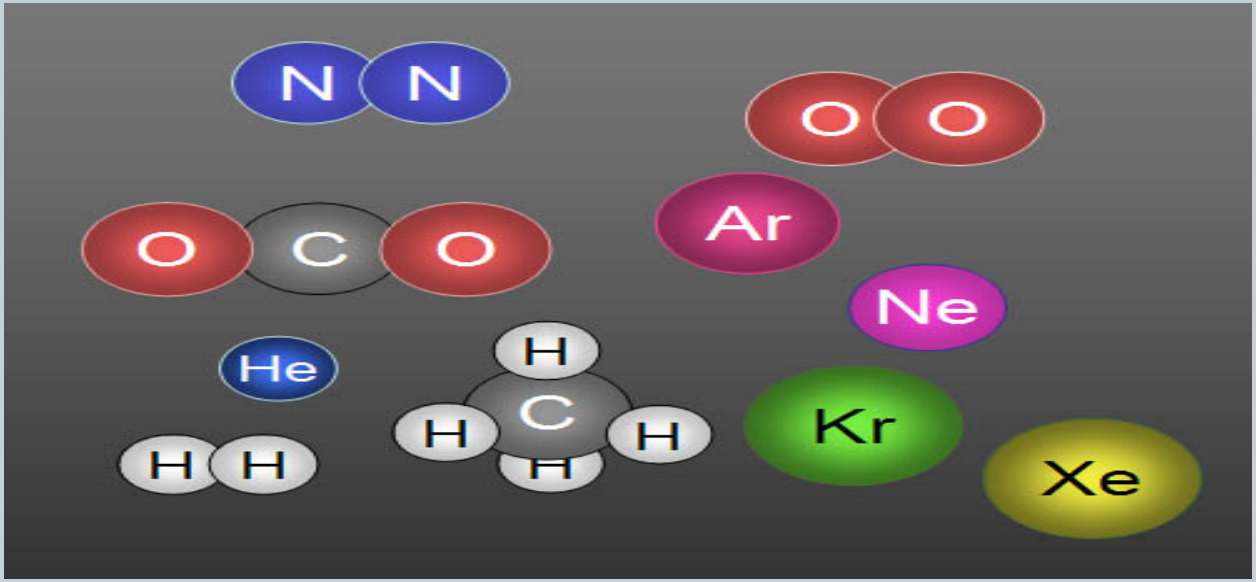
Air Pollution

CHAPTER 12

What Causes Air Pollution?

- Harmful substances that build up in the air to unhealthy levels.

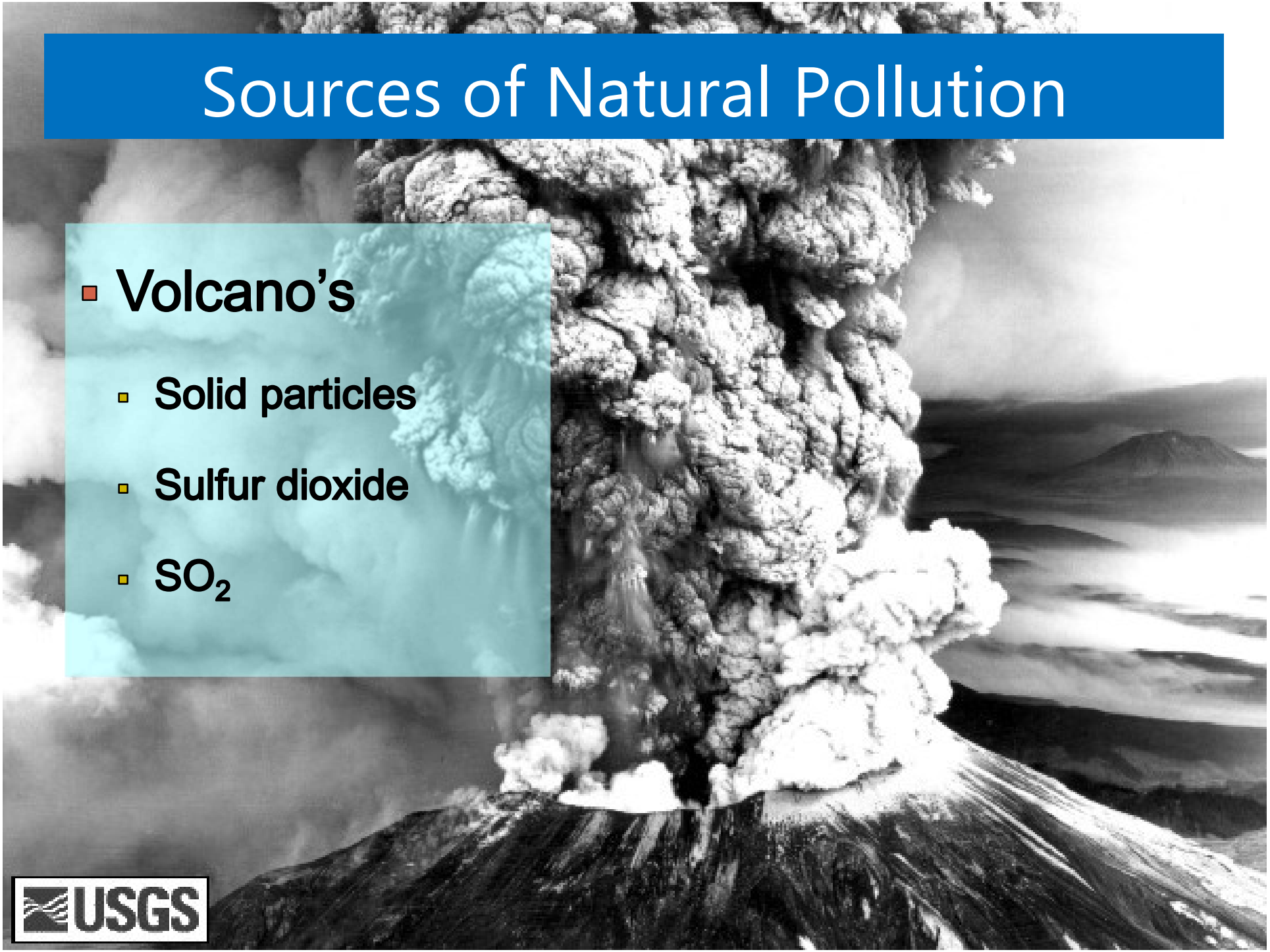
Air Composition



- 78% nitrogen
- 21% oxygen
- 1% other gases

Most pollution result of: human activity

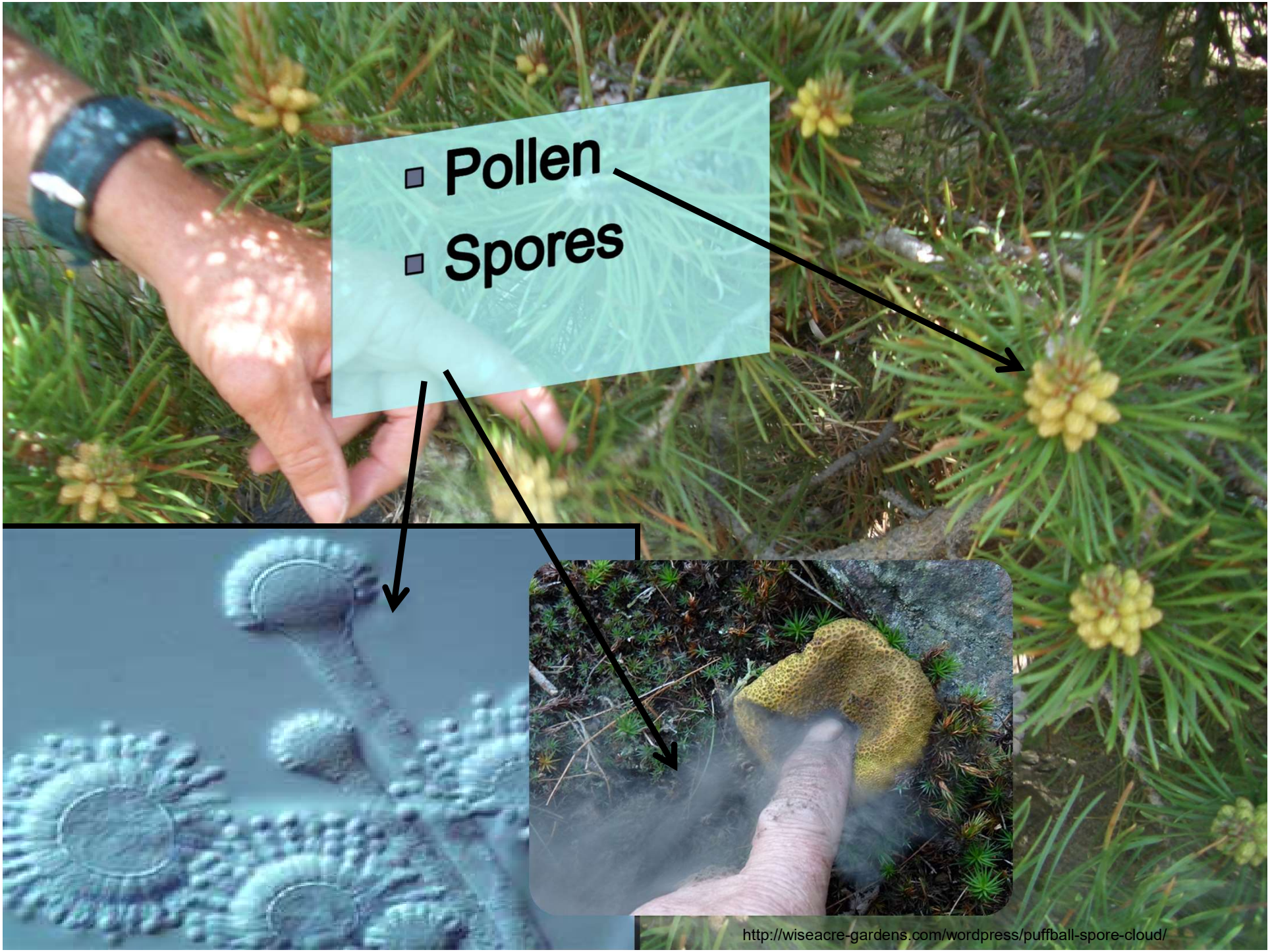
Sources of Natural Pollution



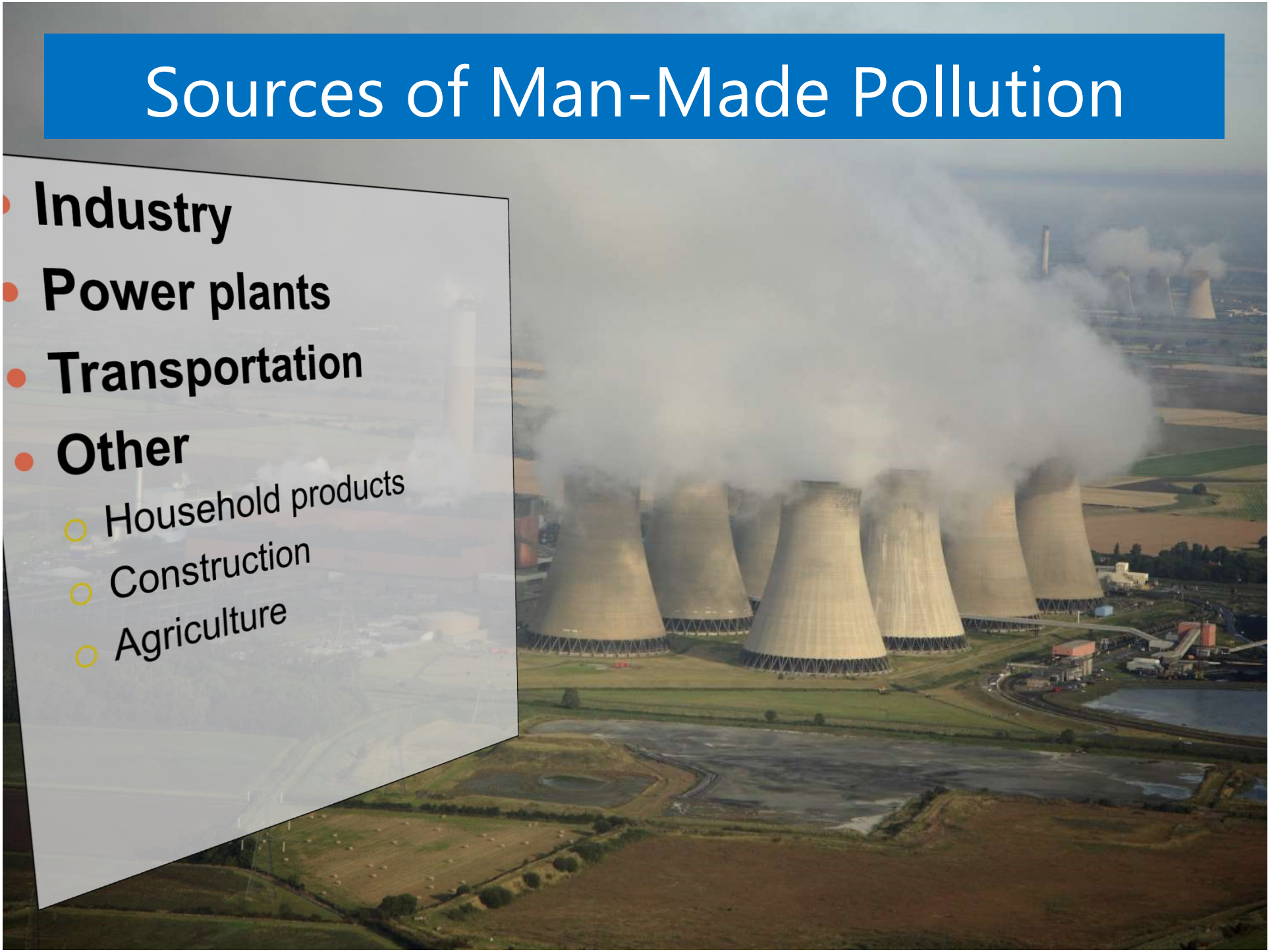
- Volcano's
  - Solid particles
  - Sulfur dioxide
  - SO_2

USGS


Dust
April 18, 1935
Stratford, Texas
http://commons.wikimedia.org/wiki/File:Dust-storm-Texas-1935.png


Pollen
Spores
http://wiseacre-gardens.com/wordpress/puffball-spore-cloud/

Sources of Man-Made Pollution



Types of Pollutants

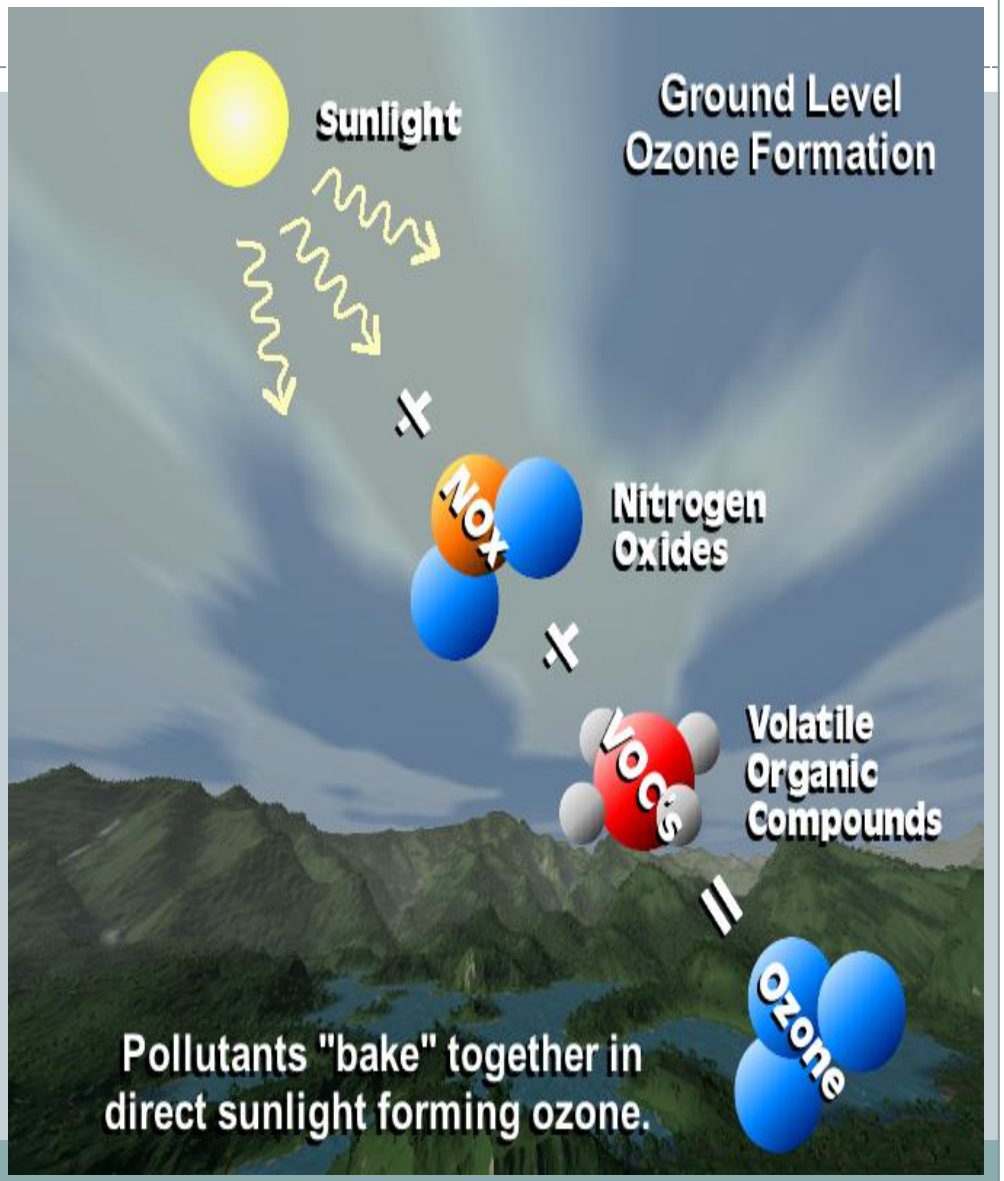
- Primary – put ***directly*** in the air by human

Soot

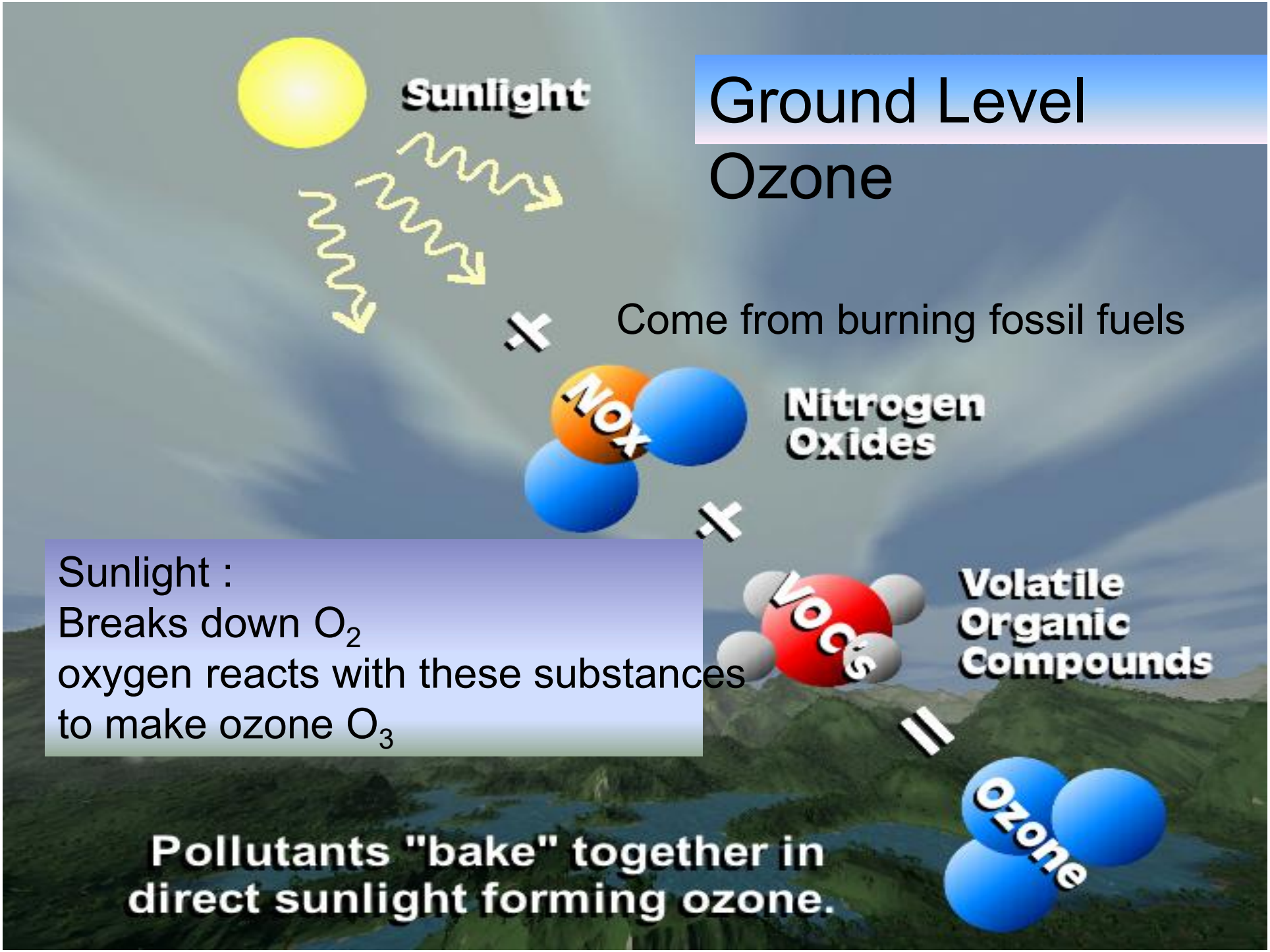
Impure Carbon from
Incomplete combustion

Types of Pollution

- Secondary – forms when
  - 1◦ pollutants reacts with 1◦ pollutants
- or with naturally occurring substances
  - Water vapor and oxygen



http://aura.gsfc.nasa.gov/outreach/garden_faq.html


Sunlight
Ground Level Ozone
Come from burning fossil fuels
NOx
Nitrogen Oxides
VOCs
Volatile Organic Compounds
Ozone
Sunlight :
Breaks down O_2
oxygen reacts with these substances
to make ozone O_3
Pollutants "bake" together in direct sunlight forming ozone.

"London Fog"

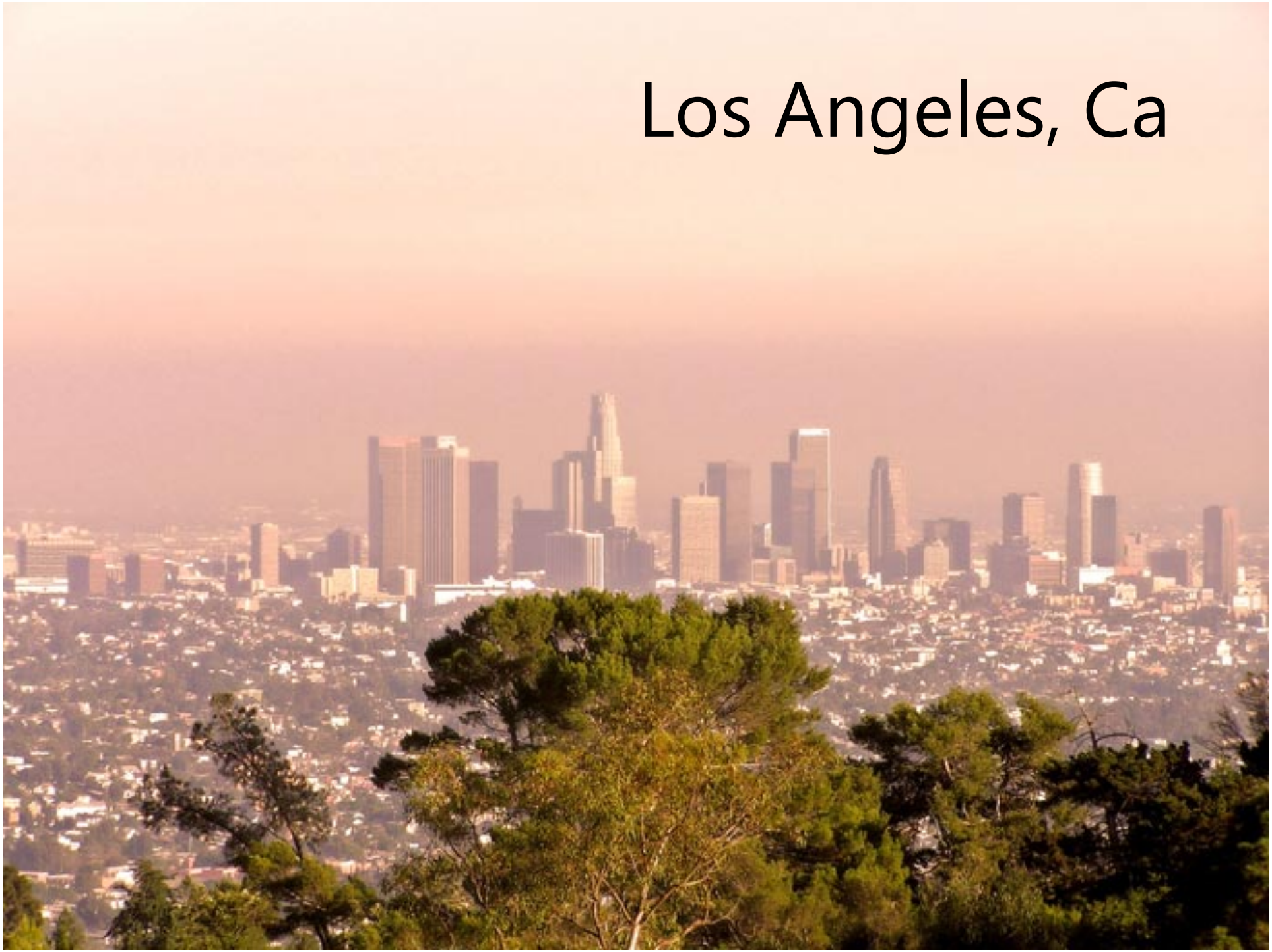
- December 5th to 9th 1952:
- Conditions:
  - Cold weather
  - No wind + anticyclone
- Airborne pollutants trapped
  - Burning coal
  - 4 000 + deaths
  - 100 000 ill cases

http://blogs.sun.com/robsblog/entry/the_great_smog_of_1952

Beijing, China

Early morning

Los Angeles, Ca



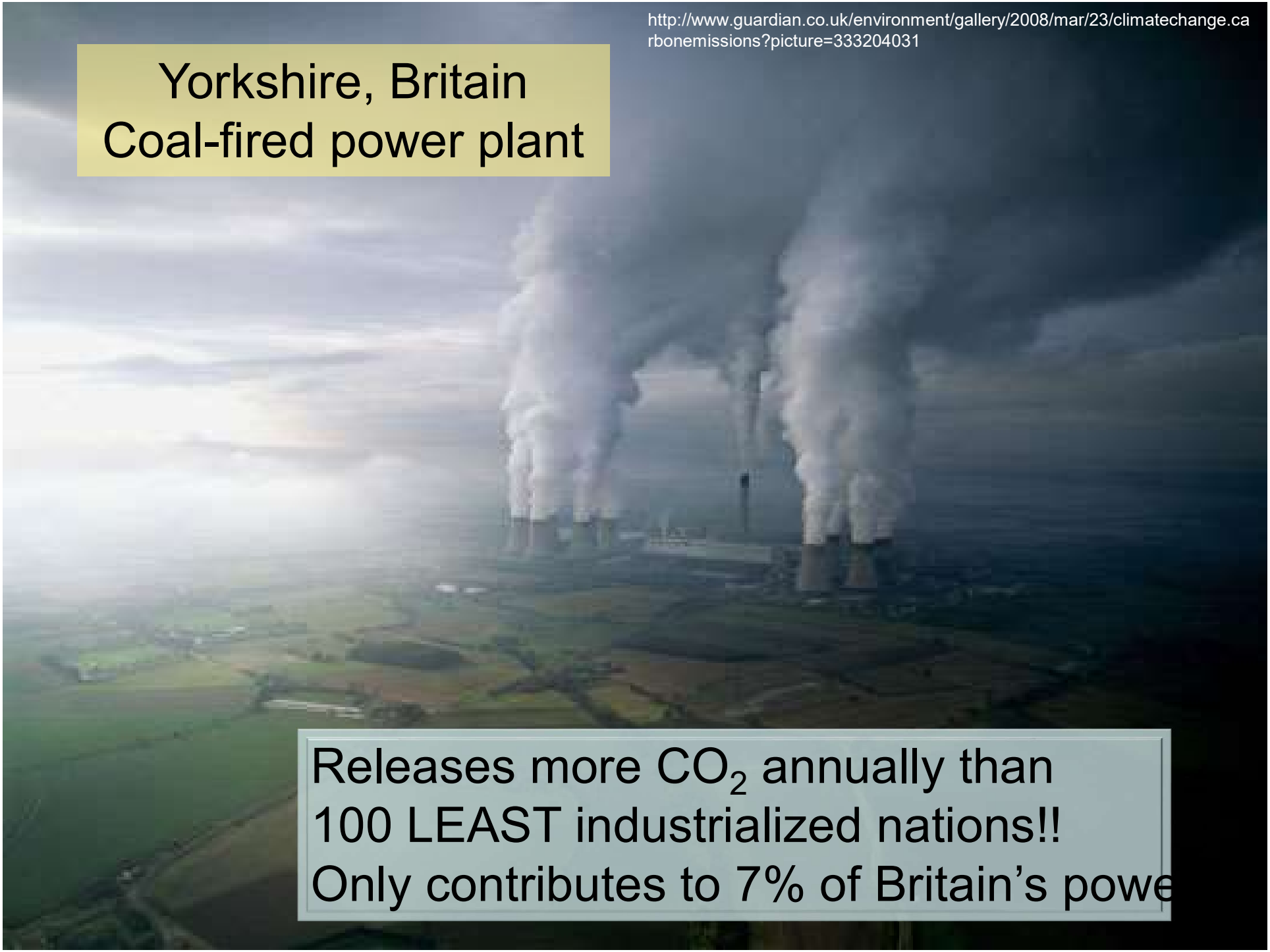
New York City

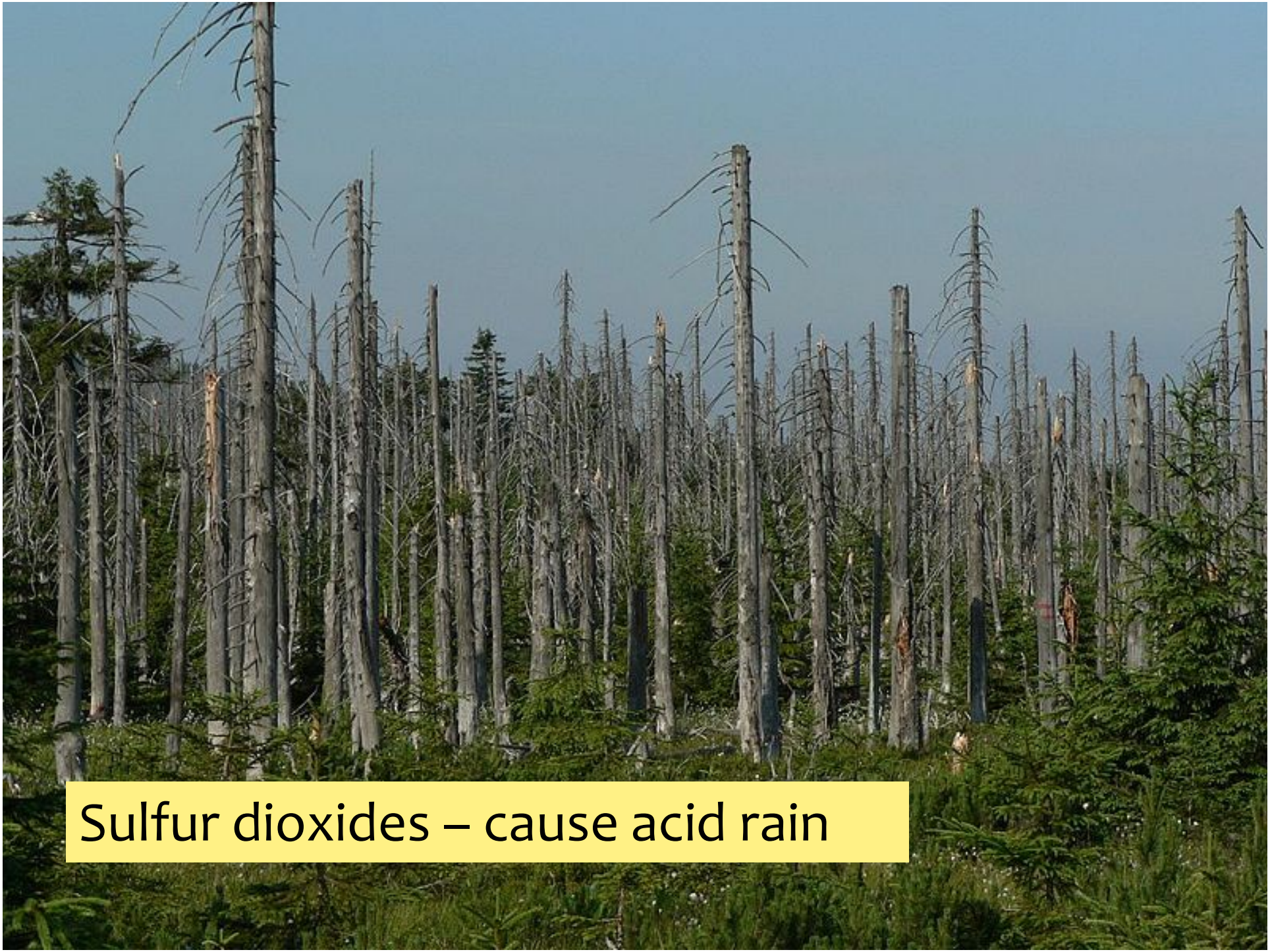
Sources of Primary Air Pollution

- Household products
- Power plants
- Motor vehicles
- Oil refineries
- Metal smelting
- Particulate Matter
  - Burned fuel from vehicles
  - Coal-burning power plants
  - Cement plants
  - Mining
  - Incinerators

FIVE Primary Air Pollutants

- Carbon monoxide (CO)
- Nitrogen oxides (NOx)
- Sulfur dioxide (SO2)
- Volatile organic compounds (VOCs)
- Particulate matter (PM)

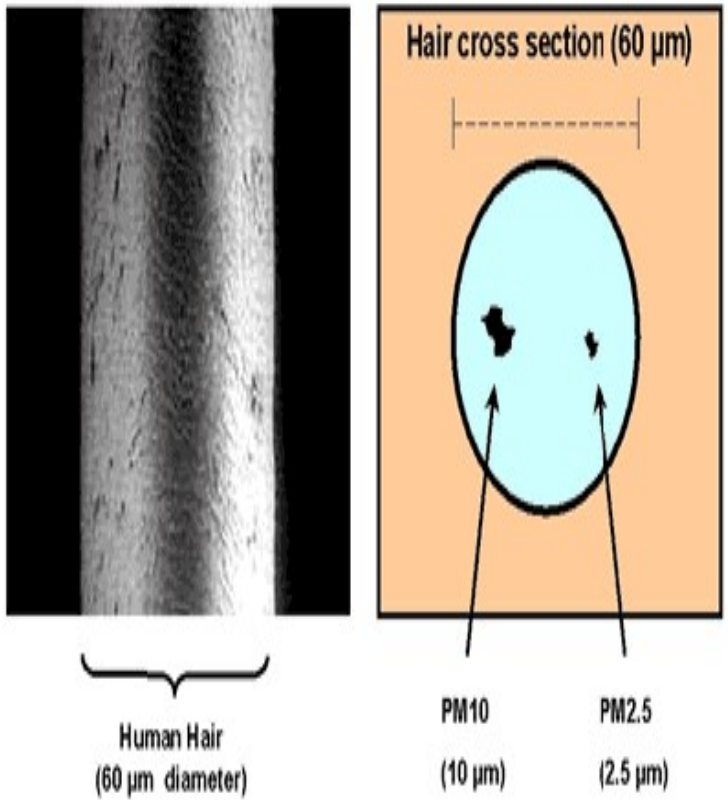

http://www.guardian.co.uk/environment/gallery/2008/mar/23/climatechange.carbonemissions?picture=333204031
Yorkshire, Britain
Coal-fired power plant
Releases more CO_2 annually than
100 LEAST industrialized nations!!
Only contributes to 7% of Britain's powe


Sulfur dioxides – cause acid rain

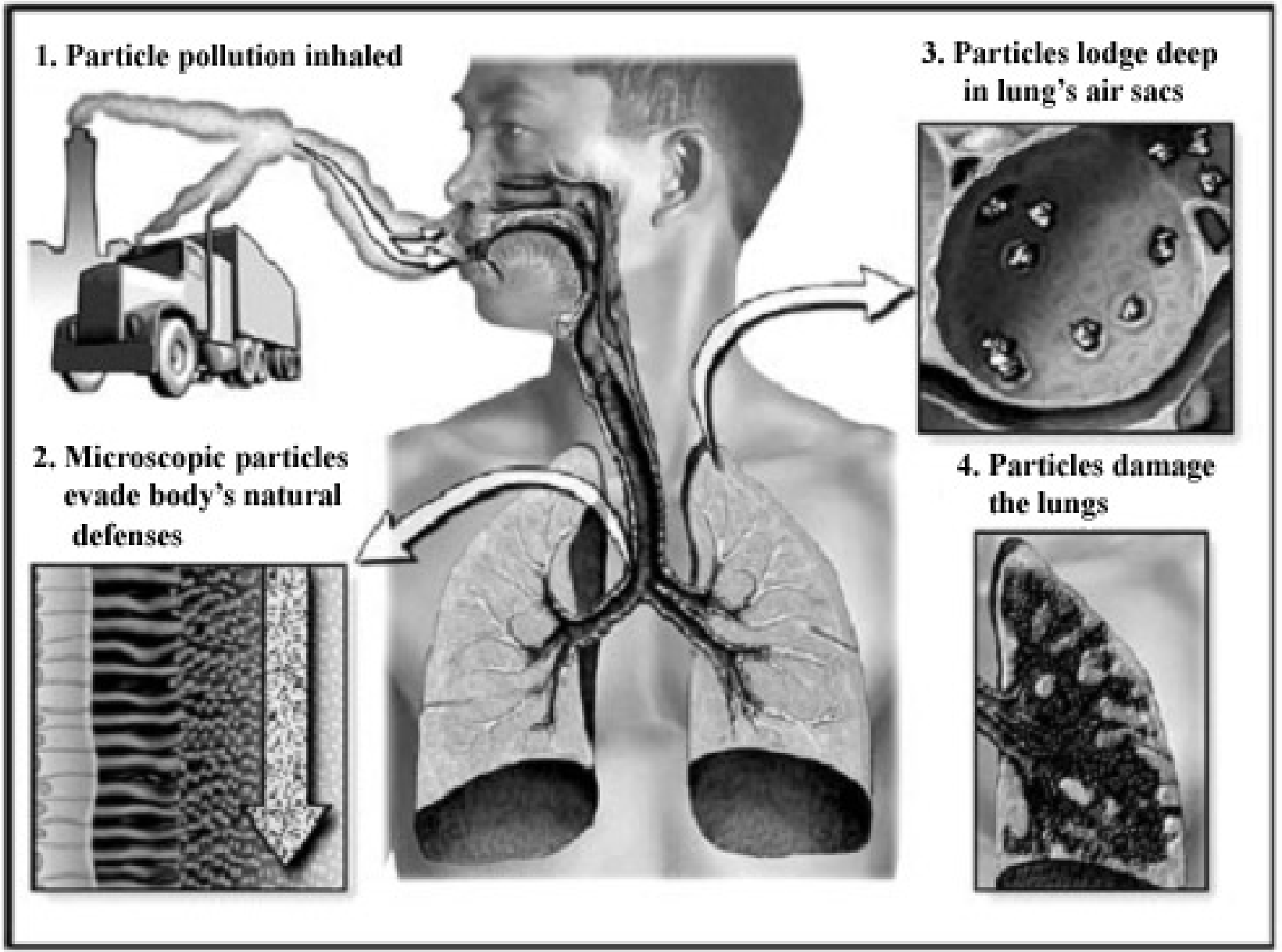
VOCs


Klean-Strip
Paint Thinner
Thins oil-based
Diluyente
DANGER!
Paint Thinner
Diluyente de Pintura

HOW SMALL IS PM?



USGS


1. Particle pollution inhaled
2. Microscopic particles evade body's natural defenses
3. Particles lodge deep in lung's air sacs
4. Particles damage the lungs

Why is the world air quality worse than previous era's?

Modern Industrial Society burn LARGE amounts of fossil fuels

Gasoline:

Contributes to 1/3rd of air pollution

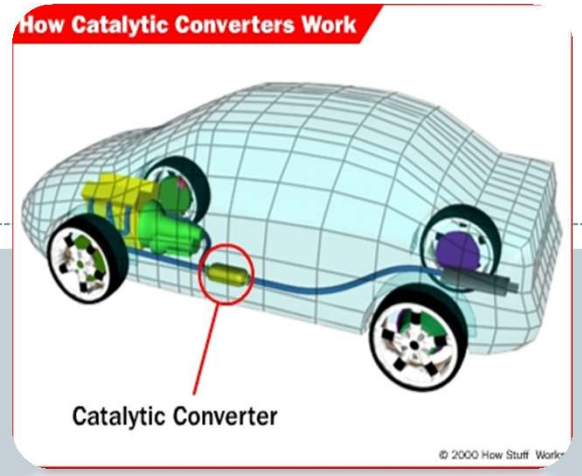
Clean Air Act (1970)

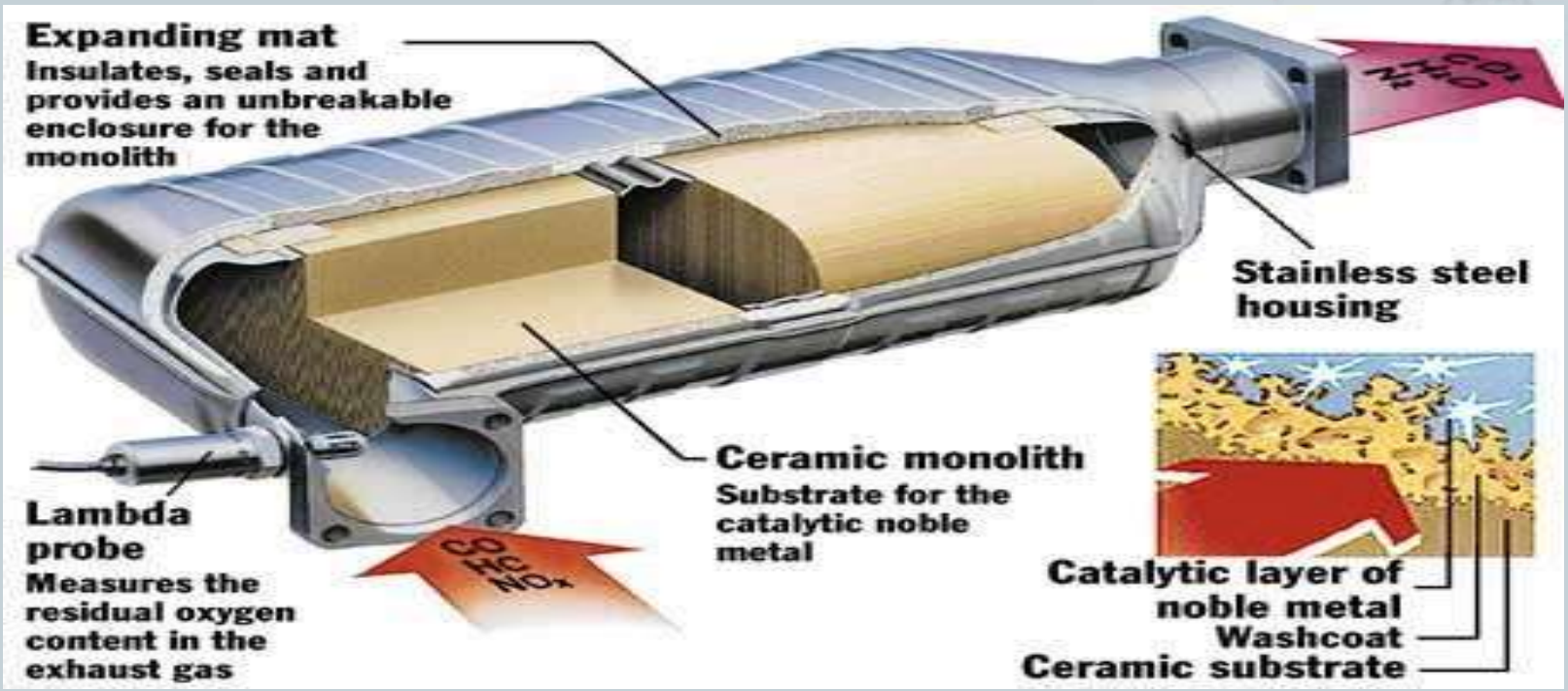
- Gives the EPA the authority to regulate vehicle emission.
- They are responsible for protecting and improving the nation's air quality and the stratospheric ozone layer.
- EPA = Environmental Protection Agency
- Eliminated lead from gasoline

http://www.epa.gov/air/caa/

Catalytic Converters

Controls emissions from vehicles





Zero Emission Vehicles

- full ZEV
- Electric car = powered by battery
  - NO tailpipe emissions
  - NO emission control systems
    - No catalytic converters

- partial ZEV
  - Hybrids – battery & gasoline
  - Methanol fuel cell = alcohol

Industrial Air Pollution

- Primary fuel source
  - fossil fuel
  - Release sulfur oxides and nitrogen oxides
- VOC's
  - Chemical compounds that form toxic fumes
- Examples:
  - Refineries
  - Chemical manufacturers
  - Paint and refinishing facilities
  - Dry cleaners

Regulating Air Pollution from Industry

The Clean Air Act requires industries to use

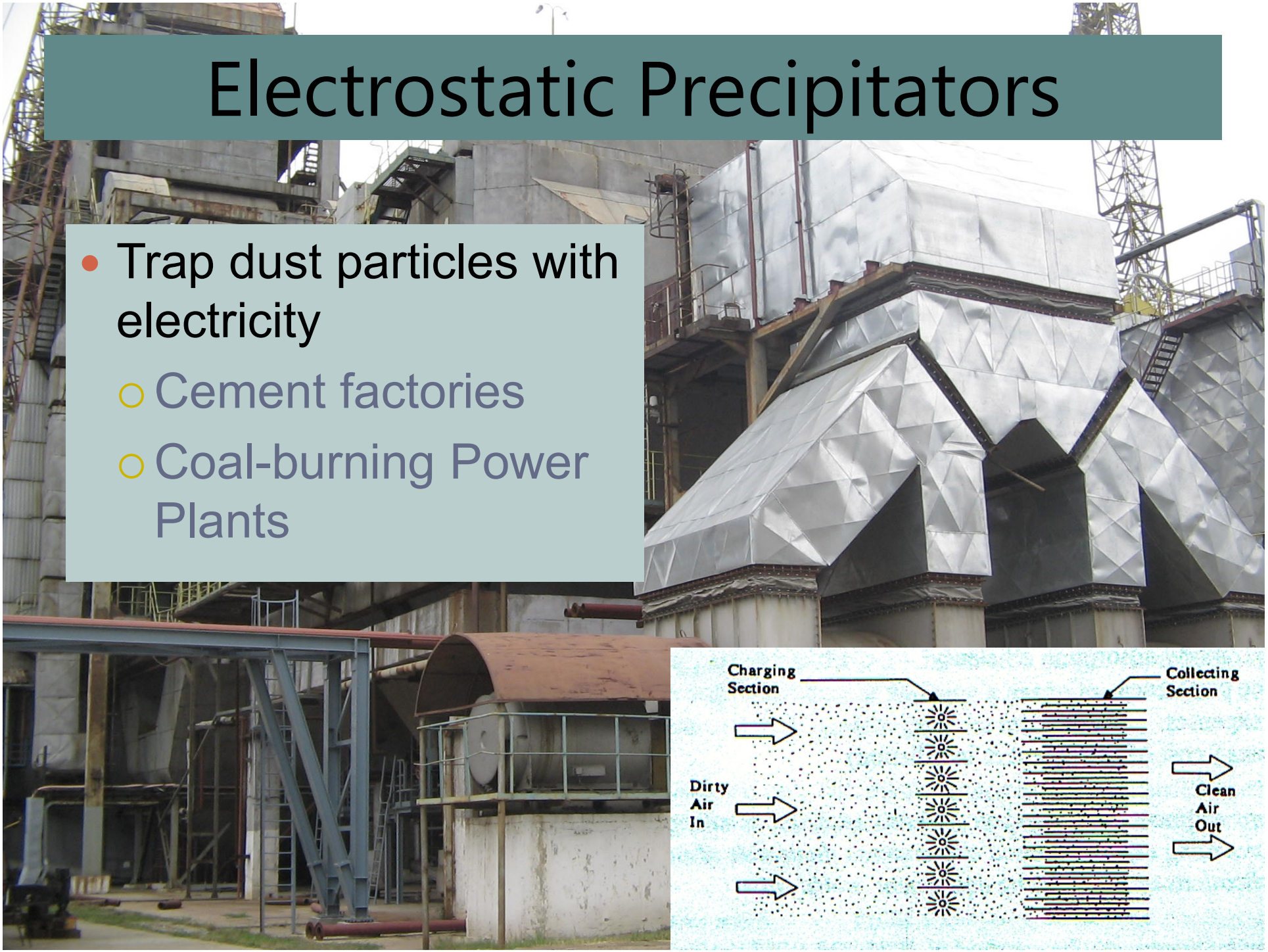
- Scrubbers
- Other pollution-control devices

Cleaning Industrial Pollution

- **Scrubber** – a machine that moves gases through a spray of water to dissolve pollutants

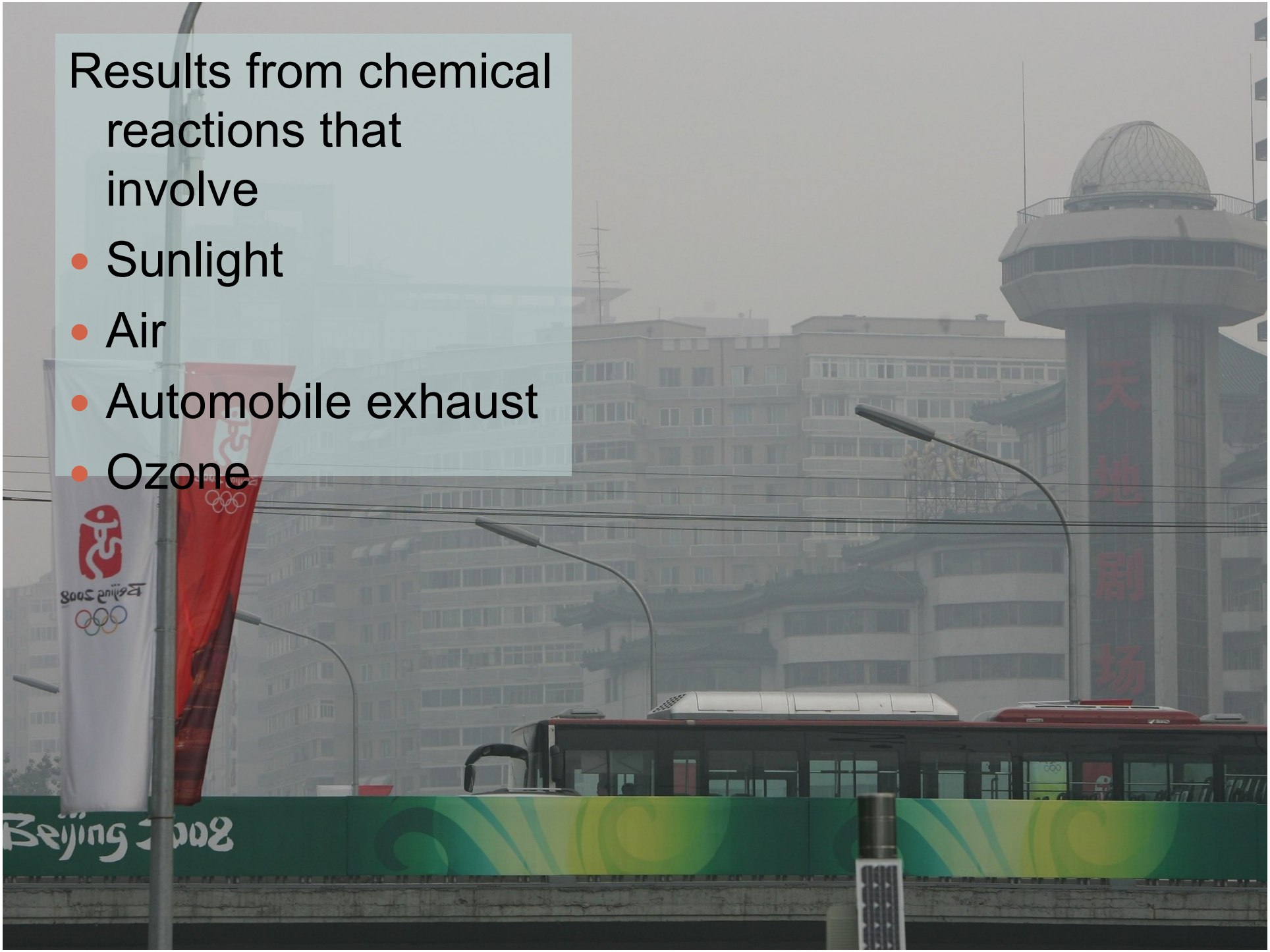
Electrostatic Precipitators

- Trap dust particles with electricity
  - Cement factories
  - Coal-burning Power Plants



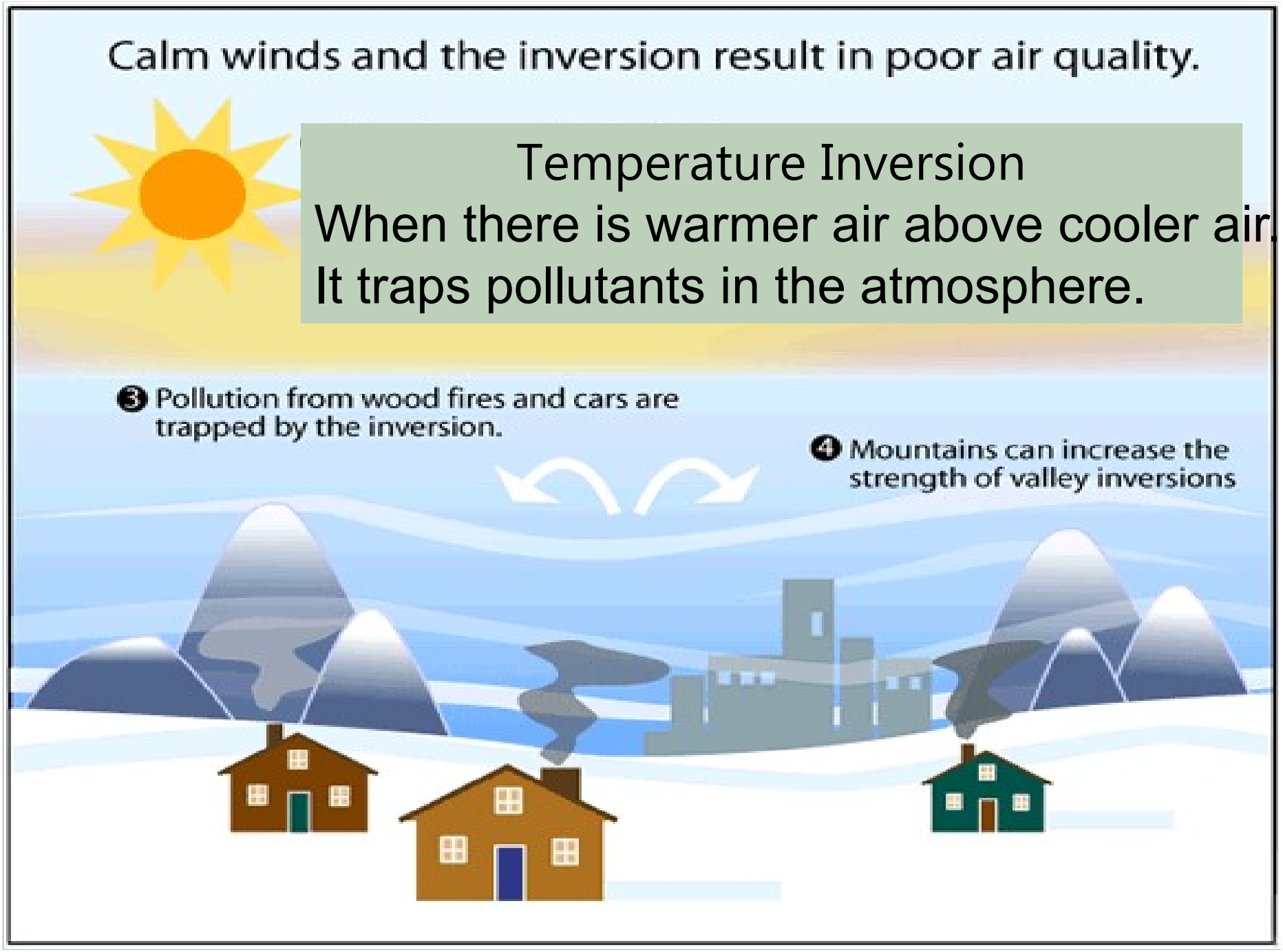
Smog

When air pollution hangs over urban areas and reduces visibility



Results from chemical reactions that involve

- Sunlight
- Air
- Automobile exhaust
- Ozone


Calm winds and the inversion result in poor air quality.
Temperature Inversion
When there is warmer air above cooler air.
It traps pollutants in the atmosphere.
❸ Pollution from wood fires and cars are trapped by the inversion.
❹ Mountains can increase the strength of valley inversions

Air , Noise and Light Pollution

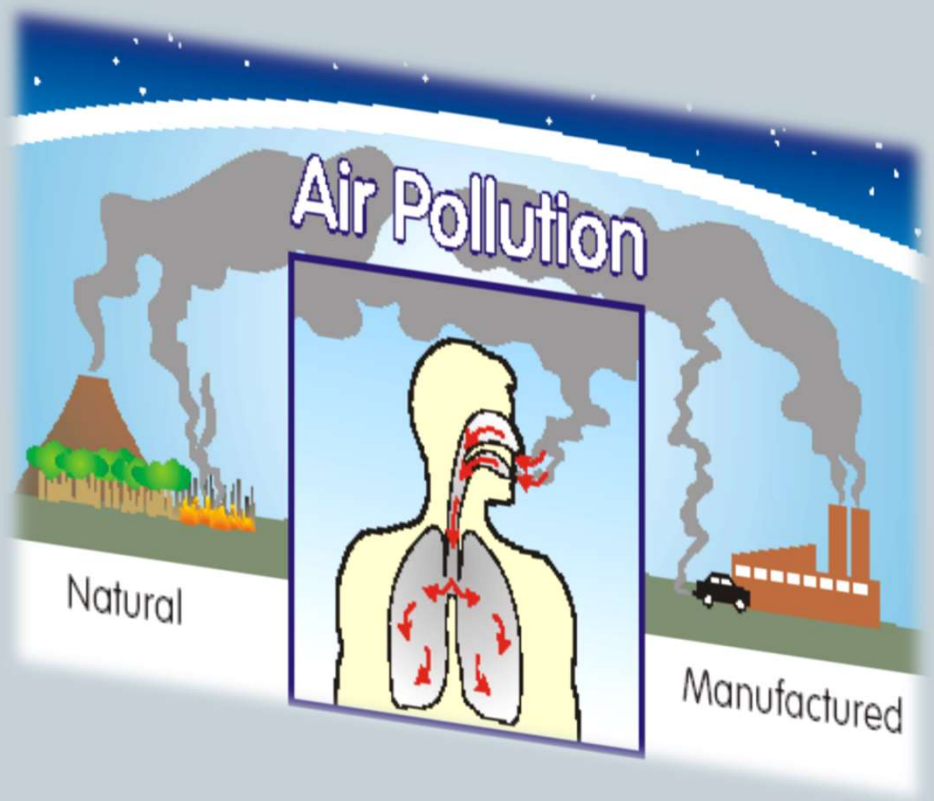
- Who is most affected by Air pollution?
  - Very young
  - Very old
  - People with heart and lung disease.

Short Term Effects

- If exposure to air pollution is decreased, then health effects are short term and reversible.
- Signs and Symptoms
  - Headache
  - Nausea
  - Irritation to eyes, nose and throat.
  - Tightness in chest
  - Coughing
  - Upper respiratory infections.

Long Term Effects

- Long term effects on the health of people linked to air pollution include
  - Emphysema
  - Lung cancer
  - Heart disease



Indoor Air Pollution

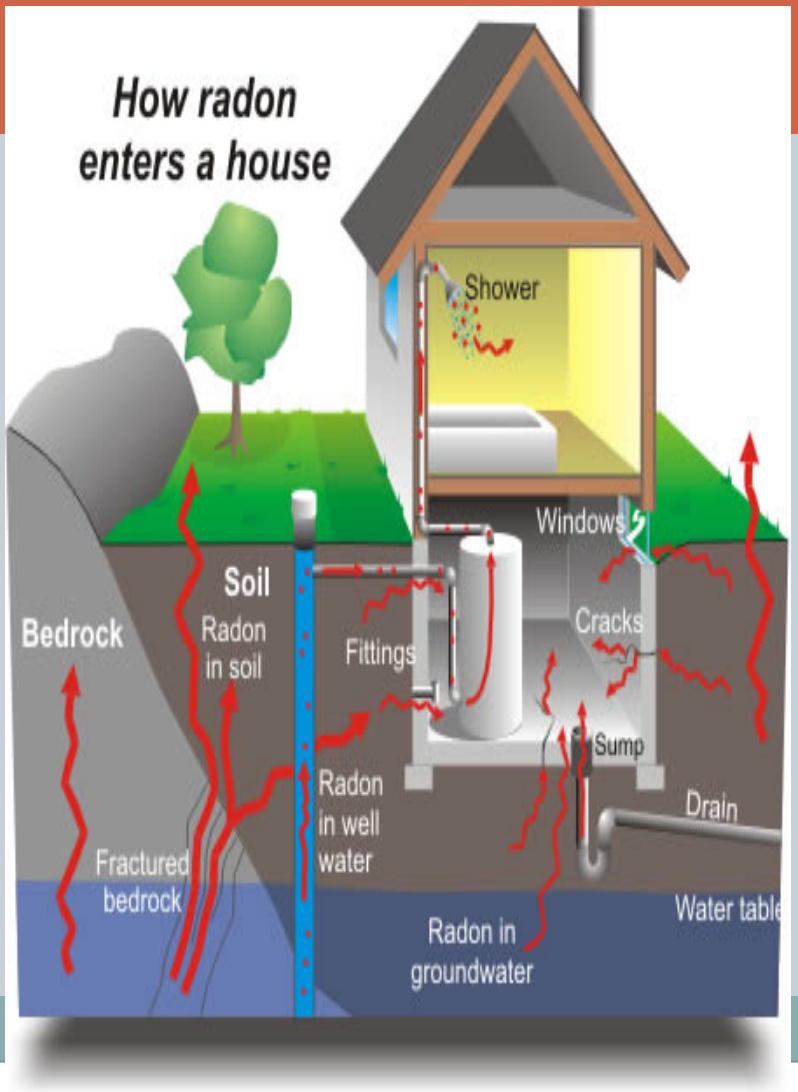
Many products and materials used in homes are filled with chemicals that pollute indoor air.

<u>Sick-building syndrome-</u> buildings with poor air quality

Primarily found in areas with hot climates. Southeastern U.S

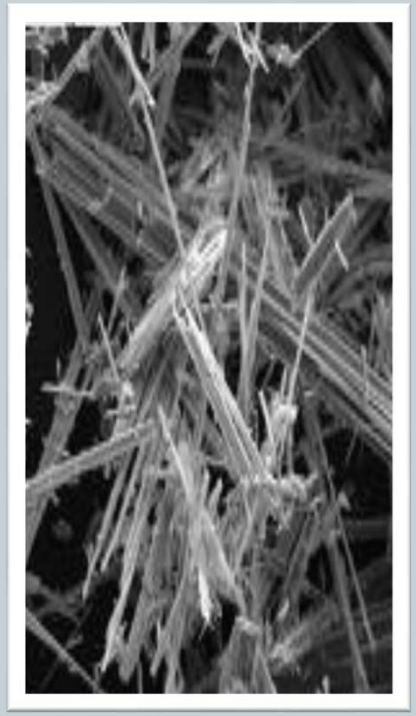
Radon Gas

- Radioactive, colorless, tasteless, and odorless.
- It can seep through cracks and holes of your foundation.
- When inhaled can destroy genetic material in cells that line your airways.
- 2nd leading cause of lung cancer.



Asbestos

- Long fibers consisting of several minerals that resist heat.
- Used for insulation and as a fire retardant. Banned in the early 70's
- If inhaled can cut and scar the lungs.



Noise Pollution

- Unwanted sound; a.k.a Rap music
- Irritating, and damages hearing by destroying cells in the ear.
- Intensity of sound measured in units called decibels(dB).

Type of Sound	dB	Pressure (Pa)
gnat farting	0	0.00002
rustling leaves	20	0.0002
whispering	25	0.00036
quiet library	30	0.00063
hum of refrigerator	45	0.00356
average home	50	0.00632
normal conversation	60	0.02
dishwasher	65	0.03557
car interior on freeway	70	0.06325
downtown street corner	75	0.11247
outboard motor	80	0.2
electric shaver	85	0.35566
screaming child	90	0.63246
convertible on freeway, top down	95	1.12468
subway train	100	2
jackhammer	105	3.55656
sandblaster	110	6.32456
rock concert	120	20
threshold of pain	120	20
air raid siren at 1 m	130	63.24555
jet engine	140	200
instant perforation of eardrum	160	2,000.00
shuttle launch at ground zero	180	20,000.00

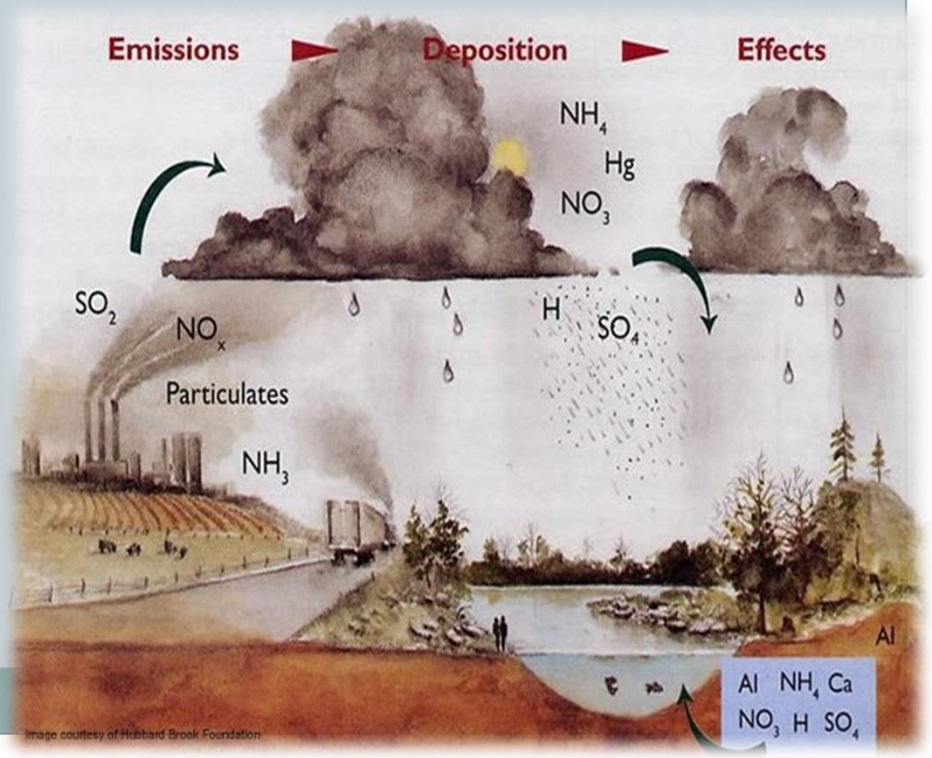
Light Pollution

- No direct human health hazards.
- Does negatively affect the environment.
  - Waste energy
  - When light is directed upward in the sky and lost in space.
  - Lighted billboards
  - Poor quality street lights
  - Lighted buildings. More energy used , the more coal burned.

What causes acid precipitation?

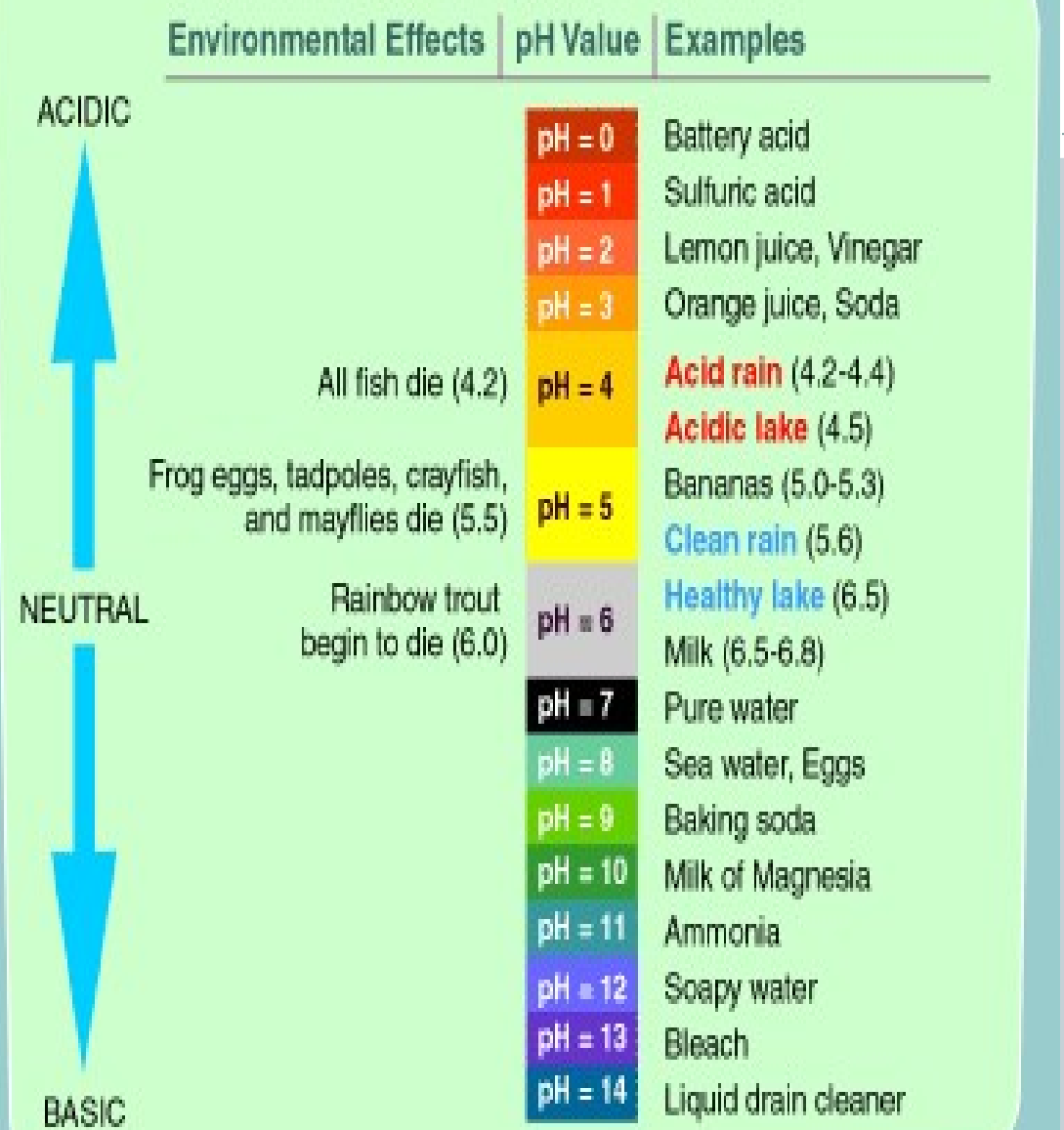
Definition - rain, snow or sleet that contains a high concentration of acids.

- When fossil fuels are burned, sulfur oxides (SOx) and nitrogen oxides (NOx) combine with
  - water in the atmosphere
    - To form ACID
      - sulfuric acid (H_2SO_4)
      - nitric acid (HNO_3)
- Flows over and through:
  - Ground and into
    - soil
    - lakes
    - rivers and streams



pH

- Measure of the acidity or basicity of a substance – use a pH SCALE



Effects of Acid Rain

MSN Encarta

Acid Rain:

- Washes nutrients away
- Increases toxic metal levels

- Aluminum accumulates in the gills of fish and interfe with oxygen and salt exchange.

Reproduction

- Produce fewer eggs that often do not hatch.
- Birth defects are common in offspring

Trees are damaged – used for building & warmth