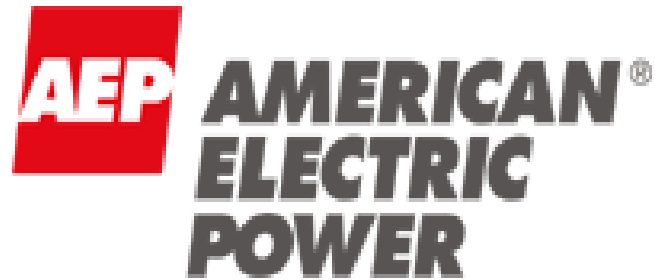


Climate Change and Carbon Capture and Storage (CCS) Technology



Mountaineer Plant - New Haven, WV



Northeastern Plant - Oologah, OK

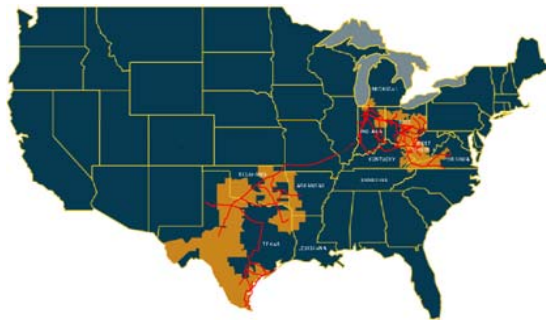
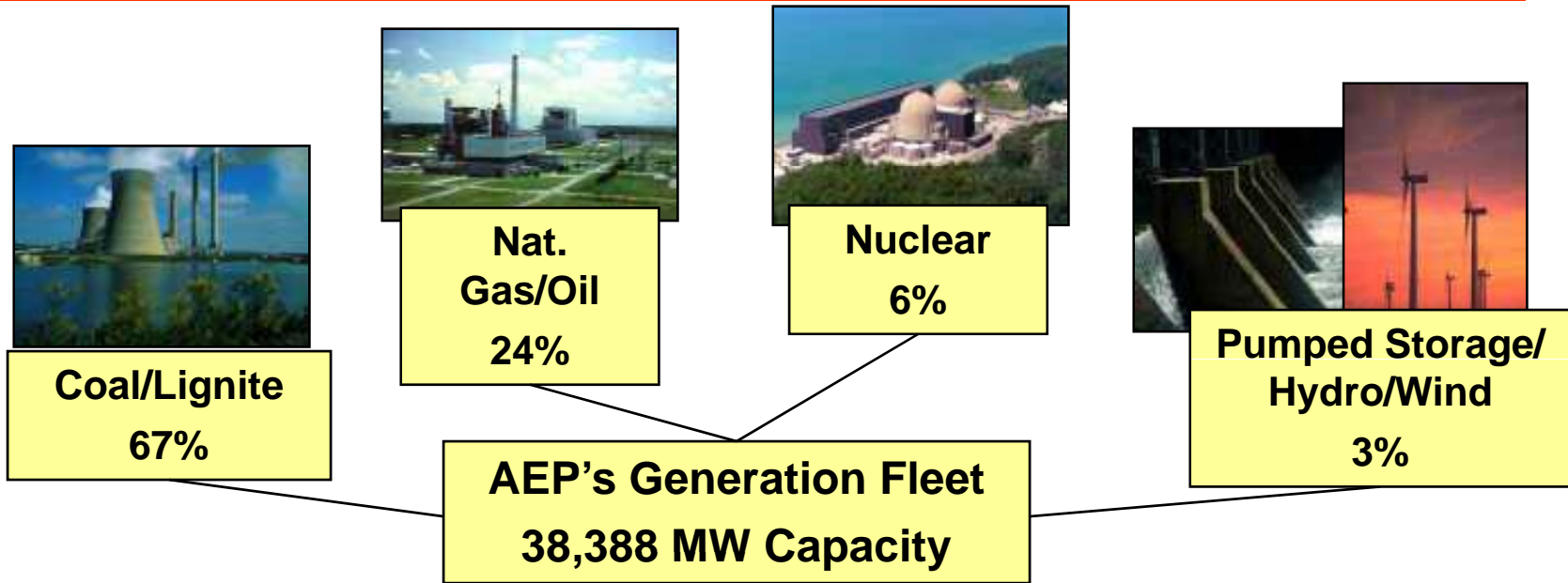
Bruce Braine

Vice President - Strategic Policy Analysis

Expert Workshop on Financing CCS

May 29, 2008

Company Overview



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

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



AEP's Climate Strategy



GLOBAL ROUNDTABLE
ON CLIMATE CHANGE



- Being proactive and engaged in the development of climate policy
- Investing in science/technology R&D
- Taking Voluntary action now, making real reductions thru CCX (2003-07: 40 MM Tons reductions); 2011 Voluntary Commitment (additional 5 MM Tons/year reductions).
- Investing in long term technology (e.g., IGCC, Ultra-supercritical PC and CCS)



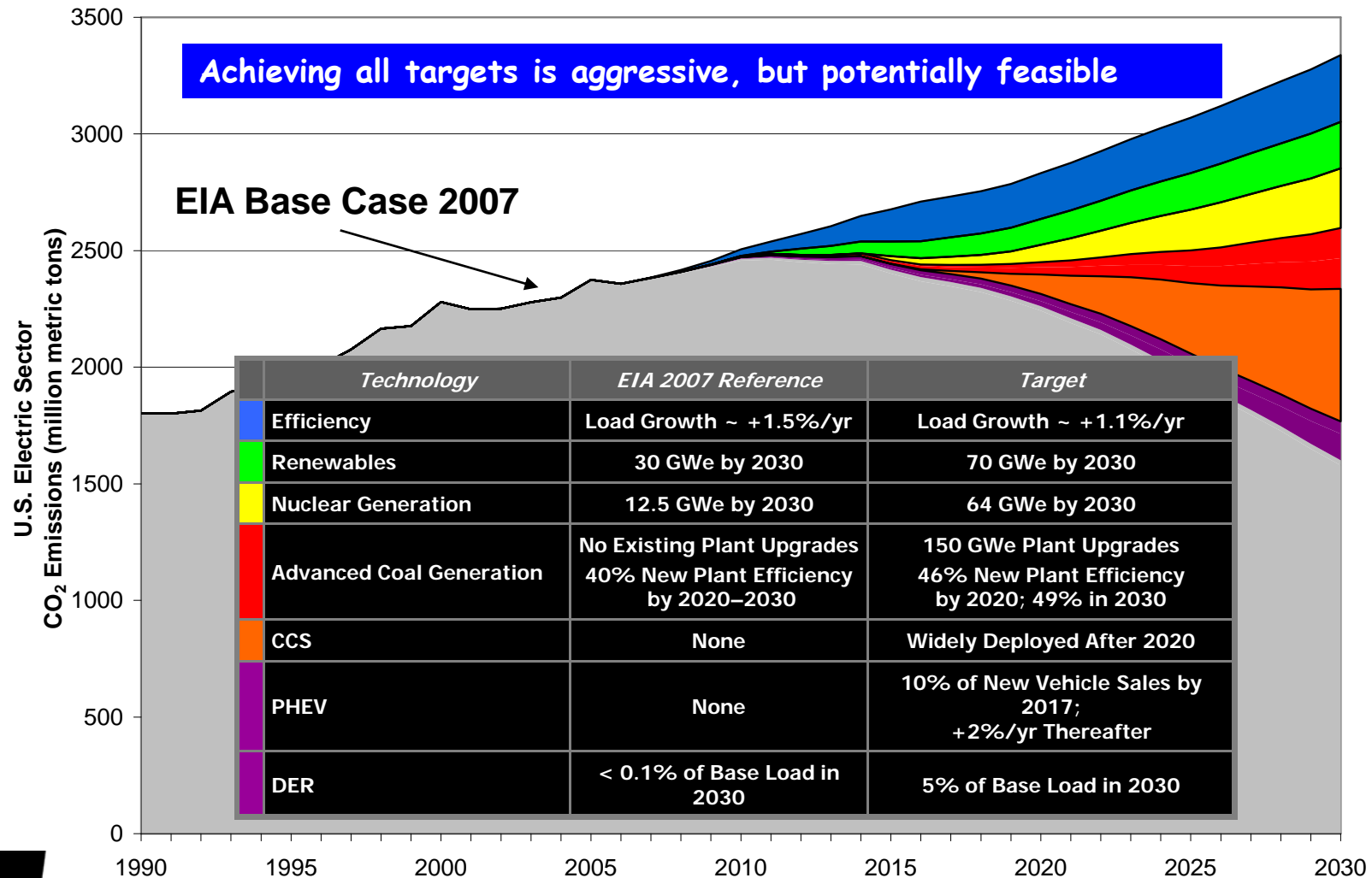
AEP must be a leader in addressing climate change

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.

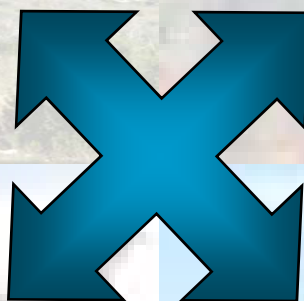
EPRI CO₂ Reduction “Prism”



AEP's Long-Term GHG Reduction Portfolio

Renewables (Biomass
Co-firing, Wind)

Supply and Demand
Side Efficiency



Off-System Reductions
and Market Credits
(forestry, methane, etc.)

Commercial Solutions of
New Generation and
**Carbon Capture &
Storage Technology**



AEP is investing in a portfolio of GHG reduction alternatives

AEP Leadership in New Technology: IGCC and USC

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)



CO₂ Capture Techniques

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

- Relatively low CO₂ concentration in flue gas – Thus difficult to capture
- Amine technologies commercially available in other industrial applications
- **High parasitic demand**
 - Conventional Amine ~30-35%, Chilled Ammonia target ~10-15%
- Amines require **very** clean flue gas, Chilled Ammonia less sensitive to contaminants

Modified-Combustion Capture - *Oxy-Coal*

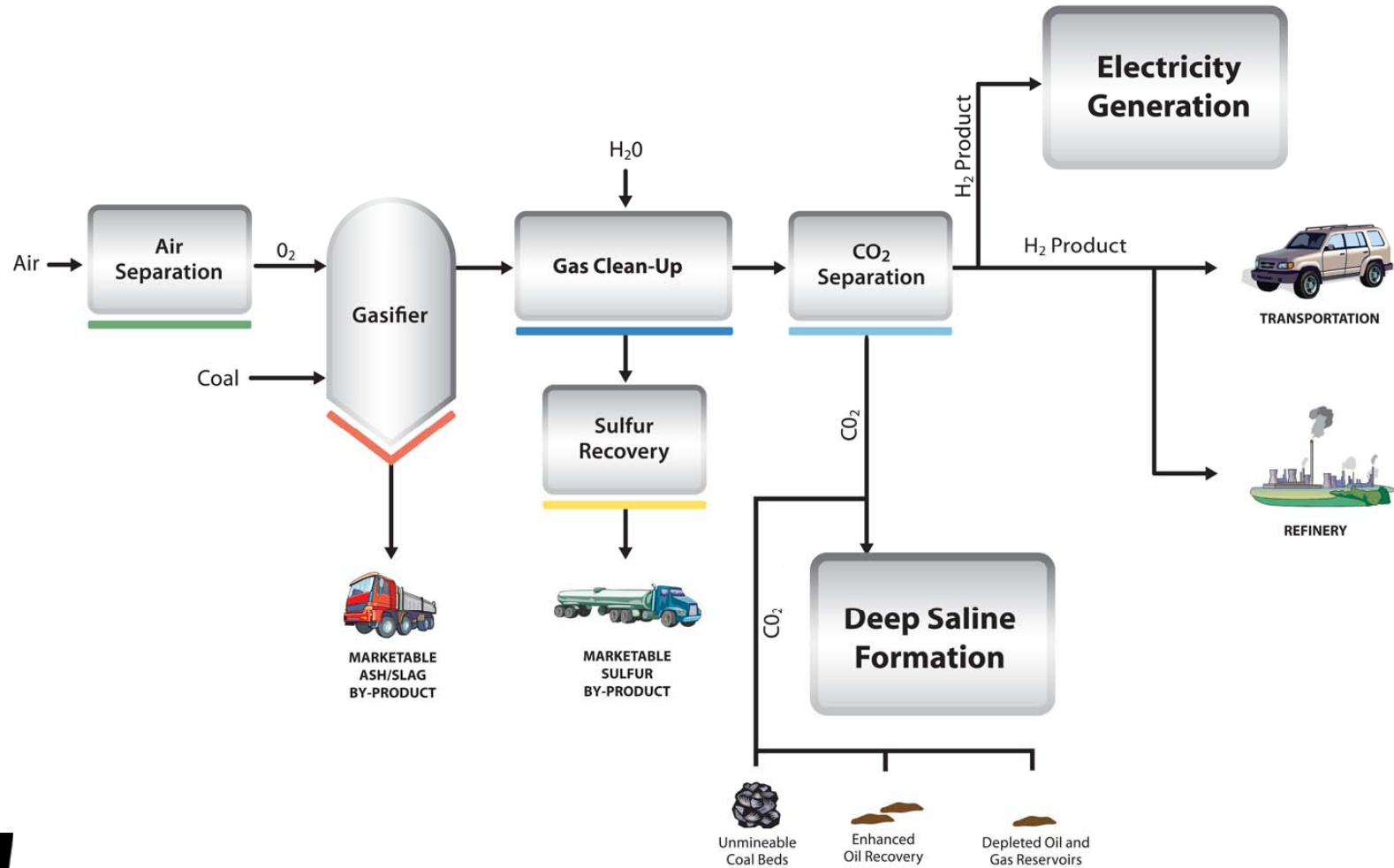
- Technology not yet proven at commercial scale
- Creates stream of very high CO₂ concentration
- High parasitic demand, >25%

Pre-Combustion Capture - *IGCC with Water-Gas Shift*

- 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 (~15-20%) for CO₂ capture - lower than amine or oxy-coal

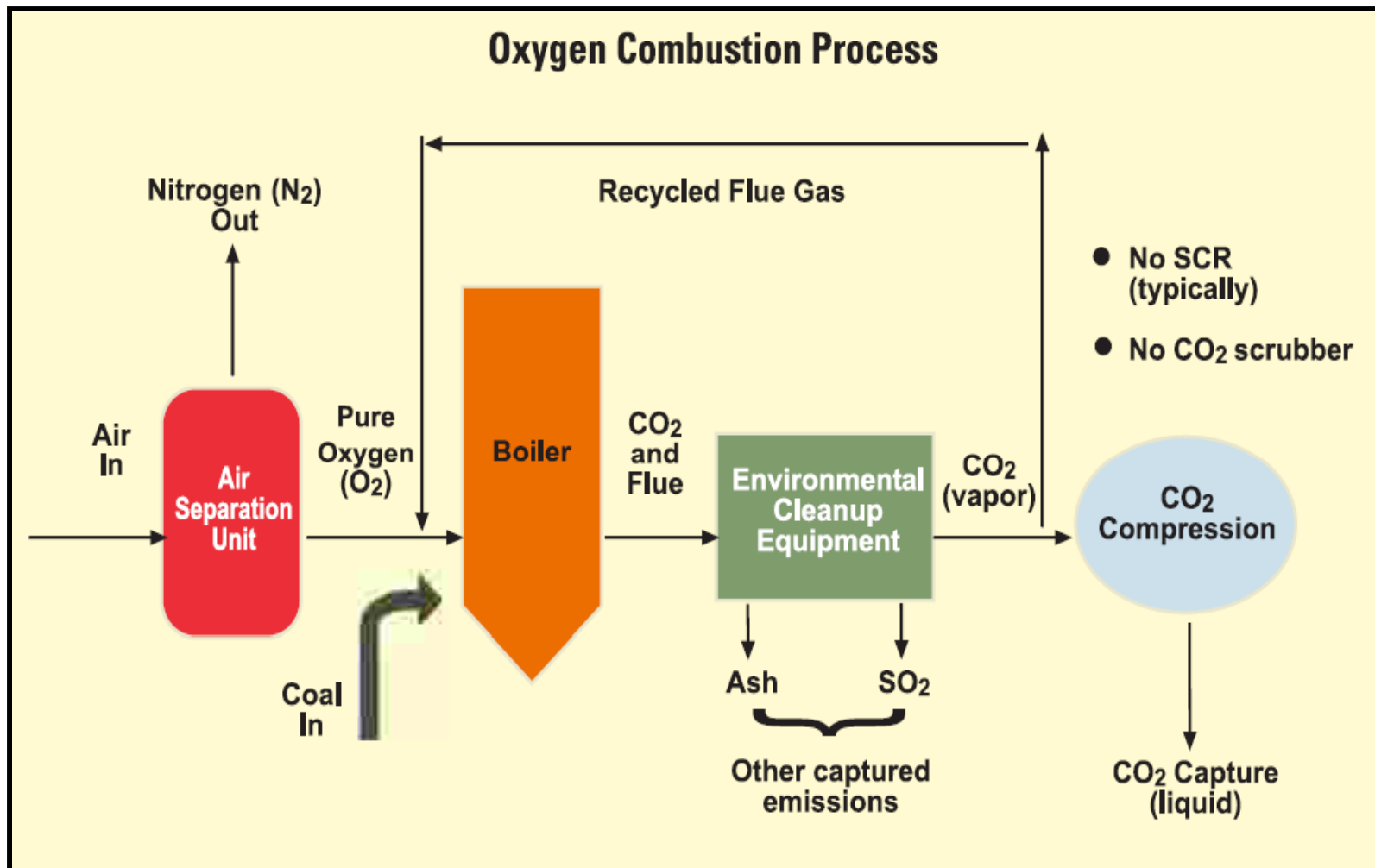
IGCC Water-Gas Shift Process

Pre-Combustion Capture



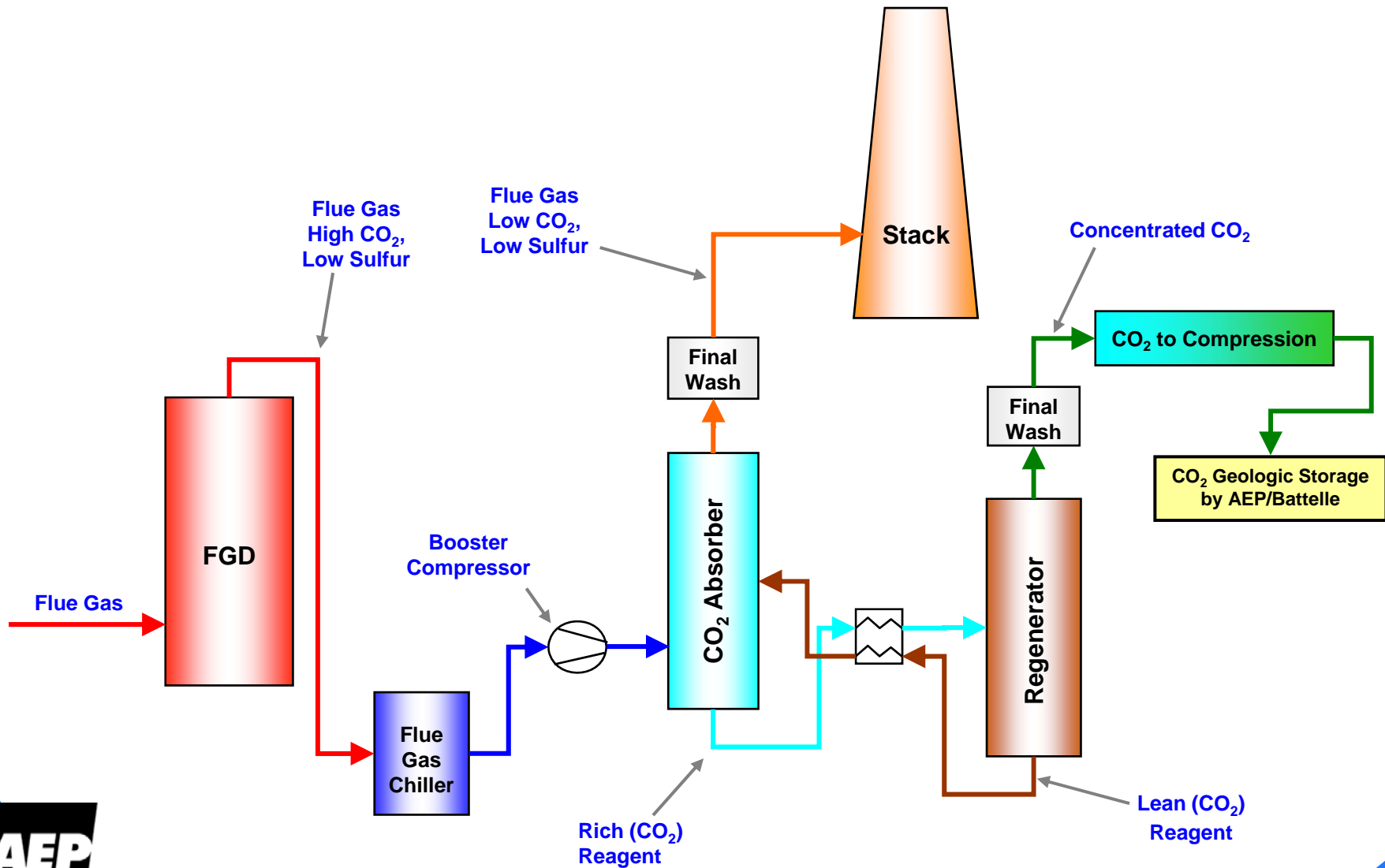
Babcock & Wilcox Oxy-Coal Process

Modified Combustion Capture



Alstom's Chilled Ammonia Process

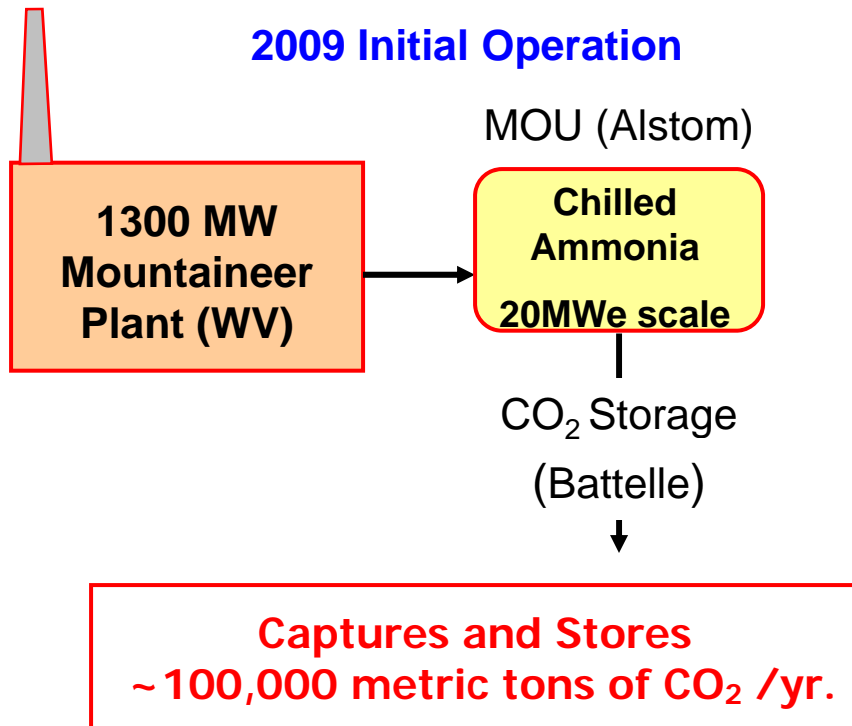
Post-Combustion Capture



AEP Leadership in New Technology: Chilled Ammonia CCS

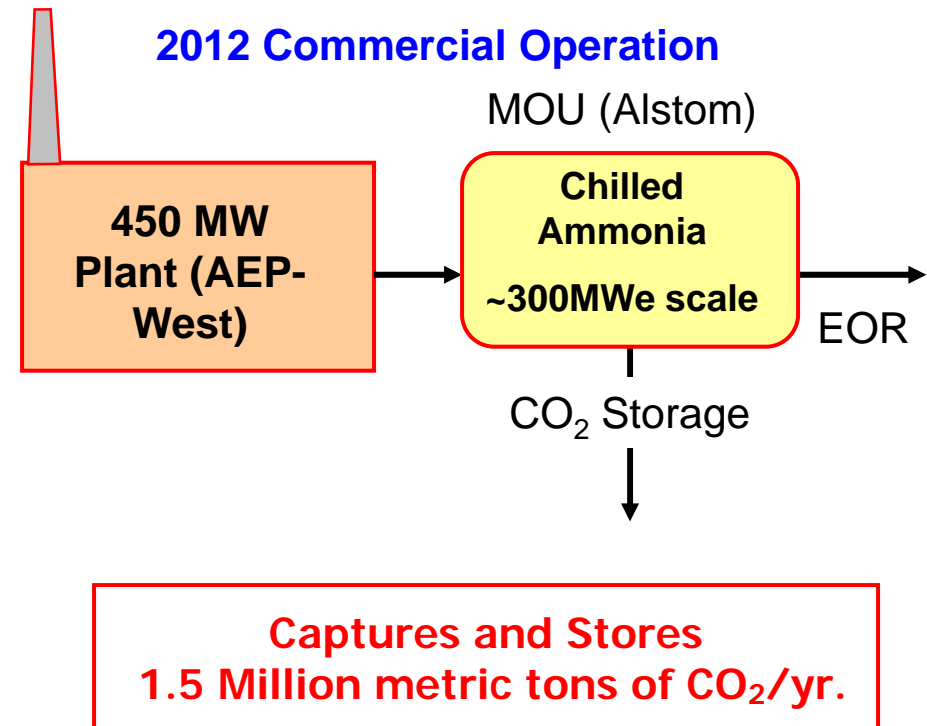
Phase 1

2009 Initial Operation



Phase 2

2012 Commercial Operation



The Challenge: CCS is Expensive

\$50+

\$/ton CO₂e

\$0

- Carbon Capture w/ Geologic Sequestration
- Other renewable, advanced geothermal and/or solar
- Carbon Capture for Enhanced Oil Recovery
- New Biomass Generation
- Dispatch of additional gas vs. inefficient coal
- Biomass Co-firing
- Biological Sequestration (e.g. Forestry)
- New Wind
- Energy Efficiency
- Methane Offsets

Nuclear?

CCS: The Business Case

- CO₂ Legislation Requiring Very Substantial Long Term Reductions is Likely
- A Portfolio of Reduction Options Will Be Needed
- Future Electricity Demand Requires New “Baseload” Power Options (Predominantly Coal and Nuclear)
- Half of Existing Demand is Met By Coal and Early Retirement of Coal is Expensive. Thus, Retrofit CCS becomes essential.

Key Issues for CCS Development

- Overcoming the “Economic” Hurdle—Bonus Allowances and Other Financial Support
- 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