

Air Pollution

Clean Air

Consists of

- Nitrogen 78%
- Oxygen 21%
- Argon, CO₂, Water vapor 1%

Air Pollution

- When harmful substances end up in the air at unhealthy levels
- Primarily → human activities
- BUT can come from natural sources → dust, pollen, spores
- Volcano → particles, SO₂

Types of Pollutants

- Primary Pollutant
- Secondary Pollutant

Primary Pollutants

Put into air by human activity. Examples:

- carbon monoxide (CO)
- sulfur oxides (SO_x)
- nitrogen oxides (NO_x)
- volatile organic compounds (VOCs)
- particulate matter (PM)

Major Sources of Primary Pollutants

- Stationary Sources
 - Combustion of fuels for power and heat – Power Plants
 - Other burning such as Wood & crop burning or forest fires
 - Industrial/ commercial processes
 - Solvents and aerosols
- Mobile Sources
 - Highway: cars, trucks, buses and motorcycles
 - Off-highway: aircraft, boats, farm equipment, construction machinery .

Nitrogen Dioxide (NO₂)

- **Properties:** reddish brown gas, formed as fuel burnt in car, strong oxidizing agent, forms Nitric acid in air
- **Effects:** acid rain, lung and heart problems, decreased visibility (yellow haze), suppresses plant growth
- **Sources:** fossil fuels combustion, power plants, forest fires, volcanoes, bacteria in soil
- **Class:** Nitrogen oxides (NO_x)
- **(Environmental Protection Agency) EPA Standard:** 0.053 ppm

Carbon Monoxide (CO)

- **Properties:** colorless, odorless, heavier than air, 0.0036% of atmosphere
- **Effects:** binds tighter to Hb than O₂, mental functions and visual acuity, even at low levels
- **Sources:** incomplete combustion of fossil fuels 60 - 95% from auto exhaust
- **Class:** carbon oxides (CO₂, CO)
- **EPA Standard:** 9 ppm
- 5.5 billion tons enter atmosphere/year

Suspended Particulate Matter

- **Properties:** particles suspended in air.
- **Effects:** lung damage, mutagenic, carcinogenic, teratogenic
- **Sources:** burning coal or diesel, volcanoes, factories, unpaved roads, pollen, spores, burning fields
- **Class:** SPM: dust, soot, asbestos, lead, dioxins, pesticides
- **EPA Standard:** 50 ug/m³ (annual mean)

VOCs (Volatile Organic Compounds)

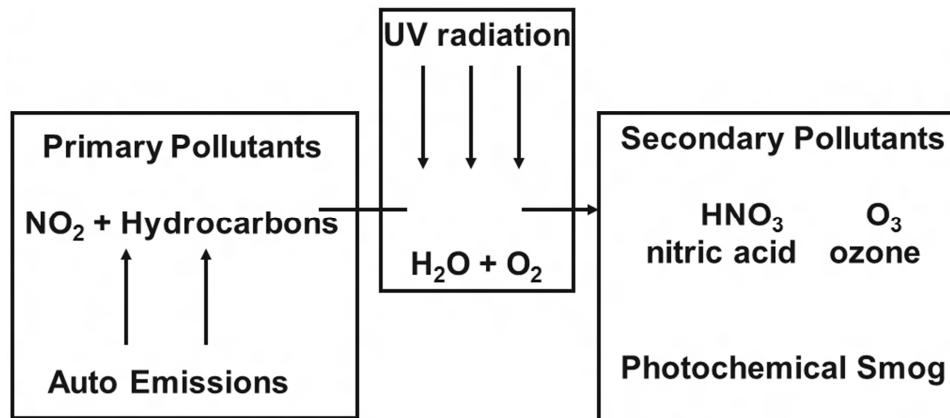
- **Properties:** organic compounds (hydrocarbons) that evaporate easily.
- **Effects:** eye and respiratory irritants; carcinogenic; liver, CNS, or kidney damage; damages plants; lowered visibility due to brown haze; global warming
- **Sources:** vehicles (largest source), evaporation of solvents or fossil fuels, aerosols, paint thinners, dry cleaning
- **Class:** HAPs (Hazardous Air Pollutants)
 - Methane
 - Benzene
 - Chlorofluorocarbons (CFCs), etc.
- Concentrations indoors up to 1000x outdoors
- 600 million tons of CFCs

Sulfur Dioxide (SO₂)

- **Properties:** colorless gas with irritating odor
- **Effects:** produces acid rain (H₂SO₄), breathing difficulties.
- **Sources:** burning high sulfur coal or oil, smelting of metals, paper manufacture
- **Class:** sulfur oxides
- **EPA Standard:** 0.3 ppm (annual mean)
- Combines with water and NH₄ to increase soil fertility

Secondary Pollutants

When a primary pollutant comes in contact with another primary pollutant OR with naturally occurring substances and a chemical reaction takes place. **Ex:** O_2 reacts w/ VOCs $\rightarrow O_3$



Pollution on Wheels

Cars/ Vehicles

- Car exhaust \rightarrow Major Source
- Gasoline burns \rightarrow NO₂, CO₂, CO, HCs released
- Fuel Tanks \rightarrow VOCs released when being filled

Industry

- Industries and power plants \rightarrow burn fossil fuels \rightarrow large amounts of oxides released

Industrial Pollution

- Electric Power plant \rightarrow 2/3 of SO₂, 1/3 NOs, 1/3 particulates
- Petroleum Refineries \rightarrow Use VOCs \rightarrow crude oil to gasoline
- Auto & Airplane \rightarrow VOCs when painting

Thermal Inversion

- Cool air traps pollution because air above is warmer.

Effects on Human Health

Diseases Linked to Pollution

- Chronic Bronchitis
- Asthma
- Emphysema
- Lung Cancer

Possible Health Effects

- Pollution aggravates existing respiratory diseases.
- Death \rightarrow resp. disease, not air pollution.
- Who is at RISK?
- Old, Young, Smokers,
- People with lung & heart disease

Body's Defense

The body has natural defenses

- Skin, hairs in the nose, mucus, cilia in the respiratory tract → sneezing & coughing
- Immunity
- Pollution breaks down body's natural defenses

Indoor Air Pollution

- Is it safer indoors or outdoors? We live 70% - 98 % of our time indoors

Indoor Air → High pollution

WHY?

- Many home products give off fumes
- Air circulation is poor
- Buildings are tightly sealed → open windows pollution will circulate & move out.

Sick Building Syndrome

Buildings

- Have poor air quality
- Are tightly sealed to keep out heat
- Occupants have persistent symptoms that disappear when they go outside

Main Indoor Pollutants

1. Formaldehyde, a toxic gas, emitted from furniture, carpets, plywood, cabinets, and countertops. ½ mobile homes have high levels
2. Asbestos → fibers containing silica stick to lungs & cause scarring when inhaled → ASBESTOSIS (difficulty breathing & death due to heart failure). Asbestos → insulation, floor tiles, ceilings, fire proof materials.
3. Radon Gas: colorless, odorless, radioactive gas → radium in soil breaks down and enters homes through basements
 - Sticks to air & enters persons lungs
 - Long exposure → cancer
4. Microorganisms
 - Ex: bacteria, fungi and mold stick to ventilation ducts
5. Cigarette smoke
 - Deadliest of all → particulates, gases and other chemicals

Controlling Air Pollution

1. Regulate emissions ↓
2. Use unleaded gasoline.
3. Catalytic converters → exhaust becomes less harmful
4. Alternative fuels → solar, battery, H₂ Nat. Gas, Ethanol