



# U.S. Experience with Air Emissions Cap and Trade

Presentation for MIT's Endicott House  
by  
U.S. Environmental Protection Agency  
Office of Air and Radiation

August 16, 2006





# Cap and Trade Programs



## Federal Programs

- Acid Rain Program (ARP)
- NO<sub>x</sub> Budget Trading Program (NBP)
- Clean Air Interstate Rule (CAIR)
- Clean Air Mercury Rule (CAMR)
- *Clean Air Visibility Rule (CAVR)*
- *Clear Skies and Other Multi-Pollutant Legislation*

## Other Programs

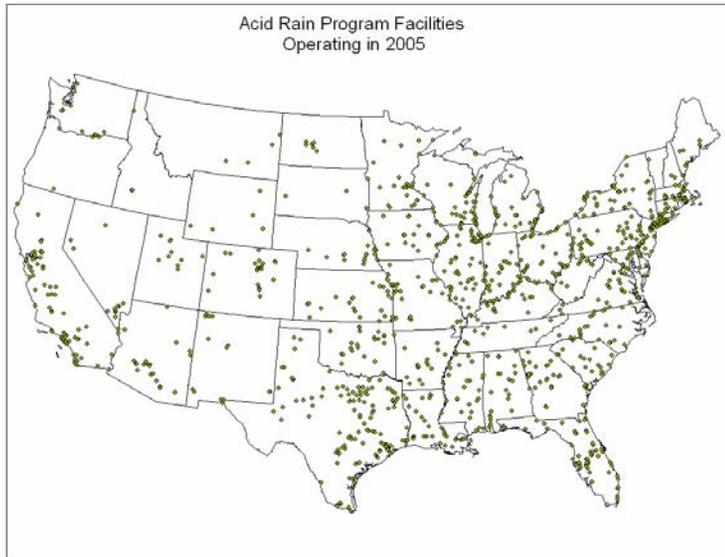
- Ozone Transport Commission
- Regional Clean Air Incentives Market (RECLAIM)
- Western Regional Air Partnership
- Chicago VOC Program
- Houston/Galveston Emission Allowance Program (NO<sub>x</sub>)
- *RGGI*
- *EU Emissions Trading Scheme*



# Basic Elements of Federal Cap and Trade

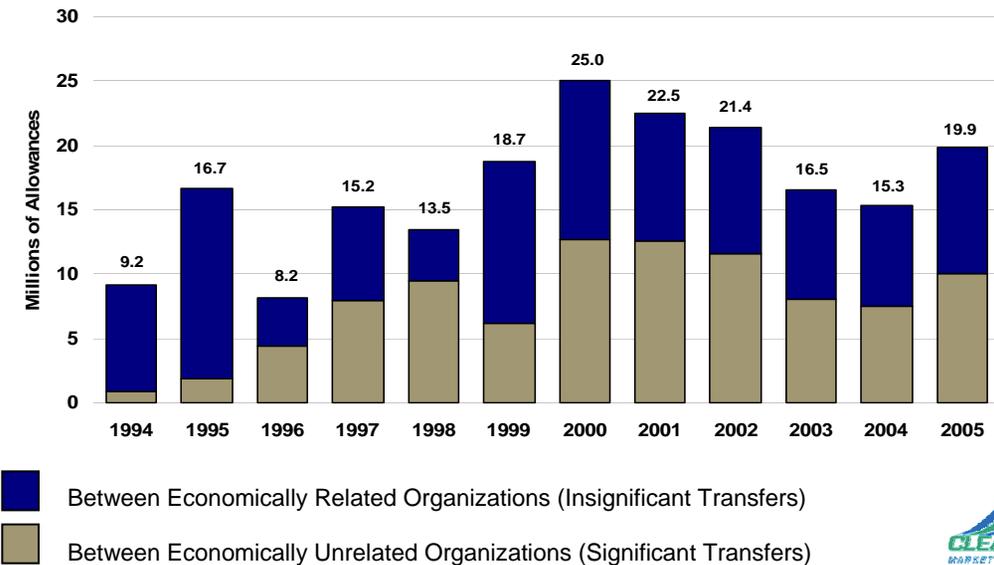
- 
- **Air emission cap(s) are set for pollution sources in defined area**
  - **Allowances to emit are allocated to sources in amount not to exceed the cap**
  - **Sources must hold allowances to cover emissions**
  - **Tailored monitoring records source emissions**
  - **Programs rest on reasonable technical and analytic foundations**
  - **All emissions and allowance holdings are routinely recorded, reported and made publicly available**
  - **Sources can “trade” allowances and may “bank” them**
  - **There are automatic penalties and other enforcement sanctions**
  - **Assessment is conducted to see whether the program is working**

# Acid Rain Program At-a-Glance

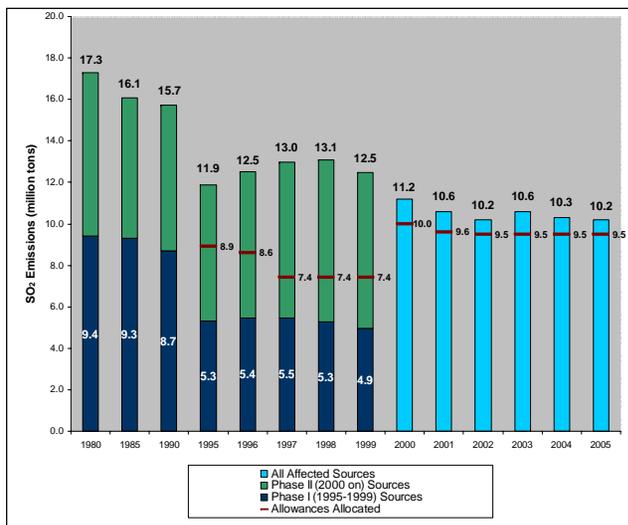


- Program has grown from 2,200 electric generation units in 1995 - about 300 units were subject to compliance while remaining units submitted emissions and other data to us - to about 4,600 units now.
- Vast majority of emissions come from 1,100 coal-fired units at about 420 power plants - all these units use Continuous Emissions Monitors (CEMS) subjected to detailed operating and QA requirements.
- Other units may also have CEMS, but many have monitoring that is less extensive, which does not add significantly to the measurement uncertainty.
- In 1995, covered units lowered SO<sub>2</sub> emissions about 3.5 million tons below their allowance cap and “banked” unused allowances. By 2000, “over control” had led to a bank well over 11 million tons. At the end of 2005, the bank held 6.1 million tons of SO<sub>2</sub> allowances.
- Coal-fired units face NO<sub>x</sub> control based on “fleet emissions averaging.”

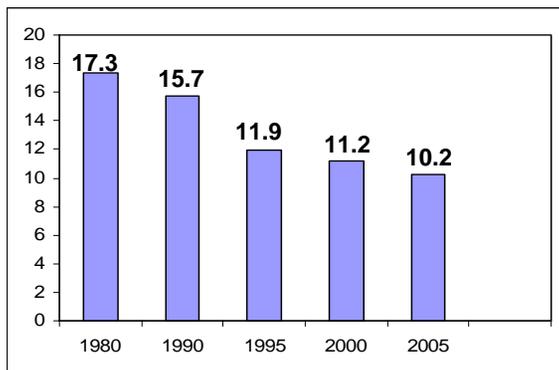
## SO<sub>2</sub> Allowances Transferred under the Acid Rain Program



## SO<sub>2</sub> Emissions Covered by the Acid Rain Program

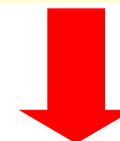


# Results of Acid Rain Program: Major Reductions in SO<sub>2</sub> Emissions and Acid Rain



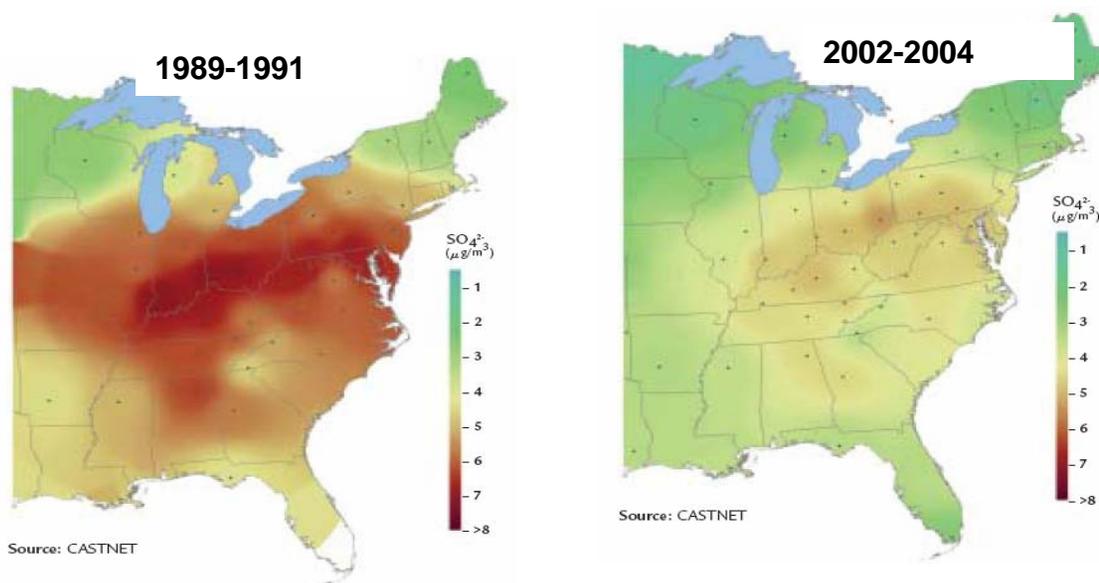
Million Tons of SO<sub>2</sub>

SO<sub>2</sub> emissions from power plants down by 5.5 million tons since 1990



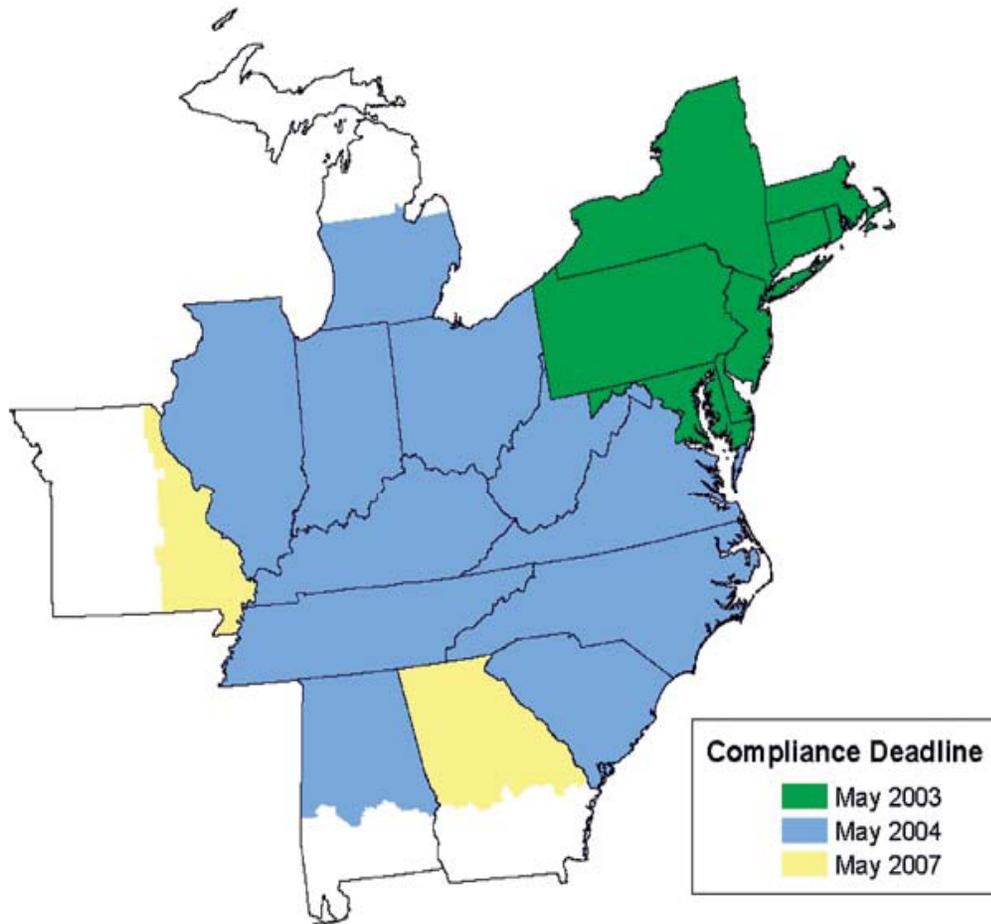
Acid rain cut by 25 – 40%

Sulfate  
(Acid Rain)  
Concentrations



Substantial health, visibility, and other benefits provided

# NO<sub>x</sub> Budget Trading Program (NBP)



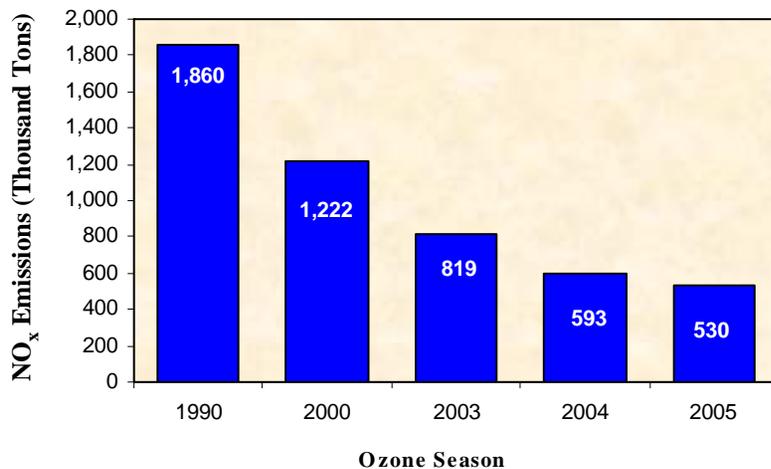
- Problem: Reduce summer ozone/smog levels
- Scope: Eastern U.S.
- Target: Reduce NO<sub>x</sub> emissions from electric generators and industrial boilers by 1 million tons (70% below 1990 levels)
- Coverage: 2,570 units

# Summertime NO<sub>x</sub> Emission Reductions

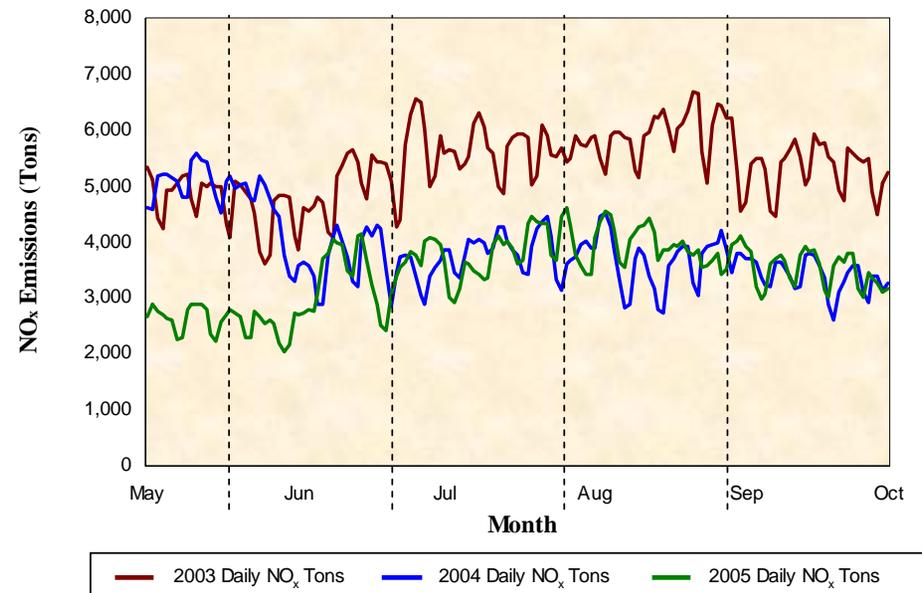
2005 NBP states' ozone season reductions (May 1 – September 30)

- ▶ 72% from 1990 baseline
- ▶ 57% from 2000 baseline
- ▶ 11% from 2004

**Total NBP Ozone Season NO<sub>x</sub> Emissions**



**Daily Emission Trends for NO<sub>x</sub> Budget Trading Program Units in 2003, 2004 and 2005**



Source: EPA, 2006

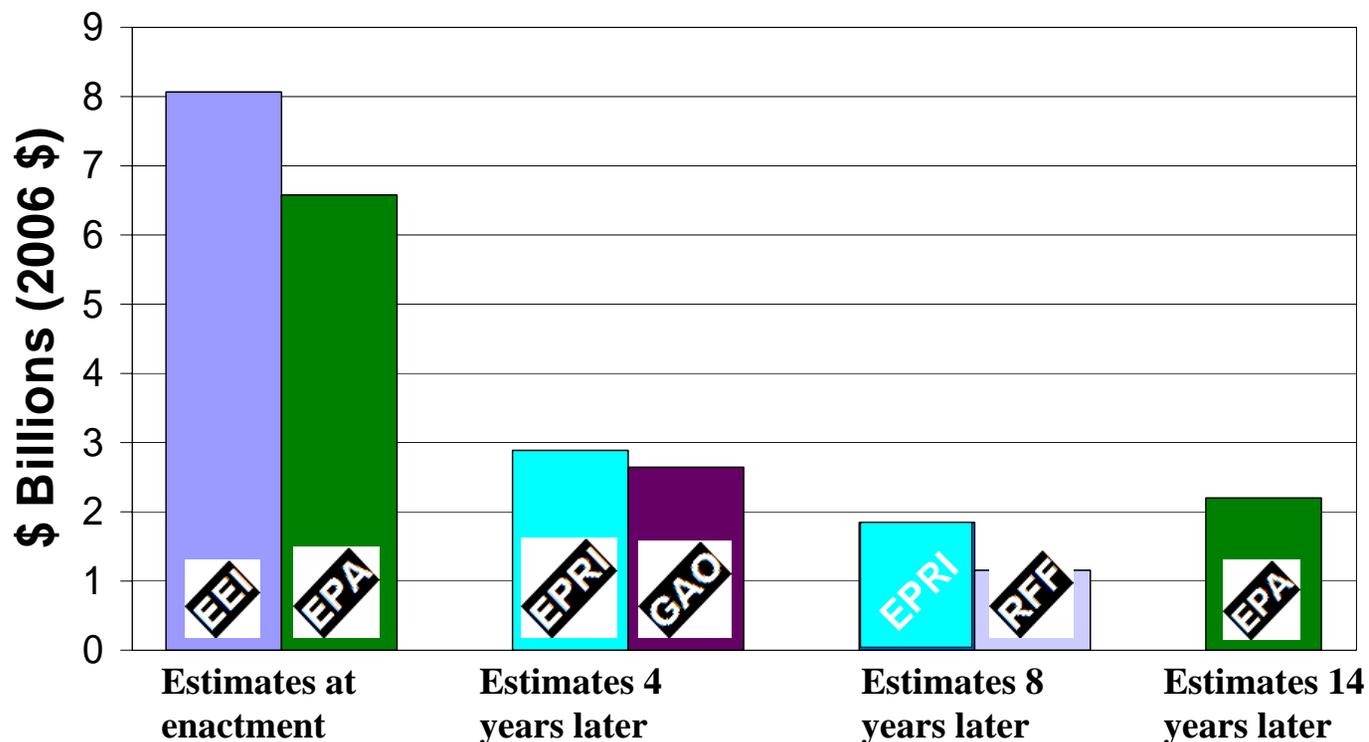


# Major Features of Federal Cap and Trade

- 
- **An alternative to traditional regulation and credit trading**
    - Not a trading feature added to existing regulation
  - **Certainty that a specific emission level will be achieved**
  - **Emissions measurement and reporting is emphasized for complete accountability**
  - **More regulatory certainty and compliance flexibility**
  - **Fewer administrative resources needed by industry and government (if kept simple)**
    - Lower permitting and transaction costs for sources
  - **Promotes innovation and early reductions with banking**
  - **Compatible with other mechanisms to ensure local protection**
  - **Lower costs – this also makes further improvements feasible**
  - **Need for formal enforcement procedures is minimized**

# Acid Rain Program Costs: Much Lower than Originally Predicted

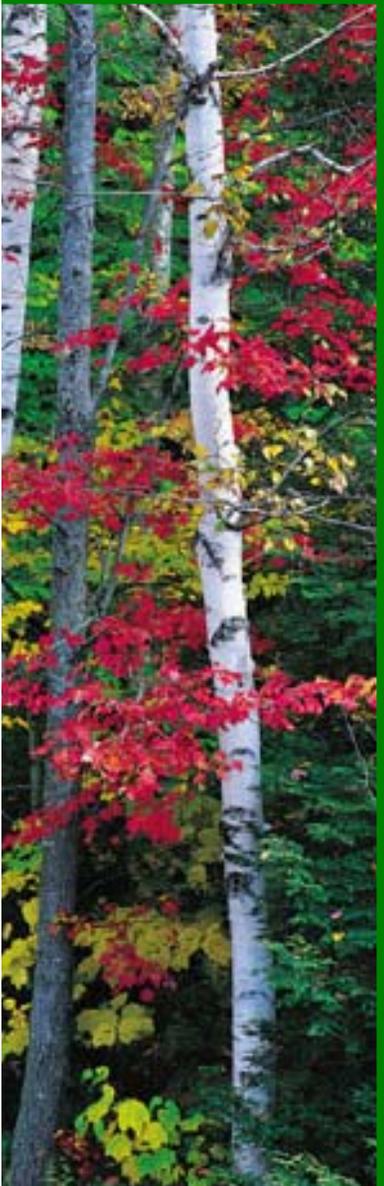
## Acid Rain Program: Projected Annual Costs at Full Implementation in 2010



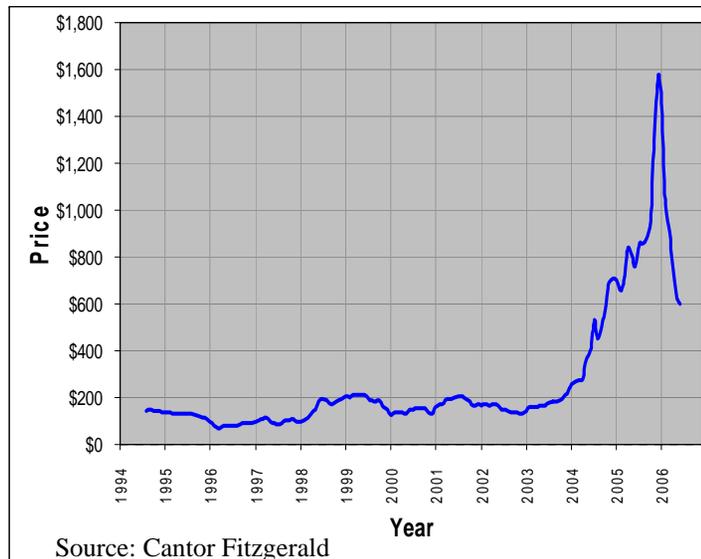
*All estimates cover the SO<sub>2</sub> trading program and do not cover the NO<sub>x</sub> program which EPA recently estimated annually cost about \$ 1.1 billion (in 2006 \$).*

Source: EPA, 2006

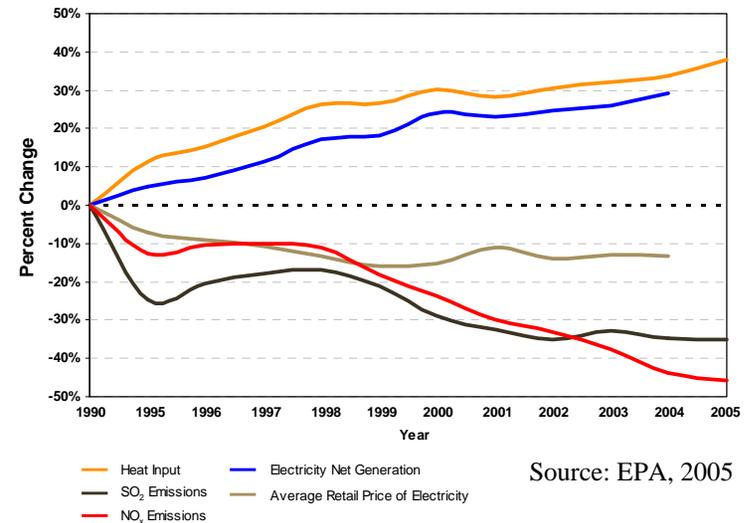
# Acid Rain Program Impacts: Less than Expected



SO<sub>2</sub> Allowance Prices



Trends in Electricity Generation and Emissions from the Electric Power Industry



- Early SO<sub>2</sub> allowance prices much less than expected – recent prices are driven by CAIR
- Over most of the last 15 years, the Acid Rain Program has led to lower air emissions while electricity demand and fossil energy use increased substantially and real electricity prices declined. ARP appears to have benefited from productivity gains in mining and transportation and competitive economics of combined- cycle generation
- Compliance largely occurred from installing scrubbers and shifting to lower sulfur coals
- Over the last 15 years we have seen few coal-fired units retire and shifting away from oil driven by better natural gas technology
- Nonwestern coal miners saw some increased unemployment added to problems they faced due to mining productivity gains and delivered coal prices declining more in the West.

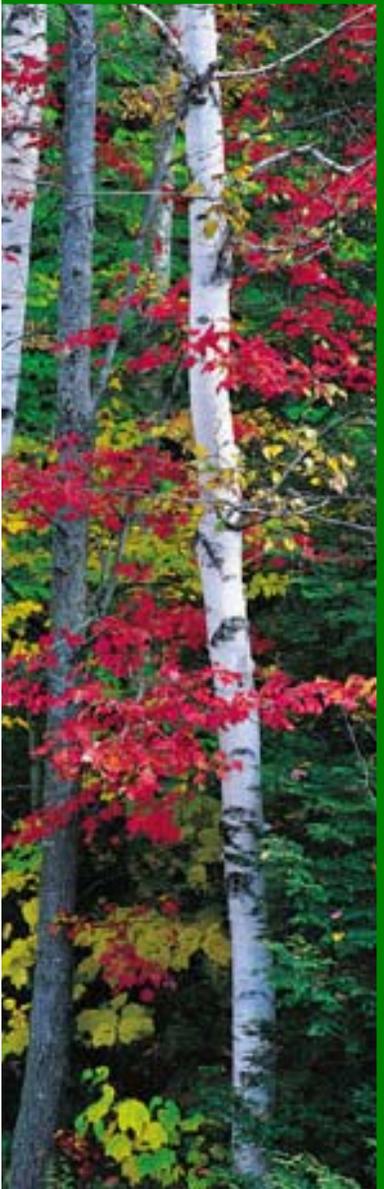


# Why Federal Cap and Trade Works

- 
- **Programs cover industries with wide variation in compliance options and costs that have capability to monitor and report emissions reliably**
  - **Cap on emissions – Government issues a fixed quantity of allowances**
    - **Focuses on environmental goal**
    - **Limits creation of “paper credits” and “anyway tons”**
    - **Provides certainty to allowance market**
  - **Full sector coverage – all sources (existing and new) included**
    - **Minimizes shifting of production and emissions (“leakage”)**
    - **Achieves emission reduction goal without case-by-case review**
  - **Strong monitoring – accurate and complete measurement and reporting**
    - **Assures accountability and program credibility**
  - **Unrestricted trading and banking – complemented by source-specific limits where needed to protect local air quality**
    - **Allows companies to choose compliance options**
    - **Addresses “hotspots” with added direct controls, if they emerge**
    - **Reduces costs**



# Distributing Allowances

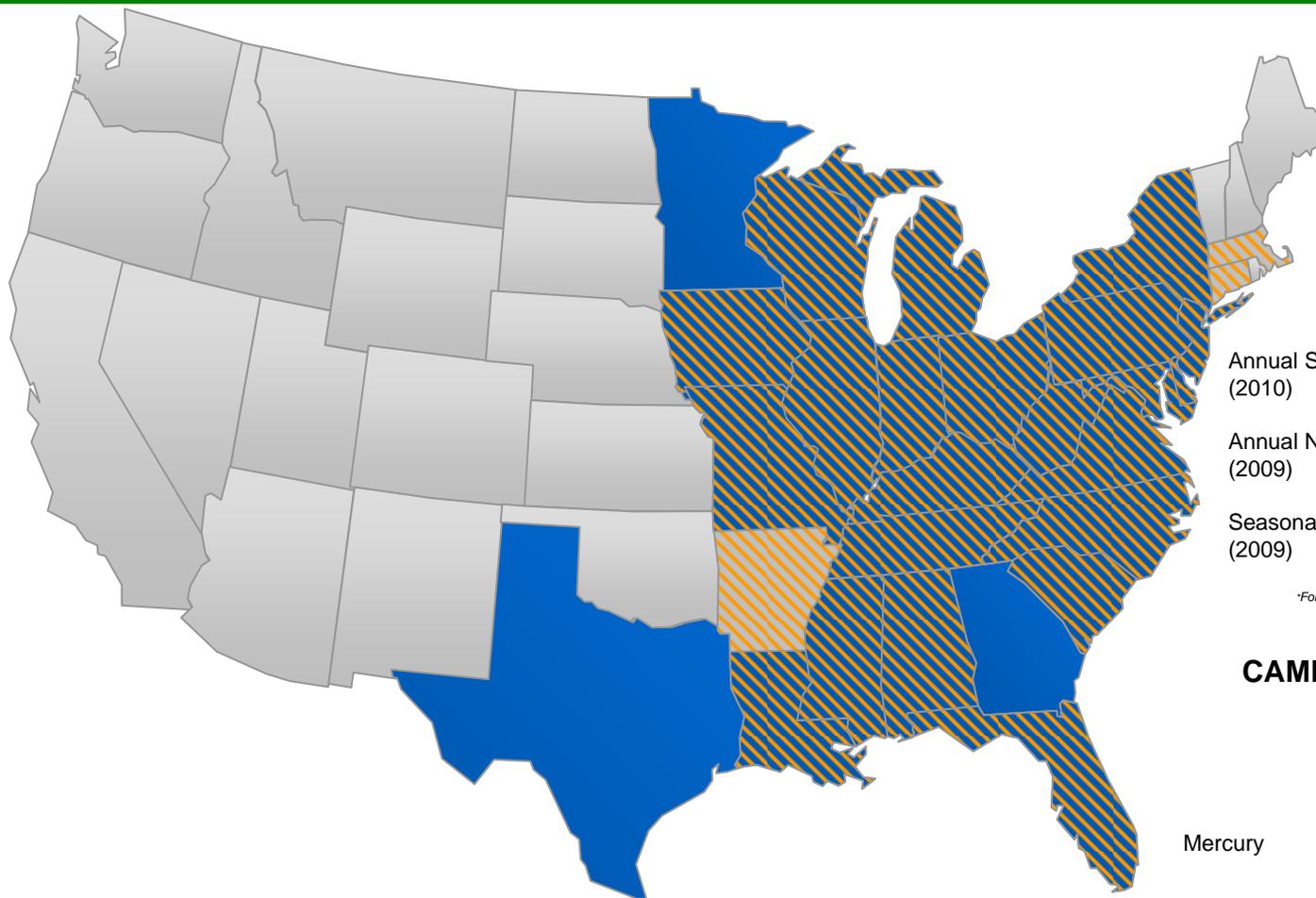
- 
- **Considerations: Equity, environmental incentives, efficiency**
  - **Recognition that vast majority of allocation approaches that EPA has considered all lead to the same level and distribution of emission reductions: the emission caps and banking drive reductions.**
  - **Many ways, none are perfect:**
    - **Direct allocation to sources based on historical and/or current emissions, energy use (input), or production (output, e.g. MWH)**
      - **Set asides (new sources, renewables, demand side efficiency)**
    - **Auction**
    - **Hybrid**
  - **Allowance allocation should balance need for certainty and changing circumstances**
    - **EPA programs have allocations for several years into the future**



# Compliance and Enforcement

- 
- **Annual reconciliation: Actual emissions compared to allowances in accounts**
  - **Penalties for non-compliance**
    - **SO<sub>2</sub> Program:**
      - **Automatic offset (deduct allowance from next year's allocation) *keeps "environment whole"***
      - **Automatic inflation-indexed financial penalty (about \$3,000 per ton of SO<sub>2</sub> in 2005)**
      - **Possible civil and criminal penalties**
    - **NBP, CAIR and CAMR Programs**
      - **3 allowances surrendered for each ton from next year's account (no automatic monetary penalty)**
      - **Possible civil and criminal penalties**
  - **99.9% compliance rate for both ARP and NBP programs**
    - **Penalties have ranged from \$3,000 to \$1,500,000**

# CAIR Sets Stage for CAMR and CAVR



- States not covered by CAIR
- States controlled for fine particles (annual SO<sub>2</sub> and NO<sub>x</sub>)
- States controlled for both fine particles (annual SO<sub>2</sub> and NO<sub>x</sub>) and ozone (ozone season NO<sub>x</sub>)
- States controlled for ozone (ozone season NO<sub>x</sub>)

## CAIR Emission Caps\*

*(million tons)*

	<u>2009/2010</u>	<u>2015</u>
Annual SO <sub>2</sub> (2010)	3.7	2.6
Annual NO <sub>x</sub> (2009)	1.5	1.3
Seasonal NO <sub>x</sub> (2009)	.58	.48

*\*For the affected region.*

## CAMR Emissions Caps

*(tons)*

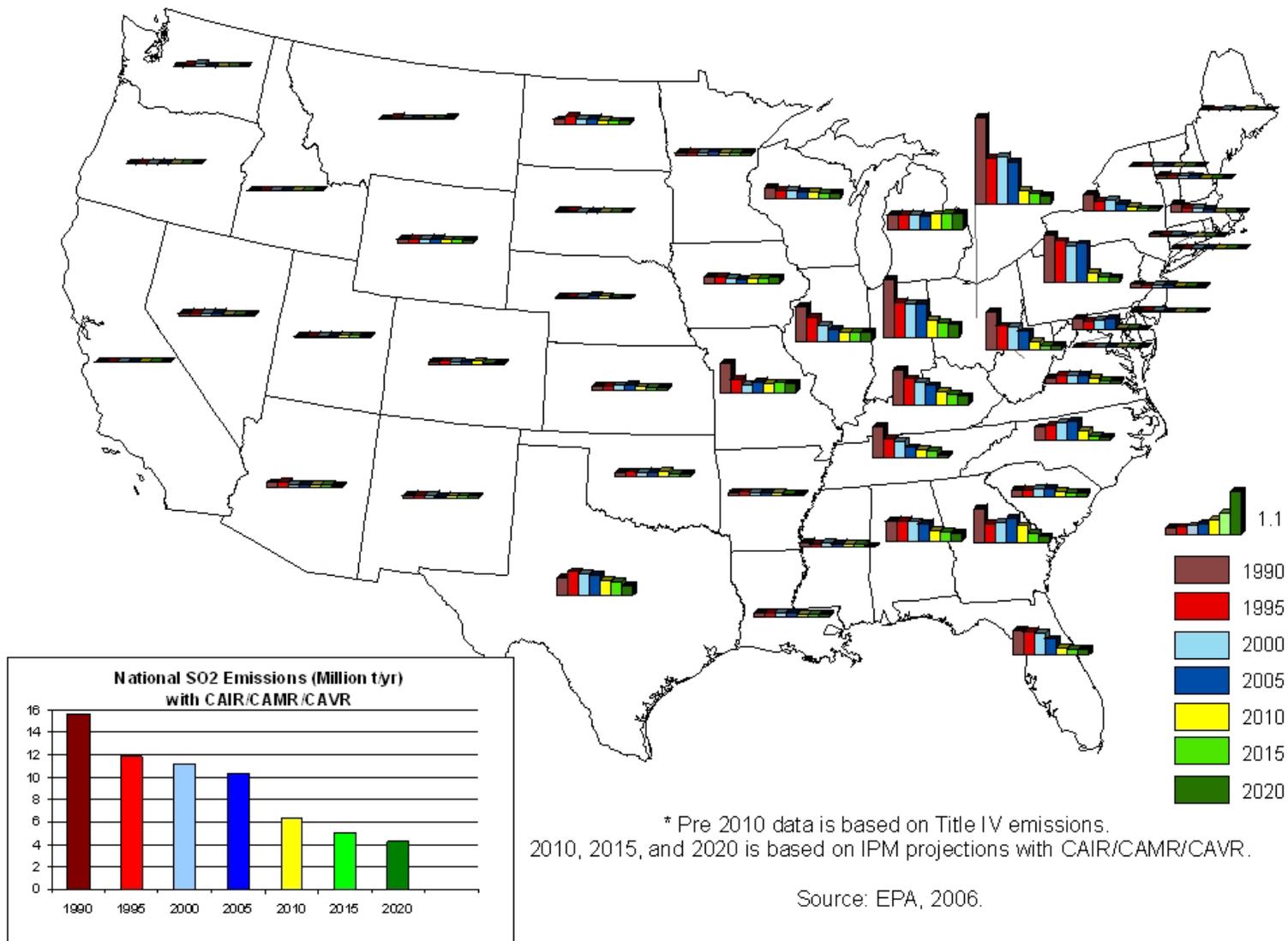
	<u>2010</u>	<u>2018</u>
Mercury	38	15

## CAVR

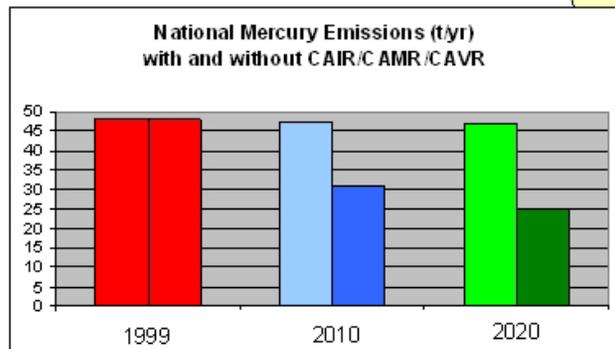
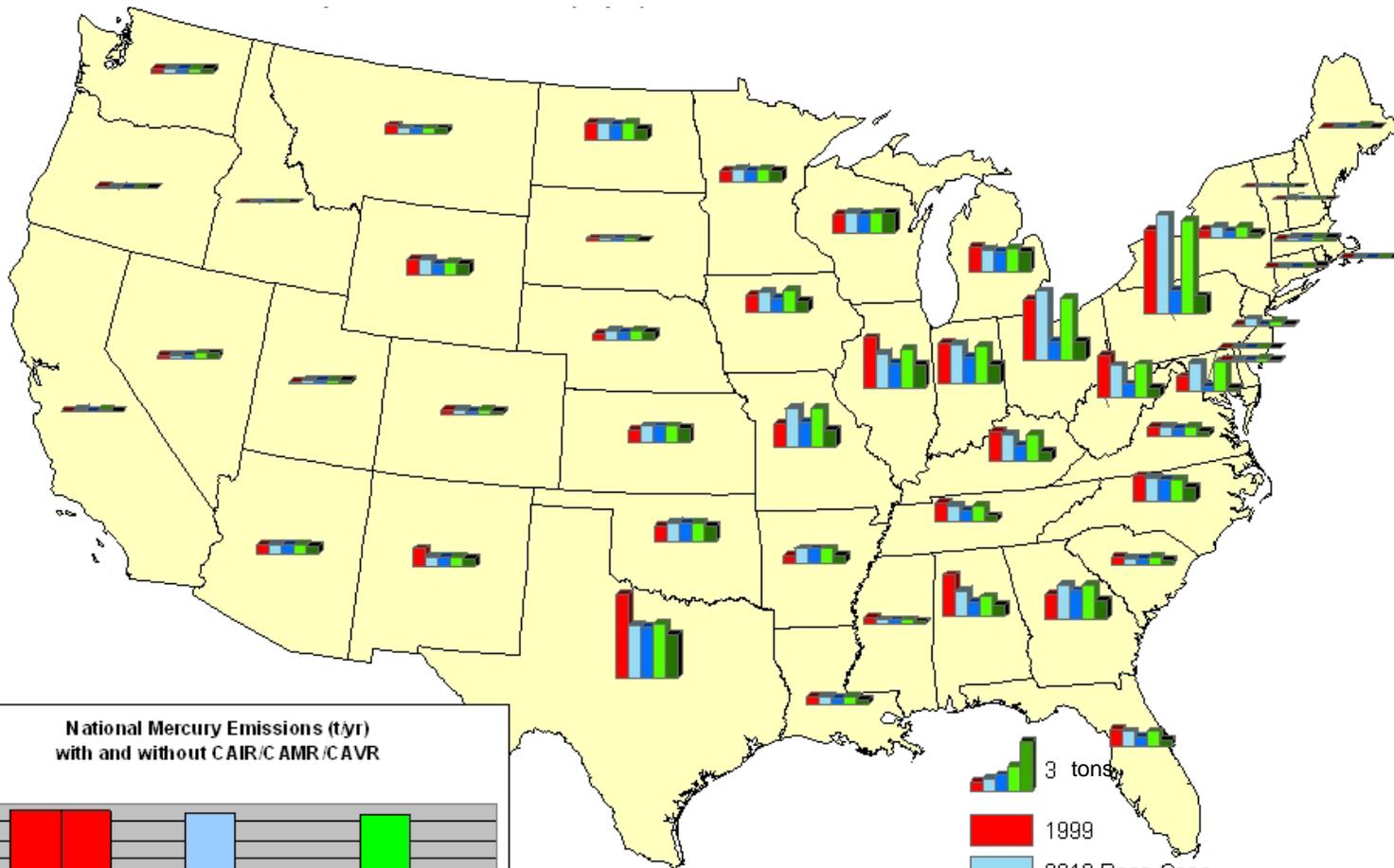
**Outside of CAIR Region – BART**



# SO<sub>2</sub> Emissions under Acid Rain and CAIR/CAMR/CAVR



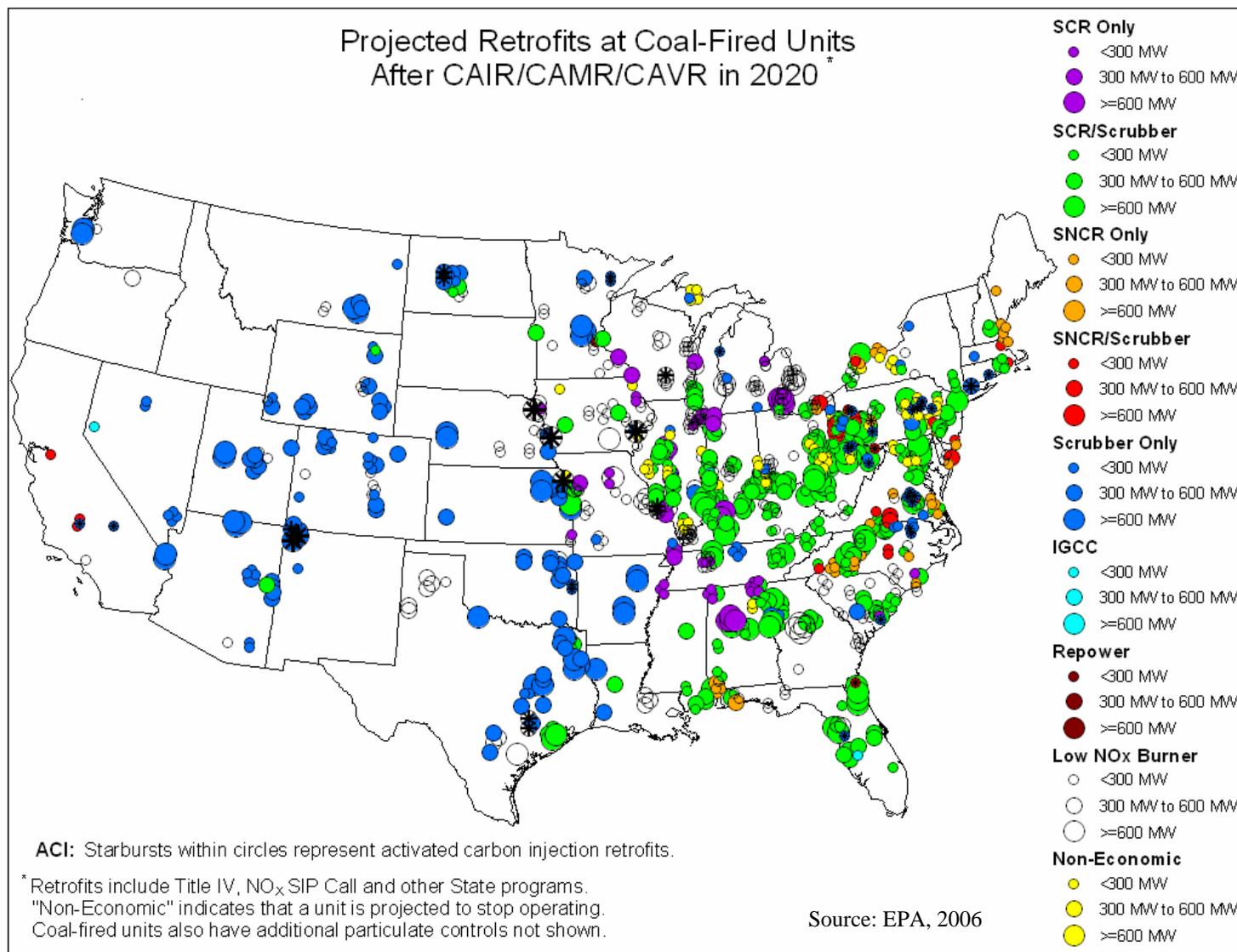
# Mercury Reductions with and without CAIR/CAMR/CAVR



Emissions represent units > 25 MW

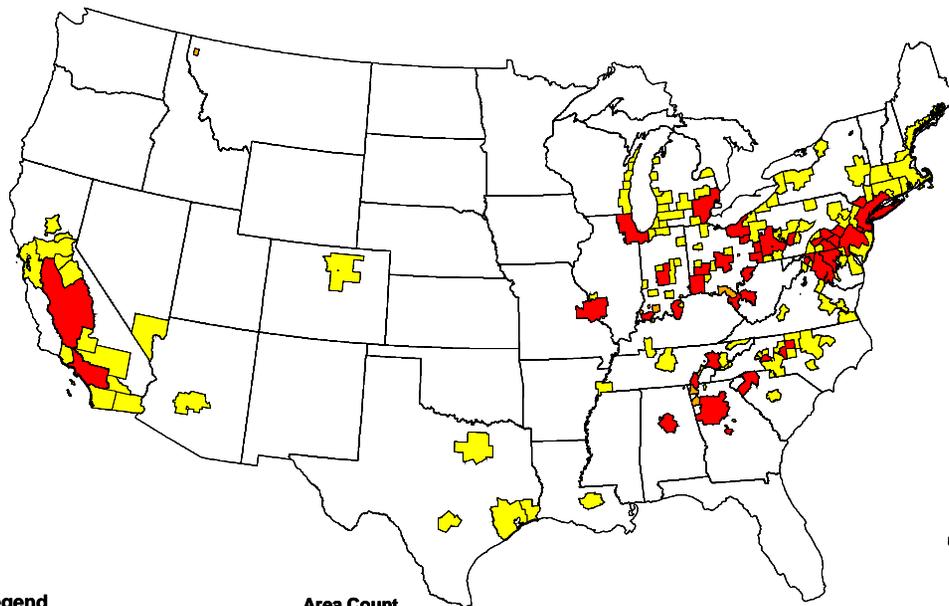
Source: EPA, 2006.

# Pollution Controls in Place in the Power Industry 2020 with Addition of CAIR/CAMR/CAVR



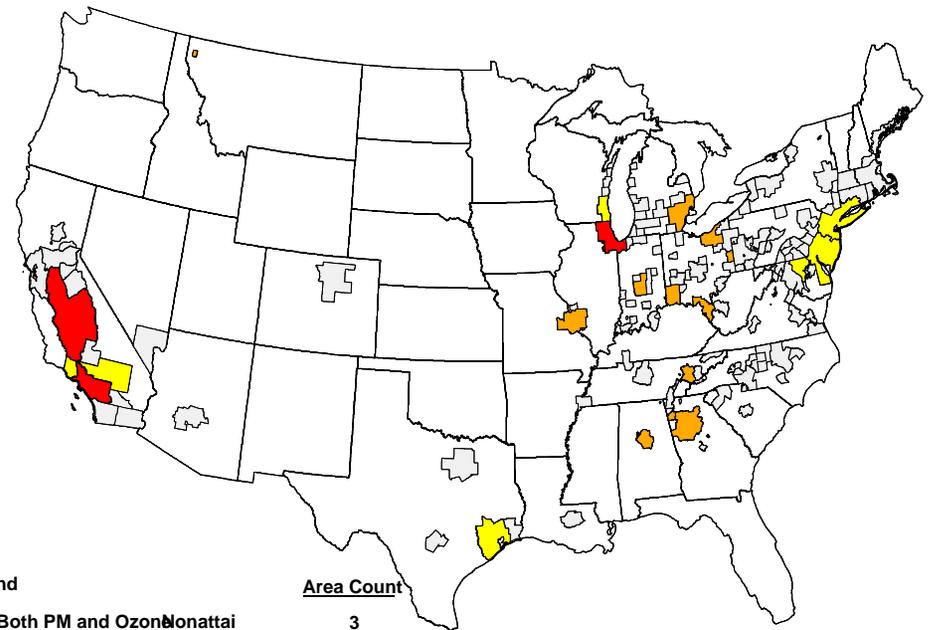
# CAIR, CAMR, and CAVR's Addition to Existing Programs Should Lead to Much Cleaner Air

Areas Currently Designated as Nonattainment for PM2.5 and/or 8-Hour Ozone (April, 2005)



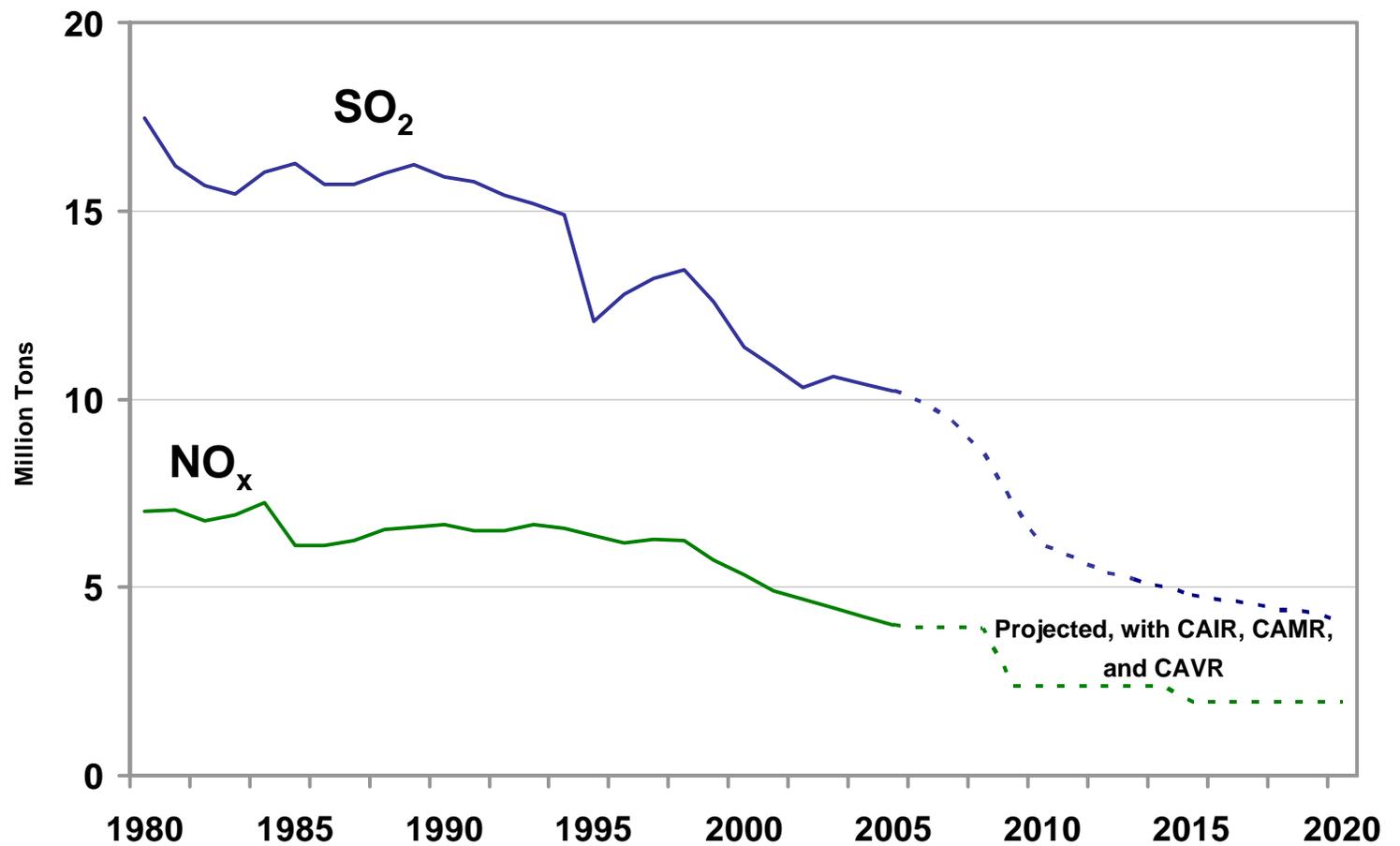
Legend		Area Count
<span style="color: red;">■</span>	Both PM and Ozone Nonattainment	36
<span style="color: orange;">■</span>	PM Only Nonattainment	3
<span style="color: yellow;">■</span>	Ozone Only Nonattainment	90

Areas Projected to Meet the PM2.5 and 8-Hour Ozone Standards in 2020 with CAIR/CAMR/CAVR and Some Current Rules, Absent Additional Local Controls



Legend		Area Count
<span style="color: red;">■</span>	Both PM and Ozone Nonattainment	3
<span style="color: orange;">■</span>	PM Only Nonattainment	13
<span style="color: yellow;">■</span>	Ozone Only Nonattainment	7
<span style="color: lightgray;">■</span>	Nonattainment areas projected to attain	106

# Nationwide SO<sub>2</sub> and NO<sub>x</sub> Emissions from the Power Sector with Cap and Trade Controls



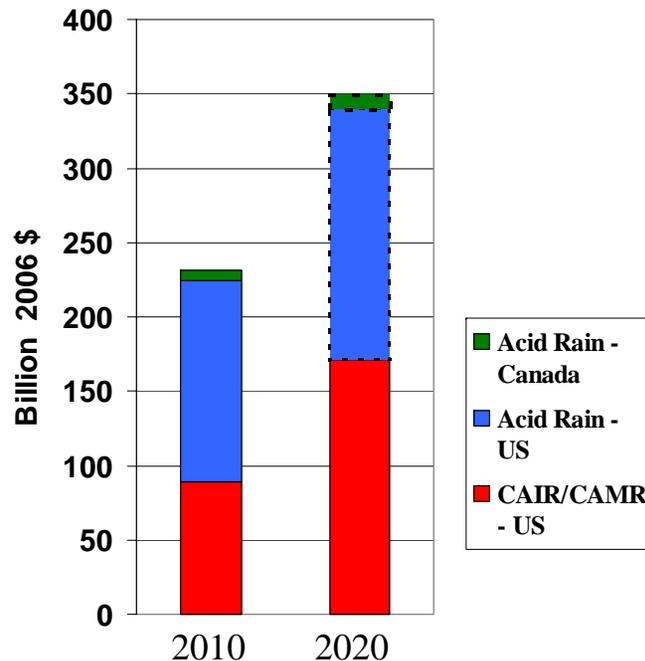
Source: EPA, 2005



# Benefits of Acid Rain and CAIR/CAMR Programs

## Annual Benefits

*-Qualified Assessment-*



*Note: All estimates used a 3% discount rate. Use of 7% discount rate would lower estimates about 15 percent. CPI-U used to convert 1999\$ and 2000\$ to 2006\$. Sources: Used Chestnut & Mills Analysis, "A fresh look at the benefits and costs of the US acid rain program" (Oct. 1, 2004) for 2010 Acid Rain Benefits and EPA's Multi-pollutant Regulatory Analysis: CAIR, CAVR, CAMR (Oct. 2005) for 2010 and 2020 estimates for these programs. Acid Rain 2020 benefits extrapolated from 2010 estimates.*

- All benefits estimates, except 2020 Acid Rain based on detailed analyses. 2020 Acid Rain is a simple extrapolation from 2010 estimates done conservatively (likely to be low) after review of predicted emission reductions, population growth and other factors.
- Benefits driven by:
  - Reduced premature deaths
  - Lowering aggravation and incidence of heart and lung ailments
- There also some benefits estimated for increased worker productivity, reduced absences from school and work, and visibility improvement in some parks
- Many benefits not included in estimates:
  - CAIR's Canadian Health Benefits
  - Acid rain environmental benefits
  - Mercury benefits
  - Remaining visibility benefits from parks and urban areas
  - Others



## Some Lessons Learned (Federally)

- 
- **It works!**
  - **Greatest reductions occur where the greatest emissions exist**
    - This inoculates programs against “hot spots”
  - **Trading provides broad regional reductions, but often should be considered with direct controls to strike right balance**
  - **Innovation happens!**
  - **Clarity of purpose, simplicity, and flexibility of trading and banking have combined to not only save money, but to provide:**
    - Lower administrative efforts to manage regulatory programs
    - High level of compliance
    - More environmental protection
  - **Keep it simple**
  - **Caps protect the environment, not allowance allocation**
  - **“Banking” can be beautiful – Offers early emission reductions and flexibility**
  - **Cap and trade lowers emissions without significant impact on business activities – limited price increases, “closures”, entry effects, operating changes**
  - **The “perfect,” is also the enemy of “excellence”**

# For More Information on U.S. Cap and Trading

## General

[www.epa.gov/airmarkets](http://www.epa.gov/airmarkets)

## Clean Air Interstate Rule

[www.epa.gov/cleanairinterstaterule](http://www.epa.gov/cleanairinterstaterule)

## Clean Air Mercury Rule

[www.epa.gov/mercury](http://www.epa.gov/mercury)

## Clean Air Visibility Rule

[www.epa.gov/visibility/actions.html#bart1](http://www.epa.gov/visibility/actions.html#bart1)

## Multi-Pollutant Legislative Analysis

[www.epa.gov/airmarkets/mp](http://www.epa.gov/airmarkets/mp)

[www.epa.gov/airmarkets](http://www.epa.gov/airmarkets) -- *click on “News of Interest”*

