Today, we will:

- Discuss various ways the EPA **classifies** air pollutants
- Discuss **CAPs**, **HAPs**, and **NAAQS**
- Discuss the **Clean Air Act of 1970** and air pollution trends since then

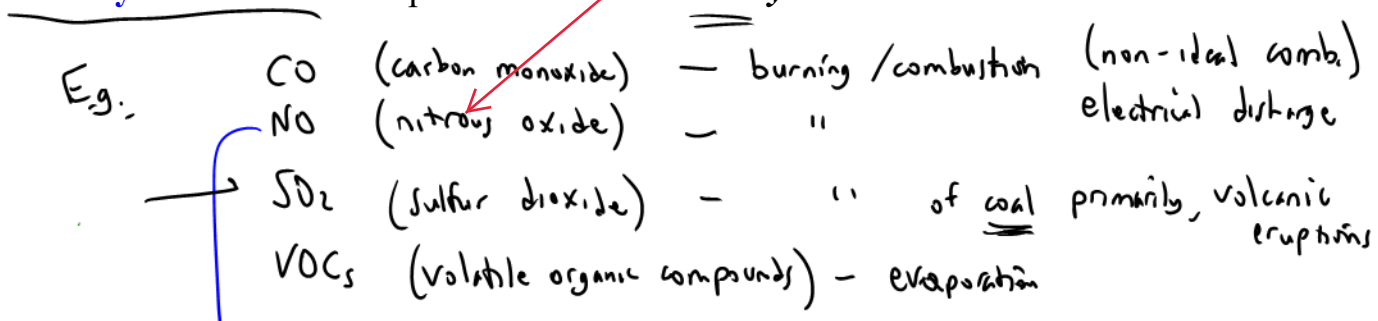
Classification of Air Pollutants: Know these terms and their definitions!

The Evironmental Protection Agency (EPA) classifies air pollutants as follows:

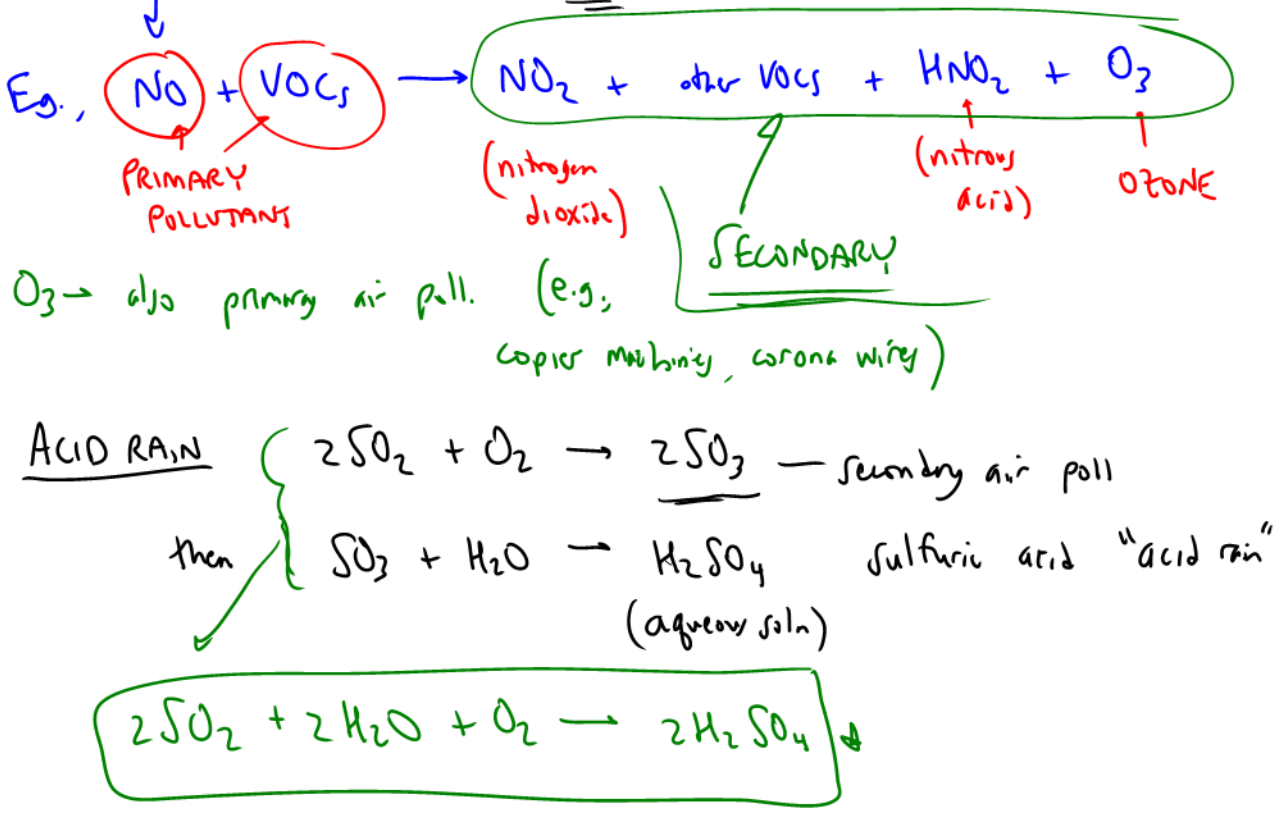
One way that EPA classifies air pollutants:

correction after the video: This is nitric oxide, not nitrous oxide

Primary Air Pollutant: A pollutant emitted ***directly*** from the source.



Secondary Air Pollutant: A pollutant ***not*** emitted *directly* from the source, but ***formed in the atmosphere by chemical reactions of primary sources***.



The EPA is concerned with *both* primary and secondary air pollutants.

A second way that EPA classifies air pollutants:

Natural Air Pollutant: A pollutant emitted by processes ***not associated with human activity***.

e.g., Volcanoes, lightning, natural fires, decaying plants/animals, ...

Anthropogenic Air Pollutant: A pollutant emitted by processes ***associated with human activity***.

e.g., Power plants, automobile exhaust, chemical production, refineries, agriculture, construction, ...

A third way that EPA classifies air pollutants:

Criteria Air Pollutants (CAPs): Pollutants for which ***National Ambient Air Quality Standards (NAAQS) exist***.
There are 7 ***original*** CAPs. Memorize these!

- CO (carbon monoxide)
- SO_2 (sulfur dioxide)
- NO_2 (nitrogen dioxide)
- O_3 (ozone)
- $PM_{2.5}$ (Particulate Matter < 2.5 microns diameter) Also called **fine particles**
- PM_{10} (Particulate Matter < 10 microns diameter) Also called **coarse particles**
- Pb (lead)

combine

greatly reduced lead in atm.

Hazardous Air Pollutants (HAPs): Pollutants on EPA's list of chemicals that are considered to be ***hazardous to your health***. EPA defines HAPs as "***pollutants that cause of may cause cancer or other serious health effects.***" See list on EPA's website at https://www.epa.gov/haps/initial-list-hazardous-air-pollutants-modifications

Initial List of Hazardous Air Pollutants with Modifications

Under the Clean Air Act, EPA is required to regulate emissions of hazardous air pollutants. This original list included 189 pollutants. Since 1990, EPA has modified the list through rulemaking to include 187 hazardous air pollutants.

CAS Number	Chemical Name
75070	Acetaldehyde
60355	Acetamide
75058	Acetonitrile
98862	Acetophenone

189 originally

187 now

Lead is only CAP that is a HAP

Clean Air Act of 1970: ☆

Legislation that established NAAQs (National Ambient Air Quality Standards) **for each of the CAPs** (Criteria Air Pollutants).

- Sets standards (maximum concentrations for healthy air) – NAAQS
- Sets criteria to pick the CAPs
  1) Anticipates to endanger public health or welfare
  2) Numerous & diverse mobile or stationary sources

NAAQS Standards: ☆

Primary standards: Standards to ***protect the health of "sensitive" populations***.

e.g., elderly, children, asthmatics

Secondary standards: Standards to ***protect the public welfare***.

e.g., visibility (see - block views)

damage to animals, vegetation, crops, buildings

EPA United States Environmental Protection Agency

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NAAQS Table

The Clean Air Act, which was last amended in 1990, requires EPA to set National Ambient Air Quality Standards (40 CFR part 50) for pollutants considered harmful to public health and the environment. The Clean Air Act identifies two types of national ambient air quality standards. ***Primary standards*** provide public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly. ***Secondary standards*** provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

The EPA has set National Ambient Air Quality Standards for six principal pollutants, which are called "criteria" air pollutants. Periodically, the standards are reviewed and may be revised. The current standards are listed below. Units of measure for the standards are parts per million (ppm) by volume, parts per billion (ppb) by volume, and micrograms per cubic meter of air ($\mu g/m^3$).

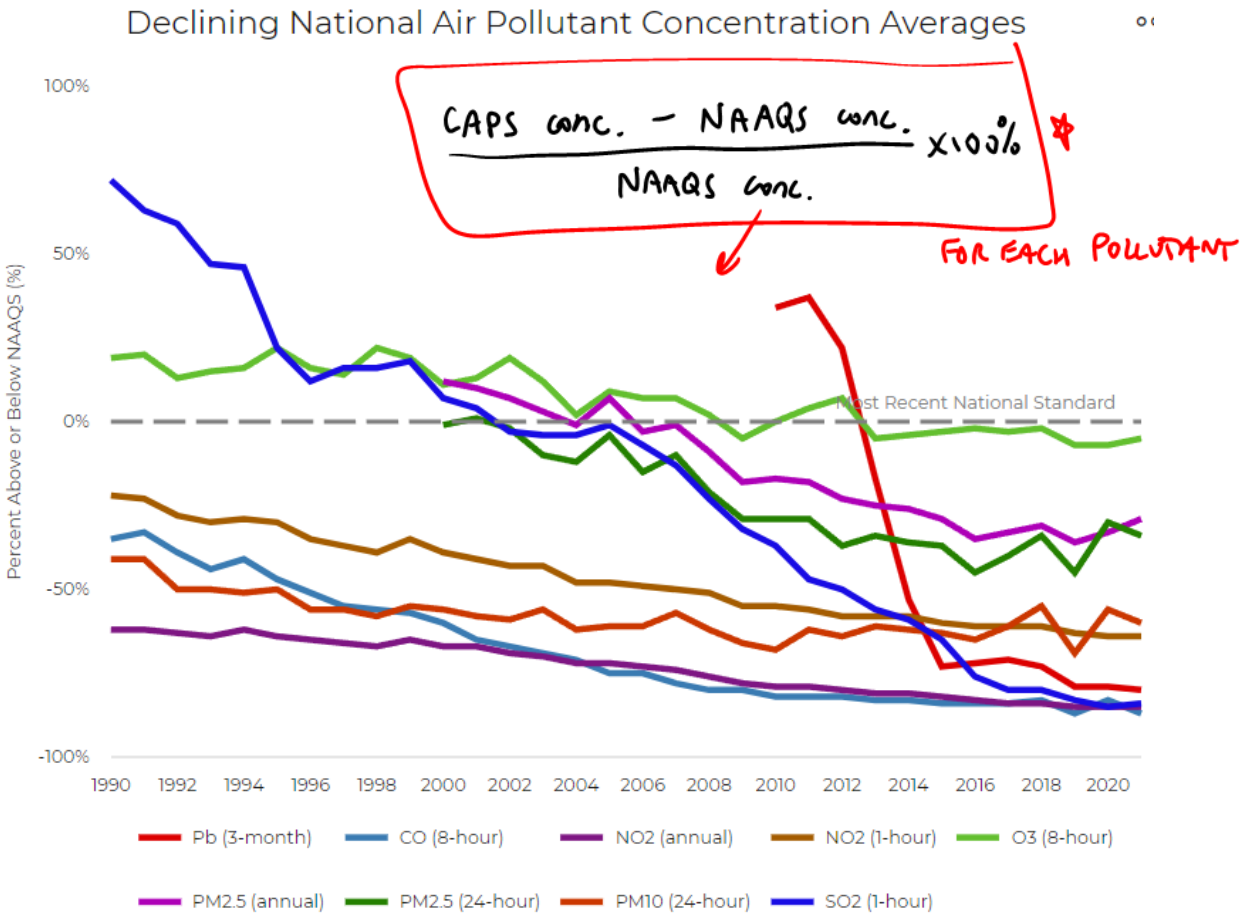
See current NAAQS table at https://www.epa.gov/criteria-air-pollutants/naaqs-table
[This one downloaded January 11, 2021] Did not change as of January 2023

Pollutant [links to historical tables of NAAQS reviews]		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide (CO)		primary	8 hours	9 ppm	Not to be exceeded more than once per year
			1 hour	35 ppm	
Lead (Pb)		primary and secondary	Rolling 3 month average	0.15 µg/m^3 (1)	Not to be exceeded
Nitrogen Dioxide (NO_2)		primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		primary and secondary	1 year	53 ppb (2)	Annual Mean
Ozone (O_3)		primary and secondary	8 hours	0.070 ppm (3)	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particle Pollution (PM)	$PM_{2.5}$	primary	1 year	12.0 µg/m^3	annual mean, averaged over 3 years
		secondary	1 year	15.0 µg/m^3	annual mean, averaged over 3 years
		primary and secondary	24 hours	35 µg/m^3	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24 hours	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (SO_2)		primary	1 hour	75 ppb (4)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

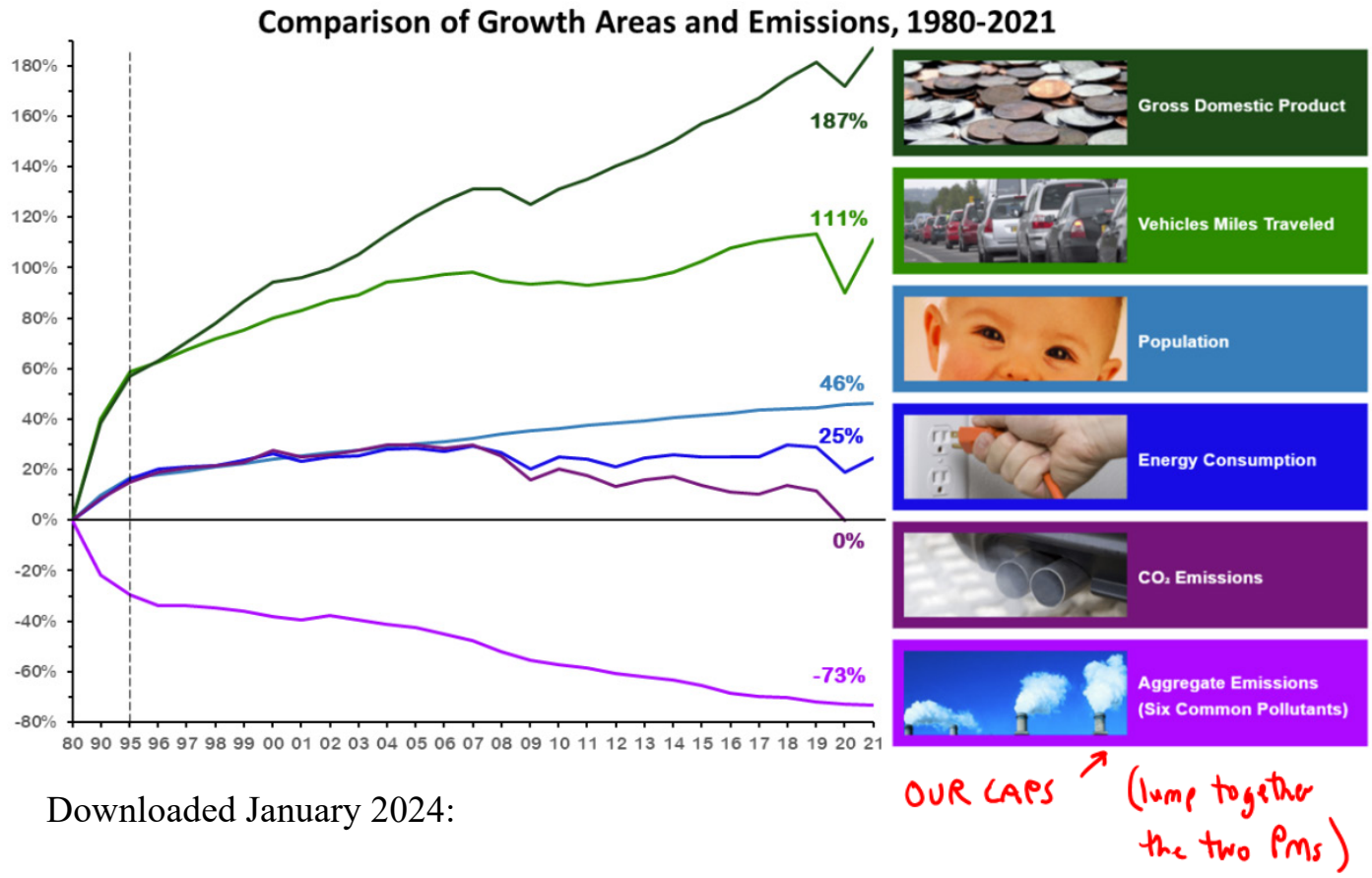
Changed to 9.0 in Feb., 2024

[Trends of Air Pollutants and Other Measures since the Clean Air Act of 1970]():

EPA plots trends each year. Here is the one downloaded on January 2023, from https://gispub.epa.gov/air/trendsreport/2022/#air_trends



The air in the USA is getting cleaner each year in spite of growth of GDP, vehicle miles traveled, and population. Here is an interesting comparison plot from EPA (downloaded January 2023 from https://www.epa.gov/air-trends/air-quality-national-summary)



OUR CAPS (lump together the two PMs)

Downloaded January 2024: