

# DOE-NETL's Mercury Control Technology R&D Program



## *Program Review Meeting*

*August 12, 2003  
Pittsburgh, PA*

**Scott Renninger**  
**National Energy Technology Laboratory**



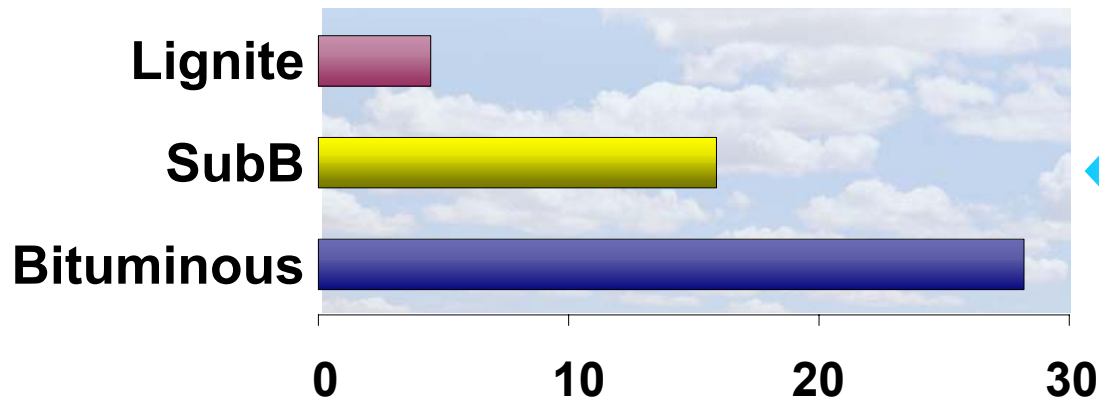
# Presentation Outline

- **Hg Program Goals & Drivers**
- **Phase I Projects**
- **Phase II Field Testing Solicitation 41718 Status**
- **Other NETL Related Activities**

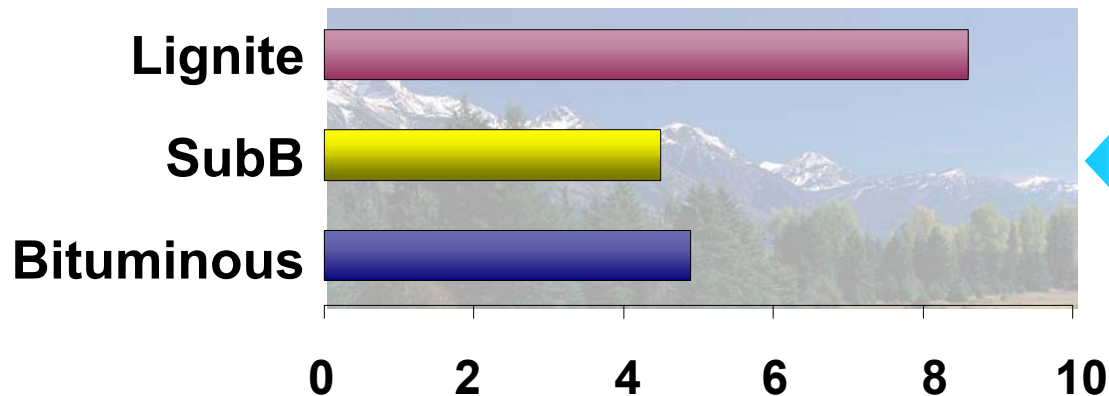


# Power Plant Mercury Emissions

*Coal Plants Emit ~ 48 tons/year*



**Total US Hg Emissions  
(tons per year)**



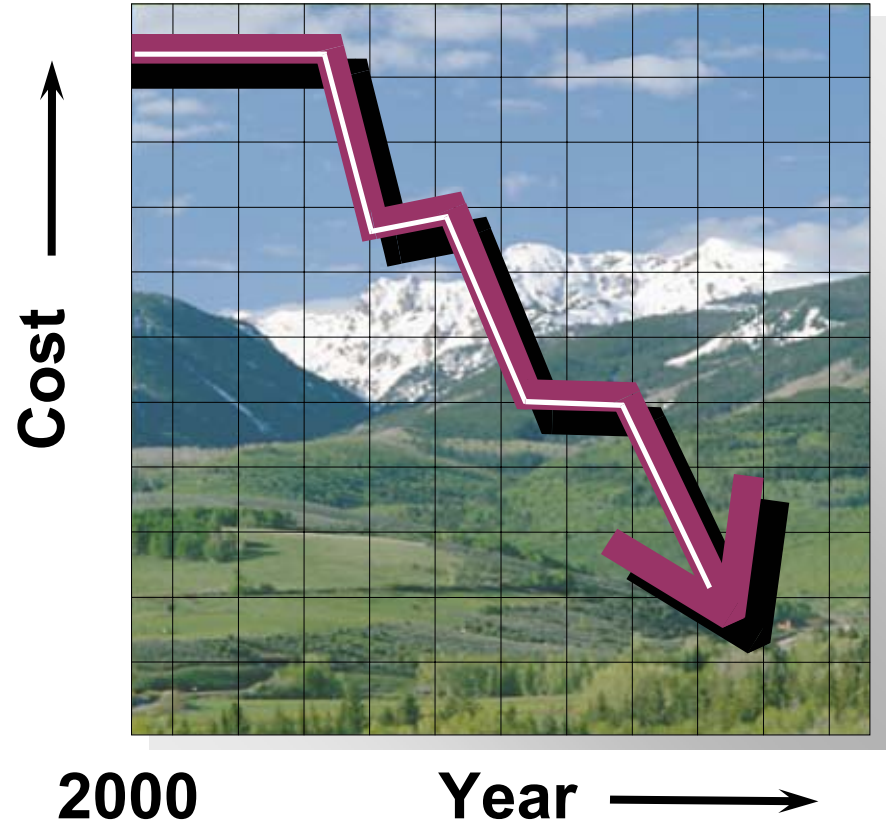
**Hg Emission Rate  
(lb per TBtu)**

# R&D Goals

## *DOE-NETL Mercury Control Program*

Have technologies ready for commercial demonstration:

- By 2005, reduce overall emissions 50-70%
- By 2010, reduce overall emissions by 90%
- Cost 25-50% less than current estimates



**Baseline Costs: \$50,000 - \$70,000 / lb Hg Removed**

# Multi-pollutant Control Legislative Proposals

## Proposed Emissions Caps

### *Tons / Year*

|   | <b>Actual<br/>2001</b> | <b>S. 485 -<br/>Clear Skies</b> | <b>S. 366 -<br/>Jeffords</b> | <b>S. 843 –<br/>Carper</b>                       |
|---|------------------------|---------------------------------|------------------------------|--|
| <b>Sulfur Dioxide<br/>(SO<sub>2</sub>)</b>  | 10.6 M                 | 4.5 M in 2010<br>3.0 M in 2018  | 2.25 M in 2009               | 4.5 M in 2009<br>3.5 M in 2013<br>2.25 M in 2016 |
| <b>Nitrogen Oxides<br/>(NO<sub>x</sub>)</b> | 4.8 M                  | 2.1 M in 2008<br>1.7 M in 2018  | 1.51 M in 2009               | 1.87 M in 2009<br>1.7 M in 2013                  |
| <b>Mercury<br/>(Hg)</b>                     | 48 (1999)              | 26 in 2010<br>15 in 2018        | 5 in 2008                    | 24 in 2009<br>10 in 2013                         |
| <b>Carbon Dioxide<br/>(CO<sub>2</sub>)</b>  | 2.47 B (est.)          | N.A.                            | 2.05 B in 2009               | 2.57 B (est.) in 2009<br>2.47 B (est.) in 2013   |



Source: EIA AEO 2003 Reference Case Forecast, S.485, S.366, S.843

# Multi-pollutant Control Legislative Proposals

## Proposed Emissions Caps

### *% Reduction from Baseline Actual*

|   | <b>Actual<br/>2001</b> | <b>S. 485 -<br/>Clear Skies</b> | <b>S. 366 -<br/>Jeffords</b> | <b>S. 843 –<br/>Carper</b>                        |
|---|------------------------|---------------------------------|------------------------------|---|
| <b>Sulfur Dioxide<br/>(SO<sub>2</sub>)</b>  | 10.6 M                 | 58% in 2010<br>72% in 2018      | 79% in 2009                  | 58% in 2009<br>70% in 2013<br>79% in 2016         |
| <b>Nitrogen Oxides<br/>(NO<sub>x</sub>)</b> | 4.8 M                  | 56% in 2008<br>65% in 2018      | 69% in 2009                  | 61% in 2009<br>65% in 2013                        |
| <b>Mercury<br/>(Hg)</b>                     | 48 (1999)              | 46% in 2010<br>69% in 2018      | 90% in 2008                  | 50% in 2009<br>79% in 2013                        |
| <b>Carbon Dioxide<br/>(CO<sub>2</sub>)</b>  | 2.47 B (est.)          | N.A.                            | 17% in 2009                  | ~4% <i>increase</i> in 2009<br>2001 level in 2013 |



Source: EIA AEO 2003 Reference Case Forecast, S.485, S.366, S.843

# Six Mercury Control Field Tests

| Technology / Utility Plant   | Test Completion   |
|--|---|
| <p><b>ADA-ES – Sorbent Injection</b></p> <p>Alabama Power – Gaston<br/>We Energies – Pleasant Prairie<br/>PG&amp;E – Brayton Point<br/>PG&amp;E – Salem Harbor</p> | <p>April 2001<br/>November 2001<br/>August 2002<br/>November 2002</p> |
| <p><b>McDermott-B&amp;W – Enhanced Scrubbing</b></p> <p>Michigan South Central Power – Endicott<br/>Cinergy – Zimmer</p>   | <p>October 2001<br/>November 2001</p>                                 |





# Observations From Field Tests

- **Activated carbon removes Hg**
  - Range of effectiveness depends on coal type and plant configuration
- **Many uncertainties remain**
  - Capture effectiveness with low-rank coals
  - Sorbent feed rate and costs
  - By-product use and disposal
    - At Pleasant Prairie, LOI increased from 0.6% to 2.5-3.5% at 10 lb/MMacf
  - Need for fabric filter for units equipped with ESP
  - Balance-of-plant impacts





# Advanced Mercury Control Concepts

- **Apogee Scientific**
  - Advanced Hg sorbents
- **CONSOL**
  - Multi-pollutant control for Hg, SO<sub>2</sub>, acid gases
- **UNDEERC**
  - Hybrid particulate control system
- **Powerspan**
  - Multi-pollutant control for Hg, SO<sub>2</sub>, NO<sub>x</sub>, particulates, acid gases
- **Southern Research Institute**
  - Calcium-based additives to control Hg
- **URS Group**
  - Catalyst to convert elemental to oxidized Hg

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



# Mercury Control Technology R&D

## *Phase II Field Testing Program*

- Targeted solicitation issued Feb. 5, 2003: First closing date of April 7, 2003; Second closing date of Jan. 29, 2004
- Second phase of field testing at commercial coal-fired power plants
  - Activated carbon/sorbent injection
  - Enhance capture across FGD
  - Oxidation technology
  - Novel concepts
- One-month or longer duration testing at optimum conditions with focus on broader suite of boiler configurations and coal-types (e.g., lignite)



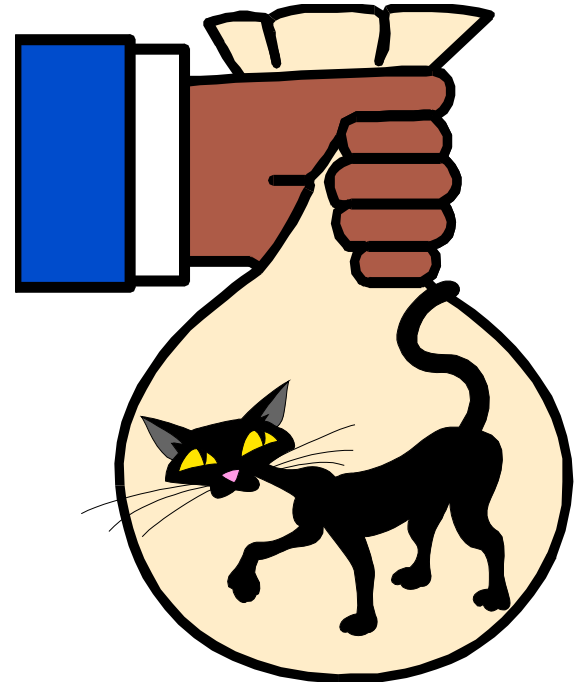
# Solicitation Development/Structure

- Held two workshops to obtain stakeholder input (6/4/02 & 9/12/02):
  - Coal types to be evaluated
  - Plant size and configuration, including downstream control equipment
  - Length of testing
  - Application of Hg CEMs
  - Other issues
- Cost-sharing
  - 3/4 DOE
  - 1/4 Proposing Team
- Requested multi-site proposals with integrated project team



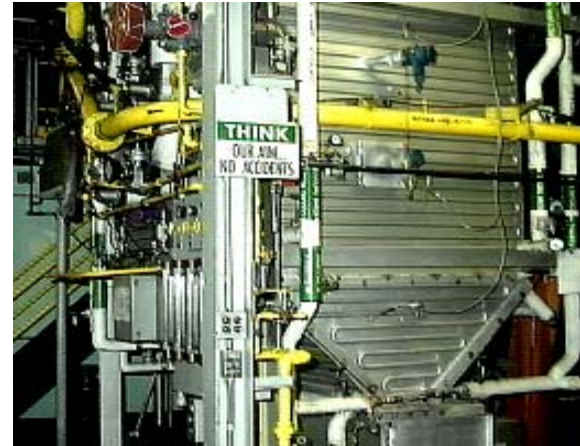
# AND THE WINNERS ARE?

- **Congressional Notifications have been sent to Headquarters for Approval**
- **Winners to be notified within the next few weeks**



# NETL's Inhouse R&D Activities

- **THIEF Process** - Capture Hg on semi-combusted coal extracted from furnace and re-injected downstream of air preheater
- **GP-254 Process** - Uses 253.7-nanometer ultraviolet radiation to increase fraction of oxidized Hg



**NETL's  
500#/hr  
Coal  
Combustion  
Pilot Unit**



**Dr. Evan Granite, co-inventor of  
GP-254 Process**

# Coal Combustion Byproduct Research

- Increase national beneficial use of coal byproducts from 33% to 50% by 2010
- Characterization of Hg (and other trace metals) leaching and volatilization from coal byproducts



*Fly Ash and Scrubber Solids*

**Hazardous Designation of All By-products  
Would Cost \$11 Billion/Year**

# Policy and Regulatory Implications of R&D

- **Results of research and subsequent cost and performance analyses critical to:**

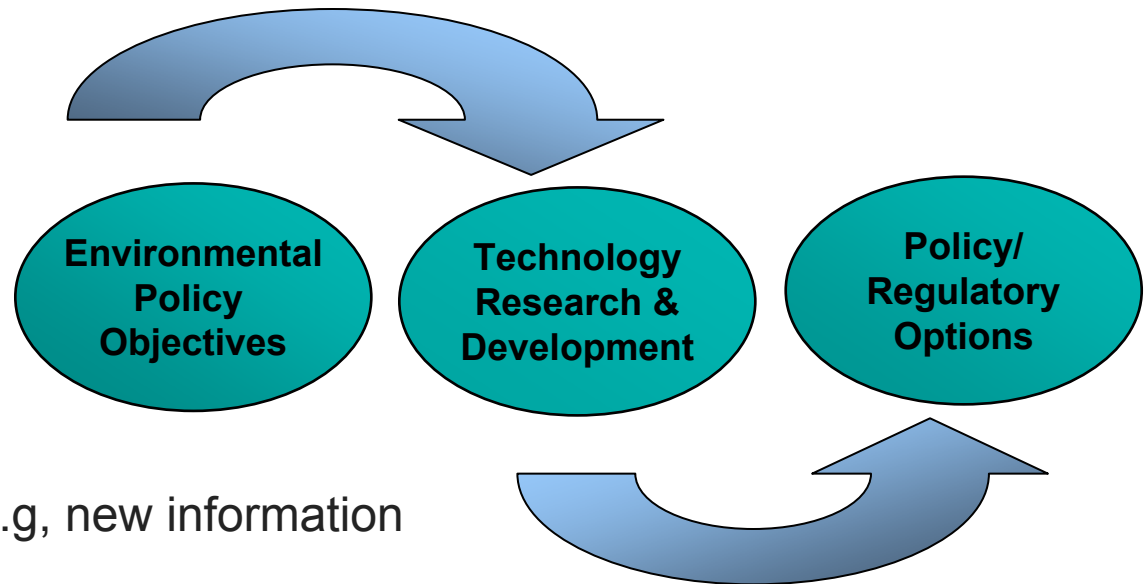
- Hg and HAP Reports to Congress

- Hg MACT Interagency Review

- Administration's Clear Skies Initiative, e.g, new information "re-opener"

- Alternative multi-pollutant control proposals

- United Nation Environmental Programme (UNEP) Global Mercury Assessment





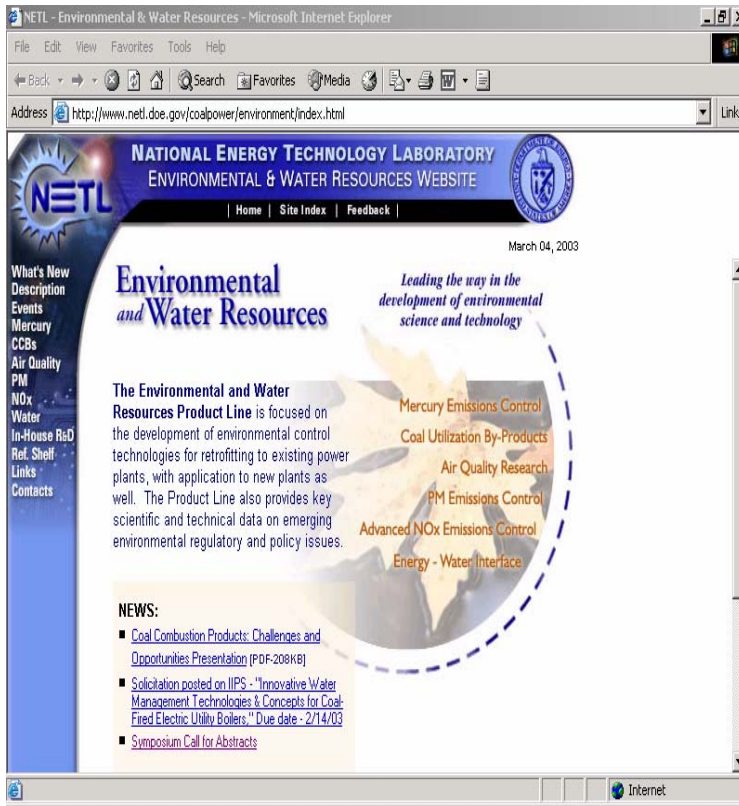
# Key Unresolved Issues



Coal-fired Utility Plant Manager

- **MACT or Clear Skies ?**
- **Trading?**
- **State vs. Federal limits**
- **Sustainability of Short-Term Results Over Much Longer Removal Periods**
- **Low Rank Coal Removals**
- **Confidence in CEMs**
- **Mercury Capture in By-Products/Regulatory Status?**

# DOE-NETL Environmental and Water Resources Home Page



- *To find out more about DOE-NETL's Environmental R&D activities visit us at:*

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

