

Chapter 1: Air Quality Management Overview

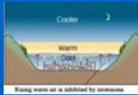
Chapter Overview

- Early History of Air Pollution Problems
- Hazardous Effects of Air Pollutants
 - Human Body
 - Environmental Effects
- Overview of Air Quality Management System
- Strategic Planning Session Involving South Africa's Developing Air Quality Management Program

Early History of Air Pollution



Air Pollution Episodes



- 1930, Muese River Valley, Belgium - 63 deaths
- 1948, Donora, Pennsylvania - 23 deaths, 7,000 people affected
- 1950, Poza Rica, Mexico - 22 deaths, 320 hospitalized
- 1952, London - 4,000 deaths
- 1953, New York City - 200 deaths
- 1962, London – 700 deaths
- 1984, Bhopal, India - 4,000 immediate deaths, 15,000 deaths later
- South Africa – Foskor, fertilizer and sulfuric acid plant

Air Pollution Episode: London Fog (1952)



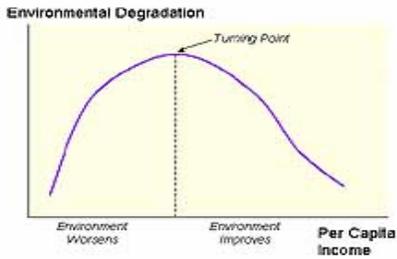
Why Focus on Air Quality?

- Air pollution causes human health effects
 - Major air pollution episodes
 - Relationship between exposure and health effects
- Environmental activists
 - Rachel Carson
 - Environmental Organizations
- Human health care and economy
 - Increased lifespan in US (from 40 to 75 years)
 - Understanding of a connection of long term exposures, and dangers to children's health.
 - It's not the economy OR the environment, we can have both

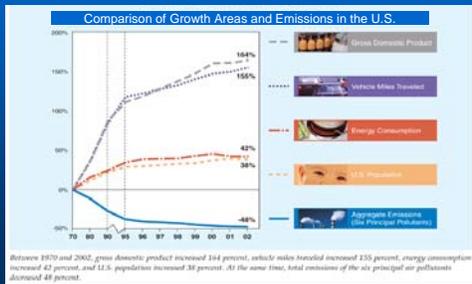


Benefits From Reducing Air Pollution

The environmental Kuznets curve



Benefits From Reducing Air Pollution – U.S. Example



Hazardous Effects of Air Pollutants

- Air Pollutant Entry into the Human Body
- Health Effects of Criteria Pollutants
- Health Effects of Toxic Air Pollutants
- Health Effects on Children
- Environmental Effects of Air Pollution

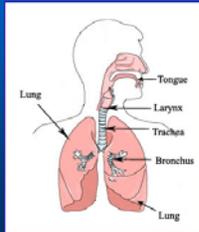
Air Pollutants Enter the Body through:

- Breathing, exposing the nose, throat, and lungs,
- Ingestion: air pollutants can deposit on food or vegetation that will be eaten by humans or livestock, or
- Absorption through the skin.



Pollutants in the Respiratory System

- Pollutants are inhaled through the nose or mouth
- Defenses
 - Cilia
 - Phagocyte cells
- Soluble toxins may enter the bloodstream



Effects of Air Pollutants

- Effects can include:
 - Decreased respiratory efficiency, diminished pulmonary circulation, enlargement and weakening of the heart and blood vessels, skin and eye irritation, inflammation, and allergic reaction.
 - Impedance of the lung's ability to absorb oxygen from the air and remove harmful carbon dioxide from the bloodstream.
- Long-term health effects can include:
 - lung cancer, pulmonary emphysema, bronchitis, asthma, and other respiratory infections.

US EPA Air Pollutants

- Major Air Pollutants (known as "Criteria" Pollutants)
 - Particulate Matter (PM)
 - Lead (Pb)
 - Sulfur Dioxide (SO₂)
 - Carbon Monoxide (CO)
 - Nitrogen Dioxide (NO₂)
 - Ozone (O₃)
- Toxic Air Pollutants
 - Not criteria pollutants
 - 188 substances defined as hazardous air pollutants

Health Effects of Criteria Pollutants

CRITERIA POLLUTANT	BODY SYSTEM	HEALTH EFFECTS
Particulate Matter (PM ₁₀ and PM _{2.5})	Lower respiratory system.	<ul style="list-style-type: none"> • Asthma • Bronchitis • Reduced lung function • Cancer • Heavy metal poisoning
Lead (Pb)	Organs and soft tissue.	<ul style="list-style-type: none"> • Anemia • High blood pressure • Cabot's • Neurological disorder • Intellectual function
Carbon Monoxide (CO)	Circulatory system.	<ul style="list-style-type: none"> • CO poisoning • Angina pectoris • Neurological dysfunction • Brain damage • Fetal abnormalities • Asphyxiation
Nitrogen Dioxide (NO ₂)	Respiratory system.	<ul style="list-style-type: none"> • NO₂ poisoning • Asthma • Lowered resistance to infection
Sulfur Dioxide (SO ₂)	Respiratory system.	<ul style="list-style-type: none"> • Asthma • Bronchial constriction • SO₂ poisoning • Heart attack
Ozone (O ₃)	Respiratory system.	<ul style="list-style-type: none"> • Lung inflammation • Reduced lung elasticity • Transient cough • Chest pain • Throat irritation • Nausea

Health Effects of Toxic Air Pollutants

- Toxic or hazardous air pollutants cause or may cause:
 - cancer or other serious health effects, such as reproductive disorders or birth defects
 - adverse environmental and ecological effects.
- Examples of toxic air pollutants include:
 - benzene, found in gasoline
 - perchloroethylene, emitted from some dry cleaning facilities
 - methylene chloride, used as a solvent by a number of industries
- Originate from:
 - man-made sources
 - natural sources such as volcanic eruptions and forest fires

Health Effects on Children

Children are not little adults....



Different Environmental Exposures



Physiological Differences



Windows of Vulnerability During Development

Different Health Effects in Children and Adults

Children Breathe More (per body weight)



Children's Lungs are Still Developing

Children's airways are narrower, so the effects of irritation or inflammation can be more severe

80% of alveoli develop after birth through adolescence

Pollution may permanently damage

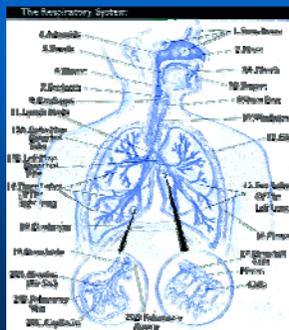


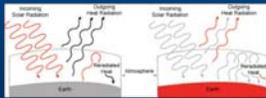
Diagram: American Lung Association

Environmental Health Threats to Children



Environmental Effects of Air Pollution

- Acid Rain
 - SO_x and NO_x react in the atmosphere to form acids
 - Acid rain falls on the soil and water bodies making the water unsuitable for fish and other wildlife
 - Speeds the decay of buildings, statues and sculptures.
- The Greenhouse Effect
 - Ozone, methane, CO₂, and other gases may contribute to global warming



Environmental Effects of Air Pollution (cont.)

- Stratospheric Ozone Depletion
 - Certain substances deplete the amount of ozone in the stratosphere, increasing the amount of UV-b radiation
- Mercury
 - Mercury in the air can settle into water bodies where it can change it into methylmercury, a highly toxic form that builds up in fish, shellfish and animals that eat fish.
- Agriculture Impacts
 - Crop yields

Transport of Air Pollution

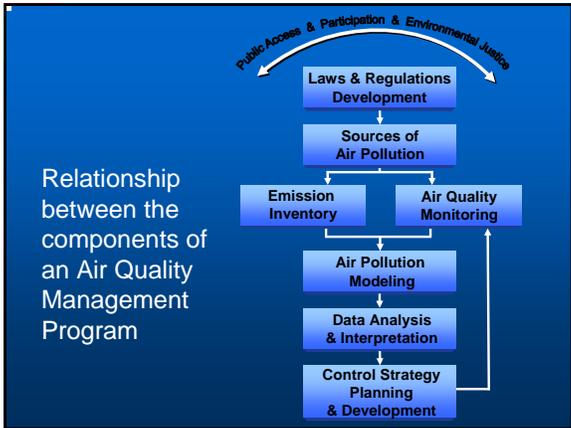
- Air pollution crosses many boundaries
- Ozone, particulates and persistent pollutants
- Causes episodic problems
- Increases background
- Requires Regional and Intergovernmental cooperation

Introduction to Air Quality Management

An air quality management program is simply a collection of air pollution strategies designed to identify problems and provide a solution to difficult municipal, national, and international air quality problems, to achieve cleaner air.

Major Components of an Air Quality Management Program

- Laws and Regulations
- Sources of Air Pollution
- Emission Inventory
- Ambient and Source Air Quality Monitoring
- Air Pollution Modeling
- Data Analysis and Interpretation
- Public Access and Participation
- Environmental Justice
- Control Strategy Planning and Development
- Compliance and Enforcement



Laws and Regulation Development

Laws make emission standards enforceable.

Air Pollution Sources and Emission Inventory

An air quality management plan should collect data on major air pollution sources.

An emission inventory is essential to provide a current, accurate, and comprehensive listing of air pollution emissions within a specific area over a specified period of time.

Air Pollution Management Measuring & Evaluating Progress

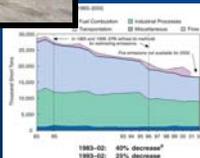


Monitoring



The effect of streamlining an obstacle during the design phase of an effluent stack.

Modeling



Data Analysis and Interpretation

Public Participation and Environmental Justice



Actively seeking and responding to input from citizens and enabling meaningful involvement in decision-making.

Control Strategy Planning and Development

- Control strategies are identified and implemented to achieve reductions in air pollution.
- Measures may vary by source type, such as stationary or mobile, as well as by the targeted pollutant.
- Costs and benefits are assessed in the development of the control strategy.



AQM Planning Tool

- Exercises for each topic
- This is YOUR work for the course
- Depends on YOUR experience and expertise
- You'll get out what you put in
- TALK – TALK – TALK

Chapter Review

- Human health effects and environmental damage.
- Key elements of a comprehensive air quality management program
- AQM Planning Tool
- Resource CD
