Climate Change and Technology: Opportunities and Risks







Northeastern Plant - Oologah, OK

Bruce Braine Vice President - Strategic Policy Analysis November, 2007 50th Anniversary CO2 Record Conference



Company Overview





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

		<u>Industry</u>
<u>Asset</u>	<u>Size</u>	<u>Rank</u>
Domestic Generation	~38,300 MW	# 2
Transmission	~39,000 miles	# 1
Distribution	~208,000 miles	# 1



AEP's Climate Strategy





ELECTRIC POWER RESEARCH INSTITUTE

- Being proactive and engaged in the development of climate policy
 - International Emissions Trading Association (IETA)
 - Electric Power Research Institute (EPRI)
 - Pew Center on Global Climate Change
 - e8

Global Roundtable on Climate Change

Investing in science/technology R&D

- FutureGen Alliance
- US DOE research on carbon capture and sequestration at our Mountaineer Plant
- EPRI combustion technologies
- MIT Energy Laboratory
- B&W Oxy-Coal
- Taking voluntary, proactive action now, making real reductions and setting policy precedents thru CCX
 - Chicago Climate Exchange (CCX)
 - EPA Climate Leaders and SF-6 Program
 - Asia-Pacific Partnership
 - DOE 1605B- voluntary reporting of GHGs Program
 - Business Roundtable Climate Resolve
 - Numerous forestry activities
- Investing in longer term technology solutions--new generation and carbon capture and storage (e.g., IGCC, Ultrasupercritical PC)



EP

AEP must be a leader in addressing climate change

AEP's Climate Position

- A certain and consistent national policy for reasonable carbon controls should include the following principles:
 - Comprehensiveness
 - Cost-effectiveness
 - Realistic emission control objectives
 - Monitoring, verification and adjustment mechanisms
 - Technology development & deployment
- Inclusion of adjustment provision if largest emitters in developing world do not take action



A reliable & reasonably-priced electric supply is necessary to support the economic well-being of the areas we serve.

Emission Reductions Under Selected Bills



EPRI CO₂ Reduction "Prism"



AEP's Long-Term GHG Reduction Portfolio





AEP is investing in a portfolio of GHG reduction alternatives

A Portfolio Approach:

AEP's Long-Term CO₂ Reduction Commitment

Existing Programs

- Existing plant efficiency improvements
- Renewable Energy
 - 800 MWs of Wind
 - 300 MWs of Hydro

Domestic Offsets

- Forestry 0.35MM tons/yr
- Over 63MM trees planted through 2006
- 1.2MM tons of carbon sequestered
- International Offsets
 - Forestry projects have resulted in 1MM tons of carbon sequestered through 2006
- Chicago Climate Exchange

AEP's reductions/offsets of CO2:

- 2003-2005: 31 MMT
- 2006-2010 (proj.): Additional 15 MMT

New Program Additions (by 2011)

- 1000 MWs of Wind PPAs: 2MM tons/yr
- Domestic Offsets (methane): 2MM tons/yr
- Forestry: Tripling annual investment to increase to 0.5MM tons/yr by 2015
- Fleet Vehicle/Aviation Offsets: 0.2MM tons/yr
- Additional actions--end use and supply efficiency and biomass: 0.3MM tons/yr

New Technology Additions

- New Generation IGCC and USC
- Commercial solutions for existing fleet
 - Chilled Ammonia
 - Oxy-Coal

AEP's reductions/offsets of CO₂: 2011+: 5 MMT/YEAR Longer Term—New Technology



AEP Wind Operations/Purchases

Trent Mesa (2001)

- **150 MW** (100 1.5 MW turbines)
- Abilene/Sweetwater, TX



Summary

- •Owned/Operated 385 MW
- •Wind Purchases 392 MW
- •Total Existing Wind at end of 2006: 777 MW
- •New Wind Purchases in 2007: 275 MW



Will acquire an additional 725 MW of new wind to attain goal of 1,000 MW by 2011

Southwest Mesa (1999)

- **75 MW** (107 700kW turbines)
- McCarney, TX
- Power Purchaser



Desert Sky (2002)

- 160 MW (107 1.5 MW turbines)
- Bakersfield, TX



Off-System Reductions

New AEP Offset Commitment by 2011:

+ 2 MM tons/year additional CO_2 offsets

Latest Announcement:

- Methane Capture Deal with Environmental Credit Corp.
 - 0.6 MM Tons CO2e per year
 - 2010 through 2017
 - 51% of credits sourced from "AEP States"



Source: Wall Street Journal June 14, 2007



AEP Leadership in Technology: IGCC/USC and Future Gen

NEW ADVANCED GENERATION

• IGCC -- AEP first to announce plans to build two 600+ MW IGCC commercial size facilities in US (OH and WV) by mid next decade

• USC -- AEP will be first to employ new generation ultra-supercritical (steam temperatures >1100°F) coal plant in U.S (AR)

• FUTUREGEN -- First Near Zero Emissions Hydrogen/ Electric (coal-fueled IGCC with CCS) - DOE, AEP and Alliance members









CO₂ Capture Techniques

Post-Combustion Capture - Conventional or Advanced Amines, Chilled Ammonia

- Amine technologies commercially available in other industrial applications
- Relatively low CO₂ concentration in flue gas More difficult to capture than other approaches
- High parasitic demand
 - Conventional Amine ~25-30%, Chilled Ammonia target ~10-15%
- Amines require <u>very</u> clean flue gas

Modified-Combustion Capture - Oxy-Coal

- Technology not yet proven at commercial scale
- Creates stream of very high CO₂ concentration
- High parasitic demand, >25%

Pre-Combustion Capture - IGCC with Water-Gas Shift, FutureGen

- Most of the processes commercially available in other industrial applications
 - Have never been integrated together
- Turbine modified for H₂-based fuel, which has not yet been proven at commercial scale
- Creates stream of very high CO₂ concentration
- Parasitic demand (~20%) for CO₂ capture lower than amine or oxy-coal



FutureGen's Water-Gas Shift Process

Pre-Combustion Capture



Babcock & Wilcox Oxy-Coal Process

Modified Combustion Capture



Alstom's Chilled Ammonia Process

Post-Combustion Capture



CO₂ Injectivity in the Mountaineer Area



CO₂ injection should also be possible in shallower sandstone and carbonate layers in the region

> Rose Run Sandstone (~7800 feet) is a regional candidate zone in Appalachian Basin

A high permeability zone called the "B zone" within Copper Ridge Dolomite has been identified as a new injection zone in the region

Mount Simon Sandstone/Basal Sand - the most prominent reservoir in most of the Midwest but not desirable beneath Mountaineer site

AEP's Carbon Capture & Storage Initiative

In March 2007, AEP announced a major new carbon capture and storage initiative:

- Chilled Ammonia CCS--We will install carbon capture on two coal-fired power plants, the first commercial use of technologies to significantly reduce carbon dioxide emissions from existing plants.
 - The first carbon capture project, at the Mountaineer plant in West Virginia, is expected to complete its product validation phase in 2009.
 - The second, at the Northeastern plant in Oklahoma, will begin commercial operation in 2012.
- Oxy-Coal--AEP will also demonstrate (10MWe) and then install oxy-coal CO₂ capture & storage at a commercial sized coal unit (about 200 MWe)—feasibility study to be completed in 2008.



AEP Leadership in New Technology: Chilled Ammonia CCS





Key Issues for CCS Development

- Overcoming the "Economic" Hurdle
- High Up-Front Capital Investment Getting Adequate Financing and Recovery in Rates
- Commercial Demonstrations of CCS at Large Coal-Fired Power Plants
- National Standards for Permitting of Storage Reservoirs
- Potential Institutional, Legal and Regulatory Barriers to Carbon Storage

