

# Mercury Control Technology Conference

*Welcome!*

*Perspectives from  
Fossil Energy Coal RD&D  
Program*

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Strategic Center for Coal  
December 11, 2006*

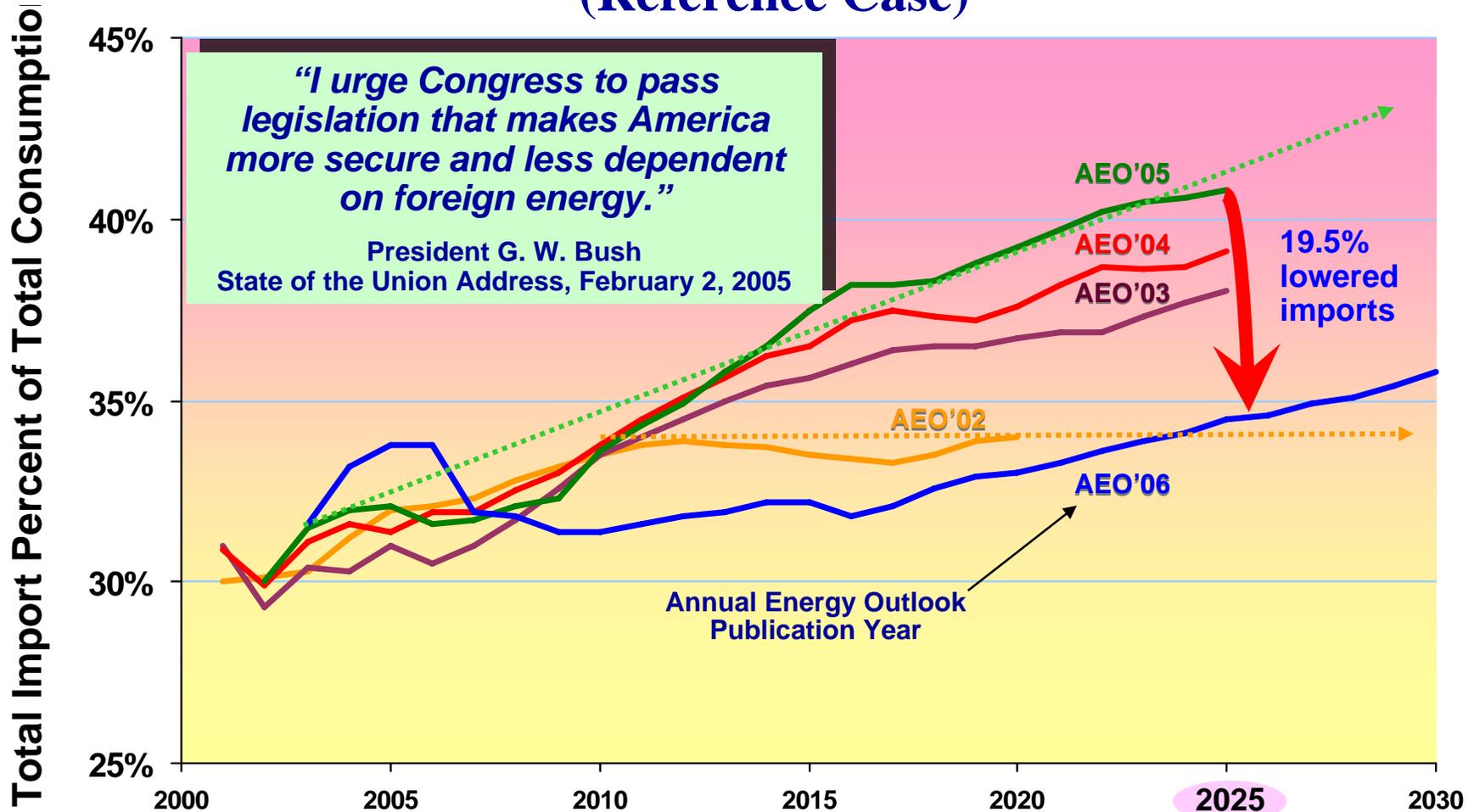
**National Energy Technology Laboratory**



# Planning for Future is Important



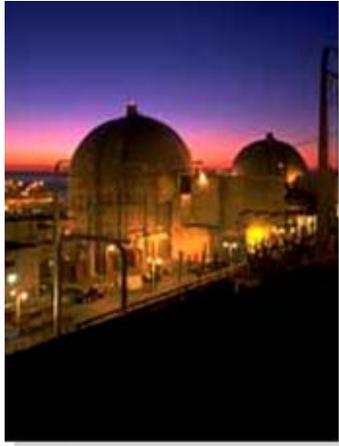
# Forecasting Dependence on Energy Imports (Reference Case)



**10.6 Quads (19.5%) Lower Imports in AEO'06 Forecast (2025)  
More Reliance on Domestic Resources; 4.6% Lower Consumption (2025)**



# Difficult to Postulate Affordable, Secure Alternatives to Coal



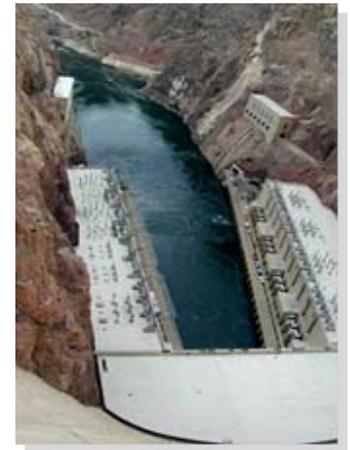
***Nuclear***  
**Cost,  
Permitting,  
Waste Disposal?**

***Wind / Solar***  
**Cost,  
Land use,  
Intermittency?**



***Biomass***  
**Cost,  
Gigantic,  
Infrastructure?**

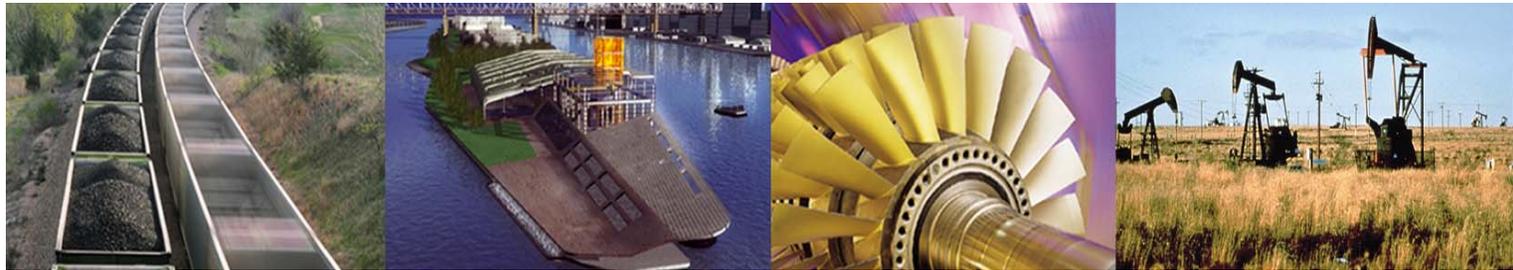
***Hydro /  
Geothermal***  
**Availability  
of sites?**



# Coal Research & Development

## Must Drive Technology

To Near Zero Emissions at Reasonable Cost



# R&D Challenges for Coal Technology



- **CO<sub>2</sub> management**
- **Mercury emissions**
- **High efficiency**
- **Water use**
- **By-product utilization**
- **Flexible (feedstocks, products, siting)**
- **Cost competitive with other energy choices**

# Clean Coal Technology Development Must Address Near and Long Term Energy Needs

## *Short-term Needs:*

- Maximize existing fleet service
- Provide advanced technologies for new, near term plants
- Provide technology bridge to transition to future plants



## *Long-term Needs:*

- Zero emissions coal technology
- Reliable coal technology
- Cost competitive coal technology
- Technology for Hydrogen Economy



# Coal Technology R&D Pathways

## *Critical R&D Challenges to Near Zero Emissions From Coal*

### Near Term Plants

#### *Pulverized Coal*

Power Generation

Improve Efficiencies

Minimize Criteria Pollutants

Minimize Water Usage

Minimize Greenhouse Gases



### Future Plants

#### *Coal Gasification*

Power and Multiple Products

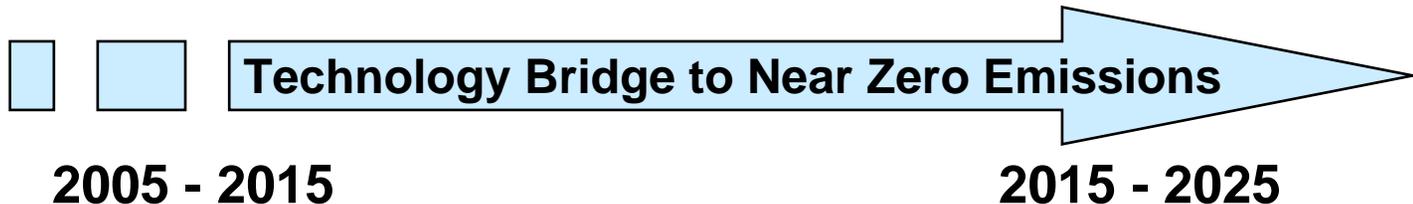
Improve Reliability

Maximize Efficiencies

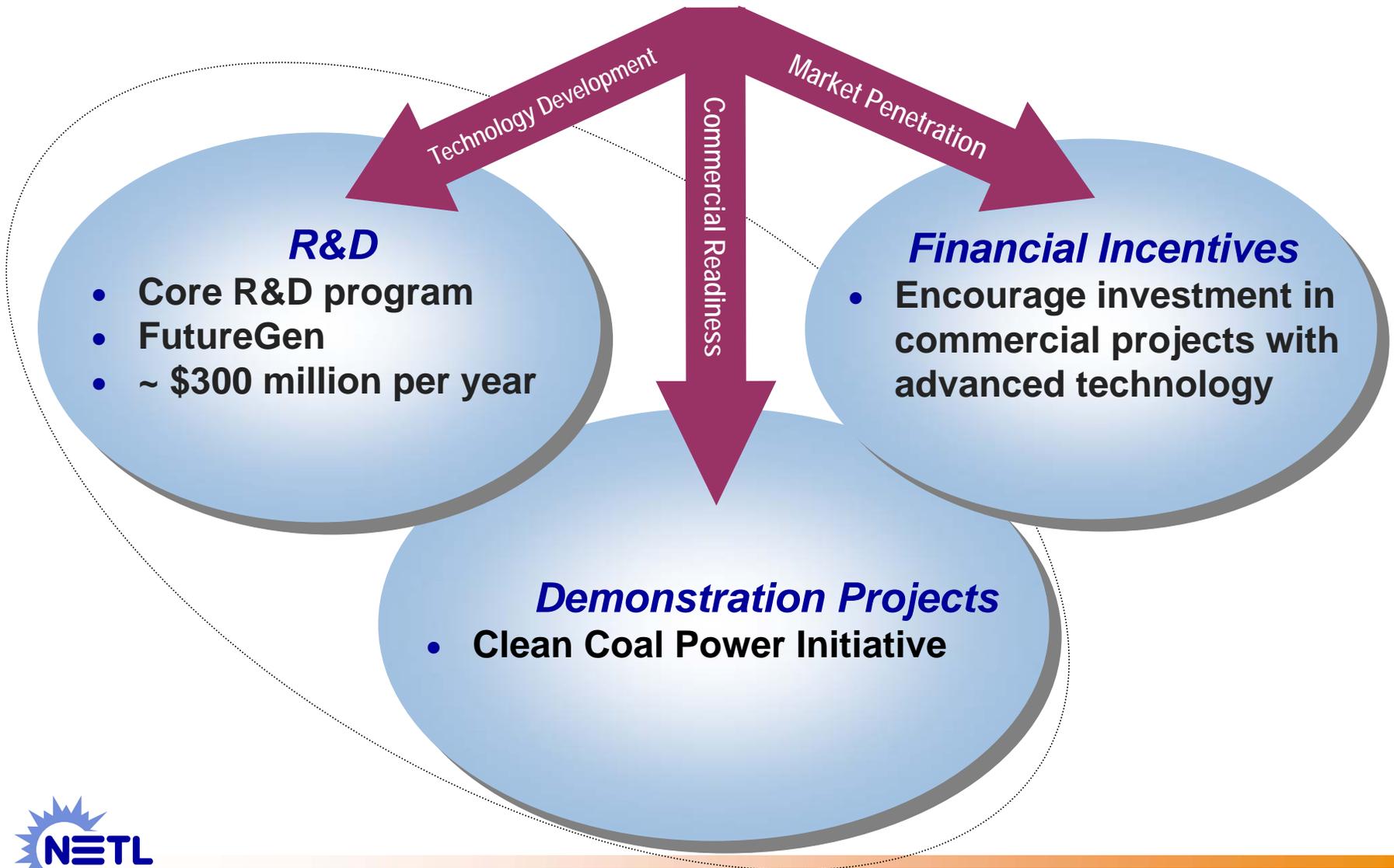
Near Zero Criteria Pollutants

Near Zero Water Usage

Near Zero Greenhouse Gases



# DOE's Coal RD&D Investment Strategy



# Critical Technology Pathways

## Environmental Control for Existing Plants

- Low-NO<sub>x</sub> combustion; reduced cost
- Mercury control (>90% capture)
- Fine particle control
- Water minimization



## Advanced Combustion

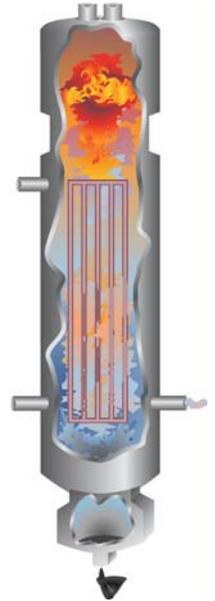
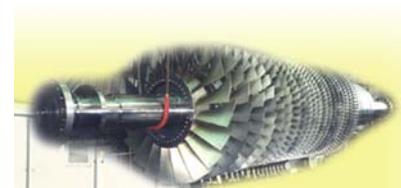
- Ultra-supercritical steam
- Oxygen combustion
- Advanced concepts (e.g. chemical looping)



# Critical Technology Pathways

## Gasification Systems

- Gasifier advances; new designs (e.g. transport gasifier)
- Oxygen membrane separation
- Syngas purification (cleaning) and separation (e.g. hydrogen, CO<sub>2</sub>)



## Energy Conversion

- Advanced gas turbine technology operating on hydrogen mixtures
- Fuel cell systems using syngas or hydrogen



# Critical Technology Pathways

## Carbon Management

- CO<sub>2</sub> capture
- CO<sub>2</sub> sequestration
- Monitoring and verification



## Systems Integration

- Integrated power plant modeling and virtual simulation
- Sensors and smart-plant process control

# FutureGen: Integrating Function for R&D Program



**Fuel Cells**



**FutureGen**



**Carbon Sequestration**



**Gasification with Cleanup Separation**



**H<sub>2</sub> Production**



**Optimized Turbines**



**System Integration**

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# DOE's Coal Demonstration Programs

## *A History of Innovative Projects*



**Clean Coal Power  
Initiative  
2002-2012**

**Power Plant  
Improvement Initiative  
2001**

**Clean Coal Technology  
Program  
1985-1993**



# TOXECON™ Retrofit for Mercury & Multi-Pollutant Control – 270 MW Commercial Demo

- **We Energies Presque Isle Power Plant, Marquette, MI**
  - ADA-ES, C&B, Wheelabrator, EPRI
- **CCPI Program - \$53.3 Million**
  - \$24.9 Million DOE
  - \$28.5 Million We Energies
- **Baseline testing complete**
- **Parametric and optimization testing ongoing**
- **90% Mercury emission reduction achievable**
- **Balance of plant issues being addressed**
- **Long term testing in 2007**



# Tentative Priority Technologies

## *Future CCPI Rounds*

- **Emission control**
  - Mercury
  - NO<sub>x</sub>
- **Advanced Power Technologies**
  - Improved efficiency / lower capital cost
  - Sequestration friendly
- **Sequestration**

Round 2

Round 3

Round 4

**Technologies  
for  
Clear Skies  
Compliance**

**Technologies  
for  
Zero-Carbon  
Emission  
Plants**

**Program  
Goals**



# CCT Program Success Stories

## *Advanced Pollution Controls*

- Now installed on 75% of U.S. coal plants
- 1/2 to 1/10 cost of older systems

*JEA CFBC Power Plant*



*PSI Energy Wabash River  
IGCC Power Plant*

*Low-NO<sub>x</sub> Burners*



## *Proven Advanced Coal Power Systems*

- Two “super-clean” coal-based IGCC plants operating reliably
- World’s largest CFBC power plant



*Tampa Electric  
IGCC Power Plant*



# Window of Opportunity for Coal Technologies

- Many U.S. coal plants need replacement or repowering starting in 2020
- Opportunity to deploy near-zero emission coal technologies
- Construction decisions need to be made starting 2015



**R&D must be underway now to provide definitive data needed to make good decisions in next 10 to 15 years**

# Please Visit Our Websites

The screenshot shows the U.S. Department of Energy website's Fossil Energy section. At the top, there is a navigation bar with links for 'ABOUT DOE', 'ORGANIZATION', 'NEWS', and 'CONTACT US'. Below this is the 'U.S. DEPARTMENT OF ENERGY' logo and a secondary navigation bar with categories like 'SCIENCE & TECHNOLOGY', 'ENERGY SOURCES', 'ENERGY EFFICIENCY', 'THE ENVIRONMENT', 'PRICES & TRENDS', 'NATIONAL SECURITY', and 'SAFETY & HEALTH'. The main content area is titled 'FOSSIL ENERGY' and features a large image of industrial pipes with the text 'Office of Fossil Energy' and 'Fossil Energy'. To the left, there is a sidebar with 'Fossil Energy' sub-topics and 'IN YOUR STATE' dropdown. Below the main image, there are sections for 'FOSSIL ENERGY NEWS SPOTLIGHT' and 'OFFICE OF FOSSIL ENERGY'.

*Fossil Energy website:*  
[www.fe.doe.gov](http://www.fe.doe.gov)

The screenshot shows the National Energy Technology Laboratory (NETL) website. At the top, there is a navigation bar with 'National Energy Technology Laboratory' and 'Site Map'. Below this is the 'NETL' logo and the tagline 'THE ONLY U.S. NATIONAL LABORATORY DEVOTED TO FOSSIL ENERGY TECHNOLOGY'. The main content area is titled 'Tackling U.S. Energy Challenges' and features a large image of an oil rig with the text 'Secure and Reliable Energy' and 'Domestic coal, oil, and natural gas resources can contribute enormously to our Nation's economic strength, energy security, and quality of life through the 21st century.' To the left, there is a sidebar with navigation links for 'ABOUT NETL', 'KEY ISSUES & MANDATES', 'ON-SITE RESEARCH', 'TECHNOLOGIES', 'SOLICITATIONS & BUSINESS', 'CAREERS & FELLOWSHIPS', 'NEWSROOM', and 'CONTACT NETL'. Below the main image, there is a section for '2005 NETL Accomplishments Report' and a 'Clarification' section.

*NETL website:*  
[www.netl.doe.gov](http://www.netl.doe.gov)

