



OxyCoal Combustion Technology for CO₂ Capture

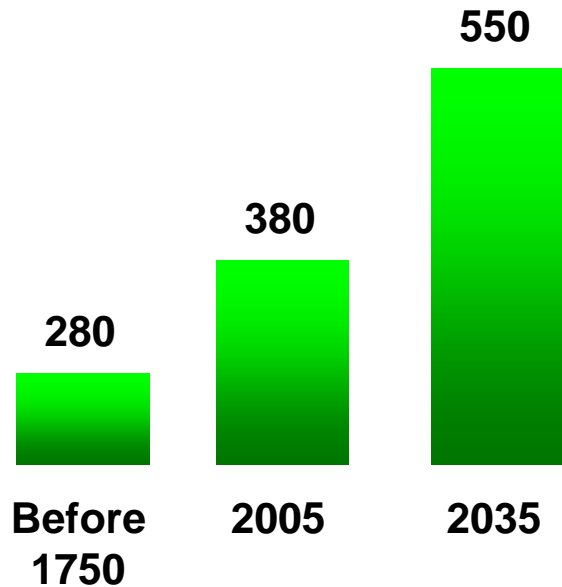
Energy and Resources
Conference
6 December 2007
The Chemists Club, New York



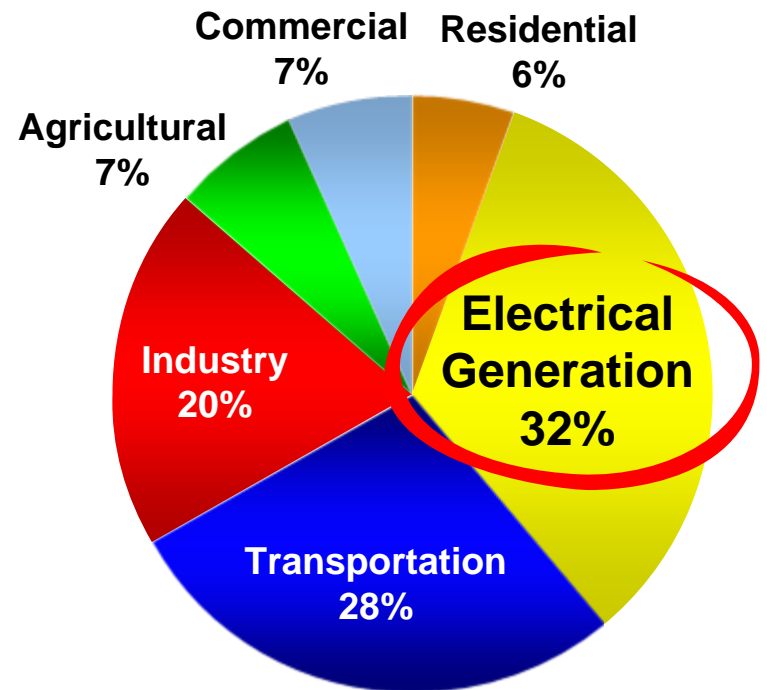
- ◆ **What is Driving OxyCoal**
- ◆ **OxyCoal Process Integration**
- ◆ **Air Separation Basics**
- ◆ **CO₂ Gas Processing**
- ◆ **CO₂ / O₂ Mixing**
- ◆ **An Integrated CFB Demonstration Project**

What's Driving Carbon Constraints

Growing CO₂ Level (ppm)



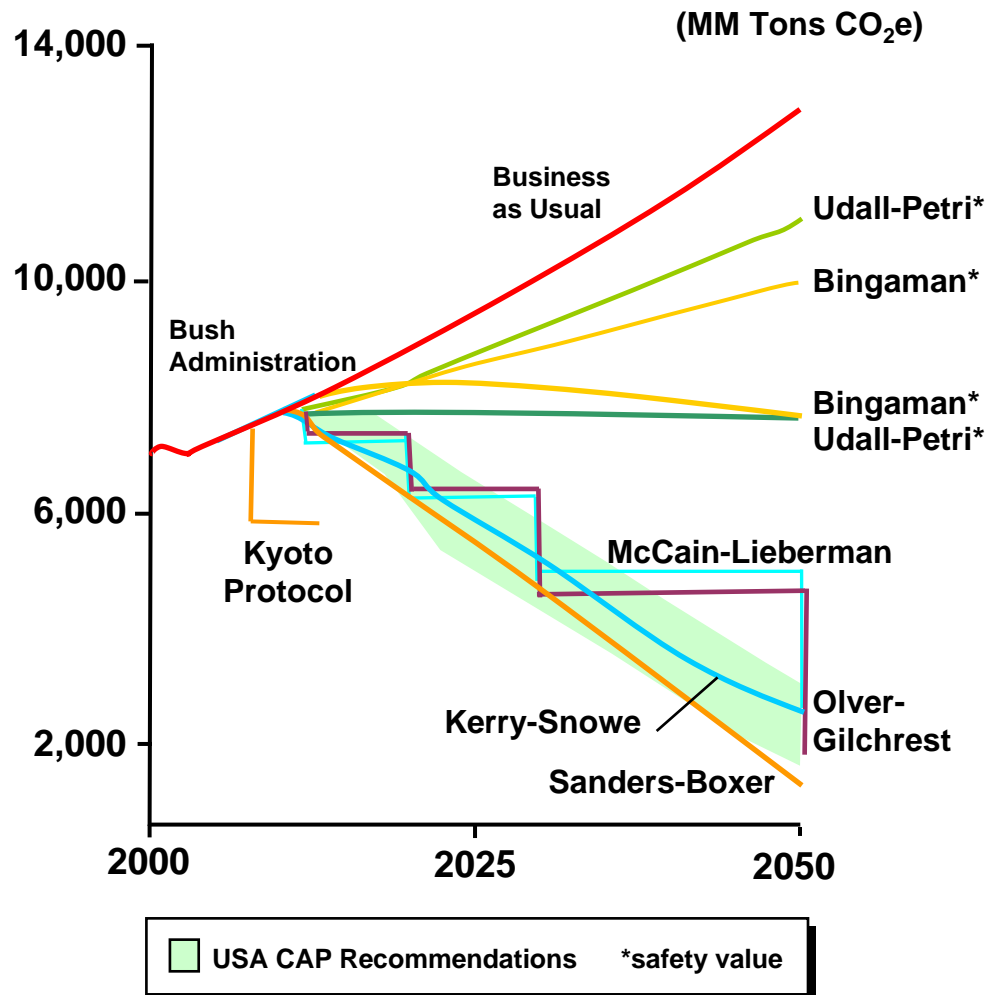
USA Greenhouse Gas Emissions by Sector, 2004



Electricity generation is the largest source of CO₂

USA Approach to Climate Change

CO₂ Goal of Legislative Proposals

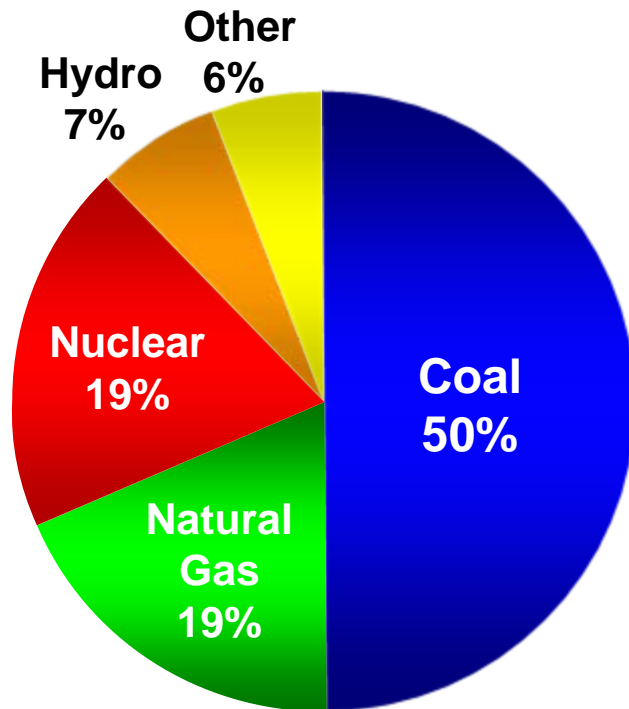


Common Themes

- ◆ **Cap & trade focused**
 - Tradable on a monetary exchange
- ◆ **Allocate CO₂ to sectors / companies at various levels**
- ◆ **Companies below their allocation receive tradable credits**
- ◆ **Companies above allocation must reduce emissions or buy credits**

The Importance of Coal

USA Power Generation, 2005 (4.1 Trillion KWh)



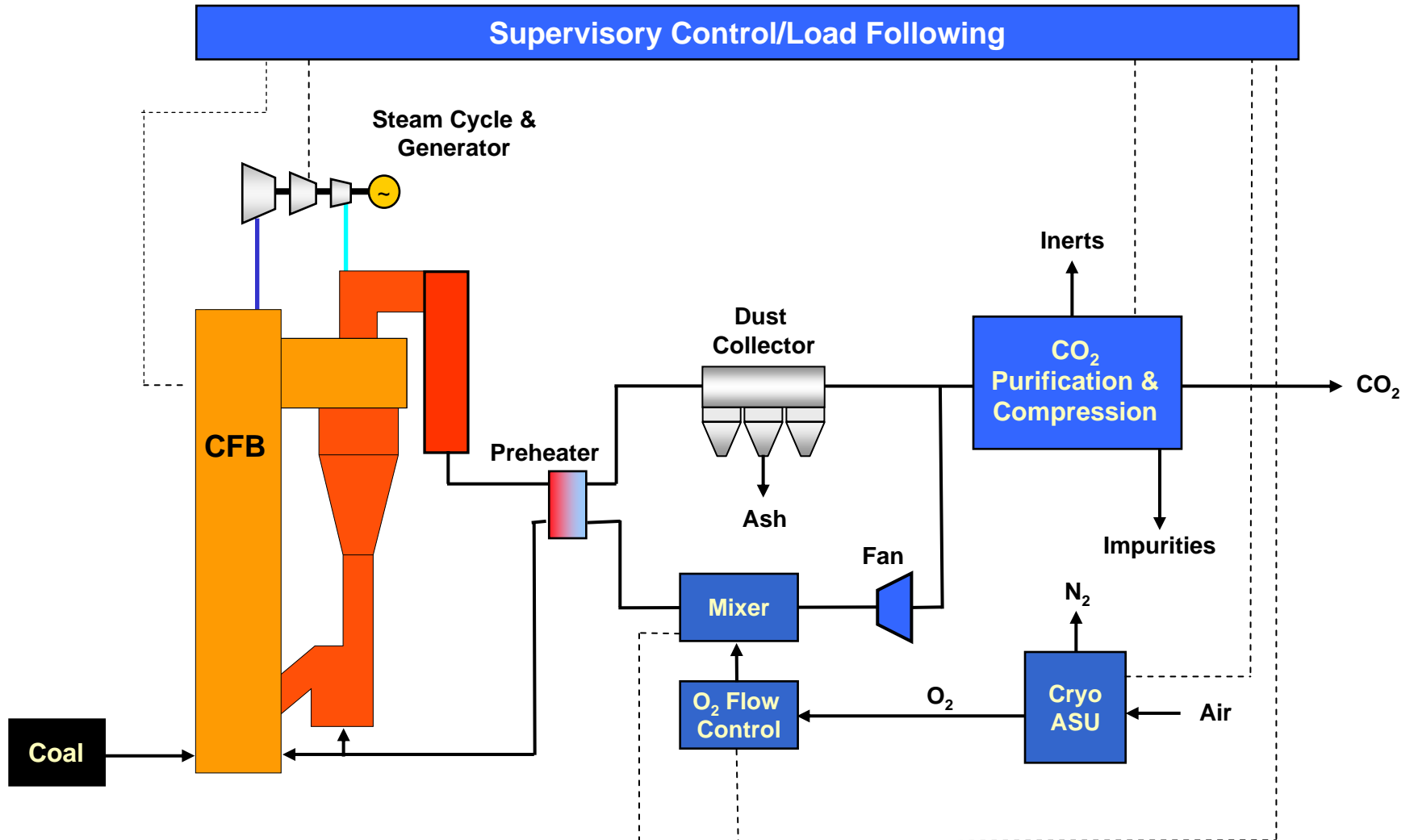
Coal Power Plants (100 MW or greater)

2005 Existing	401
Constructed 2006-2015*	80
Constructed 2015-2030*	114

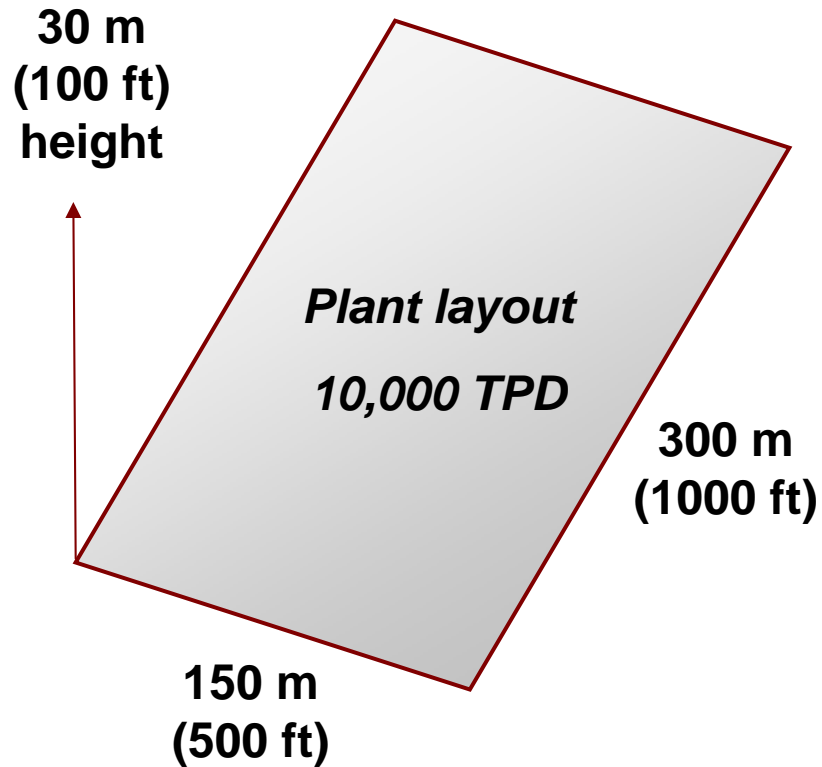
*EIA estimates of USA coal power generation, assumes 600 MW plant equivalent

Coal to remain the dominant power source through 2030

CFB Oxy-Coal Power Plant

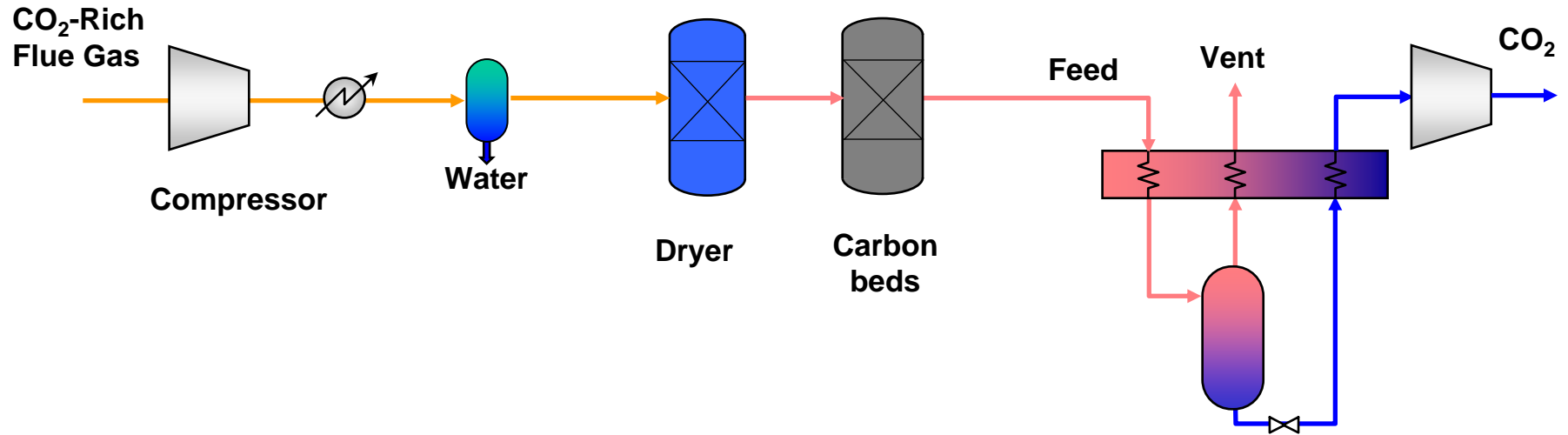


Air Separation Plant Scale



**2 X 2,500 TPD
Burns Harbor, IN**

CO₂ Compression & Purification

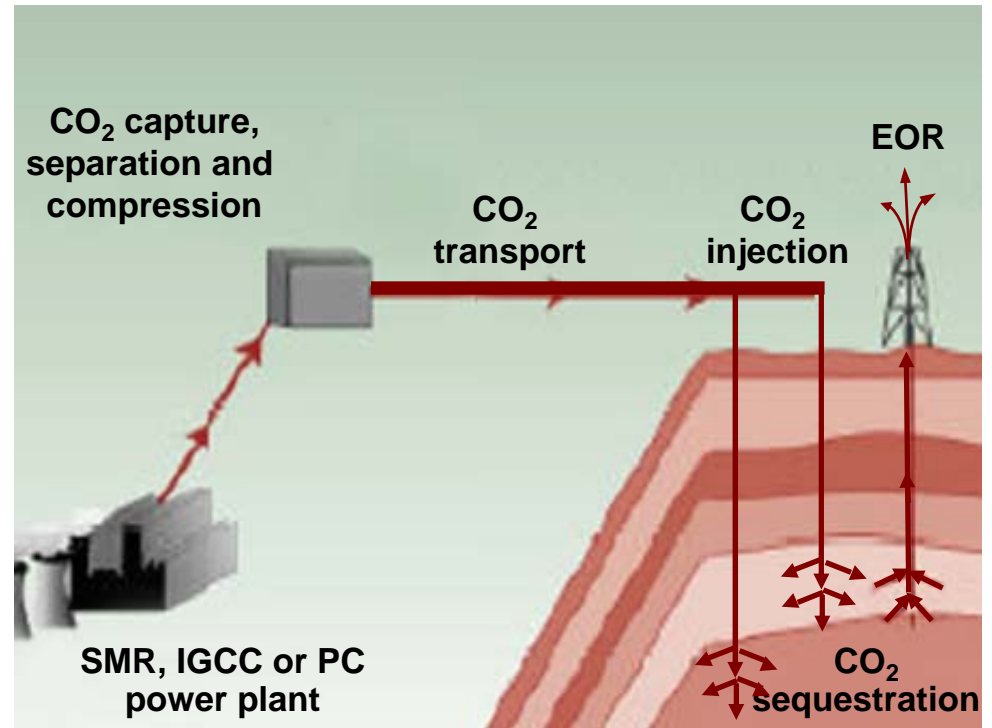


- ◆ Process similar to commercial CO₂ production CO₂
- ◆ Purity of > 95% with one stage of separation
- ◆ >99% can be achieved by distillation column
- ◆ Alternate technologies under evaluation - VPSA, Membranes

CO₂ Capture & Sequestration

Praxair Strengths

- ◆ Oxy-coal combustion technology
- ◆ Global leader in CO₂
 - 90 plants worldwide
- ◆ CO₂ capture technologies
 - Separation, purification
- ◆ Enhanced oil recovery
 - Gulf Coast Carbon Center
- ◆ 4 DOE regional partnerships
- ◆ Praxair Seeper Trace™
 - CO₂ monitoring/detection services



Praxair is uniquely positioned to provide enabling technologies

Demonstration Project Success Factors



- ◆ **Advanced coal-based systems that employ CCS**
- ◆ **Plant site geology suitable for CO₂ storage**
- ◆ **Projects with secure financials**
- ◆ **Project timing on a fast track**
- ◆ **World class technology development and project execution team**

Jamestown Oxycoal Project

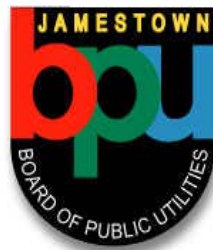
Advanced Integrated
Dual-Oxidant CFB
Power Plant with CCS
@Jamestown, NY



Battelle

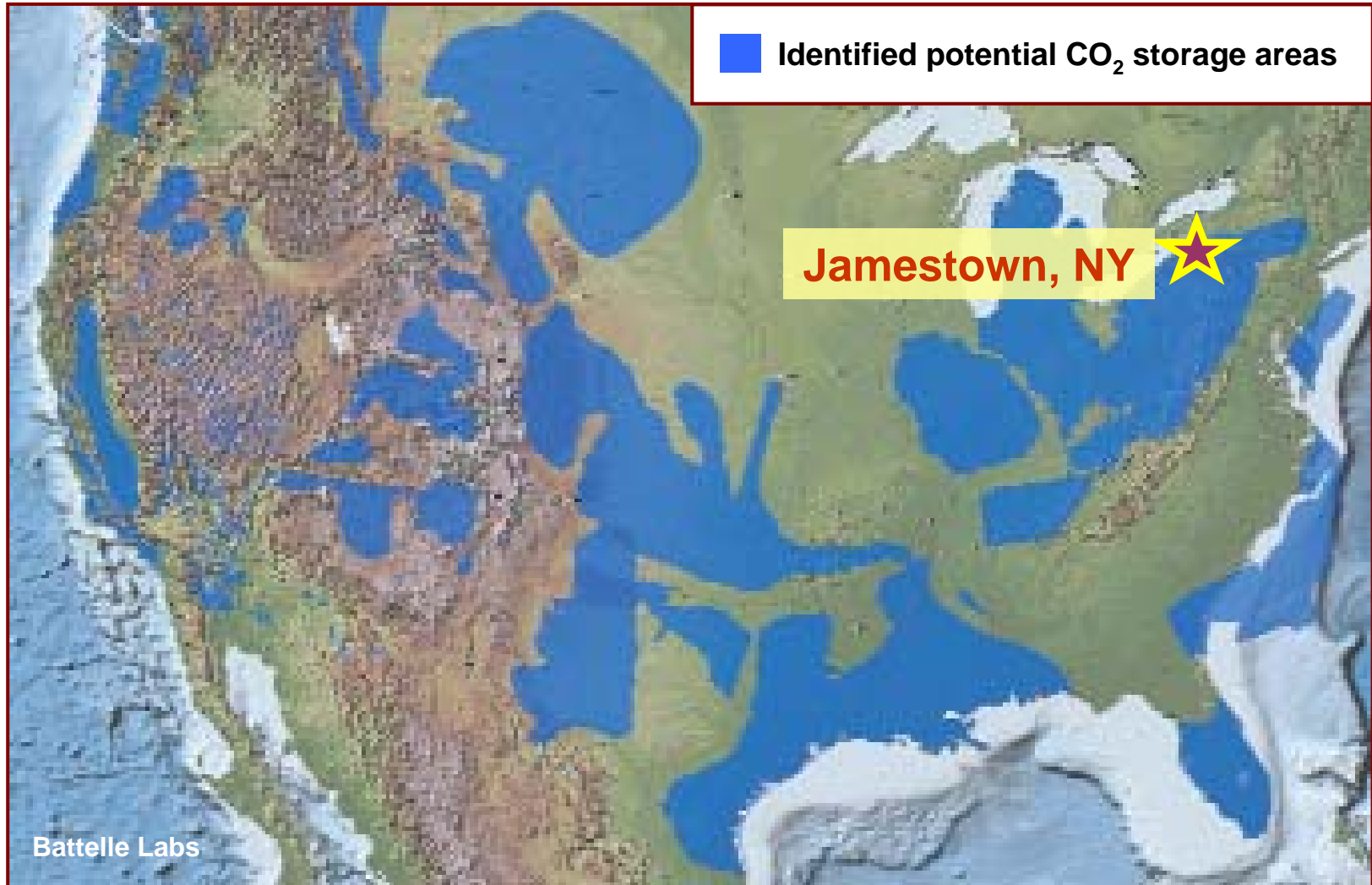
The Business of Innovation

DRESSER-RAND



- ◆ Retire 2 of 4 existing PC coal boilers
- ◆ Install 43 MW* circulating fluidized bed (CFB)
- ◆ Operates on coal, coke, TDF (20%) or biomass (25%)
- ◆ Provides up to 100 MMbtu/hr of district heat
- ◆ Full demonstration from coal feed to sequestration
 - Advanced air separation unit
 - CFB operates on air or O₂
 - CO₂ purification
 - CO₂ recycle and mixing
 - NO_x, SO_x, Hg, particulates handling
 - CO₂ compression
 - CO₂ pipeline
 - Injection and sequestration monitoring

Jamestown Plant Location



Jamestown Oxy-Coal CFB Has All Success Factors



- ◆ **Jamestown geology suitable for CO₂ storage**
 - Potential for supercritical CO₂ storage

- ◆ **Advanced coal power plants that capture and store CO₂**
 - CFB Technology allows dual-oxidant & multiple fuels
 - Advanced scalable ASU
 - Integrated scalable CO₂ capture and compression system
 - All learnings applicable to retrofit applications

- ◆ **Projects with secure financials**
 - BPU base project financed by muni-bonds

- ◆ **Project support and timing on a fast track**
 - State funding committed, more to be sought
 - Final stages of air permitting process
 - On-stream date of 2012 projected

Jamestown Oxy-Coal CFB Has All Success Factors!



- ◆ **World class technology leadership and project execution team**
 - **CFB technology**
 - **Advanced Air Separation**
 - **CO₂ gas processing technology**
 - **CO₂ compression technology**
 - **Sequestration technology**
 - **Environmental permitting**

**Team members have global market reach and
roadmap for commercialization**

Key Messages

- ◆ **The technology roadmap is clear**
- ◆ **The commercial roadmap is getting clearer**
- ◆ **Regulatory roadmap will provide clarity**

**The time is now for fully integrated
demonstration plants with CCS**