GGS 319
Air Pollution Fundamentals

- ✓ **AIR POLLUTION** REGULATIONS & STANDARDS



Worldwide Mortality

World Health Organization (2002)

Indoor air pollution	1.62 million deaths/year
Outdoor air pollution	0.80
Climate change	0.15
Tobacco smoke	4.91
Water pollution	1.73
Malnutrition	3.75
High blood pressure	7.14

Health Effects of Air Pollution

Los Angeles

- 1600 premature deaths per year
- Children have 10-15% lower lung function
- Exposure to particles in exceedence of NAAQS (42 days/yr)
  - 33% greater risk of bronchitis
  - 74% greater risk of asthma
  - 37% greater risk of cancer
- 75% of young people who died had airspace inflammation
- 27% had severe lung damage
- 39% had severe illness to bronchial glands

Early Air Pollution History

1940s: Severe smog problem in Los Angeles
1947: Los Angeles Air Pollution Control District forms
1948: Donora, Pennsylvania smog disaster
1949: First national symposium on air pollution in Los Angeles
1950s: Ozone levels in Los Angeles reach 0.65 ppmv
1951: Oregon approves agency to control air pollution
1952: Air pollution disaster in London
1955: Eisenhower asks Congress to examine air pollution

Early Air Pollution History

- The existence of air pollution and the need for legislation to protect the health and welfare of the general populace are not modern phenomena.
- In 13th century England passed a law to reduce air pollution from the sources burning soft coal.
- However, it was not until the 1940s in the US that efforts to control the degree of air pollution were initiated.
- Historically first measures against air pollution were taken by the state of California (especially in the LA basin).
- Then, federal intervention was deemed necessary.
- The major development of legislative and regulatory acts took place over the period of from 1955 to 1970.

Early Air Pollution History

- The early development of air pollution laws by the US Congress was unwilling to grant the federal government a high degree of control
- It has been thought that air pollution problems were essentially local or regional ones
- It was felt that air pollution control should be mandated on the state or local level
- Later, this approach proved impractical
- Federal involvement began in 1955.

History of Air Pollution Regulations

1955 U.S. Air Pollution Control Act of 1955 (Public Law 84-159)

Purpose: Authorized federal funds to assist in air pollution research and training for the development of cooperative federal, state, regional, local programs to control and prevent air pollution

- ✓ Research on the effects of air pollution by the Public Health Service
- ✓ Provision for technical assistance to the states by the federal government
- ✓ Training of individuals in the area of air pollution
- ✓ In-house and out-of-house research on air pollution control

History of Air Pollution Regulations

1955 U.S. Air Pollution Control Act of 1955 (Public Law 84-159)

- ✓ Although this act was a small step , it was a necessary one
  - ✓ toward the identification of air pollution sources and the analysis of pollution effects and
  - ✓ Toward the effective legislation and enforcement by regulatory agencies which was developed over the next 15 years

History of Air Pollution Regulations

1960-1962 Air Pollution Control Act Amendments of 1960 (Public Law 86-493) & Amendments of 1962 (Public law 87-761)

- ✓ A minor but important amendment was passed in 1960
- ✓ Congress directed the surgeon general to conduct a detailed study of motor vehicle exhausts in terms of their effects on human health
- ✓ This study was completed in 1962
- ✓ As a result 1955 Law was further amended in 1962, requiring the surgeon general to conduct studies relating the effects of motor vehicle exhausts to health

History of Air Pollution Regulations

1963 Clean Air Act of 1963

Purpose: Gave federal government authority to regulate interstate pollution

- ✓ At this particular time only 13 states had passed laws providing for statewide control of air pollution
- ✓ It was not clear how the responsibilities for air pollution control should be divided among federal, state, and local governments
- ✓ Federal government intervene only interstate conflicts
- ✓ Thus, the classical tree-tier system of government was preserved

History of Air Pollution Regulations

1963 Clean Air Act of 1963

- ✓ Specifically the1963 act provided for
  - ✓ Acceleration in the research and training program
  - ✓ Federal government paid to states two-thirds of the costs of air pollution regulatory control programs
  - ✓ Developing air quality criteria
  - ✓ Initiating efforts to control air pollution from all federal facilities
  - ✓ Encouraging efforts on the part of automotive companies and the fuel industries to prevent pollution

History of Air Pollution Regulations

1963 Clean Air Act of 1963

- ✓ The Clean Air Act of 1963 provided for a formal process for reviewing the status of the motor vehicle pollution problem.
- ✓ A technical committee was to be formed
- ✓ The committee was instructed to monitor the progress toward control and to indicate those specific areas in which added research and development were essential
- ✓ This led to the next legislation dealing with motor vehicles

History of Air Pollution Regulations

1965 Motor Vehicle Air Pollution Control Act of 1965

- ✓ Extensive hearings were held in Congress on the control of automotive emissions
  - ✓ "Automotive exhaust was cited as responsible for some 50 percent of the national air pollution problems. It is, in many respects, the most important and critical source of air pollution, and it is, beyond question, increasing in seriousness despite preliminary and isolated efforts to control it."
- ✓ First regulation of automobiles at federal level setting national automotive emission standards (otherwise would cause confusion)
- ✓ The automotive industry disputed the practicality of national emission standards, but agreed to meet them with 1968 model cars.

History of Air Pollution Regulations

1967 The Air Quality Act of 1967 (Public Law 90-148)

Purpose: Precursor to the 1970 Clean Air Act

- ✓ President Johnson proposed national emission standards for industries which "contribute heavily" to air pollution
- ✓ Establishment of 8 specific areas in the US on the basis of common meteorology, topography, and climate
- ✓ Designation of state air quality control regions
- ✓ Investigated adverse health effects of pollutants so that proper regulations could be set.
- ✓ Researched viable air pollution control techniques
- ✓ U.S. divided into Air Quality Control Regions (AQCR)
- ✓ Required publication of Air Quality Criteria (AQC) reports

History of Air Pollution Regulations

1967 The Air Quality Act of 1967

Purpose: Precursor to the 1970 Clean Air Act

- ✓ Science reports about effects of pollutants on health/welfare
- ✓ Provide suggestions about acceptable levels of pollution
- ✓ States required to set own air quality standards based on AQC
- ✓ State Implementation Plans (SIP)
- ✓ State plan for regulation submitted to federal government
- ✓ If no state enforcement, federal government could sue state

History of Air Pollution Regulations

1970 A turning point… The Clean Air Act (CAA)

Purpose: The primary goal of the Clean Air Act (CAA) legislation was to achieve safe and acceptable air quality through the attainment and maintenance of national ambient air quality standards.

- ✓ National Environmental Policy Act (January 1)
- ✓ First Earth Day (April 22)
- ✓ Formation of Environmental Protection Agency (July 9)
- ✓ National Air Quality Standards

History of Air Pollution Regulations

1970 A turning point… The Clean Air Act (CAA)

- ✓ National Environmental Policy Act (January 1)
- ✓ Creation of U. S. Environmental Protection Agency (USEPA)
- ✓ National Ambient Air Quality Standards (NAAQS)
  - ✓ Primary: to protect public health (e.g., asthmatics, elderly)
  - ✓ Secondary: to protect public welfare (e.g., visibility, buildings)

History of Air Pollution Regulations

1970 A turning point… The Clean Air Act (CAA) (Public Law 91-604)

- ✓ Criteria Air Pollutants
- ✓ Required U.S. Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards (NAAQS) for six common air pollutants:
  - ✓ ozone
  - ✓ lead
  - ✓ carbon monoxide
  - ✓ sulfur dioxide
  - ✓ nitrogen dioxide
  - ✓ particulate matter
  - ✓ PM_{10}, a $PM_{2.5}$ standard added in 1997

History of Air Pollution Regulations

1970 A turning point… The Clean Air Act (CAA)

- ✓ Attainment areas (regions where primary standards met)
- ✓ Nonattainment areas (regions where primary standards were not met)
- ✓ New Source Performance Standards (NSPS)
  - ✓ Set by USEPA to limit emission from new stationary sources
- ✓ National Emission Standards for Hazardous Pollutants (NESHAPS)
  - ✓ For pollutants causing mortality, severe illness
  - ✓ Initially, for, asbestos, beryllium, mercury. List expanded in 1984
- ✓ Congressional control of automobile emissions
- ✓ Required 90% reduction HCs, CO(g) by 1975 and NO_x by 1976

History of Air Pollution Regulations

1970 A turning point… The Clean Air Act (CAA)

- ✓ Hence 1970 CAA provided for the first time;
  - ✓ National ambient air quality standards
  - ✓ National emission standards for stationary sources
  - ✓ Standards of performance for existing plants
  - ✓ Initiated the study of aircraft emission
  - ✓ Outside the area of air pollution, the cause and effects of noise pollution were to be studied and a report submitted to Congress

History of Air Pollution Regulations

1977 Clean Air Act Amendments of 1977 (public Law 95-95)

- ✓ Prevention of Significant Deterioration (PSD) in areas already under attainment.
- ✓ New source must use Best Available Control Technology (BACT)
- ✓ Computer modeling mandated to check whether new pollution sources might result in standard exceedence
- ✓ Control of CFCs

History of Air Pollution Regulations

1990 Clean Air Act Amendments of 1990

- 1990: 96 cities still in violation of ozone NAAQS (nonattainment areas divided into six categories)
  - "Extreme:" Los Angeles: must attain by 2010
  - "Severe:" Baltimore, New York: must attain by 2007
  - "Severe:" Chicago, Houston,…: must attain by 2005
- New sources in nonattainment areas must achieve
- Lowest Achievable Emissions Rate (LAER) by adopting Reasonably Achievable Control Technology (RACT)
- Hazardous Air Pollutants (HAPs)
- Emission limits for 189 toxic chemicals using Maximum Achievable Control Technologies (MACTs)
- More control of CFCs

History of Air Pollution Regulations

1990 Clean Air Act Revision of 1997

- ✓ Change in ozone standard
  - ✓ 0.08 ppmv over 8-hour average instead of
  - ✓ 0.12 ppmv over 1-hour average
- ✓ Addition of $PM_{2.5}$ standard

2002 New PM standards ($PM_{2.5}$)

Federal U.S. Emission Standards for Light-Duty Vehicles

Year	(g/mi)	HCs (g/mi)	CO (g/mi)	NO_x (g/gal)	Pb (g/mi)	PM
1968	3.2	33	--	--	--	
1971	4.6	47	4.0	--	--	
1972	3.4	39	--	--	--	
1973-4	3.4	39	3.0	--	--	
1975-6	1.5	15	3.1	--	--	
1977-9	1.5	15	2.0	0.8	--	
1980		0.41	7.0	2.0	0.5	--
1981	0.41	3.4	1.0	0.5	--	
1982-6	0.41	3.4	1.0	0.5	0.6	
1987-92	0.41	3.4	1.0	0.5	0.2	
Tier 1. Intermediate Useful Life Standards						
1993		0.25	3.4	0.4	0.5	0.08
Tier 2. Full-Life Standards						
1993-		0.31	4.2	0.6	0.5	0.10

California, U.S. Ambient Standards

Pollutant	California Standard	Federal Primary Standard	Federal Secondary Standard
Ozone			
1-h average	0.09 ppmv	0.12 ppmv	Same as primary
8-h average	--	0.08 ppmv	Same as primary
Carbon monoxide			
1-h average	20 ppmv	35 ppmv	--
8-h average	9.0 ppmv	9.5 ppmv	--
Nitrogen dioxide			
1-h average	0.25 ppmv	--	--
Annual average	--	0.053 ppmv	Same as primary
Sulfur dioxide			
1-h average	0.25 ppmv	--	--
3-h average	--	--	0.5 ppmv
24-h average	0.05 ppmv	0.14 ppmv	--
Annual average	--	0.03 ppmv	--

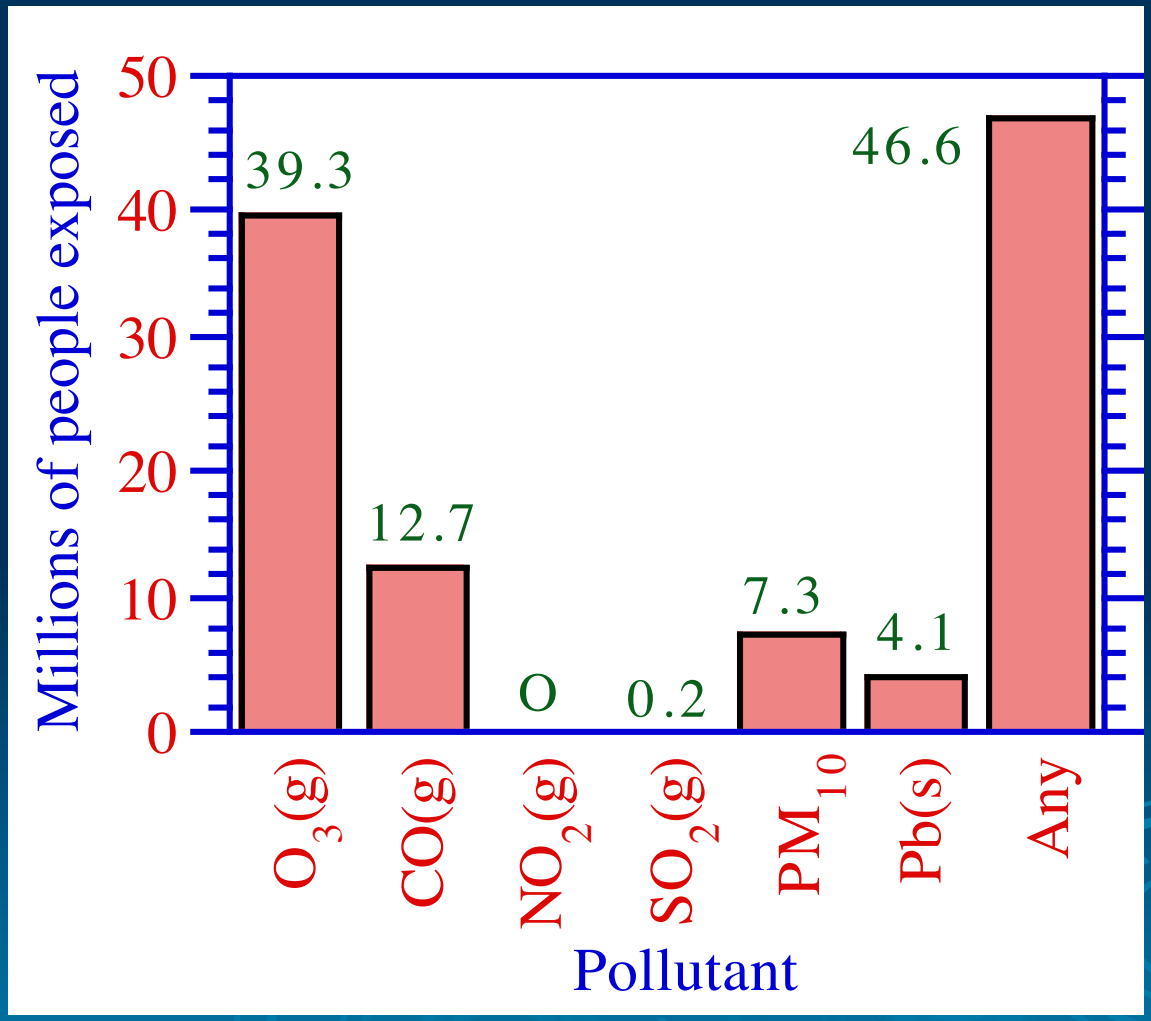
California, U.S. Ambient Standards

Pollutant	California Standard	Federal Primary Standard	Federal Secondary Standard
PM_{10}			
24-h average	50 μg m^{-3}	150 μg m^{-3}	Same as primary
An. arith. mean		50 μg m^{-3}	Same as primary
$PM_{2.5}$			
24-h average		65 μg m^{-3}	Same as primary
An. arith. mean		15 μg m^{-3}	Same as primary
Lead			
30-d average	1.5 μg m^{-3}	--	--
Calendar quarter	--	1.5 μg m^{-3}	Same as primary
Particulate sulfate			
24-h average	25 μg m^{-3}	--	--

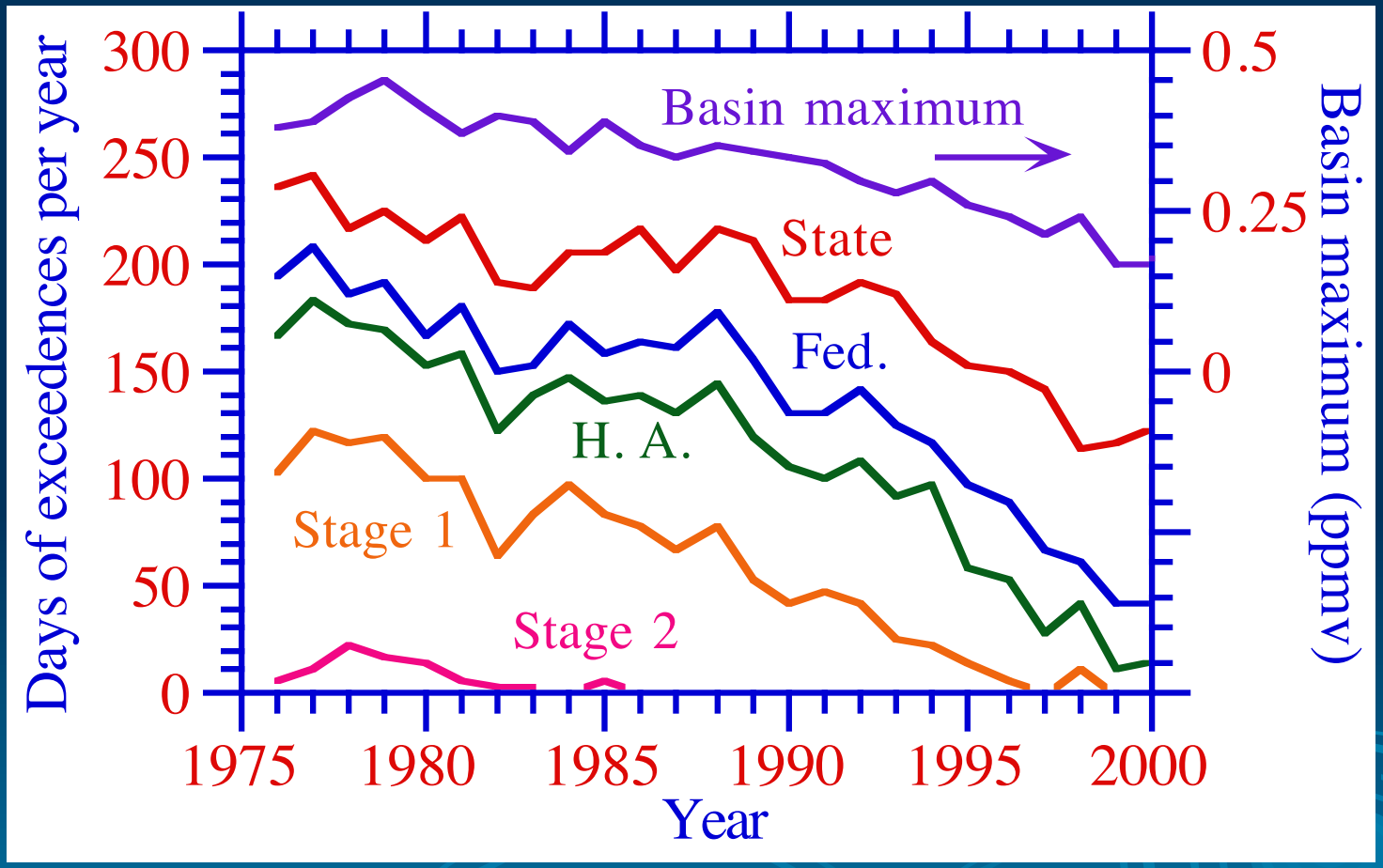
Smog Alerts

Health Standard Level	Ozone 1-h Mixing Ratio (ppmv)
California standard	0.09
Federal standard	0.12
Health advisory	0.15
Stage 1 smog alert	0.20
Stage 2 smog alert	0.35
Stage 3 smog alert	0.50

People Exposed to at Least One U.S. NAAQS violation 1996



Days per Year that Ozone in Los Angeles Exceeded Given Standard



Changes in Ambient Standard Exceedences and Emissions

Pollutant	Percent Change in Federal Standard Exceedences 1988-1997	Percent Change in Emission 1988-1997
Ozone	-19	--
Carbon monoxide	-38	-25
Nitrogen dioxide	-14	-1
Sulfur dioxide	-39	-12
PM10	-26	-12
Lead	-67	-44
Reactive organics	--	-20

Visibility-Standard Exceedences in Los Angeles

Location	1990	1994
Azusa	No data	91
Burbank	180	No data
Lancaster	14	No data
Long Beach	155	No data
Los Angeles	154	No data
Ontario	250	No data
Riverside	200	No data
San Bernardino	200	176

Contributions of Pollutant Particles to Visibility Reduction

Pollutant	West	East
Sulfates	25-65	>60
Organic carbon	15-35	10-15
Nitrates	5-45	10-15
Black carbon	15-25	10-15
Soil dust	10-20	10-15

Sources of Pollution: U.S. Energy Consumption by Source (1998)

