November 2003

IGCC Financing Project

William G. Rosenberg
79 John F. Kennedy Street
Center for Business & Government
Belfer Center for Science & International Affairs
Harvard University
W: 617.495.0834 M: 919.601.0563
William_Rosenberg@ksg.harvard.edu

Sponsors:

--National Energy Technology Laboratory
U.S. Department of Energy

--Clean Air Markets Division
U.S. Environmental Protection Agency

--National Commission on Energy Policy

--Center for Clean Air Policy

Project Contacts:

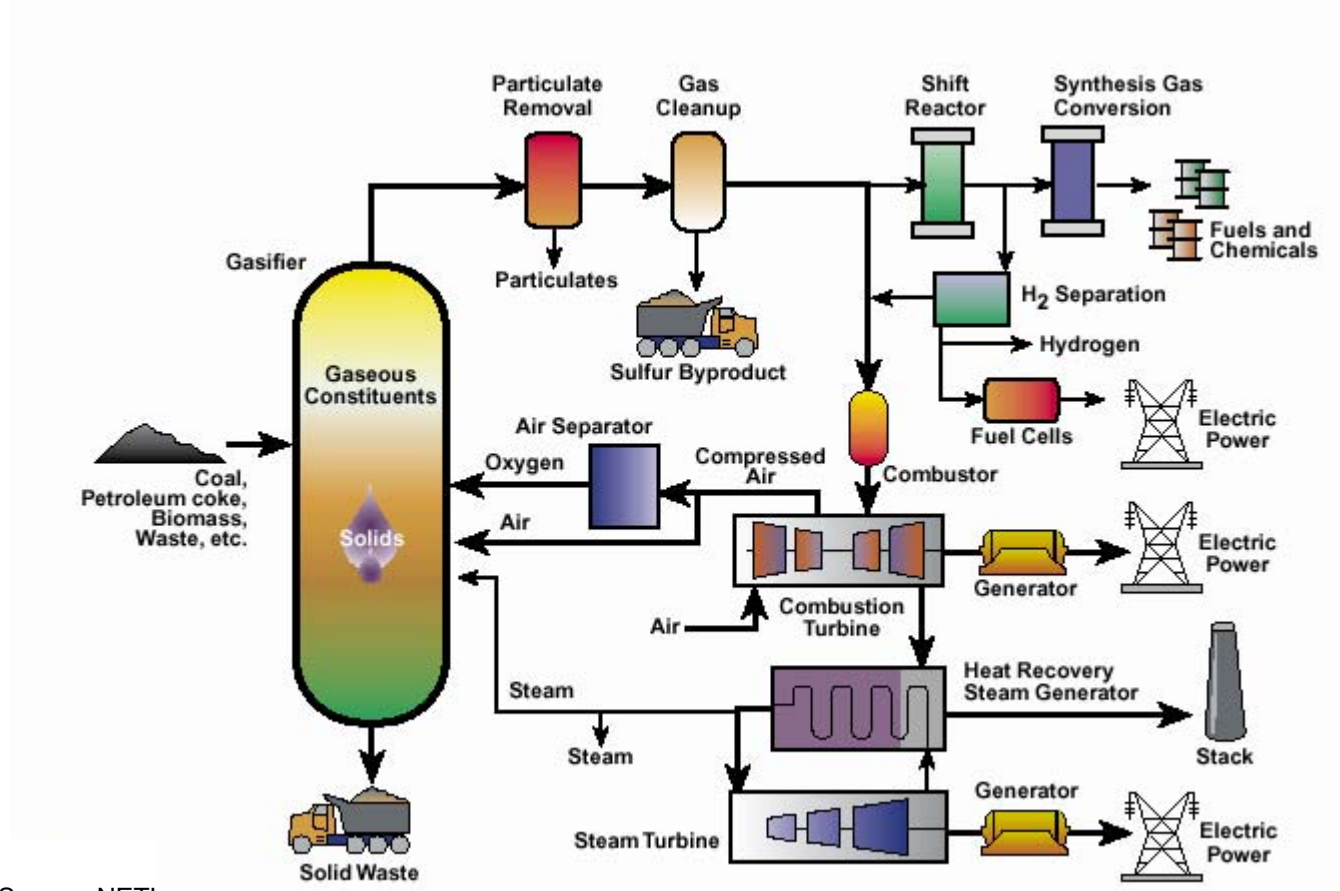
Michael R. Walker
Research Coordinator
Economic & Technical Issues
Phone: (720) 842-5345
Fax: (720) 851-5784
mwalker@e3ventures.com

Dwight C. Alpern
Research Coordinator
Legal & Regulatory Issues
Phone: (202) 564-9151
Fax: (202) 565-2141
Alpern.Dwight@epa.gov

Introduction

- **WHY IGCC** technology should be deployed now to tap vast U.S. coal reserves in an environmental sustainable manner.
- **WHAT CHALLENGES** confront IGCC financing and economics.
- **HOW 3PARTY COVENANT** attracts debt and equity investors to finance IGCC coal plants that generate electricity at cost competitive with (or less than) new PC and NGCC plants.
- **WHETHER CONCENSUS** to support 3Party Covenant, among coal producers, environmentalists, utilities, state and federal energy, utility, and environmental agencies, can develop.

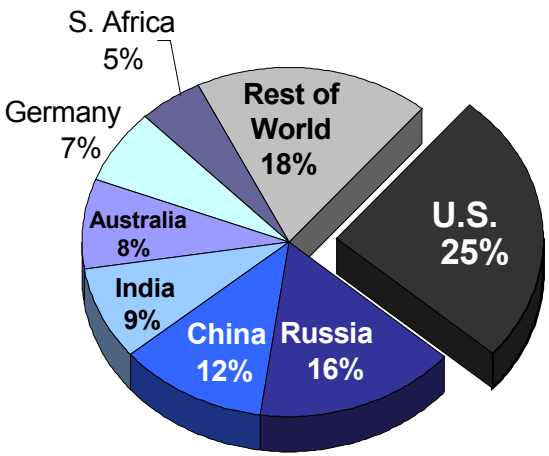
Integrated Gasification Combined Cycle (IGCC)



Source: NETL.

Coal Use Supports Energy Security

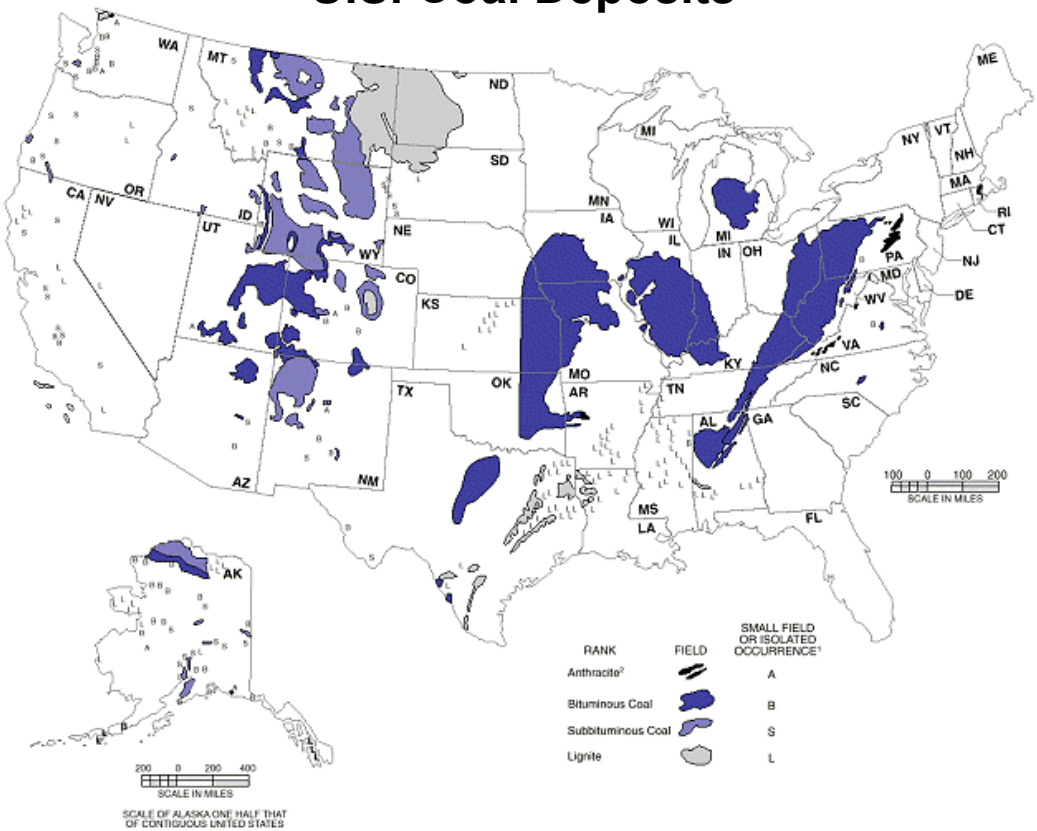
World Coal Reserves



1,083 billion tons

Source: EIA International Energy Annual 2001.

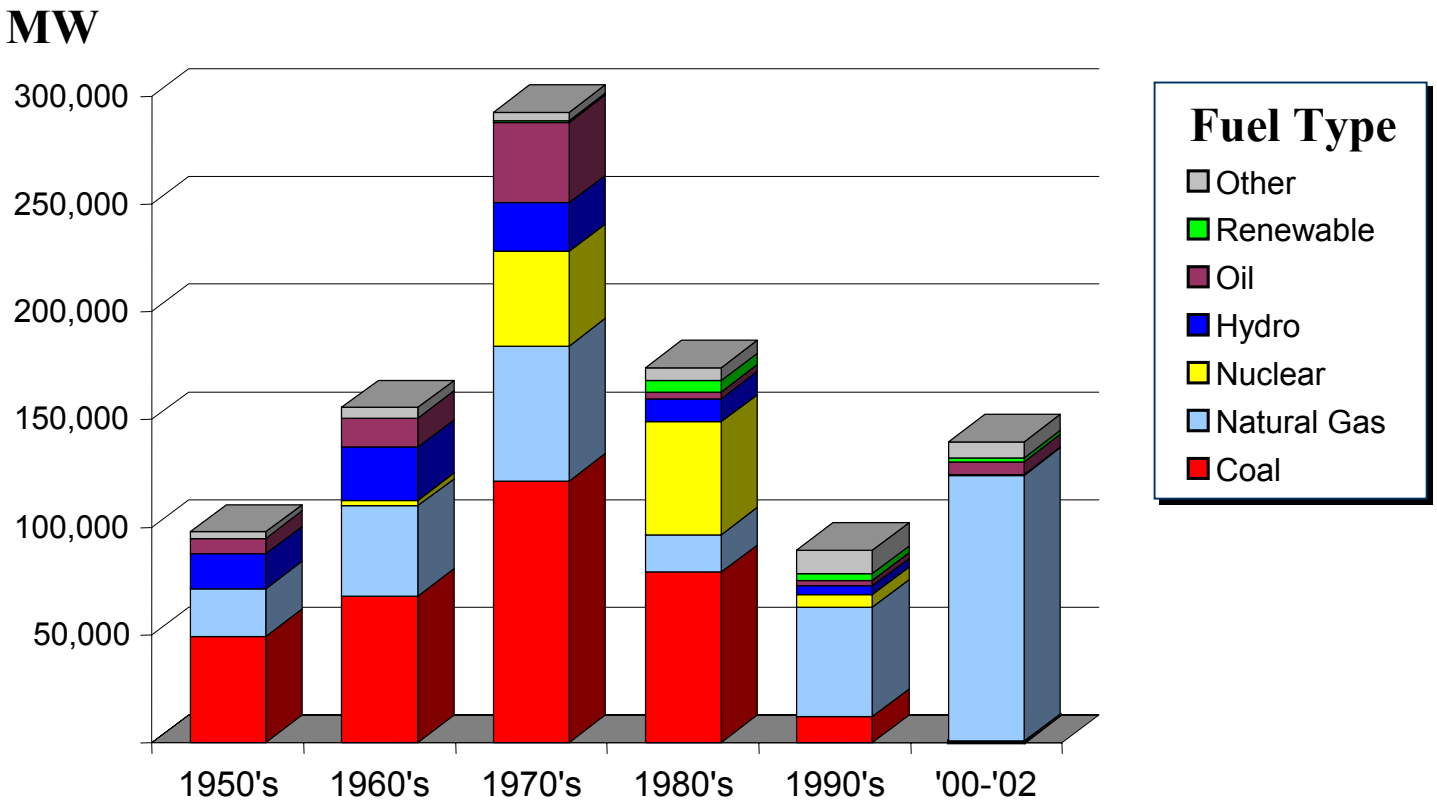
U.S. Coal Deposits



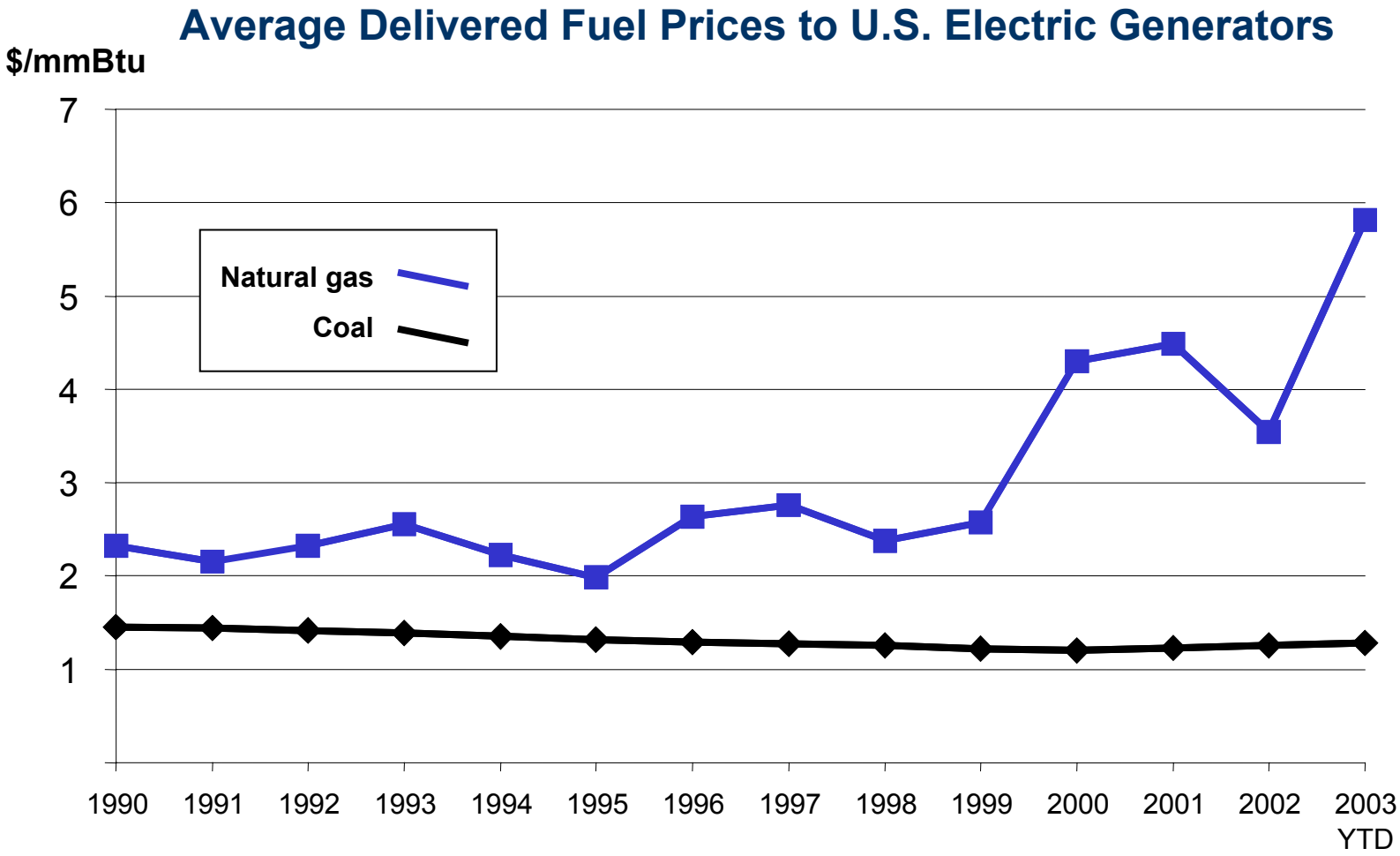
Source: EIA; http://www.eia.doe.gov/cneaf/coal/reserves/chapter1.html#chapter1a.html

New Coal Plants have not Been Built

U.S. Electric Generation Capacity Additions



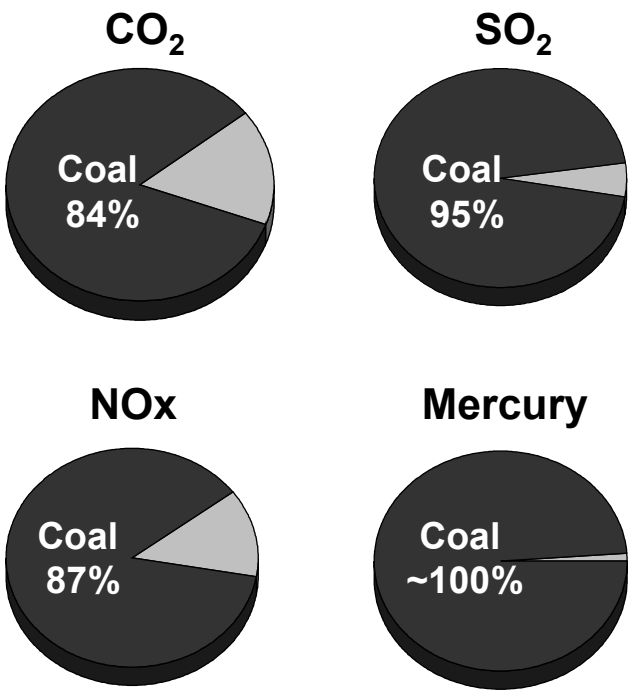
Natural Gas Price Volatility is a Problem



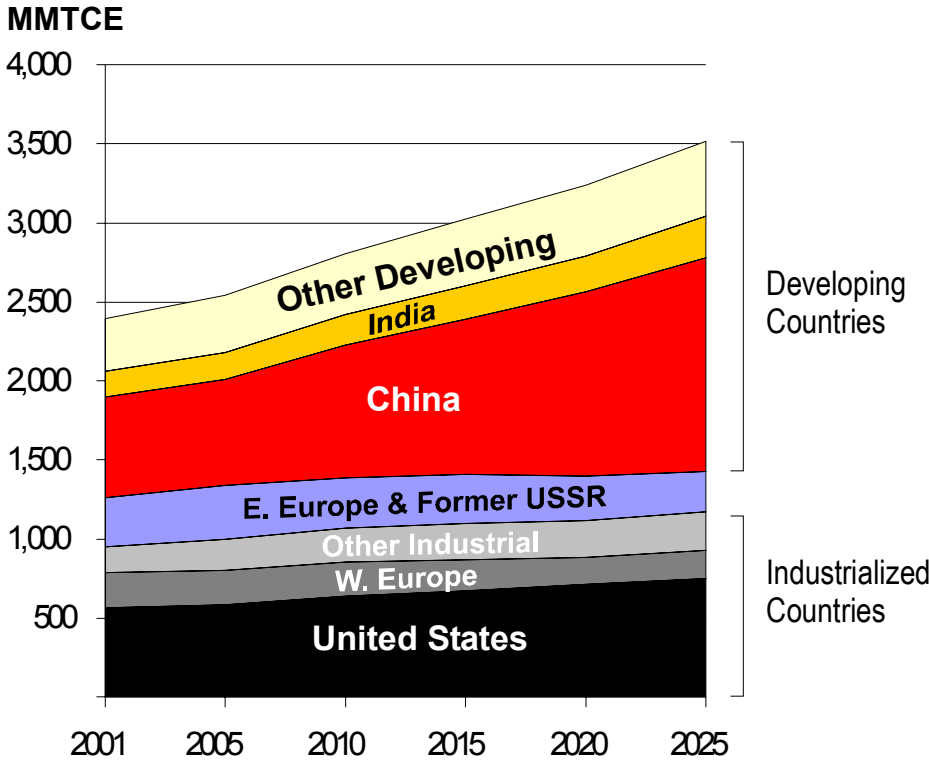
Sources: 1990-2001, EIA, Electric Power Annual 2001, March 2003.
2002-2003, EIA, Electric Power Monthly, September 2003.

Coal Plant Emissions must be Addressed

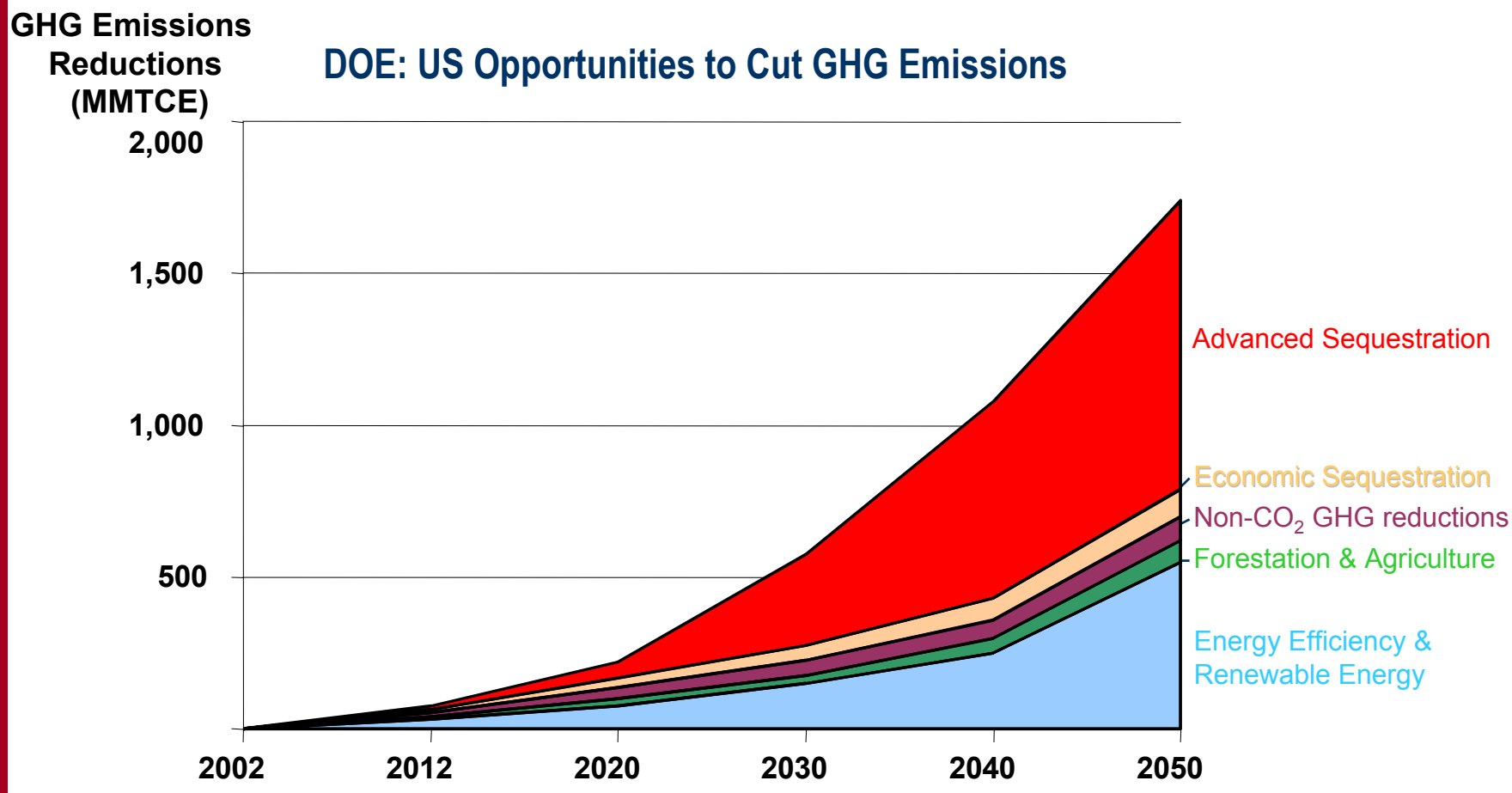
Percent of U.S. Electric Industry Emissions from Coal



Projected Worldwide CO_2 Emissions



Sequestration to Reduce GHG Emissions



Political Consensus

Bush Administration

"The budget proposes to increase funding on research activities for a new type of coal power plant that uses coal gasification to increase efficiency and reduce emissions…These are activities that have the potential to produce public benefits, such as reduced emissions, where industry has little incentive to invest to achieve these results." (Department of Energy Budget Proposal, November 2003)

Department of Energy

"It is the intent of the DOE to foster the commercialization of gasification systems so that the environmental and efficiency advantages offered by gasification become broadly available and gasification becomes the economic choice for power and energy projects."
(DOE Gasification Mission, http://www.netl.doe.gov/coalpower/gasification/adv-gas/description.html)

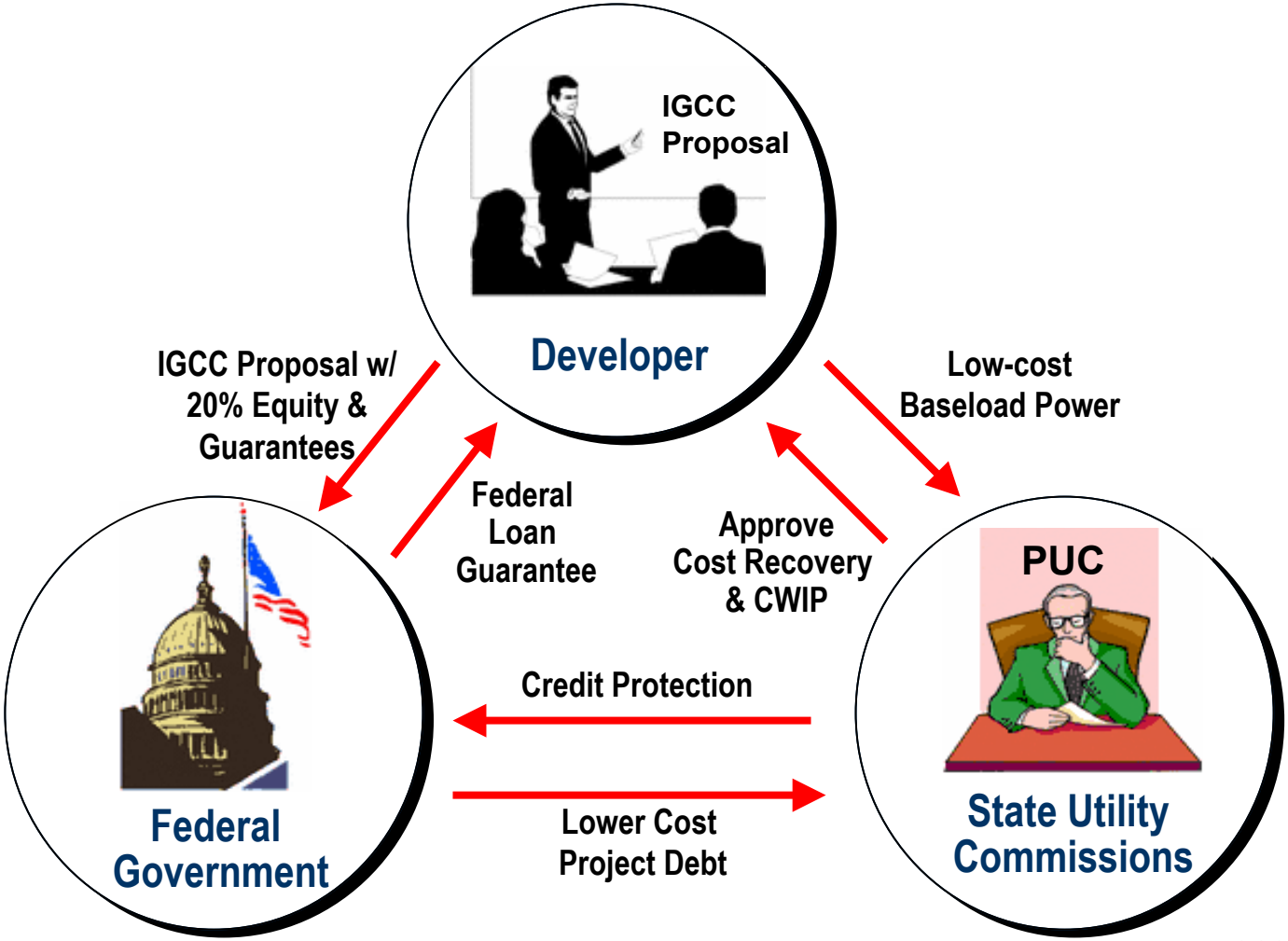
American Electric Power

"It´s important for the economy that coal, a relatively inexpensive fuel, remain a viable part of the nation´s energy mix, along with natural gas, oil, nuclear, hydro and renewables. To accomplish that, we must develop clean-coal technologies." (July 24, 2000 news release, www.aep.com)

Natural Resources Defense Council

"If coal is to continue as a major player in the U.S. and elsewhere for more than a few decades it will only be if technologies like IGCC, that make it feasible to store carbon permanently in geologic formations, are commercially deployed at sufficient scale to buy down their costs to fully competitive levels."
(Testimony of David Hawkins to the Senate Committee on Environment & Public Works, June 12, 2002)

3-Party Financing Covenant



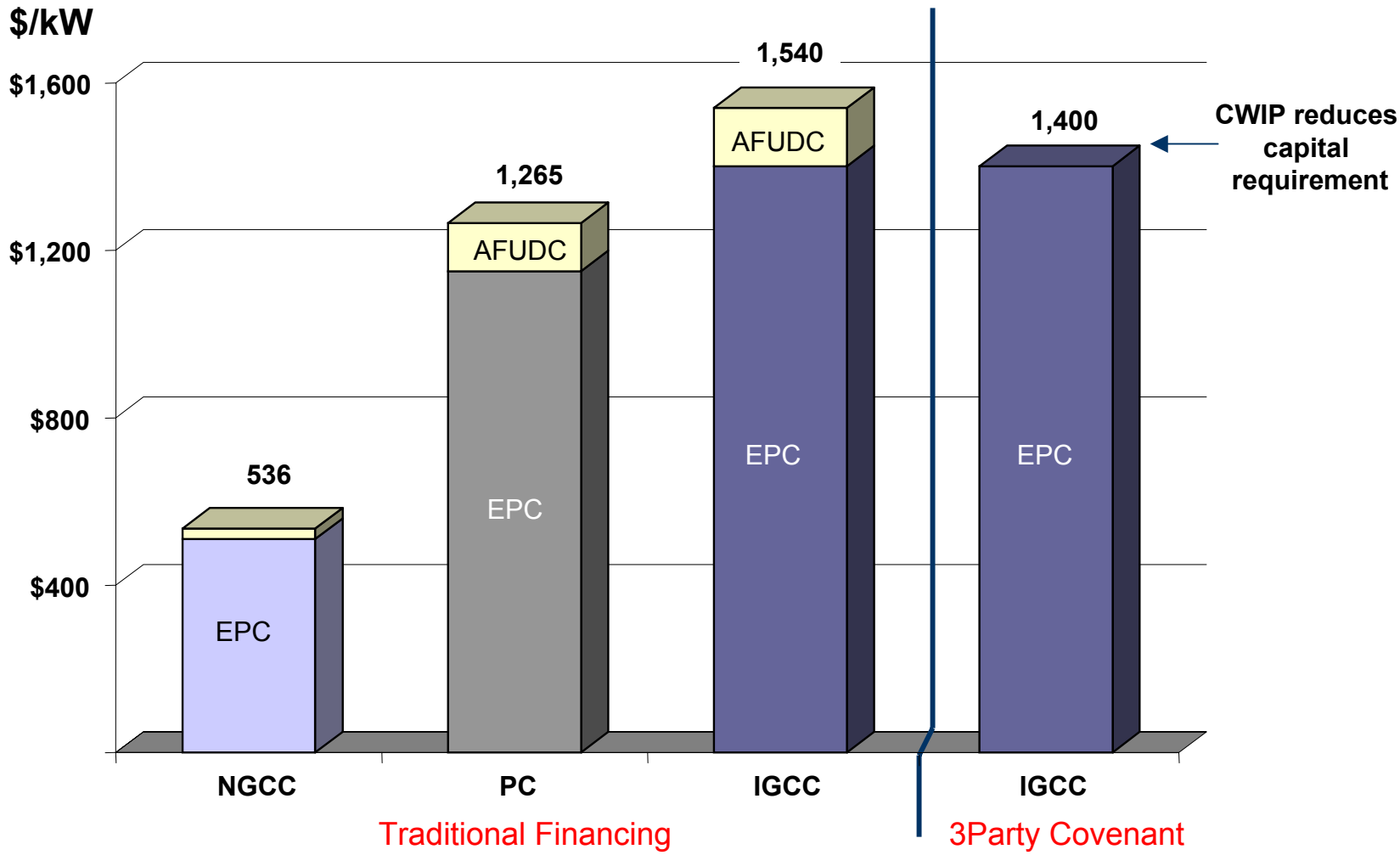
Preliminary Economic Analysis

- Objective is to compare energy costs of IGCC vs. PC and NGCC under different financing assumptions
- Begin with base case economic and operating assumptions for each type of plant
- Establish base case financial structure under merchant and traditional regulated utility financing
- Evaluate how energy costs for IGCC compare after financing structure is changed under 3-Party Covenant

Operating Assumptions

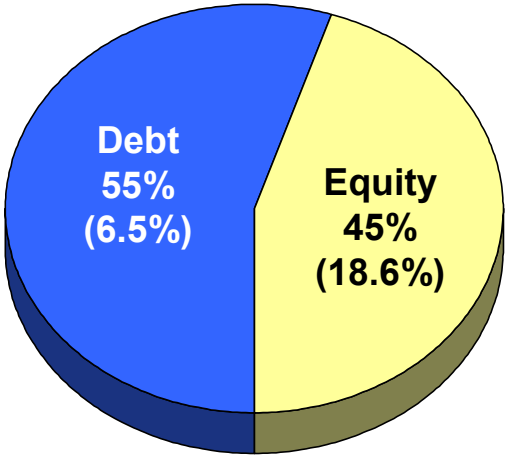
	NGCC	PC	IGCC
Fuel cost ($/mmBtu)	$4.50	$1.24	$1.24
Plant Efficiency	50%	40%	40%
Plant Availability (%)	90%	90%	90%
Plant Capacity Factor (%)	50%	85%	85%
O&M (cent/kWh)	0.25	0.75	0.88
Tax rate (%--federal & state)	38.2%	38.2%	38.2%

Capital Assumptions



Capital Structure

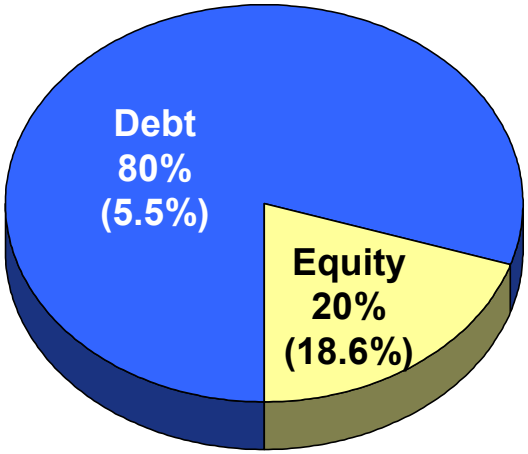
Traditional Financing



Pre-tax weighted cost of capital:

11.9%

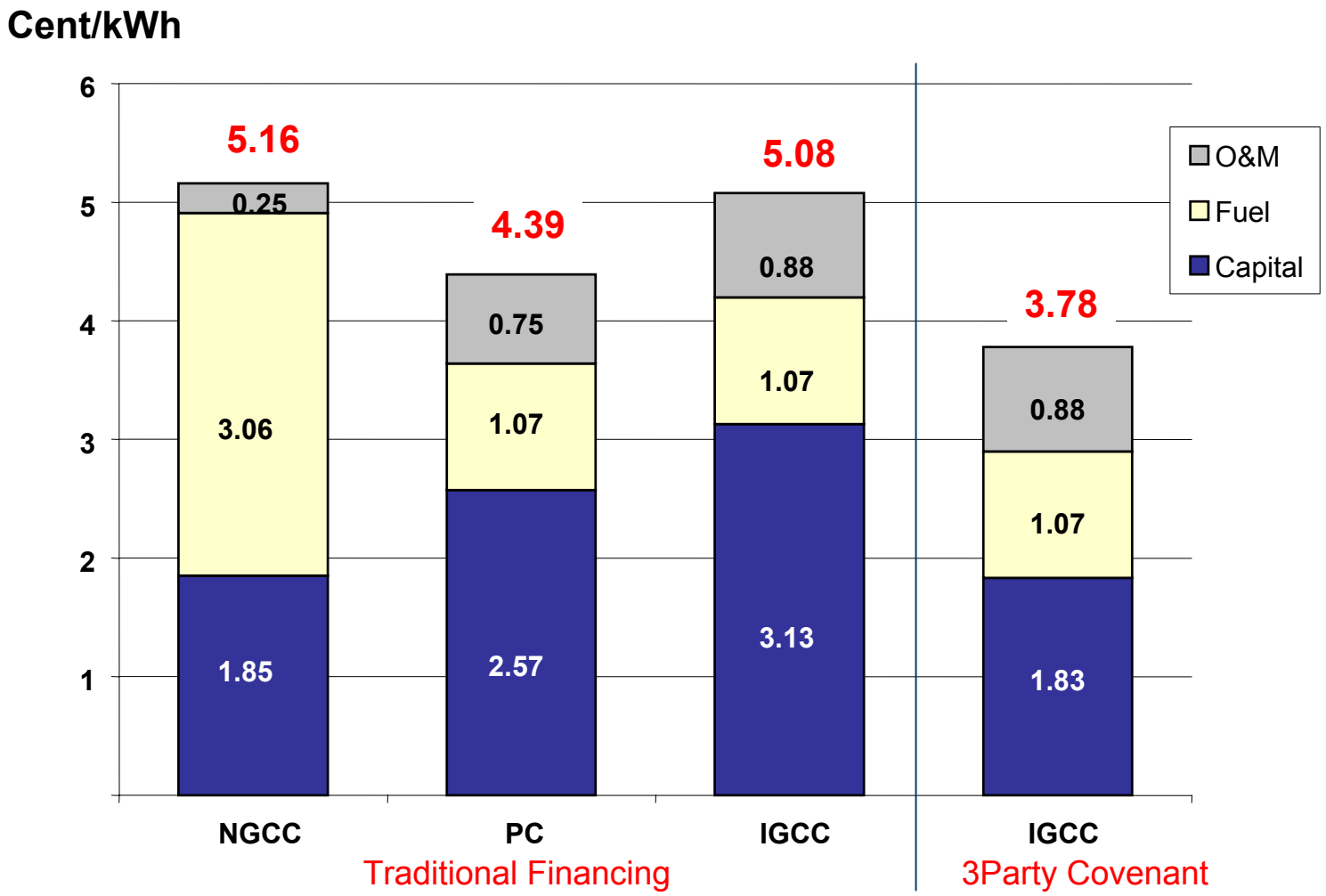
3Party Covenant



Pre-tax weighted cost of capital:

8.1%

Cost of Energy Comparison



Preliminary Economic Analysis

	Deregulated Merchant Plants			Traditional Regulated Utility Financed Plants			3-Party Covenant with Federal Loan Guarantee
	NGCC	Super Critical PC	Dual-train IGCC with extra gasifier	NGCC	Super Critical PC	Dual-train IGCC with extra gasifier	Dual-train IGCC with extra gasifier
Design and Construction							
Plant Size (MW)	500	600	600	500	600	600	600
Total Plant Cost--EPC ($/kW)	$510	$1,150	$1,400	$510	$1,150	$1,400	$1,400
Total Plant Investment -- EPC + AFUDC ($/kW)	$536	$1,265	$1,540	$536	$1,265	$1,540	$1,400
CWIP in Rate base (% of AFDC)	0%	0%	0%	0%	0%	0%	**100%**
Operation							
Fuel cost ($/mmBtu)	$4.50	$1.24	$1.24	$4.50	$1.24	$1.24	$1.24
Plant Heat Rate (Btu/kWh HHV)	6,800	8,600	8,600	6,800	8,600	8,600	8,600
Plant Availability (%)	90%	90%	90%	90%	90%	90%	90%
Plant Capacity Factor (%)	50%	85%	85%	50%	85%	85%	85%
Annual Generation (MWh)	2,190,000	4,467,600	4,467,600	2,190,000	4,467,600	4,467,600	4,467,600
Financing							
Percentage Debt				55%	55%	55%	80%
Debt Interest Rate				6.5%	6.5%	6.5%	5.5%
Percent Equity				45.0%	45.0%	45.0%	20.0%
After tax Equity Return				11.5%	11.5%	11.5%	11.5%
Federal Tax rate				34.0%	34.0%	34.0%	34.0%
State Tax rate				4.2%	4.2%	4.2%	4.2%
Pre-tax Common Equity Return				18.6%	18.6%	18.6%	18.6%
Pre-tax Weighted Avg. Cost of Capital				**11.9%**	**11.9%**	**11.9%**	**8.1%**
Levelized Carrying Charge (% of capital per year)*				**15.1%**	**15.1%**	**15.1%**	**9.8%**
Hurdle Rate	**15.0%**	**15.0%**	**15.0%**				
Estimated Cost of Energy							
O&M (cent/kWh)	0.25	0.75	0.88	0.25	0.75	0.88	0.88
Fuel (cent/kWh)	3.06	1.07	1.07	3.06	1.07	1.07	1.07
Levelized Cost of Capital (cent/kWh)	1.83	2.55	3.10	1.85	2.57	3.13	1.83
Cost of Energy (cent/kWh)	**5.14**	**4.36**	**5.05**	**5.16**	**4.39**	**5.08**	**3.78**

* Calculated with NETL contractor model based on EPRI TAG methodology utilizing straight-line depreciation and assuming a 30-year life.

State PUC Role Under 3Party Covenant

- **State PUC Approval of IGCC Project and of Timely Recovery of Project Costs Protects Federal Loan Guarantee.**

A. Multi-stage State PUC review and approval of project

1. Before construction, State PUC reviews project and issues of certificate of public convenience and necessity.
    a. In issuing certificate, State PUC determines cost of capital for project. Periodically (e.g. annually) State PUC reviews and approves cost of capital.
2. During construction, State PUC conducts on-going (e.g., quarterly), expedited review and approval of incurred project construction costs.
    a. Upon completion of each on-going review, State PUC allows recovery of cost of capital for approved project construction costs for the quarter through an adjustment clause.
    b. Future recovery of approved project construction costs after completion or termination of plant cannot be challenged, except for fraud or concealment.

State PUC Role in 3Party Covenant (cont.)

c. Federally guaranteed loan is coordinated with State PUC on-going review: after State PUC approval, loan becomes available for debt-funded share of approved project construction costs.

3. After plant completion and commencement of operation, State PUC conducts on-going (e.g., quarterly), expedited review and approval of project operating costs.

   a. Upon completion of each on-going review, State PUC allows recovery of project's approved operating costs, depreciation/amortization of approved construction costs, and cost of capital for the quarter through an adjustment clause.

B. State PUC approval of adjustment clause mechanism for recovery of approved project costs

1. In regulated States, State PUC-issued project certificate approves inclusion of adjustment clause mechanism (for recovery of costs under A(2)(a) and (3)(a) above) in retail electric rates.

2. In deregulated States, State PUC-issued project certificate approves inclusion of adjustment clause mechanism (for recovery of costs under A(2)(a) and (3)(a) above) in non-bypassable wires charge for retail electric service.

Conclusion

- 60+% of the cost of building a new coal plant is capital.
- 3-Party Covenant reduces IGCC capital cost 40%, making it cost competitive with PC.
- Federal Legislation is needed to establish 3-Party Covenant loan guarantee program.
- States opt-in to the program and may or may not need to grant additional authorities to their PUC to participate.
- Key to program is State PUC approval of dedicated assured revenue stream to cover amortization, cost of capital and plant operation.
- Broad political support from coal industry, utilities, environmental community and Administration can make this happen.