CE 326 Principles of Environmental Engineering

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What is Environmental Engineering?

ASCE Definition:

Environmental engineering is manifest by sound engineering thought and practice in the solution of problems of environmental sanitation, notably in the provision of safe, palatable, and ample public water supplies; the proper disposal of or recycle of wastewater and solid wastes; the adequate drainage of urban and rural areas for proper sanitation; and the control of water, soil, and atmospheric pollution, and the social and environmental impact of these solutions.

Furthermore, it is concerned with engineering problems in the field of public health, such as control of arthropod-borne diseases, the elimination of industrial health hazards, and the provision of adequate sanitation in urban, rural, and recreational areas, and the effect of technological advances on the environment (ASCE, 1977).

Environmental Engineering

- Air pollution
  - Control devices
  - Permitting
  - Modeling
- Water (surface and groundwater):
  - Treatment & disinfection
  - Storage and distribution
  - Dispersion
  - Quality
- Wastewater
- Solid Wastes
- Hazardous Wastes
- Radioactive Wastes
- Integrated Systems
- Pollution Prevention
- Other – noise and light pollution

Air pollution Episodes

- Meuse Valley, Belgium, 1930 – zinc smelters, 60 deaths
- Donora, Pennsylvania, 1948 – 23 deaths over Halloween weekend
- London, England, 1952 – 4000 deaths
- Bhopal, India 1984 – 2,000 deaths
- WTC, Sept. 11, 2001

Primary vs. secondary standards

- **Primary Standards** - to protect public health with an adequate margin of safety
- **Secondary Standards** - to protect public welfare (plants, animals, and property)

Primary vs. secondary pollutants

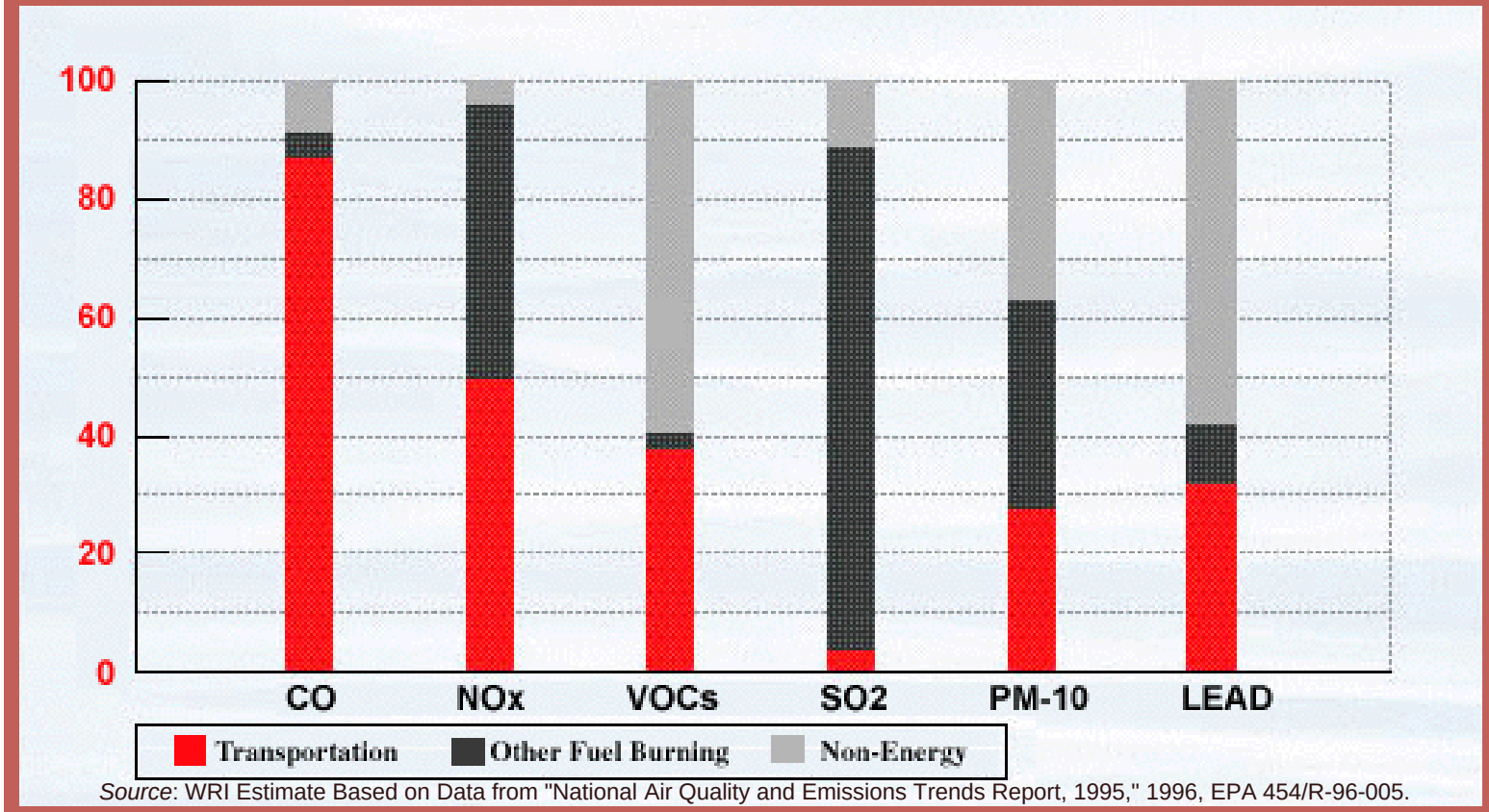
- **Primary pollutant** - discharged directly into the atmosphere (e.g., automobile exhaust)
- **Secondary pollutant** - formed in the atmosphere through a variety of chemical reactions (e.g., photochemical smog)

Stationary vs. mobile sources

- **Stationary Sources**
  - Contribute approximately 40% of total air pollution
    - 98% of SO_X,
    - 95% of particulates,
    - 56% of total hydrocarbons,
    - 53% of NO_X, and
    - 22% of CO

Stationary vs. mobile sources

- **Mobile Sources**
  - Contribute approximately 60% of total air pollution
    - 78% of CO,
    - 47% of NO_X,
    - 44% of total hydrocarbons,
    - 5% of particulates, and
    - 2% of SO_X



Source: WRI Estimate Based on Data from "National Air Quality and Emissions Trends Report, 1995," 1996, EPA 454/R-96-005.

See: National Emissions Inventory from EPA

Effects of air pollution

- Damage to human health and welfare
- Damage to vegetation and animals
- Damage to materials and structures
  - Abrasion
  - Deposition and removal
  - Direct chemical attack
  - Indirect chemical attack
  - Electrochemcial corrosion
- Damage to the atmosphere, soil, and water

Effects of Common Air Pollutants

RESPIRATORY EFFECTS

Symptoms:

- Cough
- Phlegm
- Chest tightness
- Wheezing
- Shortness of breath

Increased sickness and premature death from:

- Asthma
- Bronchitis (acute or chronic)
- Emphysema
- Pneumonia

Development of new disease

- Chronic bronchitis
- Premature aging of the lungs

CARDIOVASCULAR EFFECTS

Symptoms:

- Chest tightness
- Chest pain (angina)
- Palpitations
- Shortness of breath
- Unusual fatigue

Increased sickness and premature death from:

- Coronary artery disease
- Abnormal heart rhythms
- Congestive heart failure

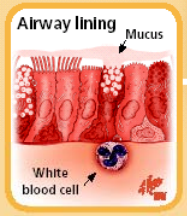
How Pollutants Cause Symptoms

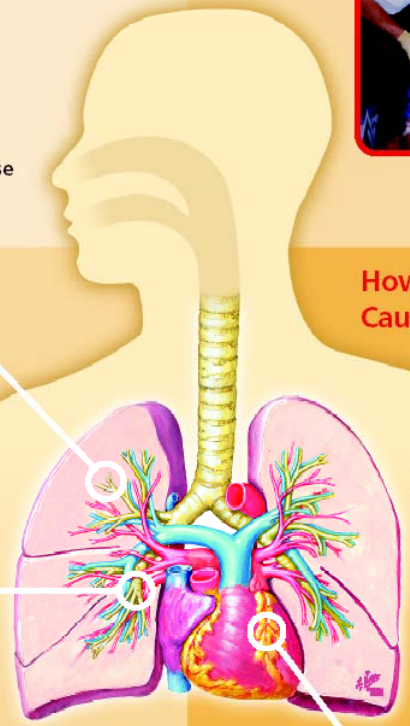
Effects on Lung Function

- Narrowing of airways (bronchoconstriction)
- Decreased air flow

Airway Inflammation

- Influx of white blood cells
- Abnormal mucus production
- Fluid accumulation and swelling (edema)
- Death and shedding of cells that line airways





How Pollutants May Cause Symptoms

Effects on Cardiovascular Function

- Low oxygenation of red blood cells
- Abnormal heart rhythms
- Altered autonomic nervous system control of the heart

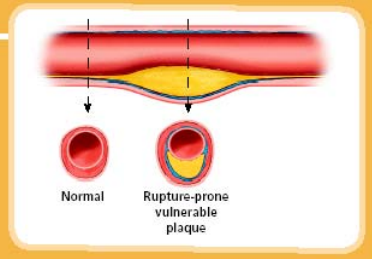
Increased Susceptibility to Respiratory Infection

Normal

Lung with respiratory infection

Vascular Inflammation

- Increased risk of blood clot formation
- Narrowing of vessels (vasoconstriction)
- Increased risk of atherosclerotic plaque rupture



http://www.epa.gov/airnow//health-prof/EPA_poster-final_lo-res.pdf