BRIGHAM AND WOMEN'S HOSPITAL
The Lung Center

Mass General Brigham
Asthma Center

Update on Severe Asthma 2024

**March 21, 2023**
**11:10-11:45 am**

# The Impact of Climate Change on Asthma


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SCHOOL OF PUBLIC HEALTH

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

# Objectives

To review the effects of climate change on health, specifically asthma.

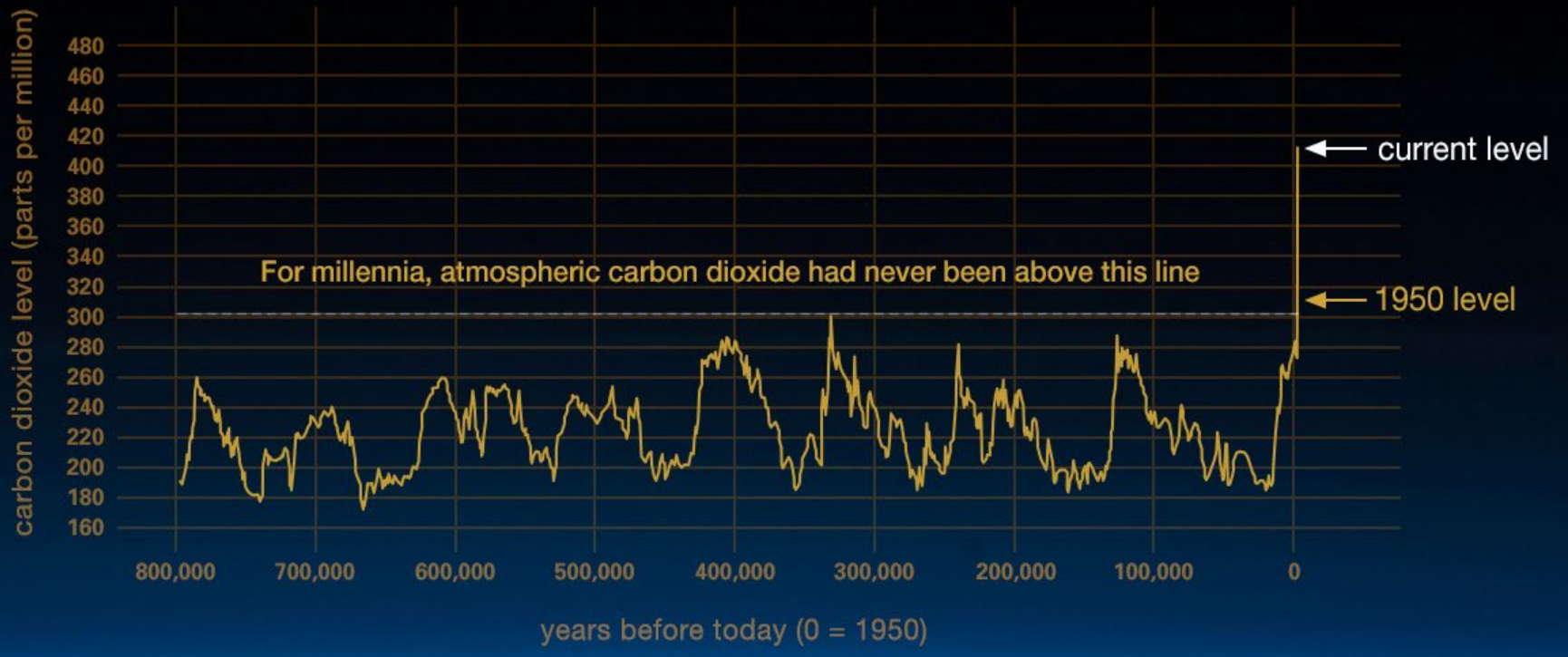
To discuss the solutions involved in adaptation and mitigation to climate change and how they affect health.

To learn about ways the health care systems can reduce green house gas emissions and improve patient’s health and public health.

# Disclosures

| Type | Company |
|---|---|
| Employment<br>full time / part time | Harvard University and Harvard-affiliated Hospitals |
| Spouse / Family member<br>employment / engagement | None |
| Research Grant (P.I., collaborator or consultant; pending and received grants) | Grants : NIAID, NHLBI, NIEHS, MacArthur Foundation-Genius Award, |
| Other research support | Past Advisor: Regeneron<br>Data and Safety Monitoring Board member at Northwestern, Univ of Chicago, and NHLBI<br>Co-founder: Before Brands, Alladapt Immunotherapeutics, IgGenix, and Latitude |
| Speakers Bureau / Honoraria | None |
| Ownership Interest (stock, stock-options, patent or intellectual property) | Patents for basophil test, multifood immunotherapy and prevention, monoclonal ab from plasmablasts, and device for diagnostics. |
| Consultant / advisory board | Board of Scientific Counselors-NIH Clinical Center, Scientific steering committee-ITN NIAID |

# ATMOSPHERIC $CO_2$ LEVELS - PAST 800,000 YEARS

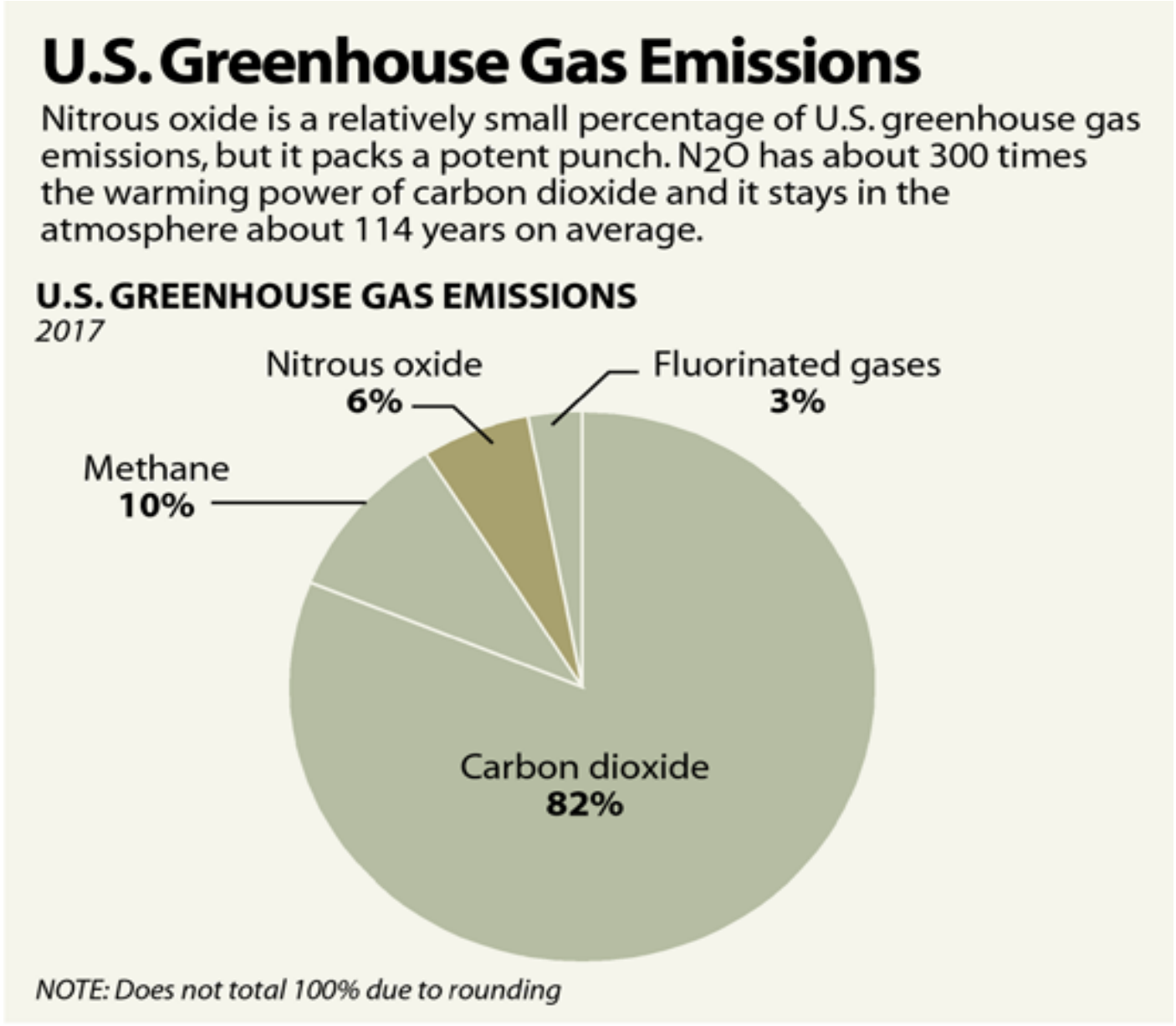



**WHAT IS CLIMATE CHANGE?**

**Warming of the earth's surface caused by build-up of carbon dioxide (CO2) and other greenhouse gases, such as methane, in the earth's atmosphere**

# $CO_2$ accounts for 2/3 of warming

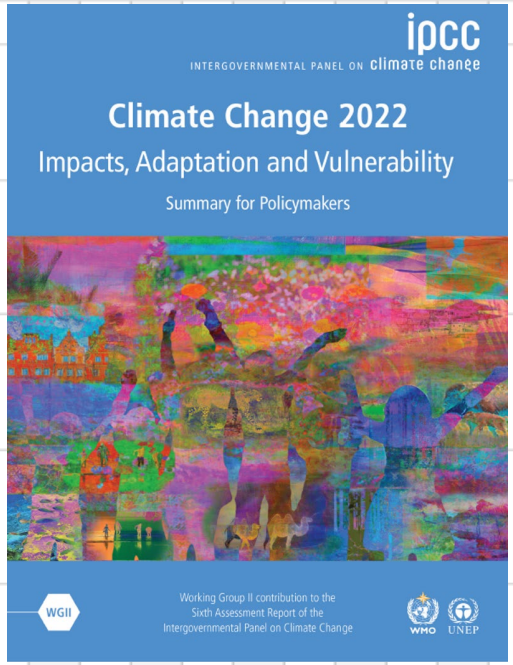
- The are other important greenhouse gases are $N_2O$, CFCs, $CH_4$



**GLOBAL TEMPERATURE – about 1.5 C higher than pre industrial levels—if no changes are made, the trajectory to 2.5-2.8 C currently**


Bearer, C.F., Molloy, E.J., Tessema, M.T. *et al.* Global climate change: the defining issue of our time for our children's health. *Pediatr Res* (2022). https://doi.org/10.1038/s41390-022-02290-7 (Note: as of Feb 1, 2024 – 81 articles on climate change in Pediatric Research)

# United States Billion-Dollar Disaster Events 1980-2022 (CPI-Adjusted)




https://www.ncei.noaa.gov/access/billions/time-series

CarbonBrief
CLEAR ON CLIMATE

# Attributing extreme weather to climate change

*Use the filters below to explore the studies*

**Finding**

Human influence found | No human influence found | Inconclusive

**Type of study**

Formal study | Rapid assessment | Trend

**Impact**

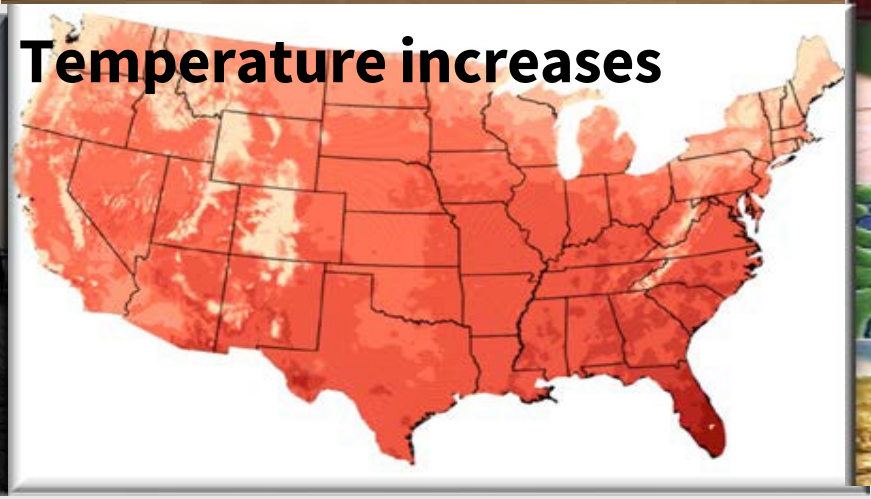
Atmosphere | Cold, snow & ice | Coral bleaching | Drought | Ecosystem function | Heat | Oceans | Rain & flooding | River flow | Storm | Sunshine | Wildfire | Compound

Select all | Deselect all

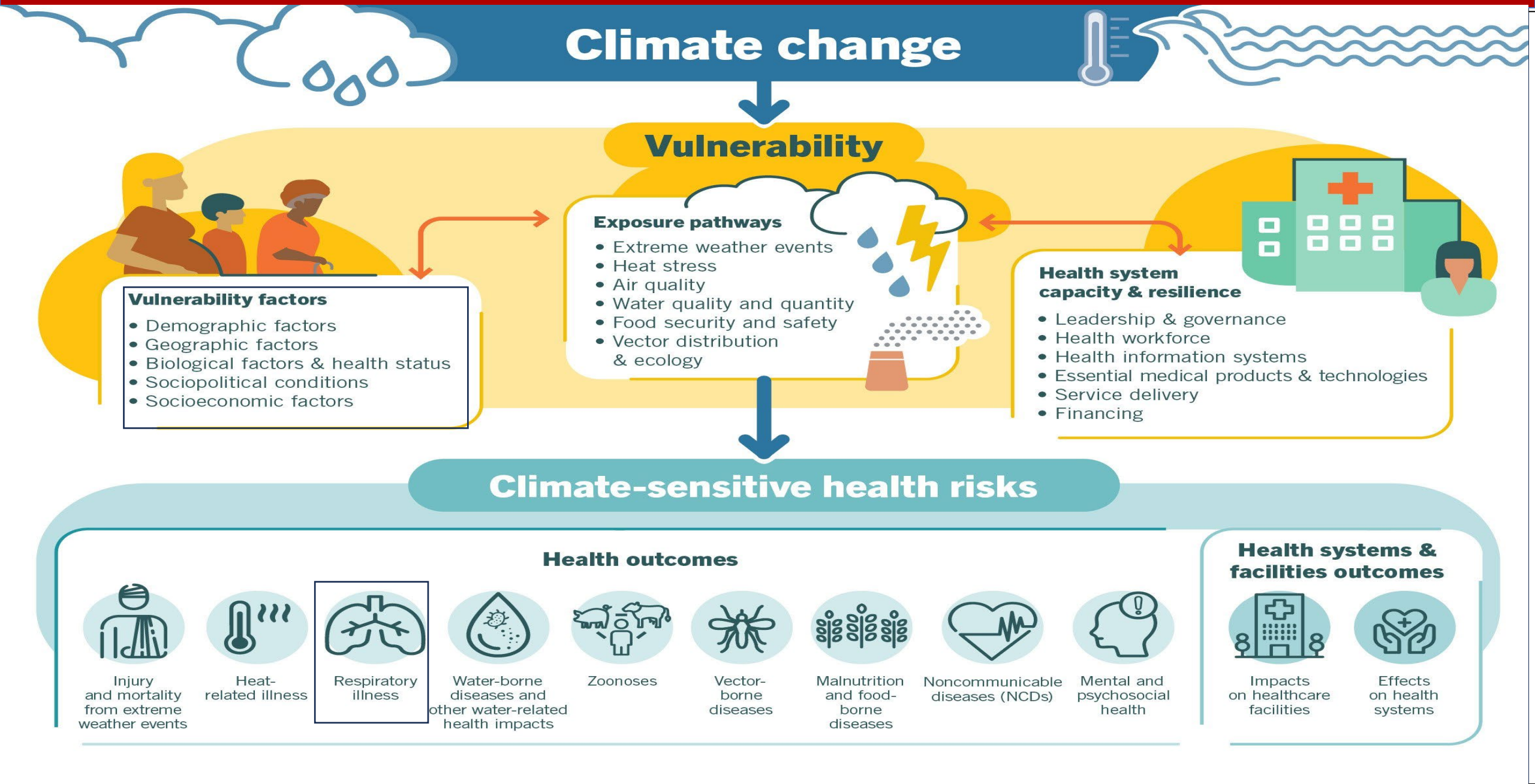
# What are the effects of climate change on planetary health?



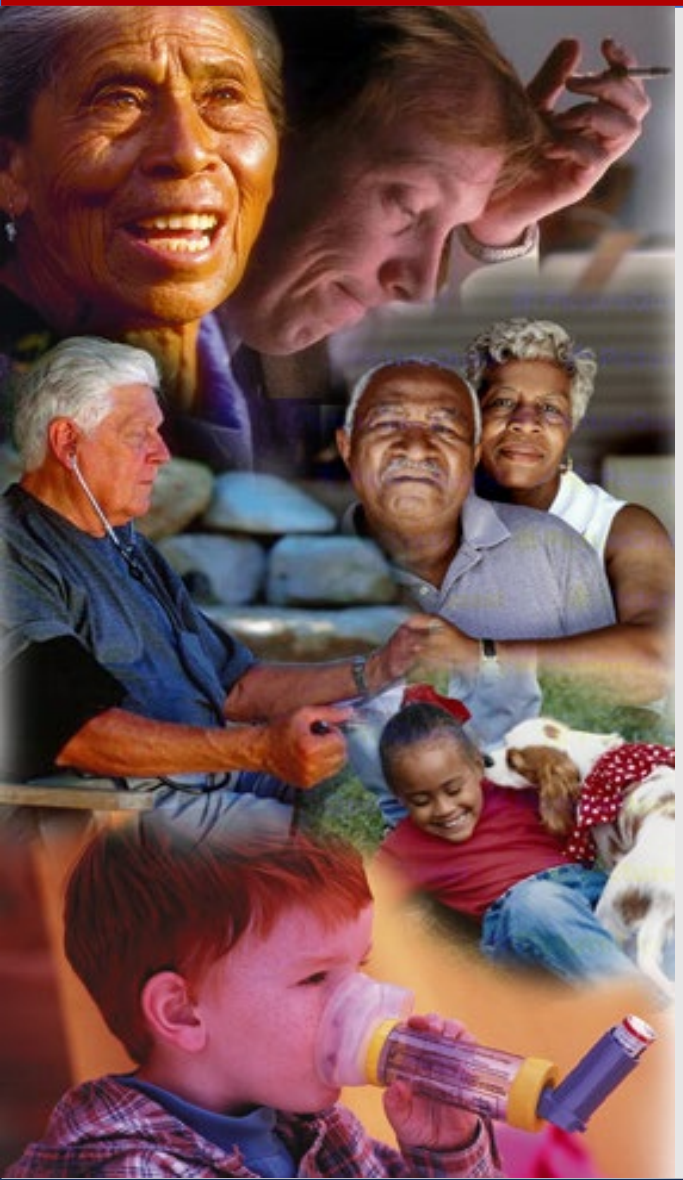





# What are the Major Health Effects of Climate Change?



# Who? Climate Change and Health…affects all people, and some groups are more vulnerable



**PEOPLE WITH HEART OR LUNG DISEASES** are more vulnerable to particle pollution because of their conditions (such as congestive heart disease, coronary artery disease, asthma, or chronic obstructive pulmonary disease.)

**THE UNDERSERVED AND UNDER-RESOURCED** climate change disproportionately harms those with the fewest resources and the least capacity to respond to threats. Majority of those living near a toxic waste dump are people of color.

**OLDER ADULTS** also are considered at risk, because they are more likely to have heart and lung disease. (sometimes that disease hasn't been diagnosed yet.)

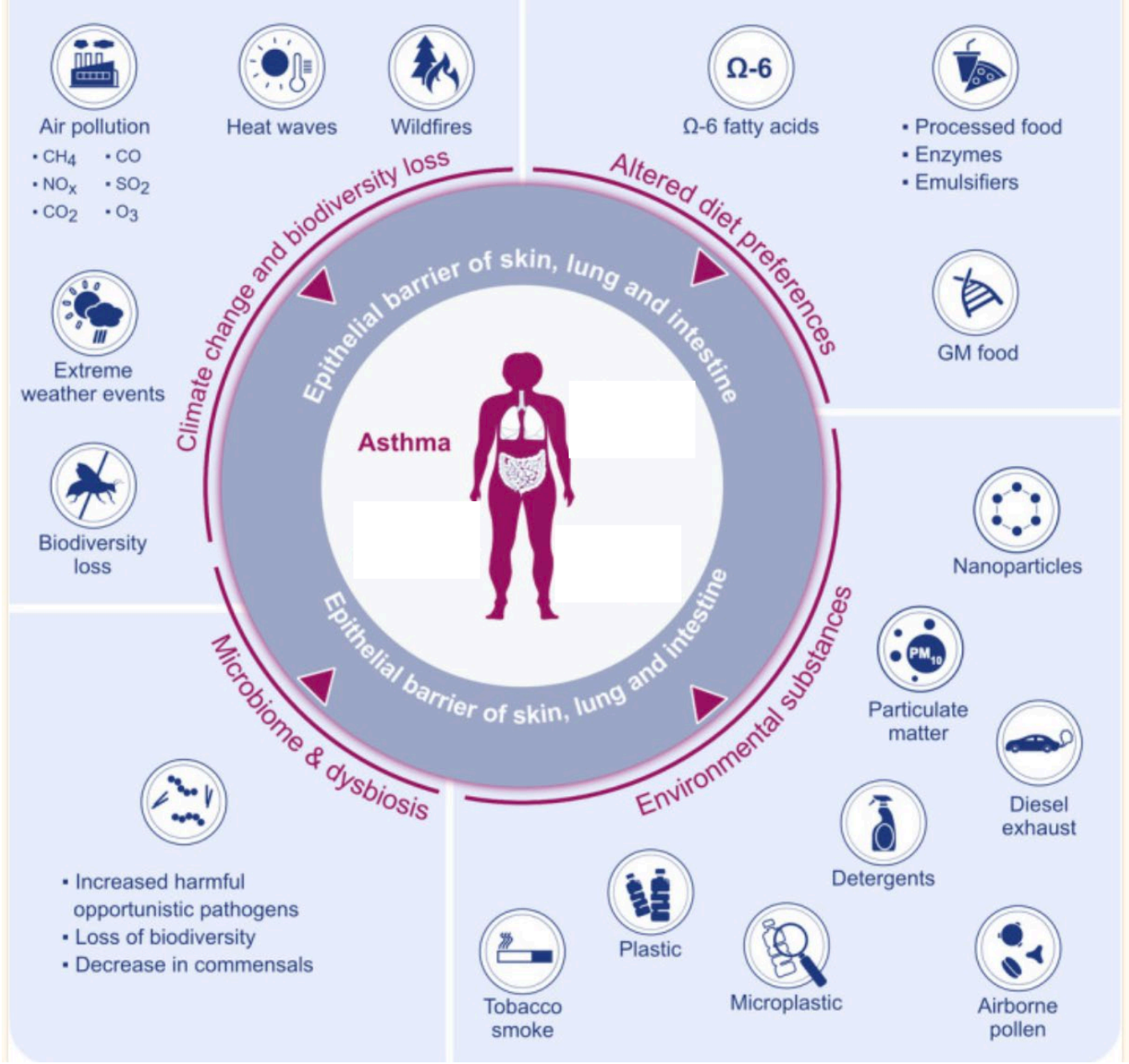
**CHILDREN** are at risk (primarily from chronic exposure), because they are more likely to be active, they breathe more air per pound of body weight than adults, and their bodies are still developing.

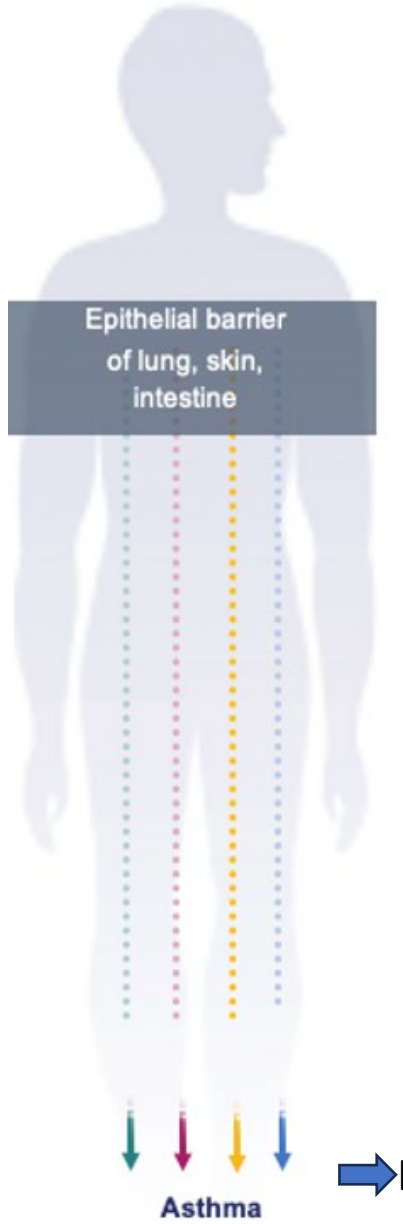
The **WHO** estimates that nearly 90% of the burden of disease attributable to climate change is borne by children under the age of 5, in both developing and developed countries.

https://www.who.int/health-topics/climate-change

**When? Climate Change events Have been found to Cause and Worsen Asthma in:**

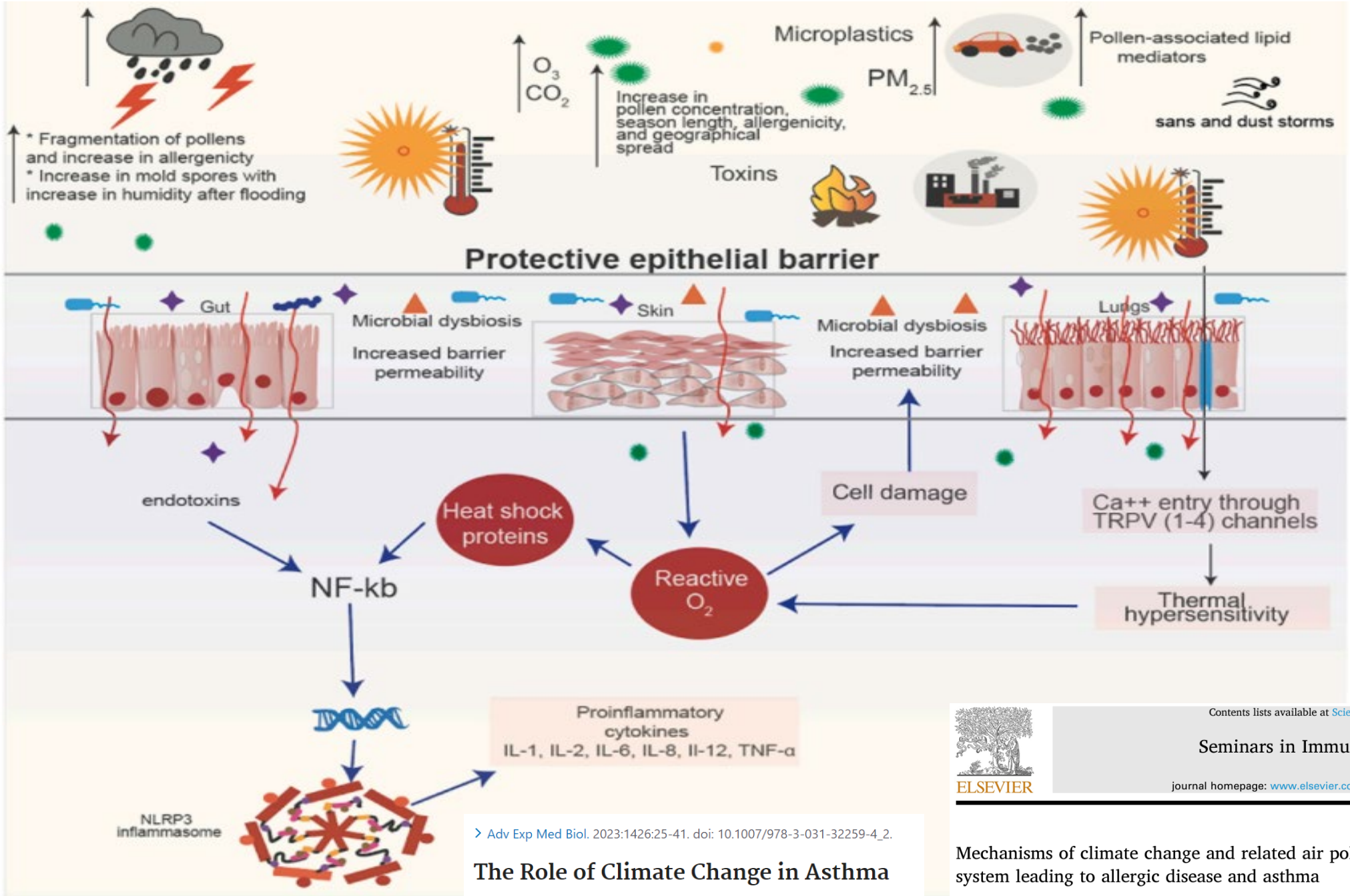
- *Heat Waves*
- *Pollen increases*
- *Dust Storms*
- *Wildfires*
- *Air Pollution*
- *Biodiversity*




➡Mechanism?

Celebi Sozener Z, et al. Epithelial barrier hypothesis: Effect of the external exposome on the microbiome and epithelial barriers in allergic disease. Allergy. 2022 May;77(5):1418-1449. and Akdis,· Boyd,· Sampath, Galli,· Nadeau Science Translational Medicine 2022 and IPCC report (Intergovernmental Panel on Climate Change-2022, 270 countries, 67 scientists/authors).




Mechanisms of Climate Change-Associate events

Adv Exp Med Biol. 2023:1426:25-41. doi: 10.1007/978-3-031-32259-4_2.

## The Role of Climate Change in Asthma

Anna Goshua [1], Vanitha Sampath [2], Jo Ann Efobi [2], Kari Nadeau [2 3]

Contents lists available at ScienceDirect

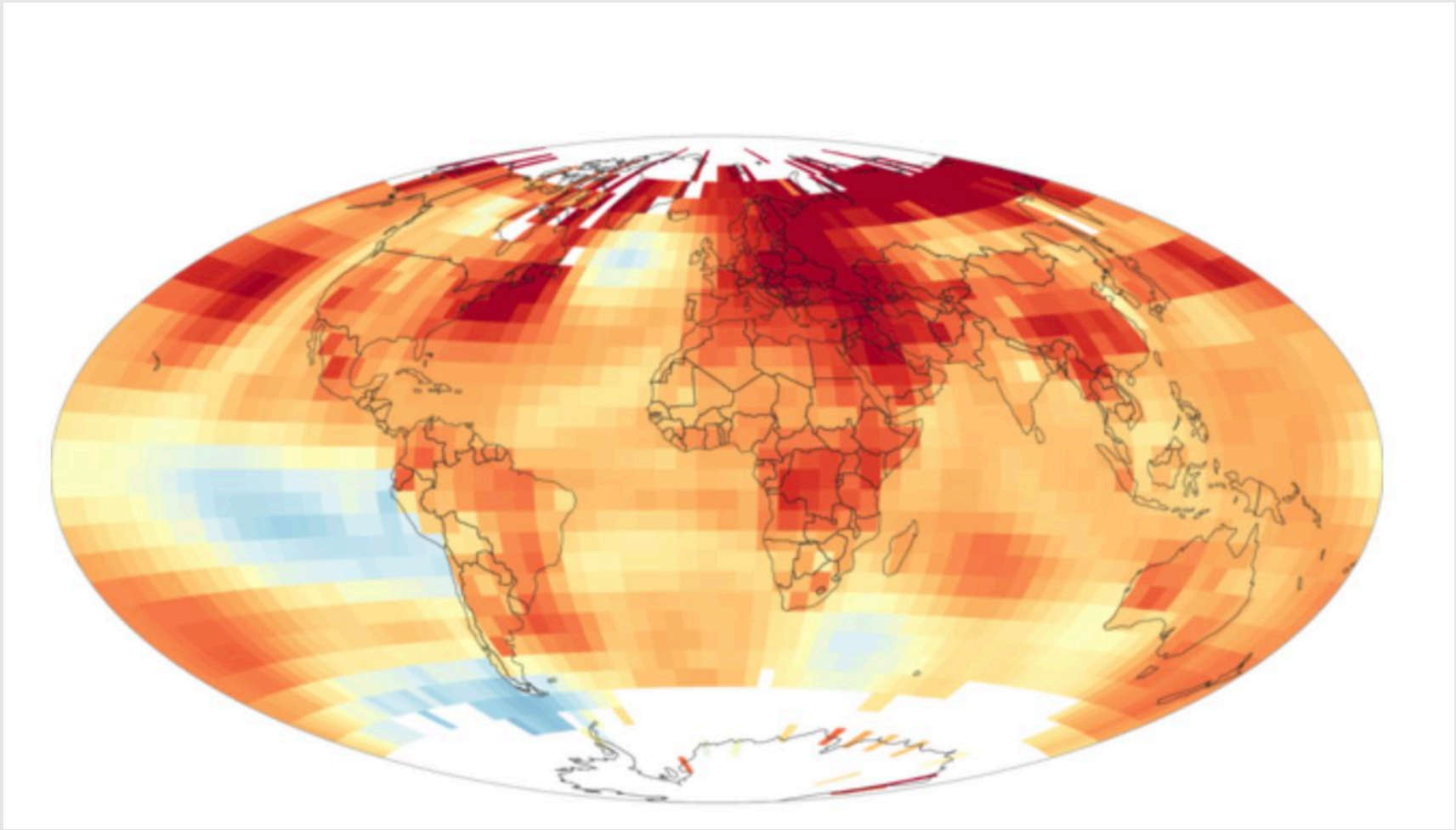
Seminars in Immunology

journal homepage: www.elsevier.com/locate/ysmim

## Mechanisms of climate change and related air pollution on the immune system leading to allergic disease and asthma

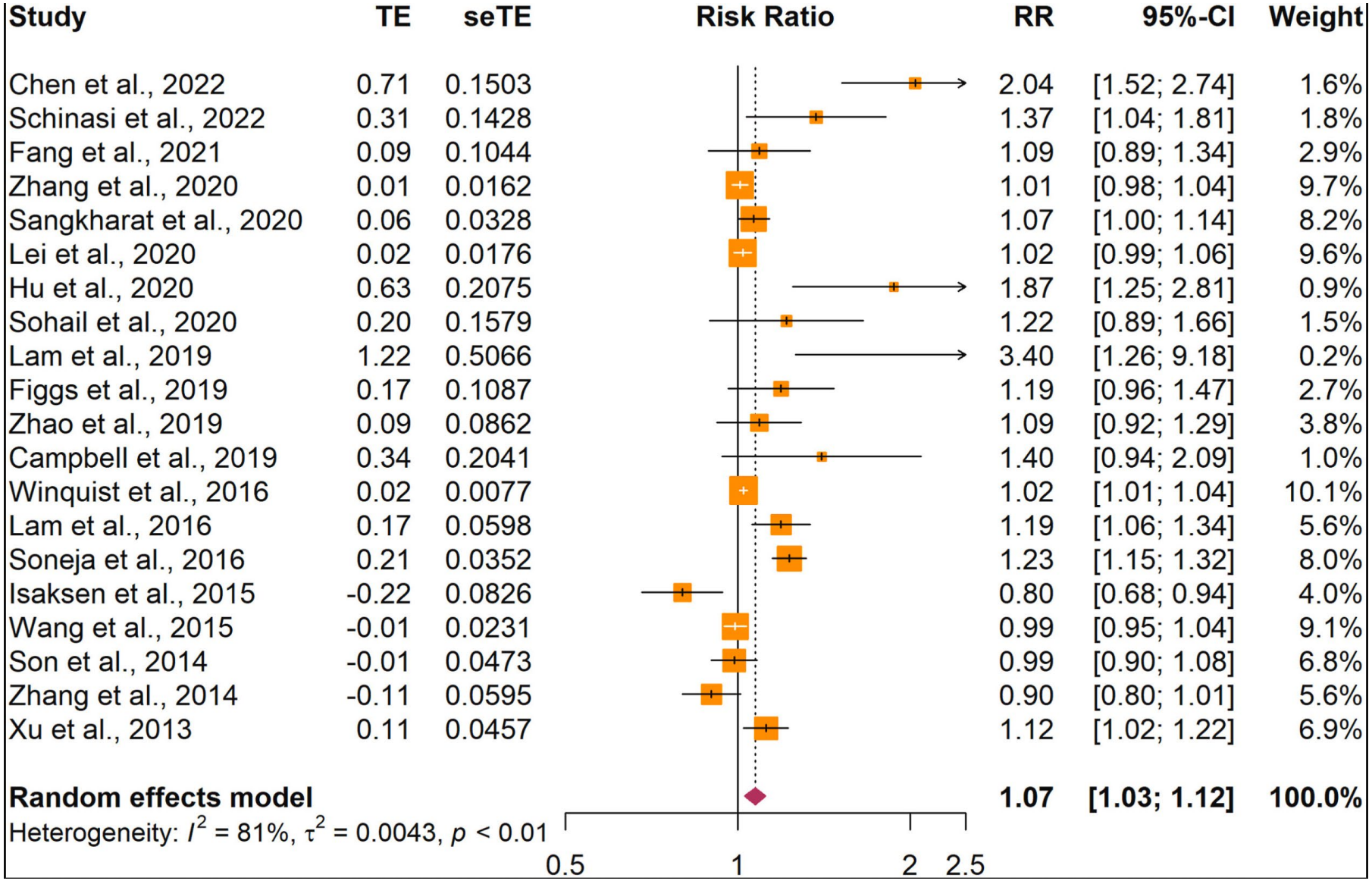
Vanitha Sampath [a,*,1,2], Juan Aguilera [b,1,3], Mary Prunicki [a,4], Kari C. Nadeau [c,5]

# Heat Waves: Recent Temperature Trends (1993-2022)



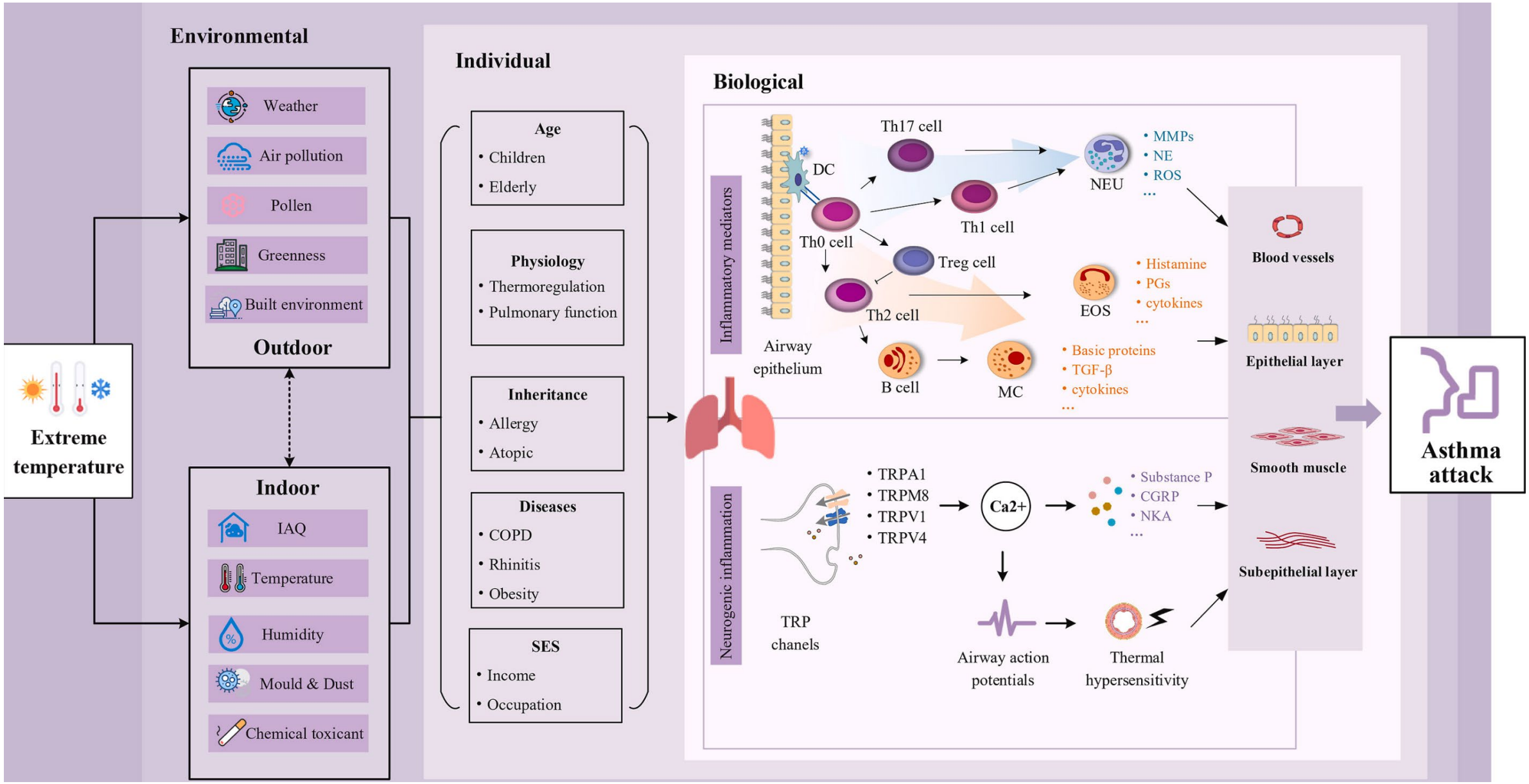

https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature

# Epidemiological Evidence of Heat Waves triggering asthma exacerbations



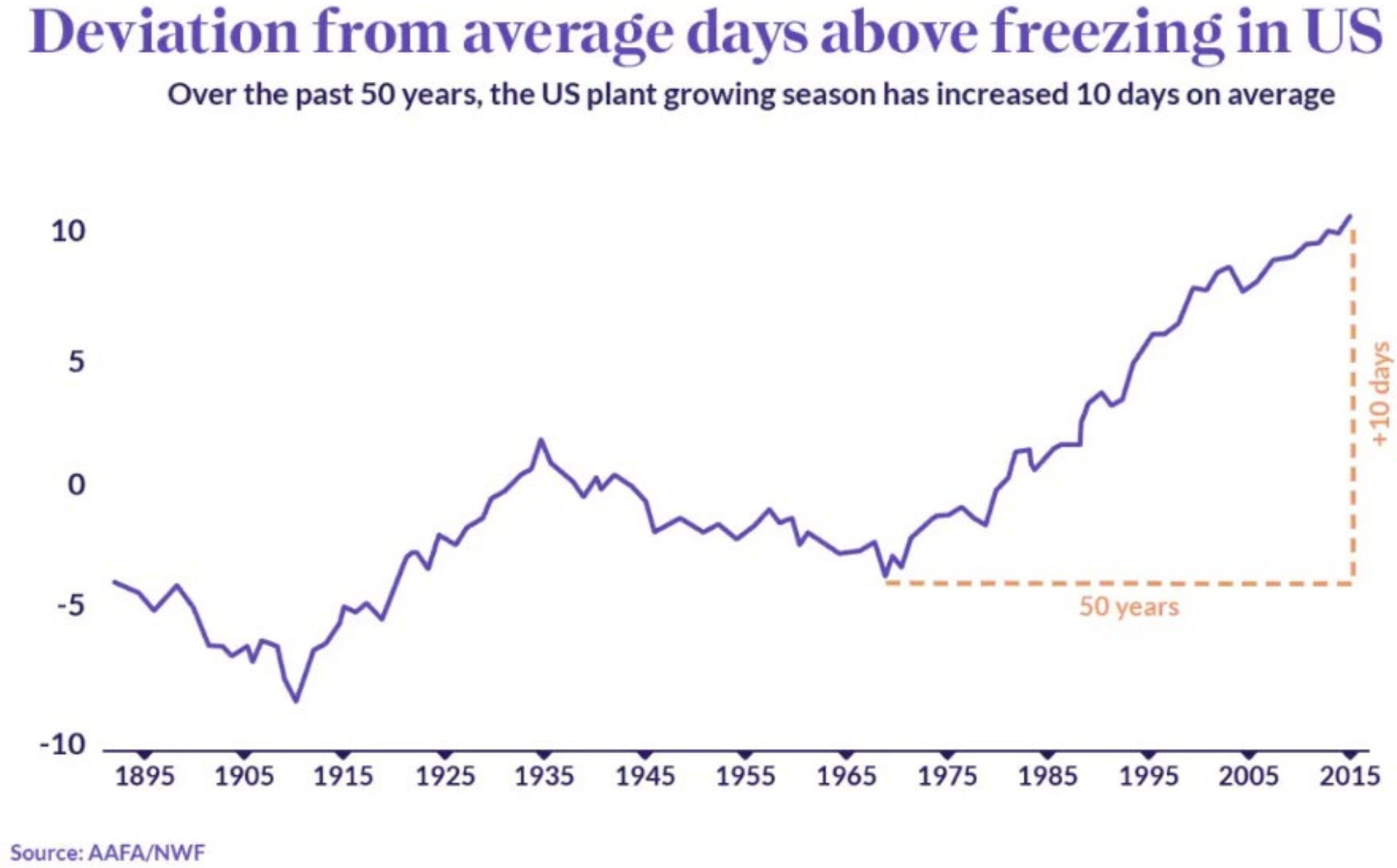

Han A, et al. Asthma triggered by extreme temperatures: From epidemiological evidence to biological plausibility. Environ Res. 2022 Oct 5;216(Pt 2):114489.

# Possible Mechanisms of how extreme temperatures trigger asthma exacerbations

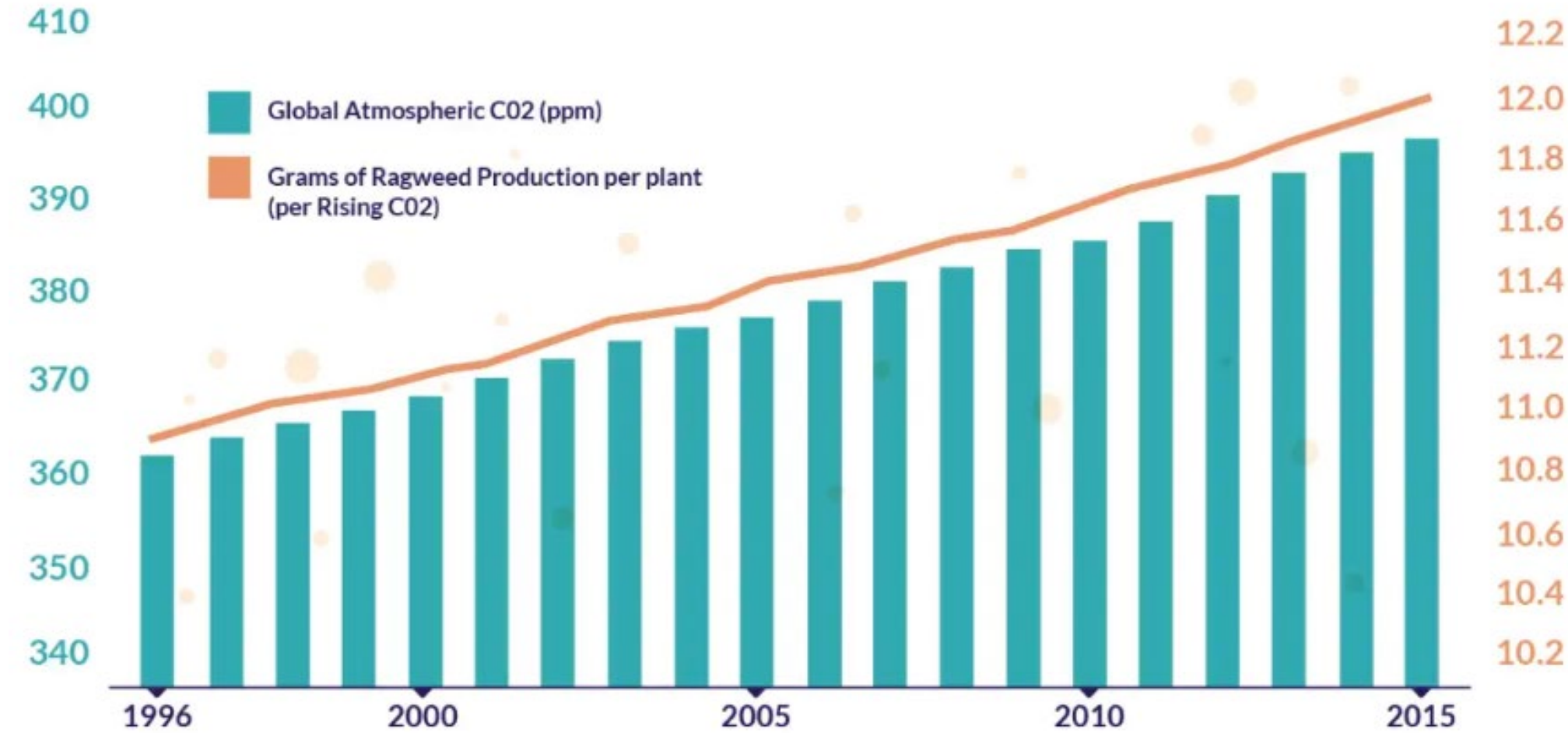



Han A, et al. Asthma triggered by extreme temperatures: From epidemiological evidence to biological plausibility. Environ Res. 2022 Oct 5;216(Pt 2):114489.

# Pollen and Climate Change:

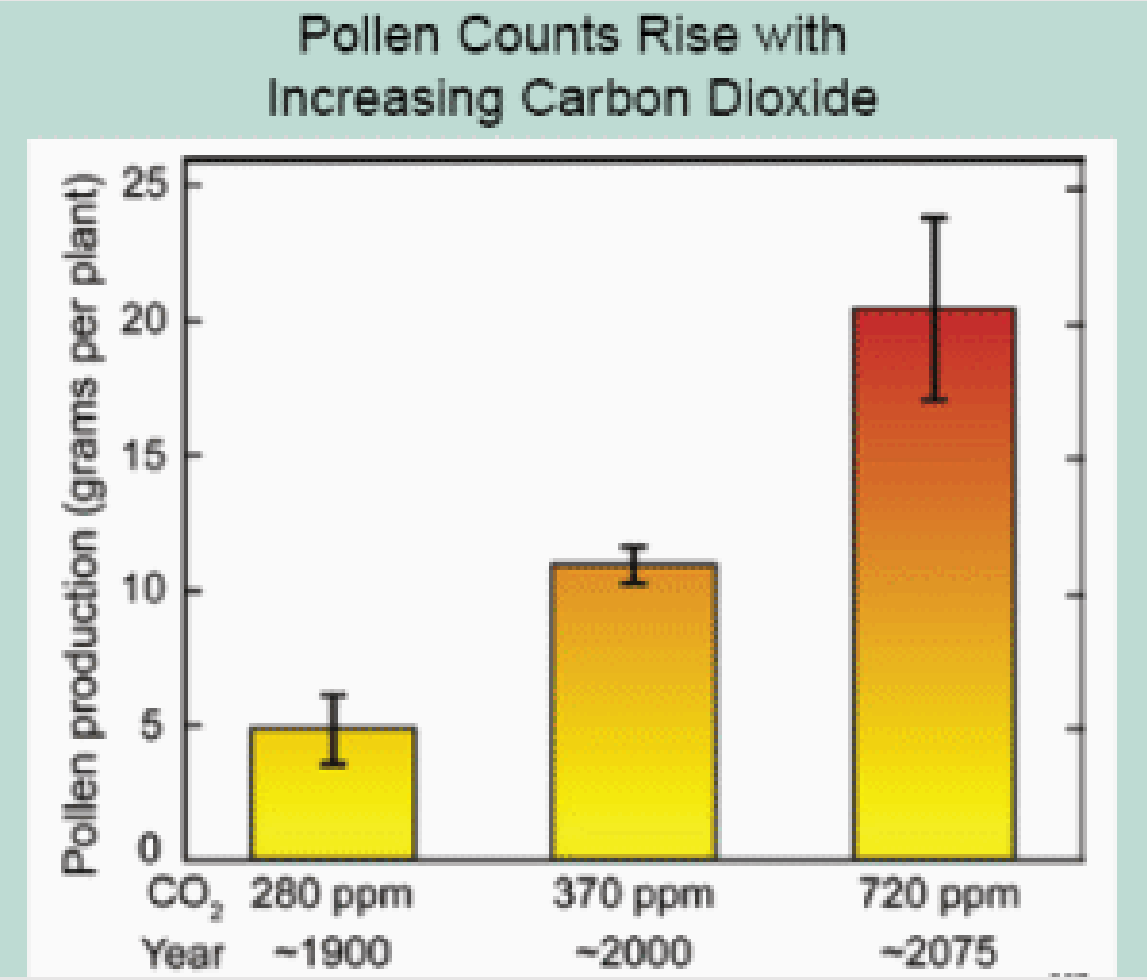


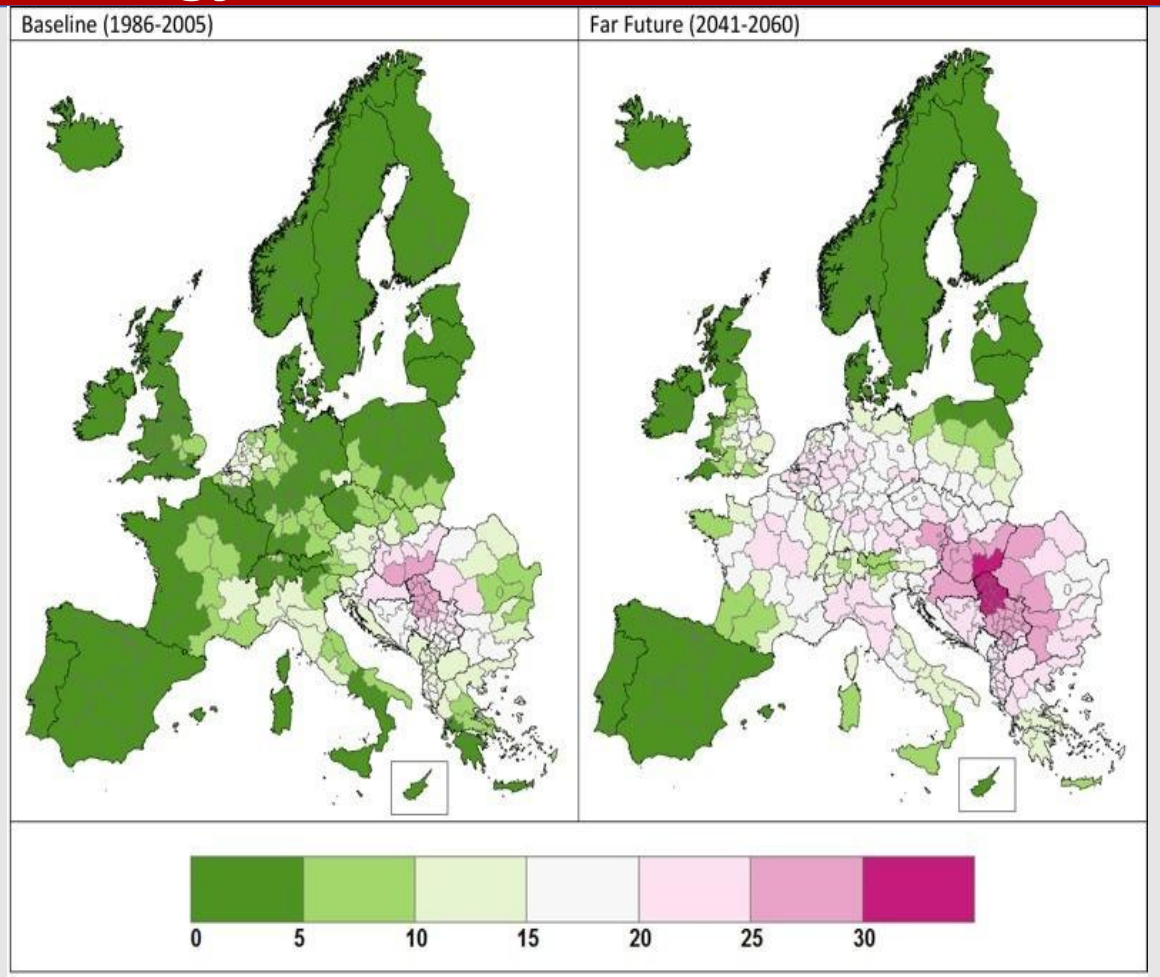
# Global atmospheric CO2 and ragweed pollen production




Source: AAFA/NWF

# Increases in Pollen Counts due to Climate Change over the next decades will likely be associated with increases in allergy and asthma exacerbations

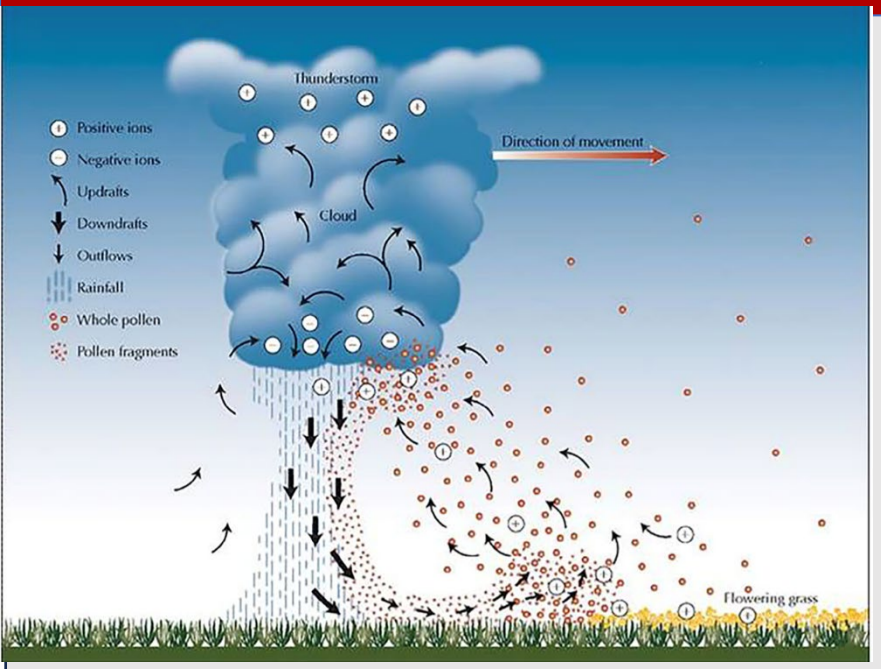


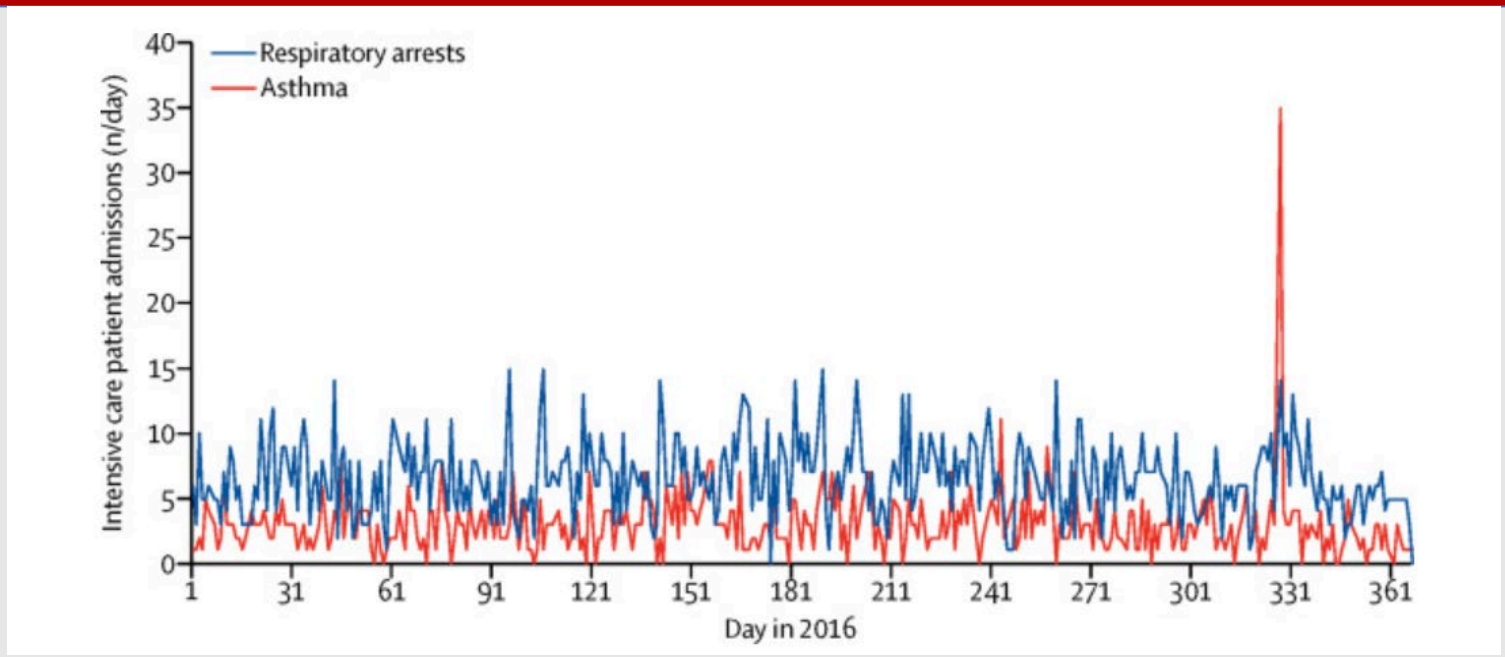




Modelled percentage of population sensitized to ragweed pollen at the baseline (left) and in the future assuming moderate greenhouse gases emissions scenario (RCP 4.5; right)

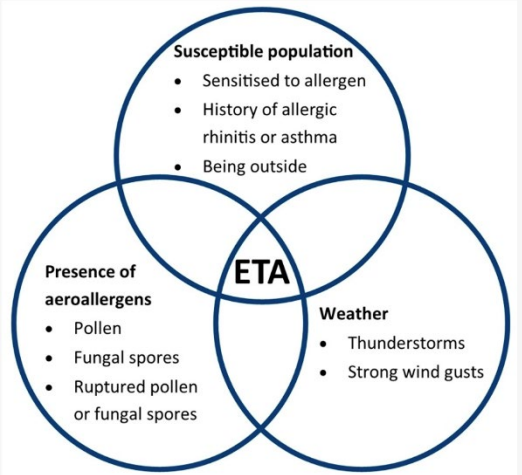
Lake, et al. 2017; Ziska, et al 2009 Environ Health Perspect.

# Thunderstorm Asthma: An Example of Climate Change




Thunderstorm asthma event on November 21, 2016. Melbourne, Australia. Data show admissions to intensive care units (ICU) for asthma (red) and respiratory arrests (blue).



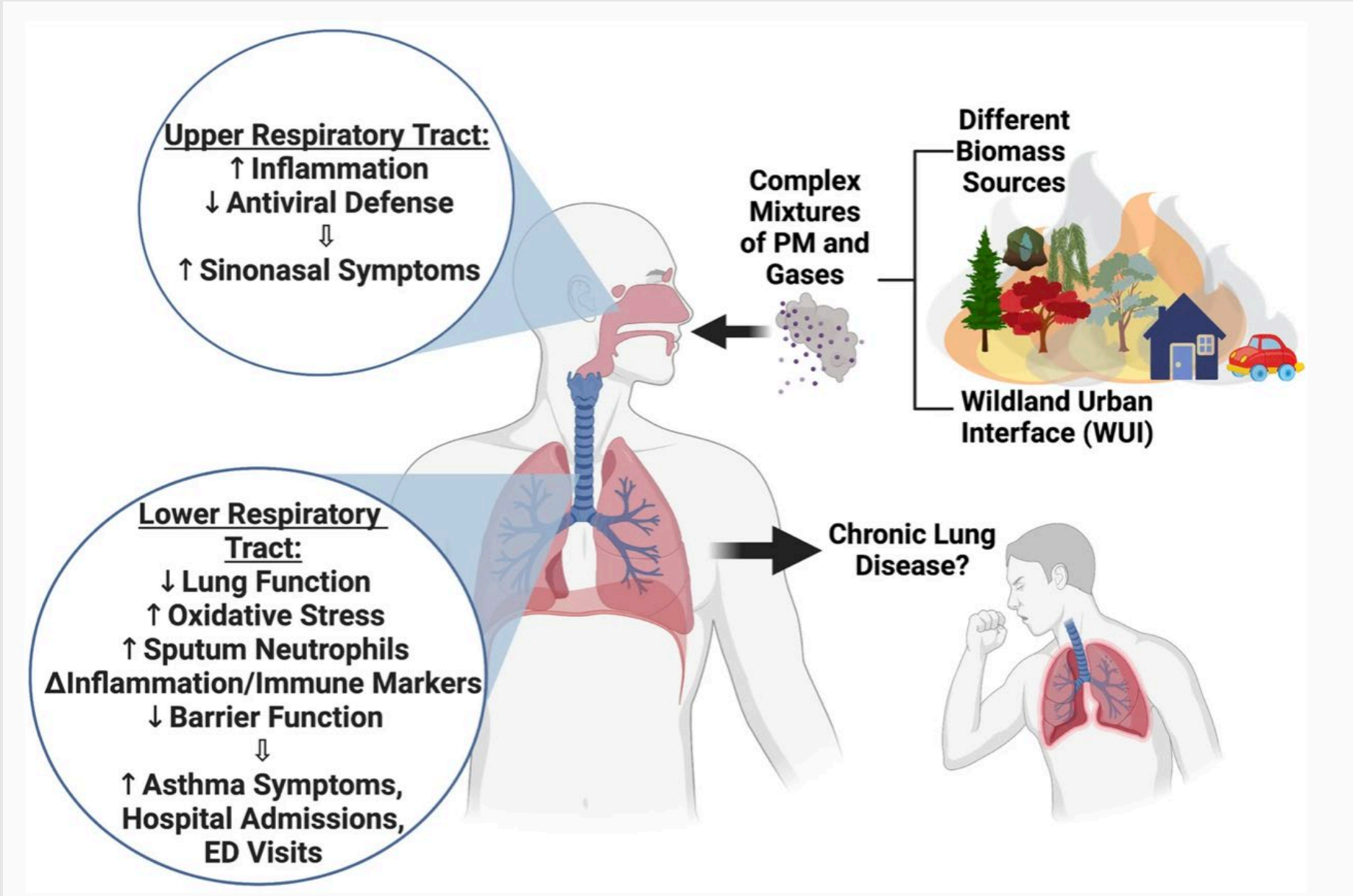

Within 30 h, there were 3365 (672%) excess respiratory-related presentations to emergency departments, and 476 (992%) excess asthma-related admissions to hospital.

3

5 individuals were admitted to an intensive care unit, all had asthma, 12 took inhaled preventers, and five died.

Cockcroft DW, et al. Thunderstorm asthma: An allergen-induced early asthmatic response. Ann Allergy Asthma Immunol. 2018 Feb;120(2):120-123; Campbell Slet al. Evaluating the

# Wildfire smoke increases asthma exacerbations



# WILDFIRES, CLIMATE CHANGE AND HEALTH

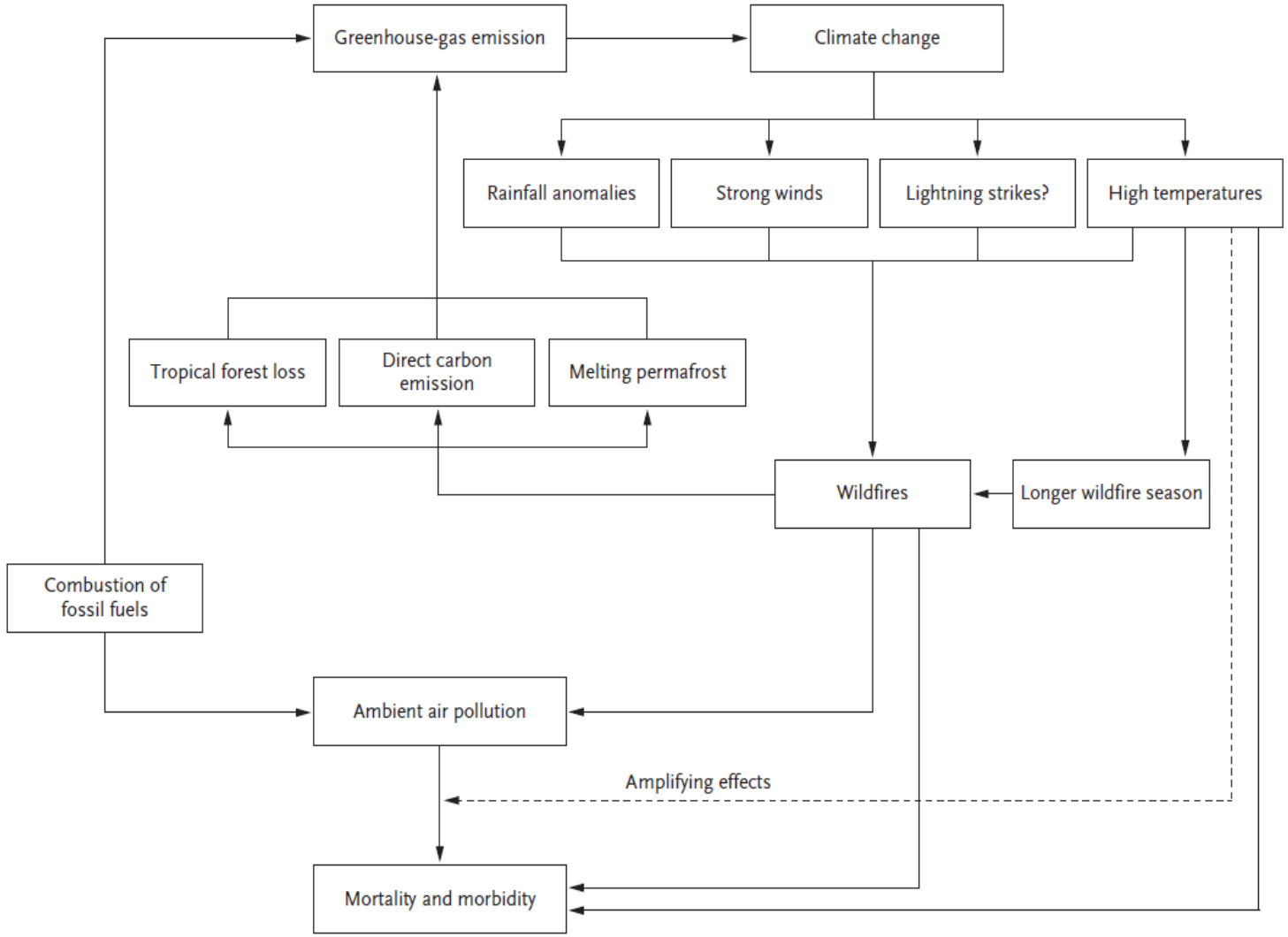



Figure 1. Potential Reinforcing Feedback Loop of Climate Change, Wildfires, and Health Risks.

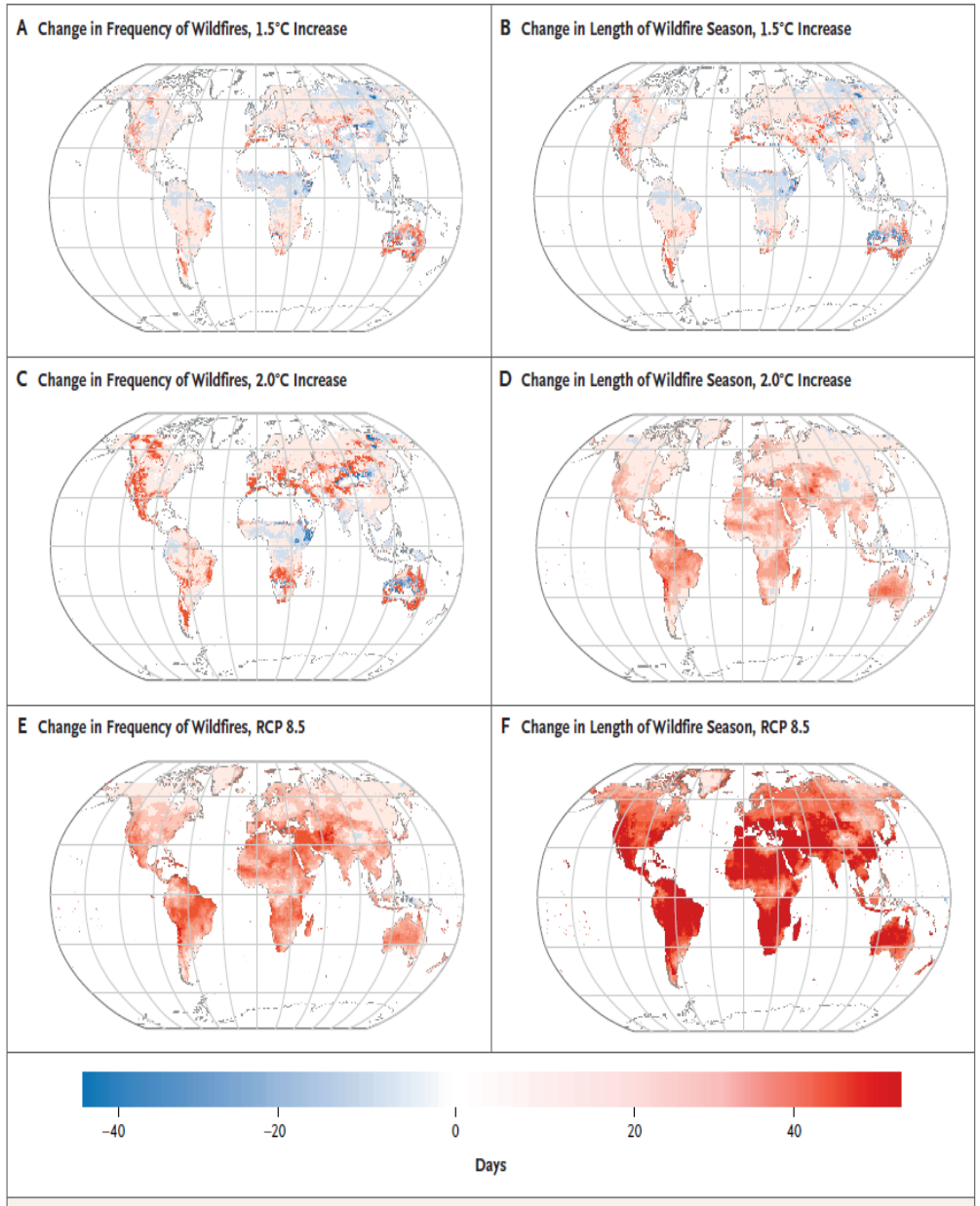
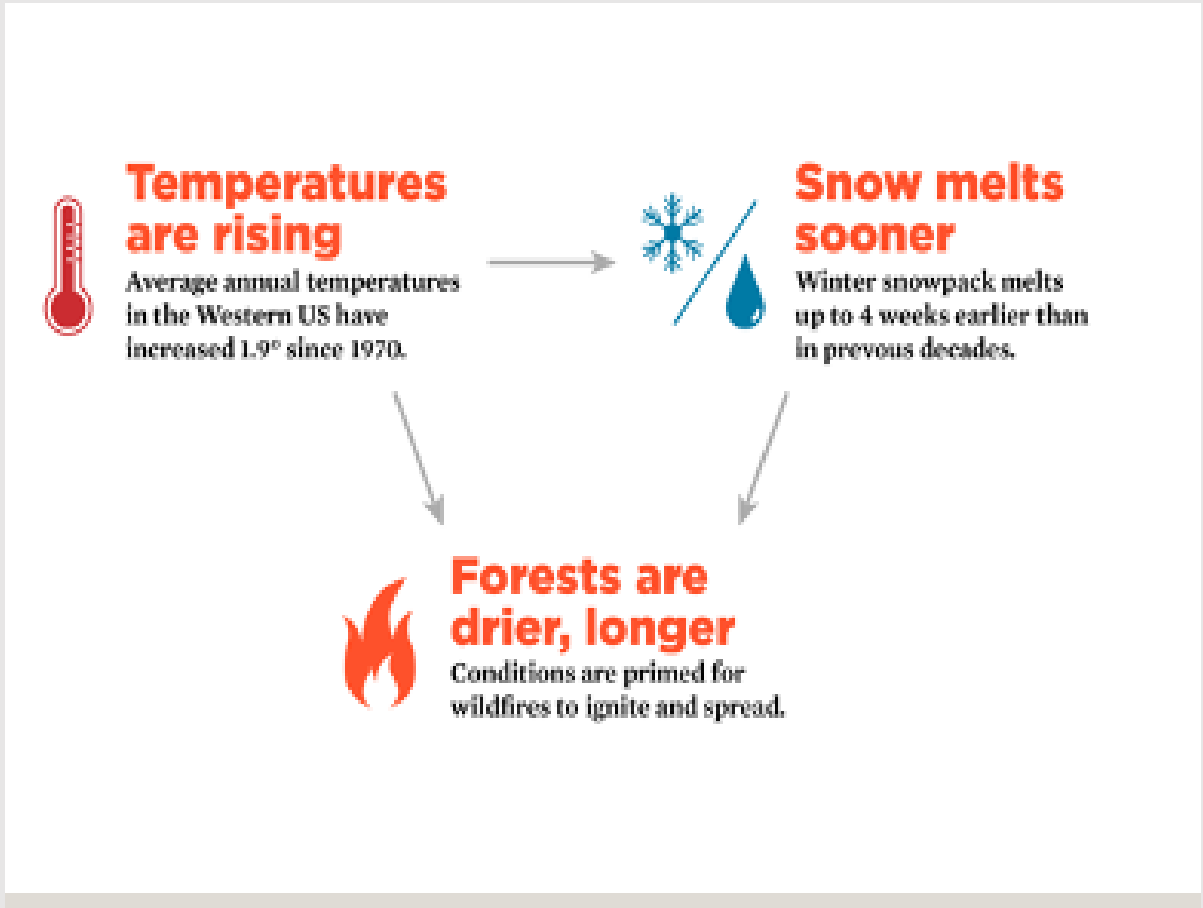
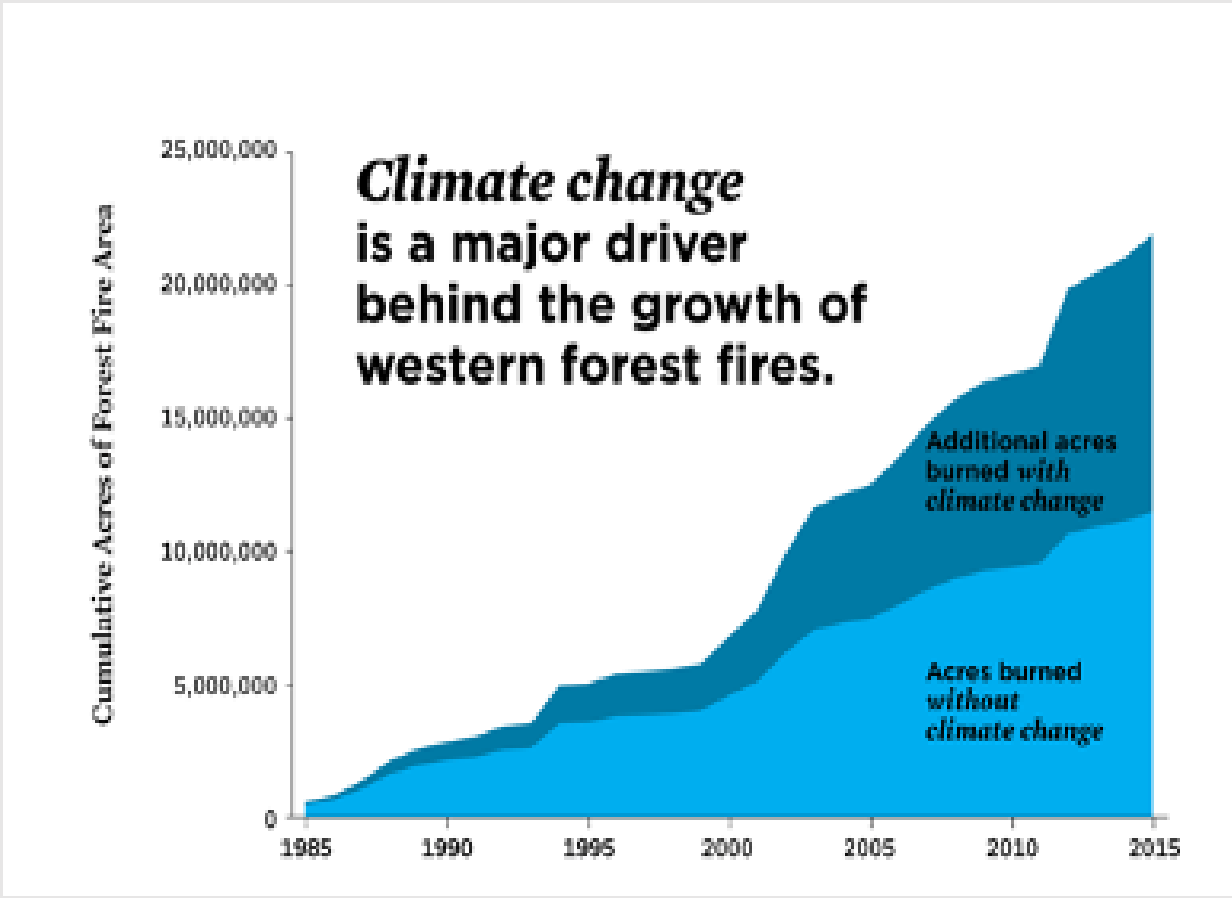



Figure 3. Projected Change from 1981–2000 to 2080–2099 in Frequency of Wildfires and Length of Wildfire Season, According to Global Mean Surface-Temperature Increase.

Xu R, et al. NEJM. 2020

# Record Breaking Fires burn more acres in a world warmed by climate change

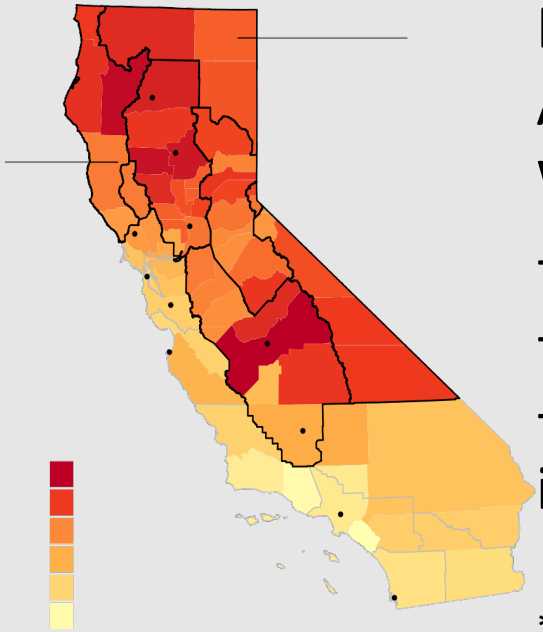



https://www.ucsusa.org/resources/infographic-wildfires-and-climate-change

# Typical Smoke exposure is equivalent to 15-20 cigarettes per day and now wildfire is ~50% residential/commercial


Most counties in CA have 60 days or more smoky days/year due to wildfires



Even after 4-5 days of AQI 100-200,
WFs are associated with
-40% increase in heart attacks
-20% increase in stroke
-50% increase in asthma
in certain ages

*there is no safe distance from wildfire smoke
10x more toxic than air pollution

Wildfires are spreading throughout the world and most are man-made: Artic, Indonesia, Brasilian Rainforest, Australia, Kenya, Chile, China—leads to worsening greenhouse gas emissions and climate change

# BACKGROUND: WILDFIRE CHEMISTRY

**Primary air pollutants**

- Particulate Matter (PM)
- CO
- Nitrogen oxides
- Polycyclic aromatic hydrocarbons (PAHs)
- Volatile organic compounds (VOCs)
- Trace minerals

**Secondary air pollutants**

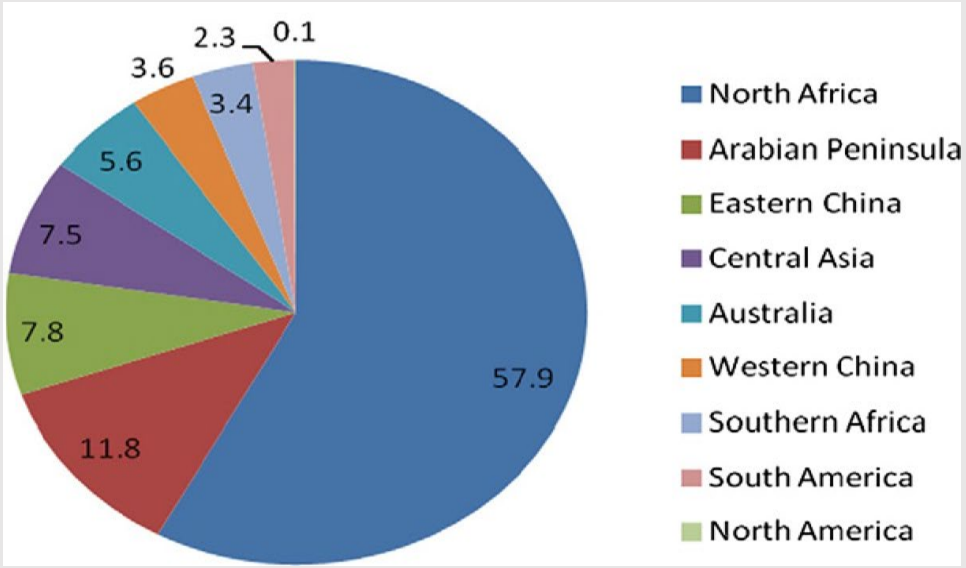
- Particulate Matter (PM)
- Ozone

**When vehicles and buildings burn**

- HCN, HCl, phosgene, metals
- toluene, styrene (disposable plastic dishes), dioxins, vinyl polymers (resin chairs, PVC pipes)
- Synthetics >10x PM than wood, most UFP < 150 nm

OEHHA.ca.gov; Griffiths, et al. 2020

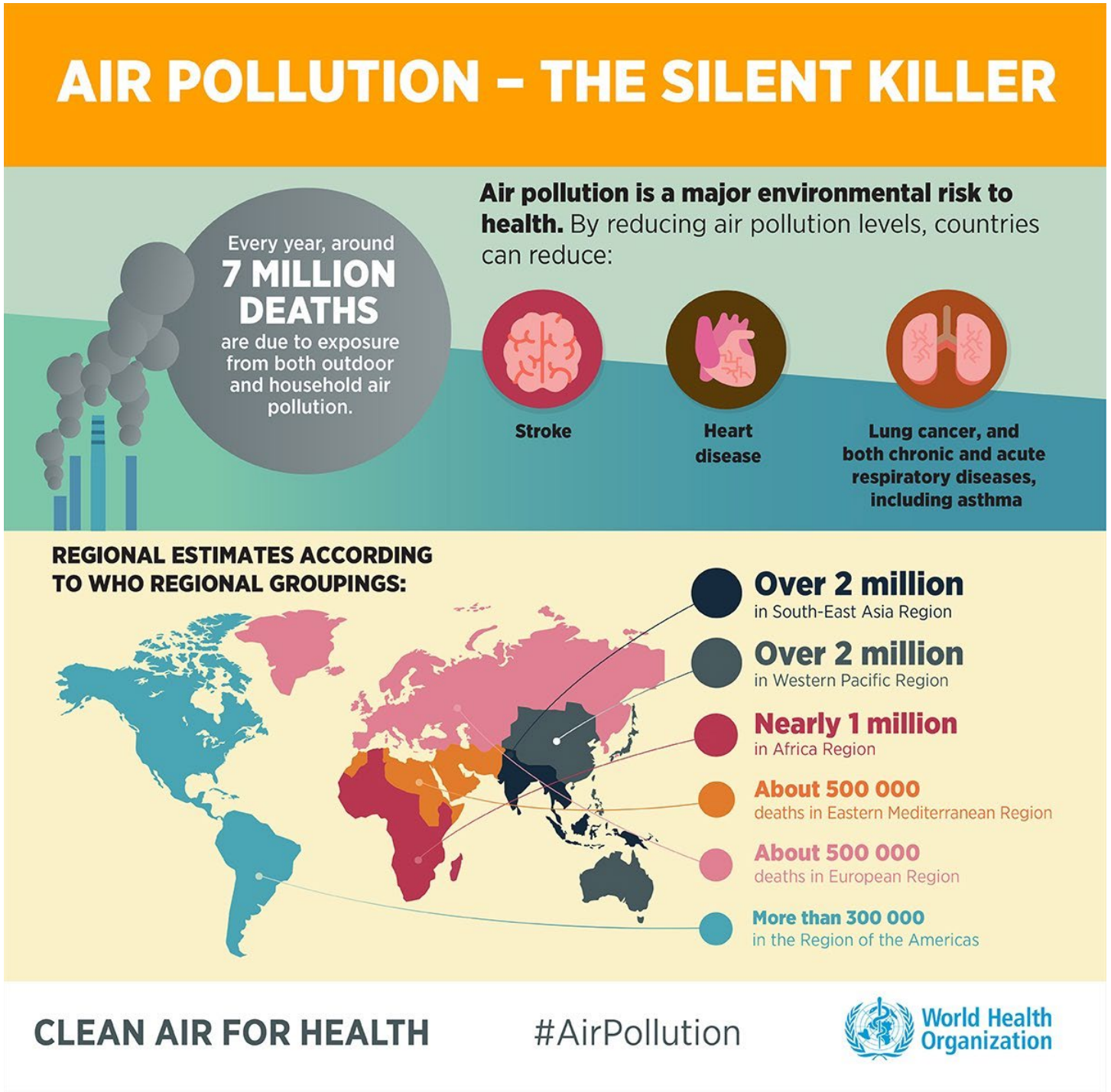
# Sand and dust storms and risk of asthma exacerbations




| Age group | Lag |
|---|---|
| <15 years | |
| Dust >200 | 0 |
| | 1 |
| | 2 |
| | 3 |
| | 5 |

Association between Dust storm events (lag of 0-5 days) and respiratory disease in less than 15 yrs with dust at PM10 > 200 ug/$m^3$


Thalib, Sct Total Env. 2012, Prunicki and Nadeau, Chapter 13.
*Extreme Weather, Health, and Communities, Extreme Weather and Society*, 2016




*"Wildfire smoke is unraveling decades of air quality gains" (Childs, Burke, et al. 2022)*

WHO AQGs 2021 recommend **annual mean concentrations of $PM_{2.5}$ not exceeding 5 µg/m³ and $NO_2$ not exceeding 10 µg/m³** and the peak season mean 8-h $O_3$ concentration not exceeding 60 µg/m³.

Garcia E, Rice MB, Gold DR. Air pollution and lung function in children.

J Allergy Clin Immunol. 2021 Jul;148(1):1-14

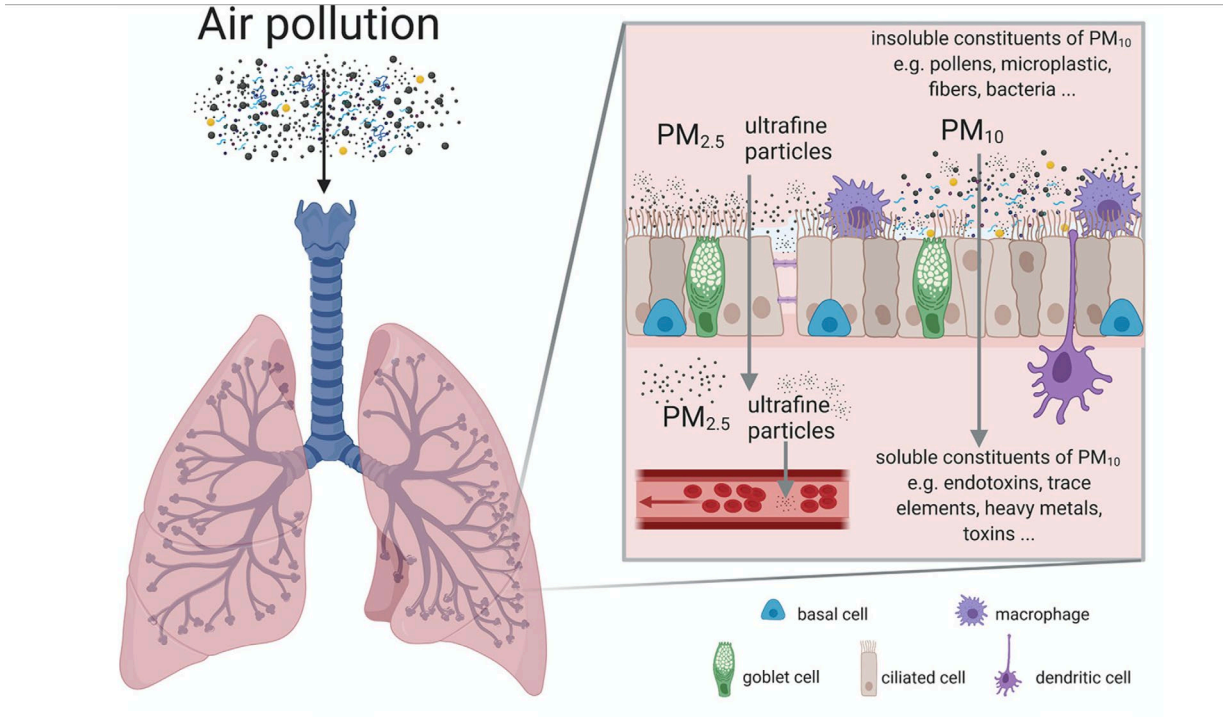
Bettiol *et al. Environmental Health* (2021) 20:46
https://doi.org/10.1186/s12940-021-00728-9

Environmental Health

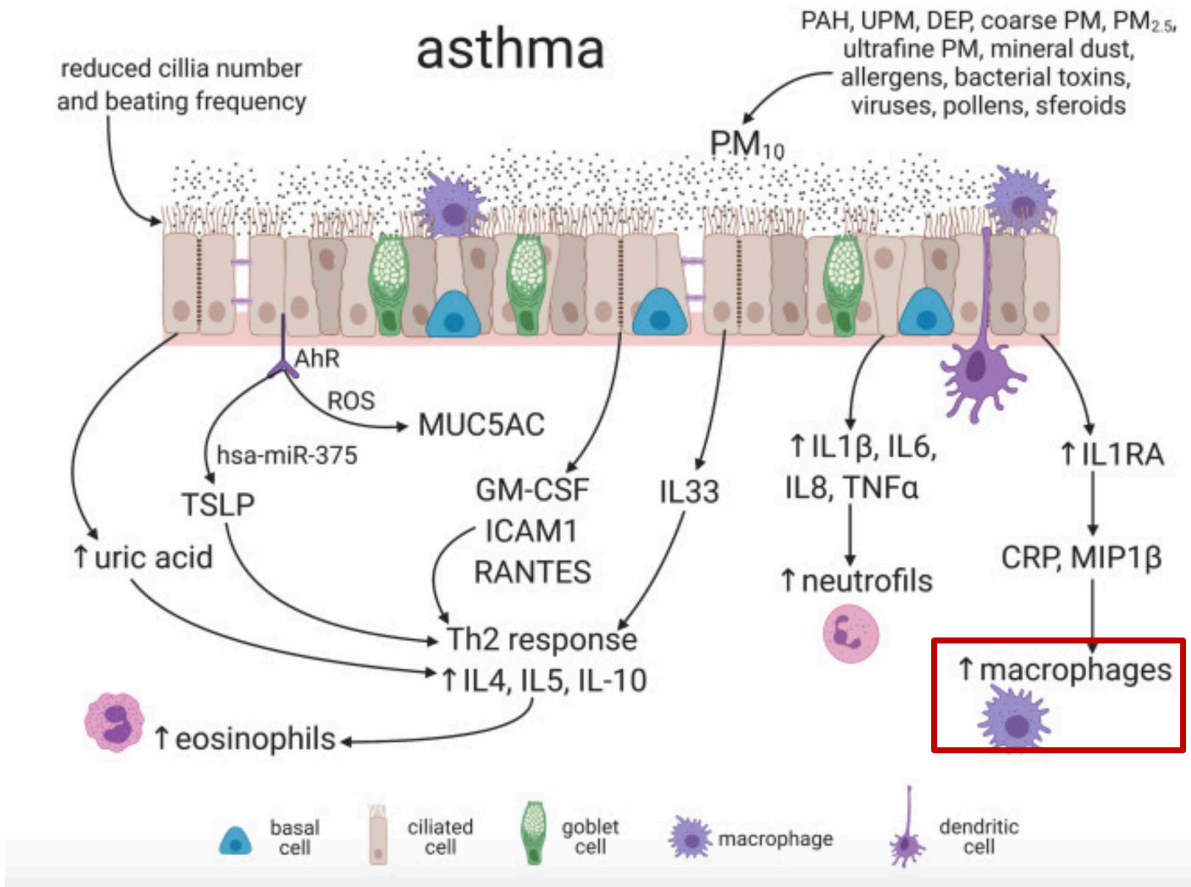
REVIEW Open Access

# The first 1000 days of life: traffic-related air pollution and development of wheezing and asthma in childhood. A systematic review of birth cohort studies

Alessandra Bettiol[1], Elena Gelain[2], Erika Milanesio[3], Federica Asta[4] and Franca Rusconi[5*]




*"most studies found a positive association between PM (7/10 studies) and NOx (11/13 studies) and the risk of asthma development"*




Misiukiewicz-Stepien P, Paplinska-Goryca M. Biological effect of $PM_{10}$ on airway epithelium-focus on obstructive lung diseases. Clin Immunol. 2021 Jun;227:108754.

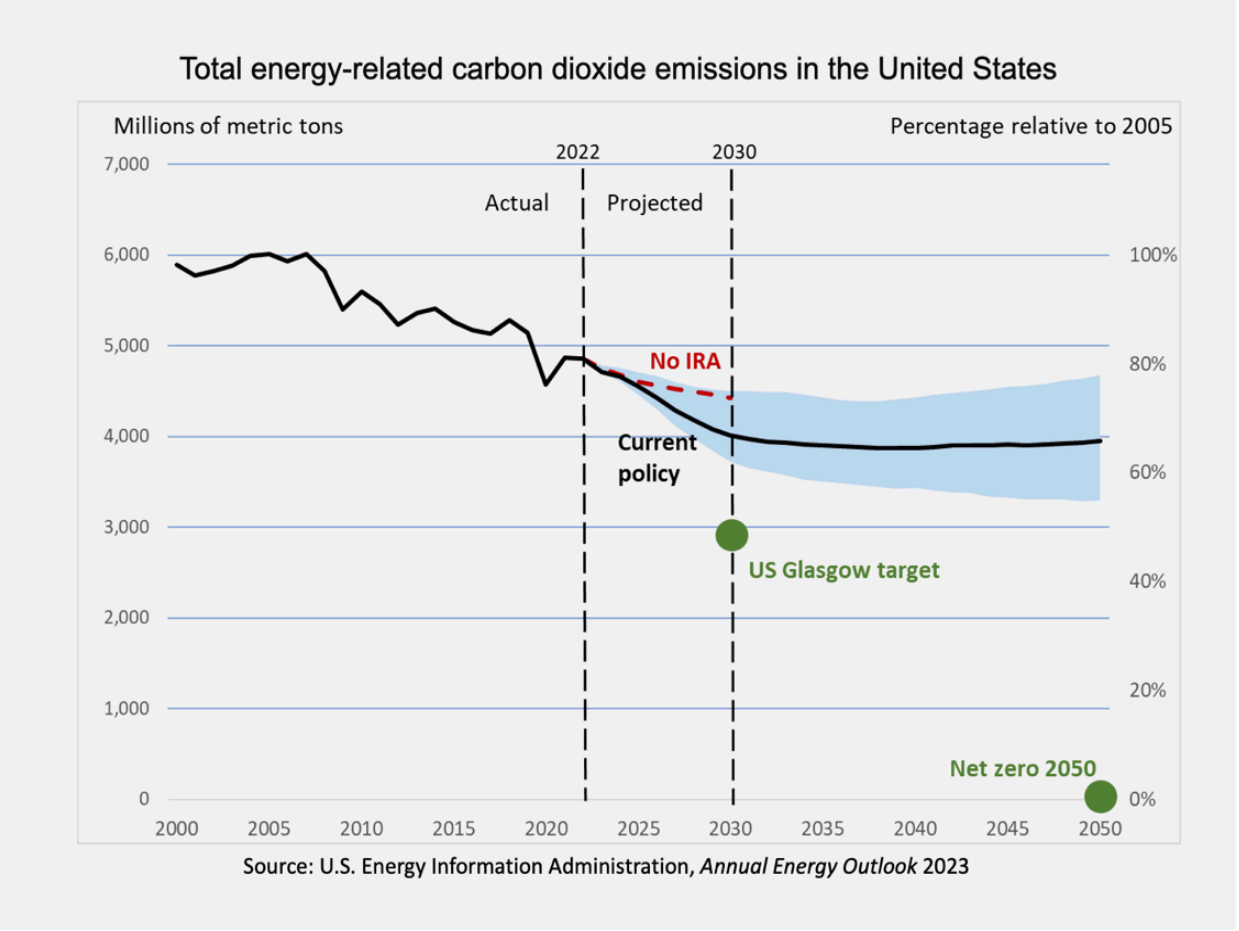
# A reason to have a balanced view for the future

Positives:

- More education occurring on climate change and health
- Youth movement is active and growing
- COP28 focused on health—143+ countries signed declaration on climate and health
- 50+ nations have signed on to decarbonize their health care systems
- Cost of clean energy has been substantially lowered
- Sales of EVs have increased by 60% in some locations
- Policy changes-IRA and EJ focus

Negatives:

- 20 nations responsible for 76% of GHG emissions
- 6 major countries contribute the most
- Need a blended finance model to work with LMIC countries
- We are heading to 2.8 C (5 F) if stay with current policies
- By 2050, we are supposed to be at net zero but at current trajectory, only 1/3 of the way
- Need to work with health inequities in climate change
- Demand on Electric system –need more federal authority to provide infrastructure



# Face towards Solutions: Adaptation and mitigation

## Adaptation

**Build defenses and prepare for the consequences of climate change.**

## Mitigation

Slow down (or stop) the warming of the atmosphere by stabilizing greenhouse gas emissions

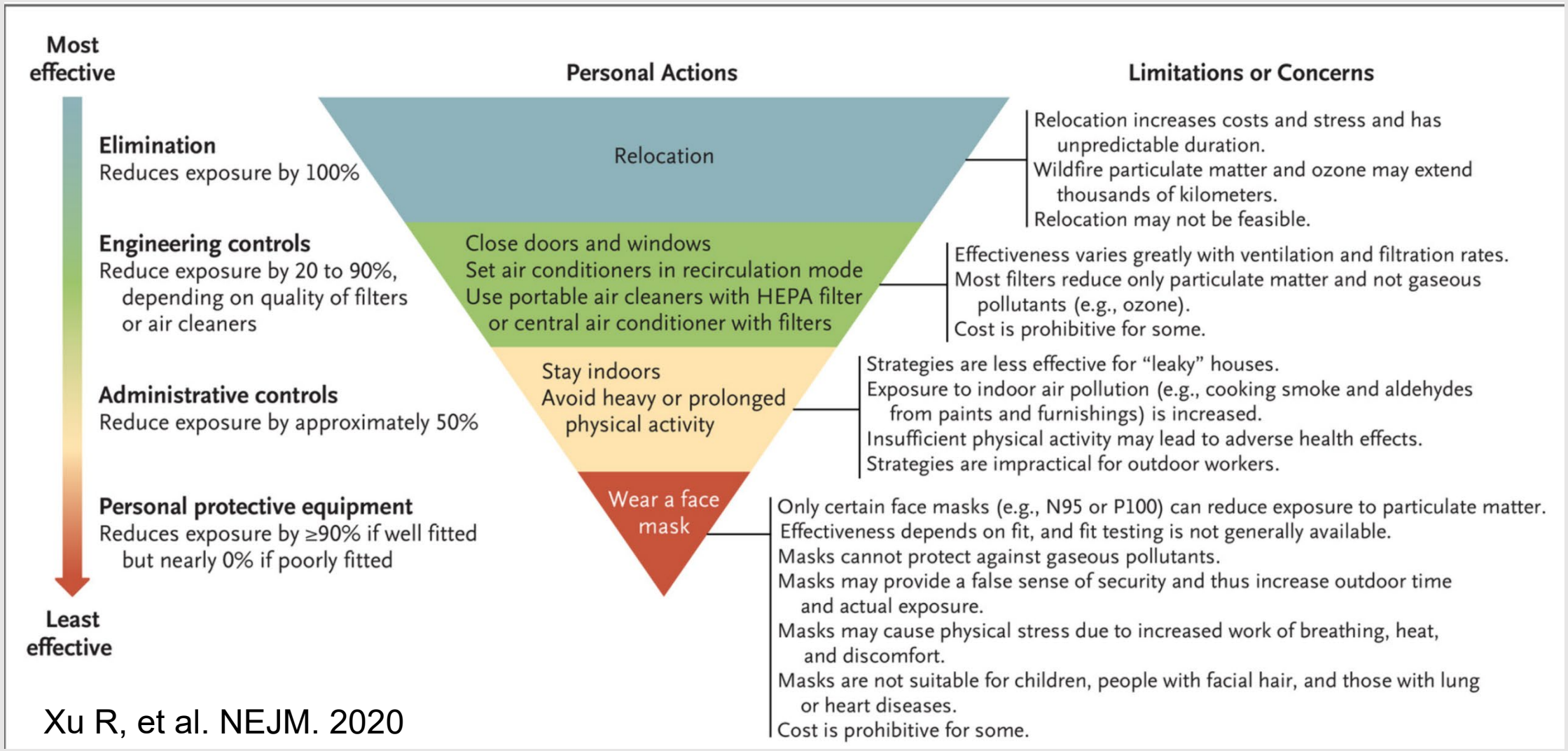
# Adaptation: Personal action


Review > J Thorac Dis. 2015 Jan;7(1):96-107. doi: 10.3978/j.issn.2072-1439.2014.12.21.

## What can individuals do to reduce personal health risks from air pollution?

Robert Laumbach [1], Qingyu Meng [1], Howard Kipen [1]

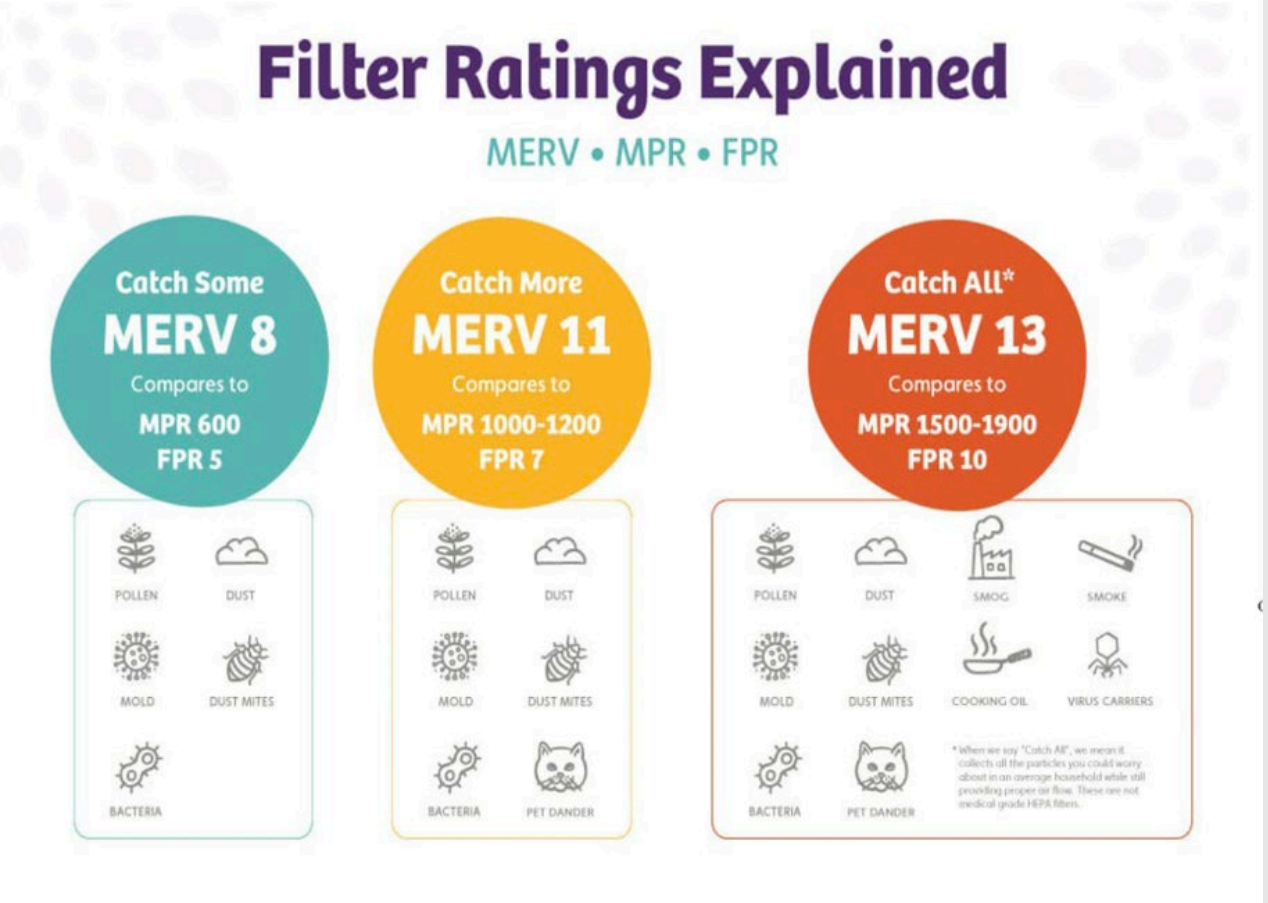
# Adaptation: Personal action




Xu R, et al. NEJM. 2020

# Adaptation: Masks

## What adaptation benefit do filters and masks give us?

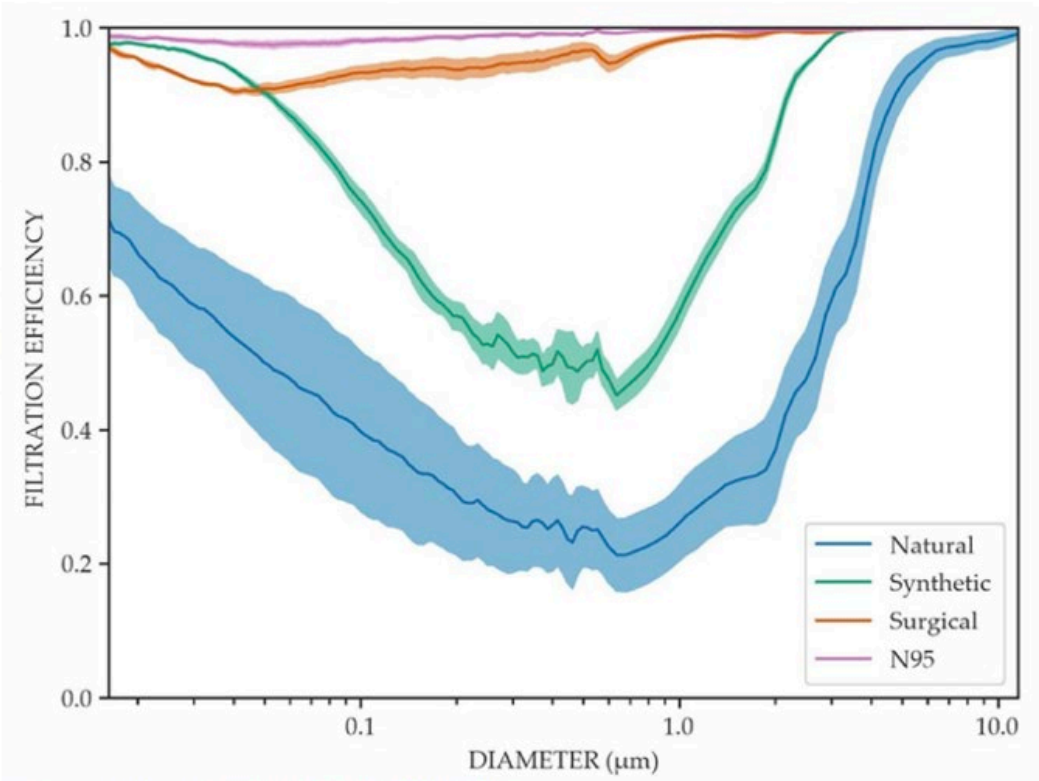



**Face masks' effectiveness against severe air pollution**

4 October 2021

Experiments and modeling confirm the superiority of N95 respirators to cloth and surgical masks in filtering the fine particles in wildfire smoke.

R. Mark Wilson




Credit: J. K. Kodros et al., *GeoHealth* 5, e2021GH000482 (2021)

PHYSICS TODAY

# Adaptation: HEPA filters

Int J Environ Res Public Health. 2022 Sep 13;19(18):11517. doi: 10.3390/ijerph191811517.

## Efficacy of HEPA Air Cleaner on Improving Indoor Particulate Matter 2.5 Concentration

Chiu-Fan Chen [1], Chun-Hsiang Hsu [1], Yu-Jung Chang [2], Chao-Hsien Lee [3], David Lin Lee [1 4]

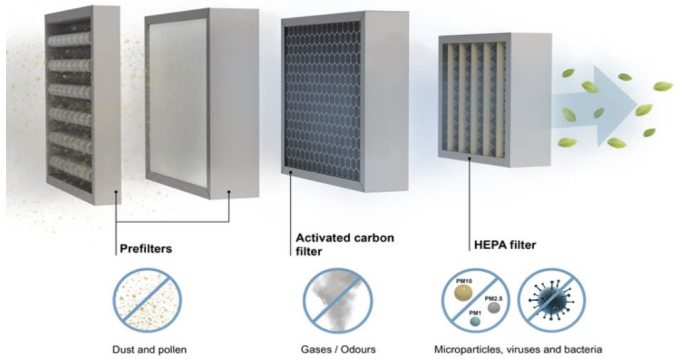
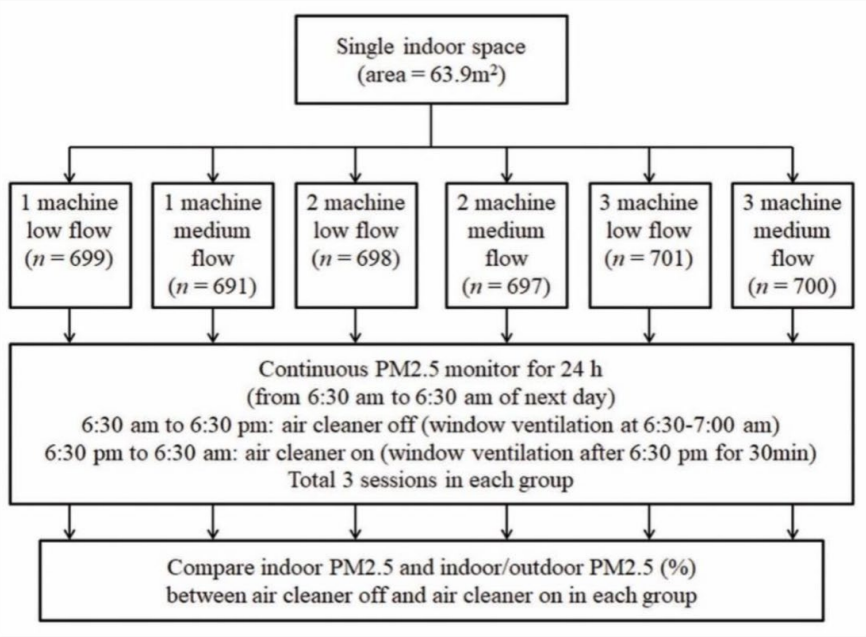
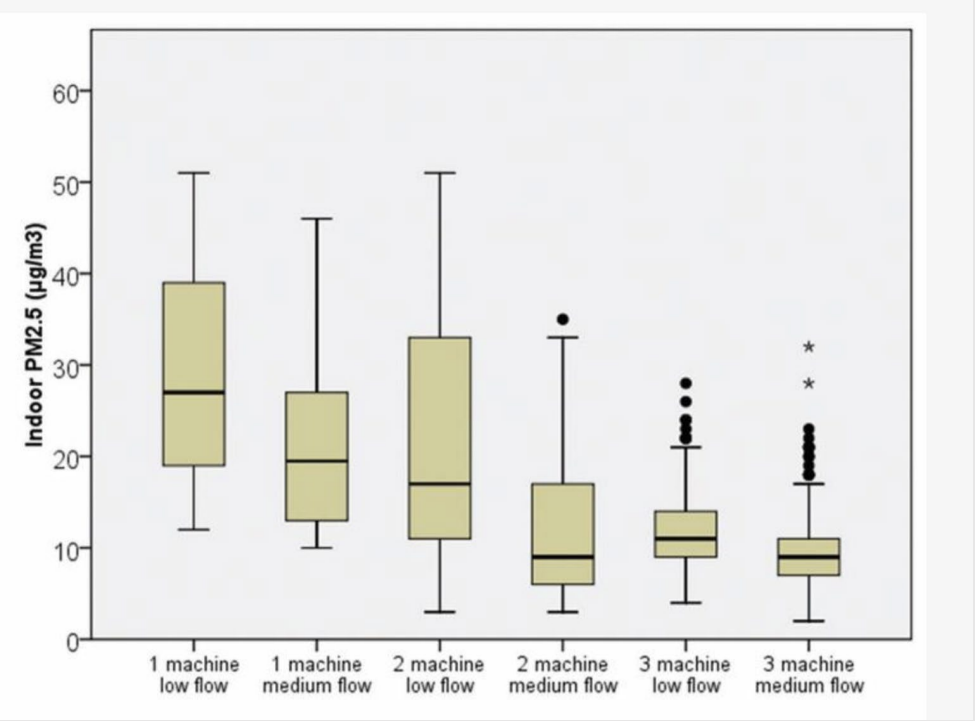



**Figure 1.** Flow chart of air cleaner study. For each experiment (24 h each time, totaling 3 times in each group), in the first 12 h the air cleaner is turned off. Then in the following 12 h, the air cleaner is turned on to evaluate the efficacy of indoor $PM_{2.5}$ removal.



# Pooled estimates on the reduction of PM according to air filter use

| Study name | Size of PM | Statistics for each study | | | Difference in means and 95% CI |
|---|---|---|---|---|---|
| | | Difference in means | Lower limit | Upper limit | |
| Eggleston *et al.* (2005)[25] | PM10 | −21.000 | −33.734 | −8.266 | |
| Butz *et al.* (2011)[24] | PM10 | −11.100 | −19.772 | −2.428 | |
| | | −14.907 | −24.346 | −5.467 | |
| Jhun *et al.* (2017)[27] | PM2.5 | −2.400 | −3.103 | −1.697 | |
| Park *et al.* (2017)[15] | PM2.5 | −3.080 | −4.243 | −1.917 | |
| Noonan *et al.* (2017)[14] | PM2.5 | −11.457 | −13.144 | −9.770 | |
| Eggleston *et al.* (2005)[25] | PM2.5 | −14.000 | −25.371 | −2.629 | |
| Butz *et al.* (2011)[24] | PM2.5 | −23.400 | −34.195 | −12.605 | |
| Shao *et al.* (2017)[18] | PM2.5 | −36.000 | −46.394 | −25.606 | |
| | | −11.452 | −16.022 | −6.882 | |

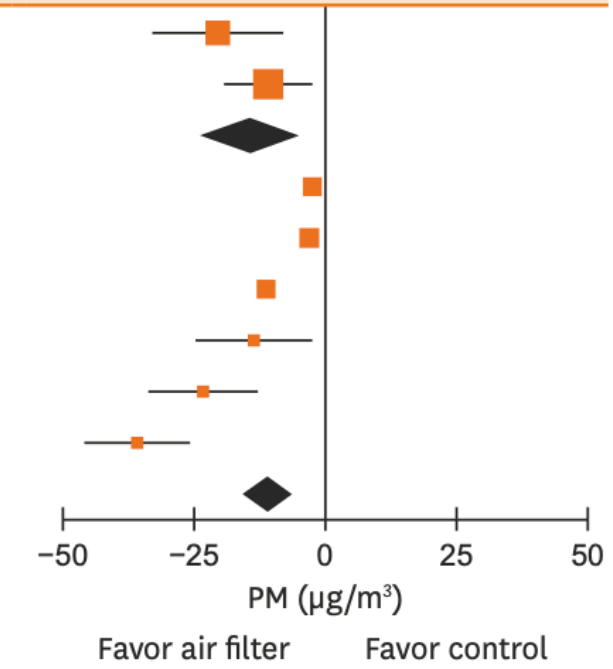
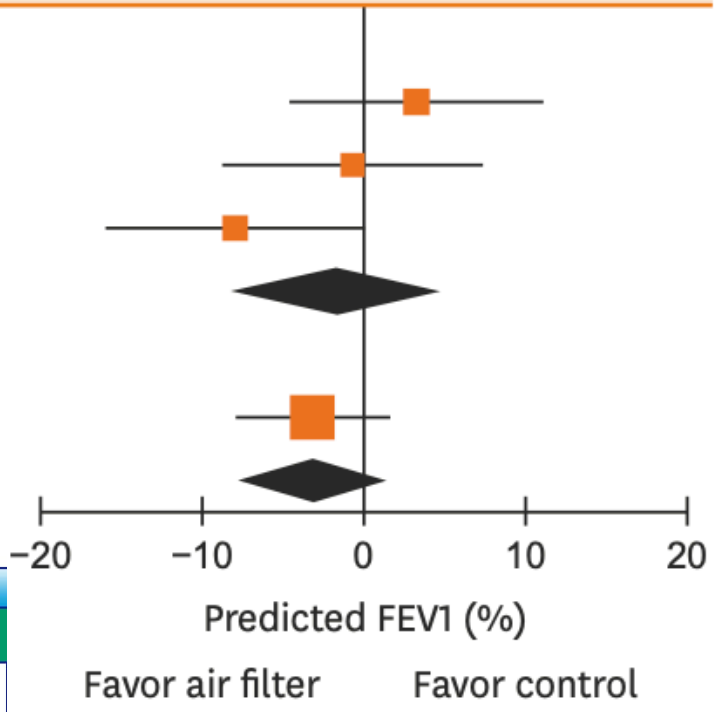



**Fig. 2.** Pooled effect estimates on the reduction of PM according to air filter use. The forest plot shows the reduction of PM in the included studies. The studies are sorted according to the baseline concentration of $PM_{2.5}$. PM, particulate matter; CI, confidence interval.

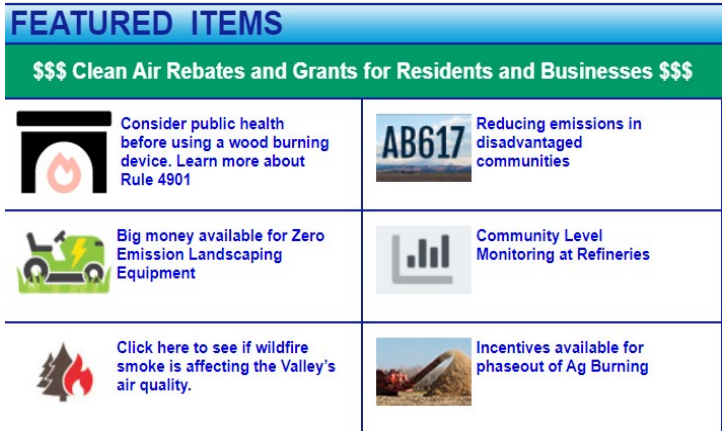
Park HJ, et al. The Effect of Particulate Matter Reduction by Indoor Air Filter Use on Respiratory Symptoms and Lung Function: A Systematic Review and Meta-analysis. Allergy Asthma Immunol Res. 2021 Sep;13(5):719-732.

# Effect of air filter use on lung function: Overall Improvement shown

| Study or subgroup | Statistics for each study | | | *P*-value | Difference in means and 95% CI |
|---|---|---|---|---|---|
| | Difference in means | Lower limit | Upper limit | | |
| Asthma | | | | | |
| Jhun *et al.* (2017)[27] | 3.250 | −4.558 | 11.058 | 0.415 | |
| Noonan *et al.* (2017)[14] | −0.710 | −8.800 | 7.380 | 0.863 | |
| Eggleston *et al.* (2005)[25] | −8.000 | −16.043 | 0.043 | 0.051 | |
| | −1.771 | −8.252 | 4.710 | 0.592 | |
| COPD | | | | | |
| Shao *et al.* (2017)[18] | −3.180 | −7.934 | 1.574 | 0.190 | |
| | −3.180 | −7.934 | 1.574 | 0.190 | |







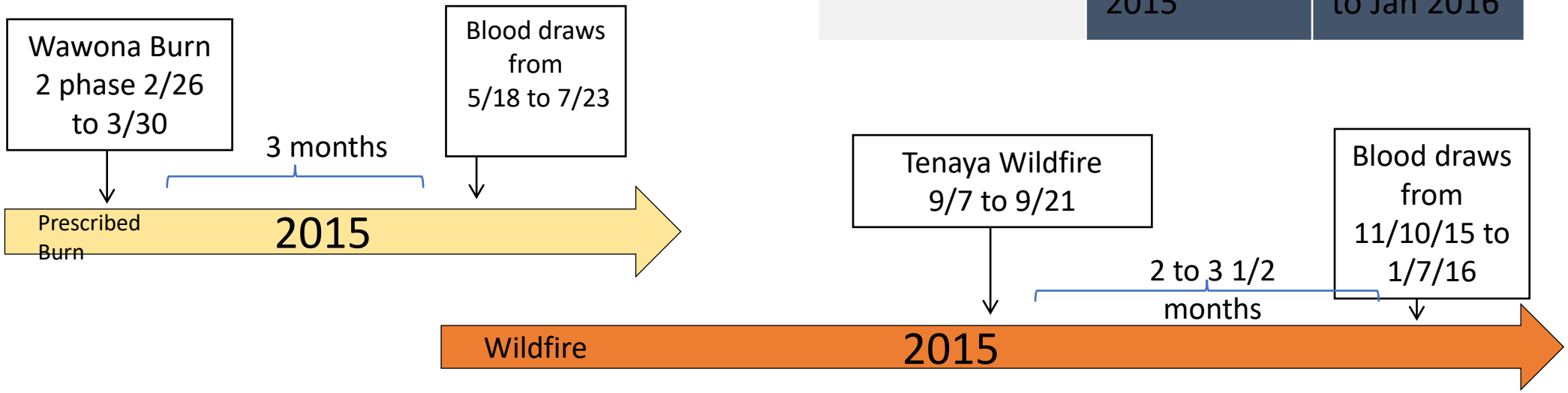

Park HJ, et al. The Effect of Particulate Matter Reduction by Indoor Air Filter Use on Respiratory Symptoms and Lung Function: A Systematic Review and Meta-analysis. Allergy Asthma Immunol Res. 2021 Sep;13(5):719-732.

# Adaptation to Wildfires Through Forest Management: Prescribed Fire vs Thinning vs No Treatment

# Adaptation: Prescribed burns versus wildfires

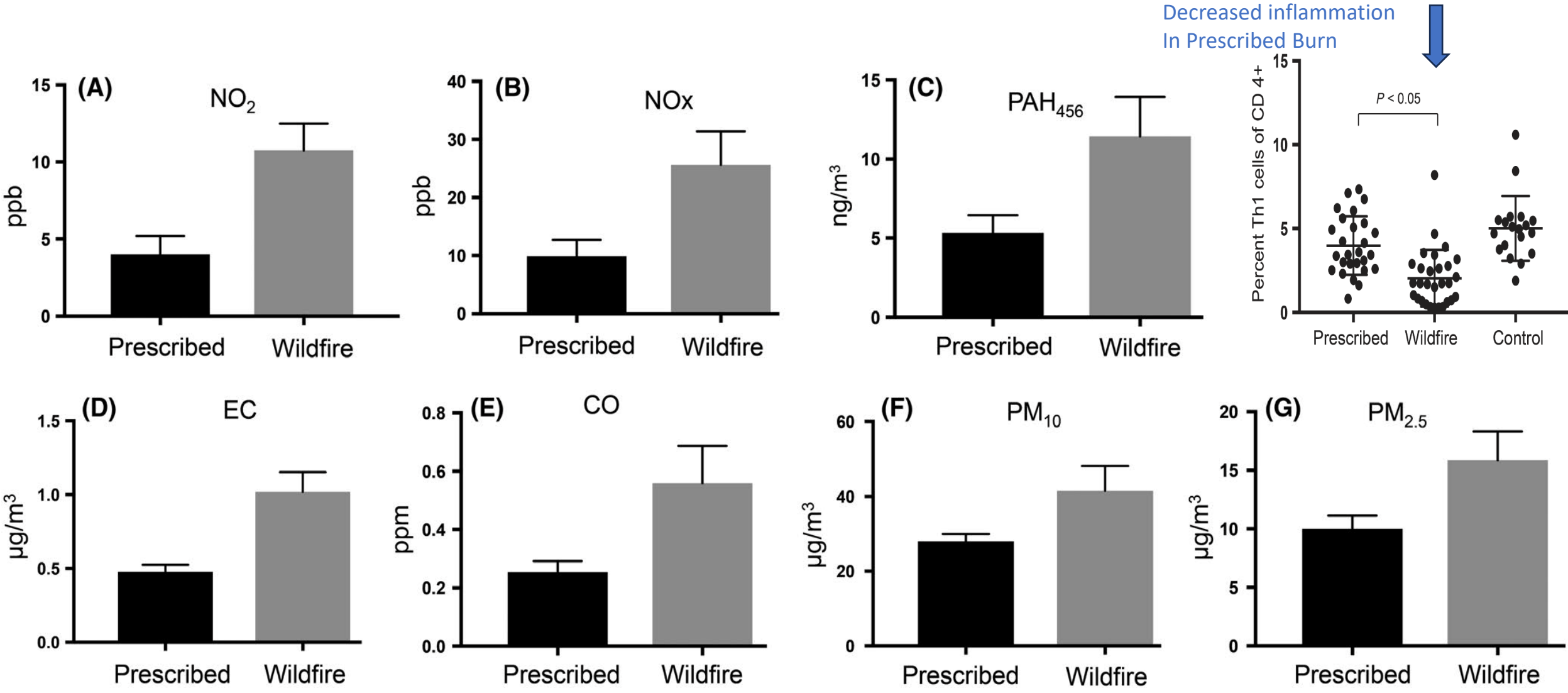
Hypothesis: The health impacts of a prescribed fire are less detrimental to the respiratory and cardiovascular systems than a wildfire in school-aged children.

| Demographic Variable | Prescribed Burn Subjects (n=32) | Wildfire Subjects (n=36) |
|---|---|---|
| % Female | 40.6% (13/32) | 41.7% (15/36) |
| % Asthmatics | 37.5% (12/32) | 25% (9/36) |
| Age | 7.16 yrs | 7.56 yrs |
| Period | May to July 2015 | Nov 2015 to Jan 2016 |




Prunicki, et al, 2019

# **Adaptation:** wildfire vs prescribed burns




Prunicki, et al, 2019

**Our research work enabled policy changes for Wildland Fire Mitigation and Management**

Beneficial fire=Prescribed fire

CBS NEWS NEWS SHOWS LIVE LOCAL

U.S. ›

# Biden's Fifth National Climate Assessment found these 5 key ways climate change is affecting the entire U.S.

BY LI COHEN
NOVEMBER 15, 2023 / 2:22 PM EST / CBS NEWS

The Commission recommends policy solutions that address the logistical, policy, and resource-related barriers to the beneficial use of fire and also provide means for better protecting public health. The Commission highlights the need for inclusive, collaborative pre-fire planning to help share decision-making, enable mutual understanding, and facilitate the consideration of tradeoffs associated with various wildfire response and management decisions.

# Biden-Harris Administration's Wildland Fire Mitigation and Management Commission Releases Report Outlining Comprehensive Recommendations to Change the Nation's Relationship with Wildfire

**WASHINGTON, Sept. 27, 2023** – Today, the Wildland Fire Mitigation and Management Commission released its report (PDF, 5.3 MB) outlining a comprehensive, consensus-based set of recommendations to Congress to address the nation's wildfire crisis.

The Commission, created by President Biden's Bipartisan Infrastructure Law and announced in December 2021, was charged

**Press Release**
Release No. 0200.23

**Contact:** USDA Press
**Email:** press@usda.gov

# Health of the Planet and its Peoples are interconnected

The future health of the planet and human health are inextricably linked.

World Health Organization

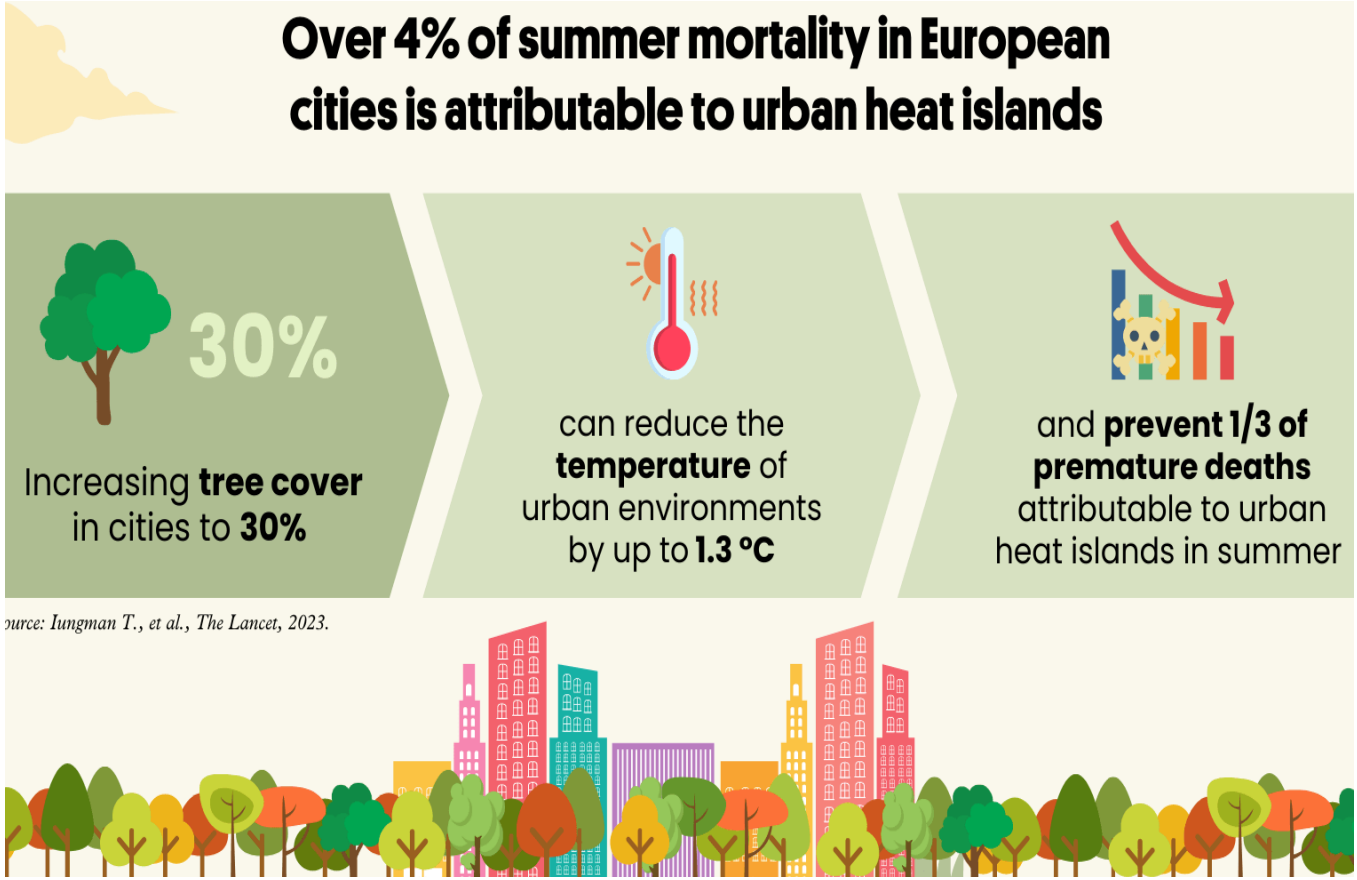
The theme of the 2022 World Health Day was “Our planet, our health,” which highlighted the interconnectedness of the two.

# Mitigations: Cooling cities through urban green infrastructure: a health impact and carbon sequestration

| | Tree coverage (%) | Population-weighted tree coverage (%) | Tree coverage increment (%) | Mean cooling (°C) | Maximum cooling (°C) | Summer preventable deaths (95% CI) |
|---|---|---|---|---|---|---|
| Oslo | 34·62 | 29·42 | 3·76 | 0·10 | 0·81 | 0·01 (-0·56 to 0·67) |
| Bari | 15·83 | 8·99 | 14·08 | -0·02 | 0·47 | 0·26 (0·01 to 0·45) |
| Glasgow | 19·02 | 17·29 | 11·97 | 0·04 | 0·24 | 0·61 (0·42 to 0·77) |
| Lille | 12·97 | 15·26 | 16·11 | 0·01 | 0·22 | 0·90 (0·72 to 1·08) |
| Edinburgh | 25·36 | 25·48 | 5·40 | 0·02 | 0·33 | 0·62 (0·43 to 0·80) |
| Palma de Mallorca | 8·03 | 5·15 | 23·03 | 0·68 | 1·04 | 62·56 (61·31 to 63·72) |
| Barcelona | 8·41 | 5·39 | 23·31 | 0·70 | 0·89 | 214·52 (205·60 to 220·98) |
| Split | 5·40 | 1·79 | 25·93 | 0·79 | 1·04 | 14·72 (13·95 to 15·38) |
| Naples | 13·05 | 6·37 | 19·67 | 0·64 | 1·00 | 75·77 (72·14 to 79·34) |
| Murcia | 10·31 | 8·85 | 20·83 | 0·66 | 1·25 | 29·85 (29·04 to 30·60) |

The ten cities associated with the lowest and highest impacts on preventable mortality are displayed.

*Table 4:* Main health impact assessment results for the 30% tree coverage scenario in ten European cities



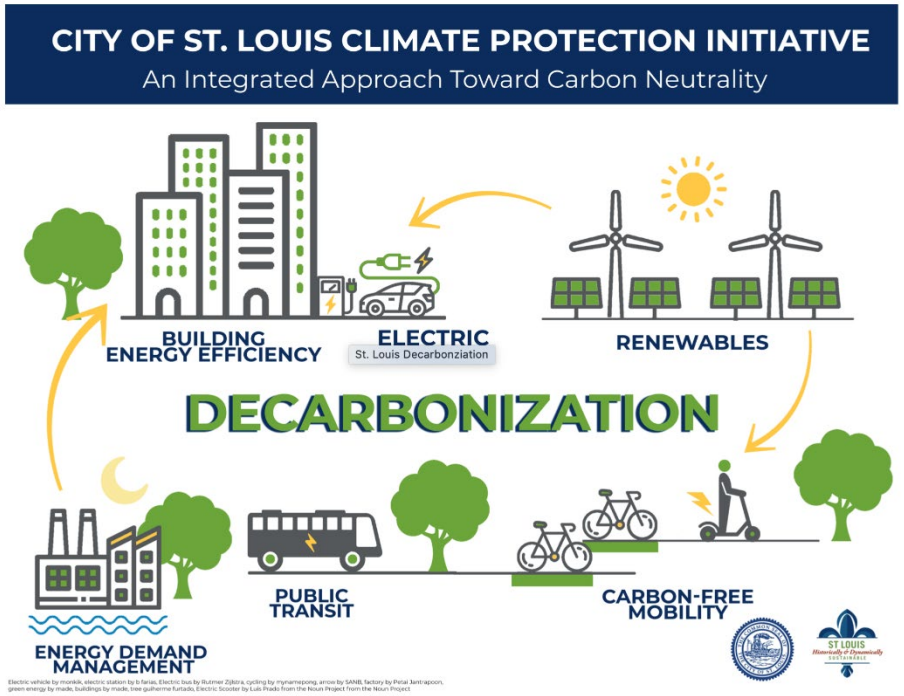

Iungman T, et al. Cooling cities through urban green infrastructure: a health impact assessment of European cities. Lancet. 2023 Feb 18;401(10376):577-589.

# Mitigation: Lowering emissions through electrification of buses

Review > AIMS Public Health. 2017 Feb 16;4(1):47-61. doi: 10.3934/publichealth.2017.1.47. eCollection 2017.

## Energy, Transportation, Air Quality, Climate Change, Health Nexus: Sustainable Energy is Good for Our Health

Larry E Erickson [1], Merrisa Jennings [1 2]




Global Covenant of Mayors for Climate & Energy


## Better residents' health after switch to electric buses

*Date:* April 29, 2022

*Source:* University of Gothenburg

*Summary:* The health of residents living alongside a bus route in Gothenburg, Sweden, became considerably better when hybrid buses were replaced by buses fully powered by electricity. Along with the noise levels there was a reduction of fatigue, day time sleepiness and low mood, a new study shows.

# Mitigation: PRESCRIBED BURNS VERSUS WILDFIRES

Hypothesis: The health impacts of a prescribed fire are less detrimental to the respiratory and cardiovascular systems than a wildfire in school-aged children.

| Demographic Variable | Prescribed Burn Subjects (n=32) | Wildfire Subjects (n=36) |
|---|---|---|
| % Female | 40.6% (13/32) | 41.7% (15/36) |
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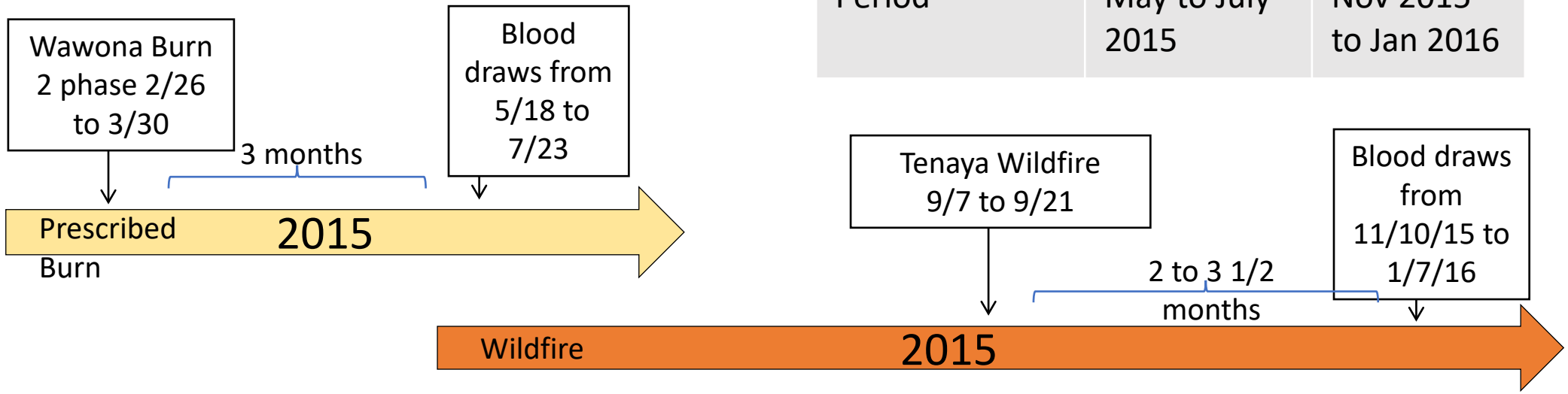
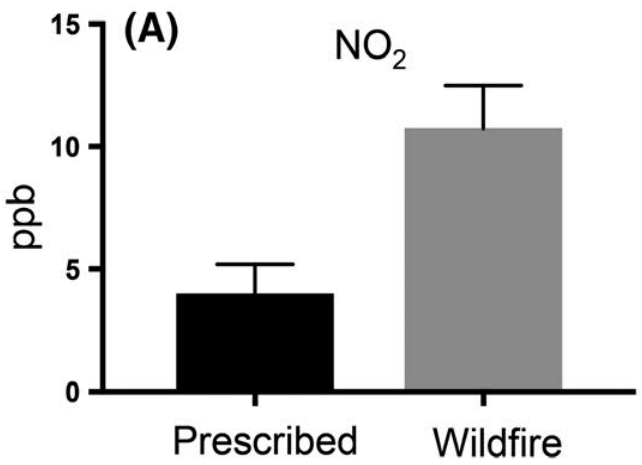
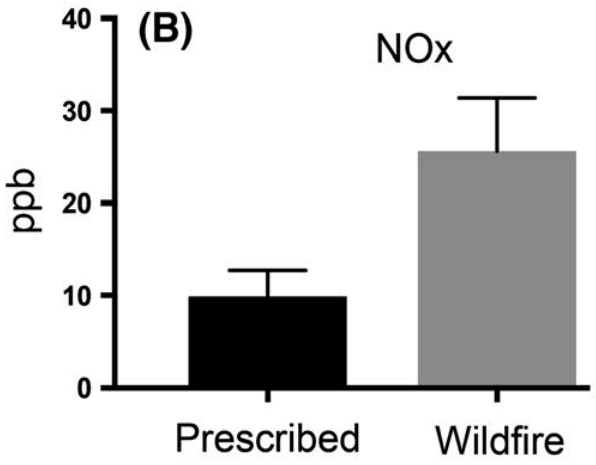
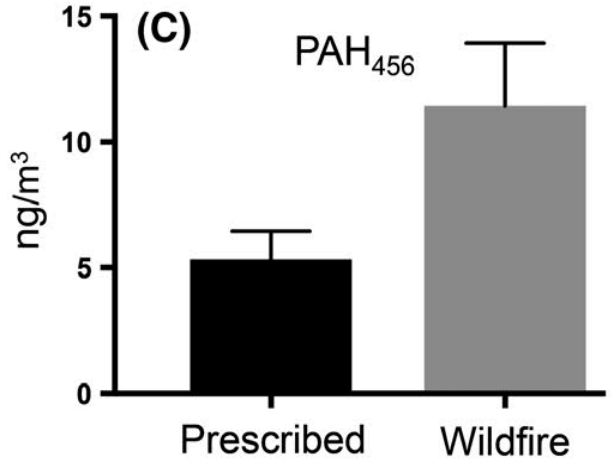
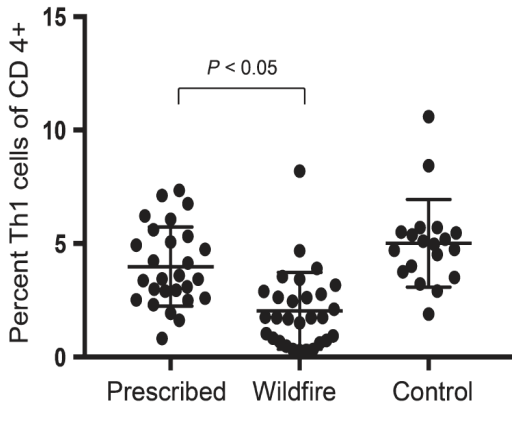


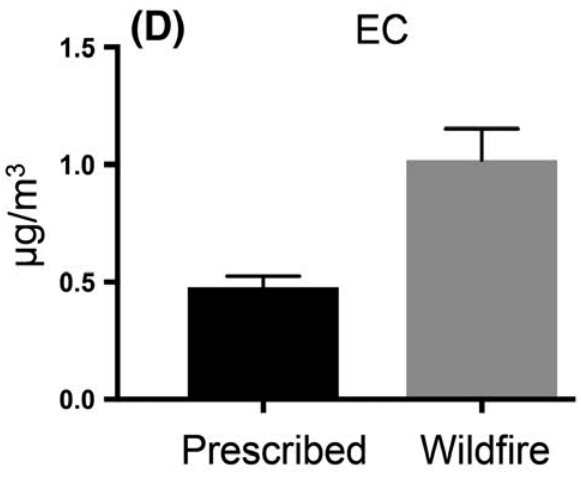
# Mitigation: WILDFIRE VS PRESCRIBED BURN

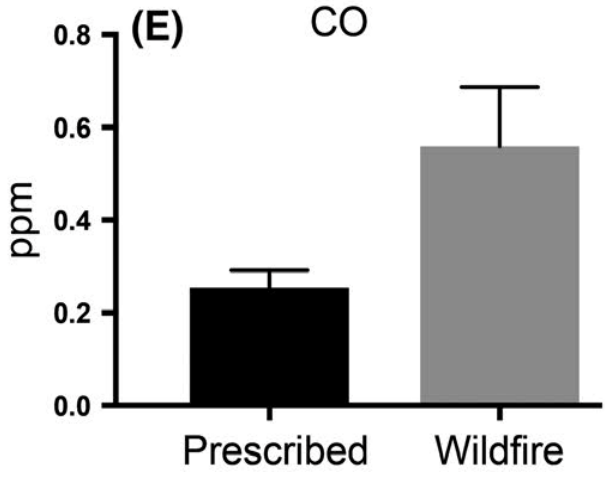


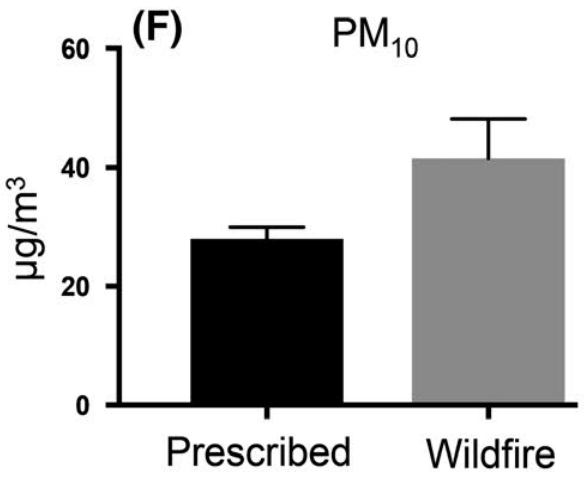



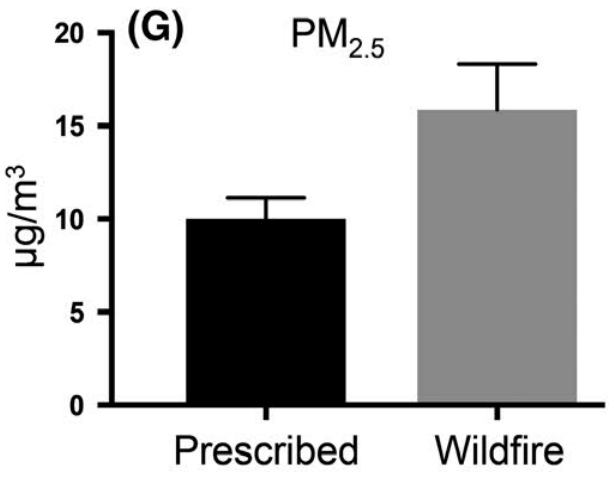



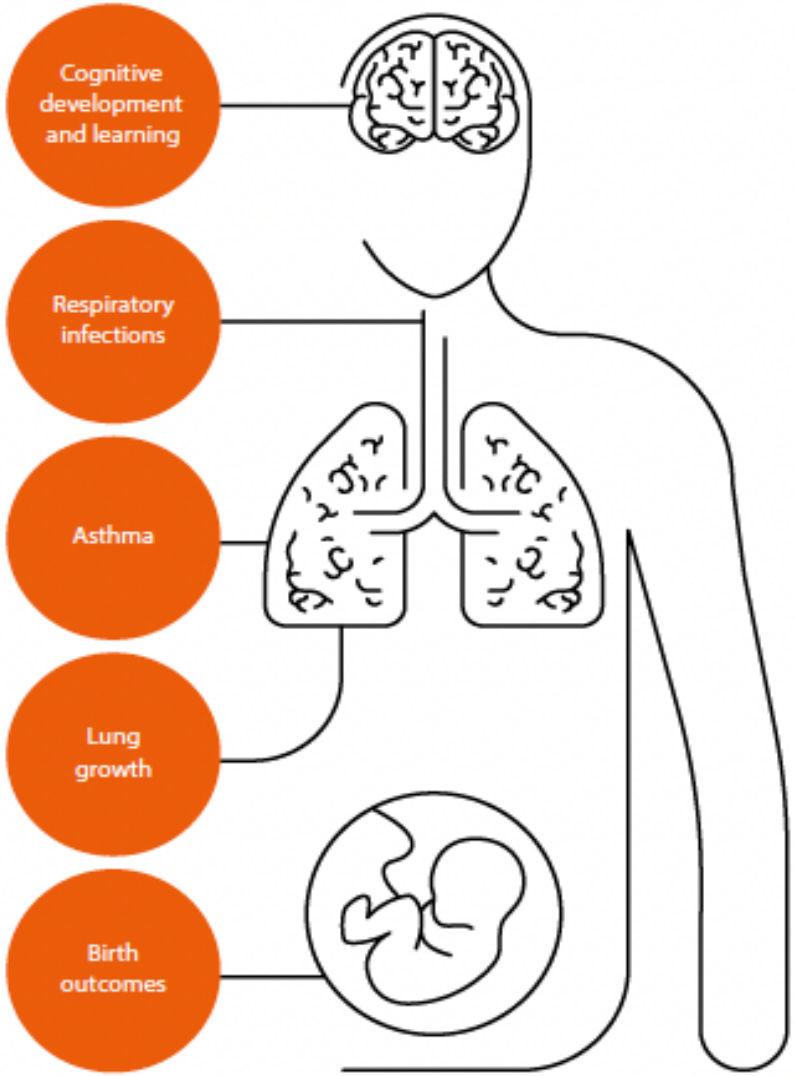




Prunicki, et al, 2019

*Global level:*

# Research on best ways to communicate and work with communities




3,222 young people (aged 13-25), parents from 59 cities

40% said air pollution one of worst things due to motor vehicles, factories

40% reported their city was better to live

LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE

Climate Change & Planetary Health

Climate, Cities, and Children

# Global level: Averted new cases/yr with ‘net-zero’ projections

| City | Total cases averted in one year | | |
|---|---|---|---|
| | Asthma | Preterm birth | Low birthweight |
| Bhubaneswar | 13 | 540 | 270 |
| Dar es Salaam | 75 | 189 | 60 |
| Dhaka | 332 | 23,889 | 13,514 |
| Freetown | 1 | 20 | 8 |
| Glasgow | 110 | 69 | 22 |
| Harare | 9 | 71 | 23 |
| Jaipur | 44 | 905 | 488 |
| Lahore | 315 | 4,643 | 3,167 |
| London | 1,791 | 813 | 262 |
| Los Angeles | 7,210 | 939 | 287 |

# Economic level: Research in cost and co benefits

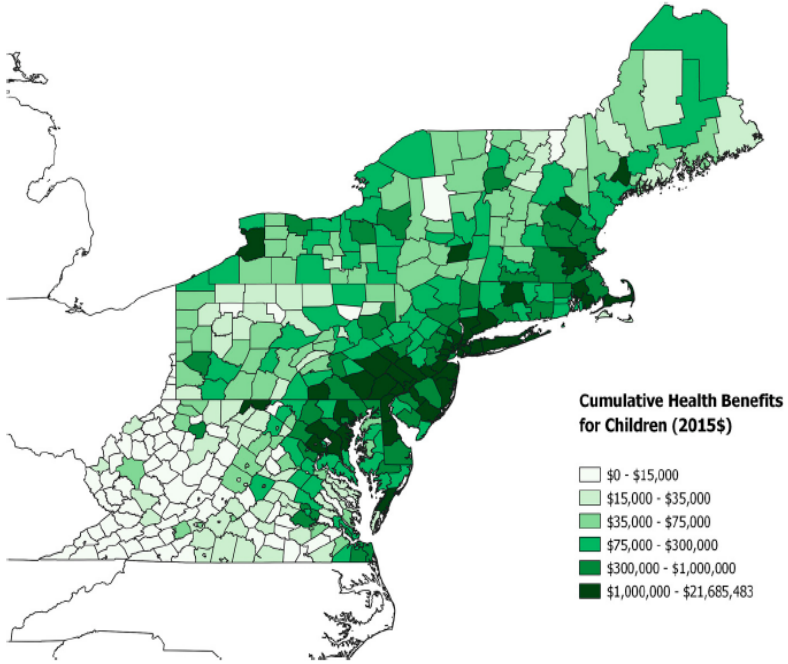
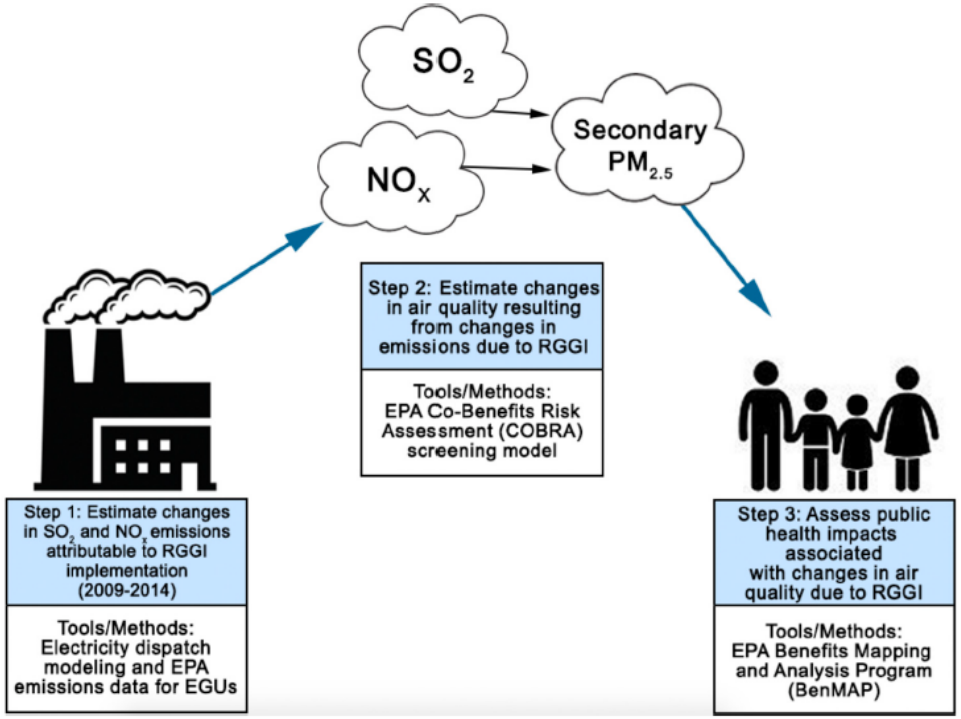



**Figure 2.** Economic benefits of avoided cases of child health outcomes attributable to RGGI by county, 2009 to 2014 (low value, 2015$). Note: RGGI, U.S. Regional Greenhouse Gas Initiative.




For every $1 dollar spent on reducing GHGs saved approximately $6+ in co benefits

## Co-Benefits to Children's Health of the U.S. Regional Greenhouse Gas Initiative

*Frederica Perera,[1] David Cooley,[2] Alique Berberian,[1] David Mills,[3] and Patrick Kinney[4]*

# Economic level: Research in cost and co benefits

- **Cost of cleaner energy:**
  - ***< $30/ $tCO_2$***

**Benefits of cleaner energy:**

***$200*/ $tCO_2$***

WHICH NUMBER IS BIGGER???


West et al. 2013

(* Range: $50 to $380 in adults)

For E. Asia, co-benefits are **10 to 70 times** greater

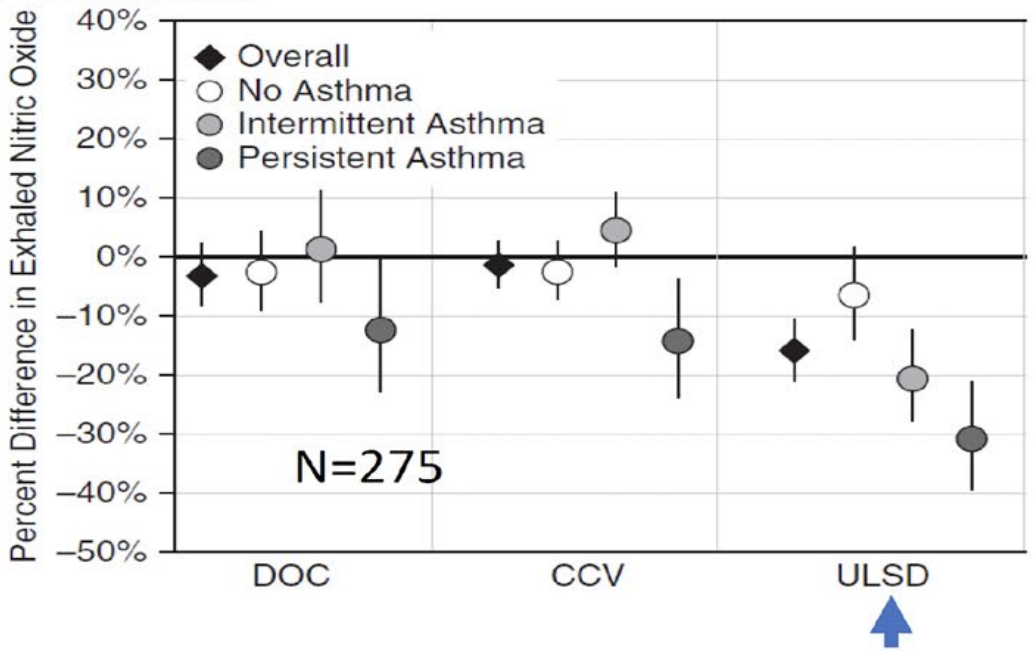
# Policy outcome: Research and community outreach

## Population level: Research can result in Community outreach and Policy Impact

Environment 10:20 AM TUE JANUARY 28, 2014

### Is The Central Valley's Air Pollution Affecting Our Cells And Genes?

Share Tweet +1 E-mail 7 Comments Print




*Community stakeholders were key for Implementing change based on science*

By 2017

CHAPS
Children's Health & Air Pollution Study

FAX FRESNO AREA EXPRESS

Zero Emission Bus **Rollout Plan**

**Green Car Congress**

*Energy, technologies, issues and policies for sustainable mobility*

9 December 2014 Go to GCC Discussions forum About GCC Contact RSS Subscribe

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« SolarCity and Honda establish investment fund to finance $65M in solar projects for Honda and Acura customers | Main | ROUSH CleanTech introduces 3 new Ford stripped chassis powered by autogas »

Print this post

**California ARB to hold public workshop on new GHG and emissions standards for heavy-duty engines and vehicles**

21 February 2013

# Climate change – a health issue and issue with health care systems

The NEW ENGLAND JOURNAL of MEDICINE

Perspective

## Climate Change — A Health Emergency

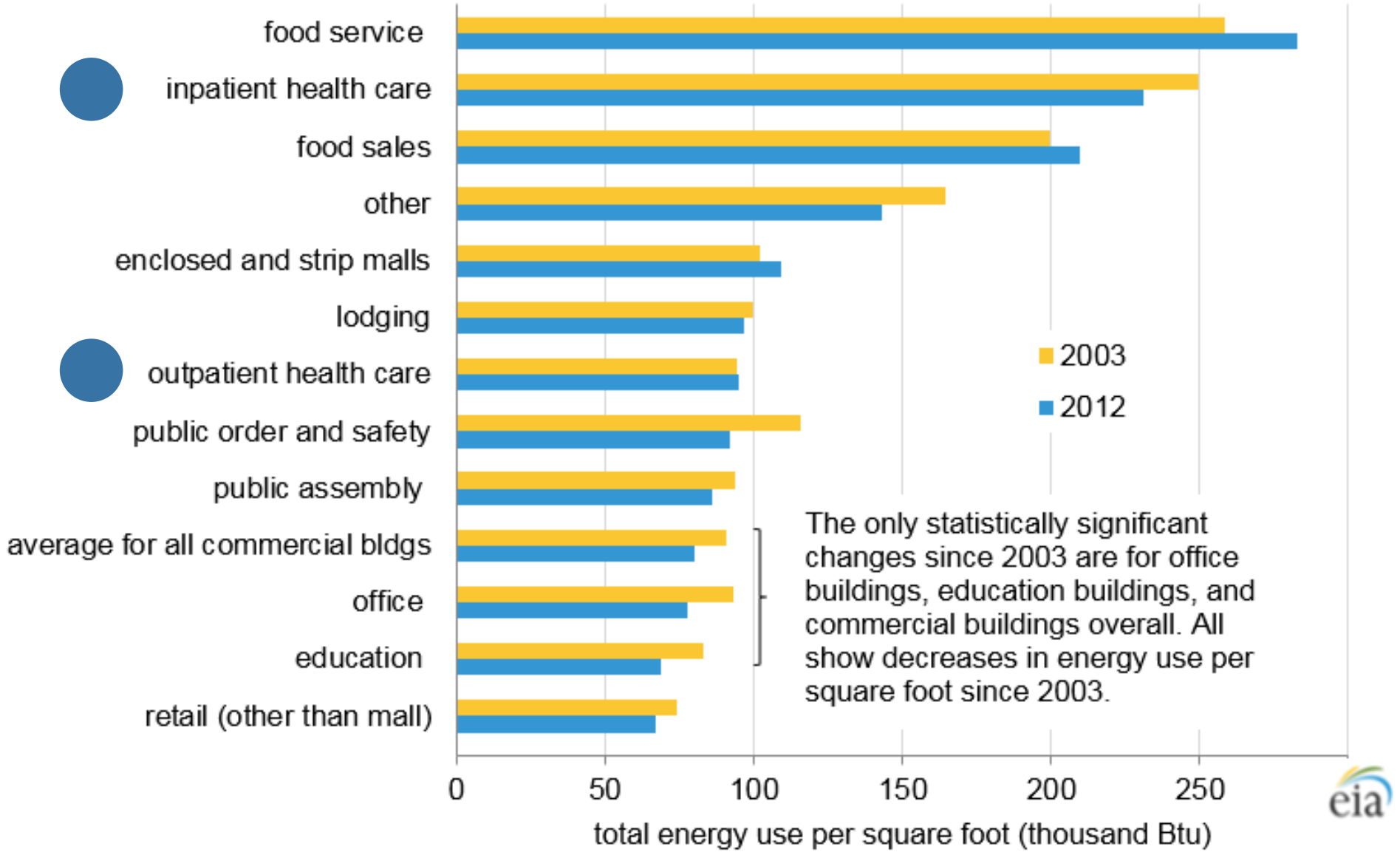
Caren G. Solomon, M.D., M.P.H., and Regina C. LaRocque, M.D., M.P.H.

January 17, 2019

N Engl J Med 2019; 380:209-211

# Get our own house in order

## Healthcare accounts for ~10% of all greenhouse gas emissions in the U.S.



# Example of Net Zero Health care


National Health Services in the UK Going to Net Zero Health Care

# Many organizations are involved in decarbonizing health care

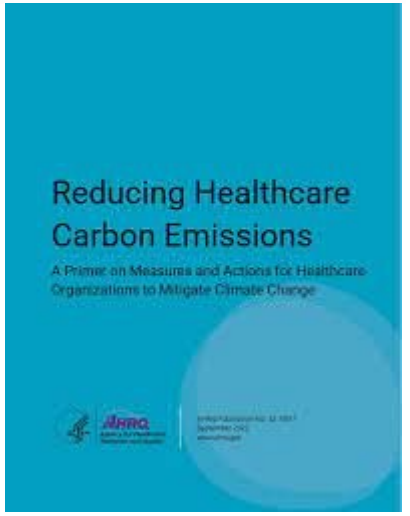
Over 50 countries have signed on to go net zero in their health care systems.

NATIONAL ACADEMY of MEDICINE
ACTION COLLABORATIVE ON DECARBONIZING THE U.S. HEALTH SECTOR

Practicegreenhealth.org


Health Care Without Harm

WHO
COP28



# When Talking with Patients- Tools are available

# Patient facing materials:

MOMS clean air FORCE
FIGHTING FOR OUR KIDS' HEALTH

Allergy & Asthma NETWORK

FOR MORE INFORMATION ABOUT OUR ORGANIZATIONS, PLEASE VISIT:

www.MomsCleanAirForce.org

www.AllergyAsthmaNetwork.org

## HOW DOES CLIMATE CHANGE AFFECT ASTHMA?

### POLLEN

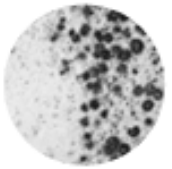
When carbon dioxide levels rise, some trees and plants make more pollen, and the pollen is more potent. Warmer weather allows trees and plants to start making pollen earlier in the season.

### HEAT

Heat waves are becoming more common. Heat waves can lead to deaths among the elderly and those who are already sick. Heat waves also trigger asthma attacks.

### SMOKE

Climate change is making wildfires worse. The smoke from wildfires can spread hundreds of miles. For asthma sufferers, wildfire smoke can trigger symptoms.



### MOLD

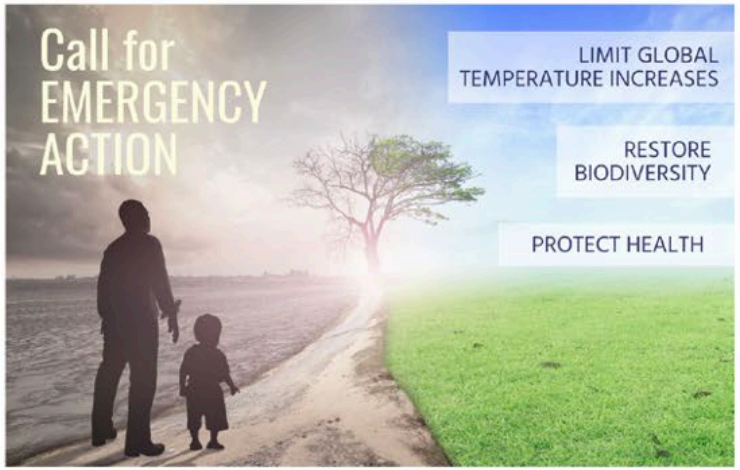
When plants are surrounded by high carbon dioxide levels, they develop mold spores that are more powerful. Climate change also increases severe weather events such as storms, flooding, and heavy rainfall. Damage to homes, schools, and other buildings could increase indoor mold. Whether indoor or out, mold triggers asthma.

### SMOG

Smog, or ground level ozone, is a powerful lung irritant formed when chemicals from power plants, cars, natural gas drilling, and other sources mix with heat and sunlight in the air. More heat equals more smog, especially in large cities.

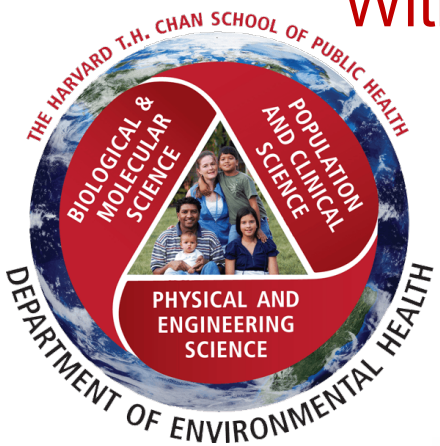
# Recommendations for Change

1. Transition to healthy, sustainable practices
2. Remove fossil fuels subsidies and invest in renewable energy
3. Talk to the community, find out their needs
4. Increase access to healthy transport options
5. Strengthen the public health system, talk to policy makers
6. Invest in a healthy recovery and prevention
7. Greening areas and buildings leads to carbon sequestration




Apha and Lancet Countdown. Lancet Countdown on Health and Climate Change: Policy Brief for the United States of America. Lancet Countdown. DEC2020, http://www.lancetcountdownus.org/wp-content/uploads/2021/01/2020-lancet-brief.pdf

# With Appreciation to: Participants, Families, Collaborators, and Sponsors




BRIGHAM AND WOMEN'S HOSPITAL
The Lung Center

SEVERE ASTHMA PROGRAM
Brigham and Women's Hospital

Mass General Brigham
Asthma Center

HARVARD T.H. CHAN SCHOOL OF PUBLIC HEALTH | C-CHANGE
CENTER FOR CLIMATE, HEALTH, AND THE GLOBAL ENVIRONMENT

BWH MGH NWH NSMC

MASS GENERAL BRIGHAM ASTHMA CENTER

Mass General Brigham
Asthma Center

STANFORD
CENTER FOR INNOVATION IN
GLOBAL
HEALTH

Immune Tolerance Network

SAN FRANCISCO FIREFIGHTERS CANCER PREVENTION FOUNDATION

CHAPS
Children's Health & Air Pollution Study

Institut Pasteur de Lille
Vivre mieux plus longtemps

EAACI
EUROPEAN ACADEMY OF ALLERGY AND CLINICAL IMMUNOLOGY

NIH National Institute of Environmental Health Sciences

NIH National Institute of Allergy and Infectious Diseases

NIH National Heart, Lung, and Blood Institute

FARE
Food Allergy Research & Education

EPA
United States Environmental Protection Agency

World Health Organization

AMERICAN LUNG ASSOCIATION.

STANFORD
MATERNAL & CHILD HEALTH RESEARCH INSTITUTE

The Bill Lane Center for the American West

natural capital PROJECT

Stanford WOODS INSTITUTE for the ENVIRONMENT

Stanford MEDICINE | Sean N. Parker Center for Allergy & Asthma Research

**The report finds a number of impacts to U.S. children's health and well-being. For example, at 2°C and 4°C of global warming:**

• Climate-driven changes in air quality are estimated to increase annual cases of asthma between 4% and 11%, respectively.

•Increases in oak, birch, and grass pollen are projected to increase children's asthma-related emergency department visits from 17%-30% each year.

•Additional cases of Lyme disease in children are projected to rise 79% to 241%, or an additional 2,600 to 23,400 new cases per year.

•Heat experienced during the school year affects concentration and learning in children. Climate-driven temperature increases are projected to result in 4% to 7% reductions in annual academic achievement per child. These learning losses can affect future income, with potential losses across cohorts of graduating students reaching billions of dollars annually (and in the thousands of dollars per individual).

•If no additional adaptation actions are taken, 1 million to 2 million+ children are estimated to experience temporary home displacement or complete home loss, respectively, from coastal flooding at 50cm to 100cm of global mean sea level.