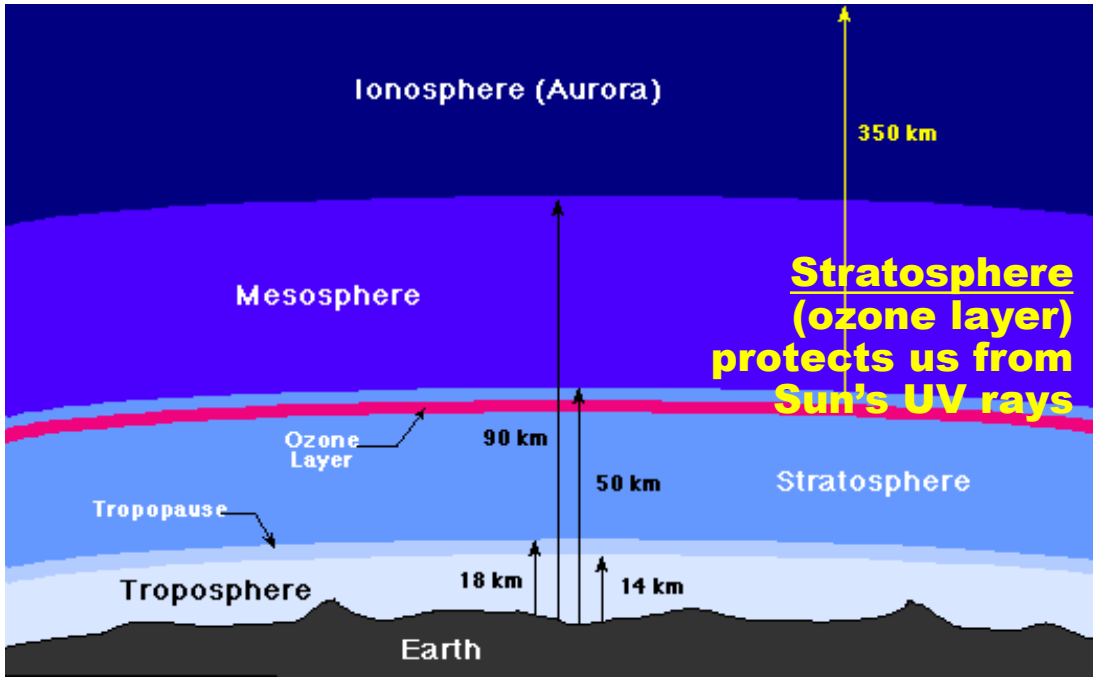
Ch. 13: Atmospheric Science & Air Pollution

The atmosphere

- **The thin layer of gases around Earth, acts as a life support system, Life can't survive without it!**
  - **Breathe, it provides oxygen! Made up of 78% nitrogen (N_2), 21% oxygen (O_2), 0.04% CO_2**
  - **Shields us from Sun's UV radiation & objects from space, holds in heat to moderate climate**
  - **Transports & recycles water, creates weather**

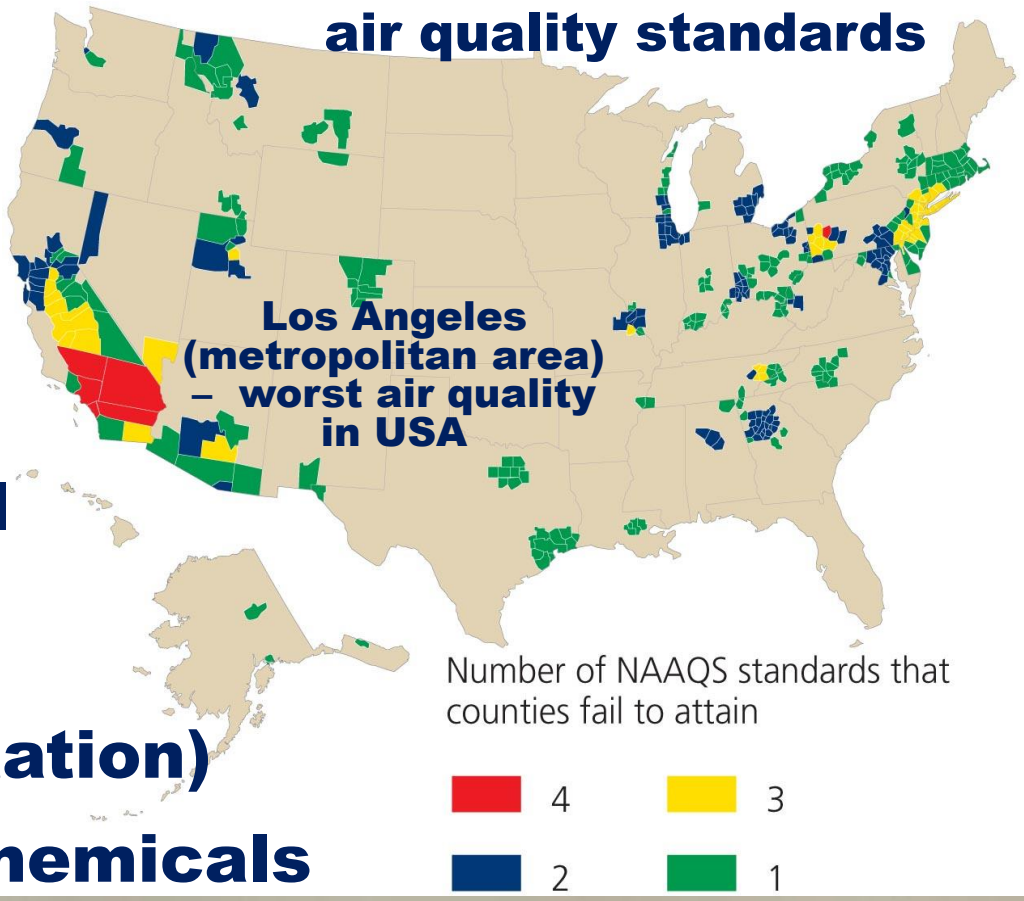
- **Human activity is changing the amount of some gases [CO_2, ozone (O_3), methane]**
- **Harms our health & other organisms, puts our life support system at risk**



We create air pollution

- **Air pollutants: gases & particulate material added to atmosphere that can affect climate or harm people & other organisms**
- **Sources: Burning Fossil Fuels (Transportation, power plants, industry)**
- **Burning wood (deforestation)**
- **Industrial & personal chemicals**

Areas in U.S. that fail air quality standards



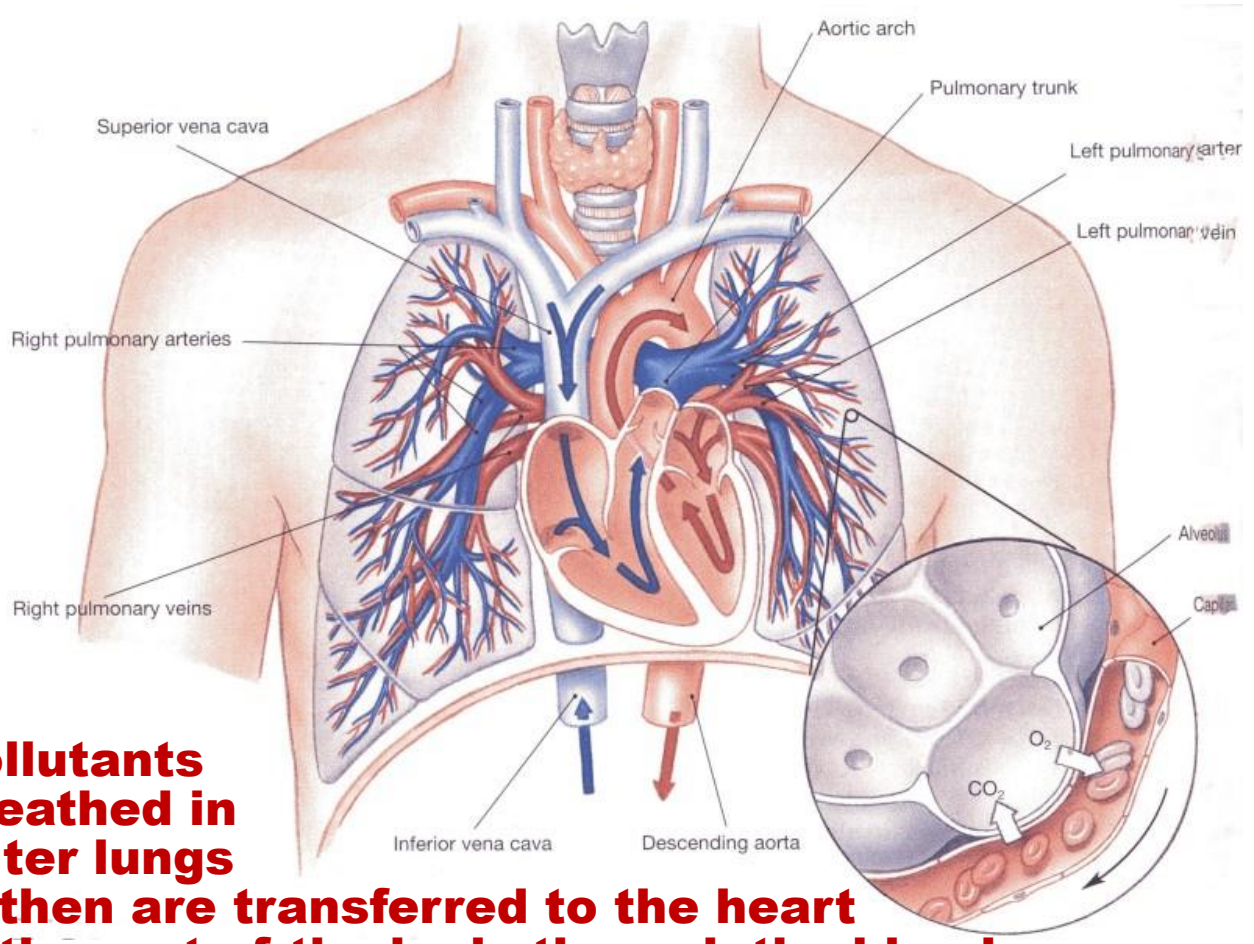
- **Agriculture (livestock – methane, soil erosion)**

Air Pollution is regulated under the U.S. EPA's Clean Air Act, State EPAs, & local agencies (CA Air Resources Board). California has strictest air quality laws in USA, which often spread to other states.

Fossil Fuels = Coal, Oil (petroleum, diesel, crude), natural gas

Health Risks

- **Cardiovascular Disease:** Arthrosclerosis, heart attack, stroke, heart failure (#1 & #3 causes of U.S. deaths)
  - –Particulates, Carbon monoxide, tropospheric ozone
  - –Can affect heart rate, blood pressure, blood vessel function, blood clotting, heart rhythm
- **Respiratory:** Lung cancer, emphysema, asthma, allergies

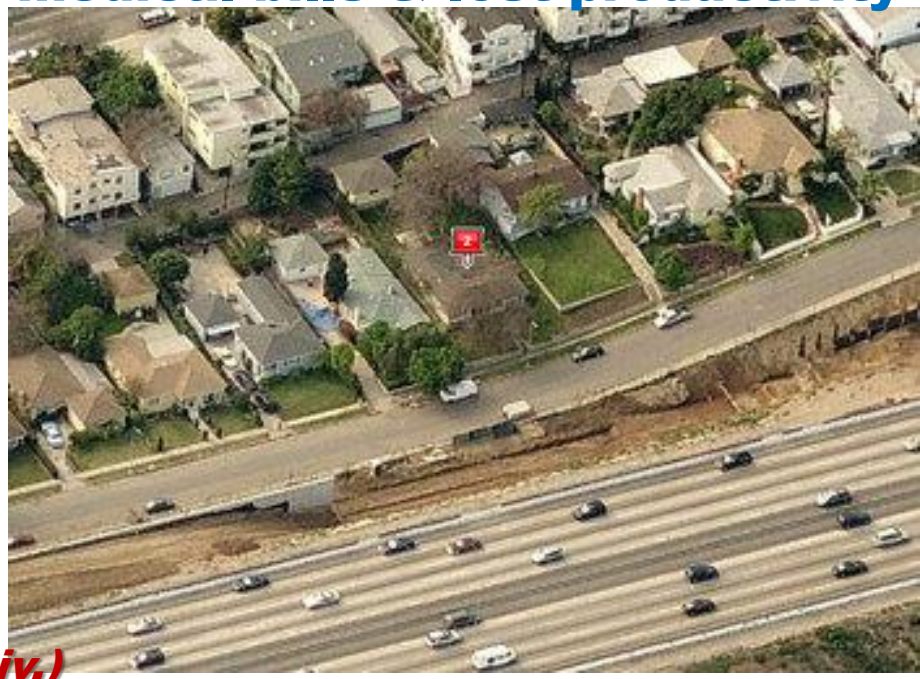


Pollutants breathed in enter lungs & then are transferred to the heart & the rest of the body through the blood

Health Risks

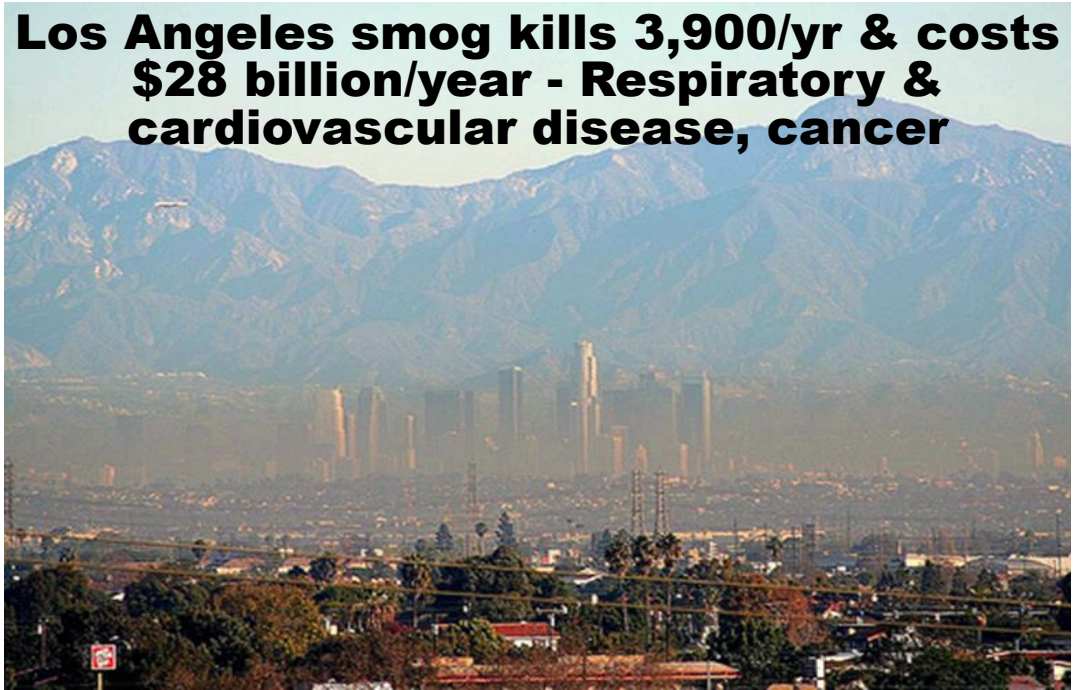
- **Nervous System:** ↓ vision, dexterity, learning, headaches, fatigue, dizziness
- **Cancer:** impacts all types (#2 cause of US death)
- **Reproductive:** infant mortality, low birth weight
- **Death: Air pollution kills 3.3 million people worldwide annually**
  - In USA, power plants & traffic emissions are leading causes of air pollution deaths
  - Switching to renewable energy would save California $127.9 billion by 2050 from prevented deaths & illness *(Stanford Univ.)*

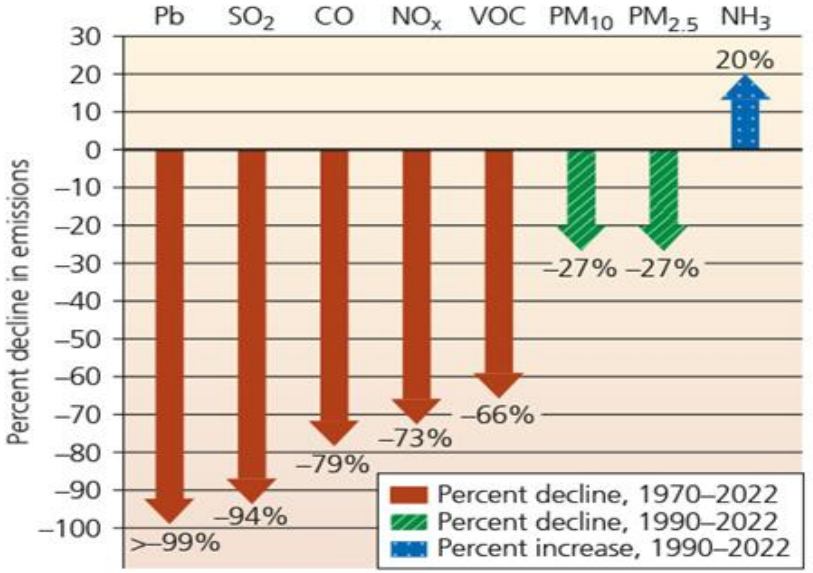
Air pollution kills 3,000/year in Hong Kong, costs $5 billion/year in medical bills & lost productivity



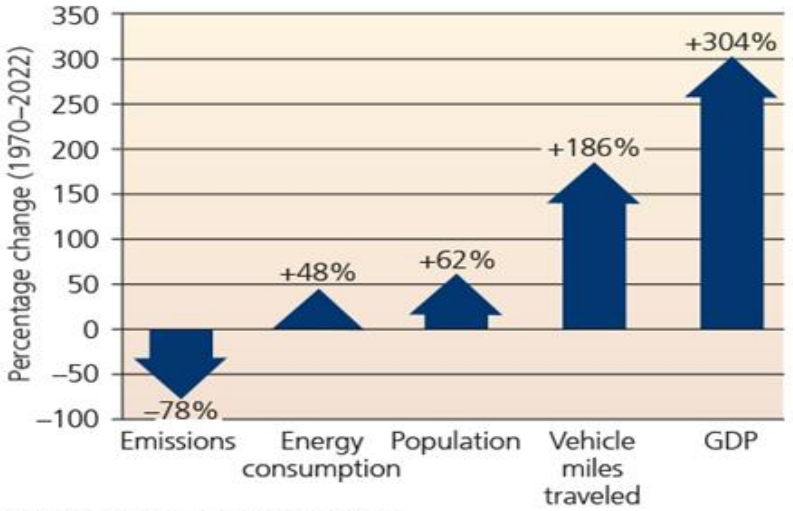
We have reduced air pollution

- **Total emissions of the 6 monitored pollutants have declined 60% since Clean Air Act of 1970**
  - **Despite increased population, energy consumption, miles traveled, & gross domestic product**
  - **Economy (GDP) improved while emissions reduced**





(a) Declines in eight major pollutants

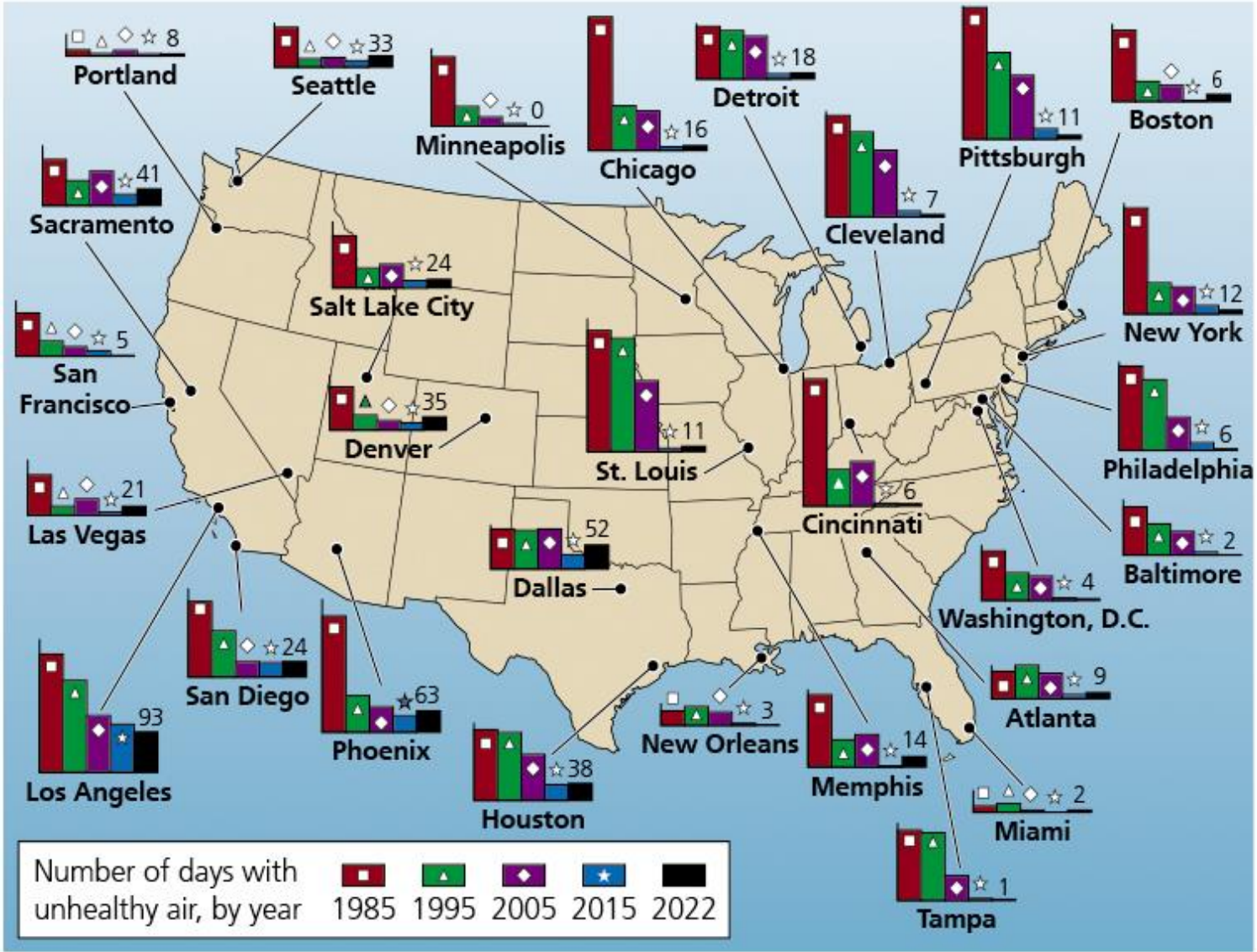


(b) Trends in major indicators

Air Quality Has Improved Dramatically

Overall, concentrations of criteria air pollutants across USA have steadily fallen since 1980

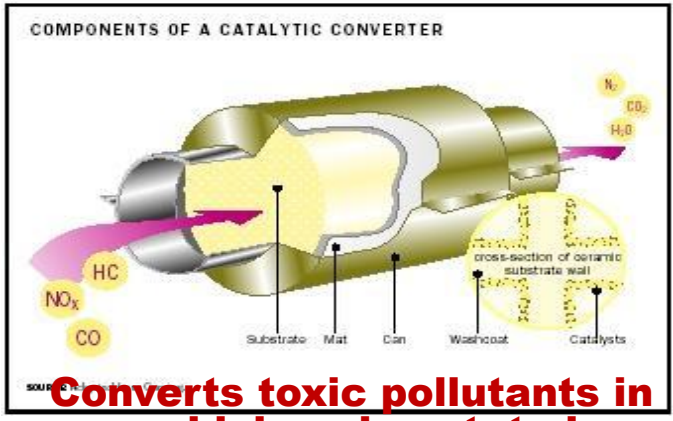
In most U.S. cities, air has become cleaner, but in places with population increases & often limited mass transit, it is rising again



Pearson

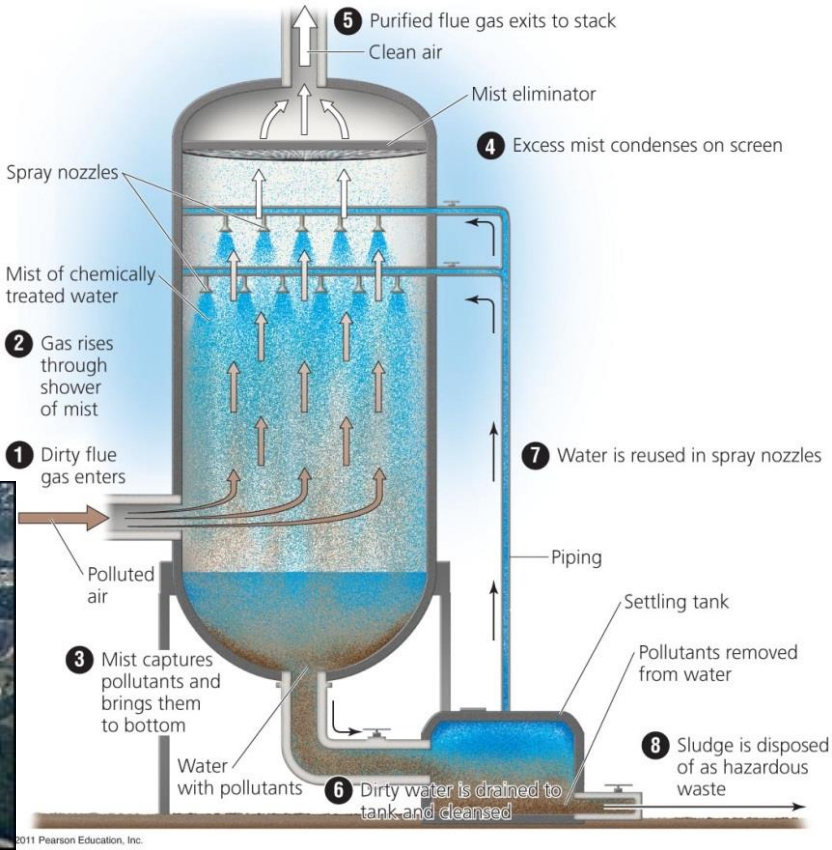
How we reduced emissions

- Technology & federal policies
- Cleaner-burning engines & catalytic converters on cars

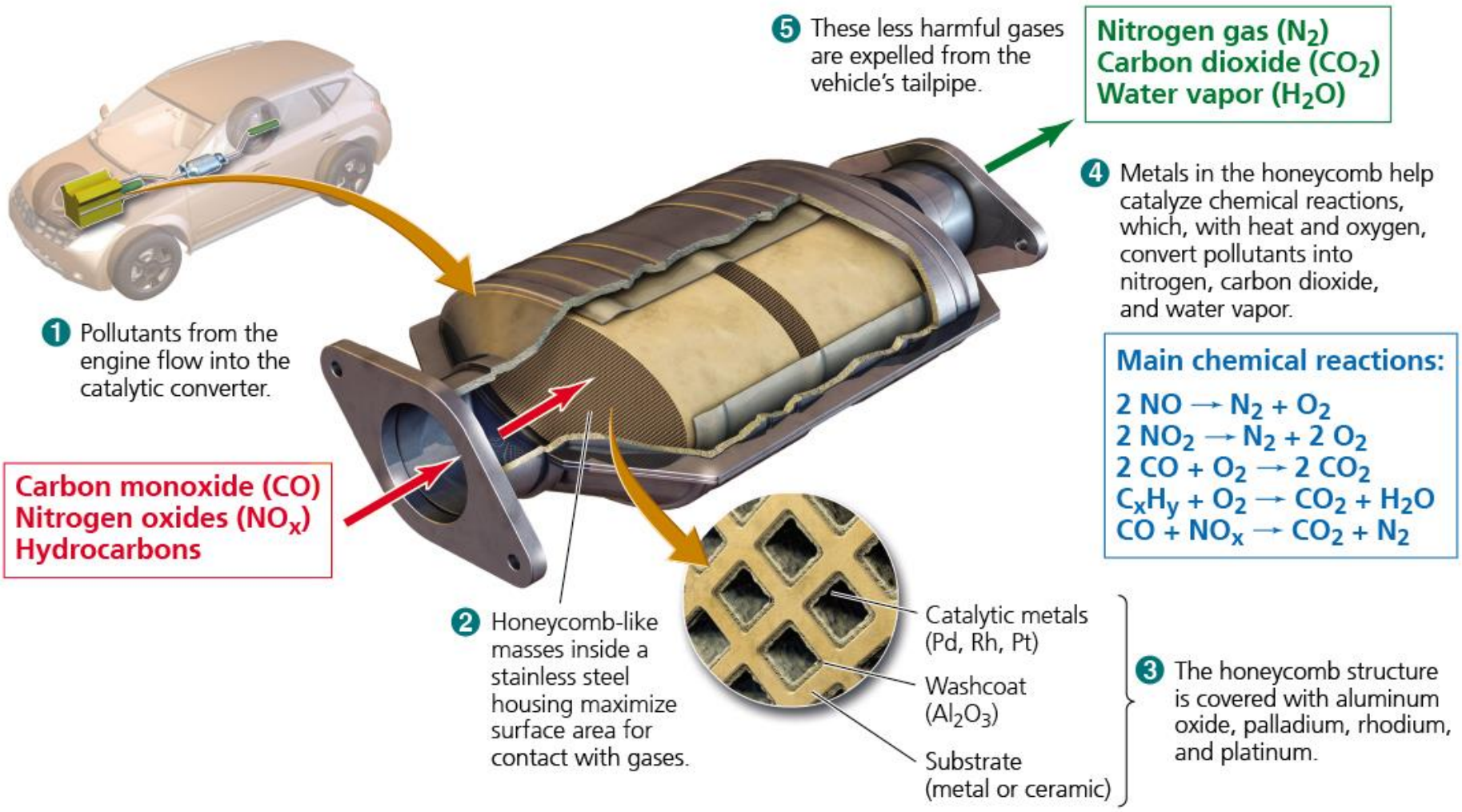


Converts toxic pollutants in vehicle exhaust to less toxic substances

- Permit-trading programs & clean coal technologies reduce sulfur emissions
- Scrubbers: chemically convert or physically remove pollutants before they leave smokestacks
- Phase-out of leaded gasoline
- Gas caps, DMV emissions testing



We Have Reduced Emissions



Catalytic converters improve air quality by filtering pollutants from vehicle exhaust.

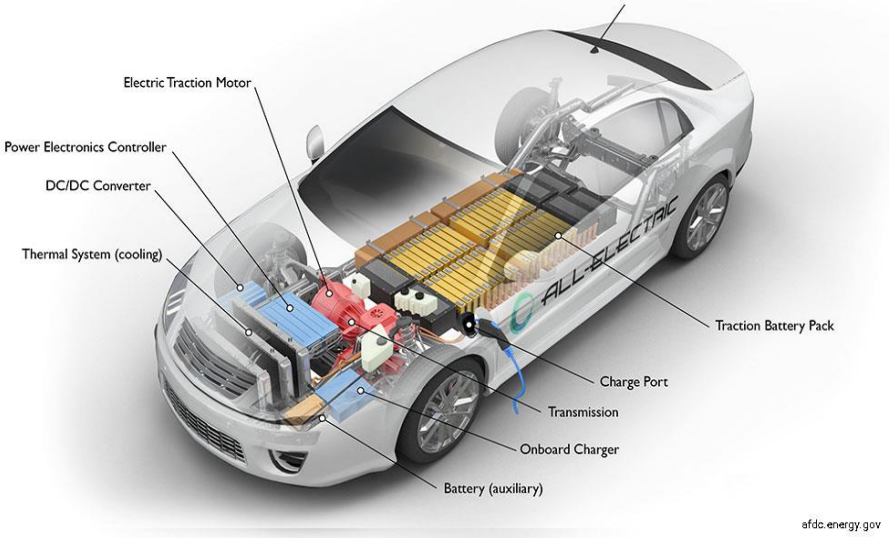
Air Pollution Solutions

- **Vehicle technology & increased fuel efficiency:**
  - **Hybrid, plug-in, & electrics, low-sulfur diesel, better batteries, hydrogen fuel cells**

Toyota, Honda, Nissan, & Hyundai released 1st hydrogen cars in 2015

- **Renewable Energy (Wind, solar, geothermal, wave, biodiesel from algae, food or plant waste) + energy storage for renewables**
- **Mass transit**
- **Conserve Energy**
- **Efficient electronics (LED & halogen lights)**
- **Decrease wood burning (deforestation)**

Electric vehicles



We've got more work to do!

We saw how good air quality could be during Covid!