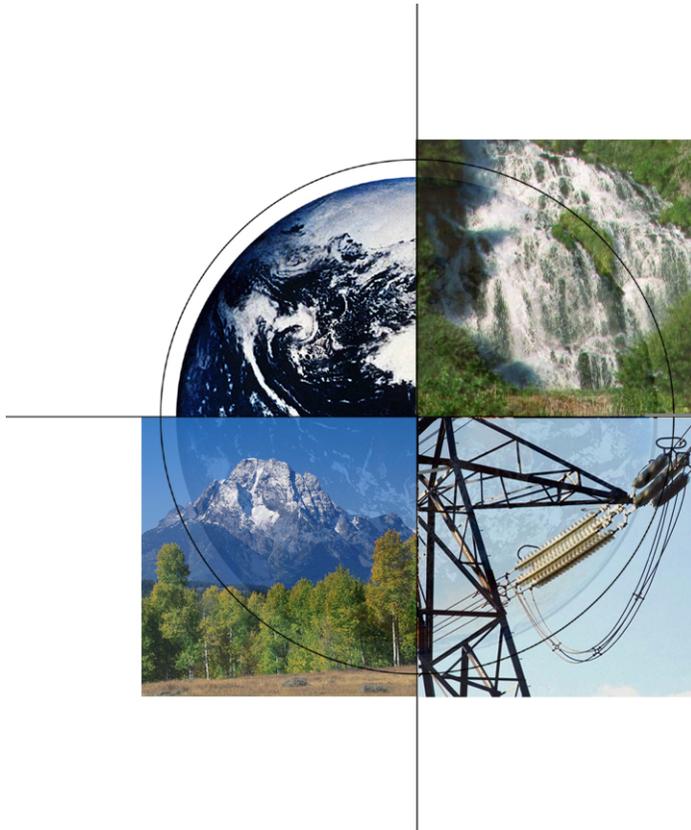


A DOE Perspective



*CCPI – Round 2
Planning Workshop*

August 26, 2003

Rita A. Bajura, Director

National Energy Technology Laboratory



Office of Fossil Energy



Outline

- **DOE's Coal & Power Programs**
 - Core R&D
 - FutureGen
 - Demonstration Programs
- **A DOE view of CCPI Round 2**

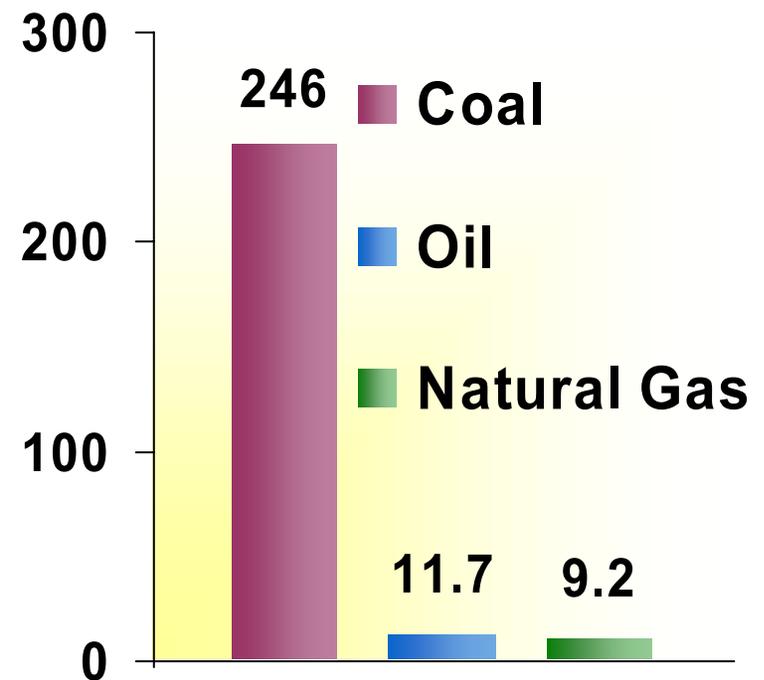


Coal Is Important

- Abundant domestic reserves
- Low and stable prices
- Provide $> \frac{1}{2}$ nation's electricity
- Future source of H₂

- Economic prosperity
- Energy security

U.S. Fossil Fuel Reserves/
Production Ratio
*Years Supply at
Current Production*



DOE Coal and Power RD&D Program

- **Coal use has environmental concerns**
 - Can be addressed with improved / new technology
 - R&D reduces cost of meeting aggressive goals
- **Public / private partnerships needed**
 - >10-15 years to ready a technology for commercial deployment
 - Risk too large for private sector to do entirely on own

Develop technological capability to assure availability of clean, affordable domestic electricity and hydrogen



Overarching Goals

Coal and Power RD&D Program

Near-term: ~ 2010

Cost-effective environmental control technologies to enable existing plants to comply with current and emerging regulations

Long-term: ~ 2020

Technology for future energy plants

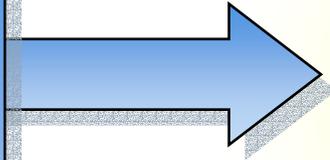
- **Electricity and hydrogen**
- **Near-zero emissions**
- **CO₂ management capability**



All Programs Contribute to Goals

Core R&D Program

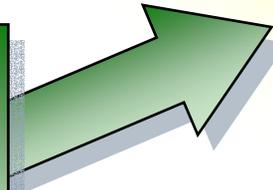
- Innovations for Existing Plants
- FutureGen Support



Near- and Long-Term Goals

FutureGen

- Integrated Sequestration, Hydrogen, and Power Research Facility



Demonstration Programs

- Clean Coal Power Initiative
- Power Plant Improvement Initiative
- Clean Coal Technology Program



New Plant Performance Targets

Based on Roadmapping With Industry

	<i>Ref. Plant</i>	<i>2010</i>	<i>2020*1</i>
SO₂ Removal	98%	99%	>99%
NO_x, lb/10⁶ Btu	0.15	0.05	<0.01
Particulate, lb/10⁶ Btu	0.01	0.005	0.002
Mercury Removal	-	90%	95%
Byproduct Use	30%	50%	~100%
Efficiency, HHV	40%	45-50%	50-60%
Availability	>80%	>85%	≥90%
Capital Cost, \$/kW	900-1,300	900-1,000	800-900
Cost Electricity, c/kWh	3.5	3.1	<3.0
Cost H₂, \$/MMBtu	6.00*2	-	4.00



**1 Sequestration Ready Plant; *2 Produced Using \$3.50 MBtu Natural Gas*

President's Management Agenda

“What matters in the end is completion. Performance. Results. Not just making promises, but making good on promises.

In my Administration, that will be the standard from the farthest regional office of government to the highest office in the land.”

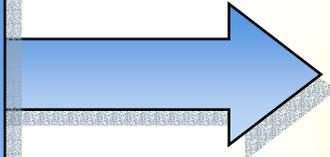


**President
George W. Bush**

All Programs Support Presidential Initiatives

R&D Program

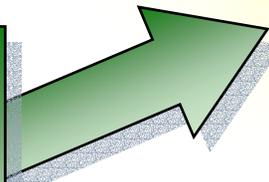
- Innovations for Existing Plants
- FutureGen Support



- Clear Skies
- Climate Change
- Hydrogen
- Sequestration

FutureGen

- Integrated Sequestration, Hydrogen, and Power Research Facility



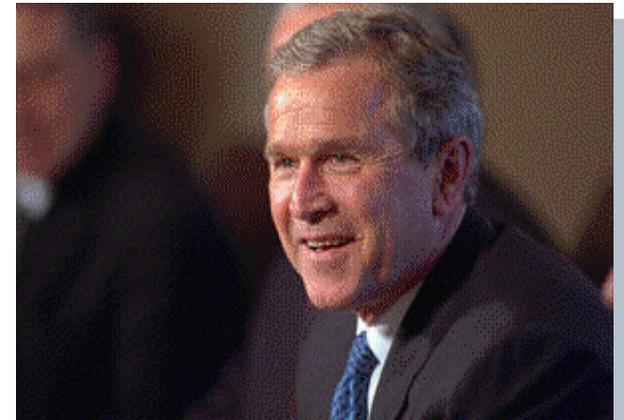
Demonstration Programs

- Clean Coal Power Initiative
- Power Plant Improvement Initiative
- Clean Coal Technology Program



FutureGen: A Presidential Initiative

One billion dollar, 10-year demonstration project to create world's first, coal-based, zero-emission electricity and hydrogen plant



President Bush
February 27, 2003

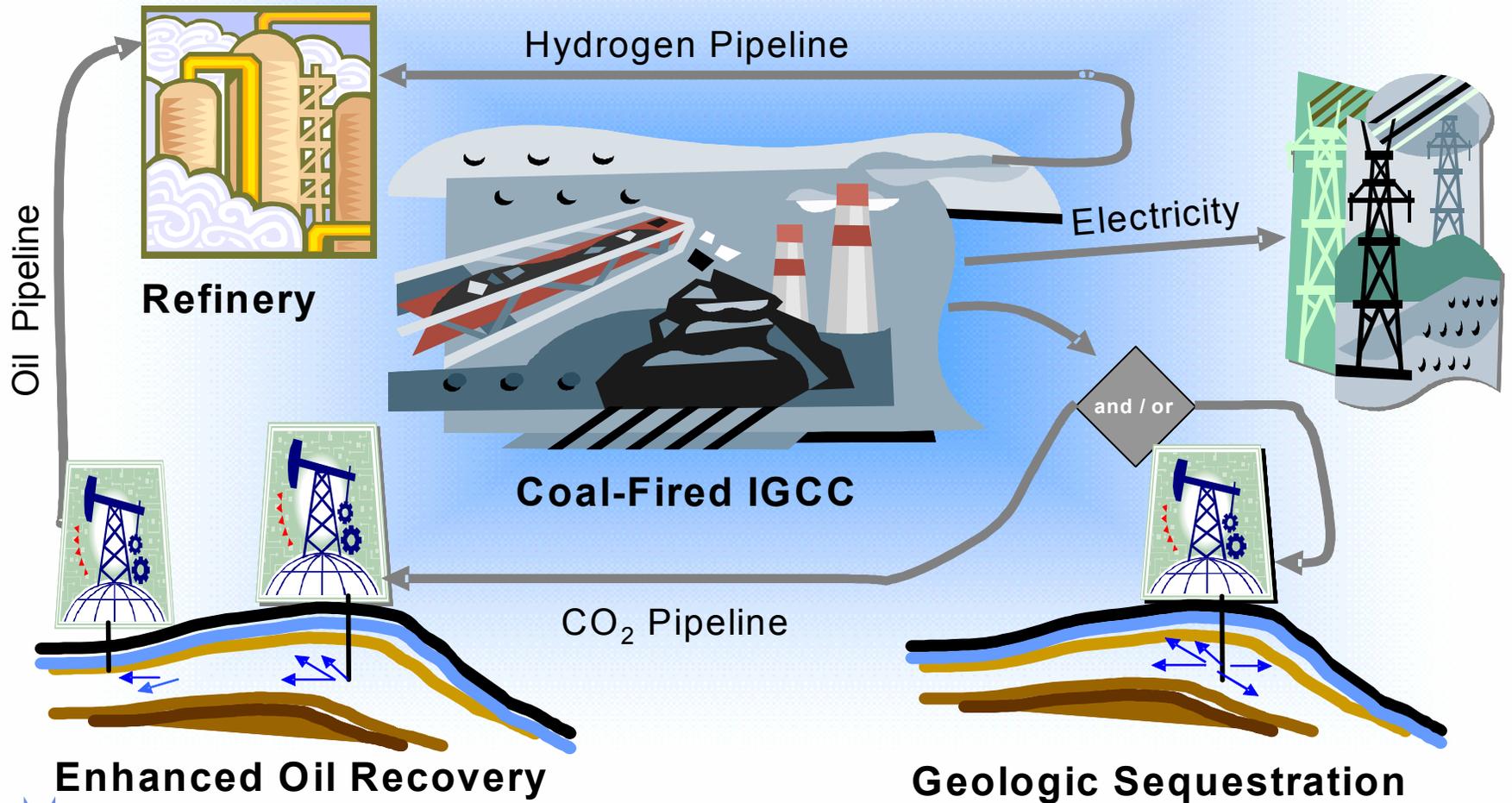


FutureGen: A Global Partnership Effort

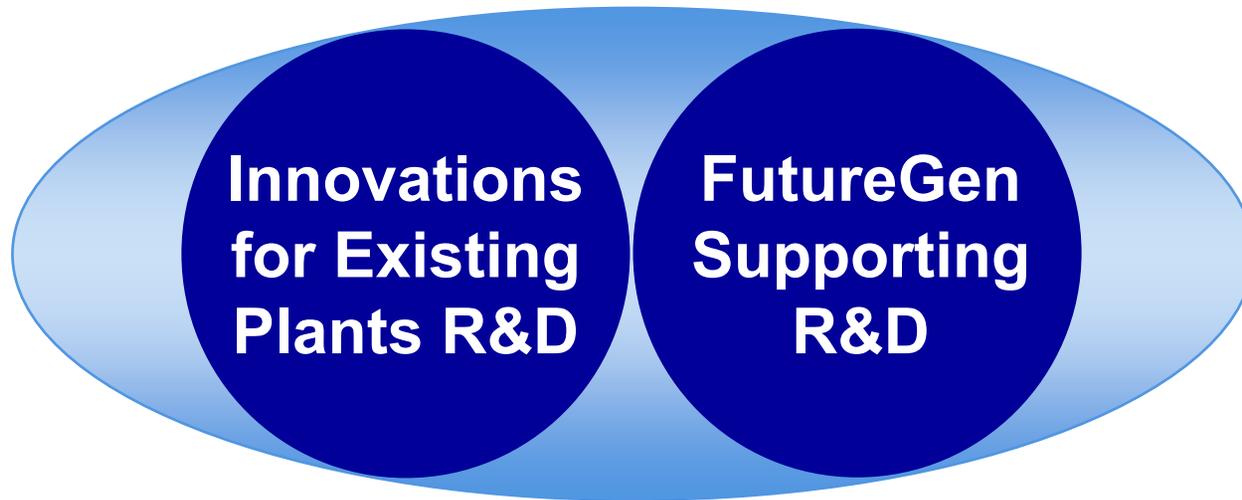
- **Broad U.S. participation**
 - DOE contemplates implementation by consortium that owns and produces $> 1/3$ of coal and $1/5$ coal-fueled electricity
- **International collaboration**
 - Carbon Sequestration Leadership Forum
- **Industry cost share $\geq 20\%$**
 - DOE cost share $\leq 80\%$



FutureGen: A “Zero Emissions” Plant



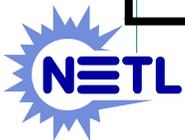
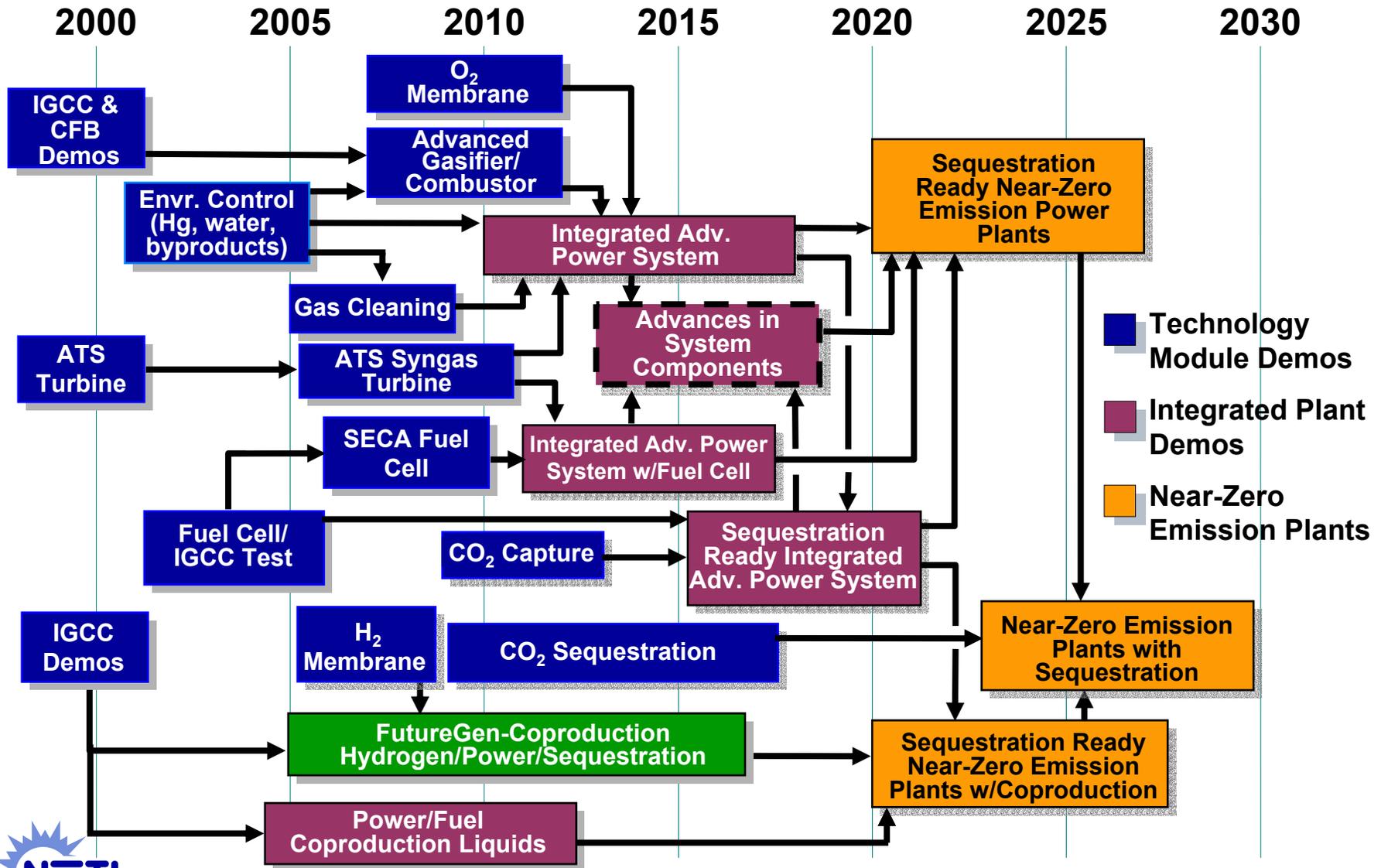
Core R&D Program



Technologies

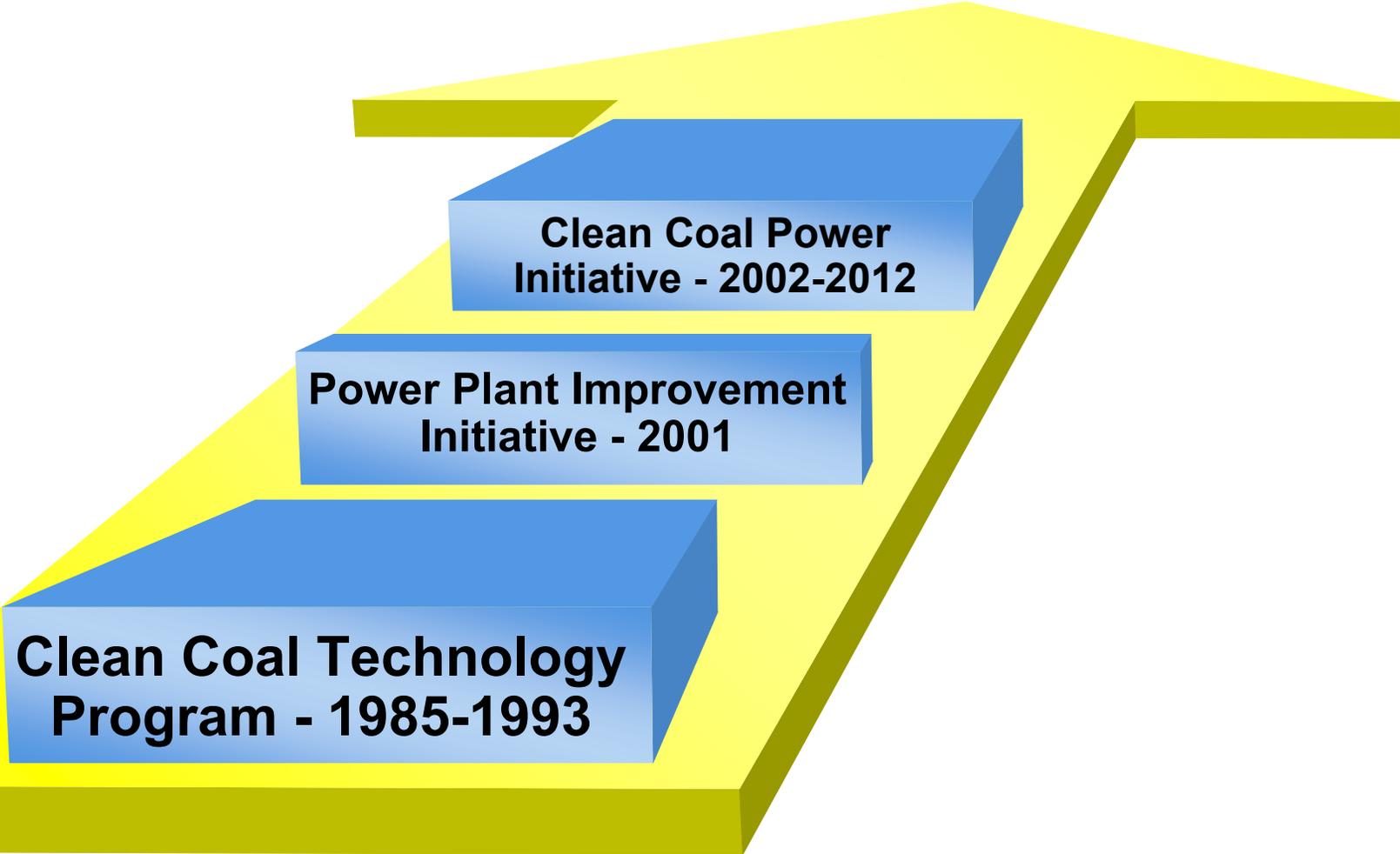
- Advanced gasification
- Gas cleaning
- Oxygen production
- Hydrogen production
- Sequestration
- Hydrogen turbines
- Stationary fuel cells
- Fuel cell / turbine hybrids
- Advanced combustion
- Byproduct utilization
- Advanced materials
- Instrumentation & controls

Technology Roadmap – Future Energy Plants



DOE's Coal Demonstration Programs

A History of Innovative Projects



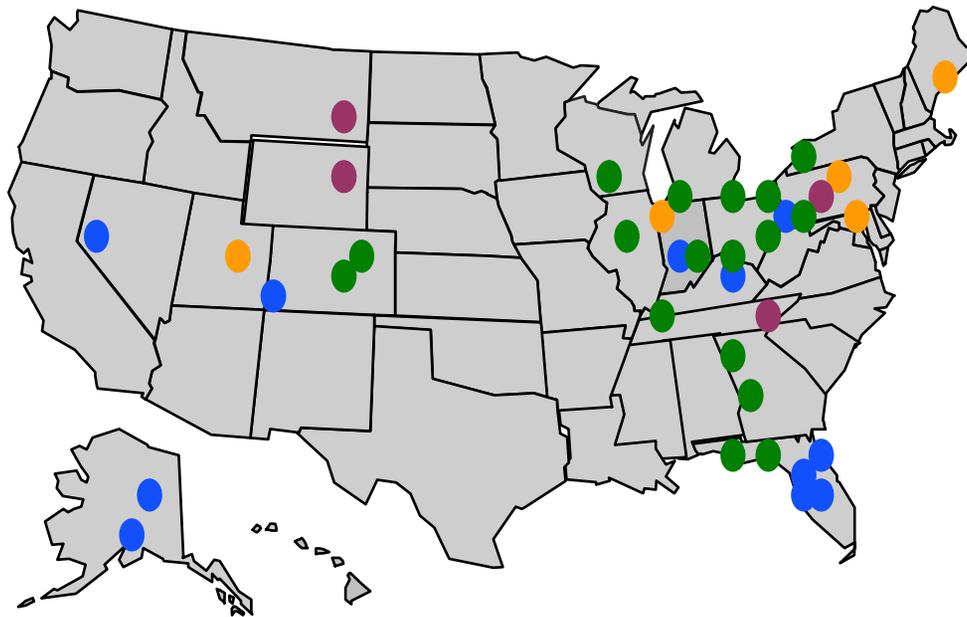
**Clean Coal Technology
Program - 1985-1993**

**Power Plant Improvement
Initiative - 2001**

**Clean Coal Power
Initiative - 2002-2012**



Clean Coal Technology Program



- Power generation
- Environmental control
- Coal processing
- Industrial applications

- Five competitive solicitations, 1985 - 1993
- 32 of 36 projects completed
- \$1.5B DOE and \$3.2B industry cost share



Two O₂-Blown IGCC Plants Built in CCT Program

One More in Design Stage

- **Wabash River**
 - 1996 Powerplant of Year Award*
 - Achieved 95% availability
- **Tampa Electric**
 - 1997 Powerplant of Year Award*
 - First dispatch power generator



Nation's first commercial-scale IGCC plants, each achieving
> 95% sulfur removal
≥ 90% NO_x reduction



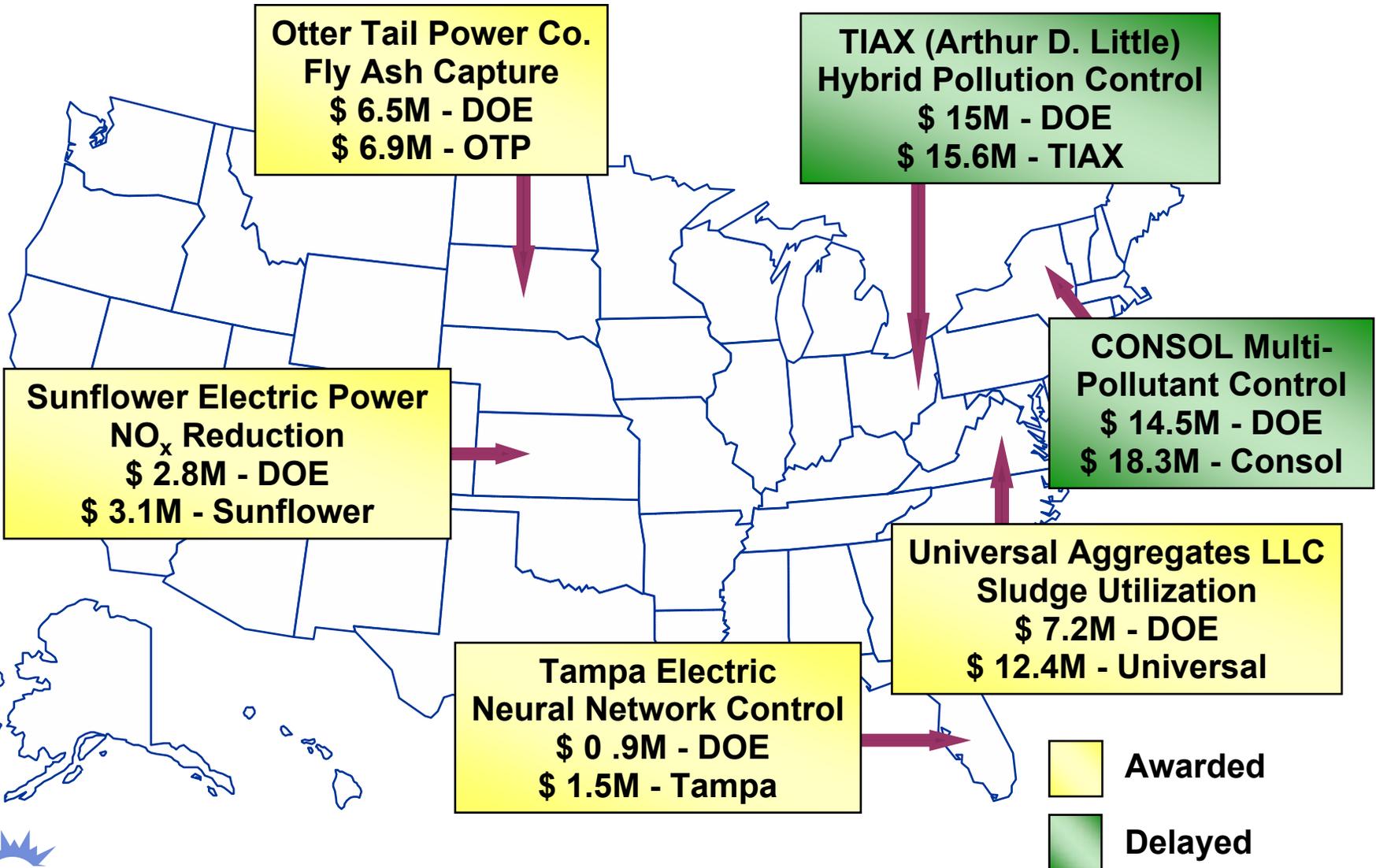
Power Plant Improvement Initiative

Precursor to CCPI

- **Competitive solicitation 2001 required:**
 - Significant advances over state-of-art
 - Not previously demonstrated
- **Six projects**
 - Emissions control
 - Waste handling/reduction
- **\$47M DOE and \$53M industry cost share**

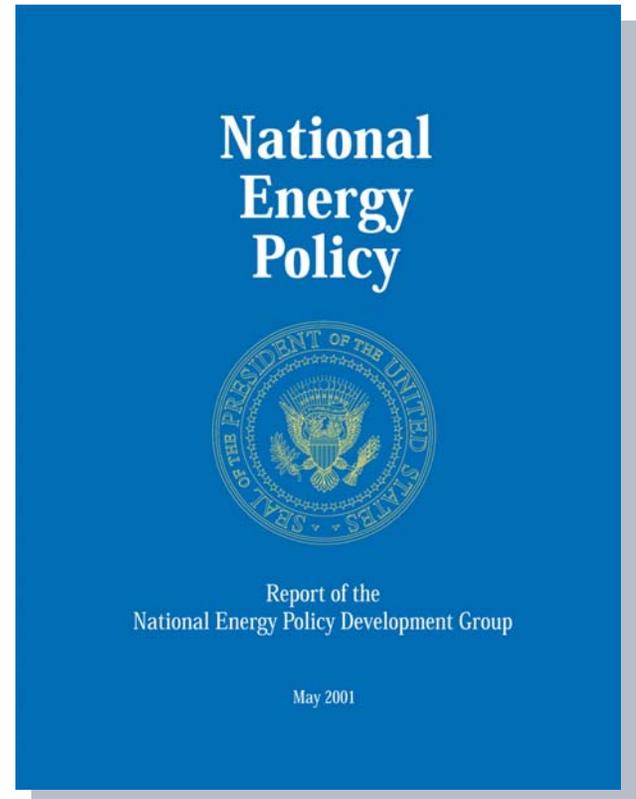


Six PPII Projects



Clean Coal Power Initiative

- Implemented NEP recommendation to increase investment in clean coal technology
- **\$2 billion over 10 years starting in FY 02**
 - Anticipates series of competitive solicitations
 - Industry cost share of at least 50%



CCPI Philosophy

- **Demonstrations necessary step between R&D and commercialization**
- **CCPI provides demonstration platform**
- **Multiple demonstrations needed for new capital intensive technologies**
 - Each demo must raise bar
 - Industry cost share commensurate with risk



Financing

Obstacle to New Coal Plants

Lenders hear words “risk” and “uncertainty”
when asked to finance new technology

<i>“Technology Speak”</i>	<i>“Lender Hear”</i>
Advanced	Untested
Innovative	Experimental
New	Risky

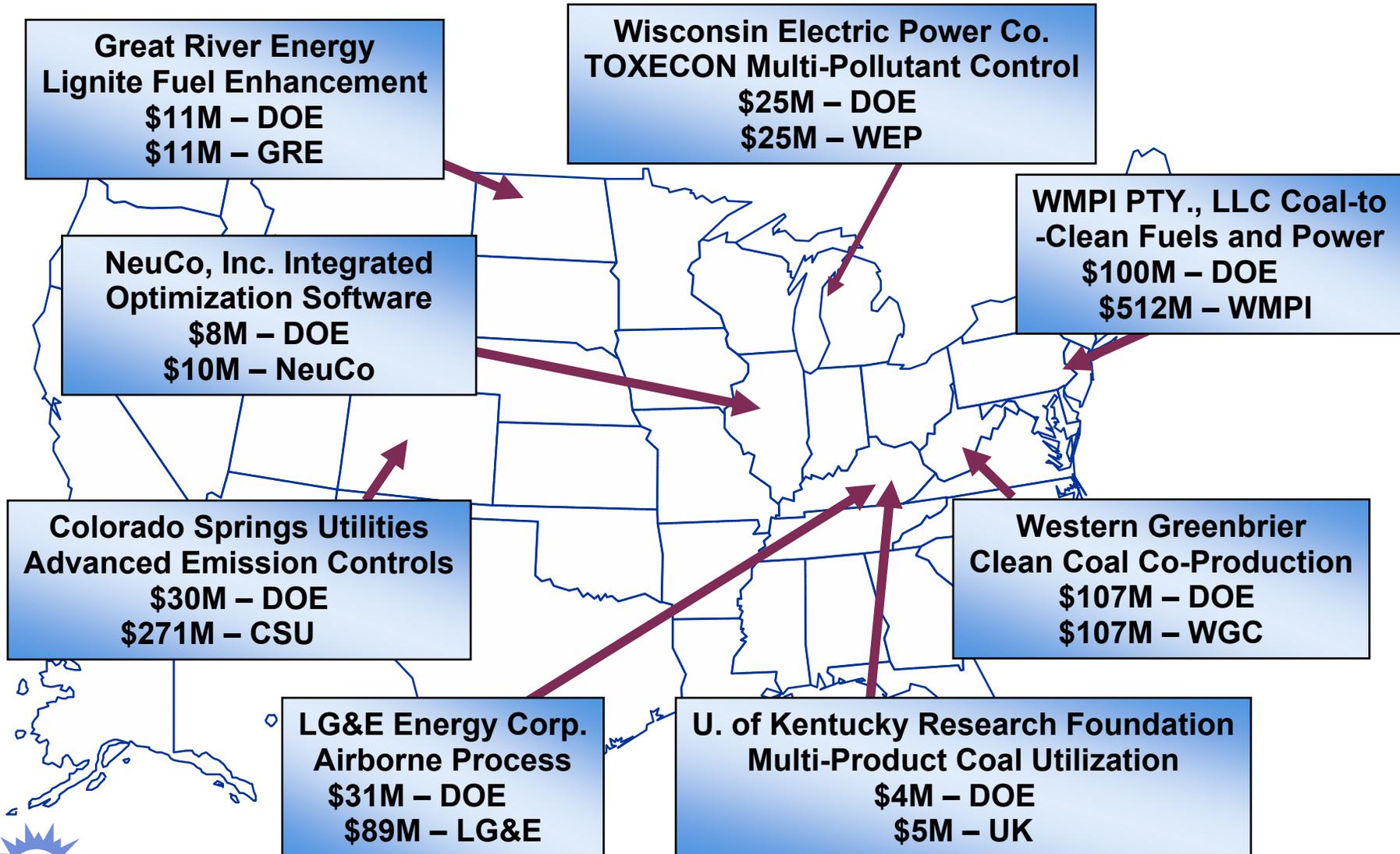


CCPI – Round I

- **Competitive solicitation FY 02**
- **Broad in scope**
 - Advanced power generation
 - Efficiency, environmental, economic improvement
- **Eight projects selected January 2003**
 - \$315M DOE cost share
 - \$1B industry cost share

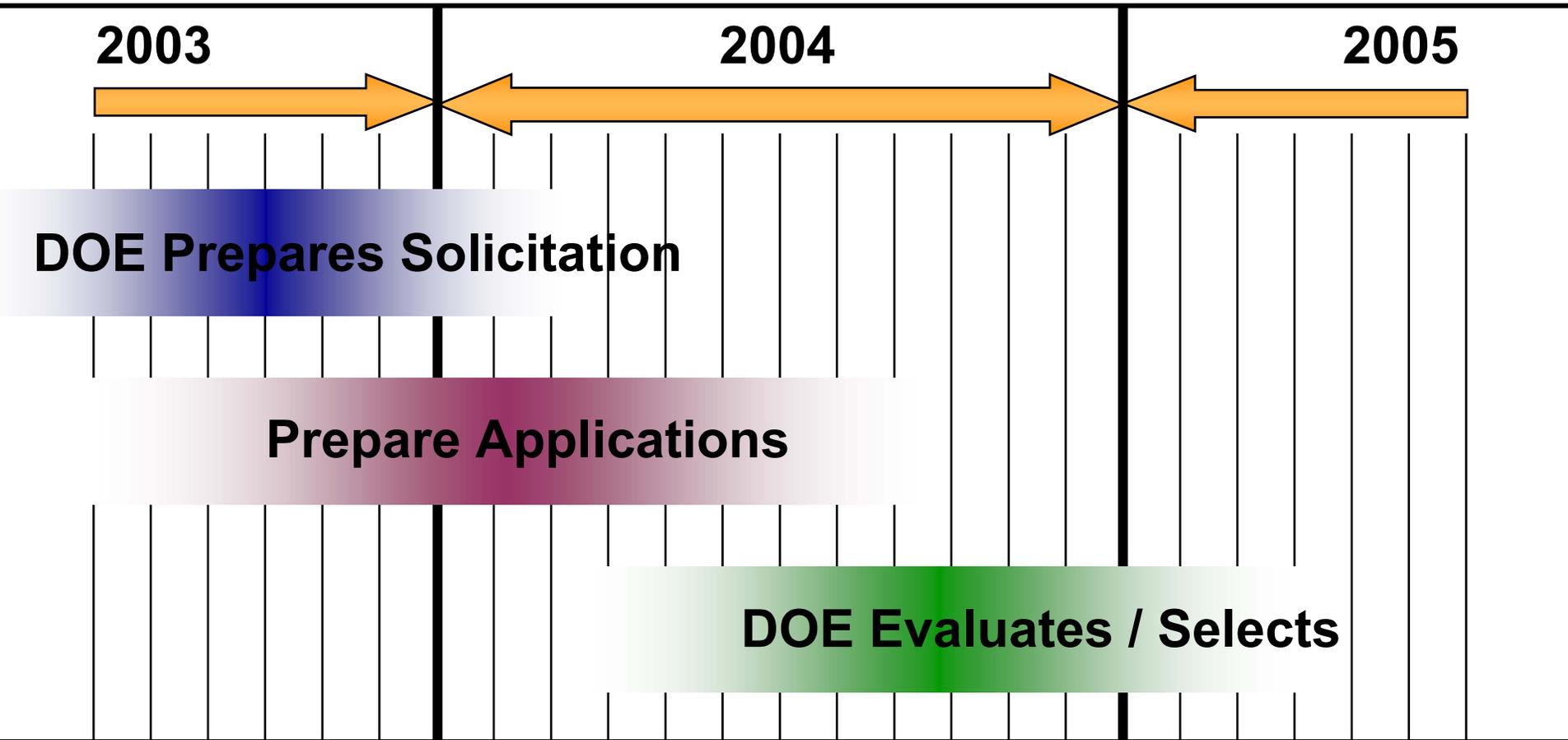


Eight Projects in CCPI – Round 1



CCPI Round 2 Schedule

Calendar Years



Funding

CCPI - Round 2

- **Anticipate ~ \$300 million DOE funding**
 - FY 04 Appropriations
 - FY 05 Appropriations
 - Carryover from PPII
and CCPI Round 1



Tentative Priority Technologies

Future CCPI Rounds

- **Emission control**
 - Mercury
 - NO_x

- **IGCC**
 - 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**



Emission Control Technologies

- **Barriers to goals of Clear Skies Initiative**
 - High costs for some existing technologies
 - No commercial Hg control technology, particularly for low-rank coals
- **Potential solutions**
 - Hg control using sorbents or FGD enhancers, especially for low-rank coals
 - Breakthrough low cost NO_x control
 - Multiple pollutant control
 - Breakthrough Hg technologies (e.g., oxidizing salts)
 - Scaling validation, plant integration



O₂-Blown IGCC

Promising Pathway to Zero-Emission Plants



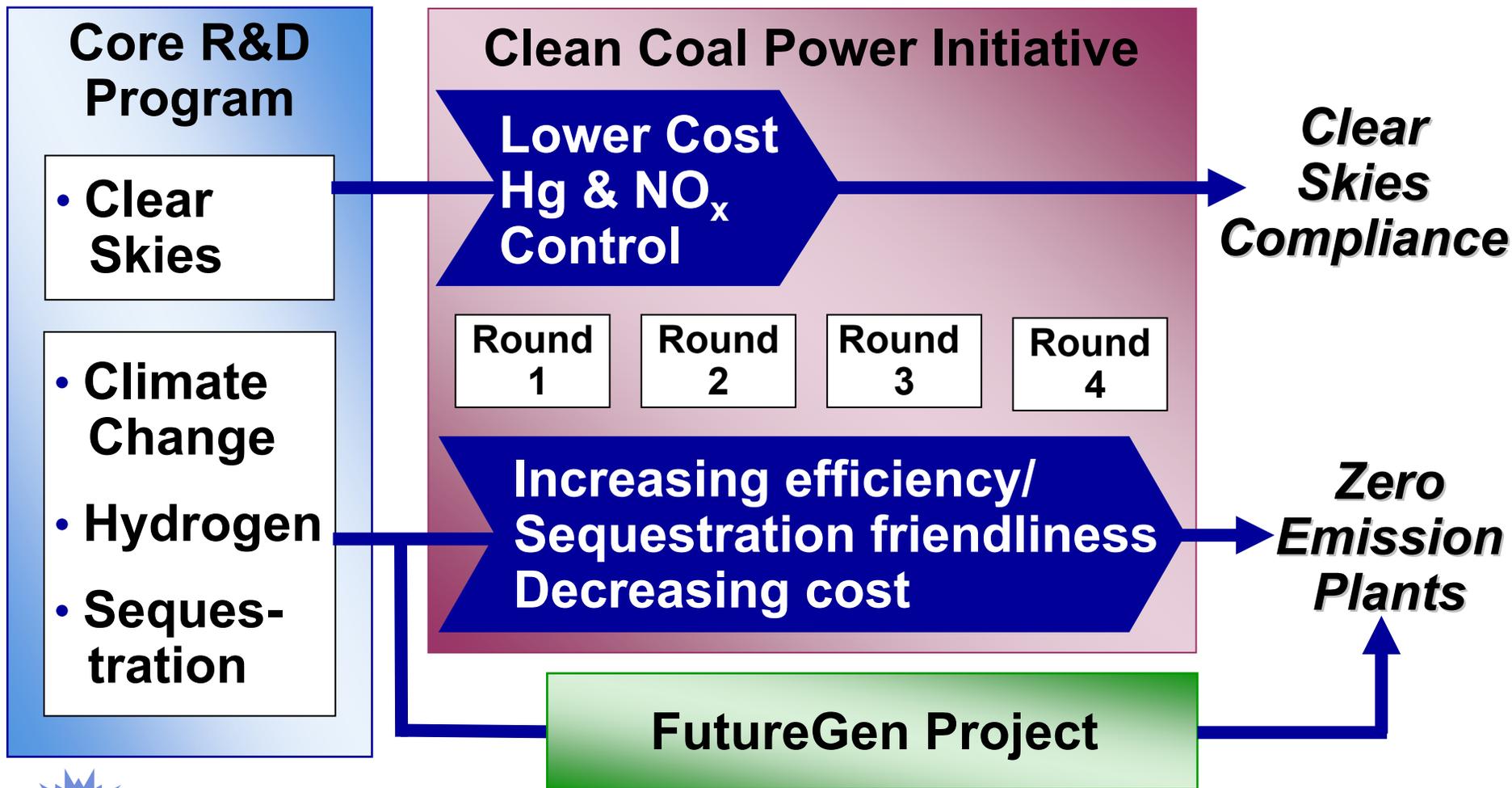
- **Fuel and product flexibility**
- **Environmentally superior**
- **High efficiency**
- **Sequestration ready**

**Producing concentrated stream
of CO₂ at high pressure**

- **Reduces capital cost**
- **Reduces efficiency penalty**

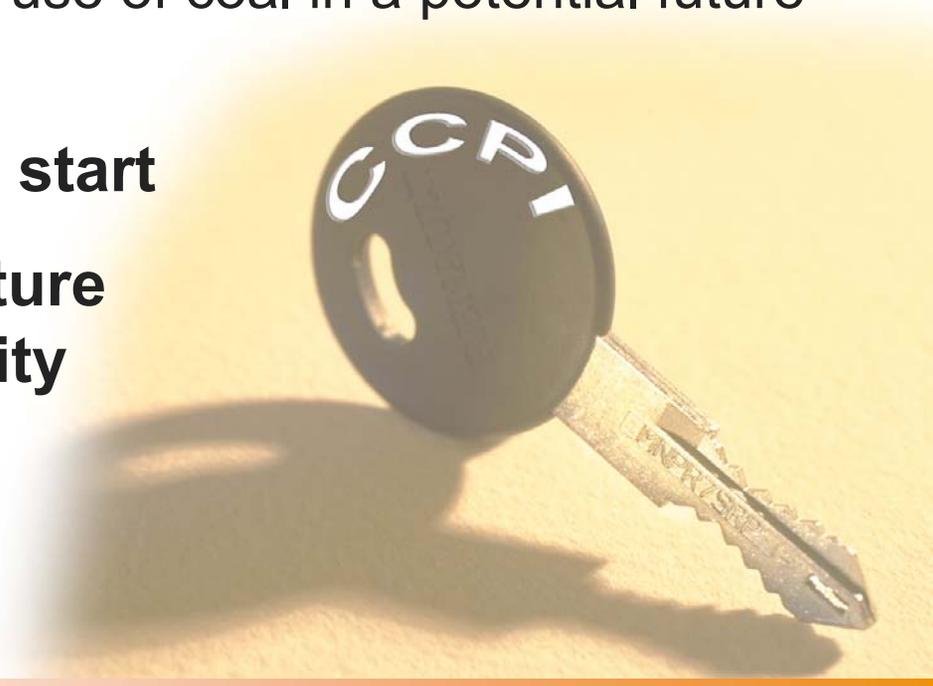
Linkages

Coal and Power Programs



Closing Comments

- **CCPI is a key element in President's National Energy Policy**
 - Supports Presidential initiatives in Clear Skies, Climate Change, FutureGen, Hydrogen, Sequestration
 - Provides path forward on use of coal in a potential future carbon-constrained world
- **CCPI – Round 1 is good start**
- **CCPI – Round 2 (and future rounds) will target priority technologies to meet roadmap goals**



Final Message

Technology is one of the Government's tools to assure clean, affordable domestic electricity and hydrogen is available

You are invited to help design and participate in CCPI Round 2 – a part of the Nation's energy future