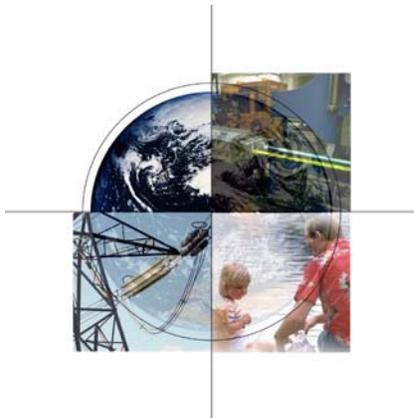


Clean Coal Power Initiative Round 3



**Technical Issues:
CO₂ Capture**

Public Workshop

November 1, 2007

José D. Figueroa, Project Manager
National Energy Technology Laboratory

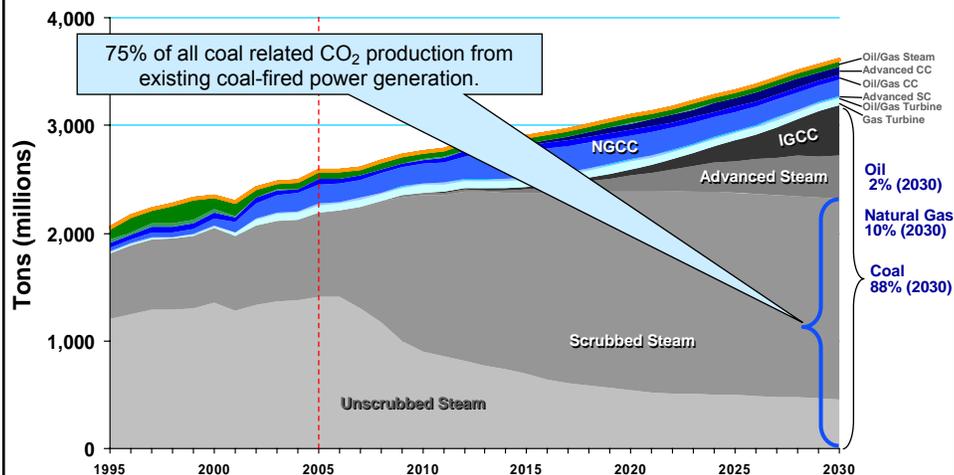


Outline

- U.S. CO₂ Power Generation Emission Forecast
- Clean Coal Power Initiative – Round 3 Program Goals
- Technology Pathways
 - Technical Challenges
 - SOA Capture Technologies



Domestic Market Outlook:



*Coal Dominates CO₂ Emissions From Fossil Power Generation
As Percent of Coal-fired Generation Grows to 59% (2030)*



Source: J. Figueroa, APPA New Generation Meeting: Carbon Dioxide, Capture & Sequestration, Potential & Issues, In the United States

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Clean Coal Power Initiative – Round 3 Goal

- Accelerate the readiness of advanced coal technologies for commercial deployment, thus ensuring that the United States has clean, reliable, and affordable electricity and power.
- Proposed projects must successfully capture and sequester or put to beneficial reuse:
 - **at least 50% of carbon emissions**
 - **at steady –state conditions**
- Demonstrate at a commercial scale in a commercial setting, technologies that make significant progress toward:
 - 1) 90% CO₂ capture
 - 2) CCS at ≤ 10% increase in COE
 - Scale sufficient to evaluate full impact of CO₂ capture on plant operations, economics and performance.



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Challenges to Carbon Capture and Storage

- Magnitude of emissions
- Scale up
- Economics
- Regulatory framework
- Long-term assurance and acceptance



Focus of CCPI-3:



Laboratory



Technically possible?

CO₂ Capture Scale-up

Economically feasible?

Commercial Power Plant





Statoil/Shell 860 MW NG power plant, Draugen, Norway



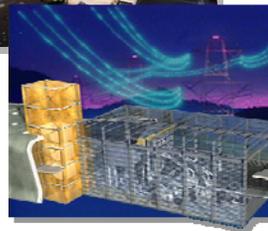
Jon Gibbins, et al., *Capture Ready Fossil Fuel Plants: definitions, technology options, and economics*, 2006. José D. Figueroa / CCPI-3 Pre-Announcement Workshop / November 1, 2007

CO₂ Capture Pathways

Separation and concentration of CO₂ from fuel or flue streams:

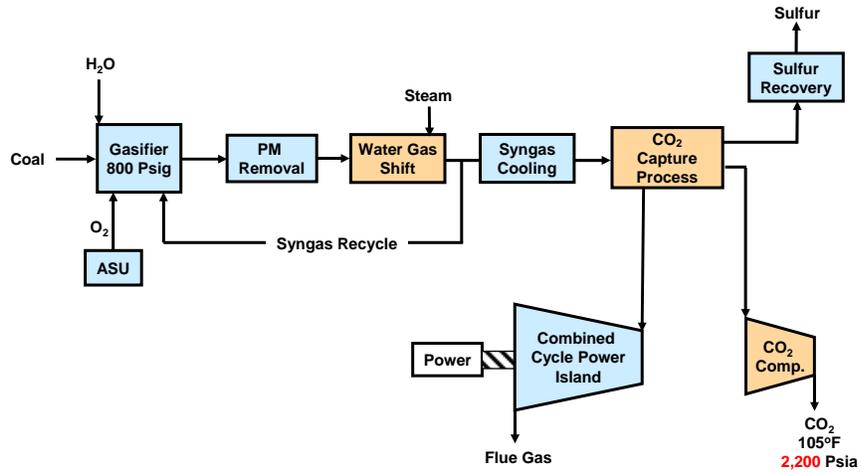
Three general classes of capture technology:

- Pre-combustion (IGCC)
- Post-combustion
- Oxy-firing combustion



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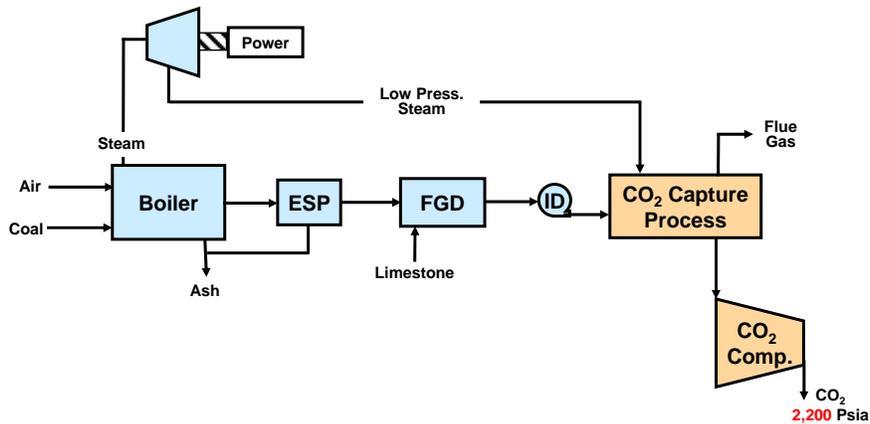
Pre-Combustion Current Technology IGCC Power Plant with CO₂ Scrubbing



Source: Evaluation of Innovative Fossil Fuel Power Plants with CO₂ Removal, DOE/EPRI, 1000316

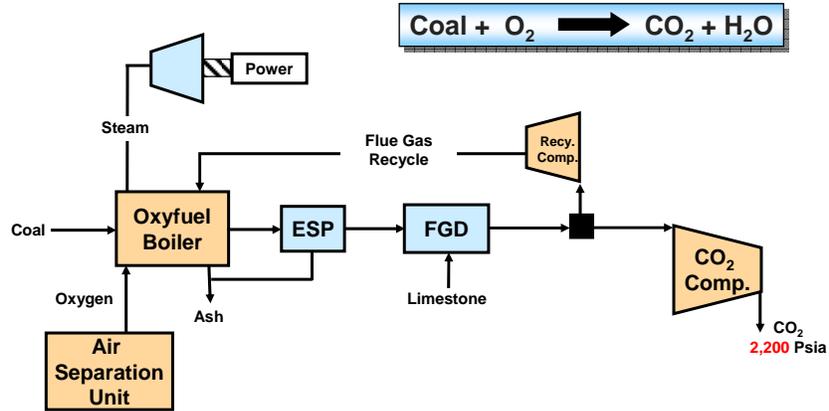
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Post-Combustion Current Technology Pulverized Coal Power Plant with CO₂ Scrubbing



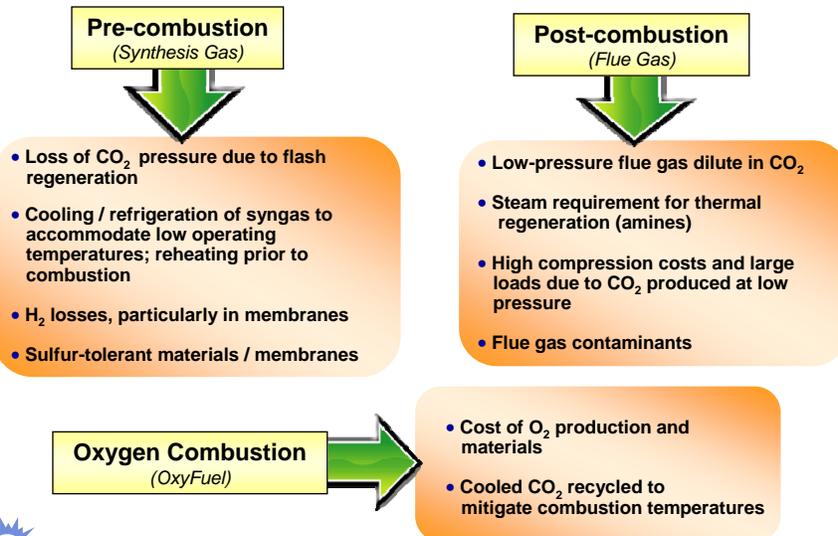
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Pulverized Coal Oxycombustion



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Capture and Separation Technical Challenges



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Why the Need for “Advanced” CO₂ Capture & Separation Technologies

Energy Penalty due to CO ₂ Capture	10%	20%	30%	40%
Target Market, GW	184	184	184	184
Fleet CO ₂ Reduction, %	50.2	49.2	47.9	46.3
New Capacity Req'd, GW	25.5	57.5	98.5	153.3
Additional Coal Req'd., tons x 10 ³	79,940	179,864	308,338	479,637
Cost of New Capacity, MM\$	45,975	103,444	177,332	275,850
Cost of CO ₂ Retrofits, MM\$	91,950	91,950	91,950	91,950
Total New Cost, MM\$	137,925	195,394	269,282	367,800

- 90% Capture rate for existing and new capacity power required.

Current Energy Penalty of
CO₂ SOA Capture System



Source: Figueroa, José D., APPA New Generation Meeting: Carbon Dioxide Capture and Sequestration Potential and Issues; http://www.netl.doe.gov/technologies/carbon_seq/refshelf/presentations/APPANewGenerationMeetingFinal.zip

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For Additional Information

The screenshot shows the NETL website interface with various sections: ABOUT NETL, KEY ISSUES & MESSAGES, CURRENT RESEARCH, TECHNICAL PAGES, RESEARCH RESULTS, COLLABORATIONS & SERVICES, CAREERS & PRESS COVERAGE, NETWORK, and CONTACT NETL. The main content area features a headline about advanced coal technologies and a sidebar with 'NEWS & FEATURES' and 'EVENTS CALENDAR'.

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