Garfield County Air Quality Presentation

Mark McMillan

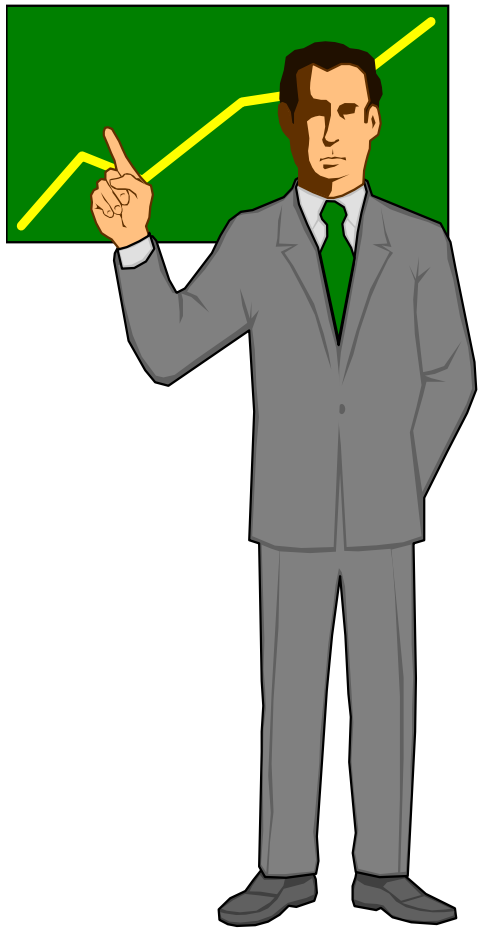
November 29, 2007

What Is To Be Covered Today

Risk

Addressing Air Quality

- **Regulatory**
- **Non-Regulatory Approaches**



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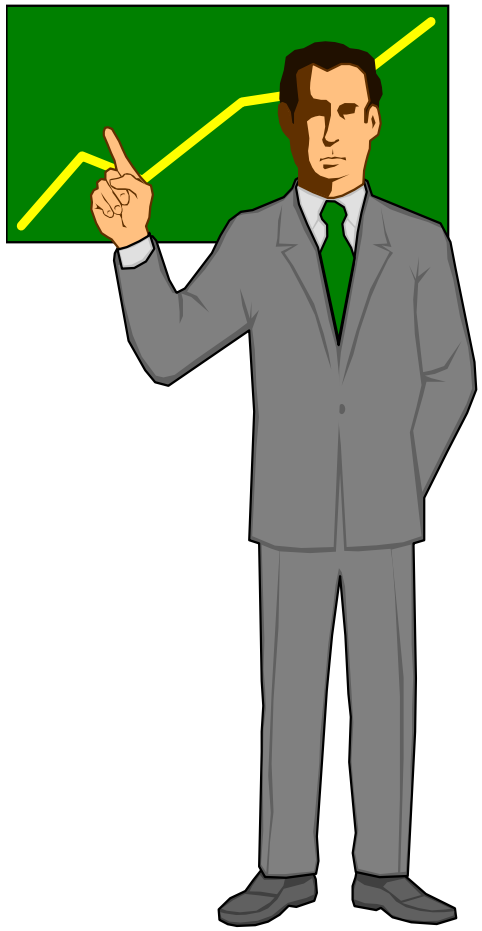


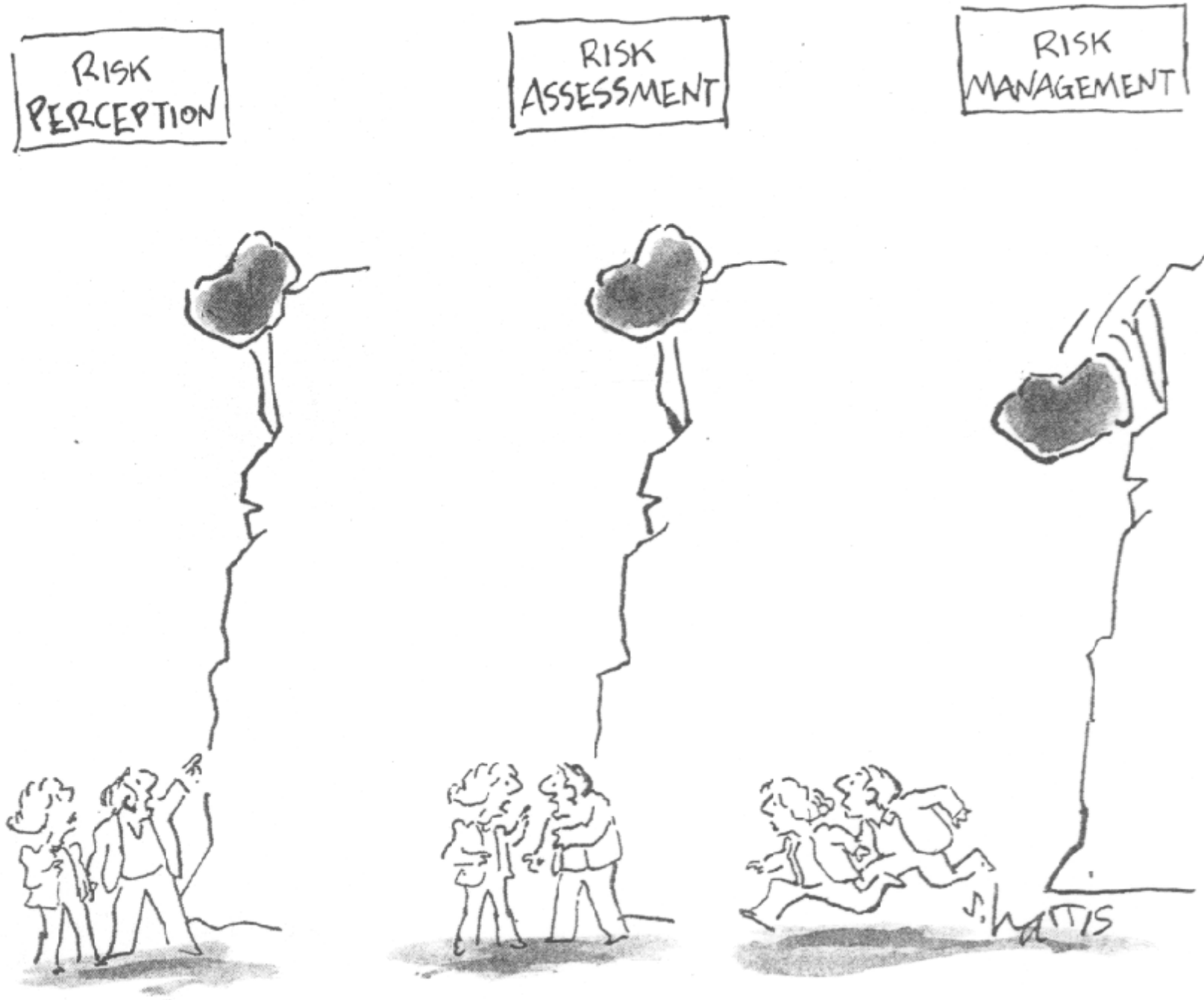
What is Risk?

Risk is “the probability that an adverse event will occur (such as a specific disease or type of injury) or the consequences of the adverse event.”

Presidential/Congressional Commission on Risk Assessment and Risk Management

WHAT IS RISK?

- Risk is the chance or probability of an event occurring (e.g., falling)
- Risk = Hazard x Exposure
- Hazard is “How toxic is it?”
- Exposure is “How likely is it to happen?”


RISK PERCEPTION
RISK ASSESSMENT
RISK MANAGEMENT
J. HATTIS

Risk Perception, Assessment, & Management

- Risk Perception: "Human health is at risk [or has been damaged] because of the proximity of the industry operation."
  - Commonly, within communities, all health problems or conditions are attributed to the perceived "health hazard"
  - Perception versus Reality (Is it important?)

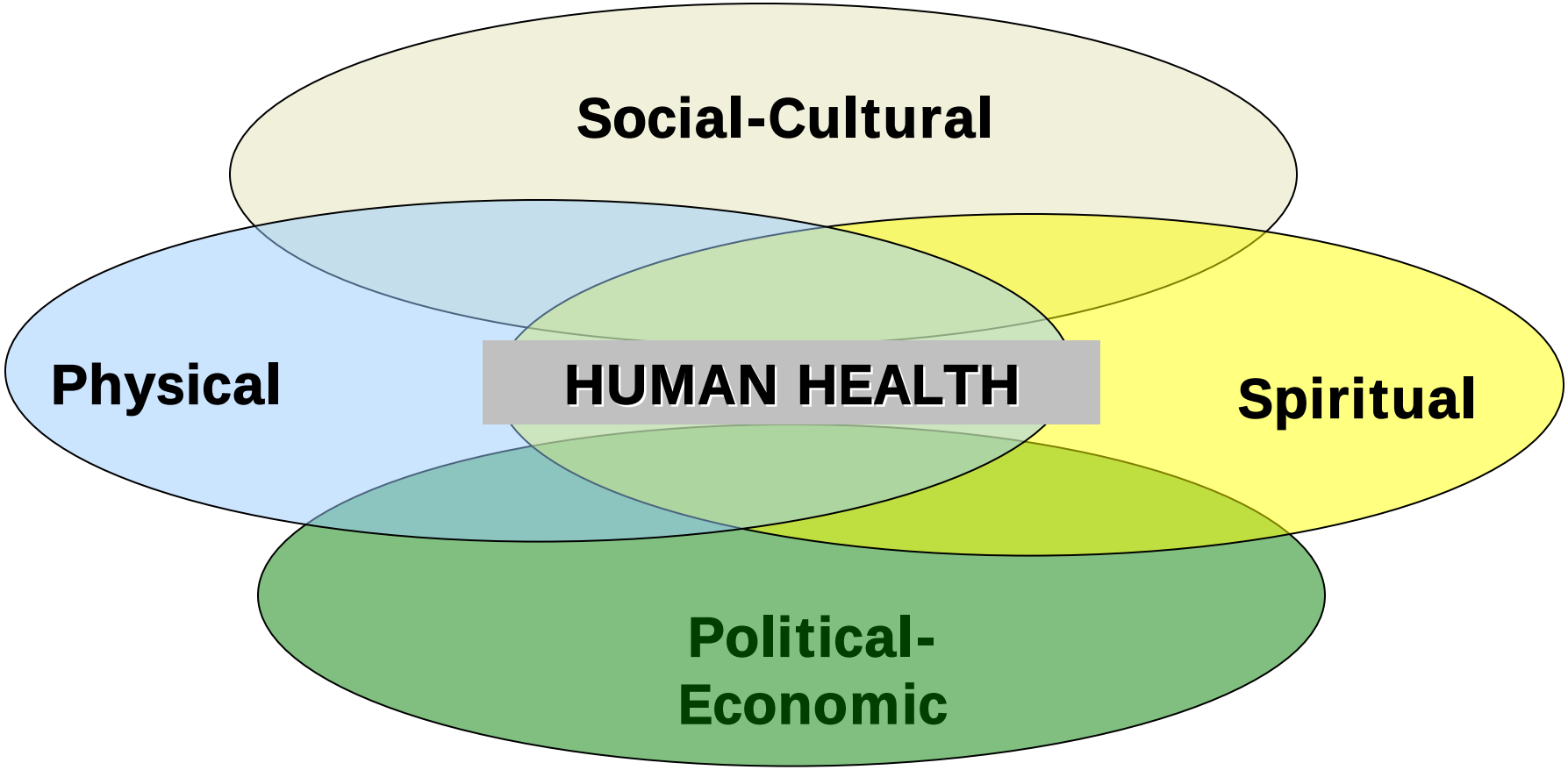
Risk Perception, Assessment, & Management

Risk Assessment: "Are there health problems within the community, and can these health problems be related to pathways of exposure?"

- Probability of harm (injury, disease, death) under specific circumstances
- What is the probability that the health problems are directly related to the industry operation?

Bottom Line Question:

Has human health been affected?



Risk Perception, Assessment, & Management

Risk Management: "How can/should the community and the industry deal with these problems?"

- What do we need to do to deal with any current problems and prevent future health problems?
- Is there a need for changes in public policy, new infrastructure, medical screening and surveillance programs?

“The Big Picture”

Relating SOURCES of contaminants and their PRESENCE in the environment to human EXPOSURE, ABSORBED DOSE, SUSCEPTIBILITY and HEALTH EFFECTS

Overview of Risk Assessment Process

- What is a Risk Assessment

  – A process to scientifically evaluate the increased chance (or likelihood) that an individual's health may be affected by exposure to air toxics (or chemicals)

Overview of Risk Assessment Process(cont.)

- Benefits of a Risk assessment
  - Attempts to understand future public health risks that may occur as a result of exposure to aid the process of risk management
  - Helps to identify chemicals that have the most potential to cause adverse health effects
  - Predicts health risks from multiple sources
  - Identifies subpopulations most at risk

No Risk if there is no exposure

Overview of Risk Assessment Process (cont.)

- Limitations of a Risk assessment

  - Uncertainty exists in risk predictions
    - Addressed by using health protective conservative assumptions
  - It cannot determine or identify whether certain individuals have suffered or will suffer an adverse health effect as a result of site-specific pollutants
  - Risk assessment is not an exact science

Risk Assessment Process

- Data Collection/Evaluation

  What contaminants exist at the site?

- Exposure Assessment

  How are people exposed to them?

- Toxicity Assessment

  How dangerous could contaminants be to human health?

- Risk Characterization

  What concentrations are safe?

Step 1 - Data Collection & Evaluation

- Determine which chemicals are being released
- Determine how much of a chemical is present
- Determine where a chemical is present

Hazard Identification

- Characterize the “sources”
  - What is the source?
  - Other sources of potentially hazardous materials (e.g. mines, mill tailings, landfills, agricultural spraying)?
- Characterize the “contaminants”
  - What are the potentially toxic materials?
  - How much is present? Where is this material?

Question:

What are the Types and Sources of Emissions Out There?

Types and Sources

Industrial

Indoor Exposures

Cigarette Smoking

Hobbies

Things We Eat, Drink

Many Others

Vehicle Exhaust

Blowing Dust (Roads, CAFOs)

Refueling Our Cars

Ambient Air Pollution (China)

Step 2 - Exposure Assessment

Exposure assessment answers three key questions:

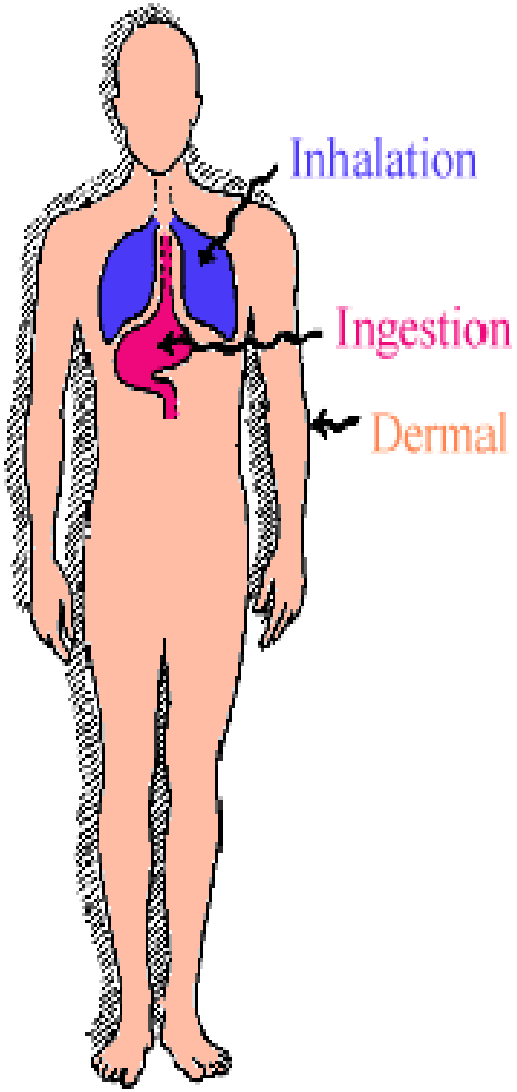
- How are people exposed?
- Who could be exposed?
- How much of the chemicals are people exposed to?

People must come in contact with chemicals from the site to be at risk

Routes of Exposure

Major routes are:

1. Ingestion (things we eat and drink)
2. Inhalation (things we breathe)
3. Dermal/Skin Absorption (soil, swimming)
4. Injection
5. Trans-placental/Nursing (mother to child)



Depending on who is thought to be exposed,…

- Resident
- Farmer
- Recreational Visitor
- Worker
- Etc.

… a daily intake factor (exposure) can be estimated. This factor tells us how much intake of a given media (air, soil, water) is expected.

Dose

"All substances are poisons; there is none which is not poison. The right dose differentiates a poison and a remedy."

- Paracelsus (1493-1541)

Intake Rate x Concentration = Dose

Dose is the amount of chemical entering the body, and is typically expressed as:

mg of chemical per kg of body weight

or

mg/kg

Exposure Assessment

- Exposure potential (hazard assessment)

Identify [all] potential hazards to human health

Determine the type and magnitude of potential human exposures to toxins

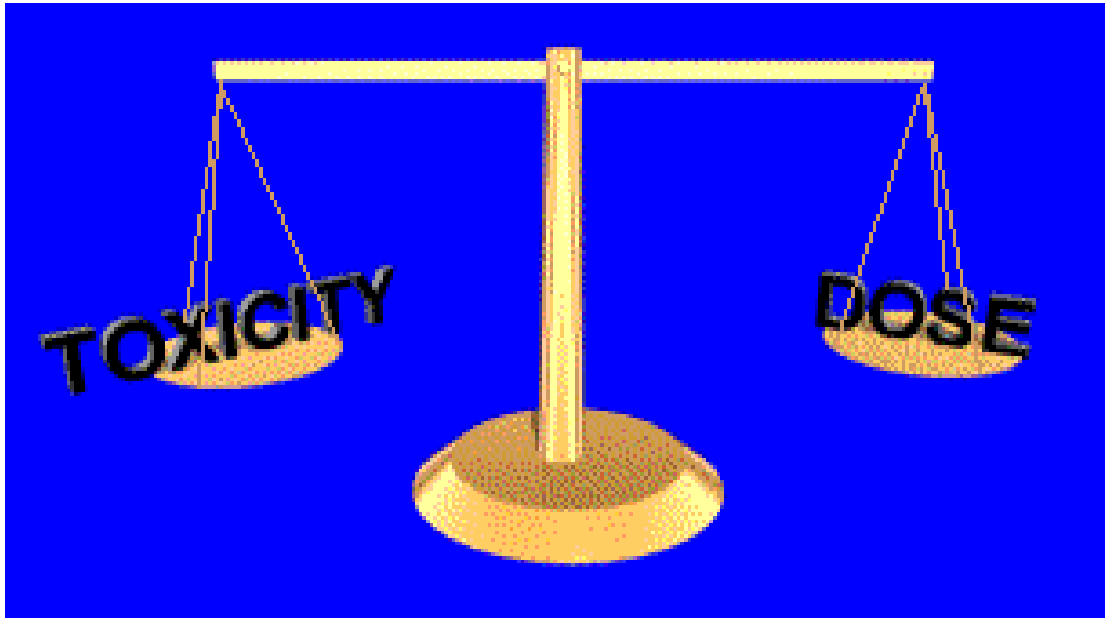
Step 3 - Toxicity Assessment

Toxicology is the study of adverse effects of chemicals in living organisms

This step of the risk assessment process considers:

1) the types of adverse health effects associated with particular chemical exposures;
2) the relationship between magnitude of exposure and adverse effects

The balance between toxicity and dose



Dose is the AMOUNT of something you are exposed to, or come in contact with. The less the toxicity, the greater the dose you can tolerate without ill effects. The greater the toxicity, the less dose you can tolerate without becoming sick.

Toxicity Assessment

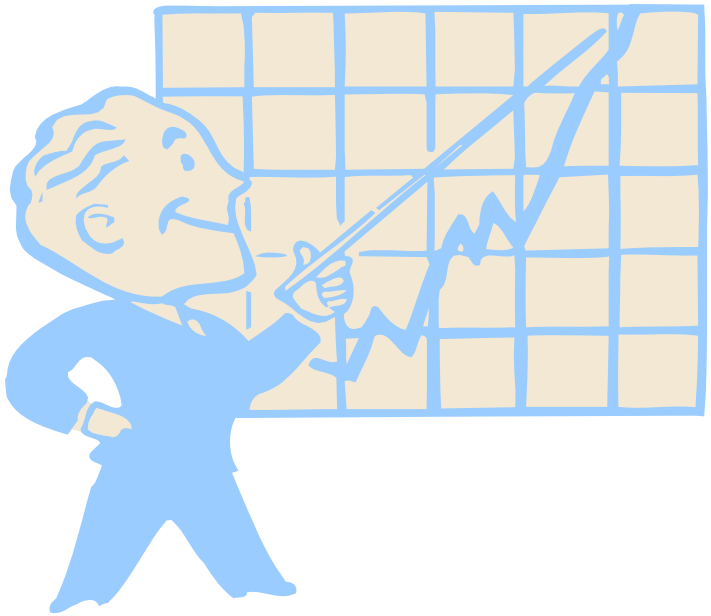
- Is the contaminant harmful?
- Characterize the “community” (Who, what is at risk?)

What Makes a Material "Harmful"?

- Source (Where does it come from?)
- Dose (How much?)
- Route of Exposure (How does it get into the body?)
- Condition of the Exposed Individual
  - concurrent illnesses/health conditions
  - previous injury/other exposures
  - age
- Duration of Exposure (How long?)
- Effects can be Acute, Chronic, or Latent

Step 4 - Risk Characterization

The risk characterization summarizes and combines outputs of the exposure and toxicity assessments to characterize risk.



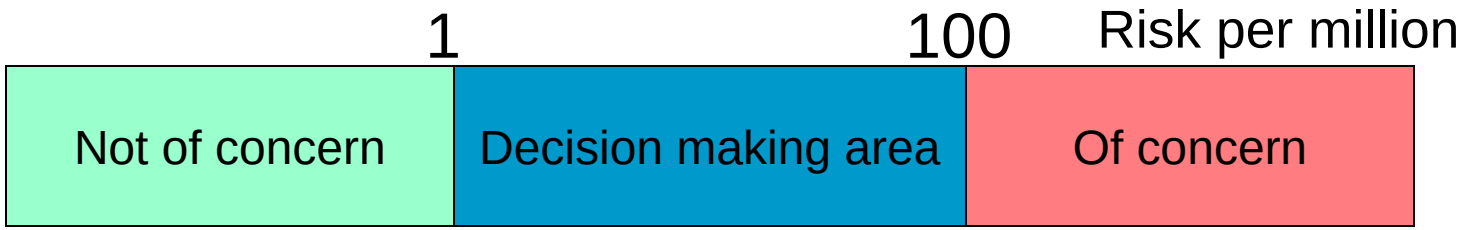
Risks from carcinogens and non-carcinogens are evaluated separately

- For carcinogens, evaluate the increased probability of individuals' getting cancer during their lifetime from a particular exposure
- For other toxicants, compare the expected exposure to an exposure that is assumed to be insignificant

The level of cancer risk that is of concern is a matter of individual, community and regulatory judgment. However,……..

Risks below 1 in a million ($1x10^{-6}$) are typically considered to be well below a level of concern

Risks above 100 per million ($1X10^{-4}$) are typically deemed large enough that some sort of action or intervention is evaluated.



Noncancer risks are described by a hazard quotient (HQ)

$$= \frac{\text{Dose from site}}{\text{“safe” dose}}$$

If the HQ is equal to or less than a value of 1, it is believed that there is no appreciable risk that noncancer effects will occur.

If an HQ exceeds 1, there is some possibility that noncancer effects may occur, although an HQ above 1 does not indicate that an effect will definitely occur.

Risk Characterization

- Develop “probability statements” about risk to individuals within the community (current or future risk)
  - Exposure potential
  - Risk factors related to age, health status, etc.
- Draw conclusions about relationship between exposure and observed health conditions

"THERE COULD BE ANY NUMBER OF CAUSES FOR THIS CONDITION. PERHAPS HE BROKE A MIRROR OR WALKED UNDER A LADDER OR SPILLED SOME SALT..."

“The Big Picture”

Relating SOURCES of contaminants and their PRESENCE in the environment to human EXPOSURE, ABSORBED DOSE, SUSCEPTIBILITY and HEALTH EFFECTS

Case Study: Benzene

Data Collection/Evaluation
Exposure Assessment
Toxicity Assessment
Risk Characterization

Case Study: Benzene - Data Collection/Evaluation

- Determine how much of a chemical is present

  Ex: Air Quality Monitoring, Occupational Monitoring, Hobbies, Smoking Habits, etc.

- Determine where a chemical is present

  Ex: Monitoring, Reported Information (MSDS, EPA), and other data sources

Case Study: Benzene - Exposure Assessment

- **How are people exposed?**

  A: Benzene in many products, processes

- **Who could be exposed?**

  A: People who put gas in their cars, smokers, workers (petroleum, mining), hobbyists, general public, etc.

- **How much of the chemical are people exposed to?**

  A: Dose will depend on sources, proximity, length of exposure, etc.

Case Study: Benzene - Toxicity Assessment

Types of adverse health effects associated with benzene exposures;

A: Cancer and non-cancer health effects

Relationship between magnitude of exposure and adverse effects

A: Dose dependent (presence $\neq$ health issue)

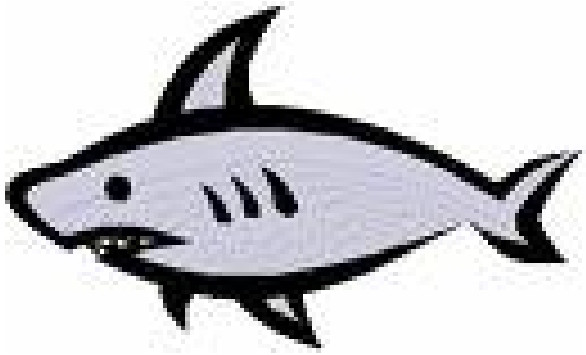
Case Study: Benzene - Risk Characterization

Develop “probability statements” about risk to individuals within the community (current or future risk)

Draw conclusions about relationship between exposure and observed health conditions

Risk characterization will be an important component of any effort to understand issues around benzene

Risk Perception



Closing Comments

• There is a Science to Understanding, Addressing Risk

Relating SOURCES of contaminants and their PRESENCE in the environment to human EXPOSURE, ABSORBED DOSE, SUSCEPTIBILITY and HEALTH EFFECTS

• There is also an Important Human Dimension
(Shark and Jelly Fish Story)
• Both Dimensions Need to Be Considered Together

Thanks …

Dr. Teri Coons
Dr. Raj Goyal
Ray Mohr
Lisa Silva

Questions?

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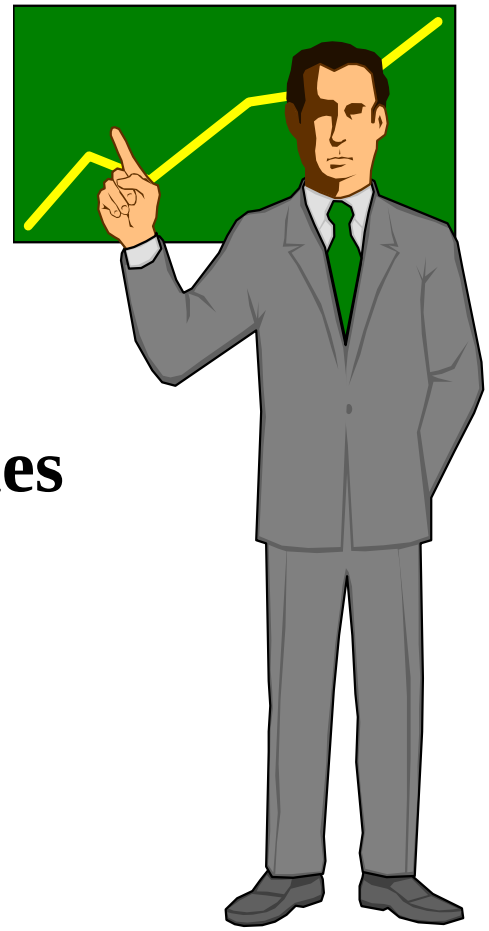


General Comments and Observations on Air Quality

"Clean Air Act provides legal framework for promoting Public Health and welfare by pursuing five major air quality goals."

National Academy of Science, from
"Air Quality Management in the United States" (2004)

Five Goals of Clean Air Act

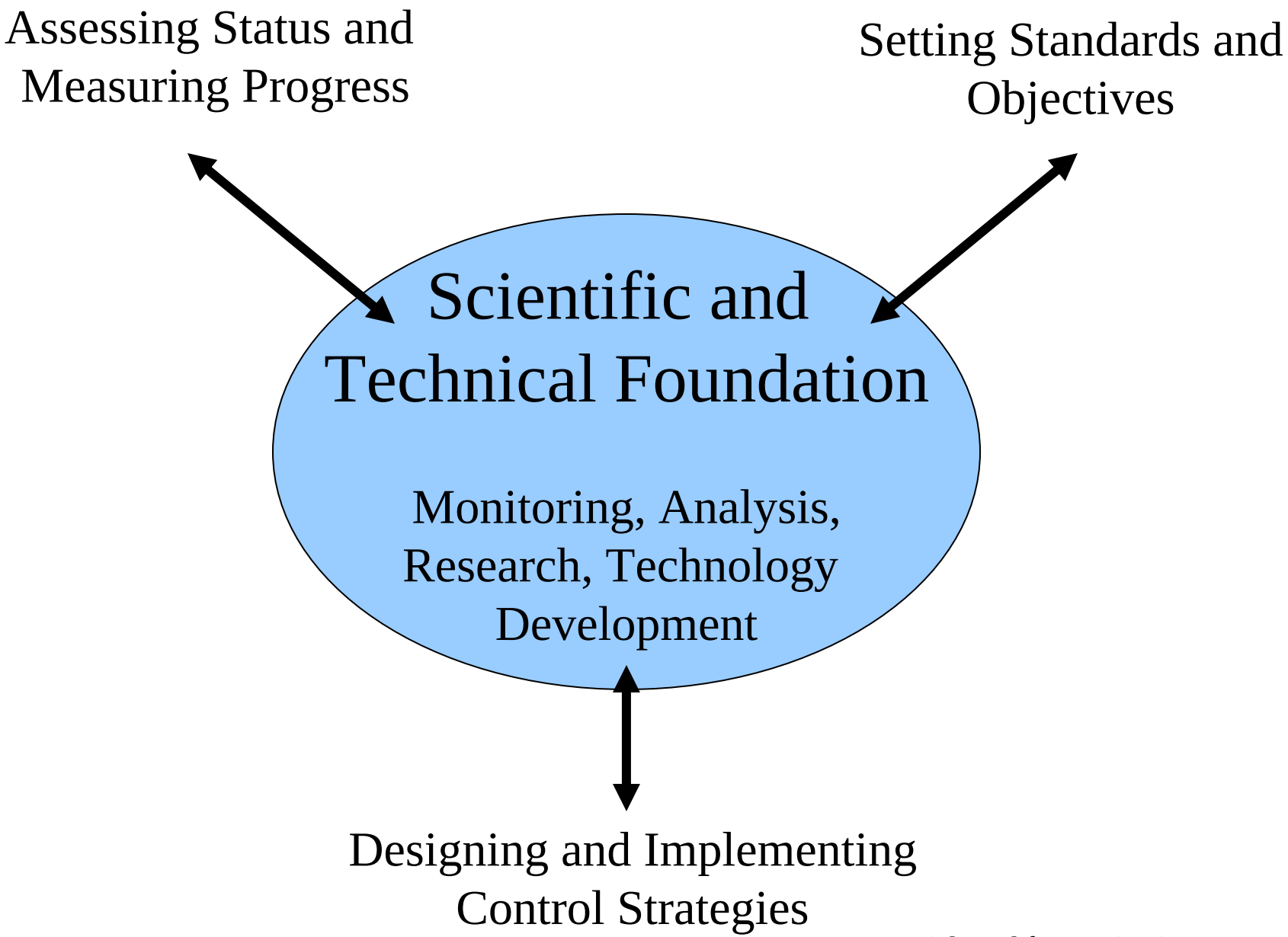
- Mitigate potentially harmful ambient concentrations of six criteria pollutants
- Limit sources of Exposure to Hazardous Air Pollutants
- Protect and Improve Visibility in Wilderness Areas and National Parks
- Reduce Emissions of Substances that Cause Acid Deposition (Sulfur Dioxide and Nitrogen Oxides)
- Curb the Use of Chemicals that Have the Potential to Deplete the Stratospheric Ozone Layer

Progress

- Substantial Decreases in Concentrations of Several Pollutants
- Regulations for Certain Vehicle and Fuel Properties
- Stationary Sources (Power Plants, Manufacturing)
- Cap and Trade Mechanisms (Acid Rain, Mercury)
- Demonstrated (Monitored) Reductions in Urban Areas, Pollutant Deposition
- Net Economic Benefits

Challenges

- New Air Quality Standards (Ozone, PM, Haze)
- Toxic Air Pollutants
- Health Effects of Lower Pollutant Concentrations
- Environmental Justice
- Protecting Ecosystem Health
- Multi-State, Cross-Border and Intercontinental Transport
- Climate Change



Adapted from NAS AQM Report

Clean Air Act Sets Standards in the Following Manners:

- National Ambient Air Quality Standards (Criteria Pollutants)
- Emission Standards for Hazardous Air Pollutants (HAPs)
- Residual Risk Efforts for HAPs
- Fuel and Product Reformulation, Reqt's for CFCs
- Reduced Caps for Certain Pollutants (e.g., SO2 and cap-and-trade programs)
- And Other Strategies

The Criteria Pollutants

Criteria Pollutants may “reasonably be anticipated to endanger public health and welfare”

Carbon Monoxide

Lead

Nitrogen Dioxide

Ozone

Particulate Matter (PM_{10} and $PM_{2.5}$)

Sulfur Dioxide

NAAQS

National Ambient Air Quality Standards are numerical standards of specific air pollutants (criteria pollutants)

Primary and Secondary Standards

- Primary Standards – Protect Public Health including the Health of Sensitive Populations (asthmatics, children, and the elderly);

- Secondary Standards – Protect Public Welfare including protection against Decreased Visibility, Damage to Animals, Crops, Vegetation, and Buildings;

National Ambient Air Quality Standards

Pollutant	Primary Stds.	Averaging Times	Secondary Stds.
Carbon Monoxide	9 ppm	8-hour[1]	None
	35 ppm	1-hour[1]	None
Lead	1.5 µg/m^3	Quarterly Average	Same as Primary
Nitrogen Dioxide	0.053 ppm	Annual (Arithmetic Mean)	Same as Primary
Particulate Matter (PM_{10})	50 µg/m^3 (Revoked)	Annual[2] (Arith. Mean)	Same as Primary
	150 ug/m^3	24-hour[1]	
Particulate Matter ($PM_{2.5}$)	15 µg/m^3	Annual[3] (Arith. Mean)	Same as Primary
	35 ug/m^3	24-hour[4]	
Ozone	0.08 ppm	8-hour[5]	Same as Primary
	0.12 ppm	1-hour[6]	Same as Primary
Sulfur Oxides	0.03 ppm	Annual (Arith. Mean)	-------
	0.14 ppm	24-hour[1]	-------
	-------	3-hour[1]	0.5 ppm (1300 ug/m^3)

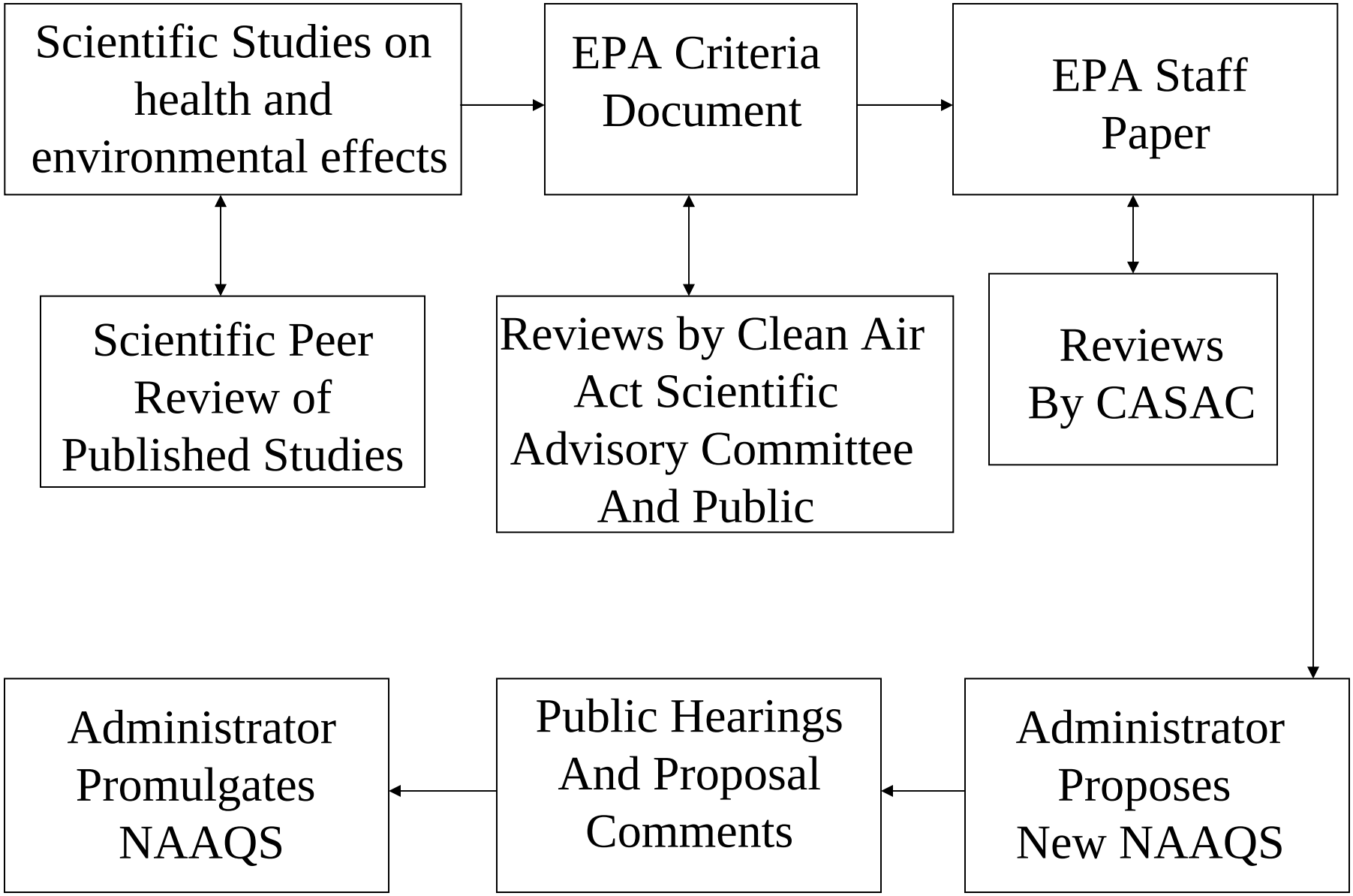
How Does EPA Evaluate Standards?

- Scientific Panel Reviews Pertinent Health and Welfare Literature for each Criteria Pollutant (Thousands of References);
- Considers Range of Issues (Physical Properties to Exposure and Health Effects);
- Provides Adequate Margin of Safety
- Develops Criteria Document for each Pollutant
- Substantial Review Process
- Meant to be Repeated Every Five Years

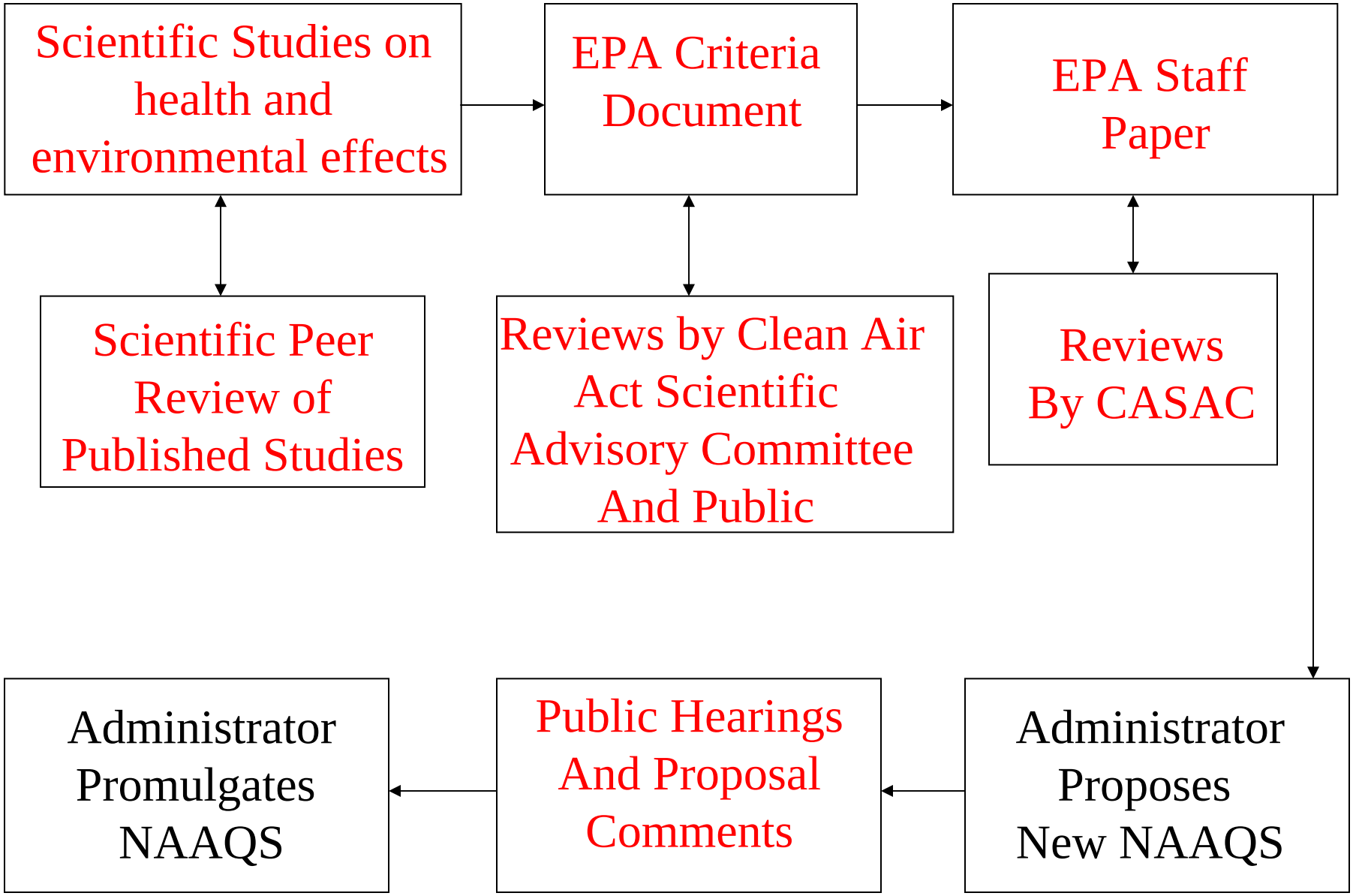
What is a Criteria Document?

- CD critically assesses latest scientific research on health effects of ambient air pollution
- Required by the Clean Air Act (CAA Sections 108 and 109)
- All Criteria Pollutants Considered
- State of Colorado Active in CD Reviews

Flow Diagram of NAAQS Review and Administration



Risk and the NAAQS Review



Standard Setting Procedure for HAPs

Unlike Criteria Pollutants, Control of HAPs is Based on Initial Development of Emission Standards and Subsequent Risk that Remains Following Implementation ("Residual Risk)

HAP Standards on:

1 - "Major" Sources (10t/yr HAP or 25t/yr HAPs)
2 – "Area" Sources (represent ≤90% of emissions from 30 or more HAPs)

More on Hazardous Air Pollutants …

• Reducing HAPs through standards:

1- Maximum Achievable Control Technologies (MACT)
- Often Technology Based

2- Generally Available Control Technologies (GACT)
- Can be Work Practice Based

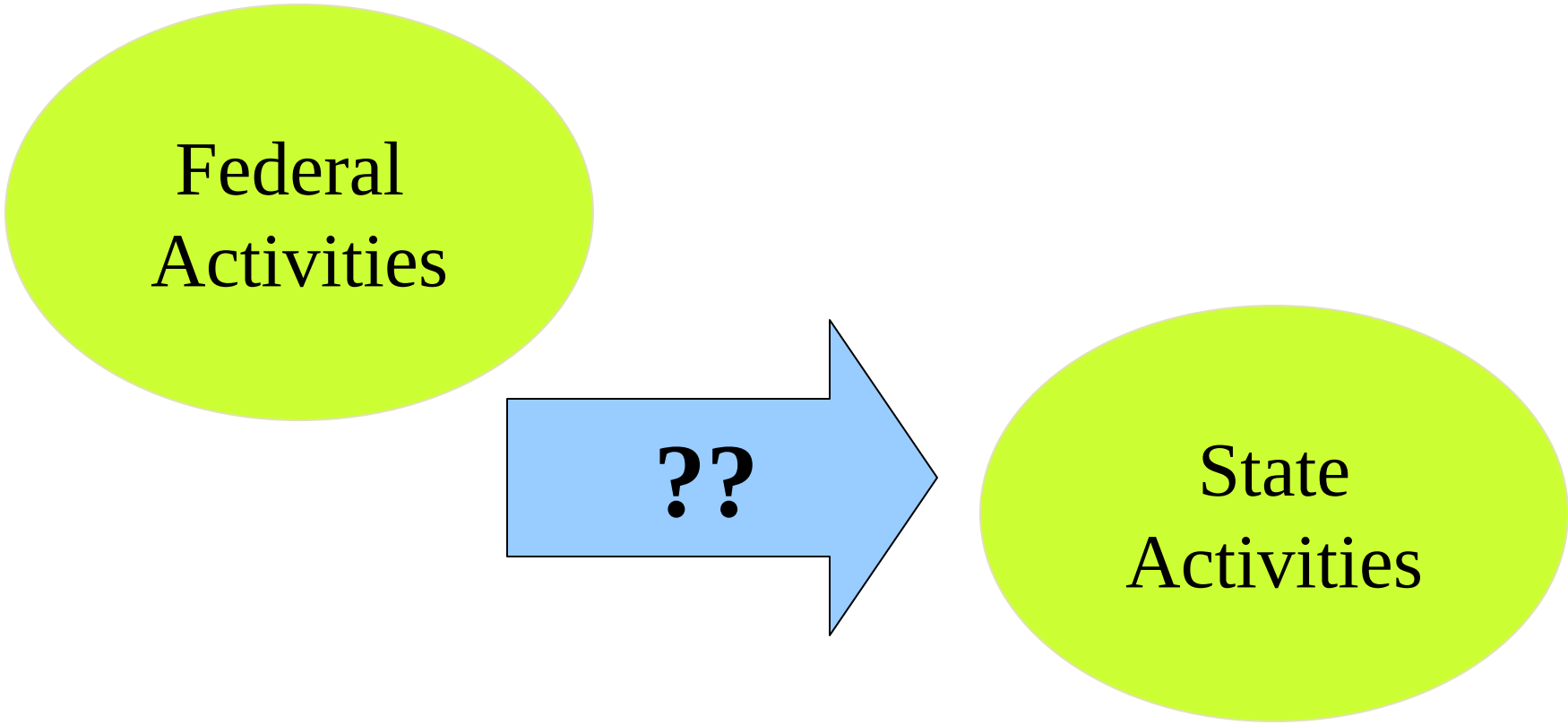
• 188 HAPs identified by Clean Air Act (Sec. 112)

Recent HAP Activities*

- There were 62 MACT standards for 100 major stationary source categories (CAA Title V);
- Many now undergoing residual risk analysis;
- Standards in place for 16 area sources;
- More to be promulgated through 2012 for additional 55 categories;
- HAPs from mobile sources and fuels – Ex: Rule targeting benzene was finalized Feb. 2007.

* As of June 2007

So, How Do We Get These Efforts More “Local?”



Strategies for States to Address Air Quality

- State Implementation Plans (e.g., Front Range Ozone)
  Ex: Use of Mandatory Local Control Measures

- Promulgation of Federal Rules
  Ex: NAAQS (Criteria Pollutants), MACT for HAPs

- State-Only Rule Development
  Ex: Blowing Dust Control Measures

- Voluntary Programs
  Ex: Mercury Free Colorado Campaign

- And Others, as Warranted

State of Colorado Air Quality Rulemaking Process

Four general categories:

(1) Request for rule-making hearing

(2) Pre-hearing process

(3) Public rule-making hearing

(4) Requirements imposed after the public rule-making hearing

Also, citizen involvement/ participation is important

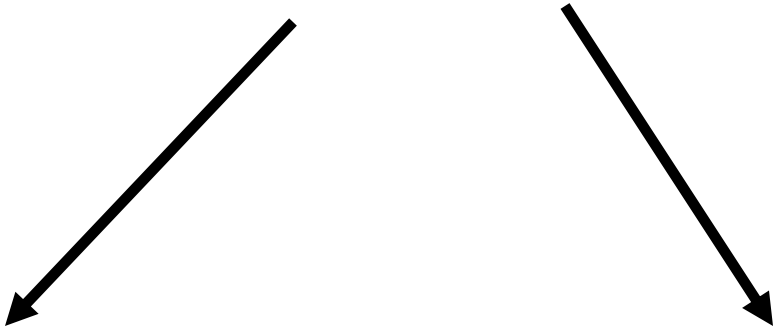
Air Quality Control Commission Regulations

- Procedural Rules [1] (amended 10/18/07 & 10/19/07, effective 11/30/07)
- Common Provisions Regulation [2] (amended 12/15/06, effective 3/7/07)
- Regulation 1 - Particulates, Smokes, Carbon Monoxide and Sulfur Oxides [3] (amended 6/21/07, effective 8/30/07)
- Regulation 2 - Odor Emissions [4](amended 12/14/06, effective 3/4/07)
- Regulation 3 - Stationary Source Permitting and Air Pollutant Emission Notice Requirements (amended 10/18/07, effective 11/30/07)
- Regulation 4 - New Wood Stoves and the Use of Certain Woodburning Appliances during High Pollution Days [6] (amended 6/16/06, effective 8/30/06)
- Regulation 5 - Generic Emissions Trading and Banking [7]-Repealed 2/17/05
- Regulation 6 - Standards of Performance for New Stationary Sources [8] (amended 10/18/07, effective 11/30/07)
- Regulation 7 - Emissions of Volatile Organic Compounds [9] (amended 12/17/06, effective 3/4/07)
- Regulation 8 - Control of Hazardous Air Pollutants [10] -(amended 10/18/07, effective 11/30/07)
- Regulation 9 - Open Burning, Prescribed Fire, and Permitting (amended 6/21/07, effective 8/30/07)

AQCC Regulations - Continued

- Regulation 10 - Criteria for Analysis of Conformity [12]
- Regulation 11 - Motor Vehicle Emissions Inspection Program [13] (amended 10/18/07, effective 11/30/07)
- Ambient Air Quality Standards [14] (amended 12/15/05, effective 3/2/06)
- Regulation 12 - Reduction of Diesel Vehicle Emissions [15] (amended 11/16/06, effective 1/30/07)
- Regulation 13 -Oxygenated Fuels Program [16] (last update effective 3/2/03)
- Regulation 14 - Reduction of Motor Vehicle Air Pollution from Alternative Fueled Vehicles [17] -(This regulation has been repealed effective 10/30/99)
- Regulation 15 - Control of Emission of Ozone Depleting Compounds [19]
- State Implementation Plan Specific Regulations for Nonattainment - Attainment/Maintenance Areas (Local Elements) [20] - (last update effective 9/30/02)
- Regulation 16 - Street Sanding Emissions [18] (last update effective 6/30/01)
- Regulation 17 - Clean Fuel Fleet Program [21] (repealed August 2002))
- Regulation 18 - Control of Emissions of Acid Deposition Precursors [22] (amended 2/6/07, effective 4/1/07)
- Regulation 19 - The Control of Lead Hazards [23], Part A: Lead-Based Paint Abatement and Part B: Pre-Renovation Education in Target Housing (amended 2/15/07, effective 4/30/07)

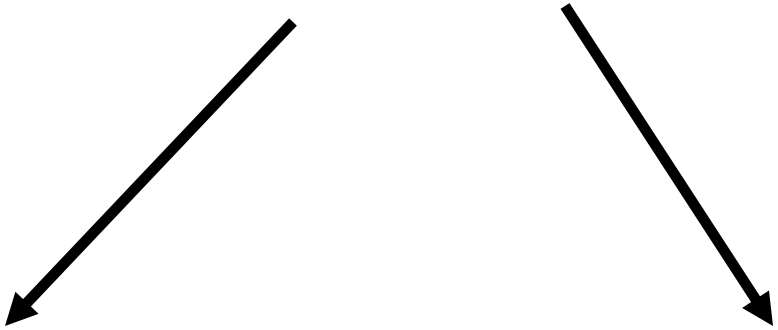
Addressing Air Quality



Regulatory

Non- Regulatory (Pollution Prevention)

Addressing Air Quality



Regulatory

Non- Regulatory (Pollution Prevention)

Regulatory Efforts to Improve AQ Case Study:

Clean Air Mercury Rule

Mercury Emissions from Power Plants

- Power Plants are Largest Human-Made Air Source in U.S.
- Mercury is Natural Component of Coal
- For Fate and Transport, Chemistry is Key
  - Hg^0 versus Hg^2
  - Chlorine Content
  - Not All Coal Created Equally
- Emissions Contribute to "Global Pool" But…
  Are Likely Local Contributors as Well
- Emissions From Plants Being Addressed by
  Clean Air Mercury Rule

Clean Air Mercury Rule

- EPA Rule to Control Mercury Emissions from Coal-Fired Electric Utilities
- New Source Performance Standard (CAA Sec. 111)
- National Cap Distributed by EPA to States
- States Distribute Mercury Allowances to Facilities
- Some States with “Excess” Allowances, Some with “Deficits”
- Allows for Mercury Emissions Trading (“Hot Spots”)
- States to Develop Plan of Action for Allowances by November 2006

Colorado CAMR

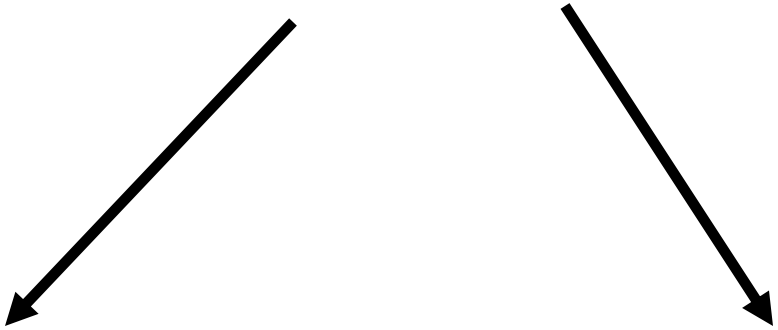
- One of the more aggressive reduction programs in the U.S.
- All mercury allowances come to State for distribution
- State distributes only what are needed
- Power plants cut emissions beginning in 2012 (80%); all facilities reduce by 2018 (90%);
- Extensive mercury monitoring requirements of facilities
- Creates “Colorado Citizens’ Hg Reduction Trust”
- Plan is currently with EPA for review and approval

The Implementation of Regulation No. 7's Oil and Gas Requirements and Regulatory Efforts

Lessons Learned with Rulemaking Efforts

- Often core of rulemaking starts with Federal activity
- Process is formal at times
- Formal nature preserves process
- Effort often takes a long time from start to finish
- Rule is often result of carefully crafted negotiation

Addressing Mercury



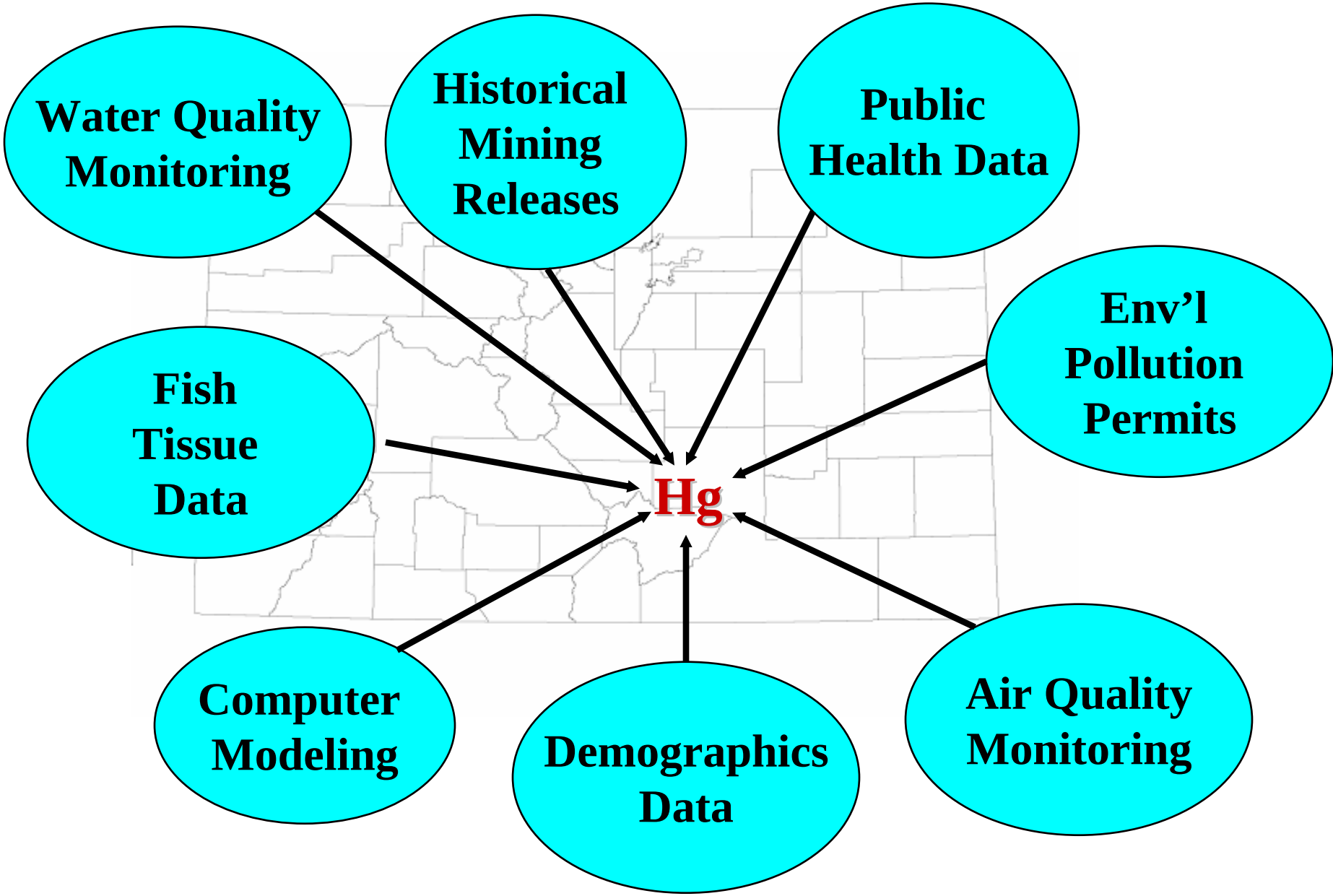
Regulatory

Non- Regulatory (Pollution Prevention)

Voluntary Efforts to Improve AQ Case Study:

National Vehicle Mercury Switch Replacement Program

Holistically Assessing Mercury Impacts



“Mercury-Free Colorado Campaign” Initiatives

- Problem Characterization
- Crematoria
- Consumer (Thermostat/ Thermometer)
- Public Education and Outreach
- Industry (Automotive Switch)
- Dental/ Oral Health

Environmental Achievement Award

Pollution Prevention Champion Award

2005

Industry Mercury Project

Goal: Reduce mercury pollution via implementation of automotive switch removal program designed to ultimately reduce air emissions at steel mill;

Environmental Metrics/ Measurable Results

- Cooperative effort between CDPHE and the Colorado Automotive Recyclers
- Identification of four dozen participating automotive recycling entities
- Implementation of switch removal program at numerous automotive sites
- Contractor handles pick up and disposal of collected switches
- Tens of thousands of switches removed to date
- Over 170 pounds of mercury diverted from area steel mill in first two years
- Possibly looking to more formally address this sector

Lessons Learned with Non-Regulatory Approaches to Air Quality

- Often core of effort starts due to lack of federal activity
- Process is often informal, though can become very formal
- Informal nature can encourage innovation
- Effort can be fluid in response to “lessons learned,” new ideas
- Lots of possible issues, need strategy to identify opportunities

  Ex: Environmental Problem Solving

Question: How Target Important Issues?

Question: How Target Important Issues?

Answer: Environmental Problem Solving

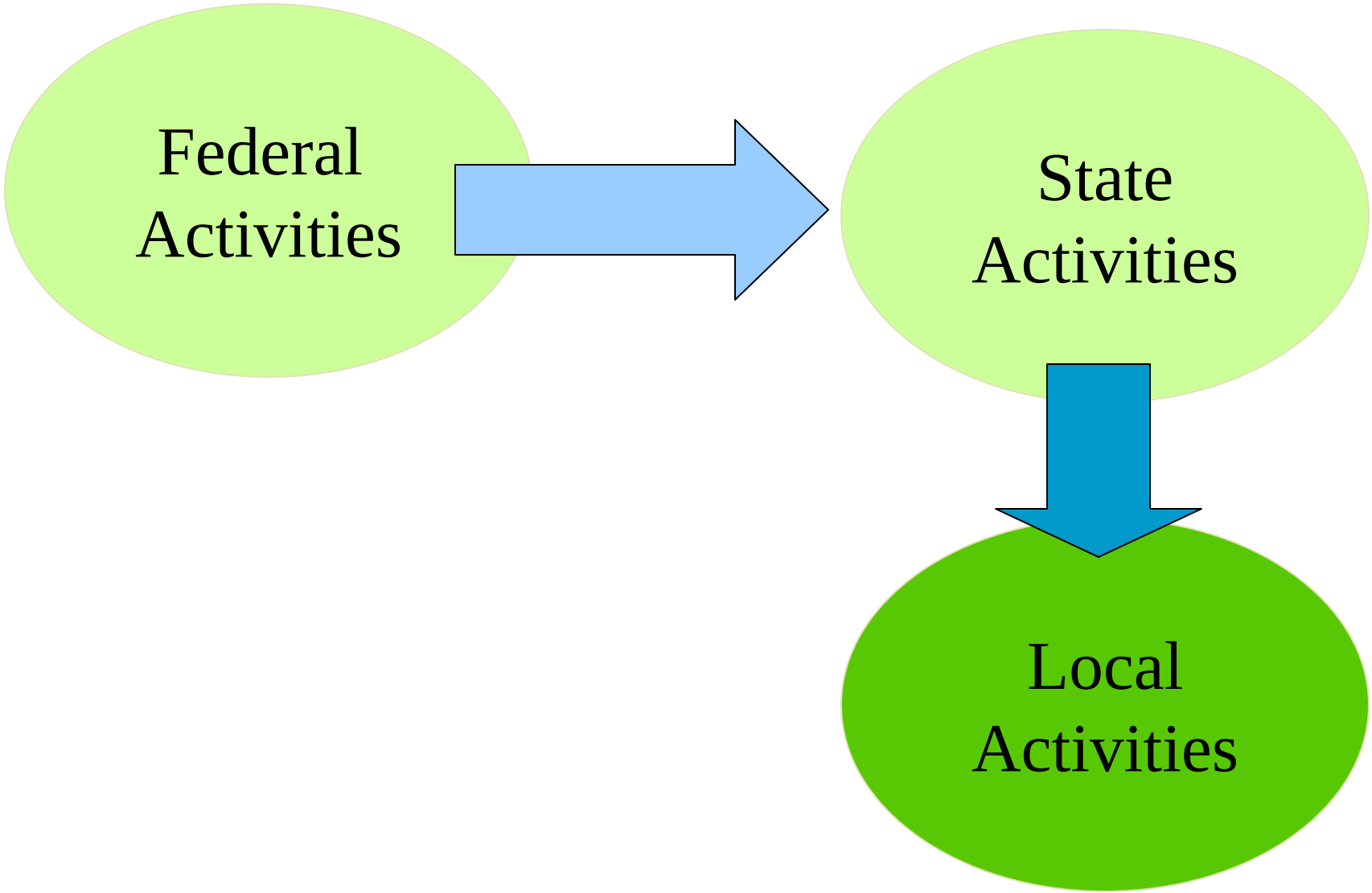
- Immediate, urgent, or significant human health risk?
- Potential for environmental harm or significant benefit?
- Is there a well-defined set of impacts?
- Is the problem recurring or a cluster of occurrences?
- Is it within the agency's role and jurisdiction?
- Is it conceivable that success could be measured?
- What are the public expectations?
- Is the problem important to the public?
- Would staff and stakeholders be willing to work on it?

Question: How Target Important Issues?
Answer: Environmental Problem Solving

CDPHE Results:

- Mercury Program (~15 initiatives)
- Pharmaceuticals in the Environment/
  Emerging Contaminants
- Health and Environmental Effects of Nanomaterials
- Cross Media Compliance Assistance
- Environmental Results Program
- Others

So, How Do We Get These Efforts More “Local?”



Regulated and Non-Regulated Activities in Garfield County

Regulated Activities In Garfield County

Oil and Gas (Reg. 7 Efforts)

Gas Plants

Dehydrators

Mining Operations

Concrete Batch Plants

Asphalt Plants

Sand and Gravel Operations

Gas Processing

Compressors

Condensate Tanks

Hospitals

Gas Stations

Dry Cleaners

Any Others (~675 Sources in State Emissions Inventory)

Non-Regulated Activities in the County

Automobiles

VOC Controls for Odor

Green Completions

Issues that Affect Climate Change

Many Indoor Air Quality Issues

And Others

So, Why Are some Activities Un-Regulated?

- Outside of Regulatory Authority (Climate Change)
- Standards Not Developed, Thus No Regulations
- Not Well Understood, Control Options Not Yet Available

- Still, use of Voluntary Programs may be of Value (EPA STAR Program)
- And, More Efforts Are Likely on the Horizon

Citizen Involvement

- Citizens can be the early “eyes and ears” for CDPHE
- CDPHE responsive to citizen inquiries, complaints
- Citizen input can carry weight (Rule development)

So, Where Do We Go From Here?

- Awaiting Results of County Emission Inventory
- Awaiting Results of Health Risk Efforts

Where Do I get More Information?

www.cdphe.state.co.us/ap/index.html
Air Pollution control Division homepage

www.cdphe.state.co.us/op/aqcc/handbook.pdf
AQCC Handbook on Air Quality Rulemaking

www.epa.gov
EPA Homepage

Questions?

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