PM Science/Policy Futures

Deconstructing a Multiple Pollutant

PM Centers Kickoff Meeting

November 20-December 1, 2005

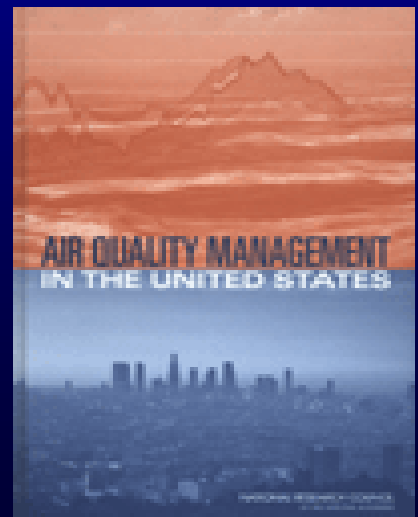
John Bachmann
Associate Director for Science/Policy and New Programs
Office of Air Quality Planning and Standards

Key Points

- EPA air regulatory programs a major consumer and contributor to PM/ozone research program
  - Monitoring, modeling, risk & benefits assessment
  - Our programs are changing the chemical climate of North America
- PM/Ozone force consideration of multi-pollutant approaches
  - National regional rules
- We are rethinking Air Quality Management to face multiple challenges in the future
  - PM/Ozone - evolving NAAQS, need to attain everywhere
  - Reducing risk from toxic air pollutants
  - Protecting health and welfare in absence of threshold exposure
  - Ensuring environmental justice
  - Assessing and protecting ecosystem health
  - Addressing multi-state, cross-border and intercontinental transport
  - Effects of air pollutants on climate, adapting AQM to climate change
  - Addressing near roadway exposures
  - Responding to calls for improved accountability

NRC Recommendations to improve the U.S. AQM System

1. Strengthen Scientific and Technical Capacity
2. Expand National and Multistate Control Strategies
3. Transform the SIP Process
4. Develop Integrated Program for Criteria and Hazardous Air Pollutants
5. Enhance Protection of Ecosystems and Public Welfare

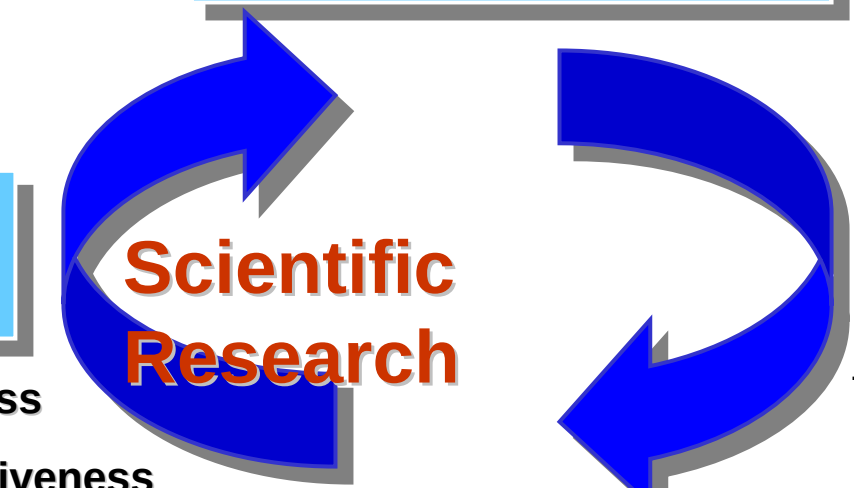


Emerging Challenges for Air Policy

- The evolving PM/Ozone NAAQS
- Reducing risk from toxic air pollutants
- Protecting health and welfare in absence of threshold exposure
- Ensuring environmental justice

and……transport /exposures on even larger and much smaller scales

The Air Quality Management Process



ESTABLISH GOALS

-- National Ambient Air Quality Standards (NAAQS)

-- Regional Haze

DETERMINE NECESSARY REDUCTIONS

-- Monitoring

-- Inventories

-- Data Analysis & Modeling

DESIGN CONTROL STRATEGIES

-- National, Regional Rules

-e.g. Mobile, NSPS

-NOx SIP call, CAIR

-- Develop State, Local, Tribal Plans

IMPLEMENT

-- State Implementation Plans (SIPs)

-- Permits

-- Compliance & Enforcement

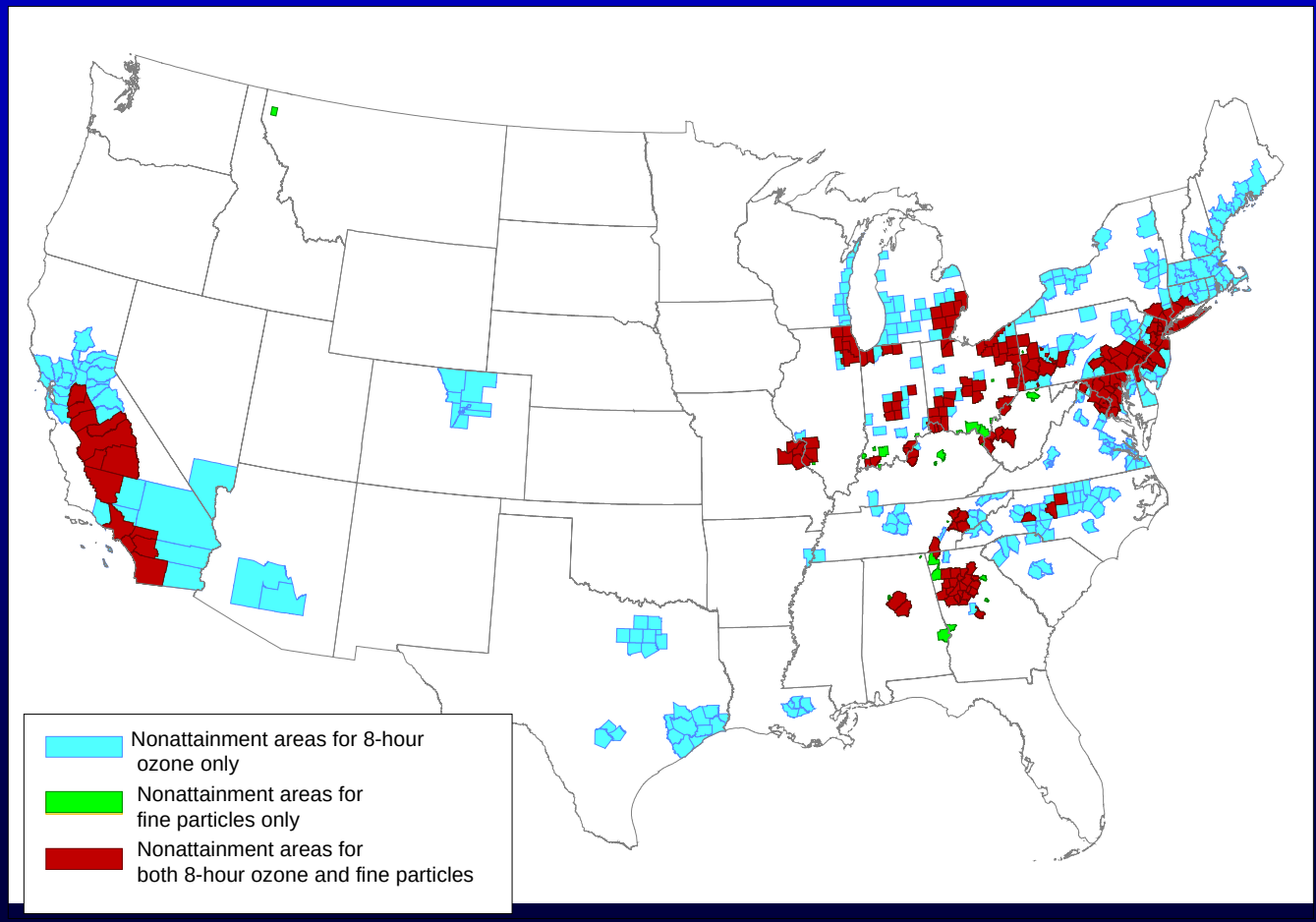
EVALUATE RESULTS

-- Assess Progress

-- Evaluate Effectiveness & Efficiency

Areas Not Meeting the NAAQS

Areas Designated Nonattainment for Ozone and $PM_{2.5}$ 2004



No. Counties with Monitors>NAAQS

CO	0
Lead	1
SO2	0
NO2	0
PM 10	12
PM 2.5	82
O_3	297

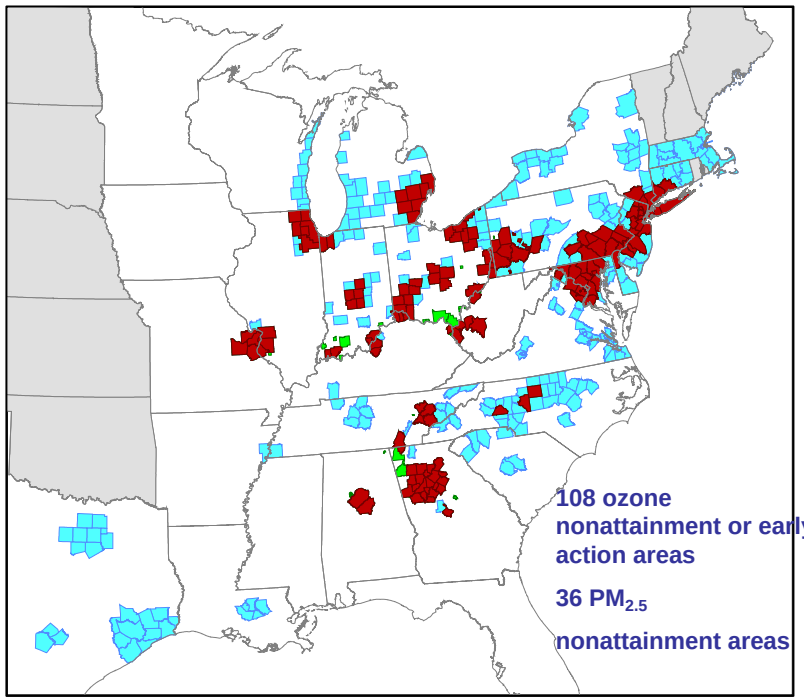
Ozone and PM are our highest priority

Where will air quality be in 10 years?

- Growth in population, energy use, VMT
- Base programs to implement the current standards more than offset growth
- State and local actions to implement the NAAQS (difficult to project)

Ozone and PM Attainment Forecast with CAIR and with Other Clean Air Programs – Eastern U.S. -- 2015

Ozone and Fine Particle Nonattainment Areas* (April 2005)

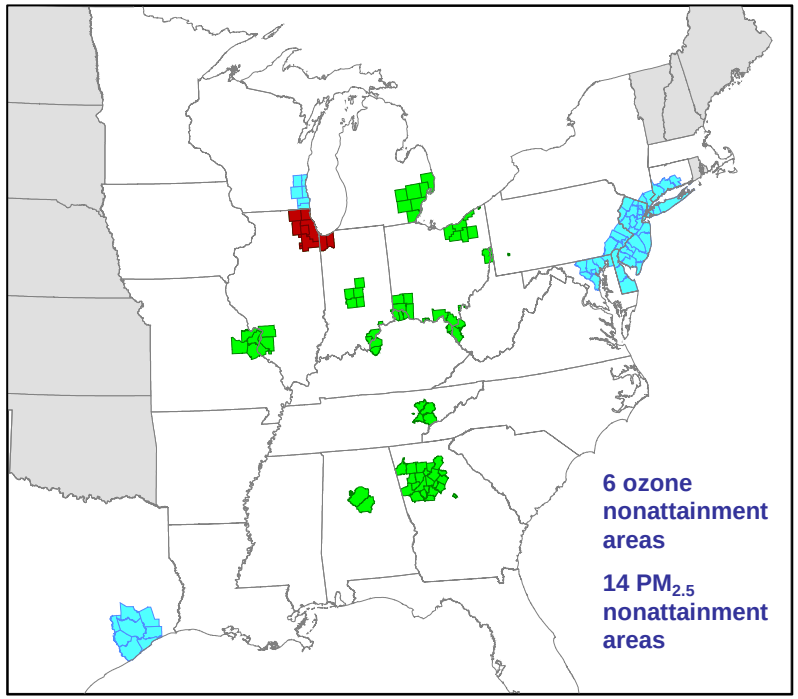


Nonattainment areas for 8-hour ozone pollution only

Nonattainment areas for fine particle pollution only

Nonattainment areas for both 8-hour ozone and fine particle pollution

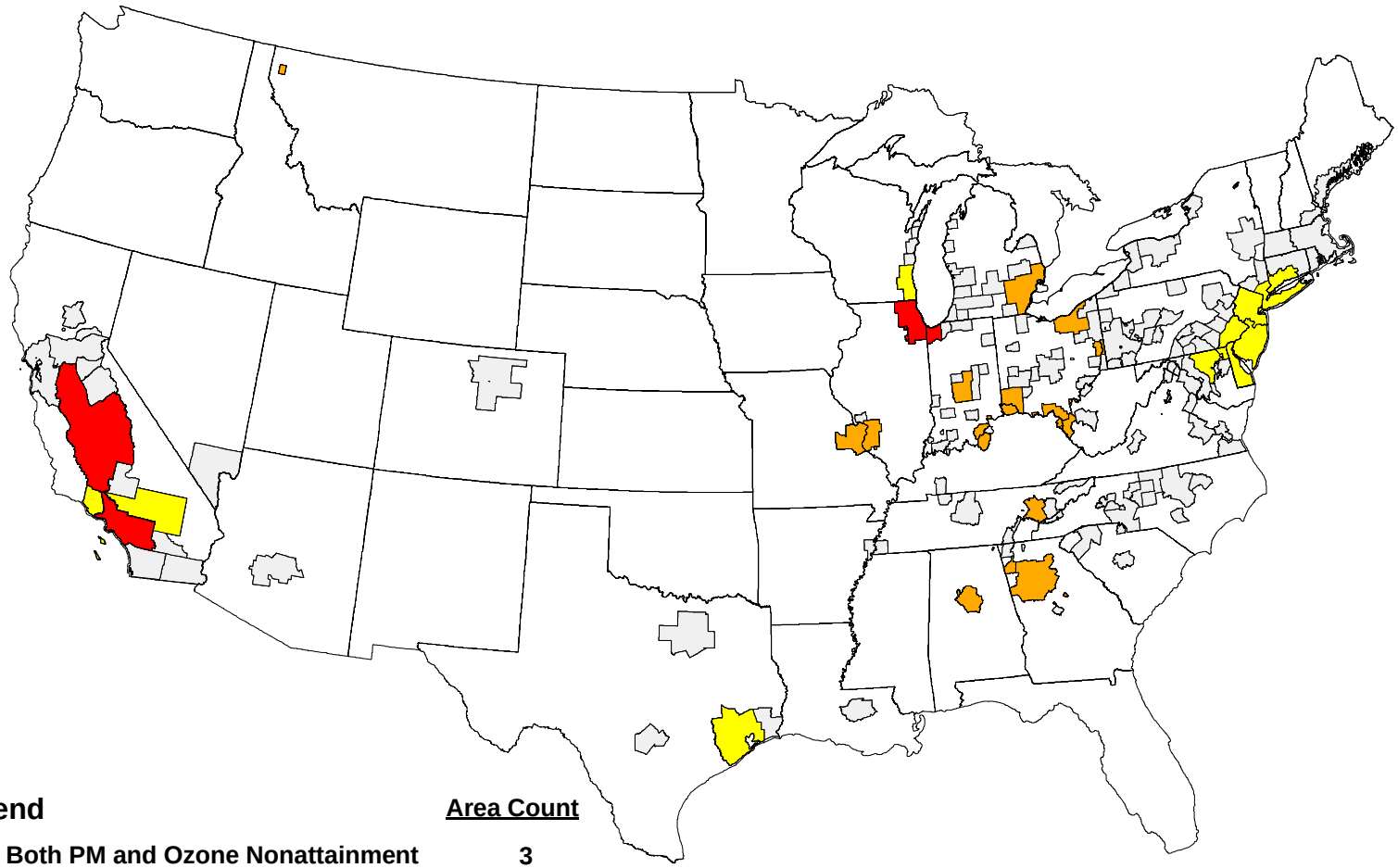
Projected Nonattainment Areas* in 2015 after Reductions from CAIR and Existing Clean Air Act Programs



*Although tallies include all nonattainment areas in the eastern U.S., maps show only those areas in States covered by CAIR. Four current O^3 nonattainment areas in New England are not pictured.

Projections concerning future levels of air pollution in specific geographic locations were estimated using the best scientific models available. They are estimations, however, and should be characterized as such in any description. Actual results may vary significantly if any of the factors that influence air quality differ from the assumed values used in the projections shown here.

Areas Projected to Exceed the $PM_{2.5}$ and 8-Hour Ozone Standards in 2015 with CAIR/CAMR/CAVR and Some Current Rules* Absent Additional Local Controls



Legend	Area Count
Both PM and Ozone Nonattainment	3
PM Only Nonattainment	14
Ozone Only Nonattainment	7
Nonattainment areas projected to attain	105

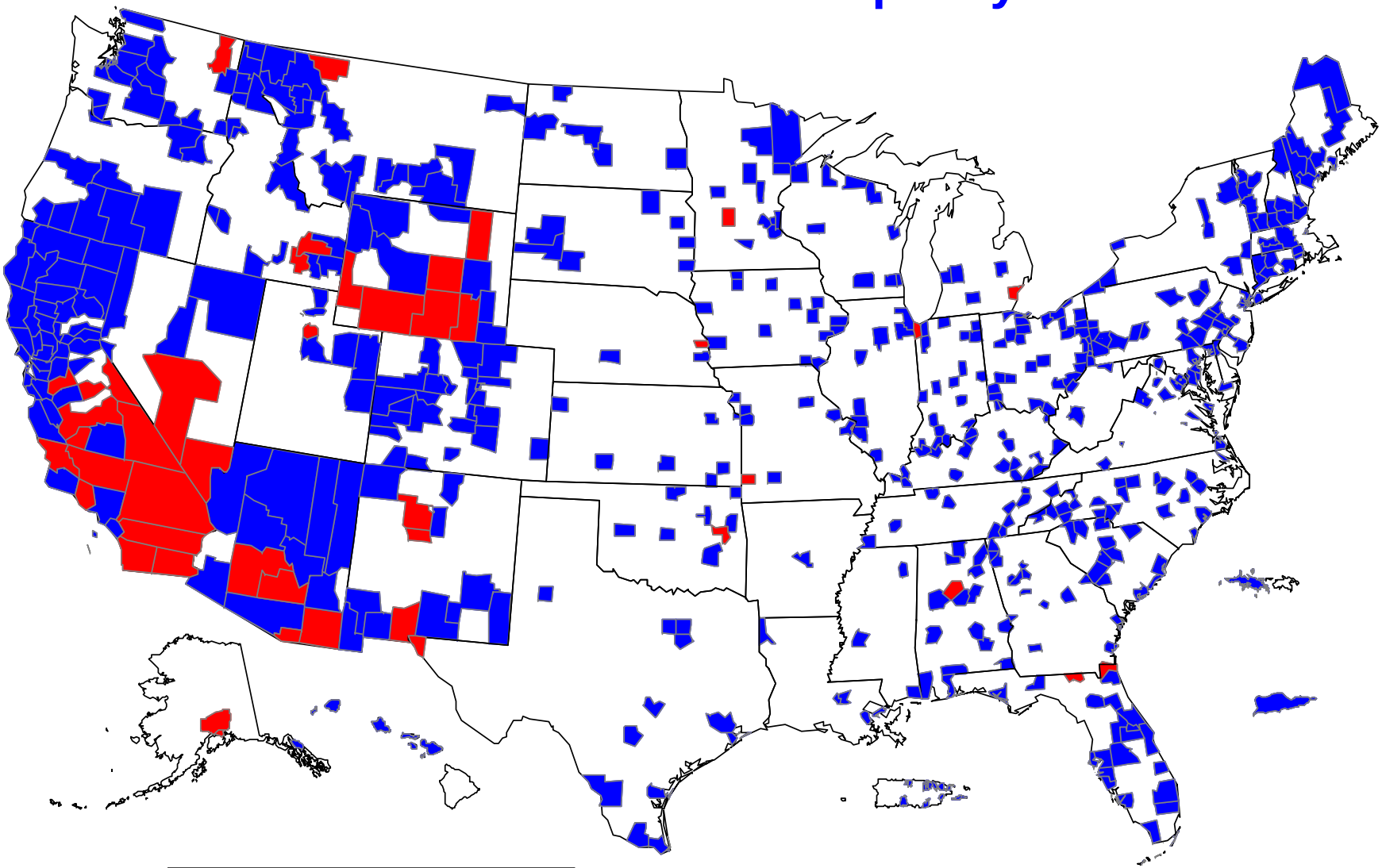
**Areas forecast to remain in nonattainment may need to adopt additional local or regional controls to attain the standards by dates set pursuant to the Clean Air Act. These additional local or regional measures are not forecast here, and therefore this figure overstates the extent of expected nonattainment.

*Current rules include Title IV of CAA, NO_x SIP Call, and some existing State rules.

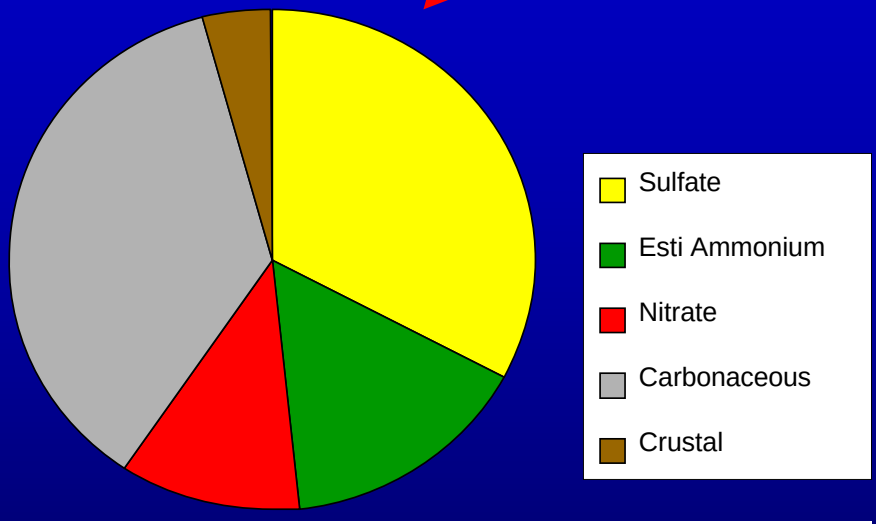
What if we revise the NAAQS?

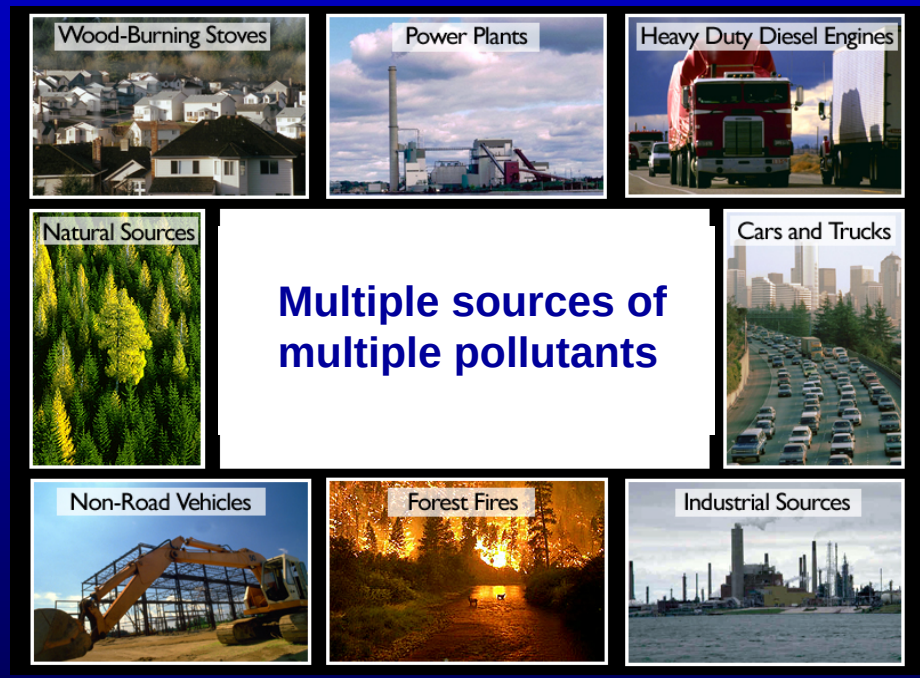
- Clean Air Scientific Advisory Committee, Staff Recommendations
  - Annual NAAQS, 13 to 15 ug/m3
  - 24 hour 98th percentile NAAQS 30-35 ug/m3
  - Replace PM10 with coarse standard excluding rural dust uncontaminated by urban, industrial sources

County-level status for current PM_{10} NAAQS based on 2001-2003 air quality data



Deconstructing $PM_{2.5}$





Pollutants contributing to PM2.5

SO2 – Sulfate particles

NOx – Nitrate PM, acid gases, formation of ozone and organic PM

VOC – formation of ozone and organic PM

VOC(C6unsat) – secondary organic PM

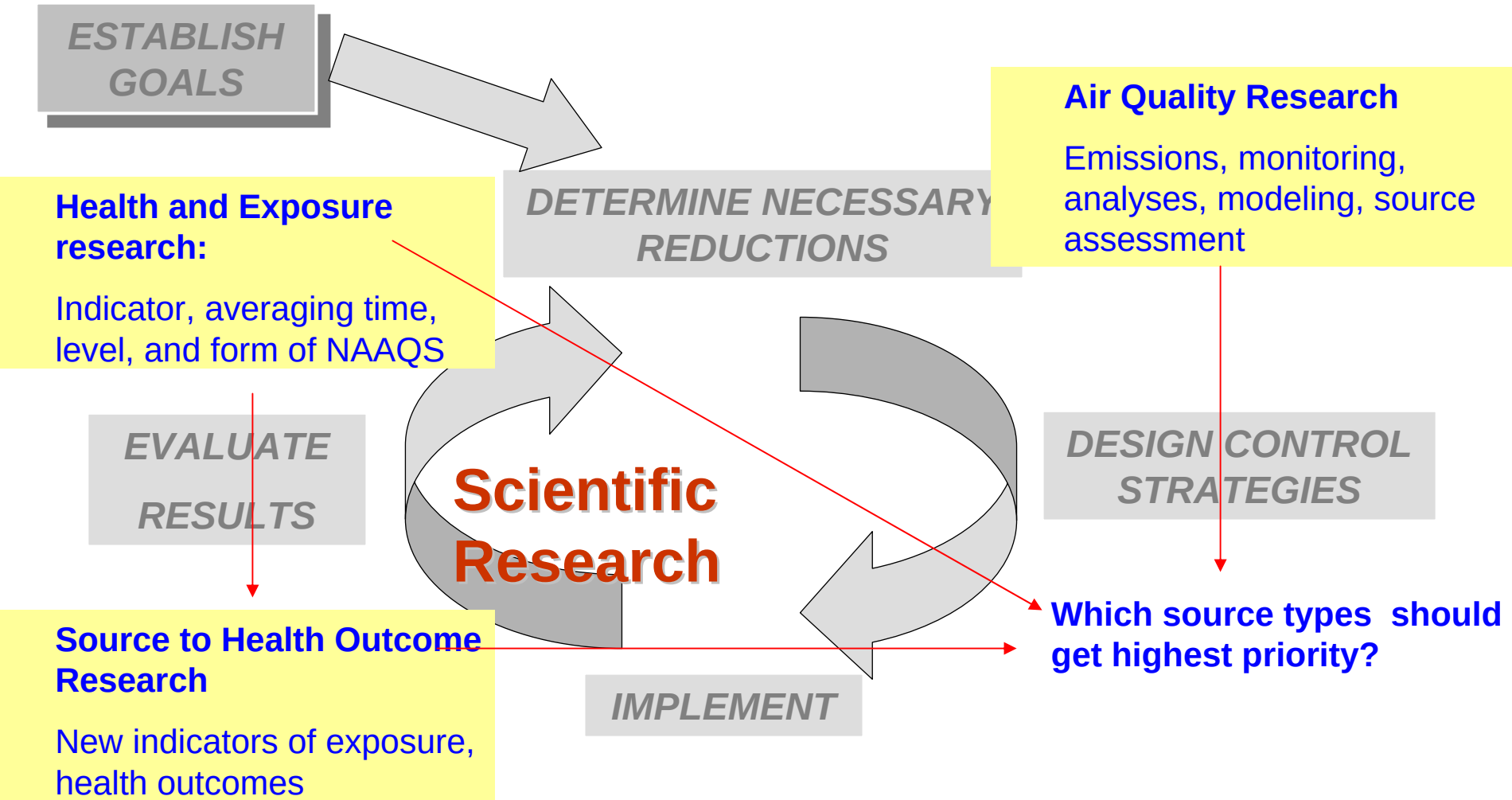
NH3 – Ammonium

Direct emissions of carbonaceous PM, crustal materials, metals

CO – weak contribution to ozone formation

The NRC dilemma – split PM into pieces or focus on integrating multipollutant sources

Multiple Interactions of Science/Policy



NAAQS Perspective: PM Staff Paper Key uncertainties/research questions

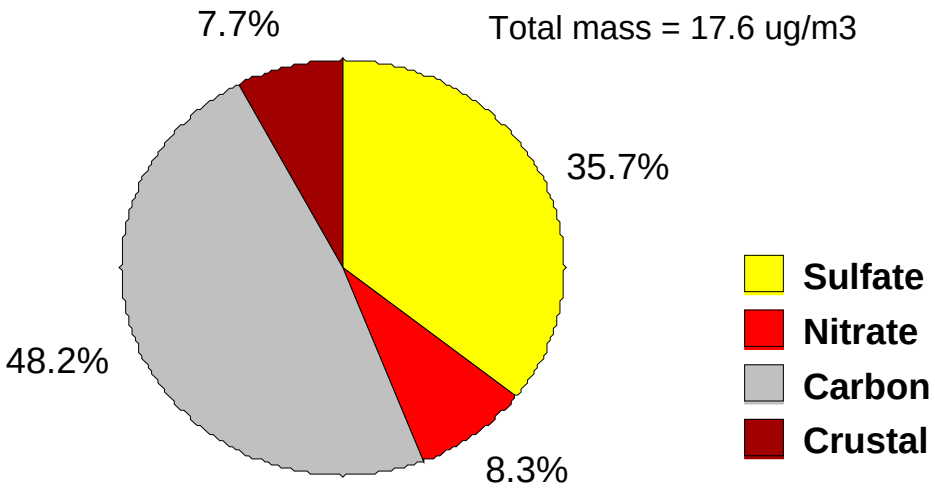
- Address numerous uncertainties on effects of thoracic coarse particles
  - More epidemiology, exposure work, laboratory work related to health effects of thoracic coarse particles in urban and non-urban areas, improved understanding of key components and sources, influence of measurement error on associations,
- Identification of specific components, properties and sources of fine particles linked with health effects
- Shape of concentration-response functions for health associations with fine and thoracic coarse particles
- Relationship between PM and other air pollutants in causing health effects
- Methodological issues; e.g., in time-series studies, modeling strategies in controlling for time-varying factors, such as temperature,
- Exposure time period for PM-related effects (e.g., 1-hr, distributed lags), for standard setting and episode communications
- Address uncertainties in annual and daily background concentrations for fine and thoracic coarse particles

Source Perspective: Multi-pollutant sector approaches

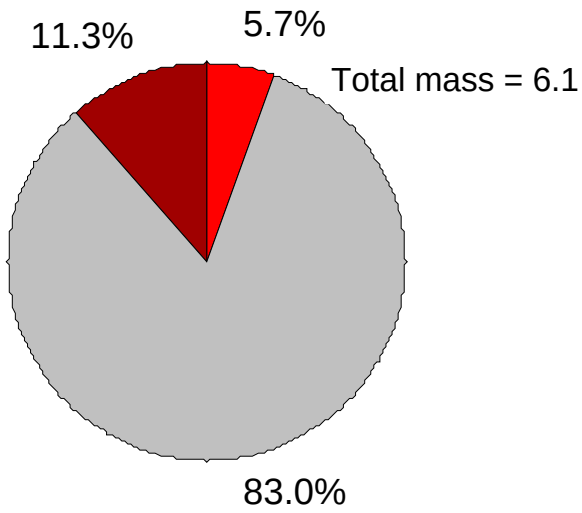
- National rules for mobile sources
  - Tier 2 motor vehicle standards (VOC, NOx, SO2)
  - Heavy duty on-road diesel standards (PM, NOx. SO2)
  - Off road diesel standards (PM, NOx. SO2)
- Regional Controls for major stationary sources
  - The NOx SIP call
  - The Clean Air Interstate Rule (CAIR/CAMR) or Clear Skies Legislation (SO2, NOx, Hg)

Example: Local/Regional Control in Birmingham

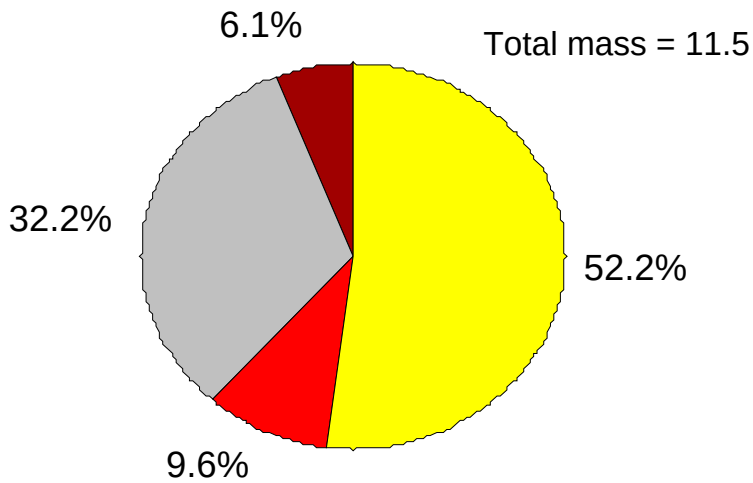
Birmingham (urban)



Urban Excess



Sipsey Wilderness (regional)



Urban – regional = "urban excess"

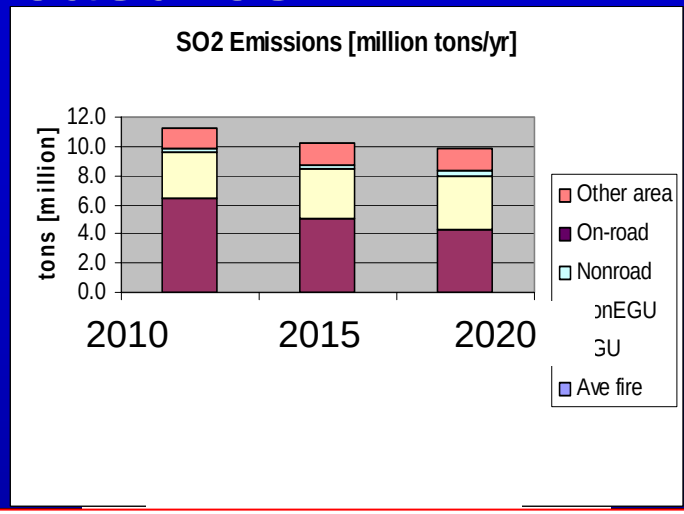
By 2015, CAIR reduces 1.5 ug/m3 of background sulfate/nitrate; Birmingham still needs 1 ug/m3 reduction

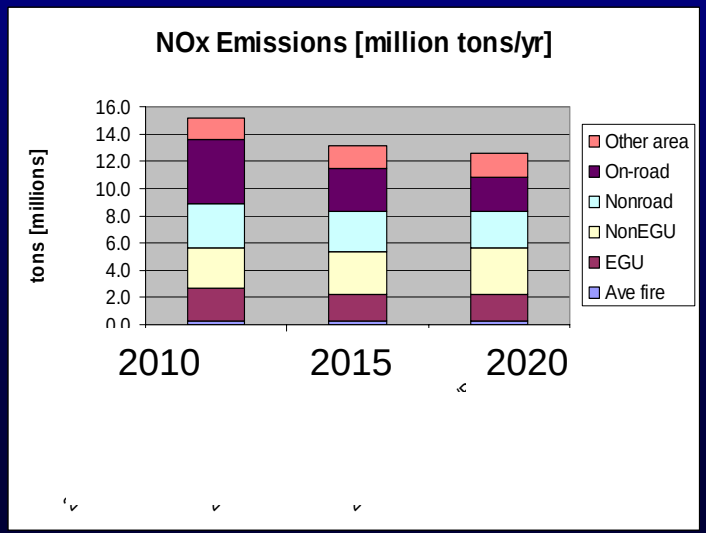
Based on 2003 monitoring data

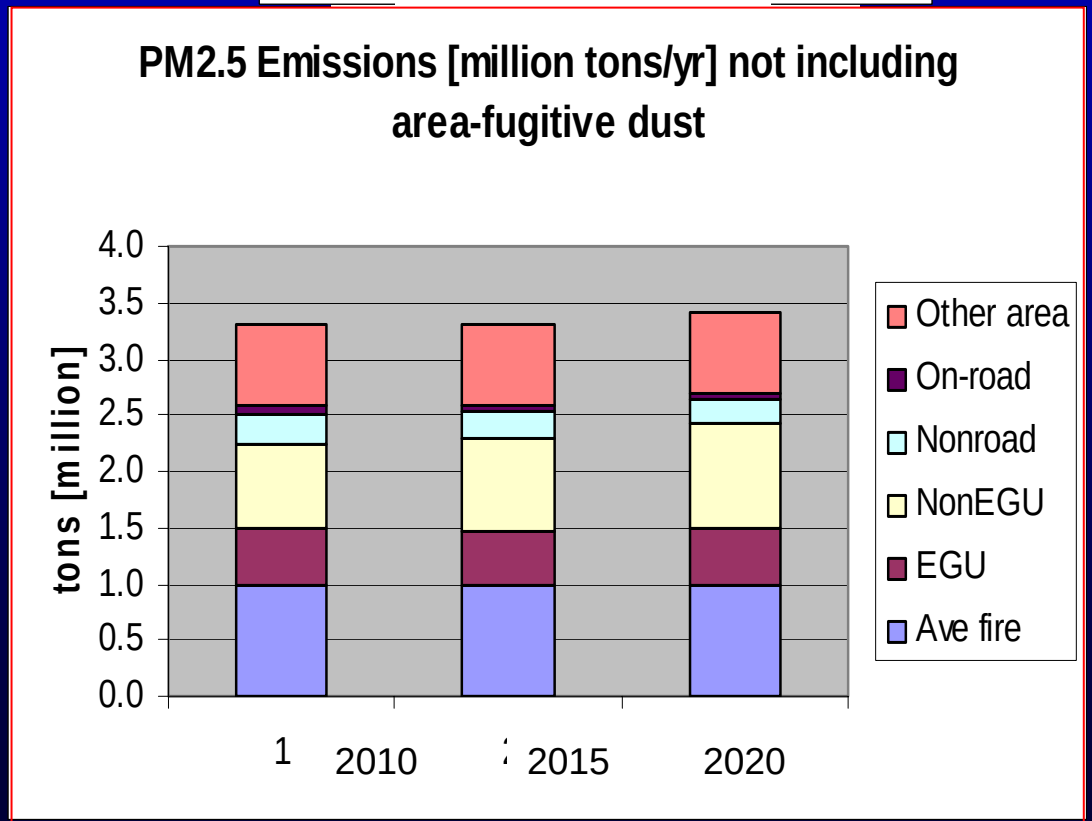
Impacts of Current Control Measures

(CAIR/CAMR/BART/Mobile rules)

Projected national emissions of SO2, NOx, and PM2.5 by sector for 2010, 2015, and 2020

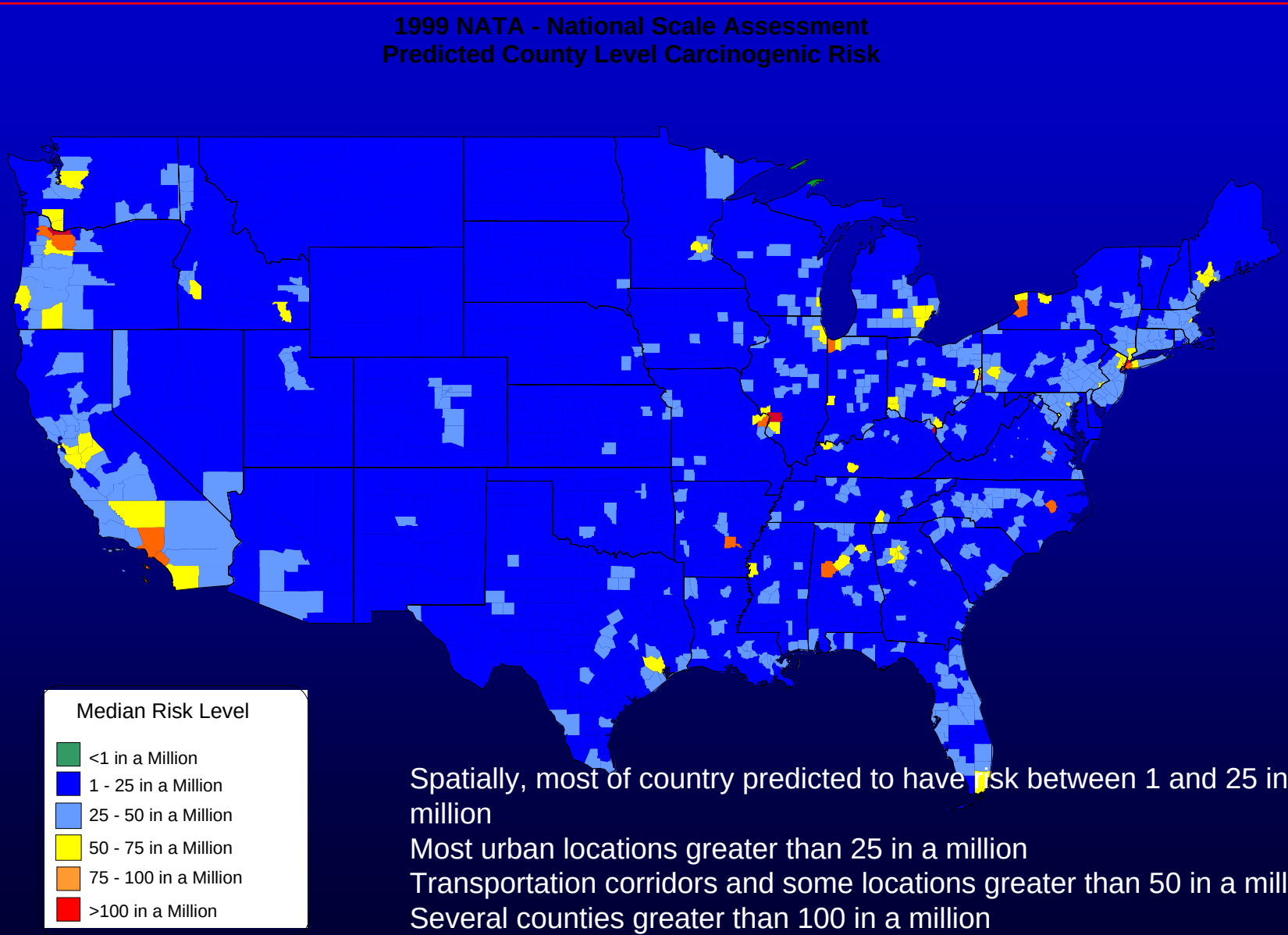






Air Toxics - National Scale Assessment

1999 Predicted County Level Carcinogenic Risk



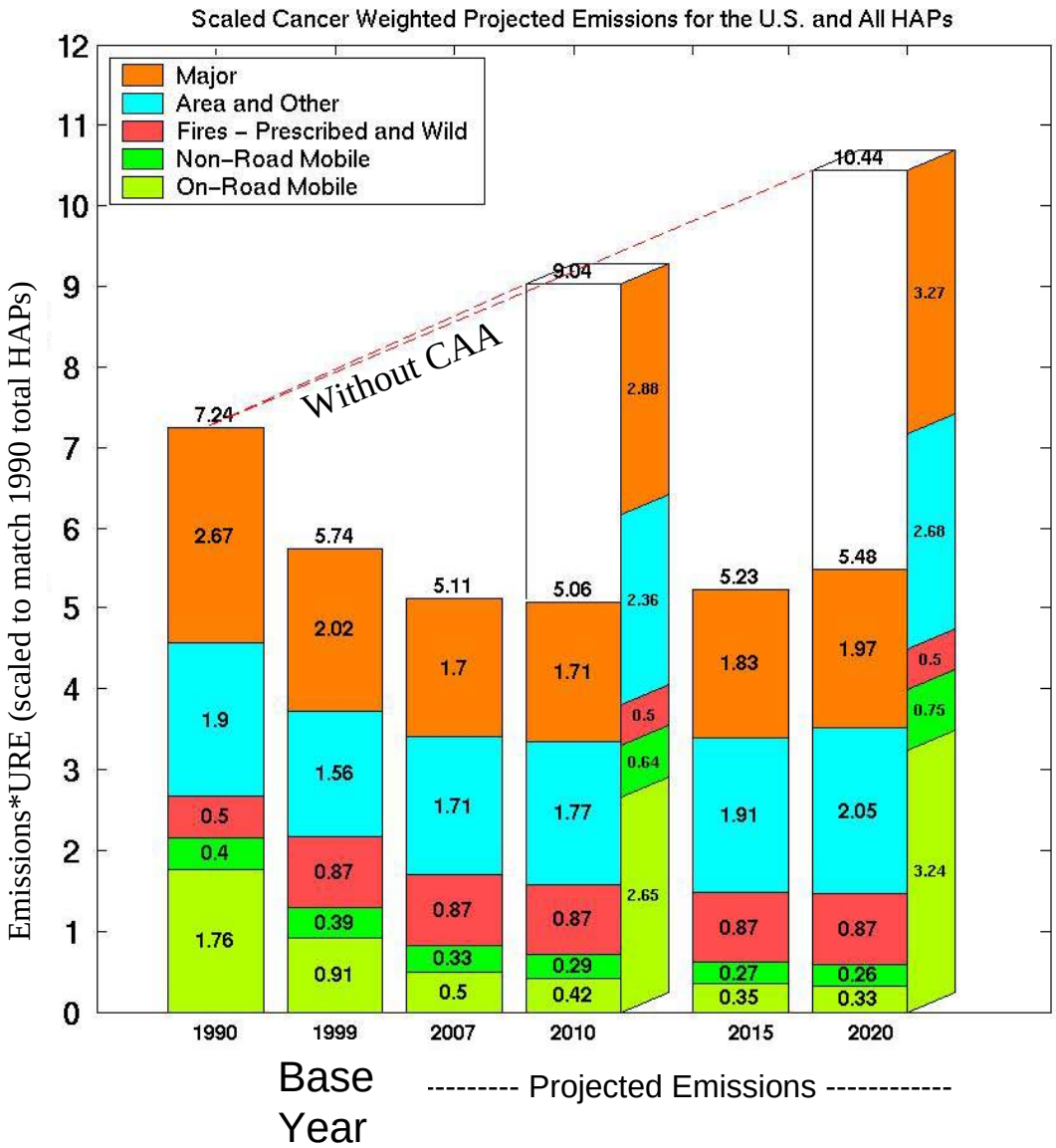
Spatially, most of country predicted to have risk between 1 and 25 in a million

Most urban locations greater than 25 in a million

Transportation corridors and some locations greater than 50 in a million

Several counties greater than 100 in a million

Toxicity-Weighted Emissions (Cancer)



Key Findings

- Major source programs target overall tonnage more than toxicity weighted tonnage
- Initial area source efforts have reduced some of the most toxic HAPs (Perc and Chromium VI)
- Mobile source tox -weighted trends closely follow total HAP trends
- Fires plays larger role for in toxicity-weighted situation; trends cannot be obtained due to methodology differences in emissions estimation

New findings on roadway pollution

High exposure to ultrafine particles, CO, other pollution near roadway

Increased risk near and on roadways

Mobile Source Perspective

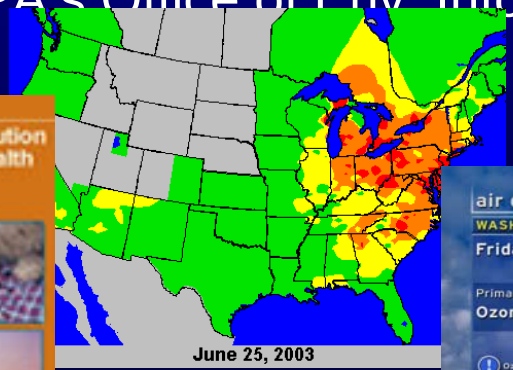
- Source/effects studies important. Key mobile source issues: which effects, on-non-road diesels, light duty gasoline vehicles, smokers
- Ultrafine particles –center work promising, further insights on near road transformation and composition
- Thoracic Coarse particles – contribution to near roadway results, speciation
- Relative risk of near-roadway exposures
- Peri-natal effects – several studies point to mobile constituents (CO, PM, NOx)

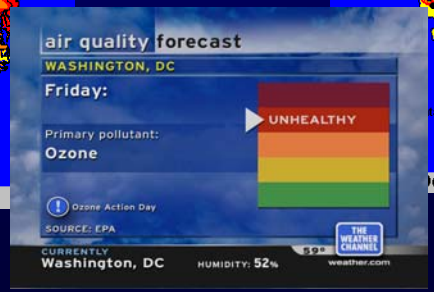
International transport/climate interactions Scale: global/regional

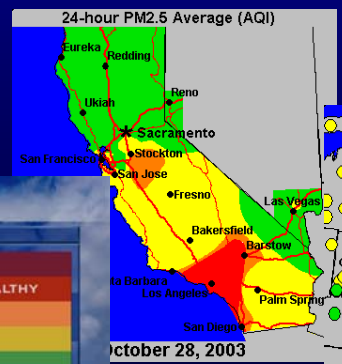
- INDOEX, other preliminary work suggest significant potential of BC aerosol for affecting hydrologic cycle on a regional basis
- Significant effects of Asian pollution on regional health, crops
- Short-life of conventional pollutants suggests rapid response to reductions
- Increasing interest in international agreements
- Need improved tools, observations to address this scale

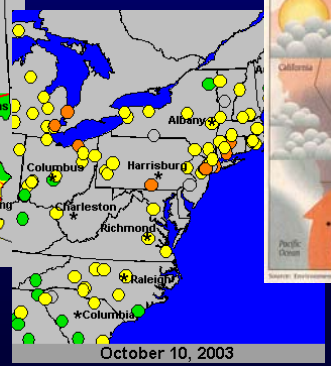
Communications: Air Quality Index

- Year Round 24/7 coverage/operations delivering real-time data (ozone & particles) for 46 States, 6 Canadian Provinces and all U.S. National Parks
- Next-day AQI forecasts for over 300 cities (summer) and over 150 cities (year-round)
- State-of-the-science information about air pollution health effects for the public, media and stakeholders
- Public/Private partnerships with The Weather Channel, USA Today, CNN, weather service providers, NOAA National Weather Service, EPA's Office of Env. Information

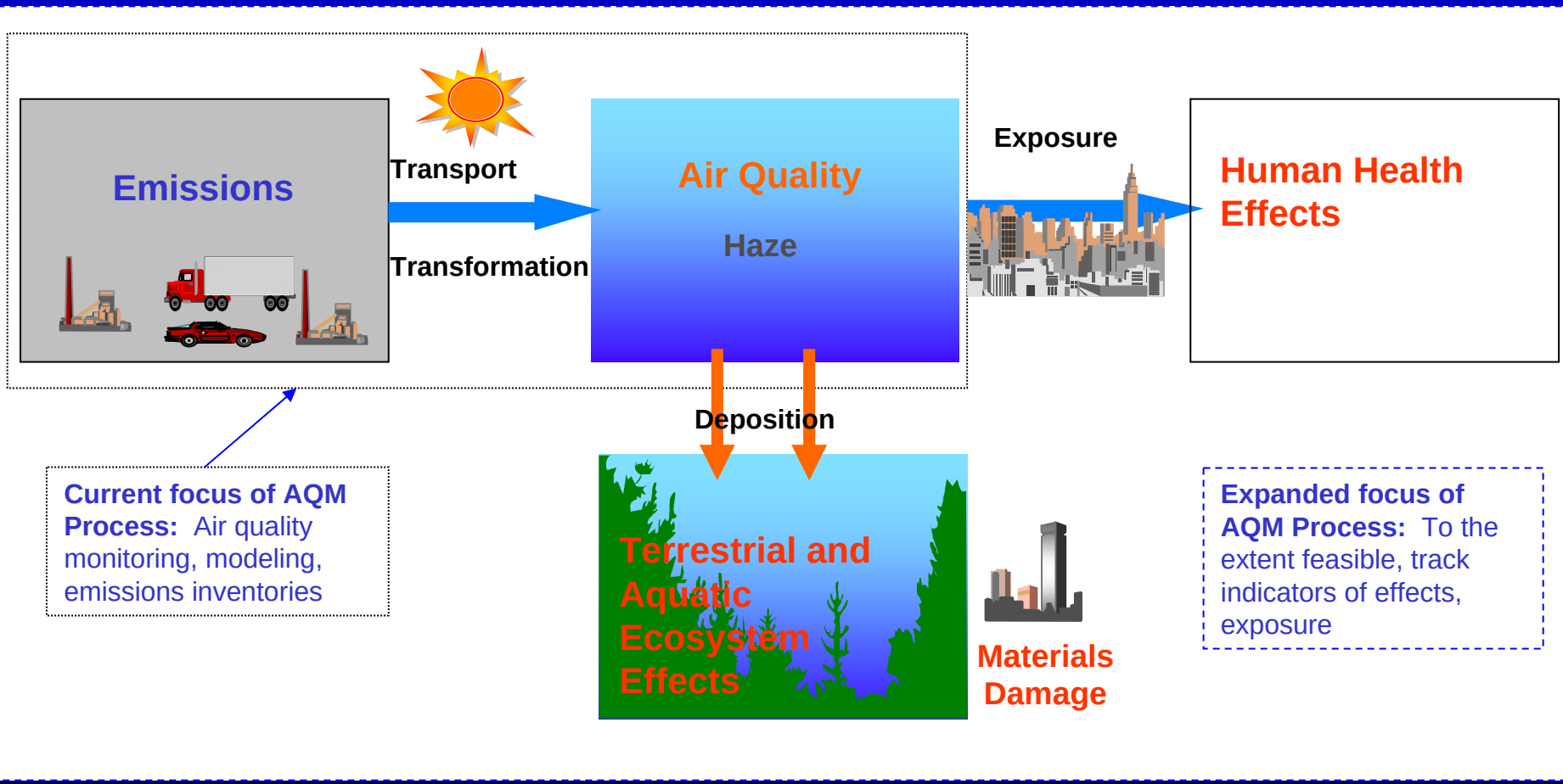








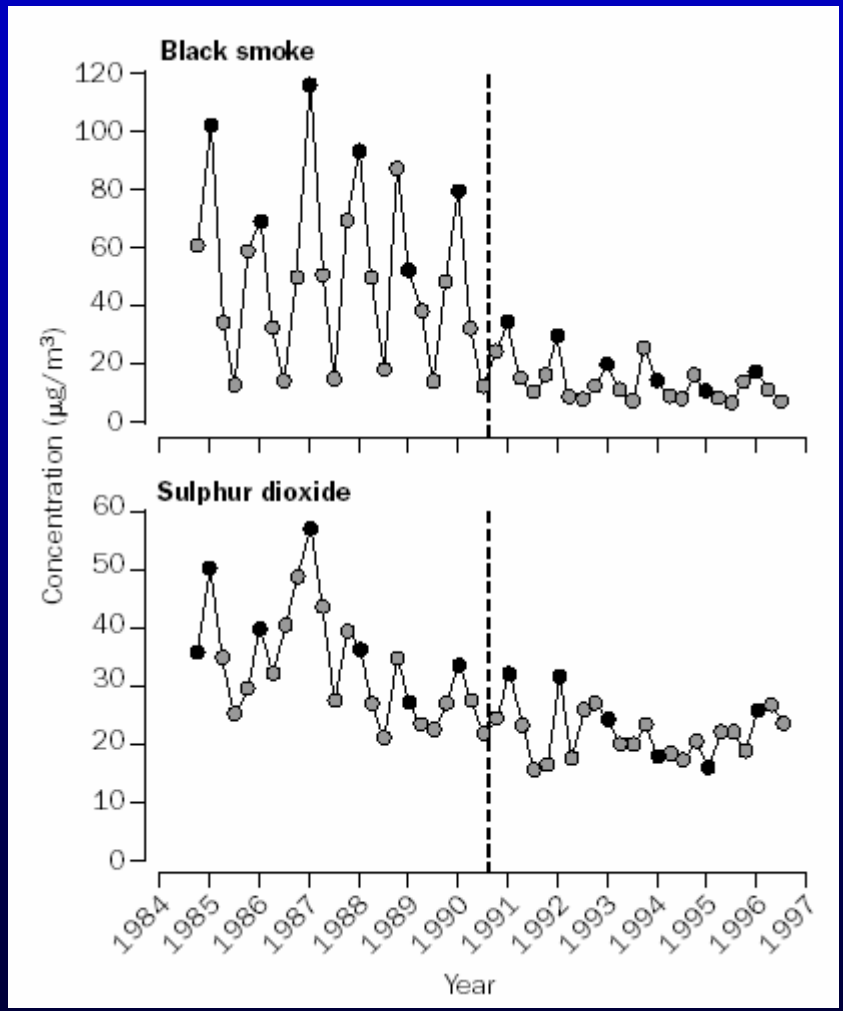
Expanding Accountability

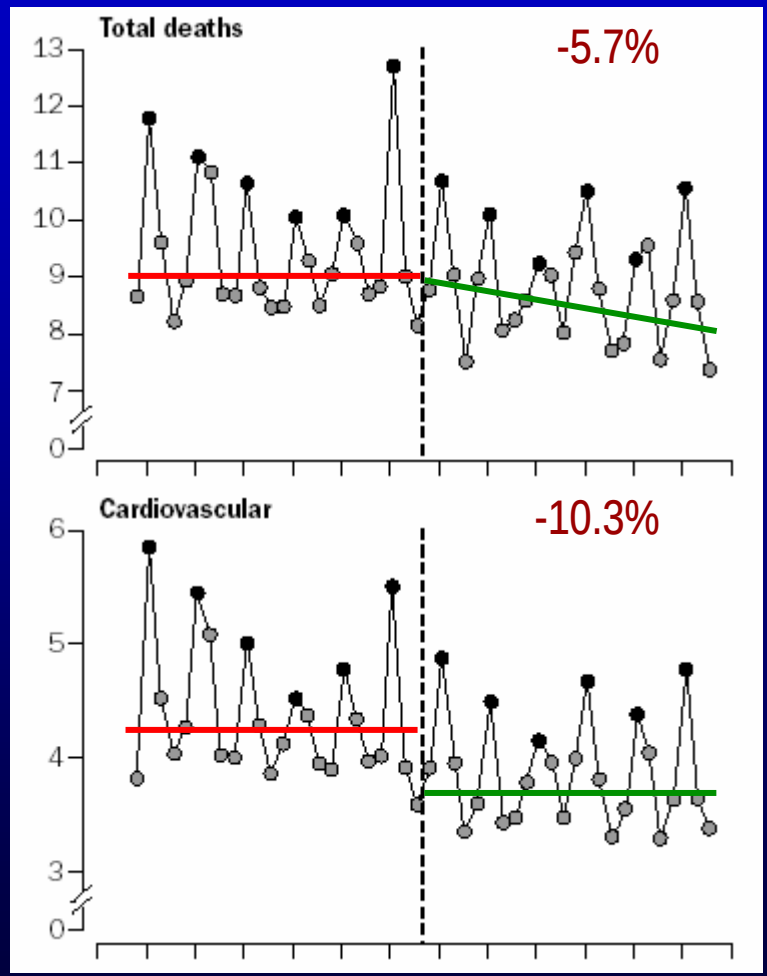


Demonstrating benefits of pollution reductions

Dublin, Ireland

Ban on bituminous coal: 9/1/90





Clancy et al. Lancet 2002; 360: 1210-1214

Clean Air Act Implementation

Coarse PM Standards

2006	Complete NAAQS Review
2008-9	Network in place?
2013	Designations?
2018-23	Attainment deadlines?

$PM_{2.5}$ Standards (current)

2004	States recommend nonattainment designations
2004	EPA makes nonattainment designations
2005	EPA Issues SOx/NOx CAIR
2006	Complete NAAQS Review
2008	**SIPs due**
2008-09	EPA approves SIPs?
2010-15	Attainment deadlines

Regional Haze Program

2005	EPA issues final BART Rule
2007-08	States submit regional haze SIPs (same as PM2.5)
2008-09	EPA approves SIPs
2013-18	Plants must install BART or comply with backstop trading program

Mobile Source Program

2004	Final non-road diesel rule
2004	Tier 2 is effective
2007	HD Diesel rules effective