

# 8.3.1 Urban Air Pollution

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# Objectives

- Outline the meaning of "air pollution"
- Outline two types of pollutants: primary and secondary
- Describe the sources of air pollution
  - wildfires
  - chemical industries
  - construction and demolition
  - indoor air pollution
  - PM

# Facts about air pollution

# What is air pollution?

- **Definition**

- Air pollution is the contamination of indoor or outdoor environments by chemical, physical, or biological agents that alter the natural composition of the atmosphere.

- **Particulate Matter (PM)**

- Consists of microscopic solid or liquid particles suspended in air.

# Sources of Air Pollution

- **Natural sources:**
  - Volcanic eruptions
  - Dust storms
  - Wildfires
  - Pollen and mould spores
- **Anthropogenic sources:**
  - Vehicle emissions
  - Industrial processes
  - Biomass burning
  - Indoor cleaning products

# Types of Pollutants

**Primary pollutants:** Emitted directly from processes, especially fossil-fuel combustion.

- Carbon monoxide
- Carbon dioxide
- Unburned hydrocarbons
- Nitrogen oxides (NO<sub>x</sub>)
- Sulfur dioxide
- Particulate matter
- Mercury
- Sulfur compounds

**Secondary pollutants:** Formed through reactions involving primary pollutants, often requiring sunlight.

- Tropospheric ozone
- Secondary particulates
- Peroxyacetyl nitrate (PAN)
- Nitrogen dioxide
- Sulfuric and nitric acids (drivers of acid deposition)

# Health and Global Impacts

- Air pollution is a major risk factor of
  - Heart disease
  - Stroke
  - Lower respiratory infections
  - Lung cancer
  - Diabetes
  - COPD

# Health and Global Impacts

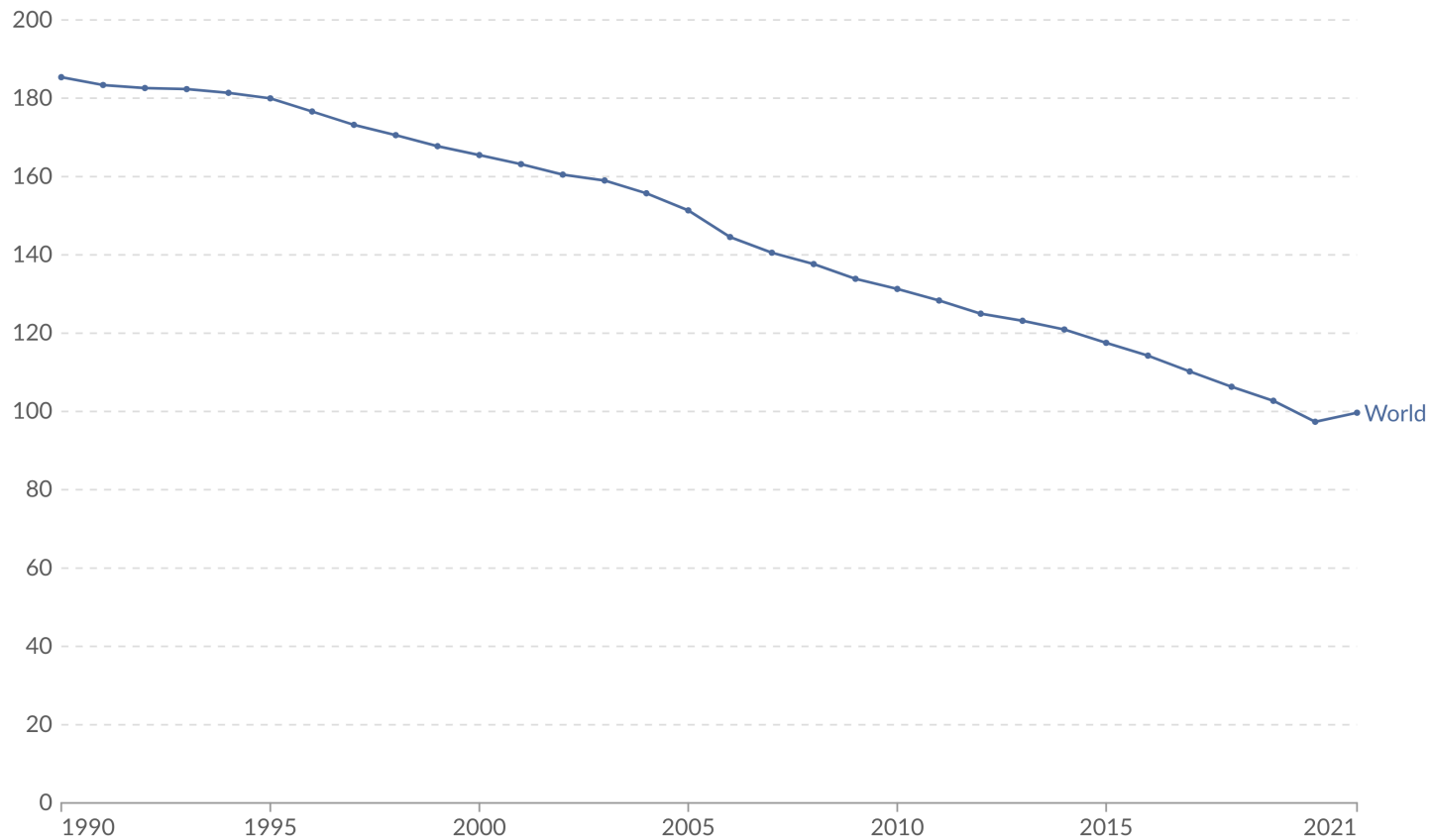
- Responsible for 11.65% of global deaths (2019).
- Higher burdens in:
  - LICs (due to indoor pollution from solid cooking fuels)
  - MICs (due to outdoor industrial pollution)
- According to WHO:
  - 2.5 billion people experience pollution levels seven times higher than guidelines.
  - 90% of urban pollution in LICs comes from poorly maintained older vehicles.



## Death rate from air pollution, 1990 to 2021

Our World  
in Data

Estimated annual number of deaths attributed to air pollution per 100,000 people.



Data source: IHME, Global Burden of Disease (2024)

OurWorldinData.org/air-pollution | CC BY

# Other Causes of Air Pollution

- Wildfires:
  - ~90% caused by humans (agricultural burning, cigarettes, campfires, arson)
  - Naturally started by lightning
  - Emit soot, dust, and toxic gases; contribute to thermal pollution
- Chemical industries:
  - Emit organic and inorganic compounds
  - Microbial decay of waste releases methane
- Construction and demolition:
  - Produce large amounts of particulate matter
  - Emissions from heavy machinery
  - Create noise and visual pollution

# Indoor Air Pollution

## Major sources

- Inefficient fuel combustion in poorly ventilated homes
- Old or poorly maintained stoves and open fires
- Tobacco smoke
- Volatile organic compounds (VOCs) from furnishings, carpets, paints, adhesives
- Certain cleaning products

# Indoor Air Pollution

- One-third of global population uses unsafe cooking fuels
- 3.2 million deaths from household air pollution in 2020
- 650 children under five die daily from household pollution
- Combined ambient + indoor pollution causes 6.7 million premature deaths annually
- Exposure linked to strokes, heart disease, pulmonary diseases, and lung cancer
- Women and children are most at risk

# Particulate Matter (PM)

- **PM<sub>10</sub>**: Particles  $\leq 10 \mu\text{m}$ ; can damage lungs or enter bloodstream
- **PM<sub>2.5</sub>**: Particles  $\leq 2.5 \mu\text{m}$ ; more hazardous due to deeper penetration
- **Health impacts depend on:**
  - Chemical composition
  - Physical properties
  - Concentration
  - Particle size
  - Duration of exposure

# Particulate Matter (PM)

## Associated health risks

- Absorption of toxic metals (cadmium, lead) → nerve/kidney damage
- Allergic reactions (sneezing, eye irritation)
- Infections from biological particles (bacteria, fungi)
- Asbestosis from asbestos fibres in old buildings
- Irritation of mucous membranes
- Increased respiratory stress and asthma exacerbation

# Group Activity – Presentation (again)

1. Select a city – preferably near us
  1. Describe the occurring urban air pollution using reported data
  2. Outline the known impacts of air pollution
  3. Discuss 5 management strategies implemented