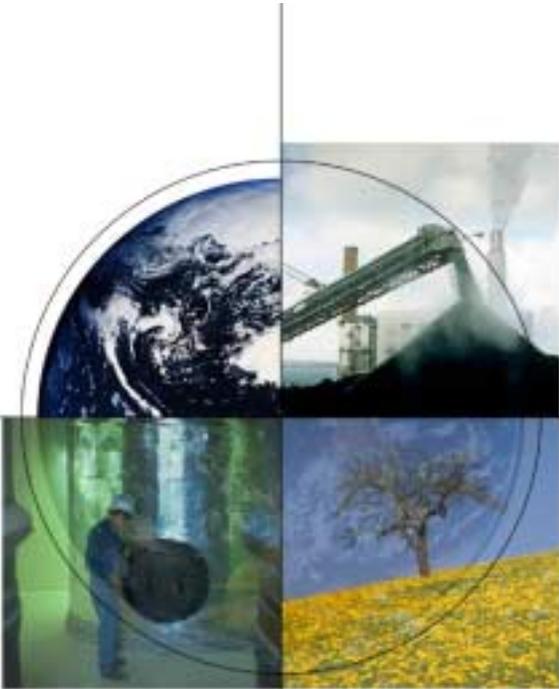


# National Energy Technology Laboratory's Compliance Technology R&D Program



*Evolution of Combustion  
Technology to Support  
National Energy Needs*

**Orlando, FL**

**January 14-16, 2002**

Thomas J. Feeley, III, Product Manager  
National Energy Technology Laboratory



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# Outline

- *Background*
- *Mercury Control*
- *NO<sub>x</sub> Control*
- *Fine Particulates and Acid Gas Control*
- *Conclusions*



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# Background



# Innovations for Existing Plants Program

- **Goal**

- Enhance environmental performance of existing fleet of coal power plants and advanced power systems

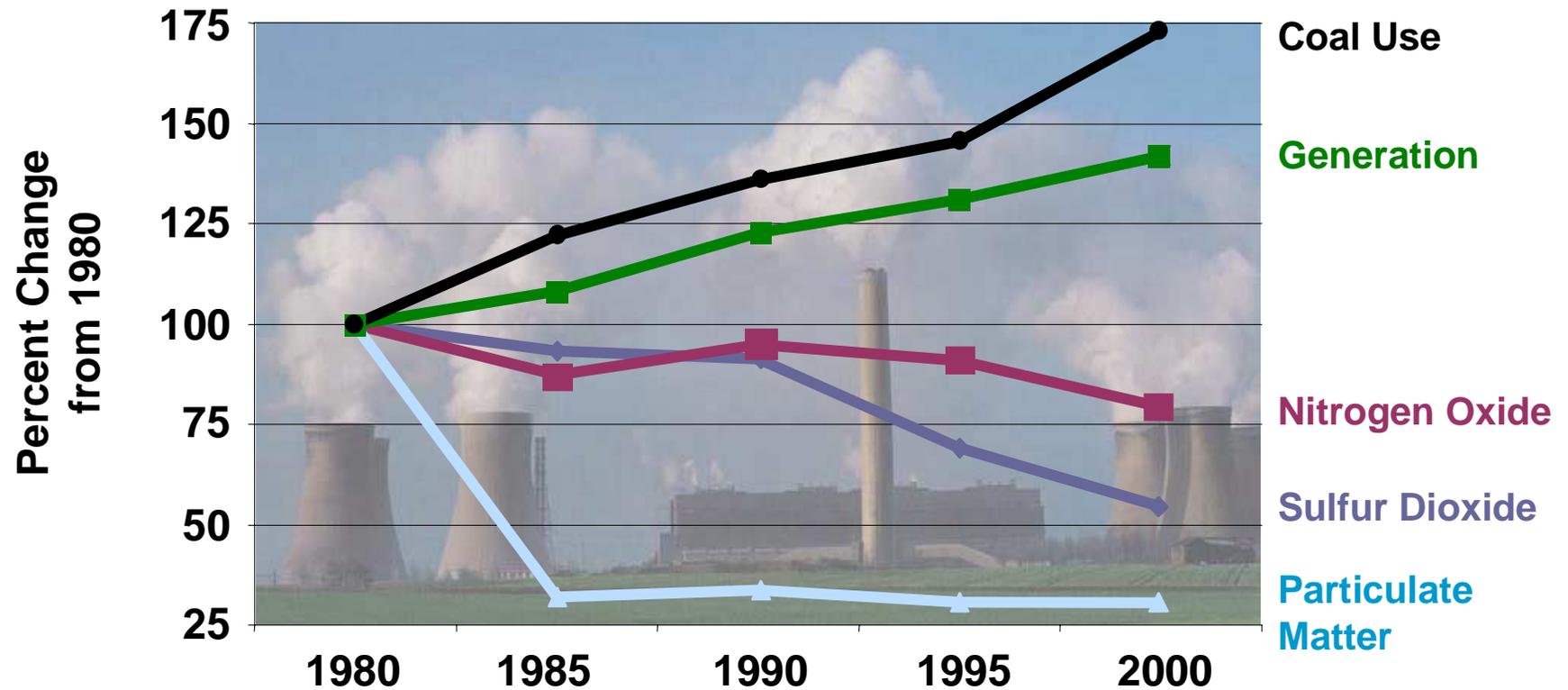
- **Objectives**

- Develop low-cost, integrated, non-complex technology to control emissions/releases (air, water, and solids) to the environment
- Provide high-quality scientific and technical information on environmental issues for use in future regulatory and policy decision making



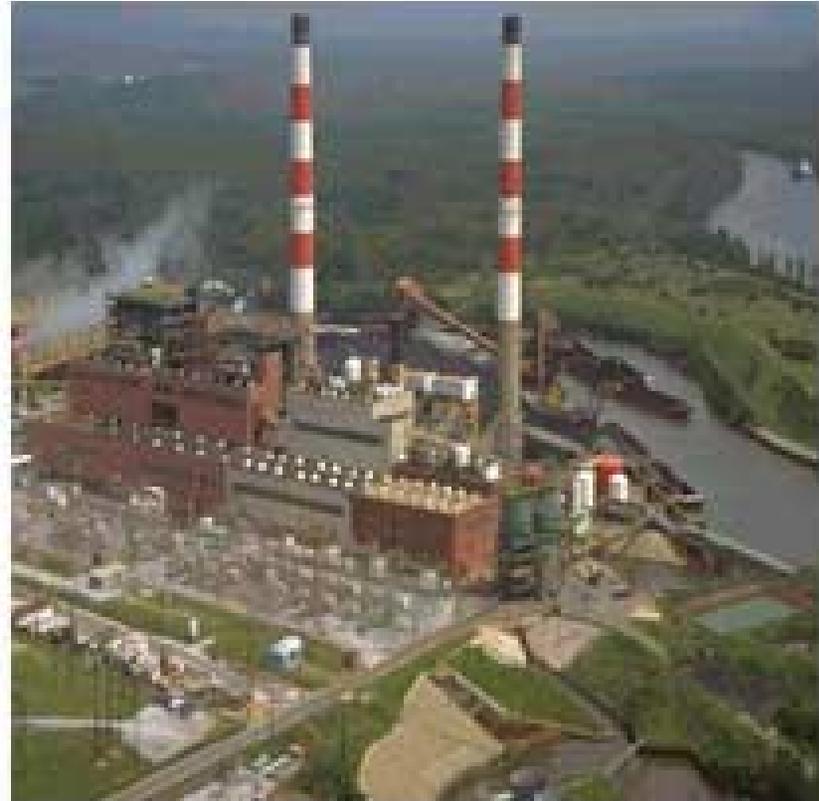
# Criteria Pollutant Emissions Down

*Significant Progress in Meeting Environmental Goals*



# Environmental Drivers

- **By-Products Use and Disposal**
- **Multi-Pollutant Control**
- **Other Toxics**
- **New Source Review**
- **Air-Water Interface**
- **Safe Drinking Water Act**
- **Toxic Release Inventory**
- **Visibility Impairment**
- **Ozone Reduction**
- **Hg Determination**
- **Ambient Fine Particulate**
- **Cooling Water Regulation**



# National Energy Policy

## *Environmental Recommendation*

- Establish a flexible, market-based program to significantly reduce and cap emissions of sulfur dioxide, nitrogen oxides, and mercury from electric power generators



## 3 Pollutant Control Strategy

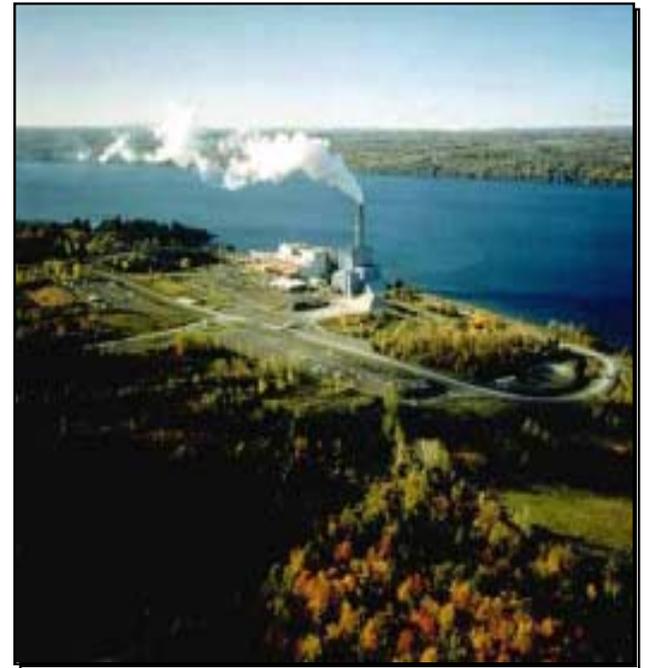
	Phase I	Phase II	Phase III
Hg	By 2008, cap at 24 tons/yr	By 2012, cap at 7.5 tons/yr + 70% minimum reduction requirement	N/A
SO <sub>2</sub>	By 2010, cap at 2 million ton/yr	N/A	N/A
NO <sub>x</sub>	By 2004, NO <sub>x</sub> SIP call compliance	By 2008, cap at 1.87 million ton/yr	By 2012, cap at 1.25 million ton/yr



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## Research Portfolio

- *Hg control*
- *NO<sub>x</sub> control*
- *Fine particulates/acid gas control*
- *Ambient air quality*
- *Coal byproducts*
- *Water science and technology*



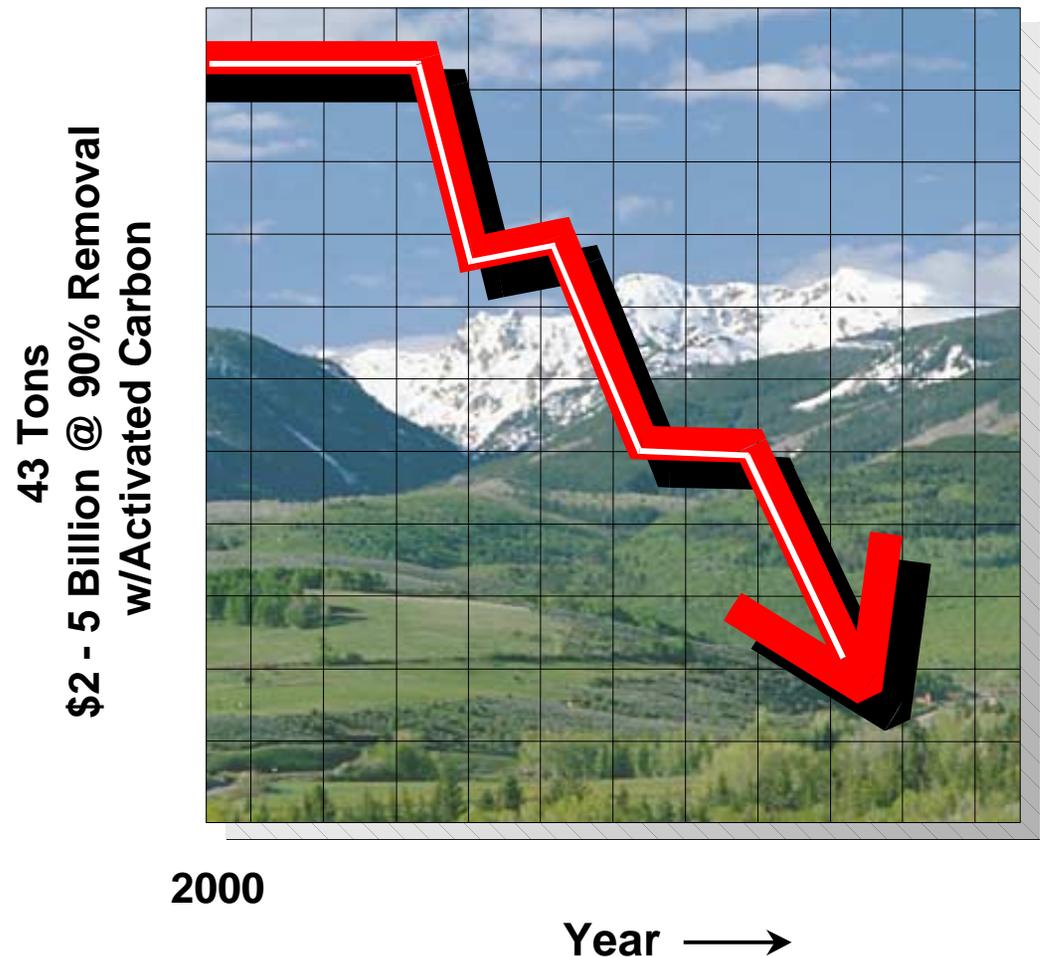
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# Mercury Control



# Mercury Control

- **Developing advanced control technology**
  - By 2005, reduce emissions by 50-70%
  - By 2010, reduce emissions by 90%
  - Cost 25-50% less than current estimates



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## Current Mercury Control Focus

- **Collect cost and performance data from field testing of two promising mercury control technologies:**
  - ADA-ES will test sorbent injection technology at four power plants that have either electrostatic precipitators (ESP) or fabric filters
  - B&W/MTI will test and evaluate a proprietary liquid reagent in two different sizes of wet FGD downstream of an ESP



# Advanced Hg Control Concepts

- **University of North Dakota Energy & Environmental Research Center**
  - Hybrid particulate control system
- **URS Group**
  - Catalyst to convert elemental to oxidized Hg
- **CONSOL**
  - Multi-pollutant control technology to remove Hg, SO<sub>2</sub>, and acid gases
- **Southern Research Institute**
  - Calcium-based additives for controlling mercury
- **Powerspan Corp.**
  - Multi-pollutant control technology to remove Hg, SO<sub>2</sub>, NO<sub>x</sub>, particulates, and acid gases
- **Apogee Scientific**
  - Advanced mercury sorbents

***Designed to Achieve  $\geq$  90% Hg Removal***



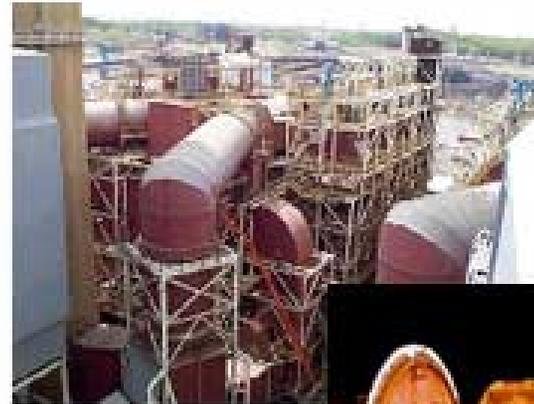
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# NOx Control



# NO<sub>x</sub> Control

- Address 22-state NO<sub>x</sub> SIP call and multi-pollutant control regulation to address ozone, fine PM, regional haze, and nitrogen deposition
- Developing ultra-low-NO<sub>x</sub> technologies to be ready for deployment between 2003-2005
- Capable of achieving 0.15 lb/mm Btu emissions limit at less than 3/4 the cost of SCR

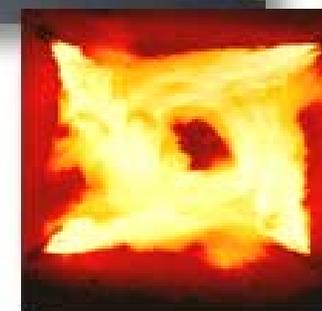
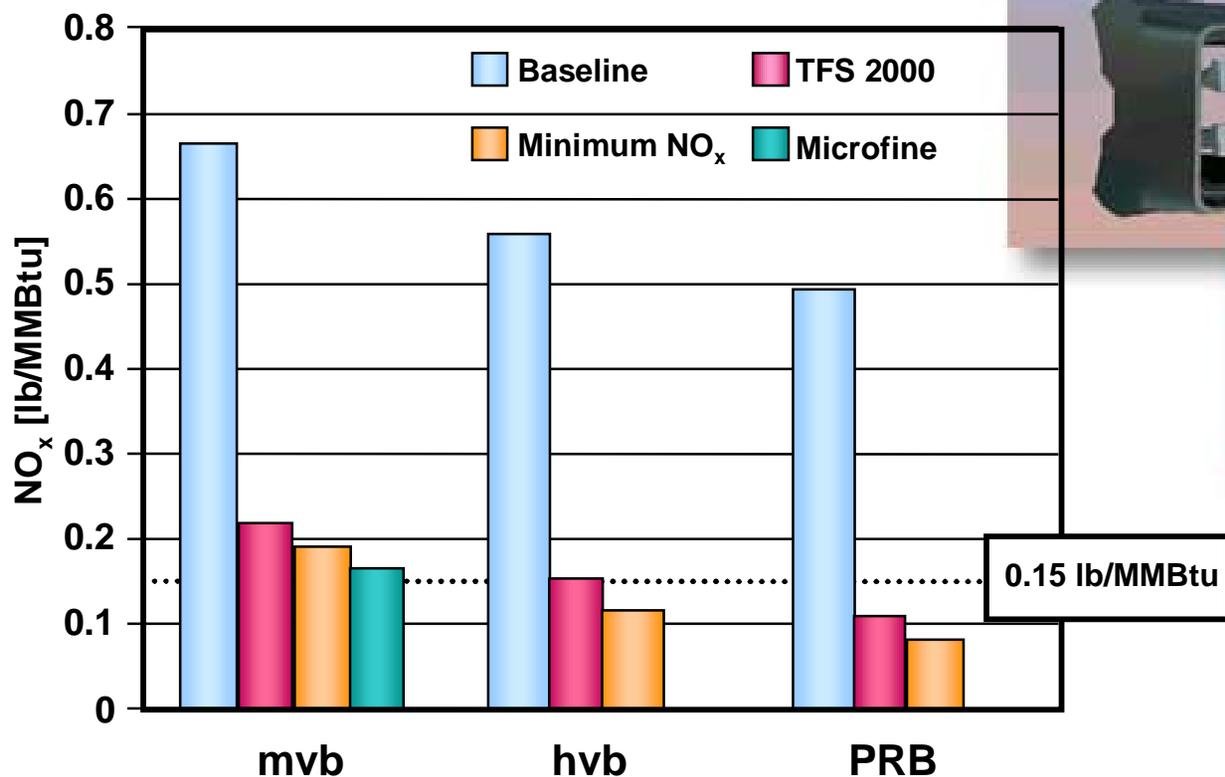


# NO<sub>x</sub> Control Technology Portfolio

- Alstom Power - *“Ultra Low NO<sub>x</sub> Integrated System for NO<sub>x</sub> Emissions Control”*
- McDermott - *“Cost Effective Control of NO<sub>x</sub> with Integrated Ultra Low NO<sub>x</sub> PC Burners and SNCR”*
- Reaction Engineering - *“NO<sub>x</sub> Control Options and Integration for U.S. Coal-Fired Boilers”*
- GTI - *“Methane de-NO<sub>x</sub> for Utility Boilers”*
- Praxair - *“Oxygen-Enhanced Combustion for NO<sub>x</sub> Control”*



# Alstom's Ultra Low NO<sub>x</sub> Burner Test Results



**Performance Goal:  $\leq 0.15$  lb NO<sub>x</sub>/MMBtu**



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# Fine Particulate and Acid Gas Control



# PM and Acid Gas Control

## *Performance Targets*

- **Developing advanced technologies that can achieve:**
  - 99.9% capture of fine (0.01-10 micron) PM
  - 95% control of acid gases (e.g., H<sub>2</sub>SO<sub>4</sub>)
- **Technologies will be ready for commercial demonstration beginning in 2003**



Advanced Hybrid Particulate Collector,  
Big Stone Power Plant, Milbank, SD

# Emissions Control Technology - Key Projects

## *Primary Particulate Control*

- **Advanced Hybrid Particle Collector**
  - Contractor: University of North Dakota (UND-EERC)
  - Combination baghouse & ESP in one “box”
  - Field demo at Otter Tail Power Co., Big Stone City, SD
- **Electrocore Separator**
  - Contractor: LSR Technologies, Inc
  - Post-ESP separation & recycling unit to enhance ESP removal of fine PM
- **Advanced Flue Gas Conditioning**
  - Contractor: ADA Environmental Solutions, LLC
  - Non-toxic conditioning agents to enhance ESP performance



# Emissions Control Technology - Key Projects

## *Acid Gas Control*

- **Furnace Injection of Alkaline Sorbents for Sulfuric Acid Control**
  - Contractor: Radian International, LLC
  - Environmental goal: plume opacity, TRI emissions
  - Operational benefits: Control of  $\text{SO}_3$  upstream of air preheater reduces fouling
  - Sorbents:  $\text{Mg}(\text{OH})_2$ ,  $\text{Ca}(\text{OH})_2$ , PHDL, dolomite
- **Field Demonstration Sites**
  - First Energy, Bruce Mansfield Plant, Shippingport, PA
  - AEP Gavin Station, OH

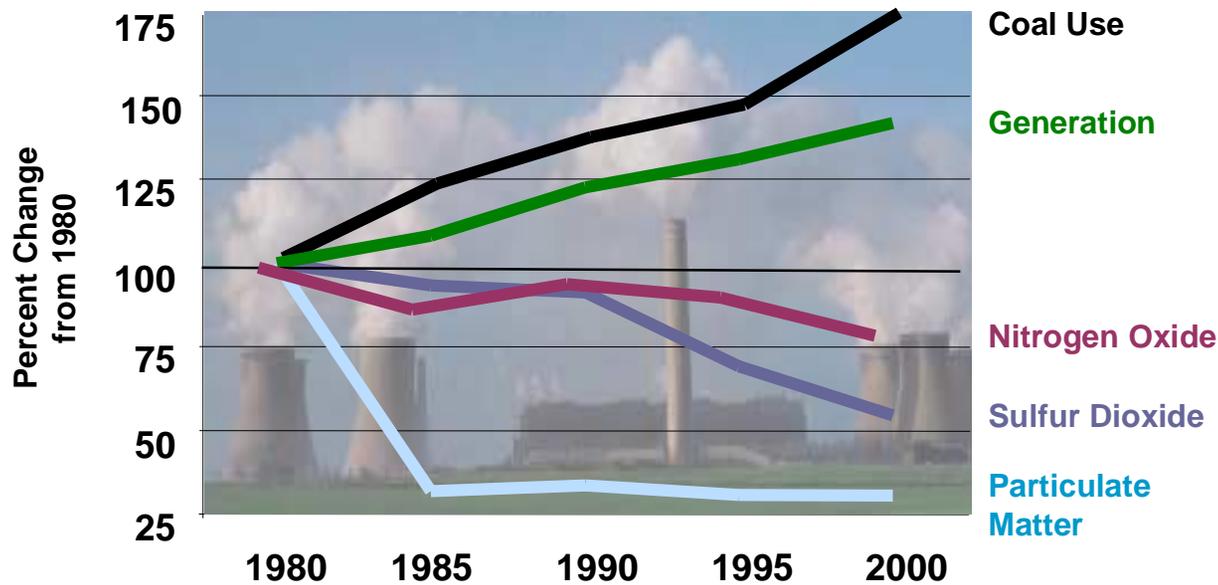


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# Conclusions



# Public Benefit



- Development of technology resulting in reduced cost of compliance and cleaner environment
- Development of sound regulatory policy

- *National Academy of Sciences reported upwards of \$60 billion in benefits have been gained from DOE's research in NO<sub>x</sub> and SO<sub>2</sub> control technology RD&D*
- *Equivalent to roughly five dollars for every dollar invested*



# Partnerships



- **NETL works closely with industry and EPA in planning and implementing its emissions control technology research program**

**Jim Kilgroe (EPA), Scott Renninger (DOE/NETL), and George Offen (EPRI) discussing strategy during the ADA-ES sorbent injection kickoff meeting at the Southern Company Gaston Station on April 18, 2001.**



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## For More Information...

- Visit our website at:

*[www.netl.doe.gov/coalpower/environment](http://www.netl.doe.gov/coalpower/environment)*

