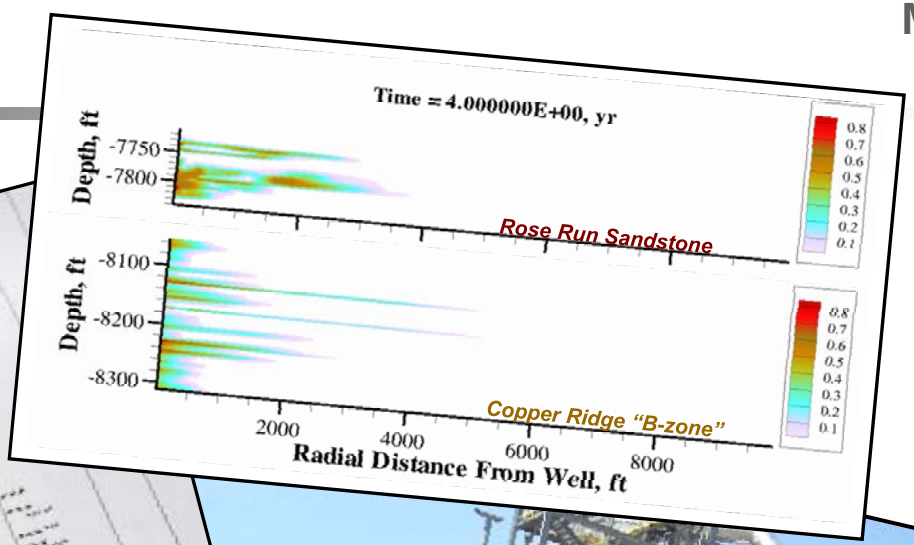
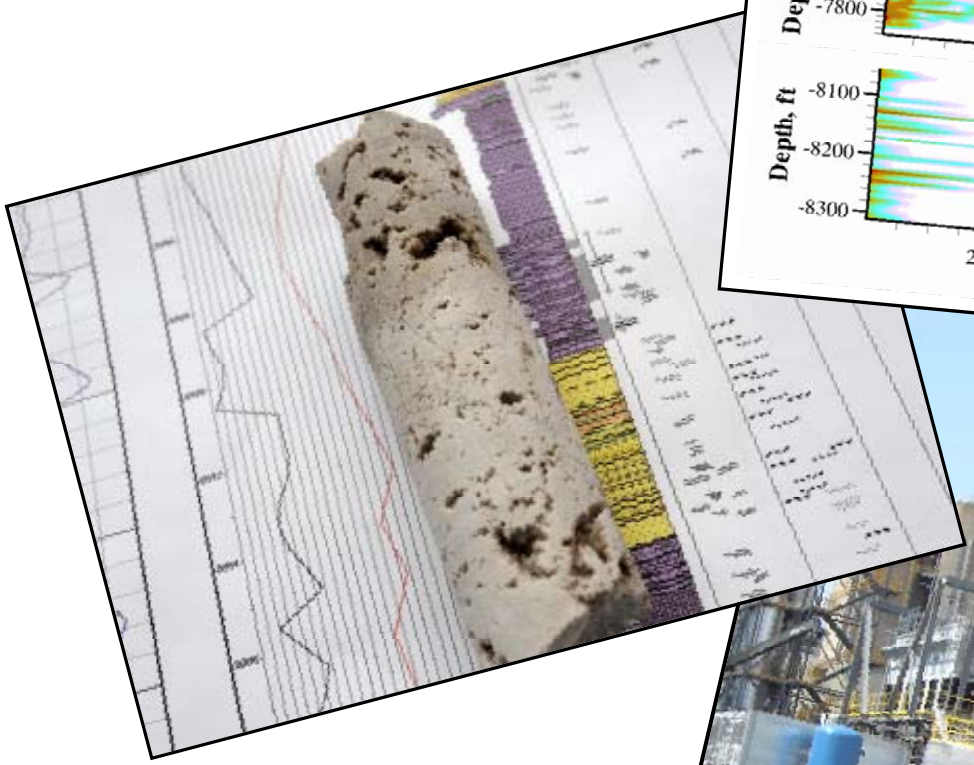
AEP CCS Program Overview

Gary O. Spitznogle

Director – New Tech Development & Policy Support

March 10, 2011



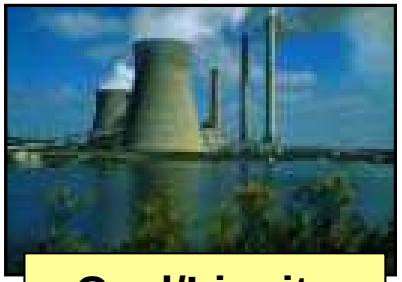


Characterization…

Simulation…

Validation…

American Electric Power Overview



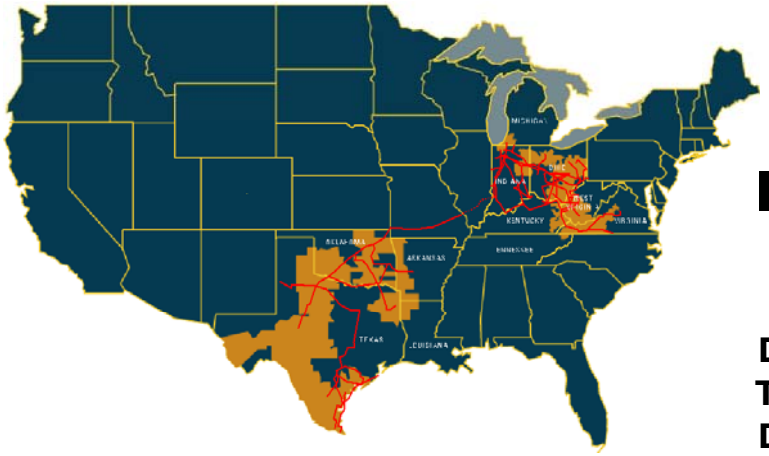
Coal/Lignite
66%

Nat. Gas/Oil
22%

Nuclear
6%

Pumped Storage/
Hydro/Wind
6%

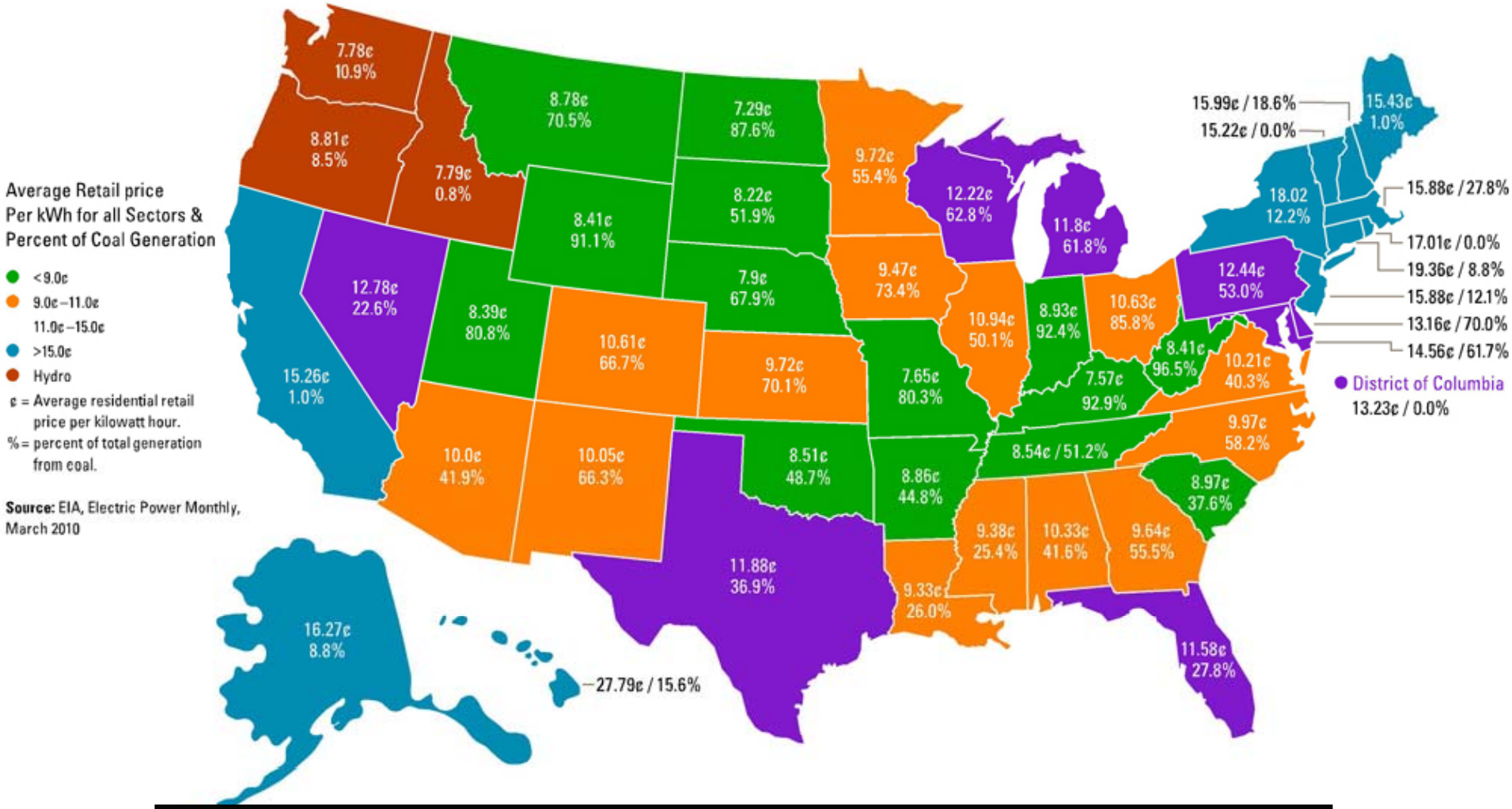
AEP's Generation Fleet
>38,000 MW Capacity



5.2 million customers in 11 states
Industry-leading size and scale of assets:

Asset	Size	Industry Rank
Domestic Generation	~38,300 MW	# 2
Transmission	~39,000 miles	# 1
Distribution	~213,000 miles	# 1

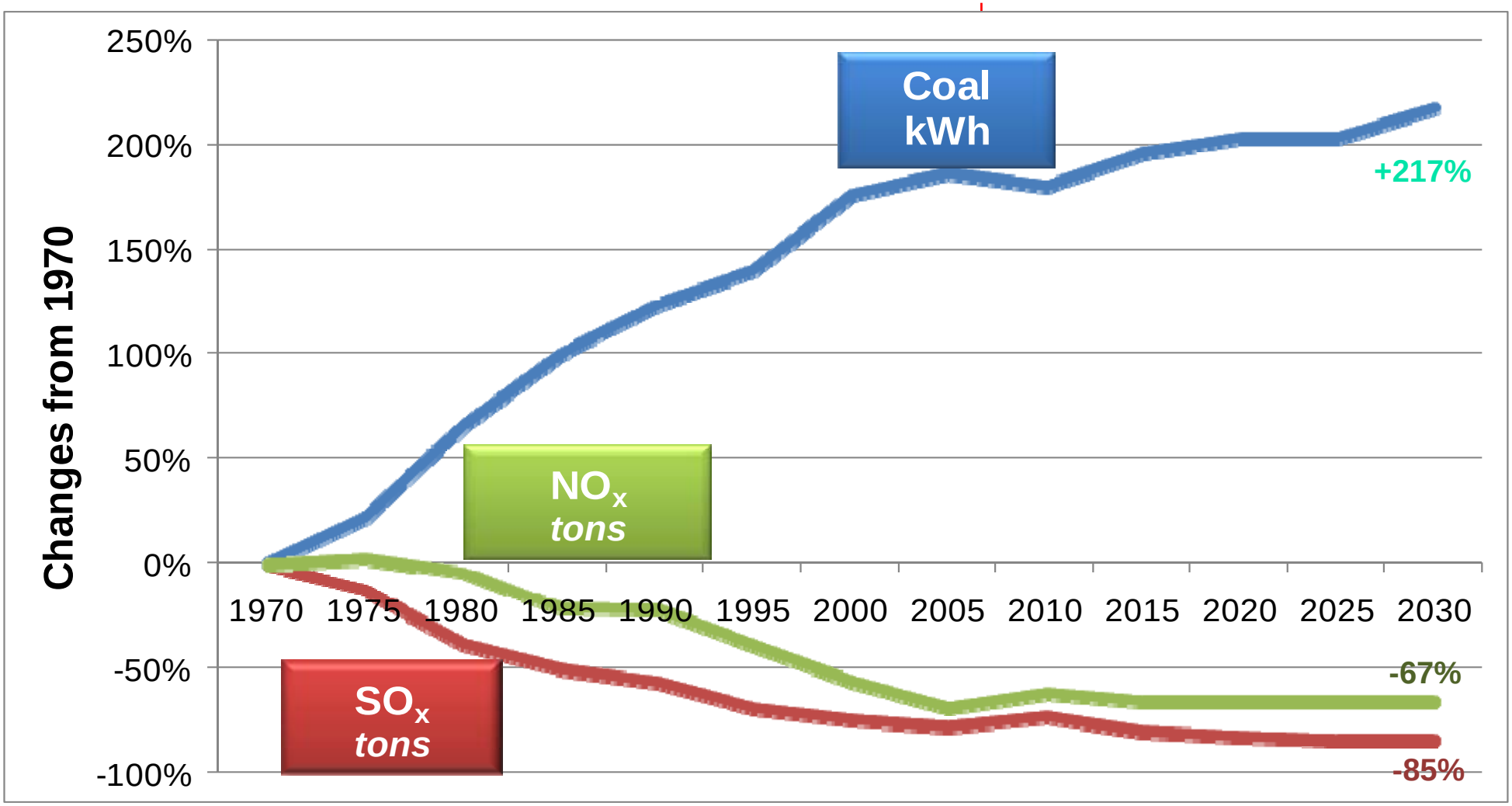
Average KW Price for Coal Generation



The more coal used, the lower the consumers electric costs

Technology is the Key to Clean Coal

Emissions Continue to Decline While Coal-Fueled Generation Increases Through 2030



NATIONAL ENERGY TECHNOLOGY LABORATORY

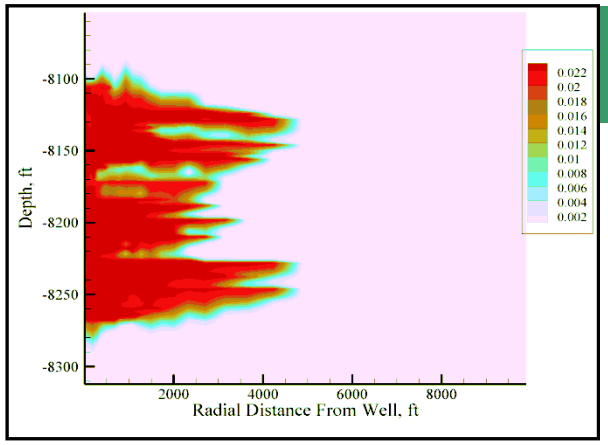
Sources: EPA National Air Pollutant Emission Trends; EIA Annual Energy Review and EIA AEO '09 AARA

Site Characterization and Feasibility Study

The foundational work for AEP's CCS program began in 2003

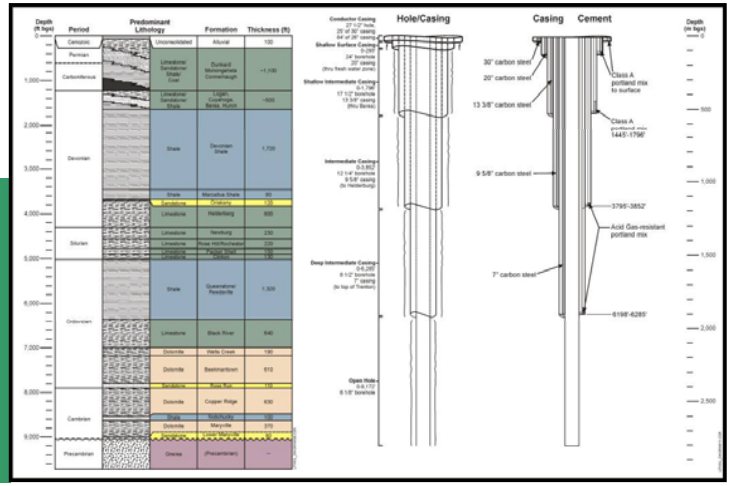
Seismic Survey
Summer 2003

Drilling and Testing
2003 - 2005



Modeling and Analysis
2006 - 2007

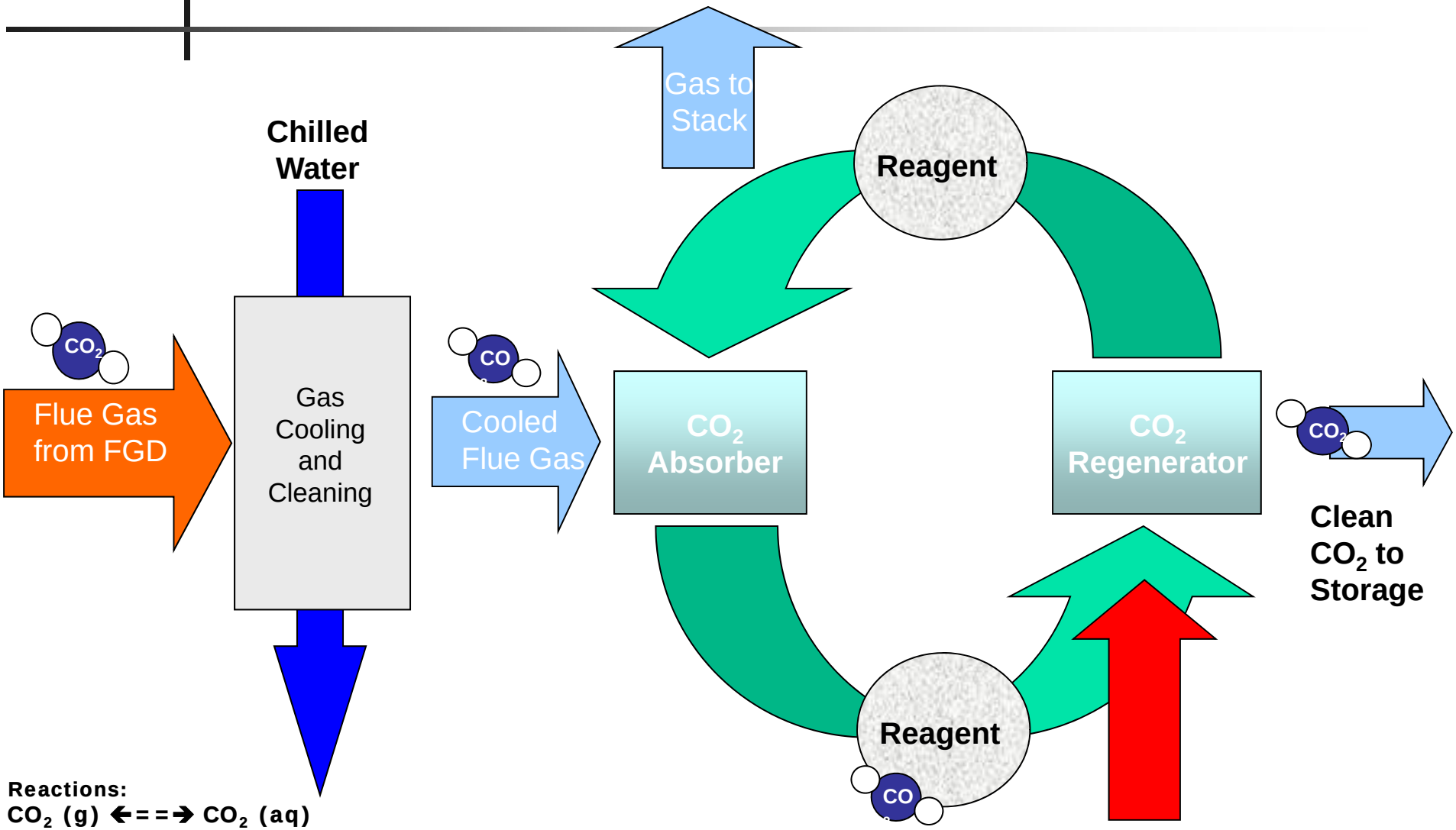
More than $7.5 million for site characterization and feasibility assessment conducted by Battelle under funding by DOE and others



Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

Alstom's Chilled Ammonia Process

Post-Combustion Capture



Reactions:

$CO_2\ (g) \rightleftharpoons CO_2\ (aq)$

$(NH_4)2CO_3\ (aq) + CO_2\ (aq) + H_2O \rightleftharpoons 2(NH_4)HCO_3\ (aq)$

$(NH_4)HCO_3\ (aq) \rightleftharpoons (NH_4)HCO_3\ (s)$

$(NH_4)2CO_3 \rightleftharpoons (NH_4)NH_2CO_2 + H_2O$

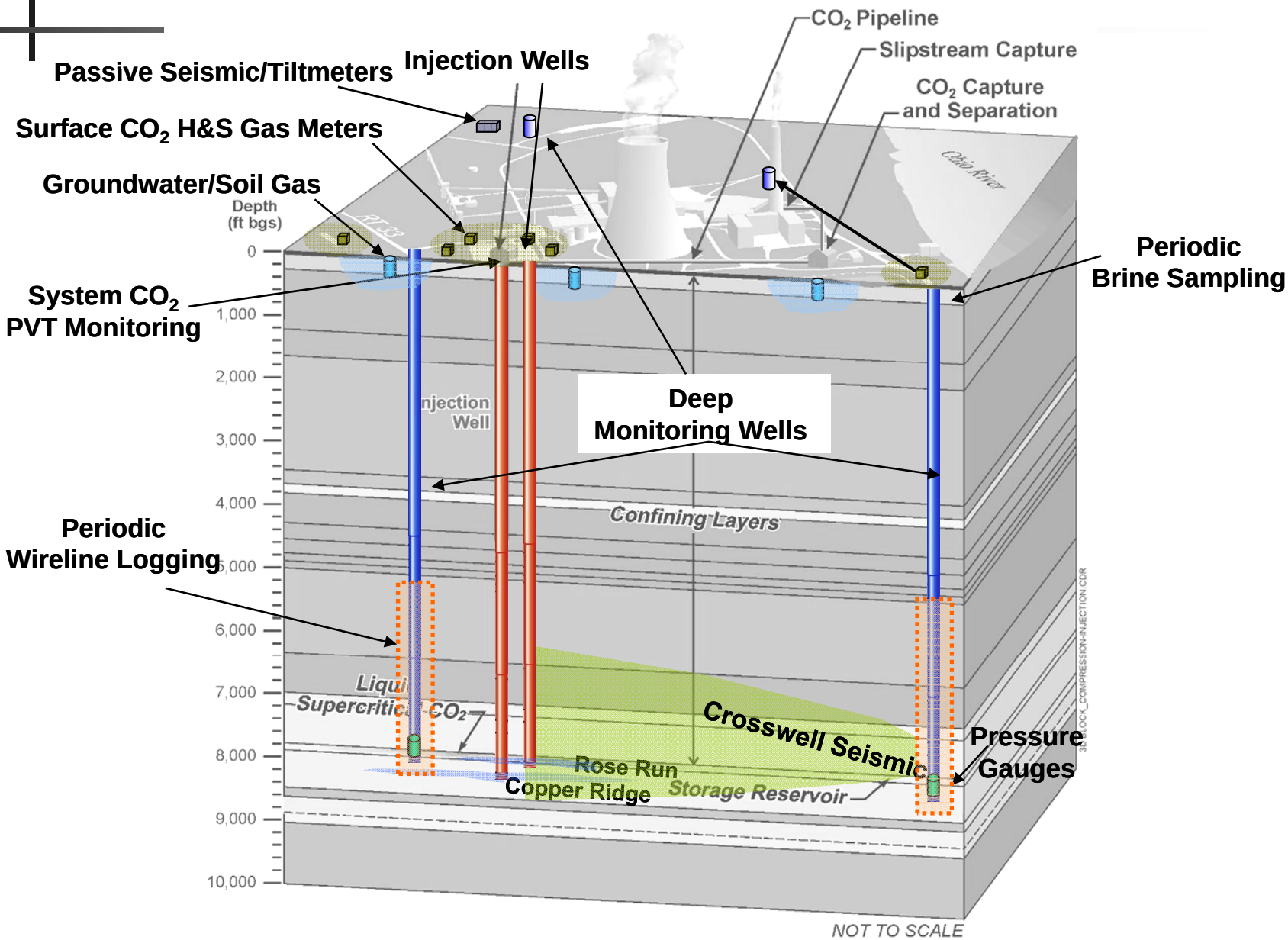
AEP CCS Validation Facility

1,300 MWe Mountaineer Plant, New Haven, WV

- **Scale: 20 MWe slipstream**
  - **~1.5% of power plant flue gas**
- **Cost: >$100M**
  - **Project initiated in September 2007**
  - **Funding by AEP, Alstom, RWE, & EPRI**
- **Capture: Alstom Chilled Ammonia Process**
  - **Ammonium Carbonate/Bicarbonate Reaction**
  - **>85% CO_2 capture rate**
- **Sequestration: Deep saline formation storage**
  - **~100,000 tons CO_2 per year**
  - **~1.5 miles below the plant surface**
- **First CO_2 Capture: September 1, 2009**
- **First CO_2 Storage: October 1, 2009**
- **Planned operation: 1 to 5 years**

Monitoring System Design

At Mountaineer Plant



Validation Facility Progress Update

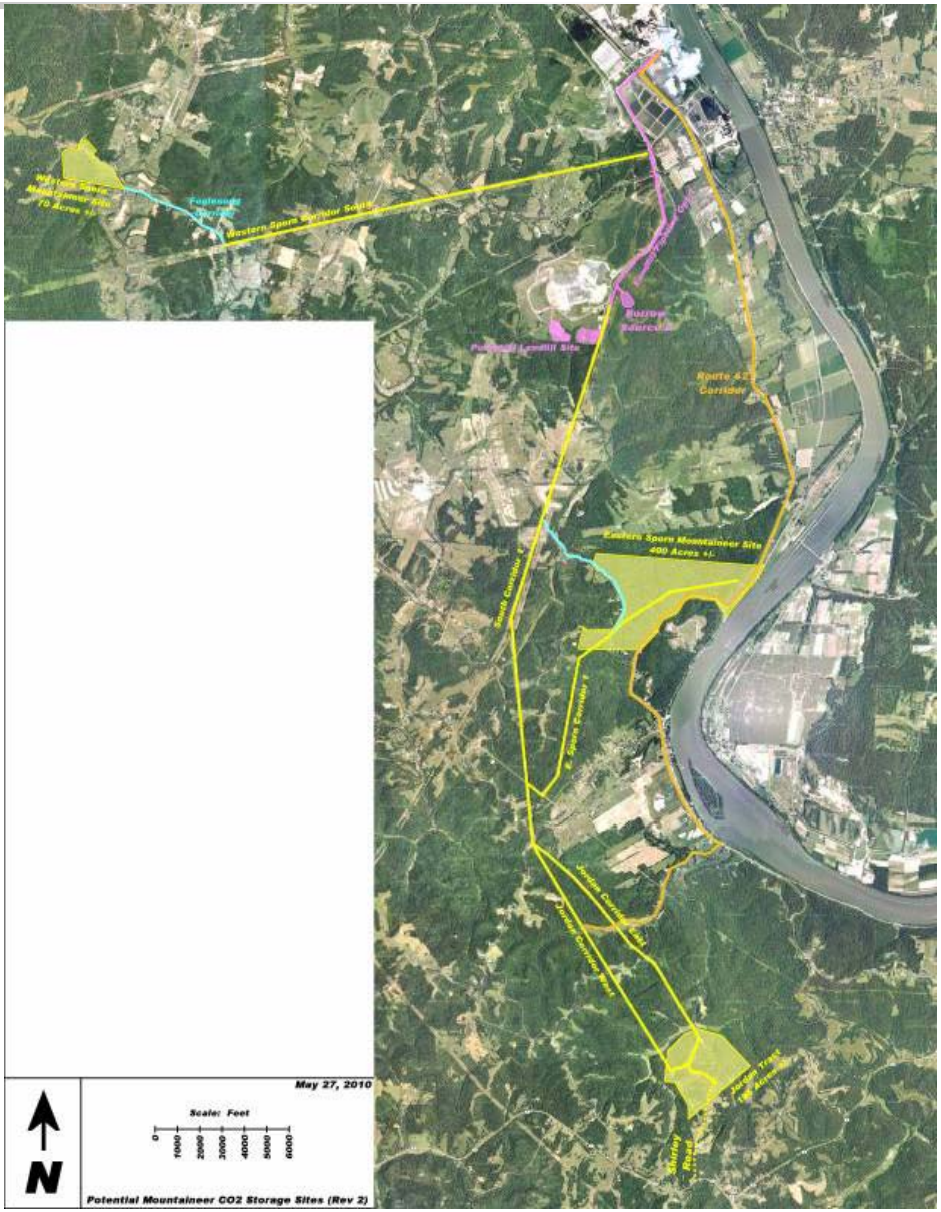
First Year of Operation

- **~4,400 hours operation**
- **~21,000 metric tons captured**
- **~15,000 metric tons stored**
  - **~13,500 into AEP-1**
    - Copper Ridge
  - **~1,500 into AEP-2**
    - Rose Run
- **Process availability approaching 100%**
  - **Both capture and storage**
- **>90% CO_2 capture rate**

AEP CCS Commercialization Project

1,300 MWe Mountaineer Plant, New Haven, WV

- **Scale:** **Full commercial demonstration**
  - **235 MWe Slipstream**
- **Cost:** **~$668M**
- **Funding:** **CCPI Round III Selection**
  - **DOE awarded 50% cost share, up to $334M**
  - **Cooperative agreement signed in January, 2010**
- **Capture:** **Alstom Chilled Ammonia Process**
  - **~90% CO_2 capture rate**
- **Sequestration:** **Battelle is Storage Contractor**
  - **Deep saline reservoirs**
  - **~1,500,000 tons CO_2 per year**
  - **~1.5 miles below the surface**
  - **Pipeline system with off-site wellheads**
- **NEPA Process Underway**
- **Geologic Experts Advisory Group:** **Actively Meeting**
  - **Battelle, CONSOL, MIT, Univ. of Texas, Ohio State, WVU, Virginia Tech, LLNL, WV Geo. Survey, OH Geo. Survey, WV DOE, NETL, RWE, & CATF**
- **Planned Operation:** **Startup in second half of 2015**



AEP and China Huaneng Sign MOU

CCS technology assessment

- **Evaluate Amine Process Developed by China Huaneng**
  - **Parasitic load consumption**
  - **Compatibility with existing power generating unit**
  - **Characterization of process effluent streams**
- **Perform "Apples-to-Apples" Comparison with Other Known Technologies**
  - **Standardize comparison conditions**
    - With compression included or without?
    - Product CO_2 quality and pressure
    - Steam and power sources
  - **Parasitic load**
  - **Land requirements (footprint)**
  - **Capability to handle load-swinging nature of generating unit**
- **Consider Path Forward for Technology Commercialization**
  - **Demonstrations and/or deployments**