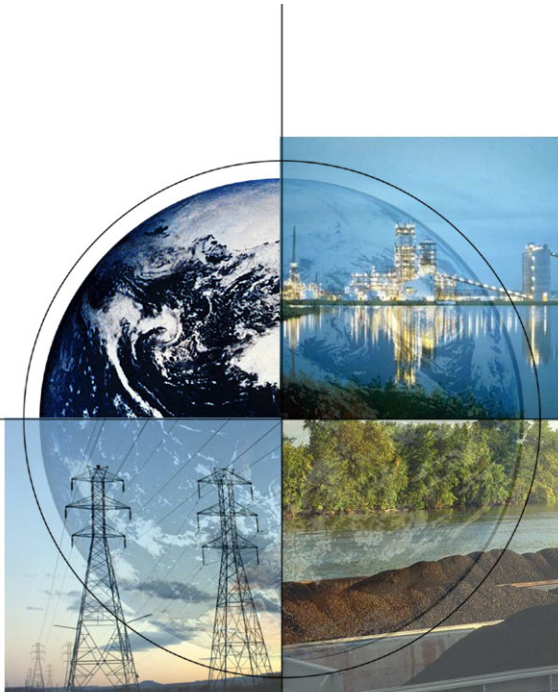


# DOE/NETL's Coal Utilization Byproduct R&D Program



## ACAA – TCAUG Annual Meeting

Dallas, TX

January 26-28, 2004

Thomas J. Feeley III  
National Energy Technology Laboratory



# Presentation Outline

- **Who we are**
- **Background & program drivers**
  - Future coal use
  - Air regulations
  - Greenhouse gases
- **DOE/NETL CUB research program**
- **Summary/conclusions**



# Coal Combustion Products Partnership (C<sup>2</sup>P<sup>2</sup>)



- EPA Deputy Administrator announced C<sup>2</sup>P<sup>2</sup> on October 10, 2002
- Approximately 110 charter members
- Collaborative effort of EPA, ACAA, DOE/NETL, USWAG, and DOT



# National Energy Technology Laboratory

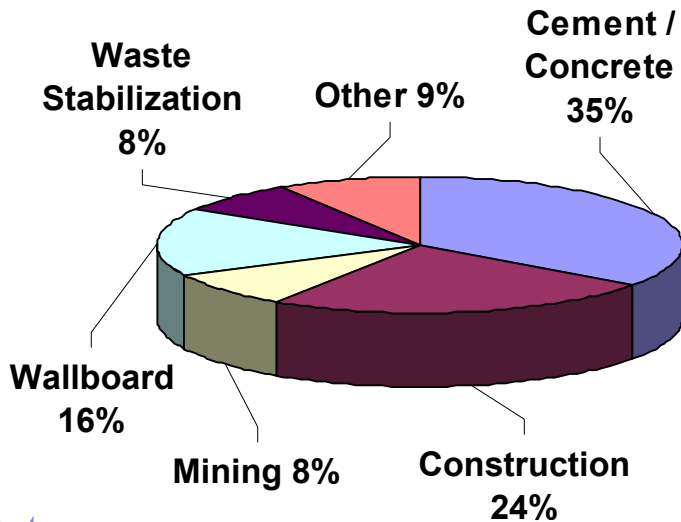
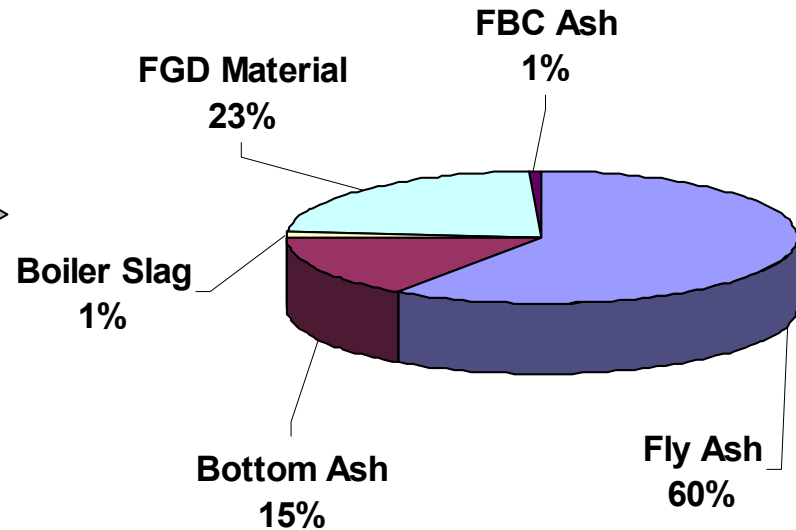


- **One of DOE's 17 national labs**
- **Government owned / operated**
- **Sites in:**
  - Pennsylvania
  - West Virginia
  - Oklahoma
  - Alaska
- **More than 1,100 federal and support contractor employees**



# Current CUB Production and Utilization

**Production**  
129 million tons



**Utilization (35%)**  
45 million tons



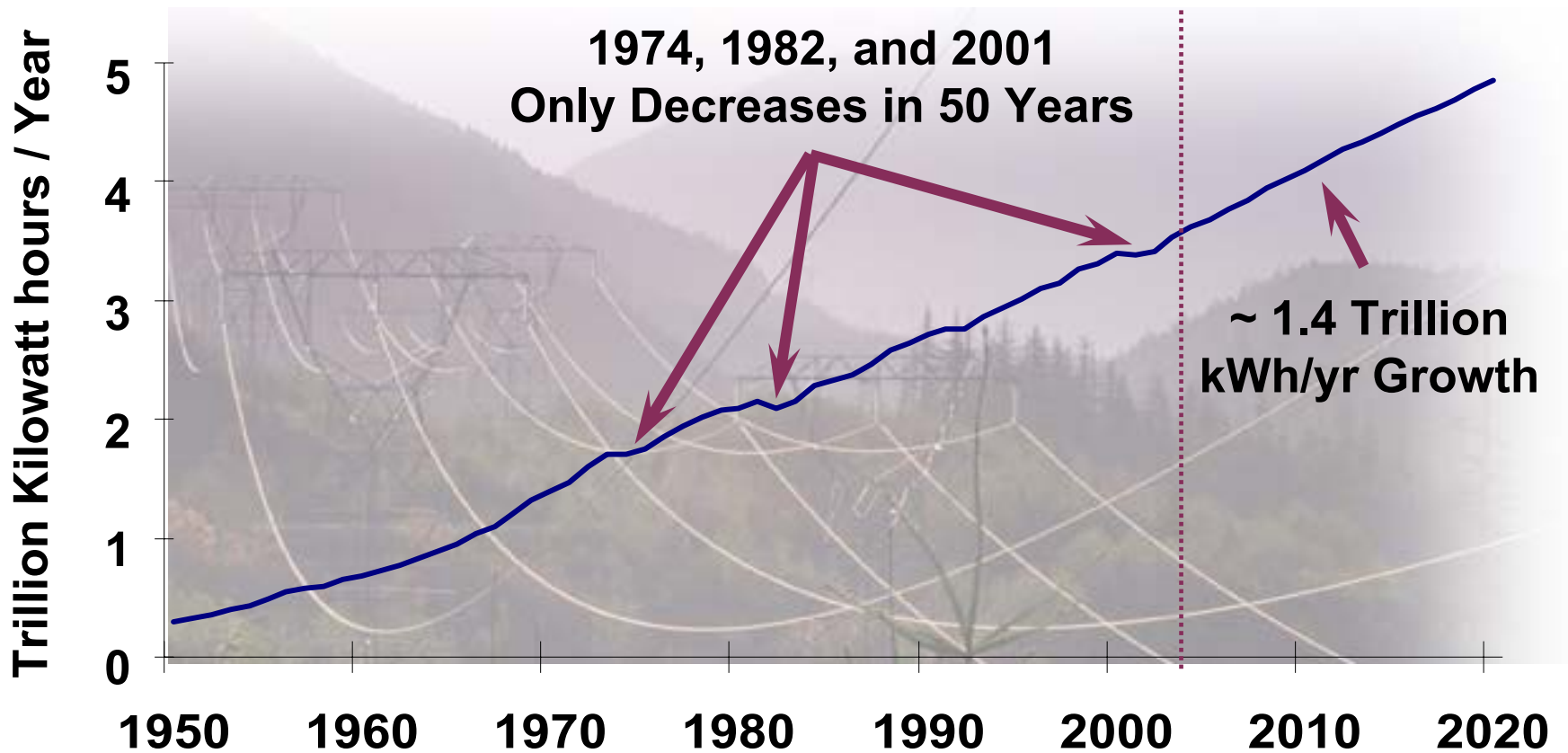
Source: ACAA 2003 CUB Survey

# What are CUBs?

- DOE/NETL defines CUBs as the solid byproducts from the utilization of coal including:
  - Combustion
  - Gasification
  - Hybrid systems



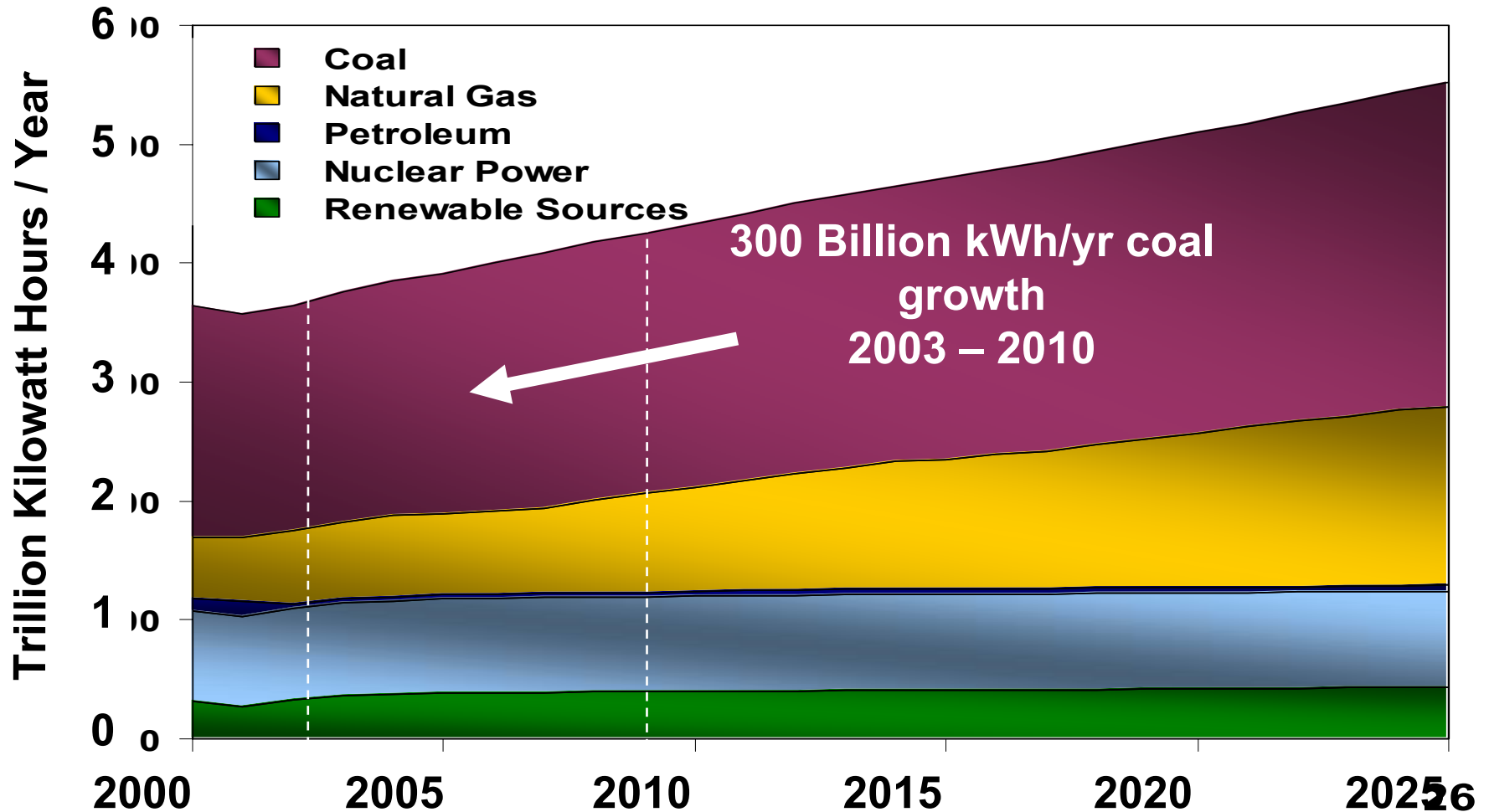
# Growth of U.S. Electricity Market



Sources: EIA Annual Energy Review 2001 and 2003 Annual Energy Outlook



# Fuel Mix for Electricity Growth



Source: Annual Energy Outlook 2003





# Implications of 300 BkWh/Year Growth

- **Using Coal-fired Heat Rate of 10,000 Btu/kWh  
Yearly New Coal Demand of 300 BkWh:**
  - = 3,000 TBtu**
  - = 150 Million Tons (@ 10,000 Btu/lb Average)**
- **Or... Assuming Same Existing Plants Operate 15% More  
Hours, Yearly New Production (based on 1 Billion  
Tons/Year Current Use):**
  - = 150 Million Tons Coal**
  - = 15 Million Tons By-products**
- **New Capacity Equivalent:**
  - ≈ 45,000 MW New Capacity (15% of 300GW)**
  - If Average Capacity Factor Remained @ 71%**



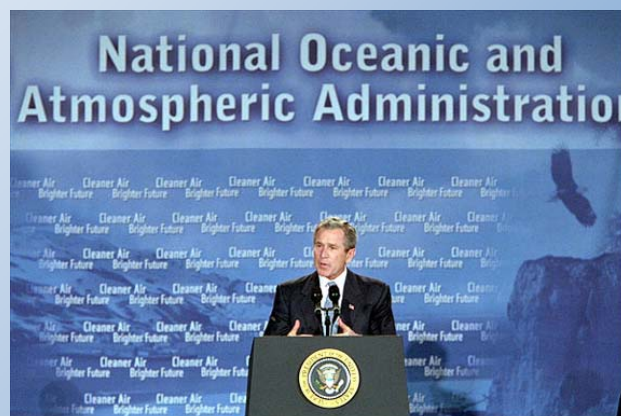
# Mercury and SO<sub>2</sub> Regulations

## Regulation:

- EPA proposal issued 12/15/03
- Several alternatives for control offered for comment
- **Maximum Achievable Control Technology (MACT)**
  - Plant-by-plant – no trading
  - Approx. 29% reduction by 2007/08
- **Cap & Trade**
  - FGD/SCR co-benefit (29% reduction) by 2010
  - 15 ton cap (69% reduction) by 2018

## Legislation:

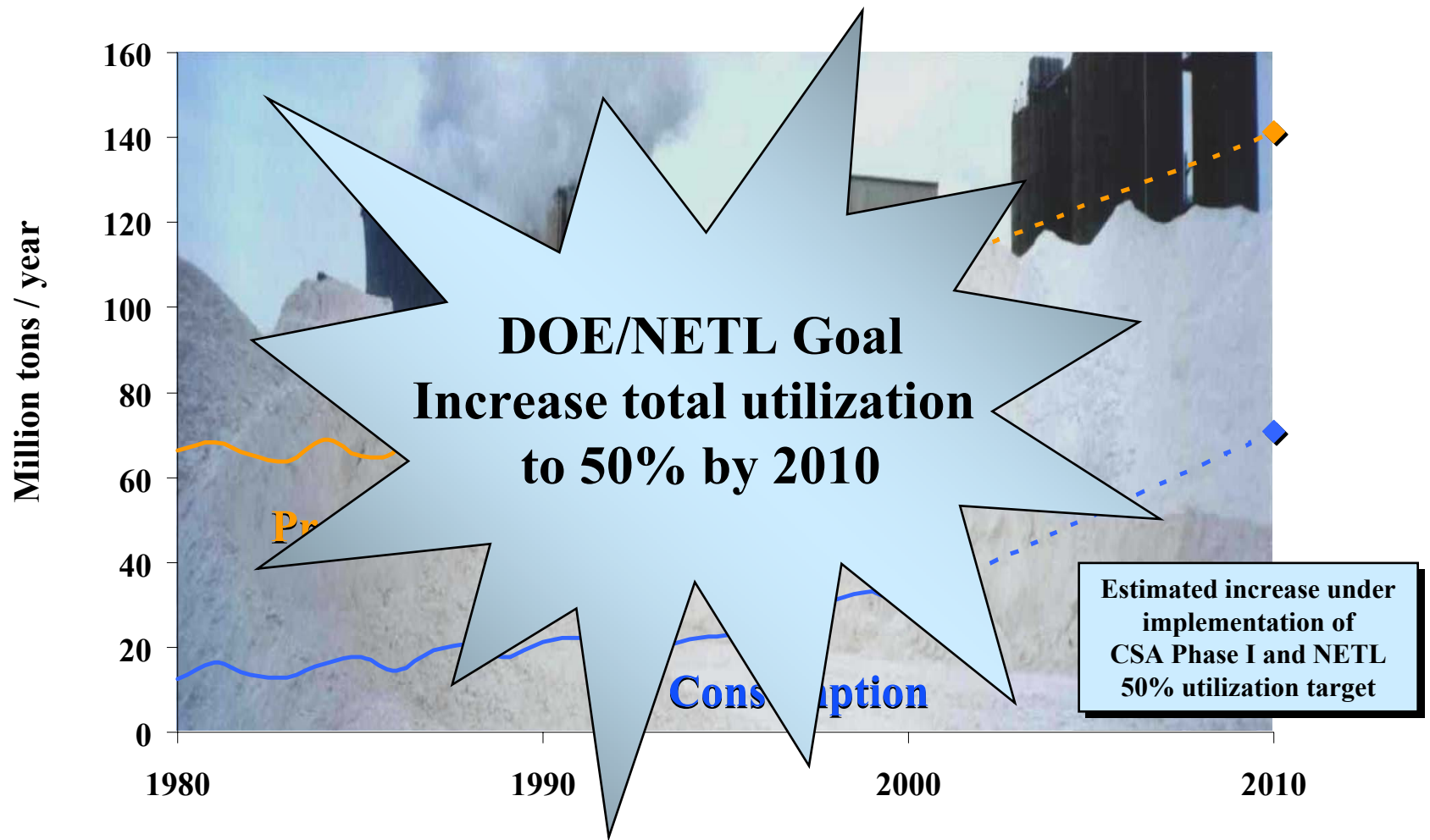
- **Clear Skies Act of 2003**
  - Cap & trade program
  - Phased in reductions in Hg, SO<sub>2</sub>, and NO<sub>x</sub>



*President Bush Announcing Clear Skies Initiative February 14, 2002*



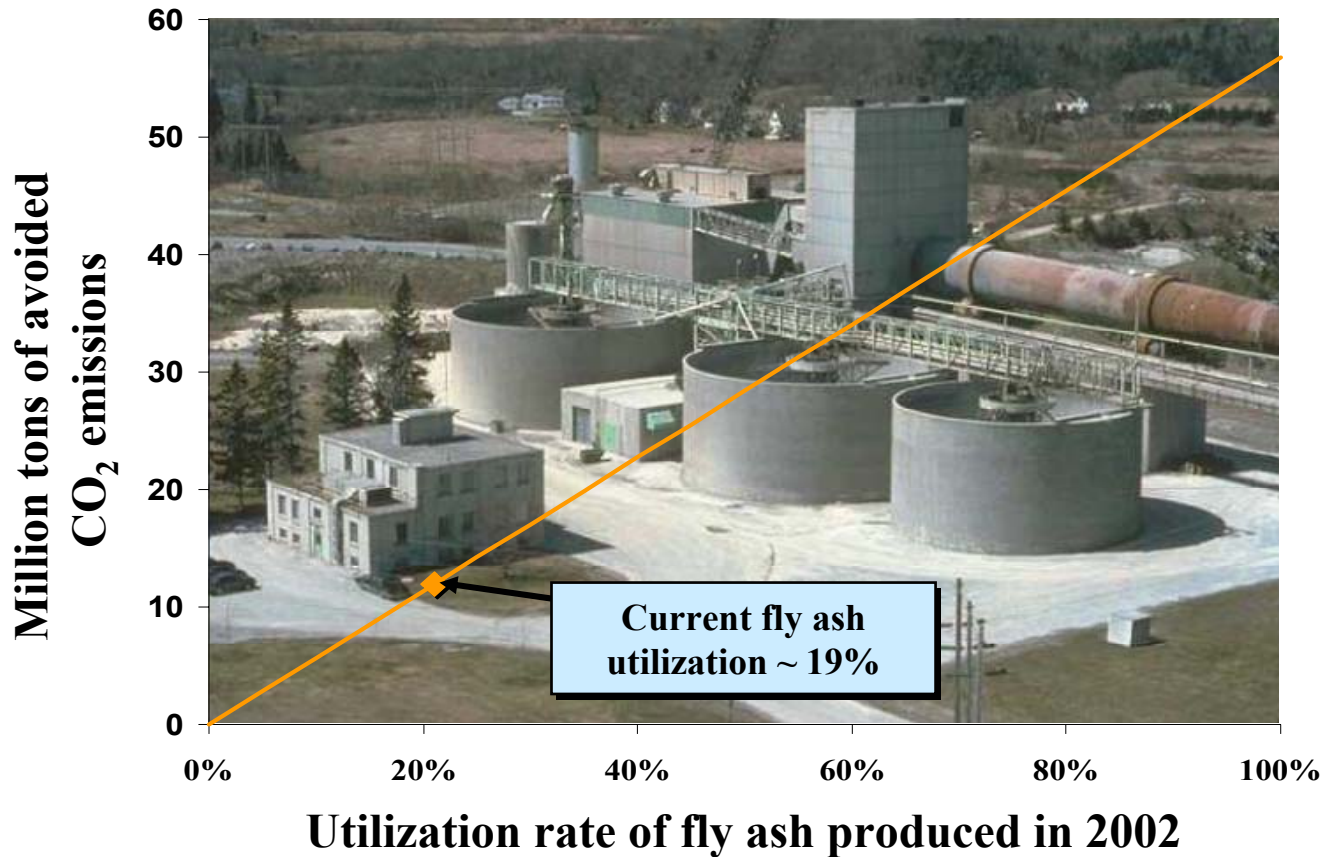
# Implications of Future Emission Regulations



Source: USGS, Historical Statistics for Mineral Commodities in the United States, May 2002

Tom Feeley, ACAA Meeting, Dallas, TX, Jan. 27, 2004

# Potential To Reduce Greenhouse Gases



1 ton of fly ash used in cement manufacturing provides for approximately 0.8 tons of avoided CO<sub>2</sub> emissions



# Innovations for Existing Plants Program

## *Goals and Objectives*

- **Enhance environmental performance of existing fleet of coal power plants and advanced power systems**
- **Objectives**
  - Develop low-cost, integrated 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 regulatory and policy decision making

***Directly supports President's Clear Skies Initiative and other environmental regulations***



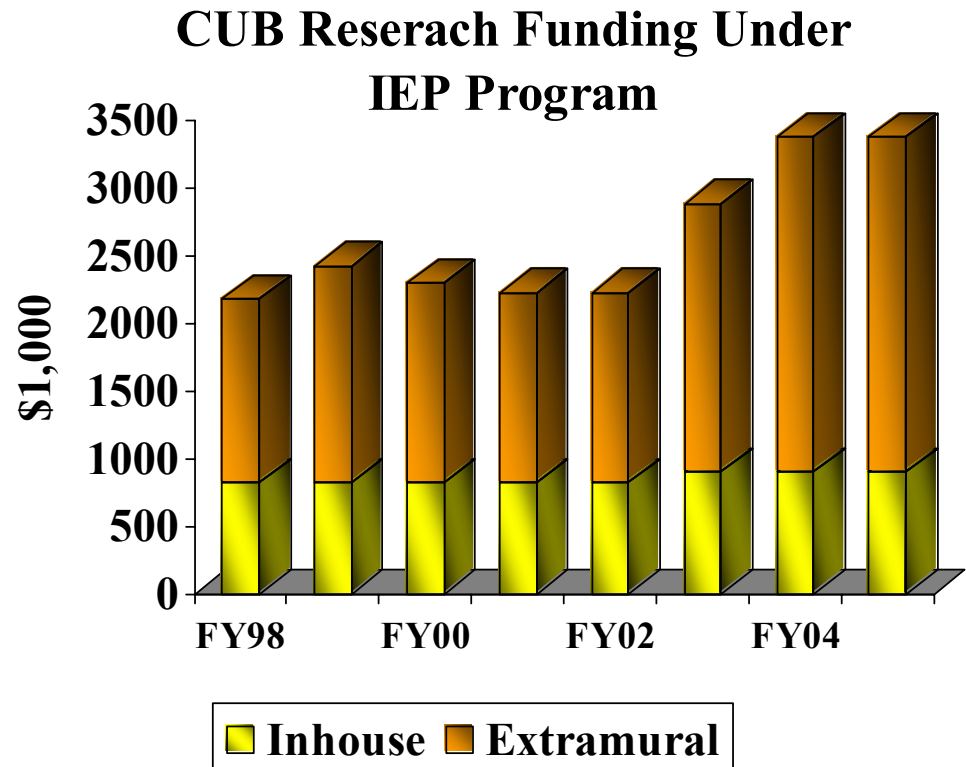
# IEP Program Components

- **Mercury control**
- **NOx control**
- **Particulate-matter control**
- **Air-quality research**
- **Coal byproducts**
- **Water management**



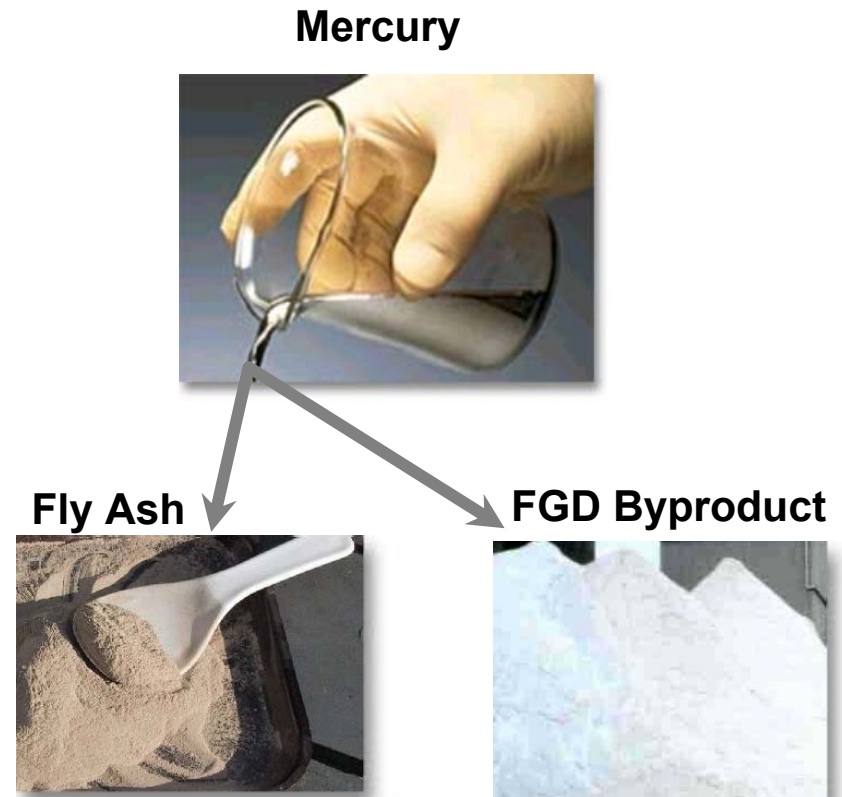
# DOE/NETL CUB Research Funding

- Over \$22 million in DOE/NETL funded CUB in-house and extramural research from FY98 – FY05
- An additional \$22 million for coal byproducts under DOE's clean coal demonstration program



# Hg Control and Coal Byproducts

- Control technologies remove Hg (and other trace metals) from power plant flue gas
- Hg concentration in byproducts increased
- Research must focus on ultimate fate of Hg in coal byproducts, e.g., fly ash, FGD solids





# Hg Regulations and Coal Byproducts

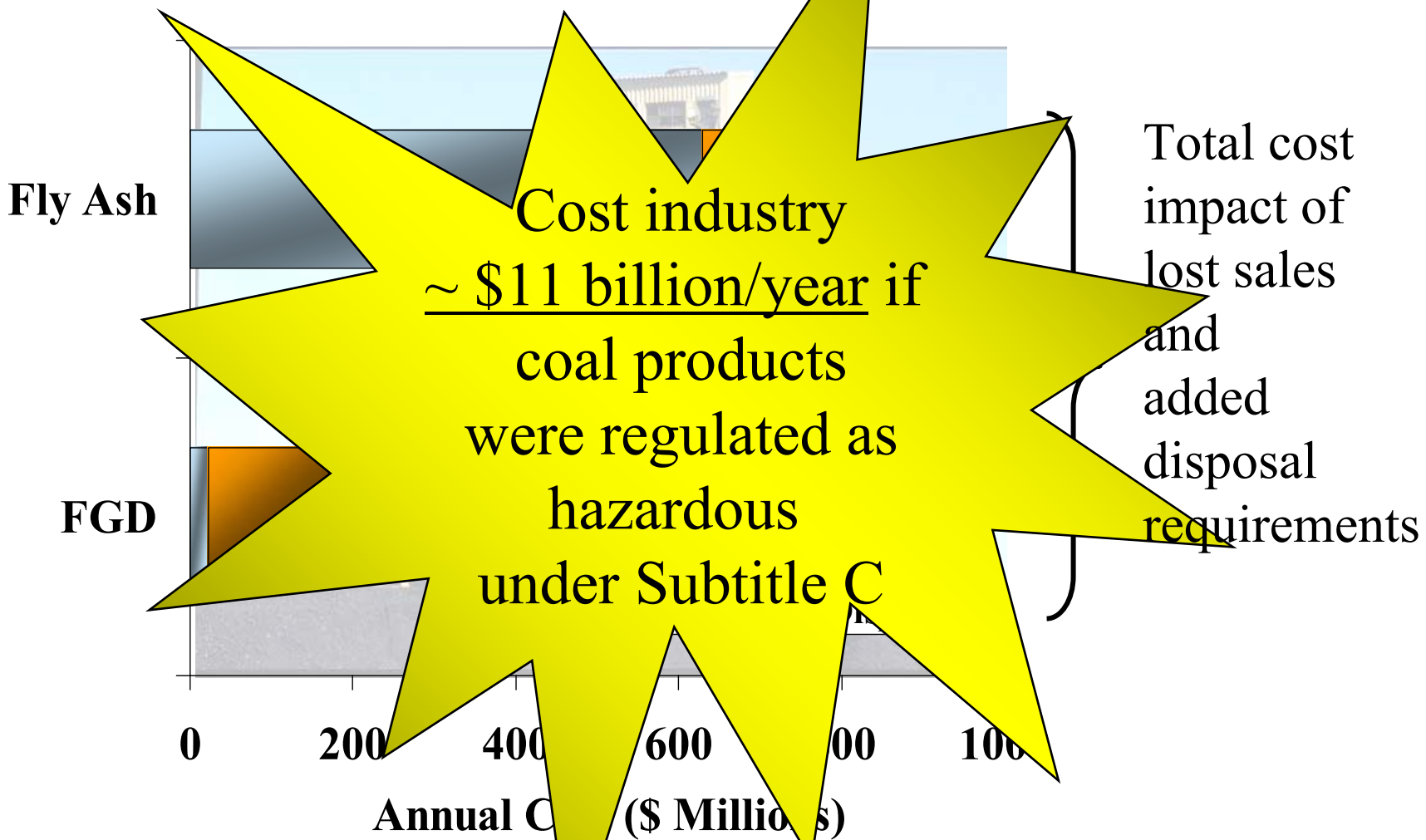
## *So What?*

- **Impact future solid-waste regulations?**
  - Limit use applications?
  - Regulate coal utilization by-products as hazardous?
- **Increased negative public perception**



*FGD Solids*

# Potential Cost Implication of Restrictions on Coal Byproduct Use



# Environmental Characterization of CUBs

## *Research Projects*

- **Fate of Hg from control technology field demonstrations**
  - ADA-ES and Reaction Engineering, B&W and McDermott Technology
  - CONSOL, Apogee, EERC, Powerspan and SRI
- **Trace element leaching from CUB disposal and utilization applications**
  - CONSOL Energy
  - University of North Dakota Energy & Environmental Research Center (UNDEERC)
  - Electric Power Research Institute (EPRI)
- **NETL's in-house evaluation of fate of Hg in coal combustion and gasification byproducts**
- **Fate of Hg in synthetic gypsum used for wallboard production**
  - US Gypsum



# Control Technology Field Testing

## *Preliminary Results*



- Activated carbon injection tested at four power plants
- ADA –ES and Reaction Engineering analysis of ash byproducts
- *Mercury in leachate below 0.01 µg/L measurement detection limit in most samples*

- Wet FGD reagent field tests at two plants
- B&W and McDermott Technology analysis of FGD by-products
- *No significant mercury in FGD liquids*
- *Minimal mercury volatilization from heated FGD solids*



# Fate of Mercury in Synthetic Gypsum Used for Wallboard Production

- U.S. Gypsum (prime), URS, EPRI (co-funding), and Shaw Environmental
- Assess fate of mercury in synthetic gypsum produced by coal-fired boiler FGD systems:
  - Aliquippa, PA
  - Bridgeport, AL
  - Galena Park, TX
- Measure mercury concentrations in solid, liquid, and gaseous streams



*USG Plant, Bridgeport, AL*

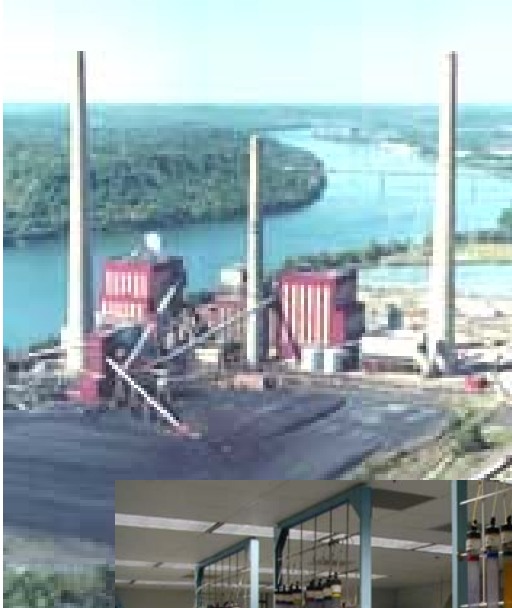


*USG Plant, Aliquippa, PA*



# Characterization of Hg in Coal Byproducts

## Targeted Solicitation



- Determine fate of Hg in coal byproducts from DOE/NETL Hg technology field testing
- Use uniform testing procedures and inter-laboratory comparison
- Examine leaching, volatilization, and microbial mobilization
- Issue solicitation in 3Q/FY04



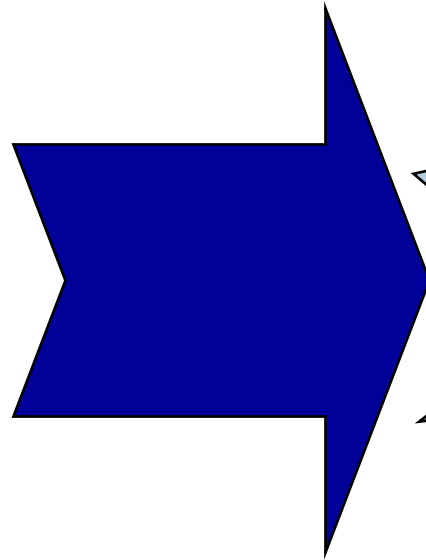
# Summary

- **Future electricity demands in parallel with calls for tighter controls on emissions of Hg and SO<sub>2</sub> from coal-fired power plants will increase CUB production**
- **Pressures to further regulate/restrict the use and disposal of CUBs will likely continue**
- **DOE/NETL will need to continue to aggressively support CUB research**



# Partnership Key to Success

- C<sup>2</sup>P<sup>2</sup>
- Industry
- DOE/NETL
- ACAA
- USWAG
- EPA

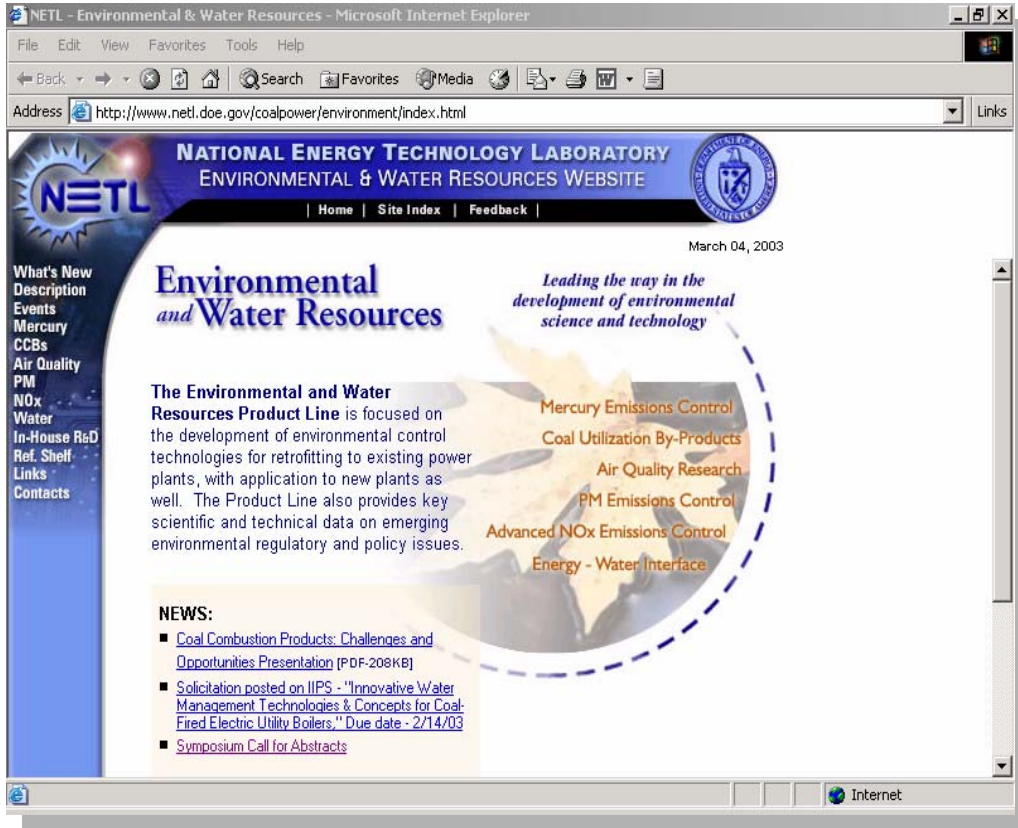


*Working Together We Can Reach Our Goals!*





# Innovations for Existing Plants Program (Environmental and Water Resources)



To find out more about  
DOE/NETL's CUB  
research program,  
visit us at:

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

