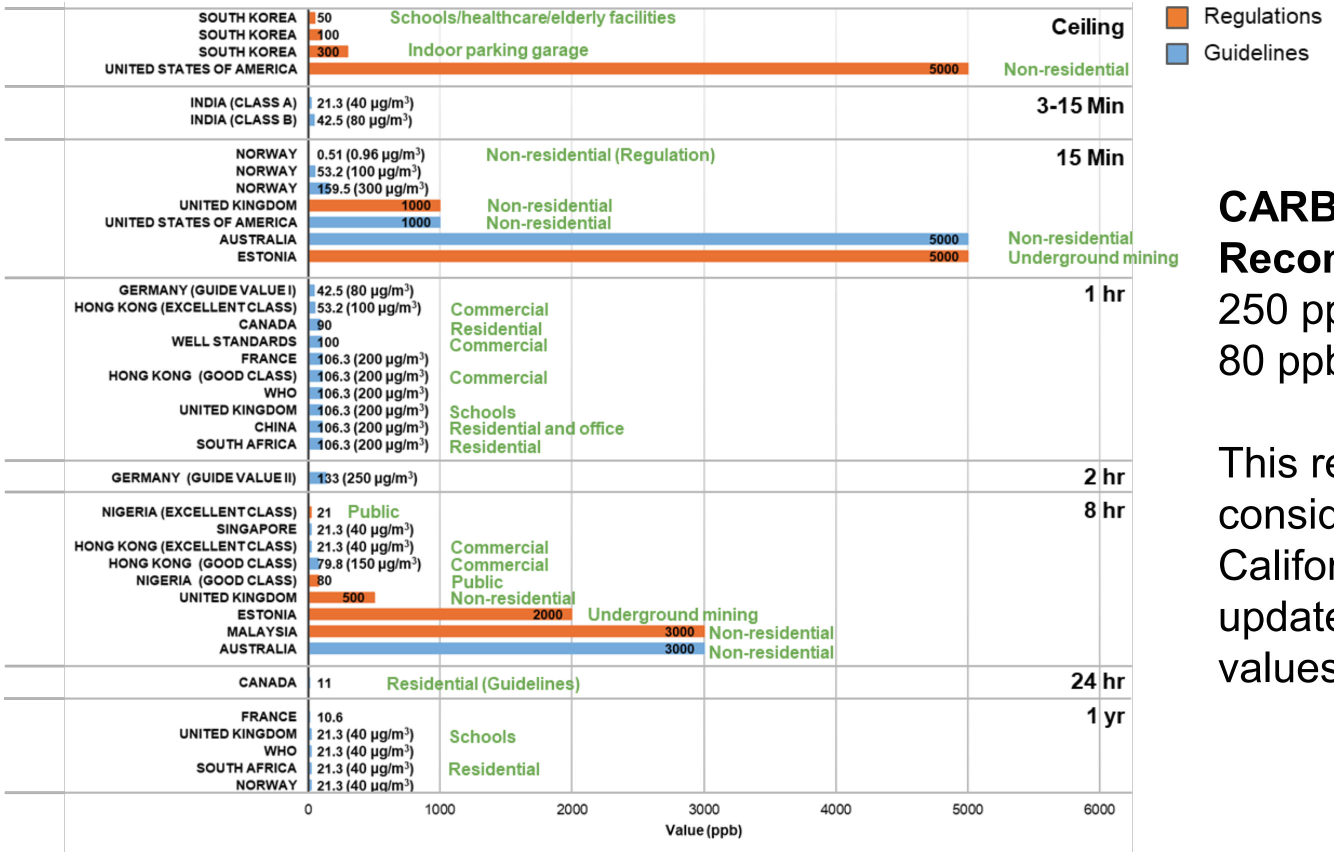


Regulations
Guidelines

CARB 2005 $PM_{2.5}$ Recommendation:
65 µg/m^3 (24-hour average)

This recommendation is now considered outdated, and California is currently evaluating updated health-based guideline values.

Worldwide Indoor NO_2 Guideline Limits



CARB 2005 NO_2 Recommendation:

250 ppb (1-hour average)

80 ppb (24-hour average)

This recommendation is now considered outdated, and California is currently evaluating updated health-based guideline values.

US Federal Regulatory Framework for IAQ

Agency / Organization	Guidelines, Standards, or Key Documents
Environmental Protection Agency (EPA)	• **Indoor Radon Abatement Act (1988)** • Residences and Schools • Radon
Occupational Safety and Health Administration (OSHA)	**Indoor Air Quality in Commercial and Institutional Buildings (2011)** • **Act:** Occupational Safety and Health Act (1970) • **Standards:** 1910.94 (Ventilation) • 1910.1000 (Air Contaminants) • 1910.1001 (Asbestos) • 1910.1048 (Formaldehyde) • 1910.1096 (Radon) • **PELs:** Permissible Exposure Limits (PELs) for workplace contaminants • **Alternatives:** Cal/OSHA, NIOSH, ACGIH
National Institute for Occupational Safety and Health (NIOSH)	• **NIOSH Pocket Guide to Chemical Hazards (2007)**
American Conference of Oovernmental Industrial Hygienists (ACGIH®)	• **Threshold Limit Values (TLVs®) and Biological Exposure Indices (BEIs®)** • Guidelines • Periodically updating • Copyrighted

Example:
Indoor NO_2 Exposure Limits

Example	OSHA	Cal/OSHA	NIOSH
NO_2	5 ppm Ceiling	1 ppm 15 min	1 ppm 15 min

IAQ Guidelines & Standards from Other States

State Agency	Guidelines, Standards, or Documents and Pollutants Addressed
IL — IDPH Illinois Department of Public Health	**Guidelines for IAQ (2011)** Relative Humidity (RH), Temperature, Carbon Dioxide (CO_2), Carbon Monoxide (CO), Hydrogen Sulfide (H_2S), Ozone (O_3), $PM_{2.5}$, PM_{10}, Formaldehyde, Nitrogen Dioxide (NO_2), Tobacco Smoke, Radon
TX — Texas Health and Human Services; Texas Department of Health	**Voluntary IAQ Guidelines for Government Buildings (2002)** Relative Humidity (RH), Temperature, Air Velocity, Asbestos, Carbon Dioxide (CO_2), Carbon Monoxide (CO), Ozone (O_3), $PM_{2.5}$, PM_{10}, Formaldehyde, Nitrogen Dioxide (NO_2), Sulfur Dioxide (SO_2), Hydrogen Sulfide (H_2S), Volatile Organic Compounds (VOCs), Tobacco Smoke, Lead, Mercury, Radon, Allergens, Fungi, Legionella, Pesticides
NJ — NJHealth New Jersey Department of Health	**IAQ Standard for Public Employees (2007)** Temperature, Carbon Dioxide (CO_2)
PA — pennsylvania DEPARTMENT OF HEALTH; Pennsylvania Department of Health	**IAQ Guidelines for Pennsylvania Schools (1999)** Carbon Monoxide (CO), Carbon Dioxide (CO_2), Pesticides, Radon, Mercury, Lead, Biological Agents, Volatile Organic Compounds (VOCs)

California Regulatory Framework for IAQ

Agency / Program	Primary IAQ Role
CARB California Air Resources Board	Consumer product VOC regulations; formaldehyde ATCM; ozone limits for air cleaners; indoor air pollutant guidelines
CEC / Title 24 Part 6 California Energy Commission	Ventilation, filtration, kitchen exhaust, energy code requirements
CALGreen (Title 24 Part 11) California Green Building Standards Code	Low-emittingi materials, moisture control, construction IAQ practices
OEHHA California Office of Environmental Health Hazard Assessment	Reference Exposure Levels (RELs), Proposition 65
Cal/OSHA & CDPH California Division of Occupational Safety and Health & California Department of Public Health	Workplace exposure standards; schools and public health guidance

Major Progress Since 2005

Period	Regulation	Source	Impact
2008–Present	**Residential Mechanical Ventilation Requirements**	California Energy Code (Title 24)	Ensures minimum outdoor air exchange in new homes, improving IAQ in increasingly airtight buildings.
2022 (Title 24)	**Stronger Kitchen Range Hood Standards**	California Energy Code (Title 24)	Requires health-based airflow and capture efficiency for range hoods, reducing cooking-related $PM_{2.5}$ and NO_2.
2022–2025 Updates	**MERV 13 Filtration Requirements**	California Energy Code (Title 24)	Higher filtration in buildings and during construction improves protection from outdoor $PM_{2.5}$ and wildfire smoke.
2007	**Formaldehyde Limits for Composite Wood Products**	CARB Airborne Toxic Control Measure (ATCM) for Formaldehyde	Reduces formaldehyde emissions from wood products, lowering indoor formaldehyde exposure.
2005–Present	**Expanded Consumer Product VOC Regulations**	CARB Consumer Product Regulations (130+ product categories)	Significantly reduces VOC emissions from consumer products used daily in homes and workplaces.
2008	**California Air Cleaner Regulation**	California Air Resources Board	Limits ozone emissions from indoor air cleaning devices and requires CARB certification for air cleaners sold in California.

Source Control

Reduce or eliminate pollutants at their source to prevent them from entering the indoor environment

1 Zero-emission appliances

- Replace fossil fuel combustion appliances with zero-emission alternatives.
- Zero-emission alternatives reduce combustion-related emissions, including NO_2, CO, benzene, and $PM_{2.5}$.
- However, cooking activities can still generate $PM_{2.5}$, ultrafine particles (UFPs), and VOCs, regardless of appliance type; effective ventilation remains essential.

↓ NO_2, CO, benzene, $PM_{2.5}$

2 Use Low-Emission Materials

- Replace older furniture and materials that emit formaldehyde, VOCs, PFAS, and flame retardants.

↓ VOCs, SVOCs, and long-term chemical exposures

3 Eliminate Indoor Smoking & Vaping

- Restrict tobacco, cannabis, and e-cigarette use indoors.
- In multifamily housing, smoke and aerosols can migrate between units, exposing neighboring residents.

↓ $PM_{2.5}$, VOCs, ultrafine particles, toxic air contaminants

4 Supplemental Source Reduction Strategies

Choose low-emission cleaning products, reduce fragranced products, and maintain combustion appliances.

↓ VOCs and other indoor-generated pollutants

[CARB resources on how to reduce your exposure to indoor air pollution]

Pollutant Capture & Removal

Remove pollutants from indoor air through effective ventilation and filtration

List of CARB-Certified Air Cleaning Devices

1 Kitchen Exhaust & Range Hoods

- Use vented range hoods during cooking to remove $PM_{2.5}$, NO_2, VOCs, and UFP near the source.

2 Wildfire Smoke Protection

- Create a designated "clean room" with a portable HEPA air cleaner during smoke events.
- Keep windows and doors closed when outdoor air quality is poor.

3 Cleaner Air During School Transportation

- High-efficiency cabin air filtration can substantially reduce students' exposure to traffic-related $PM_{2.5}$, black carbon, and ultrafine particles.

4 Air Filtration in Homes & Schools

- Upgrade HVAC filters (MERV-13+) and use portable HEPA air cleaners to reduce indoor particles.
- Schools and childcare facilities can benefit substantially from enhanced filtration.

MERV 8

- Captures larger particles
- Basic filtration
- Lower cost

MERV 13

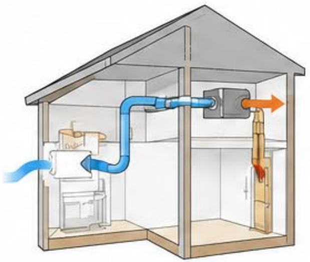
- Captures smaller particles
- Better for allergies
- Higher cost

Dilution, Ventilation, and Building Design

Proper ventilation and high-performance building design work together to dilute indoor pollutants, minimize outdoor contamination, and create healthier indoor environments

1 Residential Ventilation & Air Exchange

- Mechanical ventilation systems dilute pollutants from cooking, cleaning products, furnishings, and occupants.
- Open windows when outdoor air quality is good; reduce outdoor air intake during wildfire smoke events.



Good Outdoor Air Quality

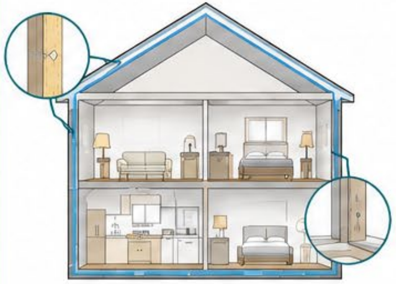
Wildfire Smoke Event

Keep windows closed and reduce outdoor air intake.

2 Building Airtightness & High-Performance Design

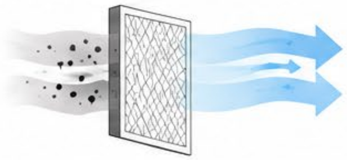
- Airtight building envelopes reduce infiltration of wildfire smoke, traffic pollution, and other outdoor contaminants.
- MERV-13+ filtration can substantially reduce particle infiltration; MERV-16 filters have achieved up to 98% $PM_{2.5}$ reduction.

Airtight Building Envelope



Sealed gaps and high-performance materials reduce unwanted air infiltration.

High-Efficiency Filtration



MERV 13+	MERV 16
✓ Reduces particle infiltration	✓ Up to 98% $PM_{2.5}$ reduction
✓ Improves indoor air quality	✓ Highest particle removal efficiency

Future Research Priorities

1 Long-term (> 6-month) indoor monitoring

across seasons, housing types, and climate regions

Spring · Summer · Fall · Winter

Single-family Homes · Multifamily Housing · Mobile/Manufactured Homes · Rural Homes

Capture seasonal and regional variability in exposures

2 Developing robust low-cost air sensors

Advance accurate, reliable, and affordable sensors for widespread IAQ monitoring and equity-focused applications.

Low-cost sensors + Data transmission + Data analytics & validation → Actionable insights

3 Improve understanding of emerging pollutants

(PFAS, microplastics, cannabis smoke, wildfire residues, post-fire off-gassing)

PFAS · Microplastics · Cannabis Smoke · Wildfire Residues · Post-fire Off-gassing

Identify sources, characterize exposures, and assess health impacts.

4 Evaluate real-world effectiveness of mitigation technologies and behavioral interventions

Technologies (e.g., air purifiers, ventilation) → Behaviors (e.g., window use, cooking practices) → Real-world performance & acceptability

Future Policy Priorities

1 Develop comprehensive statewide IAQ performance guidelines

Establish science-based, enforceable IAQ standards for homes, buildings, and communities across California.

2 Strengthen ventilation, filtration, and low-emission material requirements in buildings

Ensure adequate ventilation, high-efficiency filtration, and low-emission materials in new construction and retrofits.

3 Integrate IAQ into housing, climate resilience, public health, and energy policies

Embed IAQ considerations across interconnected policy areas for co-benefits and resilient communities.

4 Support post-wildfire indoor environmental assessment and recovery guidance

Develop clear guidance and resources for indoor air assessment, cleanup, and safe re-occupancy after wildfires.

5 Prioritize vulnerable populations, including children, older adults, and individuals with pre-existing health conditions

Ensure policies and programs address the greater risks and unique needs of those most susceptible to poor IAQ.

6 Expand access to filtration, ventilation upgrades, and appliance replacement programs

Invest in incentive and rebate programs that make healthy indoor air solutions affordable and accessible.

7 Address barriers faced by renters, low-income households, and disadvantaged communities

Remove structural, financial, and policy barriers to ensure equitable IAQ protections for all communities.

8 Improve risk communication, community engagement, and culturally appropriate outreach

Build trust and empower communities through clear messaging, two-way engagement, and culturally relevant materials and channels.

Key Takeaways

WHY IT MATTERS

Californians Spend ~87% Time Indoors

$PM_{2.5}$ VOCs NO_2

Indoor air pollutant levels are often higher than those outdoors

RESEARCH APPROACH

1. Literature Review — Over 700 Papers
2. Interviews — 32 Community Members (Bay Area, Central Valley, Los Angeles)
3. Public Workshop — 40 Participants

PRIORITY INDOOR AIR POLLUTANTS

TRADITIONAL	EMERGING
NO_2	Wildfires
$PM_{2.5}$	PFAS "forever chemicals"
VOCs (Acrolein, Benzene, Formaldhyde)	

HEALTH IMPACTS

Respiratory, Cardiovascular, Neurological

VULNERABLE & SUSCEPTIBLE GROUPS

Pregnant, Existing Conditions, Seniors, Children, Minority, Low-Income

MITIGATION STRATEGIES

- Control Emission Sources
- Improve Ventilation & Filtration
- Increase Education & Awareness

GUIDELINES & REGULATORY FRAMEWORKS

Global	From over 50 international governments & entities
United States	ASHRAE (Ventilation Std.) OSHA/NIOSH (Workplace Limit) Selected States (IL, PA, TX)
California	CARB (Emission Regulations) CEC (Title 24 Bldg. Codes) OEHHA (Ref. Exposure Lvl.)

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