

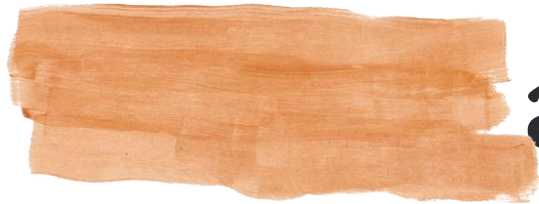
# Introduction to Air Pollution and its Global Significance

---

Pallavi Pant, PhD  
Health Effects Institute

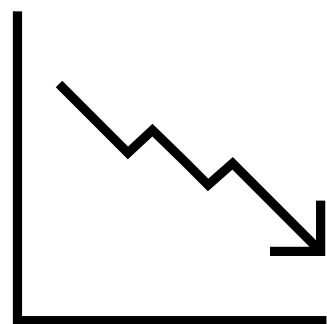
December 1, 2025 | African School on Air Quality and Pollution Prevention in Ghana

*gravioris caeli* (heavy heaven) | *infamis aer* (infamous air)

“No sooner had I left behind the oppressive atmosphere of the city  and that reek of smoking cookers which pour out, along with clouds of ashes, all the poisonous fumes they’ve accumulated in their interiors whenever they’re started up, than I noticed the change in my condition”

*gravioris caeli* (heavy heaven) | *infamis aer* (infamous air)

“No sooner had I left behind the oppressive atmosphere of the city [Rome] and that reek of smoking cookers which pour out, along with clouds of ashes, all the poisonous fumes they’ve accumulated in their interiors whenever they’re started up, than I noticed the change in my condition”



“As air pollution increased over time, contrast and visibility in paintings decreased.”





Reassessment of the Lethal London Fog of 1952: Novel Indicators of Acute and Chronic Consequences of Acute Exposure to Air Pollution

Michelle L. Bell<sup>1</sup> and Debra Lee Davis<sup>2</sup>

<sup>1</sup> Johns Hopkins University, Baltimore, Maryland, USA; <sup>2</sup>Carnegie Mellon University, Pittsburgh, Pennsylvania, USA

The price devices and assesses novel indicators of respiratory and other morbidity and mortality following London's lethal smog in the winter of 1952. Public health insurance claims, hospital admission rates for cardiac and respiratory disease, pneumonia cases, mortality records, infant reports, temperatures, and air pollutant concentrations are analyzed for December–February 1952–1953 and compared with those for the previous year or years. Mortality rates for the smog episode from December 1952 to February 1953 were 50–100% higher than the previous year. Claims that the smog only elevated health rates during and immediately following the peak fog (5–9 December 1952) and that an influenza epidemic accounted fully for persisting mortality increases in the first 2 months of 1953 are rejected. We estimate about 12,000 excess deaths occurred from December 1952 through February 1953 because of acute and persisting effects of the 1952 London smog. Public health during the London smog were 5–15 times above current regulatory standards and guidelines and approximate current levels in some rapidly developing regions. Ambient pollution in many regions poses serious risks to public health. Key words: air pollution; history; industries; London; morbidity; mortality; relative risk. — *Environ Health Perspect* 109(suppl 3):389–394 (2001). [http://ehpnet1.niehs.nih.gov/docs/2001/suppl\\_3/389-394bell/davis.html](http://ehpnet1.niehs.nih.gov/docs/2001/suppl_3/389-394bell/davis.html)

# 12,000 excess deaths occurred from December 1952 - February 1953 as a result of acute and persisting effects of the 1952 London smog episode.

In the last half of the twentieth century, several widely publicized acute episodes of lethal smog spread public understanding of the hazards of air pollution. One of the earliest such events occurred from 1 December to 5 December 1930 in the Meuse Valley in Belgium (1). Stable atmospheric conditions and industrial pollution from steel mills, coke ovens, foundries, and smelters in Liège, Belgium, contributed to the accumulation of air pollutants including sulfur dioxide (SO<sub>2</sub>), sulfuric acid mist, and fluoride gases. In the last 2 days of the event, more than 60 persons died, which was more than 10 times the normal mortality rate (2).

The first publicly recognized extreme air pollution episode in the United States took place in Donora, a small town in southwestern Pennsylvania. From 27 October to 30 October 1948, an inverse, anticyclonic meteorological inversion settled on the valley, sealed by pollution from steel works, coal-fired home and industrial facilities, coke ovens, a zinc reverb refinery, and iron and steel industries. Seventeen people died on

first 3 weeks of December 1952. With a death rate more than 3 times the norm for this period (3), the London fog of 1952 is widely regarded as a catalyst for the study of air pollution epidemiology.

The official report on the London episode by the Ministry of Health noted morbidity and mortality remained elevated from December 1952 until March 1953 in the region of Greater London. However, the report attributed these increased rates to an influenza epidemic, while recognizing some deaths may have been due to lingering effects from the fog (3). In 1954 Wilson noted this prolonged increase in mortality and suggested it could be related to air pollution. He also indicated the December 1952 fog might have impaired resistance to illness, causing higher mortality in subsequent months (4). No follow-up work was done to clarify this idea at the time, and official estimates attributed lingering increased rates of illness and death to influenza.

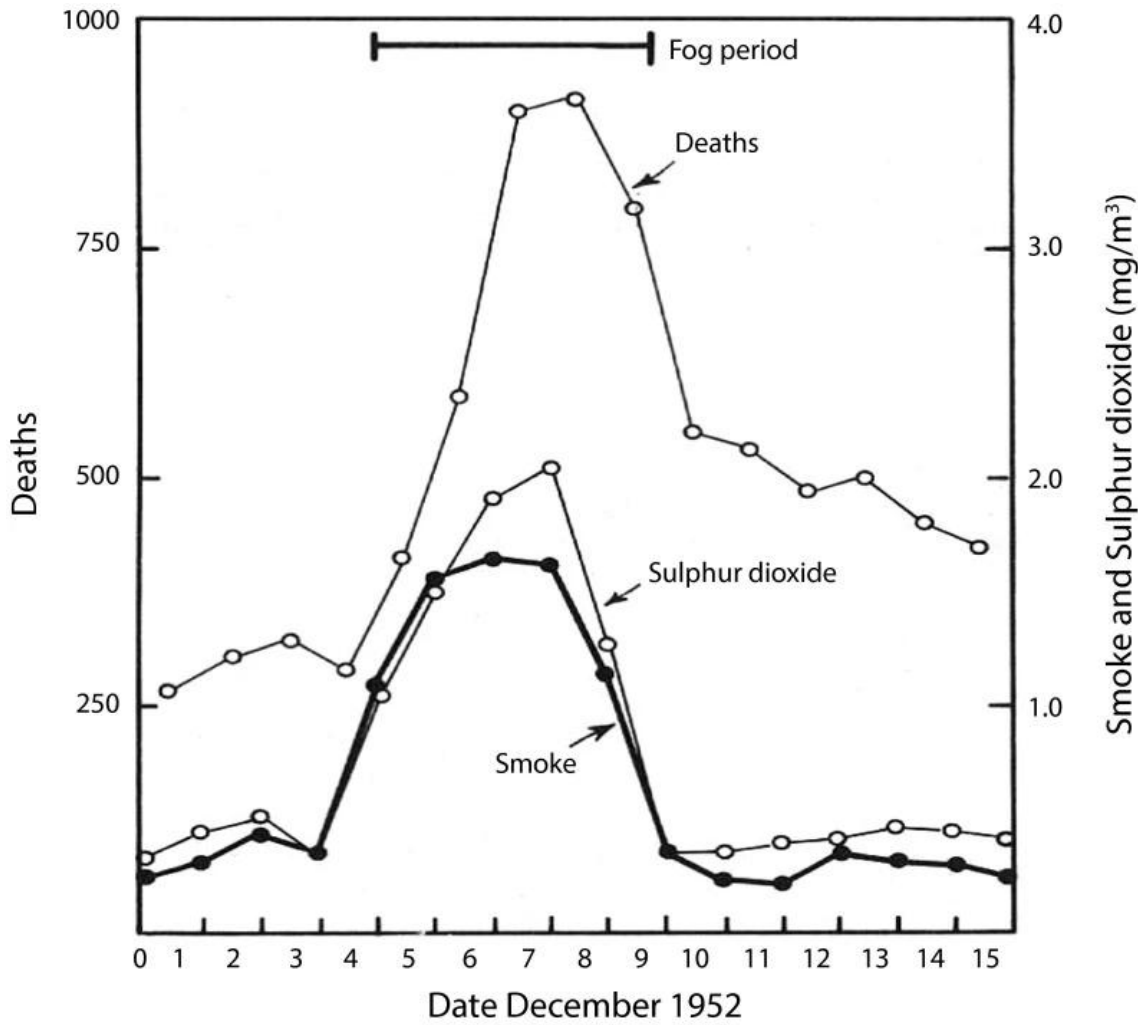
At the same time they occurred, each of these three cases was prominent in the news, signal-

ing to the public that air pollution was a serious health hazard. Since these events, public health researchers have provided extensive documentation that acutely elevated exposures do not cause only acutely evident public health effects. These exposures also contribute to chronic health problems (5). By extending the period of analysis and looking at novel direct and indirect indicators of respiratory morbidity and mortality for the 3 months after the 1952 London fog, this article establishes that the original assessment was incomplete.

## Methods

In an effort to clarify the connections between acute air pollution during the London smog and both acute and chronic health effects linked with this episode, we assembled original information and conducted regression analyses of various direct and indirect indicators of respiratory morbidity and mortality and air pollution, with appropriate lag periods. We included the following:

- Analysis of changes in the RR of daily mortality and measures of SO<sub>2</sub> and smoke or particles (TSM) for the days surrounding and including the fog in December 1952, including consideration of minimum and maximum temperature and relative humidity.
- Analysis of weekly mortality and air pollution data including several weeks before and after the episode from October 1952 through March 1953 and corresponding



📺📺📺📺📺 Killer Smog, <https://www.bbc.co.uk/programmes/m001fmtb>

Image: <https://www.bbc.com/future/article/20151221-the-lethal-effects-of-london-fog>

Brimblecombe P. The Big Smoke: A History of Air Pollution in London Since Medieval Times. 1st ed. London, UK: Routledge Kegan & Paul; 1987.

Bell and Davis. 2001. Reassessment of the Lethal London Fog of 1952: Novel Indicators of Acute and Chronic Consequences of Acute Exposure to Air Pollution . *Environmental Health Perspectives*, Vol. 109, Supplement 3 (Jun., 2001), pp. 389-394.

# A vast majority of the world's population is exposed to poor air quality.

## Air quality alerts issued in Canada and US as wildfires continue to burn

15 July 2025

Share Save

Ali Abbas Ahmadi BBC News

## How dirty air hurts economies in Europe and Central Asia and what can be done

SAMEH WAHBA, ELENA STRUKOVA-GOLUB, GAYANE MINASYAN & SANJAY SRIVASTAVA | SEPTEMBER 05, 2025

## SOUTH ASIA IS WORLD'S MOST POLLUTED REGION, NEW STUDY FINDS

Vietnam Asia

Video | Hanoi residents endure toxic air as Vietnam struggles with pollution problem

## Poor Air Quality Is Routine in Many Parts of the World

## Choking futures: How air pollution is stunting children's health in East Africa

Studies in Kenya, Uganda, and Ethiopia have shown that exposure to pollutants is linked to reduced lung function

## Thailand's extreme air pollution: 'I feel sorry for my daughter'

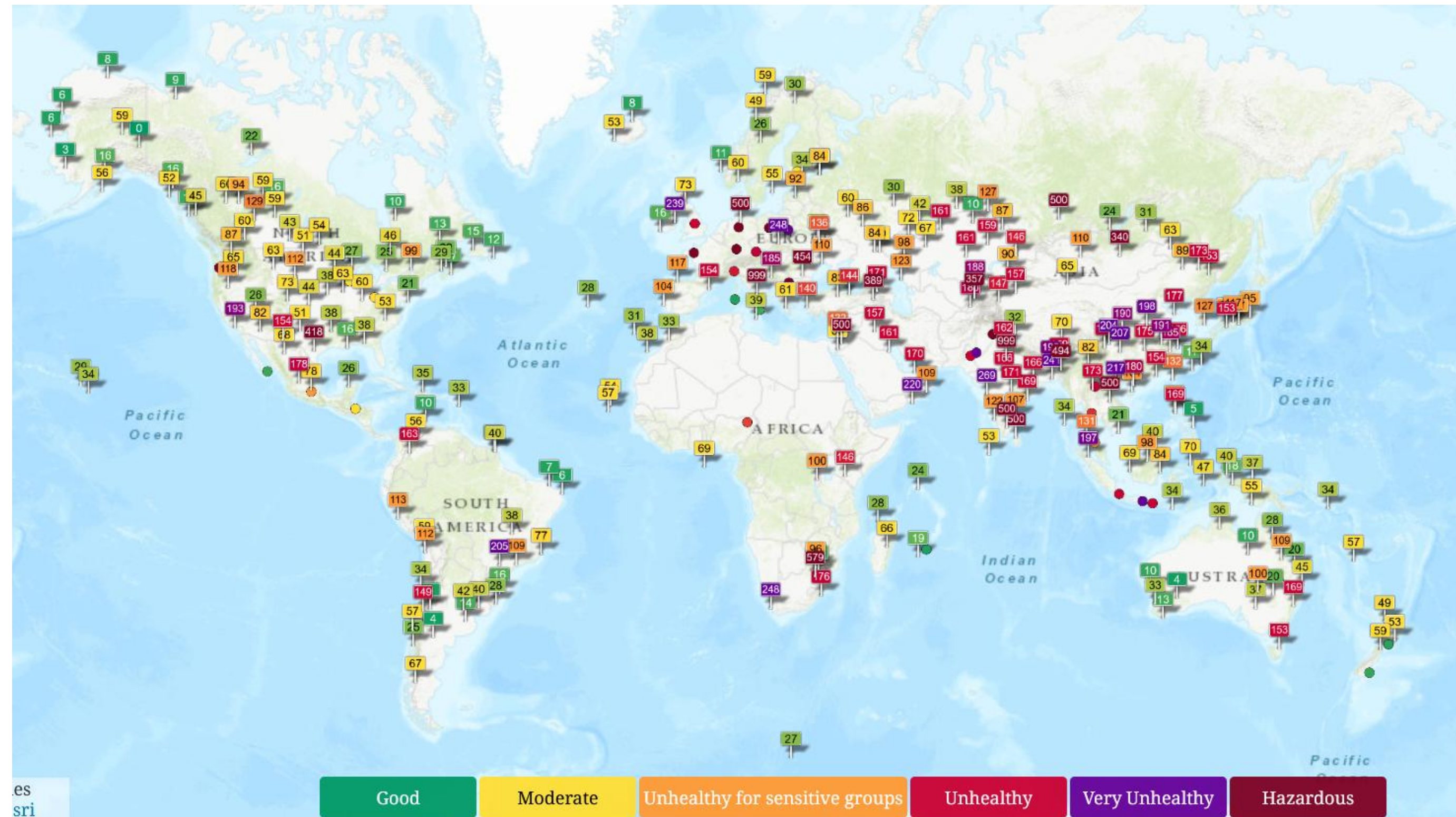
## "Air pollution and heart disease are undermining Africa's future



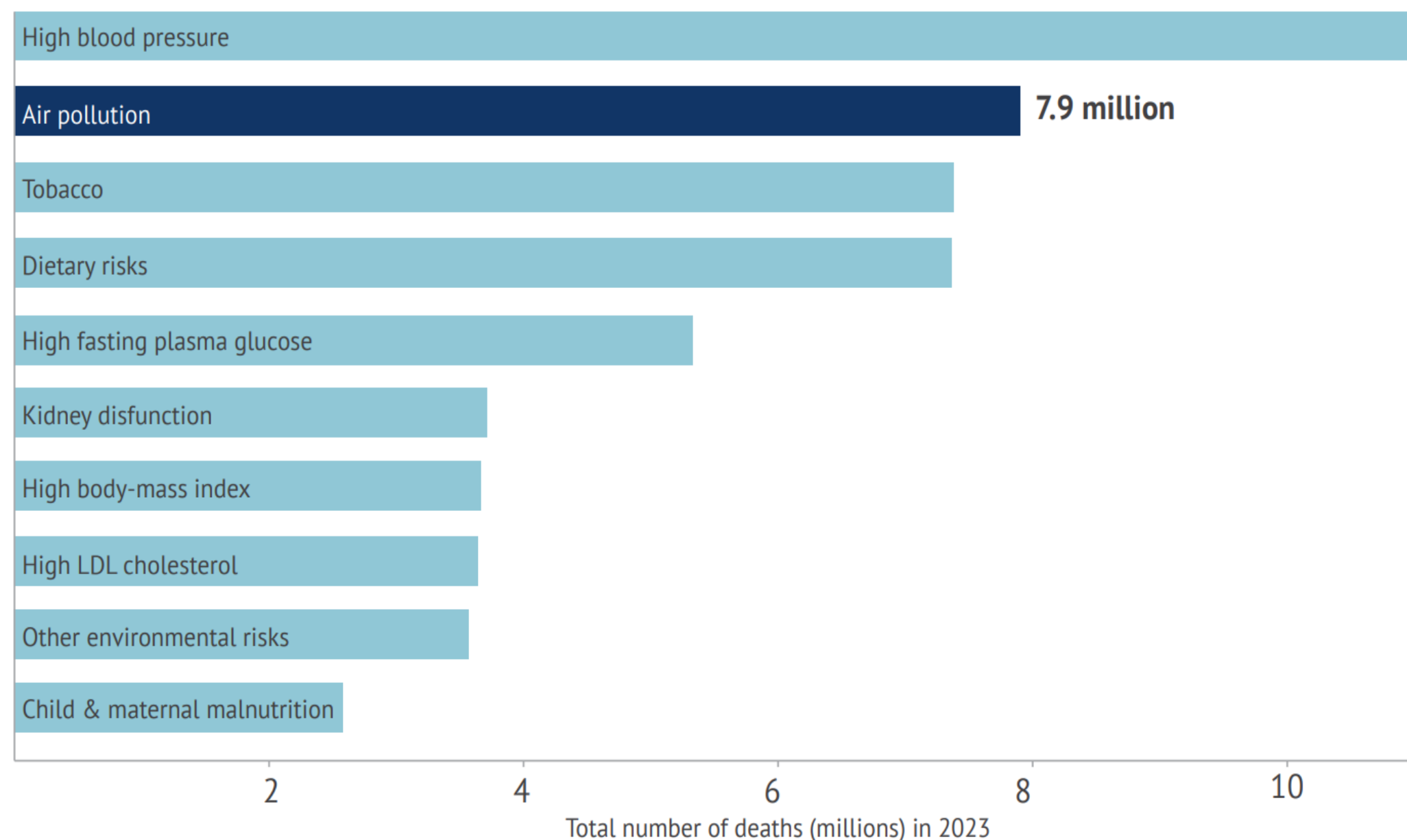
Mark Miller, Mariachiara Di Cesare  
Published: December 11, 2024 | World Heart Federation



# Global air quality today



# The big picture: air pollution's toll in 2023



**7.9 million**  
*global deaths in 2023*

**1 in 8**  
*deaths linked to exposure to air pollution*

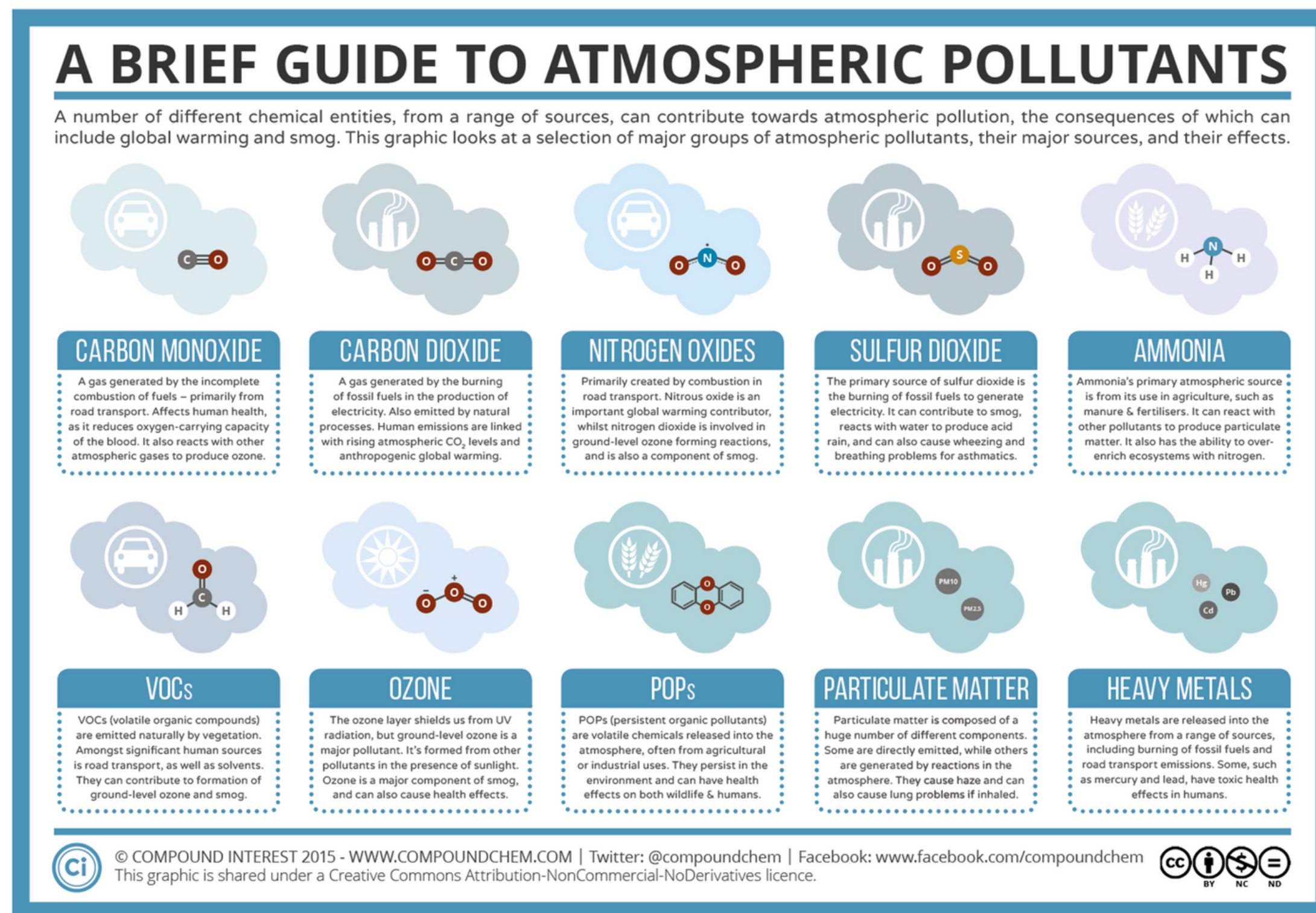
**86%** of air pollution deaths  
*attributable to noncommunicable diseases*

**3-5x**  
*Higher disease burden in LMICs compared to high-income countries*

**90%** of air pollution deaths  
*in low- and middle-income countries*



# Key air pollutants of concern



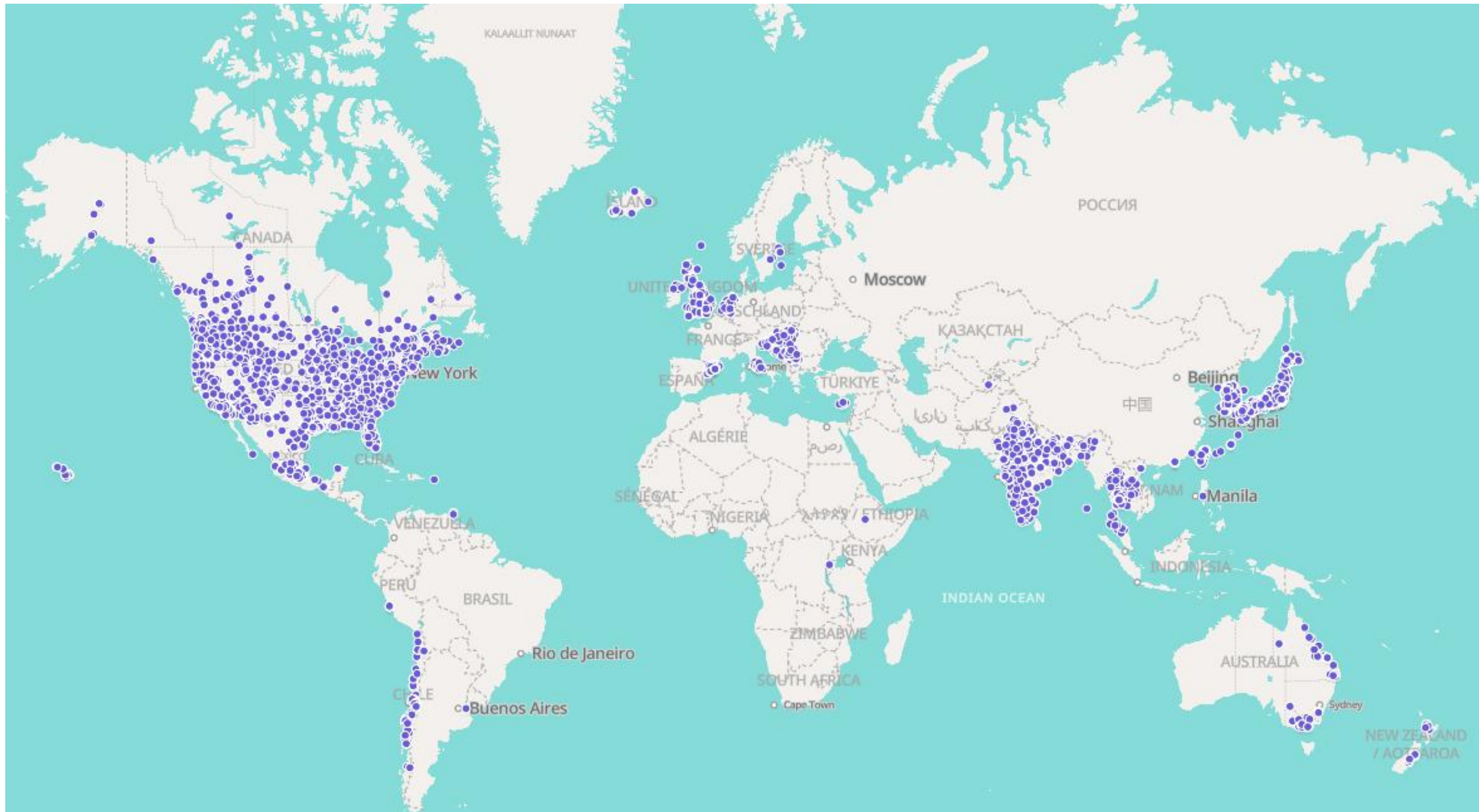
Indoor | outdoor

Anthropogenic/human-made |

Natural

# While data gaps are closing, some regions still have limited data

---

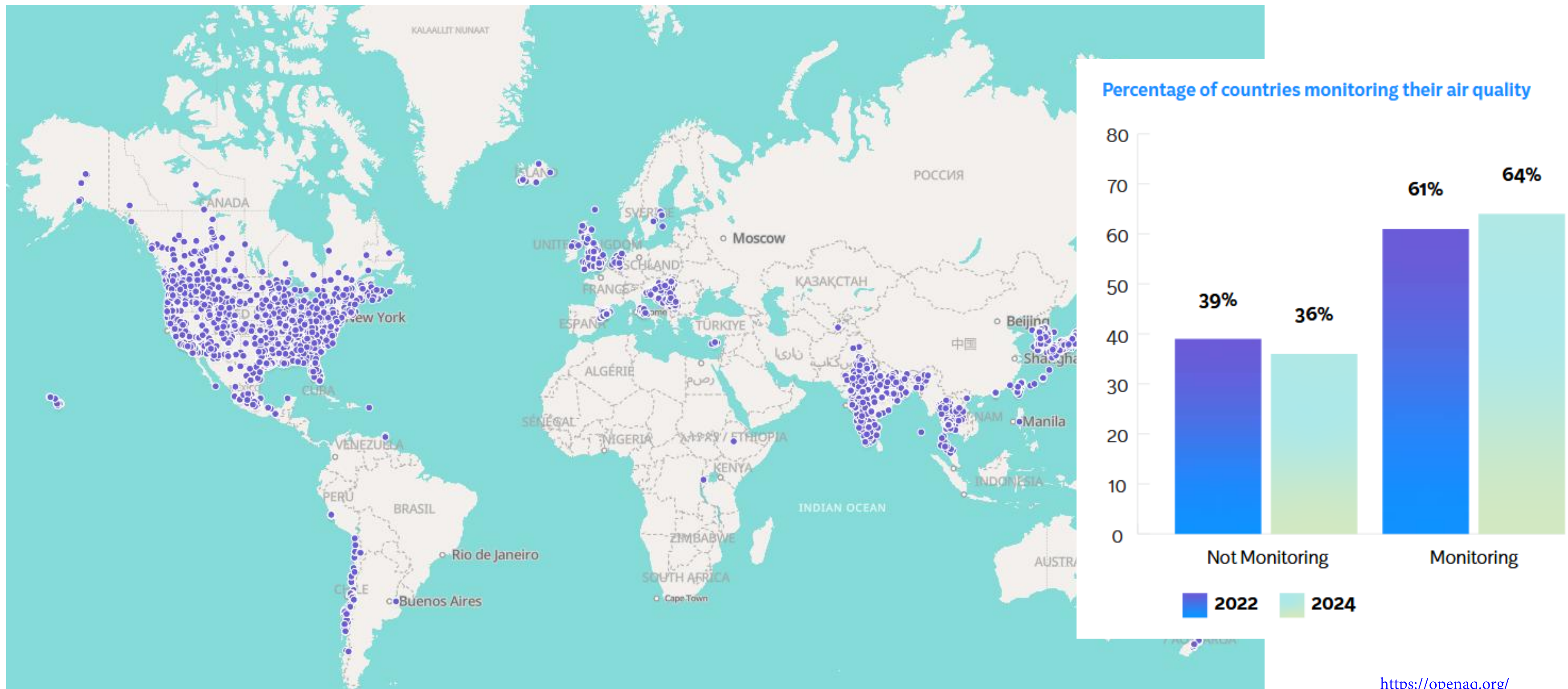


<https://openaq.org/>

Okure et al., AirQo

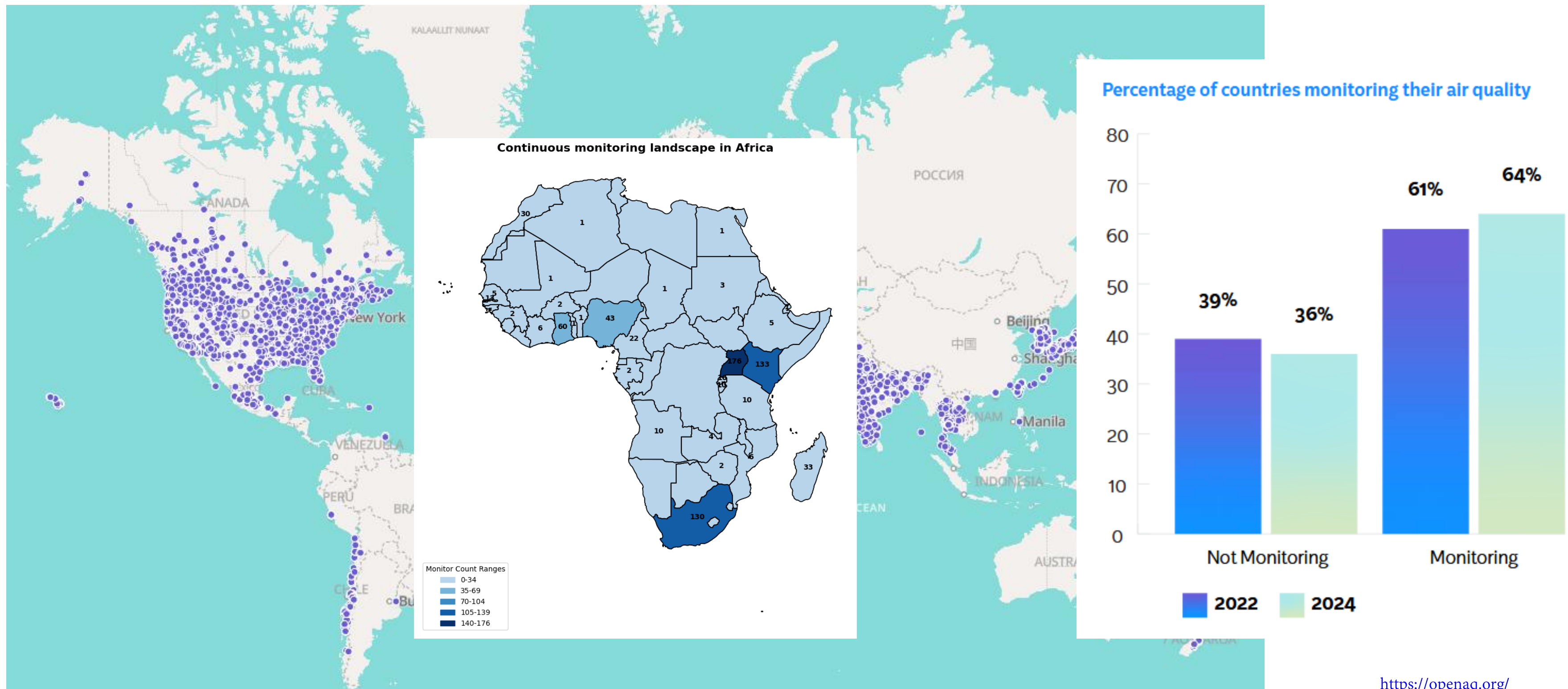


# While data gaps are closing, some regions still have limited data





## While data gaps are closing, some regions still have limited data



# Major sources of air pollution vary by region and country

Contribution of each **sector** to fine particle pollution

- Residential
- Transport
- International shipping
- Industry
- Commercial
- Anthropogenic fugitive, combustion and industrial dust
- Other combustion
- Remaining sources
- Landscape fires
- Agricultural waste burning
- Agriculture
- Waste
- Solvents
- Energy
- Windblown dust

North America

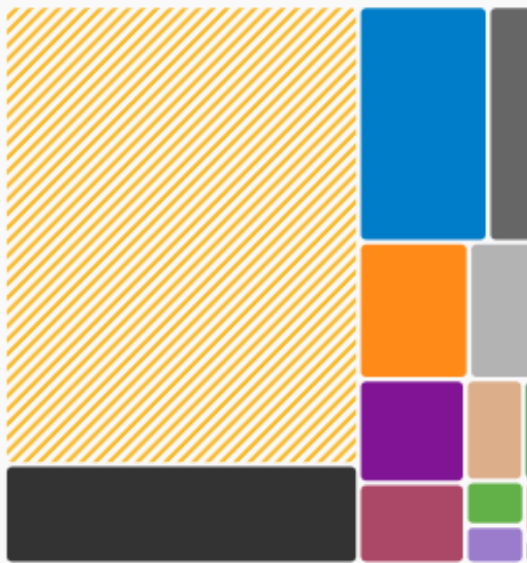


Latin America and Caribbean

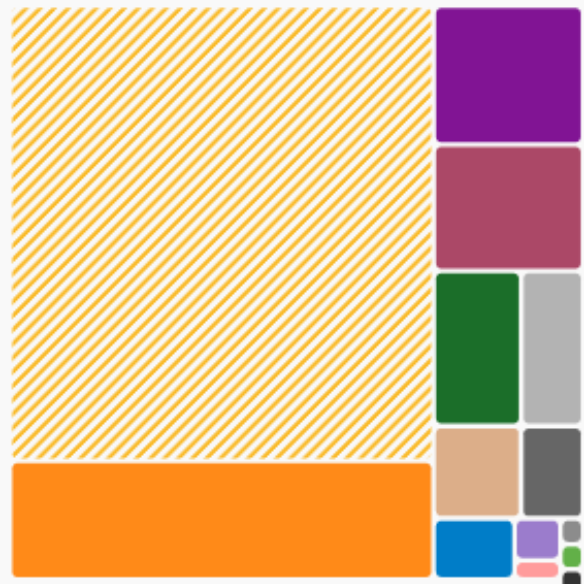
Europe



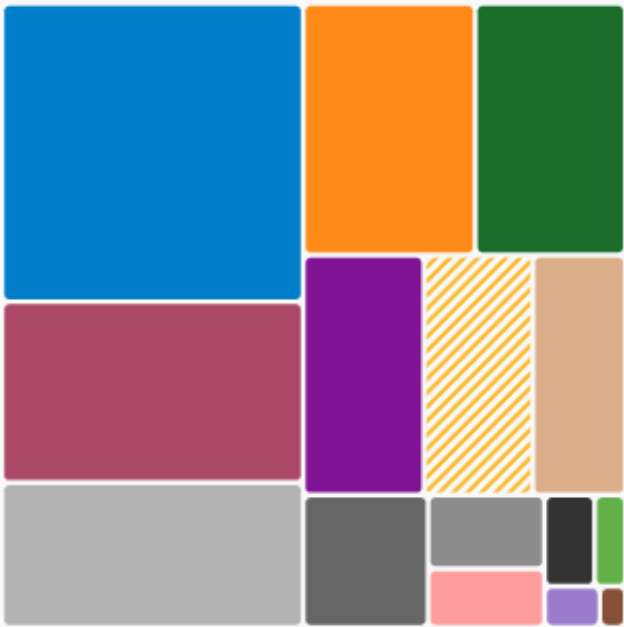
Africa



West Asia

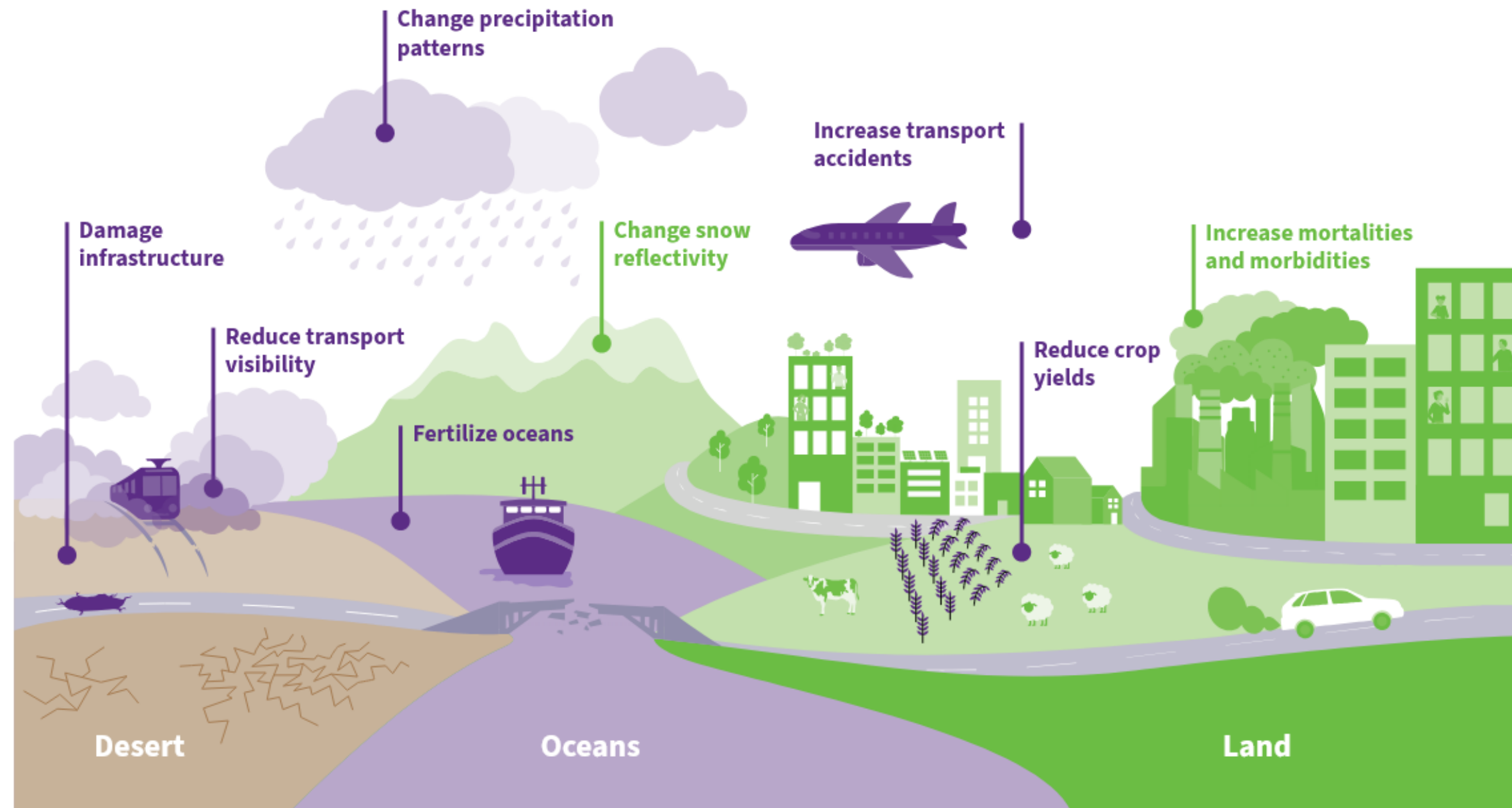


Asia and Pacific



Each big square is a world region, colored by contributing sector and sized by the annual mean levels of fine particulate matter PM<sub>2.5</sub>, measured in µg/m<sup>3</sup>.

# Sand and dust storms



“mega” sand and dust storms now affect an estimated **330 million people** annually.

Impacts on visibility, air quality

Respiratory and cardiovascular illnesses; meningitis outbreaks (West Africa)

Image: [inDust](#)

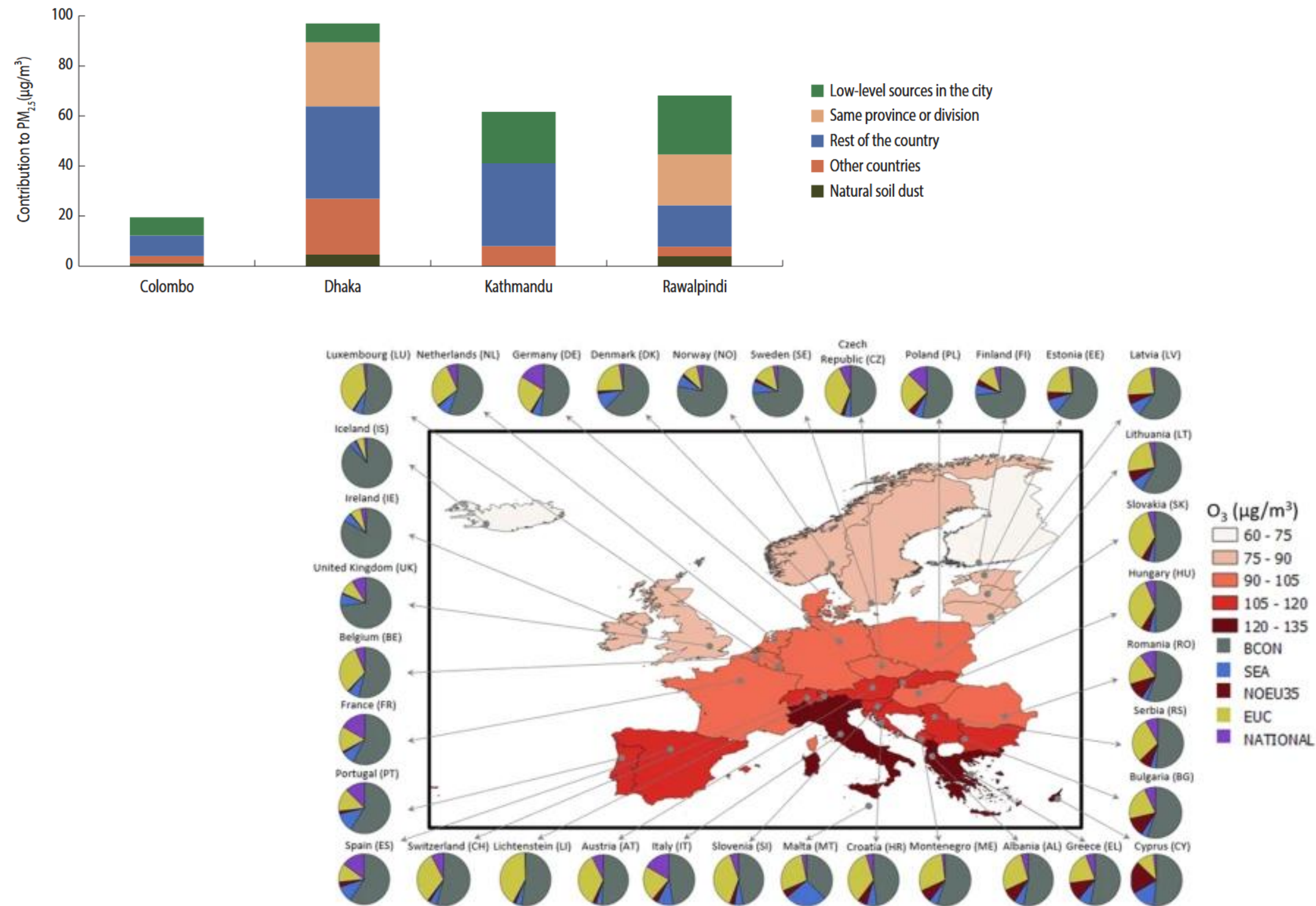
<https://news.mongabay.com/short-article/2025/10/supercharged-dust-storms-are-exposing-millions-to-deadly-air-pollution/>



<https://www.who.int/publications/i/item/B09453>



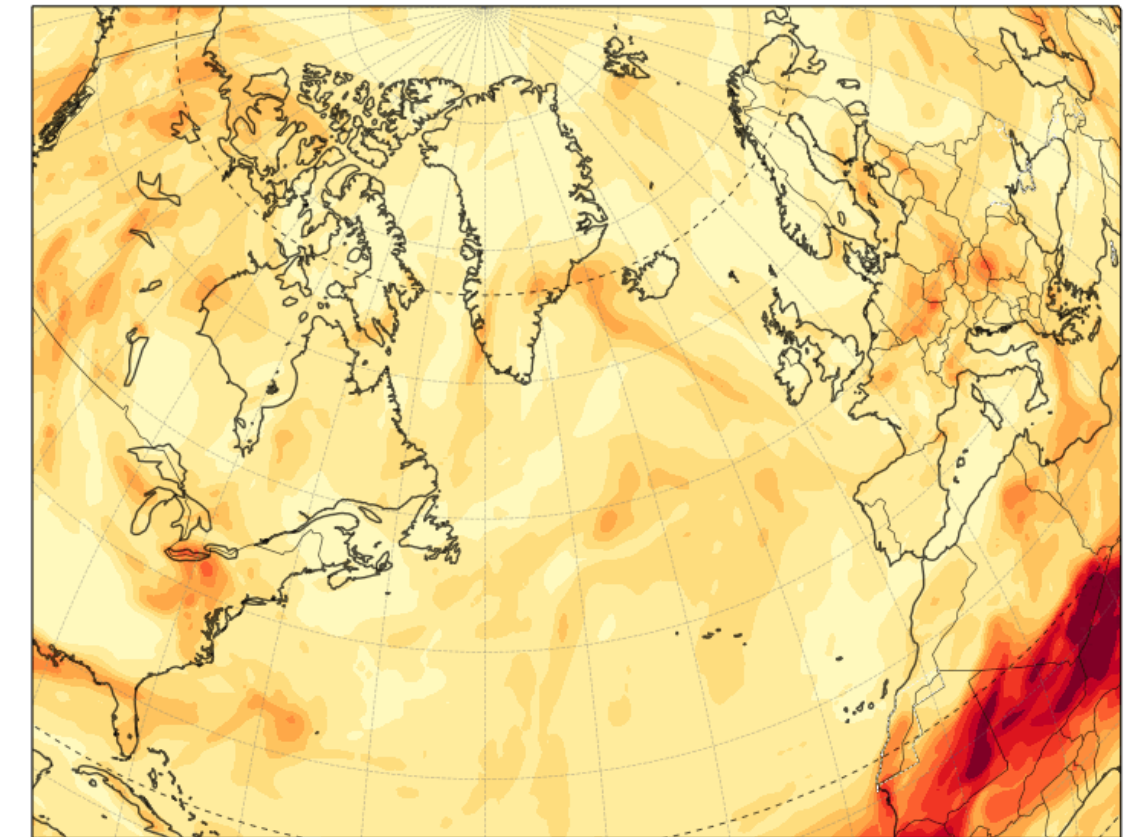
# Air pollution does not respect geographical or political borders



**CAMS Analysis Total Aerosol Optical Depth at 550nm**

2025-05-22 T00

Data: CAMS global atmospheric composition forecast • Credit: CAMS/ECMWF



<https://www.who.int/publications/i/item/B09459>

World Bank. 2023. Striving for Clean Air: Air Pollution and Public Health in South Asia. South Asia Development Matters. Washington, DC: World Bank. doi:10.1596/978-1-4648-1831-8.

Garatachea et al. 2024. National and transboundary contributions to surface ozone concentration across European countries. *Communications Earth and Environment*, Volume 5.

[CAMS tracks smoke from intense Canadian wildfires reaching Europe](#)



# Air Quality and Agriculture

---



Image: CGIAR



<https://www.who.int/publications/i/item/B09401>

Air pollution has a negative impact on crop productivity and yield, with implications for food security. As a sector, agriculture also contributes to air pollution.

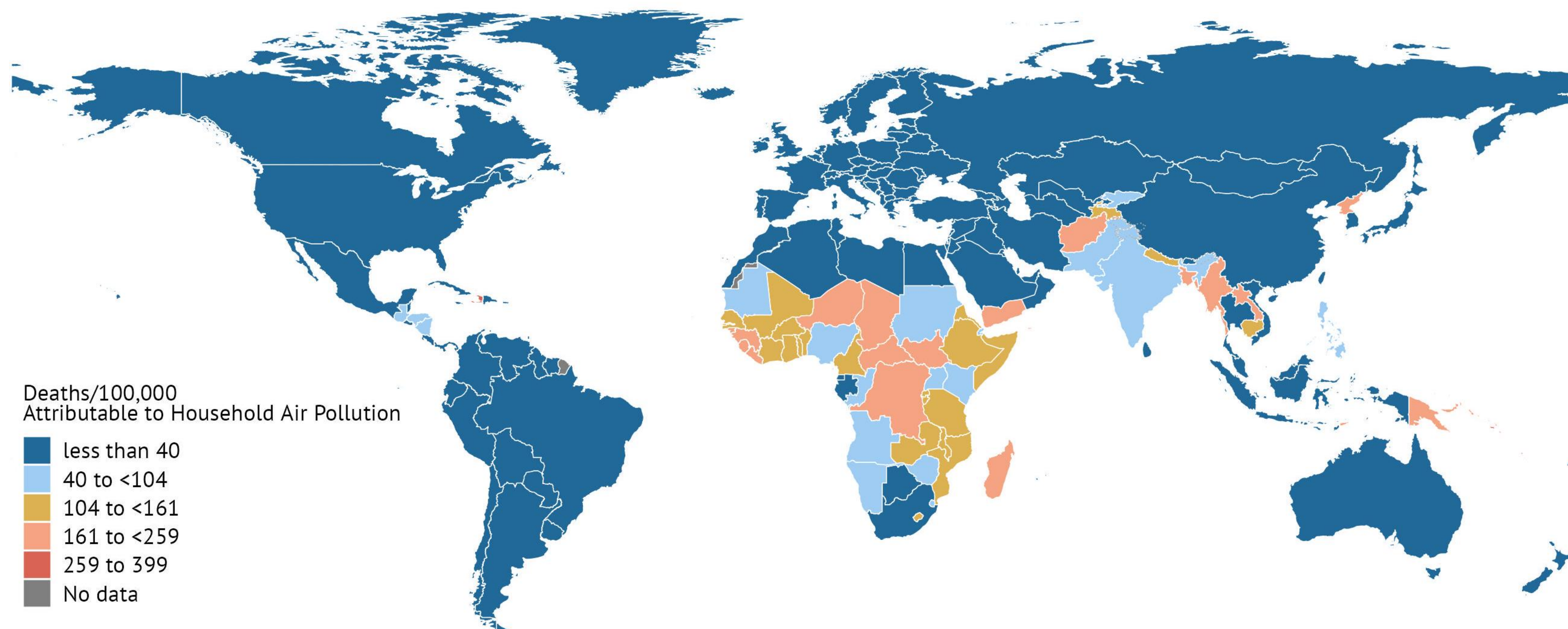
“Globally aggregated yield losses for the four staple crops  $3.6 \pm 1.1\%$  for maize,  $2.6 \pm 0.8\%$  for rice,  $6.7 \pm 4.1\%$  for soybean, and  $7.2 \pm 7.3\%$  for wheat.”

“Reductions in ozone, particulate matter, nitrogen dioxide, and sulfur dioxide between 1999 and 2019 contributed to about 20% of the increase in U.S. corn and soybean yield gains during that period – an amount worth about \$5 billion per year”



# 2.8 million deaths due to exposure to household air pollution in 2023

---





# Air Quality and Energy

**2.1 billion people** remain dependent on polluting fuels and technologies

Across 24 African countries, **over 90%** of the population is exposed to HAP from cooking with solid fuels.

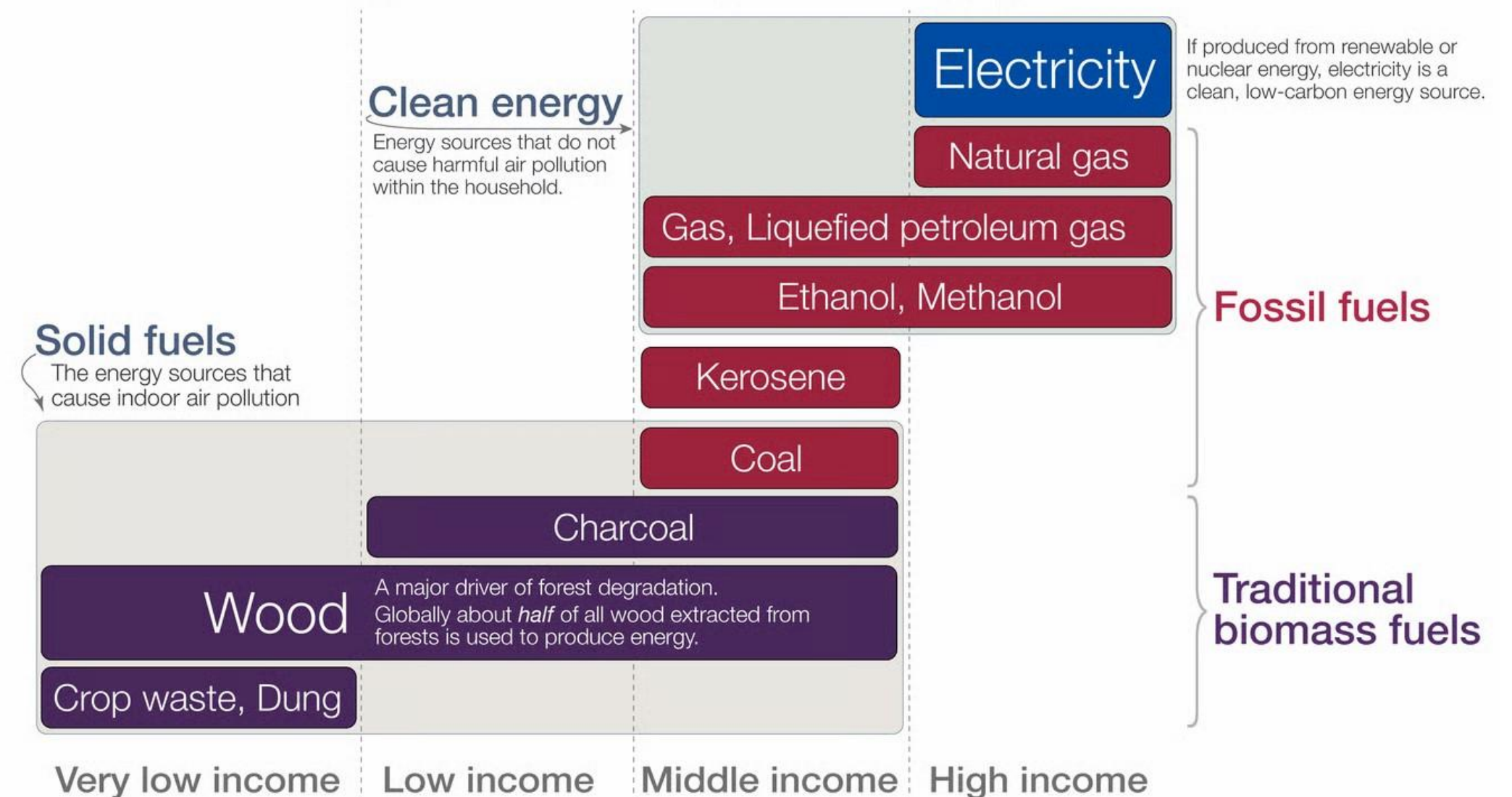
Sustainable Development Goal 7: Access to energy



## The 'Energy Ladder'

The dominant energy source for cooking and heating, by level of income

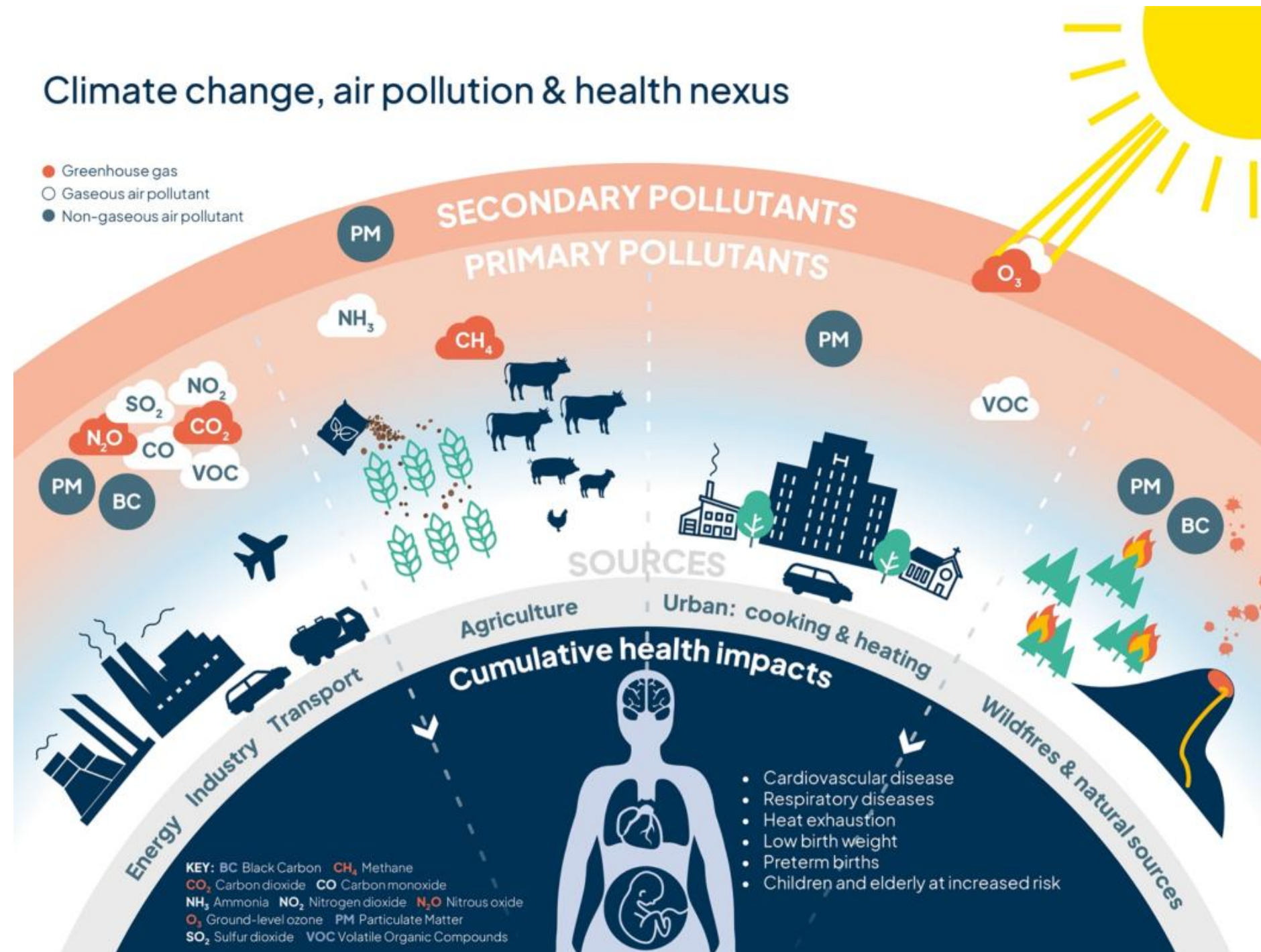
Our World in Data



Based on: WHO – Fuel for life: household energy and health.  
OurWorldinData.org – Research and data to make progress against the world's largest problems.

Licensed under CC-BY by the author Max Roser

# Air Quality and Climate



Joint effects of extreme heat and air pollution

Increasing wildfires and bushfires-  
impact on air quality and health

*“enhanced PM<sub>2.5</sub> associated with biomass burning in northern Canada, the Amazon, Siberia and central Africa [in 2024]”*

Pollen season/allergies






















Sand and dust storms

Other?



# Superpollutants



| SUPER POLLUTANTS | Climate pollutants  | Major human sources   | Atmospheric lifetime |
|------------------|---|---|----------------------|
|                  | Carbon Dioxide (CO <sub>2</sub> )                           |          | Centuries            |
|                  | Methane (CH <sub>4</sub> )                                  |          | Decades              |
|                  | Tropospheric Ozone (O <sub>3</sub> )*                       | CH <sub>4</sub> CO VOCs   | Weeks to months      |
|                  | Carbon Monoxide (CO)*                                       |    | Weeks to months      |
|                  | Volatile Organic Compounds (VOCs)*                          |    | Minutes to years     |
|                  | Fluorinated-gases (F-gases; e.g. hydrofluorocarbons (HFCs)) |    | Years to decades     |
|                  | Nitrous Oxide (N <sub>2</sub> O)**                          |    | Centuries            |
|                  | Black Carbon (BC)*  |    | Days                 |

\* Air pollutant  
\*\* Depletes the ozone layer

Extremely potent climate pollutants; greater impacts on warming than carbon dioxide per tonne; include methane, black carbon and tropospheric ozone

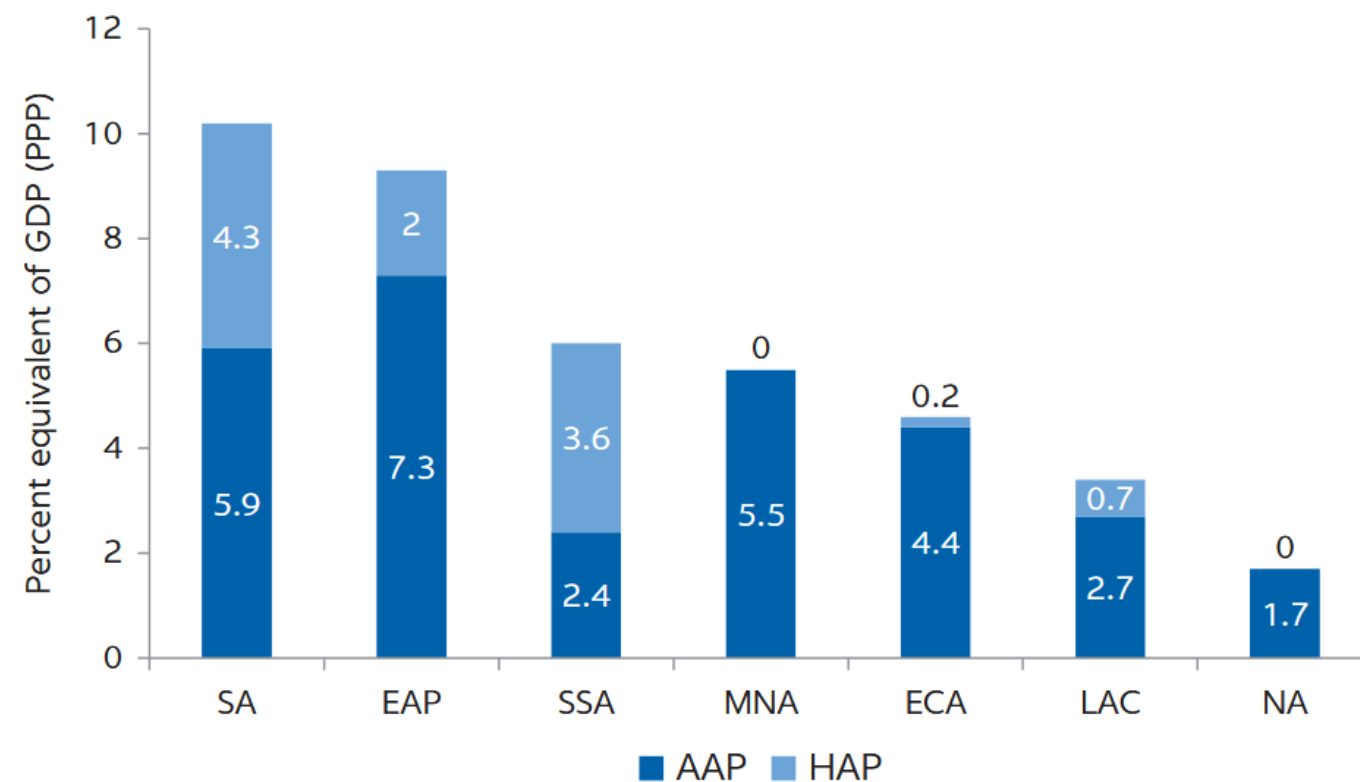
*“reducing super pollutants could prevent millions of premature deaths annually and save tens of millions of tonnes of crops annually”*



# Economic cost of air pollution

---

*Global economic costs from ambient air pollution total ~ US\$6 trillion per year, equivalent to 4.6 % of global GDP in 2020*



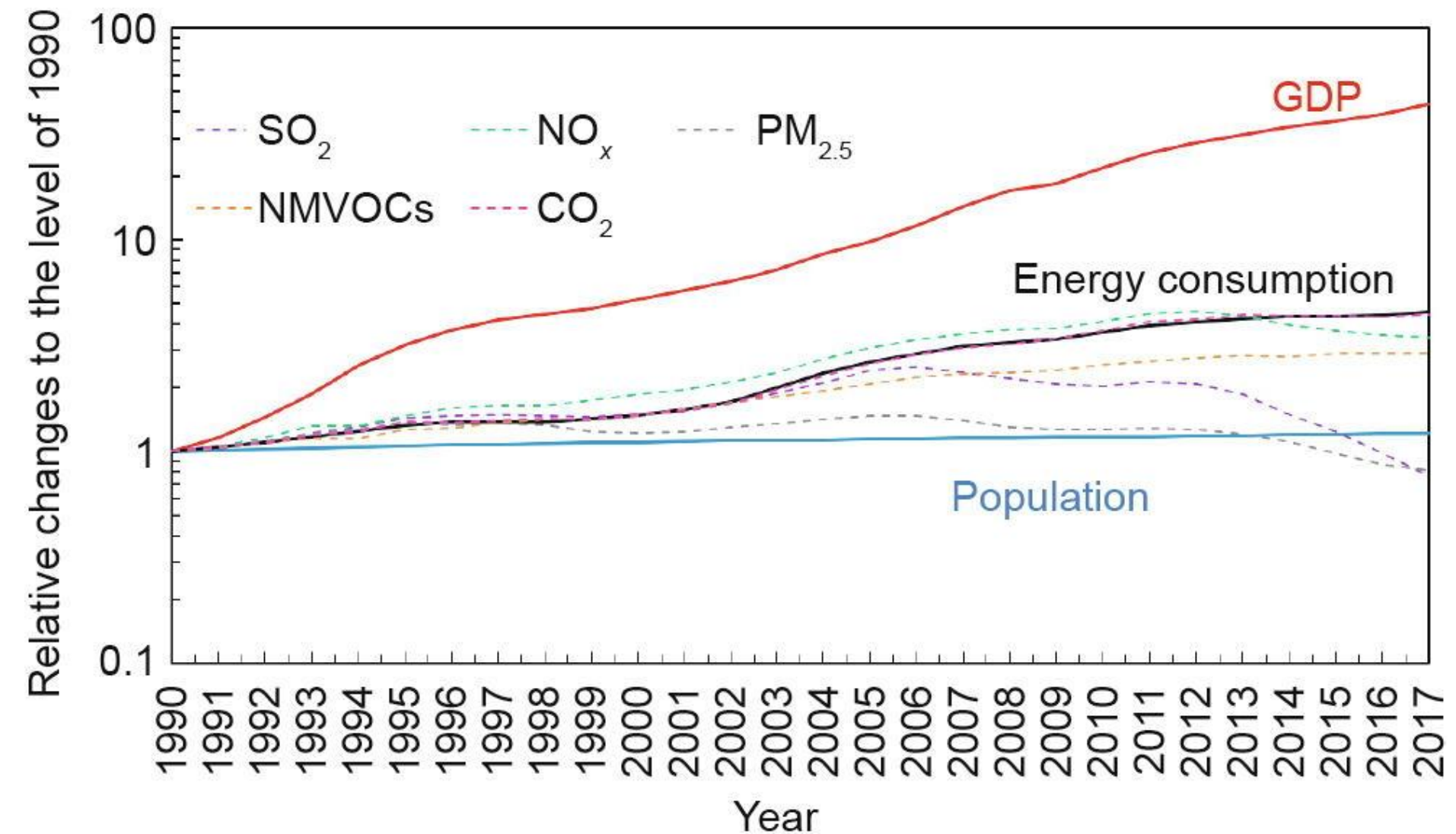
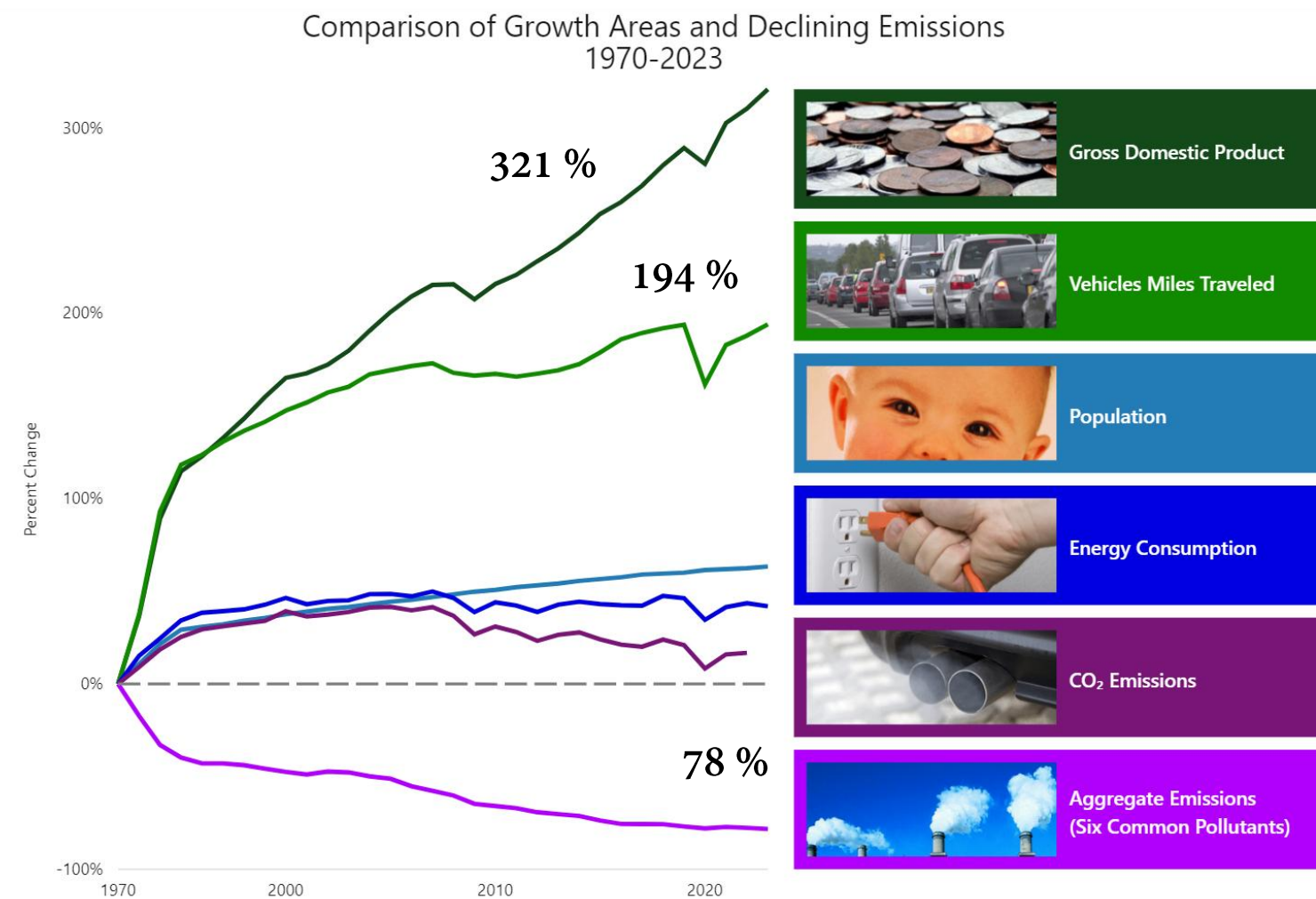
**68%** highly-skilled employees limit working hours in Sofia, Bulgaria due to air pollution

**USD\$2,500** Average healthcare cost related to air pollution for each American

**8%** of insurance claims for hospitalizations in India linked to air pollution

**8%** decline in healthcare expenditure across 98 cities in China between 2015-2017 due to clean air action

# Improvements in air quality vis-à-vis economic growth





# Critical drivers in the last decade

---

Increase in research output

(inter)national attention

**Data is increasingly accessible**

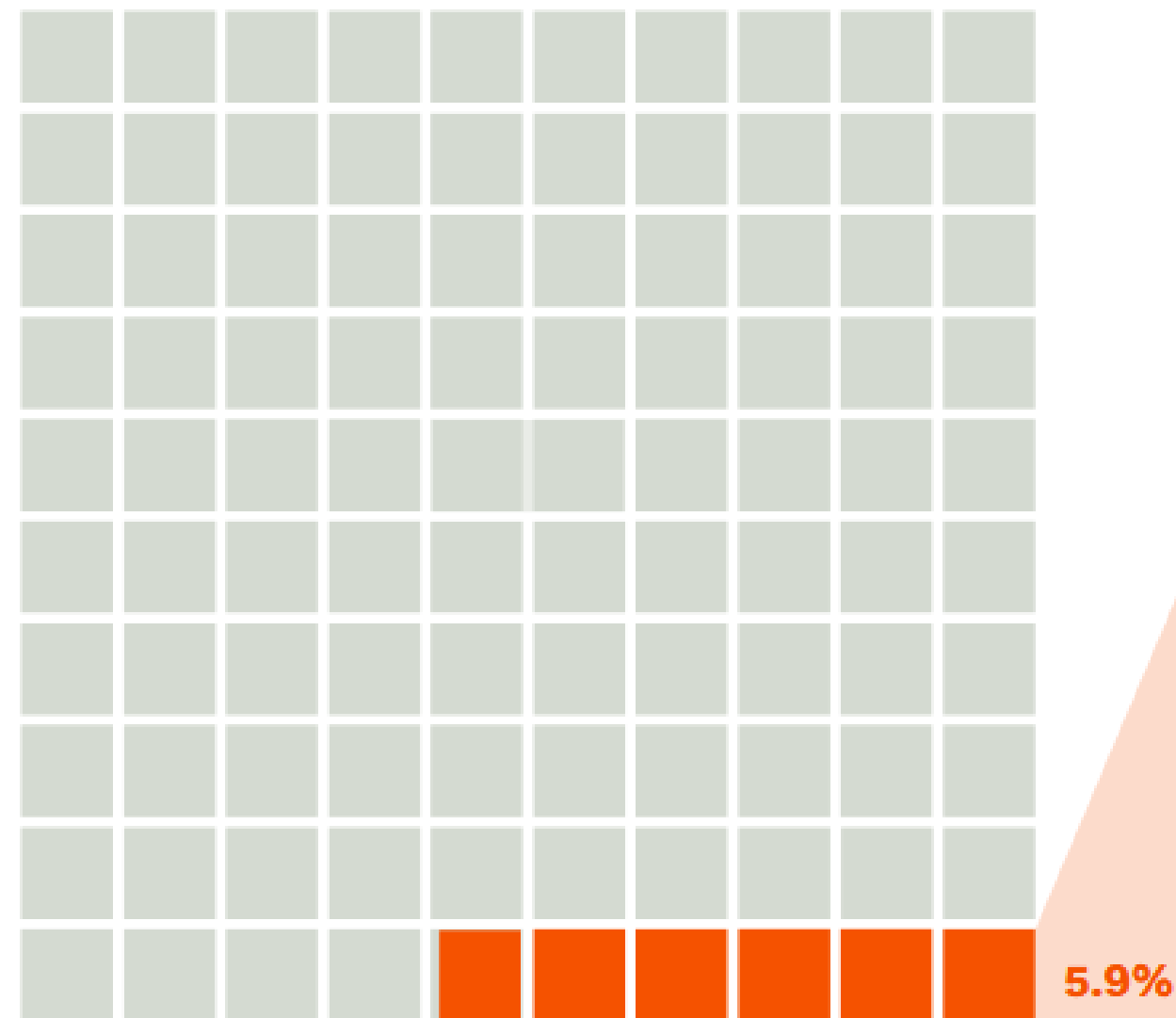
Air quality data from low-cost sensors, satellites, models



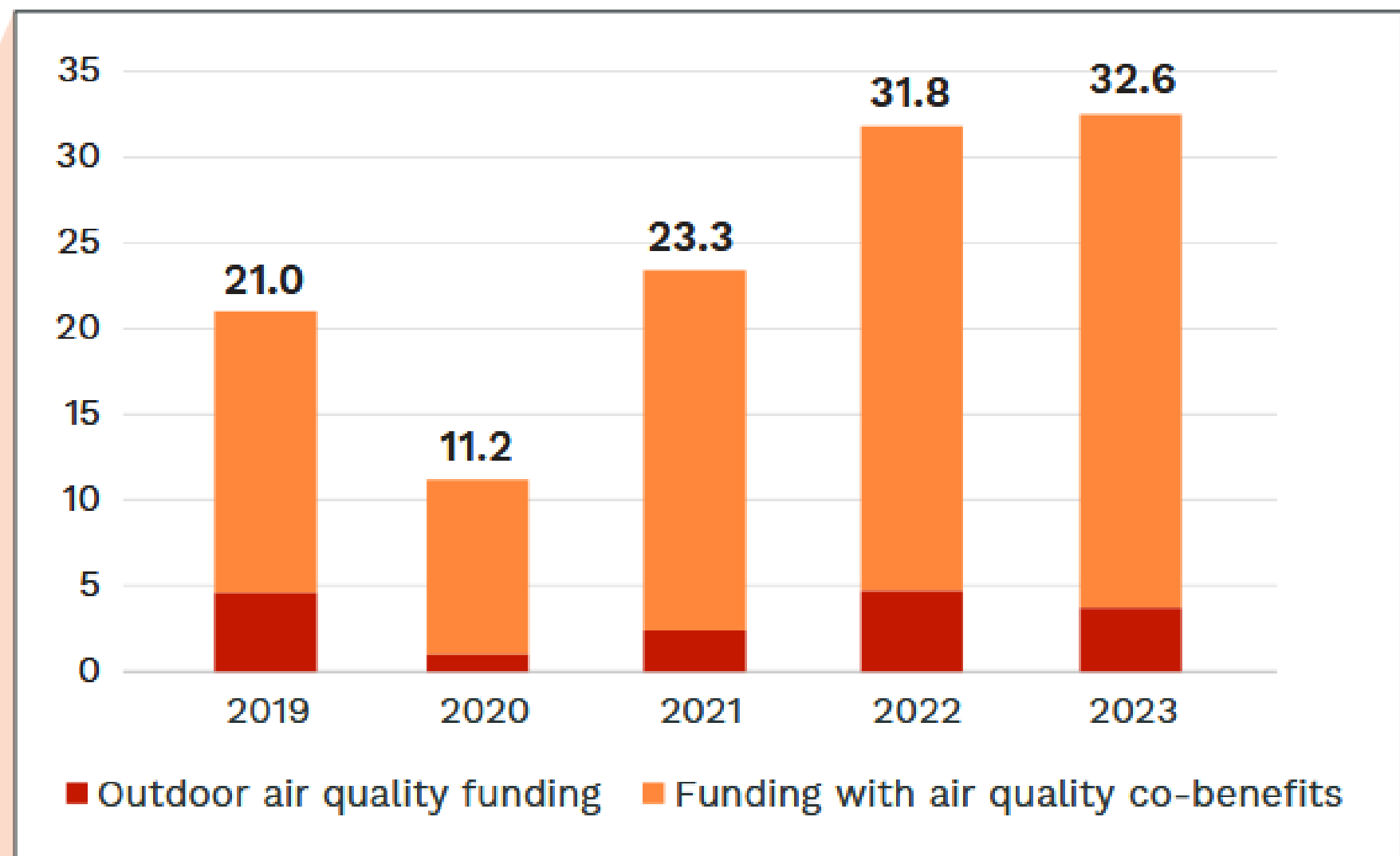
Social media

# Despite the large impacts, funding for air quality remains limited.

**International development funding,  
2019 – 2023**



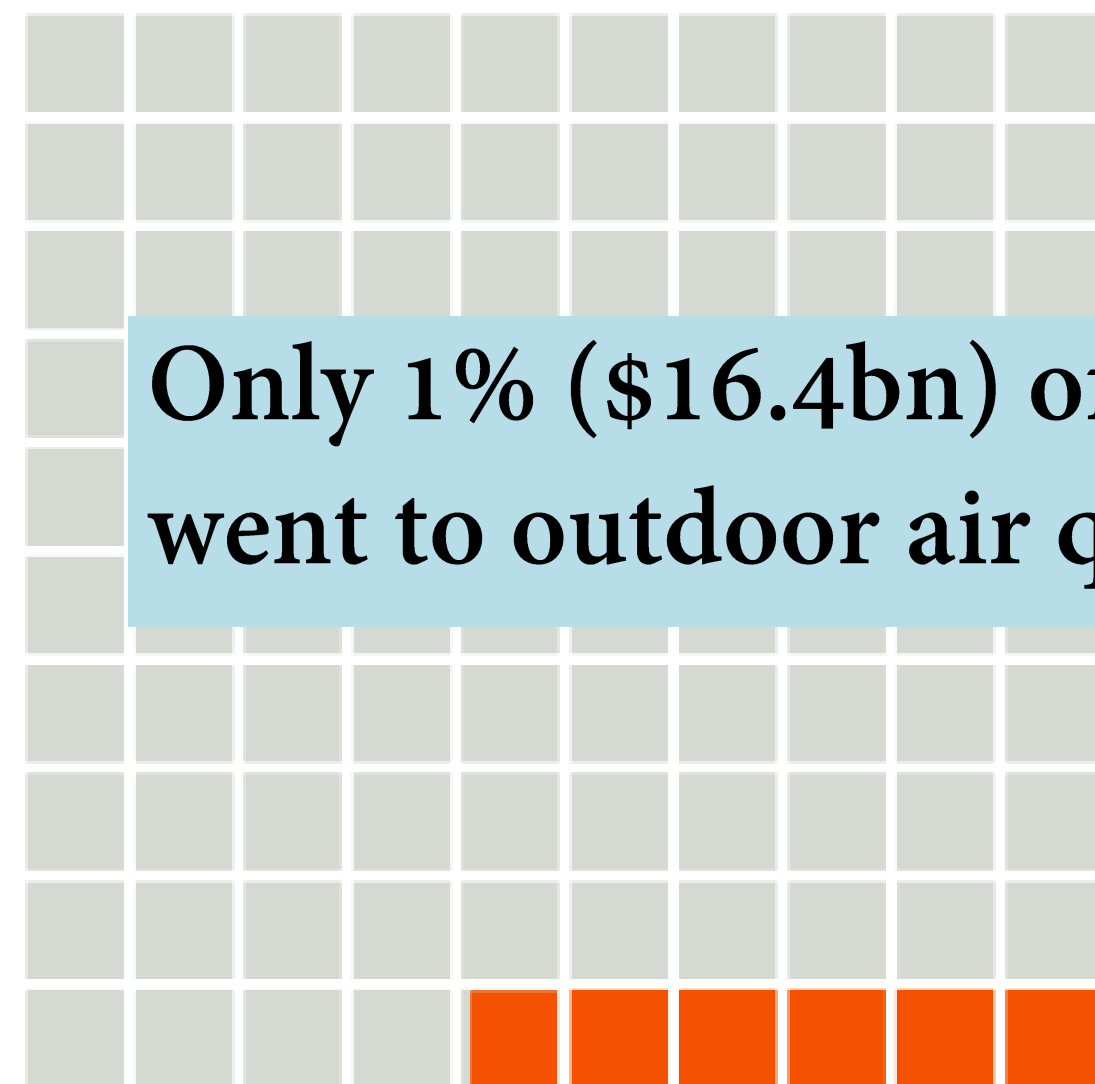
**Total air quality funding (\$ billion)**





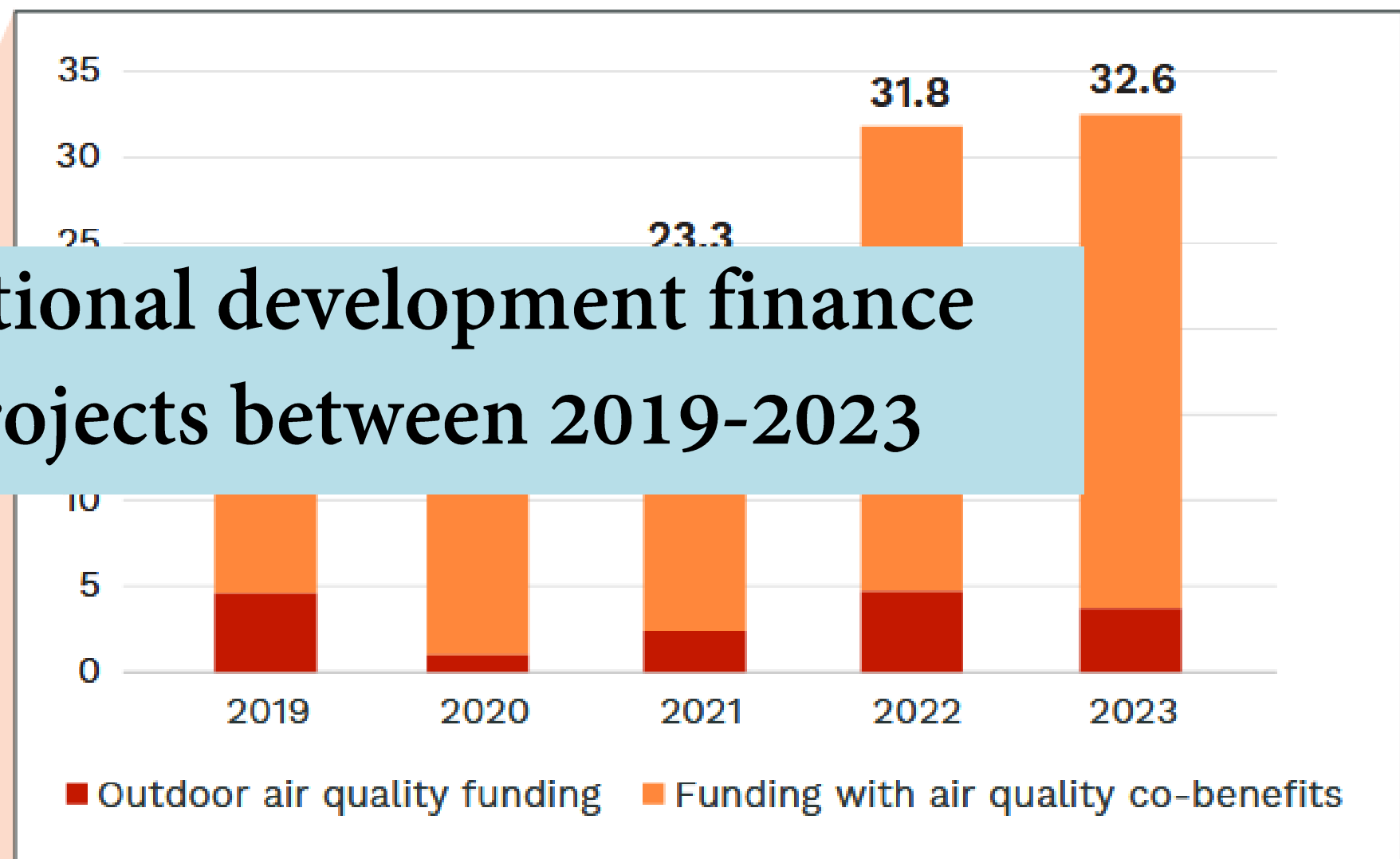
# Despite the large impacts, funding for air quality remains limited.

International development funding,  
2019 – 2023



Only 1% (\$16.4bn) of international development finance went to outdoor air quality projects between 2019-2023

Total air quality funding (\$ billion)



# Signs of progress

---

**2024** *UNEA Resolution* to bolster regional cooperation on air quality

**2025** *WHO Roadmap* adopted; includes a voluntary target to halve premature deaths caused by anthropogenic air pollution by 2040

Nearly every low- and middle-income country mentions air pollution in their Nationally Determined Contributions (NDCs)

**2020** *West African* countries adopted a comprehensive set of regulations for introducing cleaner fuels and vehicles

**2022** *China* sees steep reductions in levels of PM<sub>2.5</sub> across major cities

**2024** *Uganda* introduced the first National Environment (Air Quality Standards) Regulation

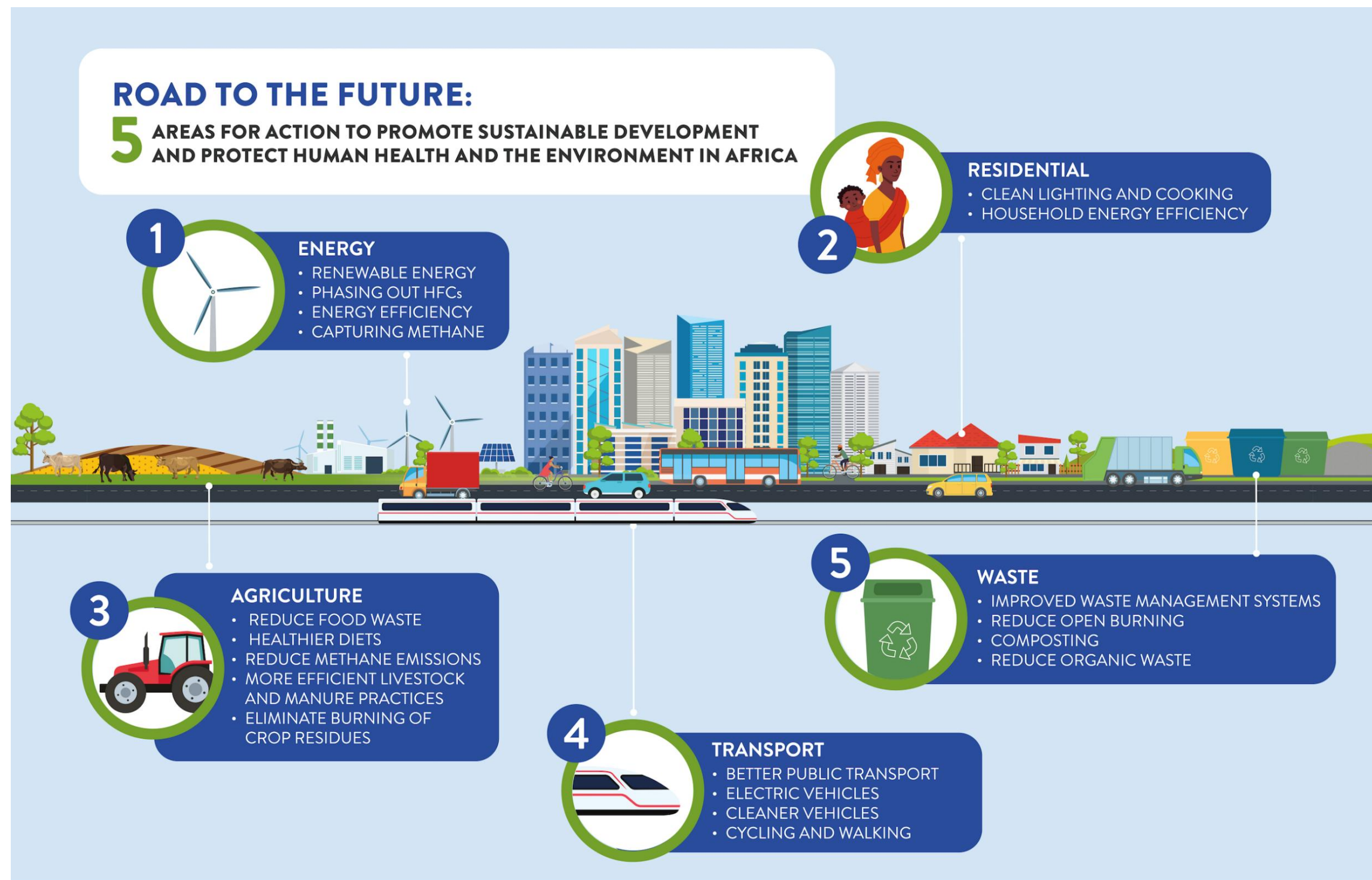
**2024** *Brazil* approved the National Air Quality Management System (MonitoAr) to provide real-time access to air quality data

**2024** *Bangladesh* introduced the National Air Quality Management Plan

**2025** *Ghana* passed the Air Quality Management Regulation into law



# Collaborative action can help accelerate progress towards Agenda 2063



*“prevent 200,000 premature deaths per year by 2030, reduce carbon dioxide and methane emissions, and improve food security” ([Africa Integrated Assessment](#))*

*“prevent 109,000 lives and save \$20bn in economic costs by reduced air pollution in six cities in Africa” ([Clean Air Fund](#))*



# Food for thought

---

What was the most surprising fact that you learnt today?

## *Resources*



[AQMx](#)



[Atmospheric Tales](#)



[A chronology of global air quality](#)



ppant@healtheffects.org | @ppant.bsky.social

