Carbon Sequestration Leadership Forum: Strategic Business Issues of CCS Deployment

Mountaineer Plant - New Haven, WV

AEP AMERICAN® ELECTRIC POWER

Northeastern Plant - Oologah, OK

27 March 2007

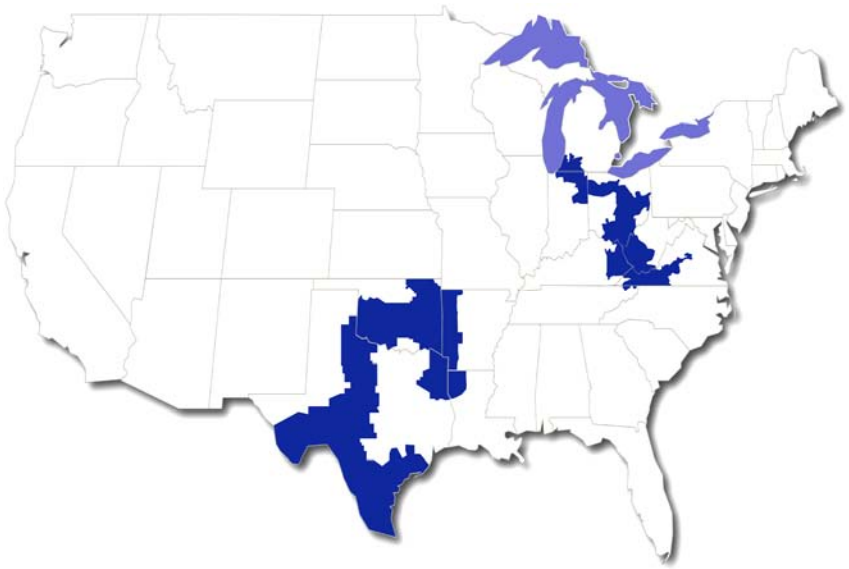
Paris

Company overview

- 5.1 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	~208,000 miles	# 1

Source: Company research & Resource Data International Platts, PowerDat 2005

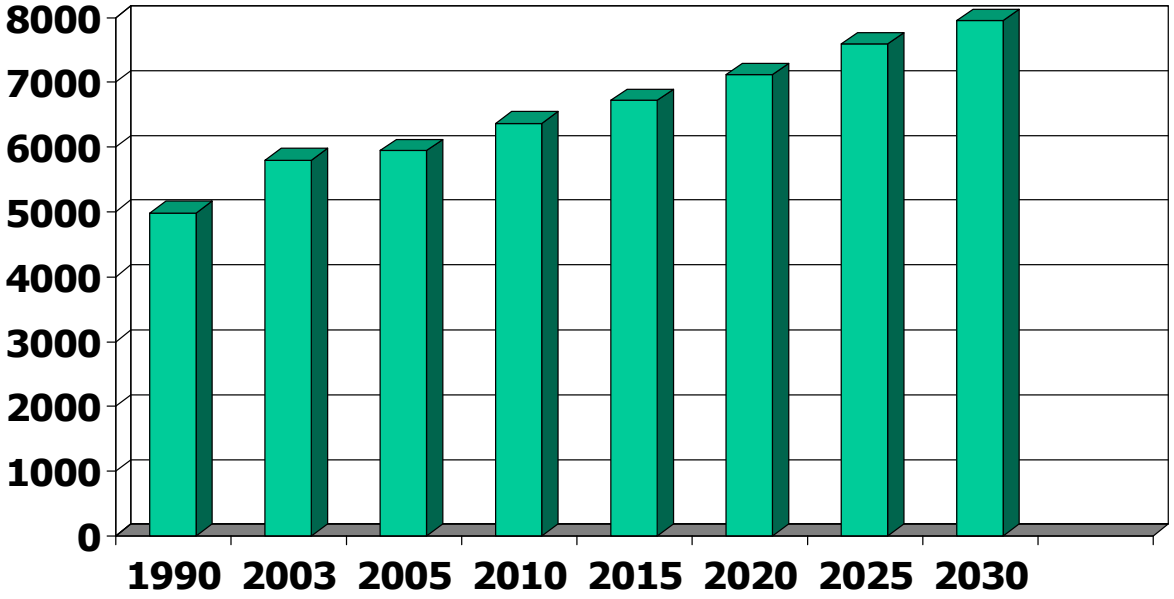


- Coal & transportation assets
  - Control over 8,000 railcars
  - Own/lease and operate over 2,600 barges & 51 towboats
  - Coal handling terminal with 20 million tons of capacity
- 20,000 employees

AEP Generation Portfolio				
Coal	Gas	Nuclear	Hydro	Wind
67%	24%	6%	2%	1%

AEP enjoys significant presence throughout the energy value chain

Investment decisions today must consider likelihood of future CO_2 emission limits



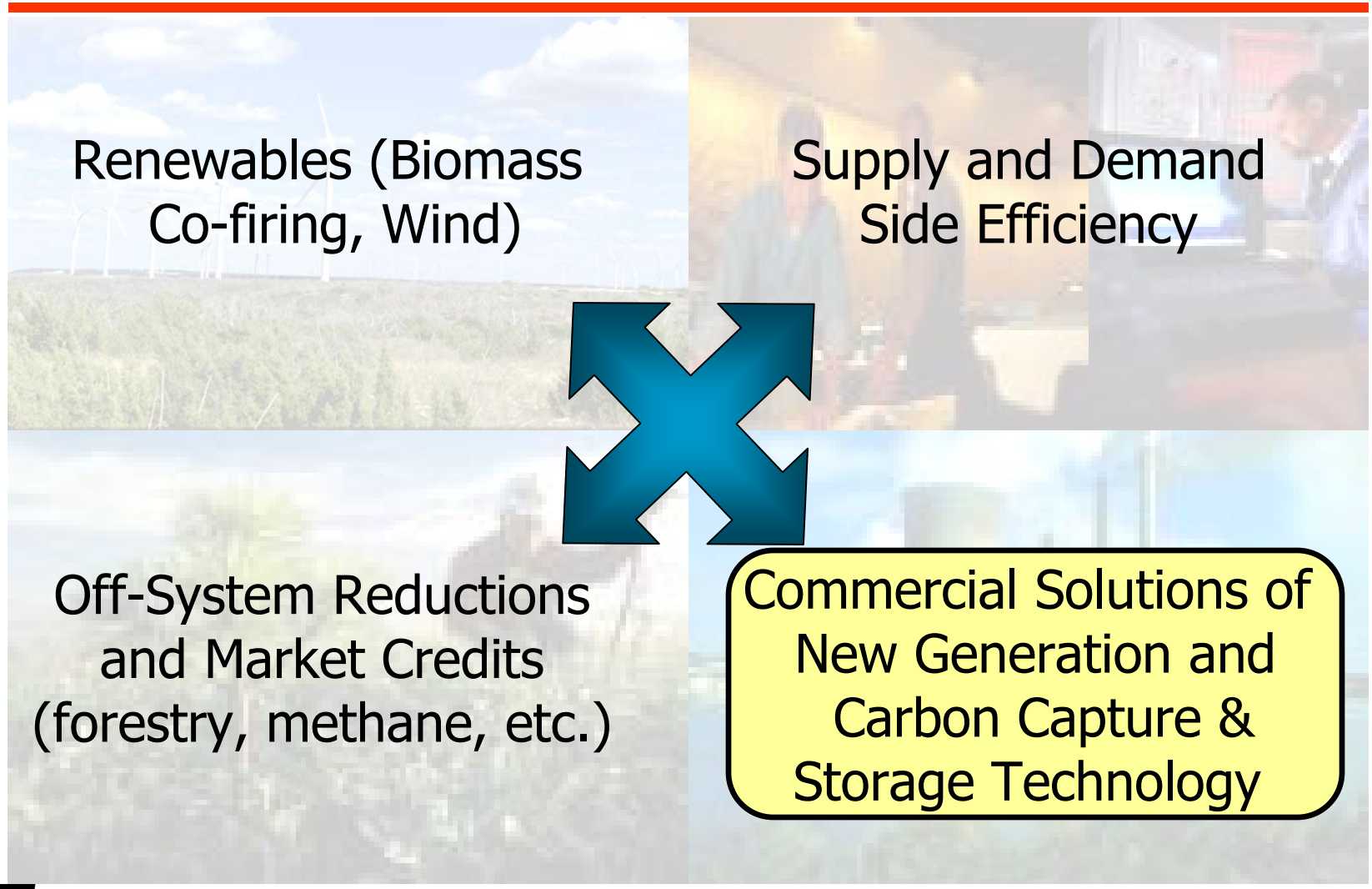
Source: Energy Information Administration/Emissions of GHG in the United States 2005

Note: Chart above assumes no mandatory limits imposed on CO_2 emissions

- Absent federal policies, long-term CO_2 growth is likely to be significant, driven by:
  - Population and economic growth
  - Increased penetration of computers, electronics and appliances
  - Increases in commercial floor space
  - Increases in highway, rail and air travel
- Likelihood of US GHG legislation is growing
  - Climate change science
  - Public perceptions
  - Political shifts in Congress

Inclusion of climate change in investment decisions and taking voluntary actions to reduce CO2 footprint will enhance shareholder return prospects

AEP's long-term GHG reduction portfolio



AEP is investing in a portfolio of GHG reduction alternatives

AEP's long-term CO_2 reduction commitment

Existing Programs

- Existing plant efficiency improvements
- Renewables
  - 800 MWs of Wind
  - 300 MWs of Hydro
- Domestic Offsets
  - Forestry – 0.35MM tons/yr @ $500K/year
  - 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**
- **By 2010 (proj.): Additional 15 MMT**

New Program Additions

- Timing: Implement during 2007 to take effect/receive credits by 2011
- Methods
  - +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 to include DSM and end use energy efficiency, biomass and power plant efficiency: 0.2MM tons/yr

AEP's reductions/offsets of CO2:
2011+: 5 MMT/YEAR

IGCC & Ultra-supercritical

IGCC

- **AEP plans to build first two 600+ MW IGCC facilities in the US**
  - Meigs County, OH & Mason County, WV
- Seeking regulatory approval
- **<u>IGCC benefits include:</u>**
  - World-class efficiency and environmental performance
  - Superior efficiency on eastern bituminous coal
  - Flexible byproduct processing (Poly-generation opportunities; Hydrogen production)
  - Conducive to carbon capture & storage
- <u>Challenges include:</u> High capital cost; Currently not economical for low-BTU coals; More IGCC must be built to reduce cost

IGCC technology presents promise for carbon capture & Storage

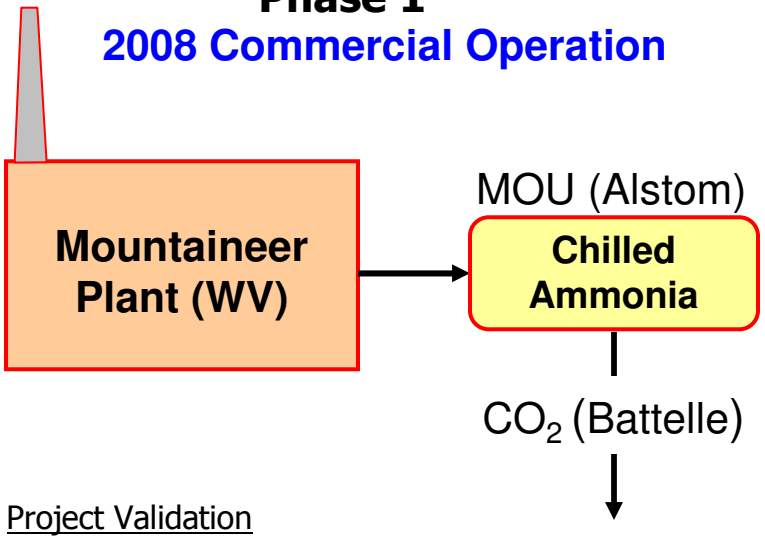
Ultra-supercritical

- **AEP plans to build first two ultra-supercritical coal plants in the US**
  - Hempstead County, AR (600-MW) & Red Rock, OK (950-MW)
- Seeking regulatory approval
- **<u>Ultra-supercritical benefits include:</u>**
  - World-class efficiency and environmental performance
  - Lower emissions than traditional PC units using PRB coal
  - <u>Challenges include:</u> Ultra-supercritical units will require different technology for carbon capture when compared to IGCC

Ultra-supercritical is the best choice for AEP's PRB-coal plants

Chilled ammonia technology program

Phase 1
2008 Commercial Operation

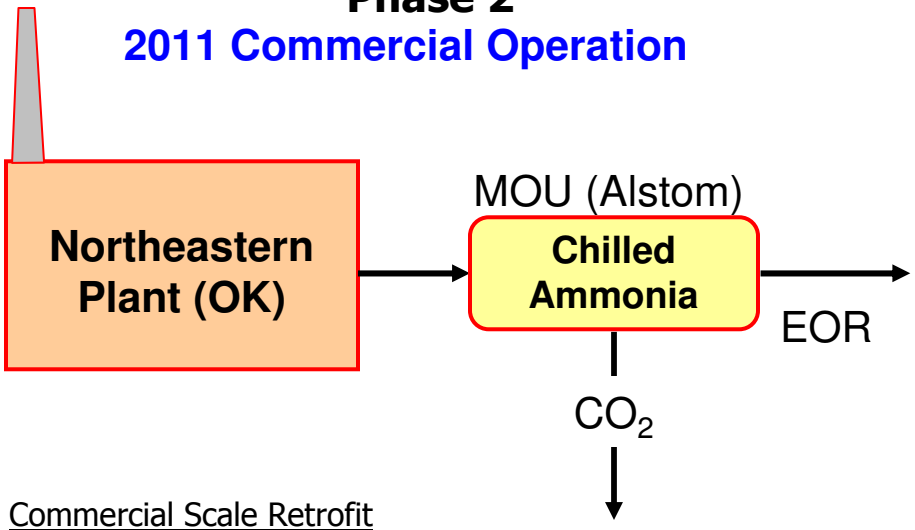


Project Validation

- 30 MW_t (megawatts thermal) scale (a scale up of Alstom/EPRI 5 MW_t field pilot, under construction at WE Energies)
- <0.1MM tonnes CO_2 per year
- In operation 4Q 2008
- Approximate total cost $50 – $80M
- Using Alstom "Chilled Ammonia" Technology
- Located at the AEP Mountaineer Plant in WV
- CO_2 for geologic storage

Phase 1 will capture and sequester 100,000 metric tons of CO2/year

Phase 2
2011 Commercial Operation



Commercial Scale Retrofit

- ~ 200 MW_e scale (megawatt electric)
- ~ 600 MW_t scale (megawatt thermal)
- ~1.5MM tonnes CO_2 per year
- In operation late 2011
- Approx. capital $250 – $300M ($CO_2$ capture & compression)
- Approx. O&M cost $12M per year
- Energy penalty ~ 35 – 50 MW steam, 25 – 30 MW for CO_2 compression
- Retrofit SCR & Wet FGD Required: ~$225 – $300M (required for CO_2 capture equipment)
- Located at AEP's Northeastern Plant Unit 3 or 4 in Oklahoma
- CO_2 for Enhanced Oil Recovery (EOR) or geologic storage

Phase 2 will capture and sequester 1.5 Million metric tons CO2/year

Oxy-coal CO_2 capture & storage project

Demonstration Scale

- 10 MW_e scale
- Teamed with B&W at its Alliance Research Center and 16 other utilities
- Demo completed 3Q 2007
- AEP funding of $50k

Commercial Scale

- Retrofit on existing AEP sub-critical unit (several available)
- 150 – 230 MW_e scale retrofit
- 4,000 – 5,000 tons CO_2 per day
- Teamed with B&W
- AEP funding of ~ $200k – $3M for feasibility study
- Feasibility study completed 2Q 2008

Combustion conversion technology for existing coal fleet -- longer lead time with enhanced viability and long-term potential

FutureGen

$1 Billion, 10-year demo project to create world's first coal based, near-zero emission electricity & hydrogen plant with permanent CO_2 storage

Alliance membership includes AEP, Anglo American, BHP Billiton, China Huaneng, CONSOL, E.ON US, Foundation Coal, Peabody, PPL, Rio Tinto, Southern Company, Xtrata

FutureGen provides promise as next-generation power production facility

CCS issues to address

- **Strategic need for CCS well established; Will drive resolution of implementation issues:**
  - **CO_2 capture issues**
    - Technology (how well it works)
    - Parasitic load
    - Financial impact
  - **CO_2 storage issues**
    - Pipeline network
    - Regulatory jurisdiction
    - Licensing & Permitting
    - Public acceptance
    - Property mineral rights
    - Monitoring & verification protocols
    - Geologic modeling validation & tuning
    - Risk mitigation
    - Life-cycle stewardship

Appendix

AEP's climate position

- AEP supports a reasonable approach to carbon controls in the US
- AEP has taken measurable, voluntary actions to reduce its GHG emissions and will support a well-thought out US mandate to achieve additional, economy-wide reductions
- Climate change is a global issue and AEP supports the US taking a leadership role in developing a new international approach that will address growing emissions from all nations, including developing countries such as India and China
- 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
- Regulatory or economic barriers must be addressed
- Recognition provided for early action/investment made for GHG mitigation
- 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

AEP's climate strategy

- **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, demonstrating voluntary programs can work and setting policy precedents thru CCX**
  - Chicago Climate Exchange (CCX)
  - EPA Climate Leaders
  - EPA SF-6 Emission Reduction Partnership for Electric Power Systems Program
  - Asia-Pacific Partnership
  - DOE 1605B- voluntary reporting of GHGs Program
  - Business Roundtable Climate Resolve
  - Numerous forestry activities
- **Evaluating longer term investment decisions such as new generation and carbon capture and storage (e.g., IGCC, Ultra-supercritical PC)**

AEP must be a leader in addressing climate change

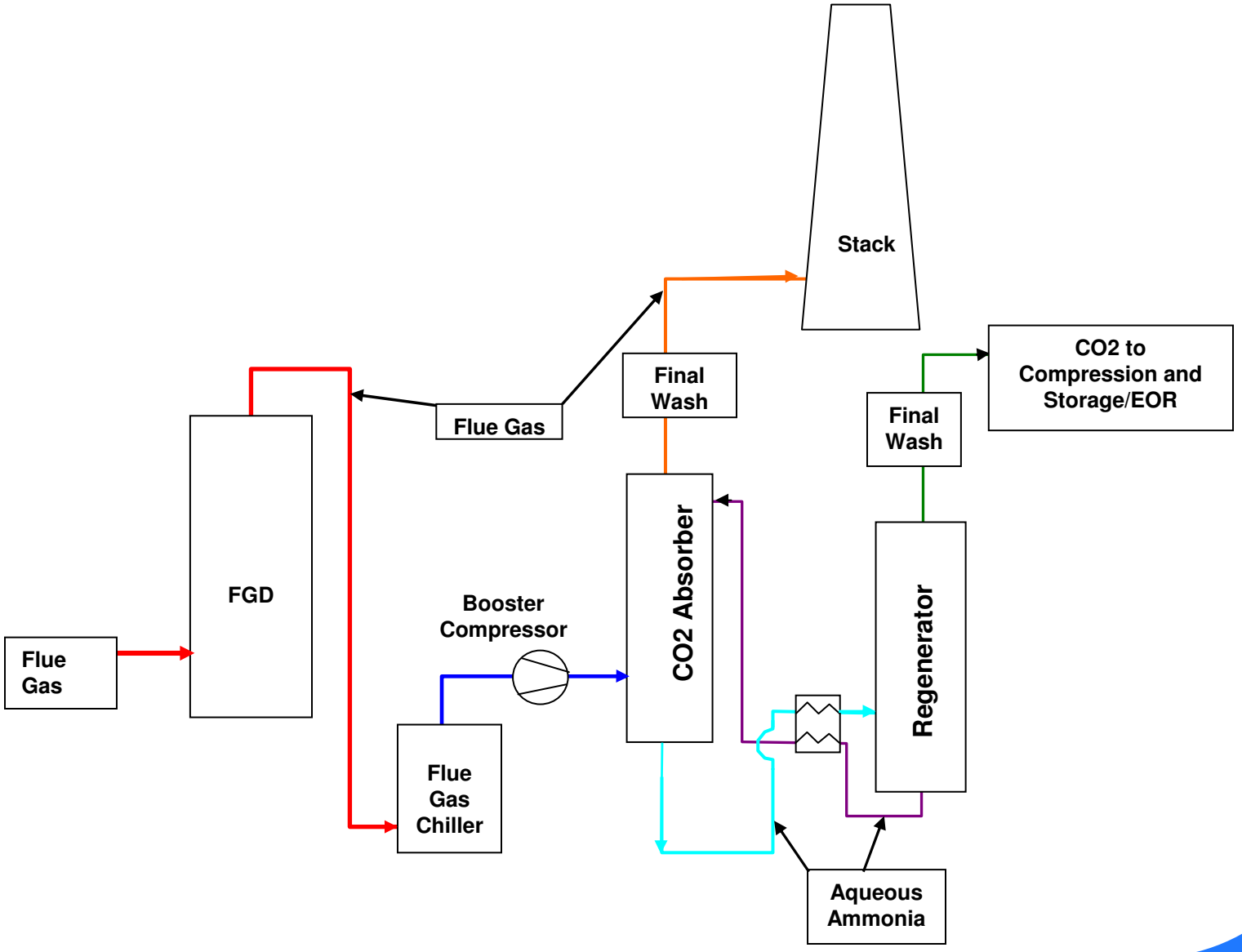
Strategic emission reduction initiatives

- Environmental Retrofit Program
- Power Plant Efficiency Improvements
- Carbon Reduction and Offset Program
- **New Generation Technology**
  - IGCC
  - Ultra-supercritical
  - FutureGen
- **Carbon Capture and Storage**

AEP has a plan to offset the growth of its future CO2 emissions

Chilled ammonia process plant footprint

Schematic of the chilled ammonia process



Oxy-coal technology initiative

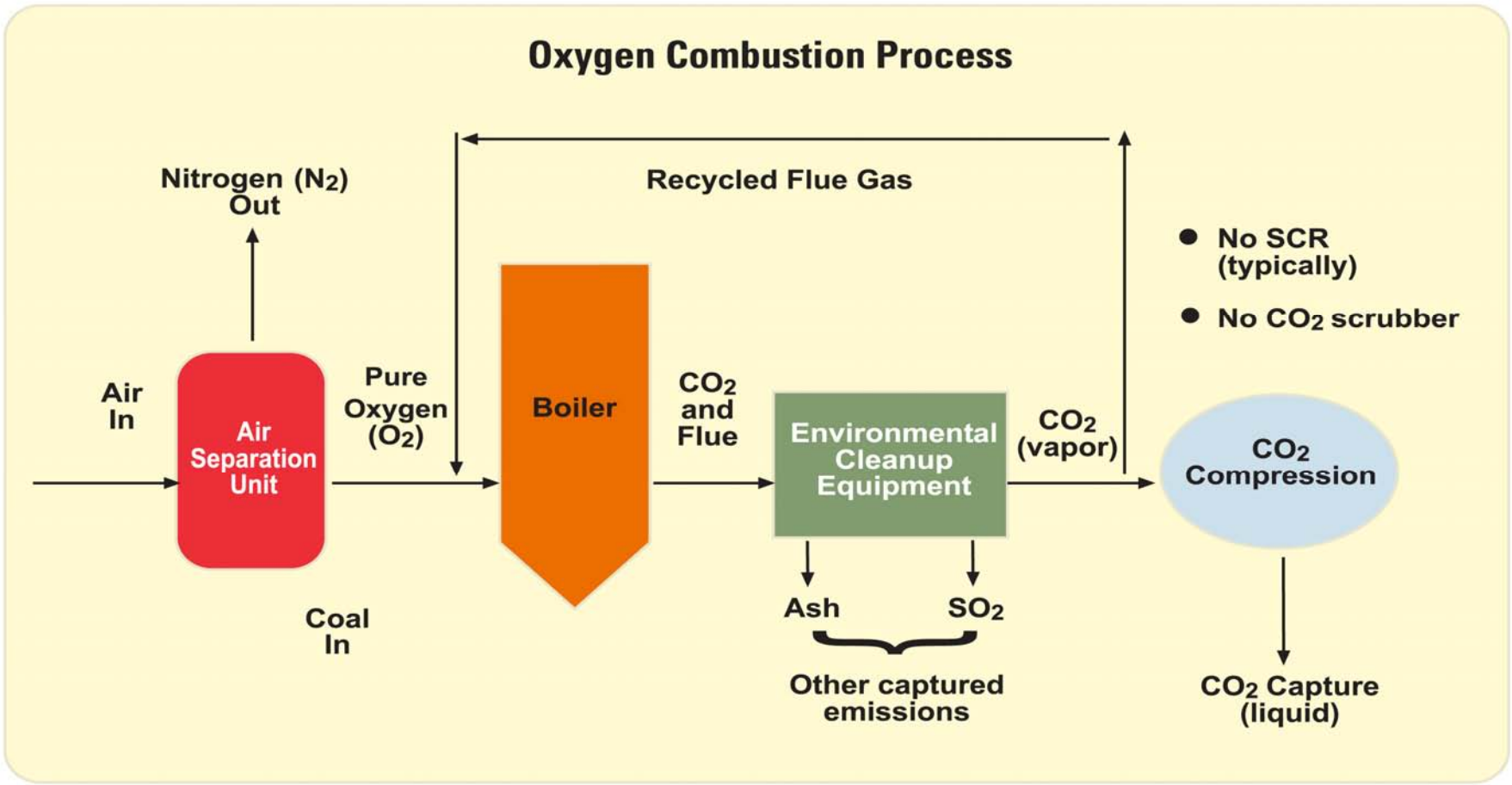


Illustration supplied courtesy of The Babcock & Wilcox Company.

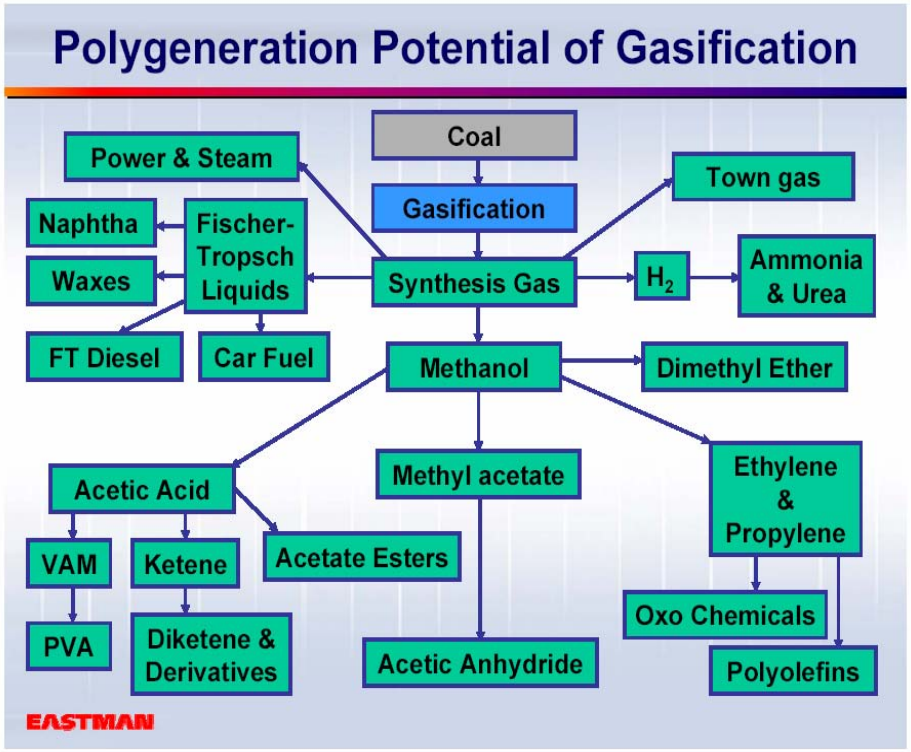
Near-zero emissions using oxy-coal combustion technology

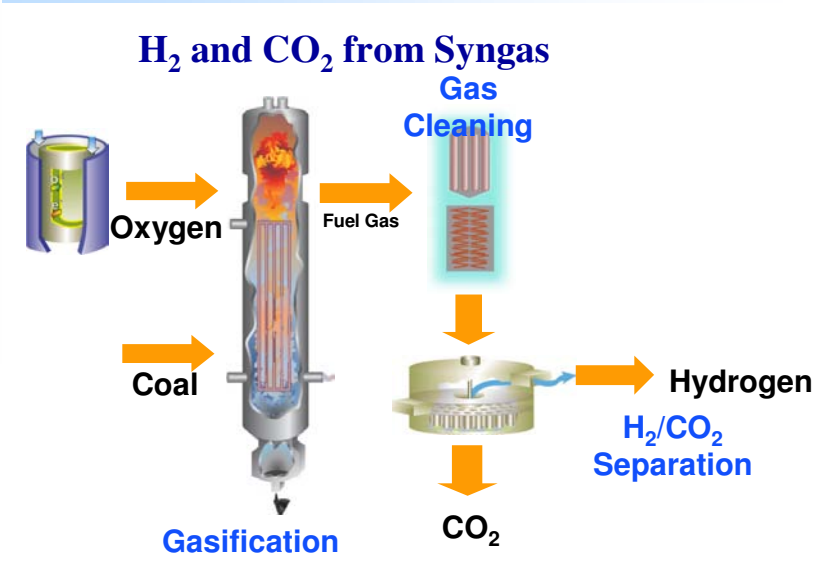
Integrated gasification combined cycle

- IGCC is a clean coal technology that combines two technologies – coal gasification and combined cycle -- to offer the benefits of a low cost fuel with superior thermal and environmental performance.
- The IGCC process uses a gasifier where coals or other carbon containing fuel react with pure oxygen to form what is commonly called synthesis gas, or "syngas". Syngas is a mixture of carbon monoxide, carbon dioxide, hydrogen sulfide, and hydrogen. This syngas then is cleaned to remove the particulate and sulfur compounds. The sulfur compounds are converted to elemental sulfur or sulfuric acid, and ash is converted into glassy slag. Mercury is removed in a bed of activated carbon.
- Coal gasification allows the removal of contaminants before the coal gas is combusted, as opposed to installing costly controls that capture emissions from the exhaust gas stream. The process is more efficient and results in lower emissions of NOx, SO2 , mercury and CO2. Carbon dioxide capture is also expected to be more cost effective from an IGCC plant than from pulverized coal plants.
- Combined-cycle plants generate electricity more efficiently than do conventional coal fired plants. A typical IGCC plant employs one or more gas turbines, a heat recovery steam generator (HRSG) and a steam turbine. The syngas is fired in a gas turbine. The hot exhaust from the gas turbine passes to the HRSG, which produces steam that drives a steam turbine. Power is produced from both the gas and steam turbines.
- One of the advantages of an IGCC plant is fuel flexibility, particularly the ability to use higher-sulfur coals while maintaining low sulfur emissions. The selected technology is well suited to the higher BTU coals, such as bituminous Appalachian coals readily available in AEP's eastern service territory.
- AEP is currently working with a technology provider to develop a firm price for an IGCC facility to be built in our eastern service region. AEP intends to seek regulatory recovery approvals in advance of building the plant.

AEP is committed to IGCC technology

IGCC


Polygeneration Potential of Gasification
Coal
Power & Steam
Gasification
Town gas
Naphtha
Fischer-Tropsch Liquids
Waxes
Synthesis Gas
H_2
Ammonia & Urea
FT Diesel
Car Fuel
Methanol
Dimethyl Ether
Acetic Acid
Methyl acetate
Ethylene & Propylene
VAM
Ketene
Acetate Esters
PVA
Diketene & Derivatives
Acetic Anhydride
Oxo Chemicals
Polyolefins
EASTMAN


H_2 and CO_2 from Syngas
Gas Cleaning
Oxygen
Fuel Gas
Coal
Hydrogen
H_2/CO_2 Separation
Gasification
CO_2

IGCC technology