

# Financing IGCC for Near-Term Deployment

## **William G. Rosenberg**

79 John F. Kennedy Street  
Center for Business & Government  
Belfer Center for Science & International Affairs  
Kennedy School of Government, Harvard University  
W: 617.495.0834 M: 919.601.0563  
wrosenberg@e3ventures.com

### *Project Contacts:*

#### **Michael R. Walker**

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

#### **Dwight C. Alpern**

Legal & Regulatory Issues  
Phone: (202) 343-9151  
Fax: (202) 343-2356  
Alpern.Dwight@epa.gov

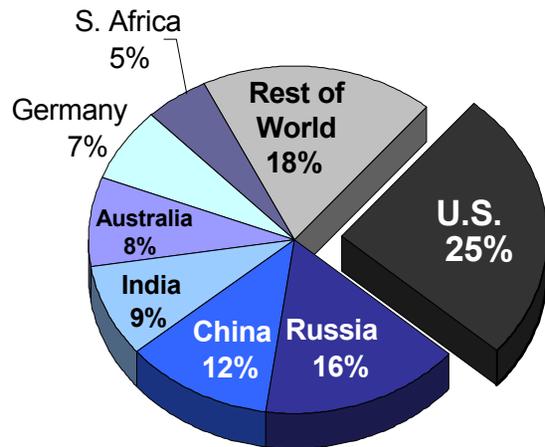
# IGCC Deployment Rationale

## Environmentally superior coal use:

- **Abundant domestic supply**
  - **Energy & national security**
  - **Energy independence**
- **Low cost electricity for economic growth**
- **Relieve natural gas price pressure**
- **Lower air pollutant emissions**
- **Less water consumption and waste**
- **Technical pathway for carbon control**
- **Foundation technology for hydrogen economy**

# U.S. Coal Resource

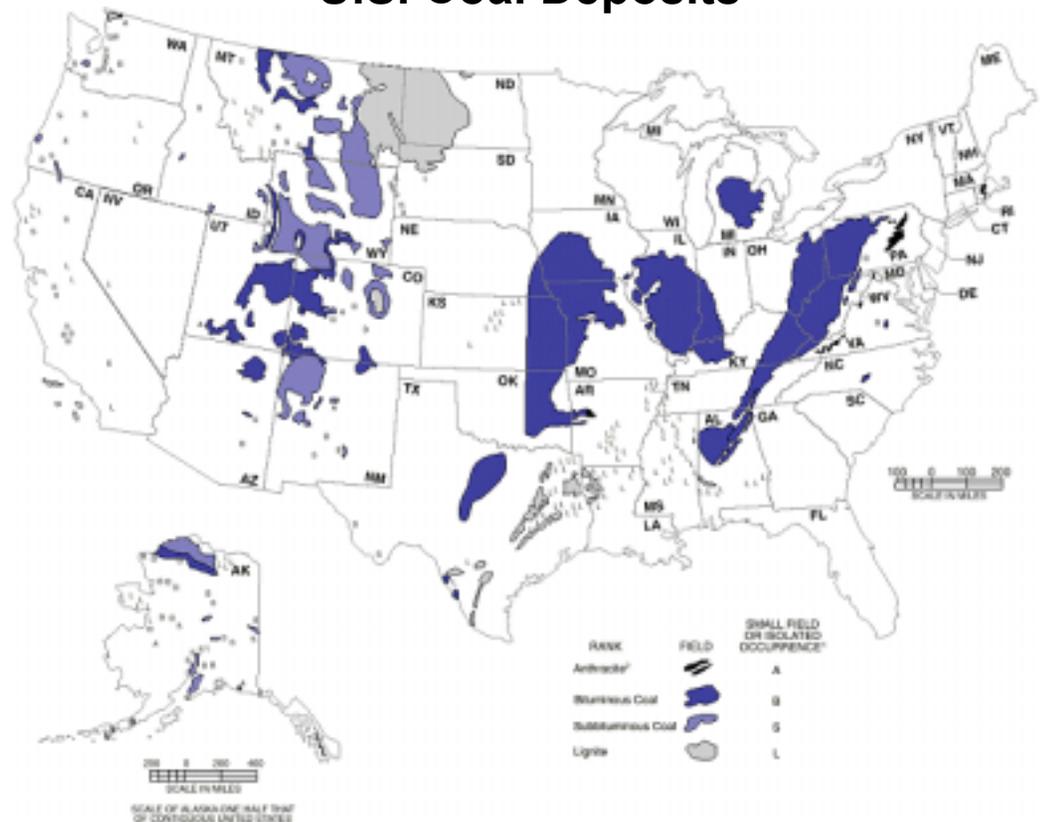
## World Coal Reserves



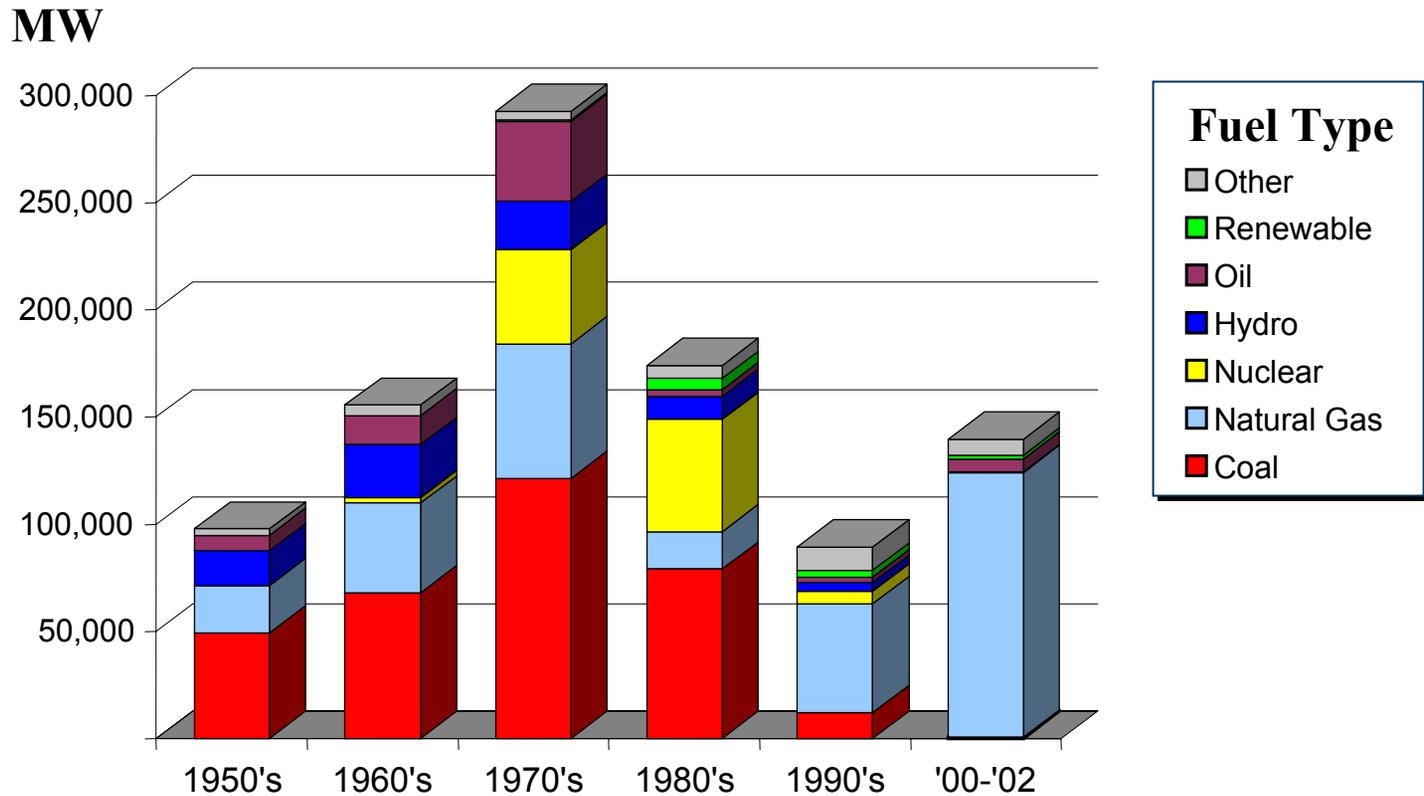
In contrast U.S. holds:

- 2% of world oil reserves
- 3% of world natural gas reserves

## U.S. Coal Deposits

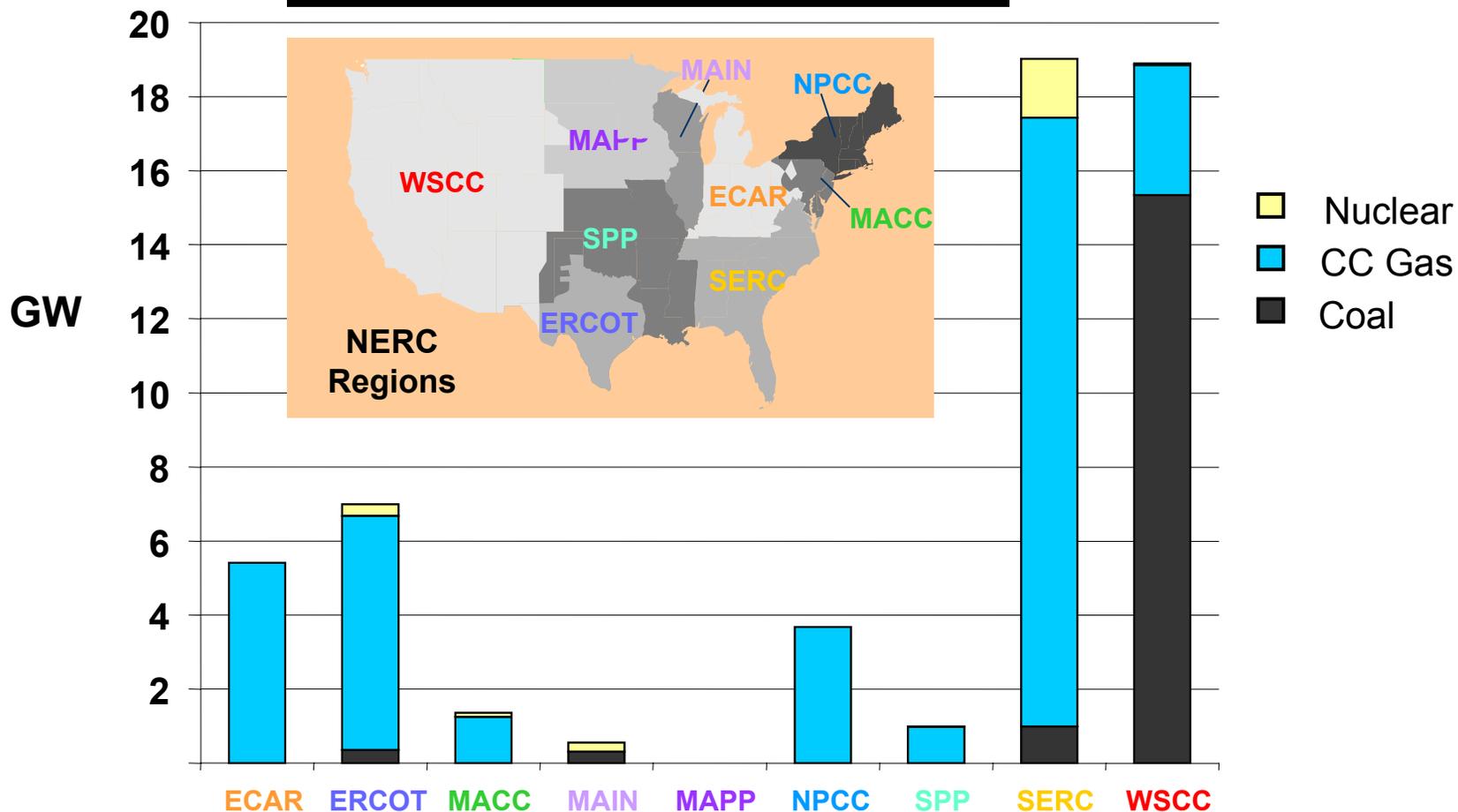


# Historic U.S. Capacity Additions



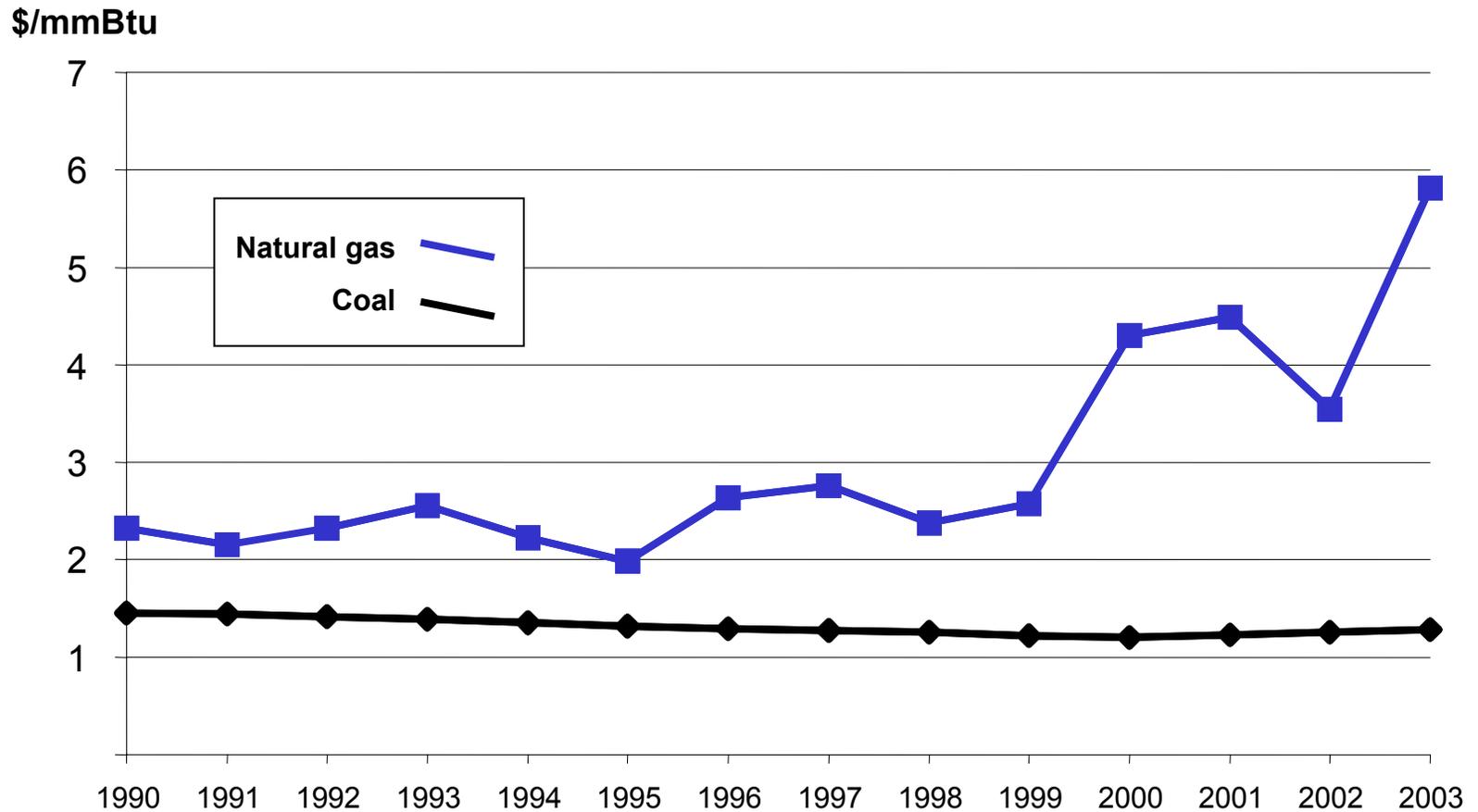
# Projected Base Load Capacity Additions

## EIA 2005-2015 Capacity Additions



# Natural Gas Price Volatility

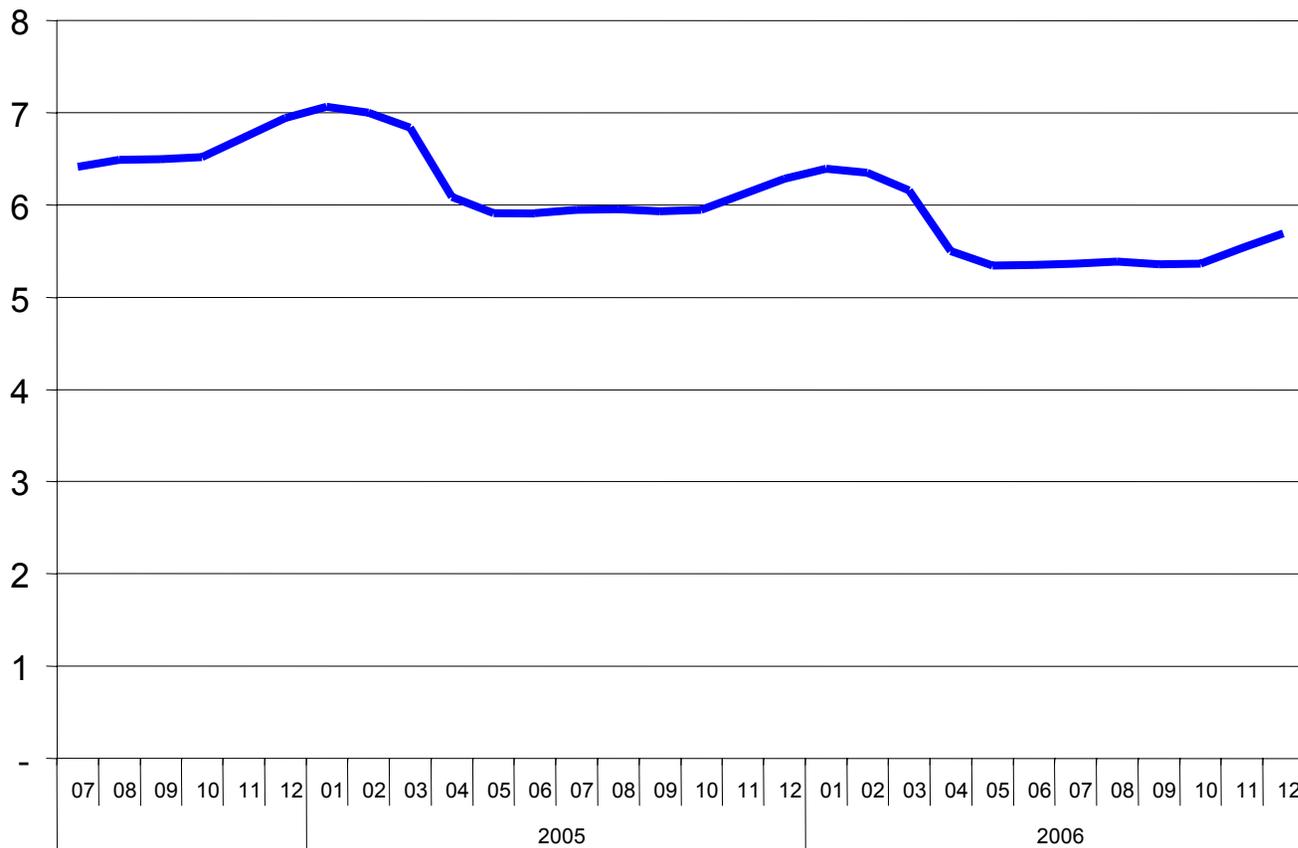
## Average Delivered Fuel Prices to U.S. Electric Generators



# Natural Gas Price Futures

**NYMEX Henry Hub Natural Gas Futures**  
(June 23, 2004)

\$/mmBtu

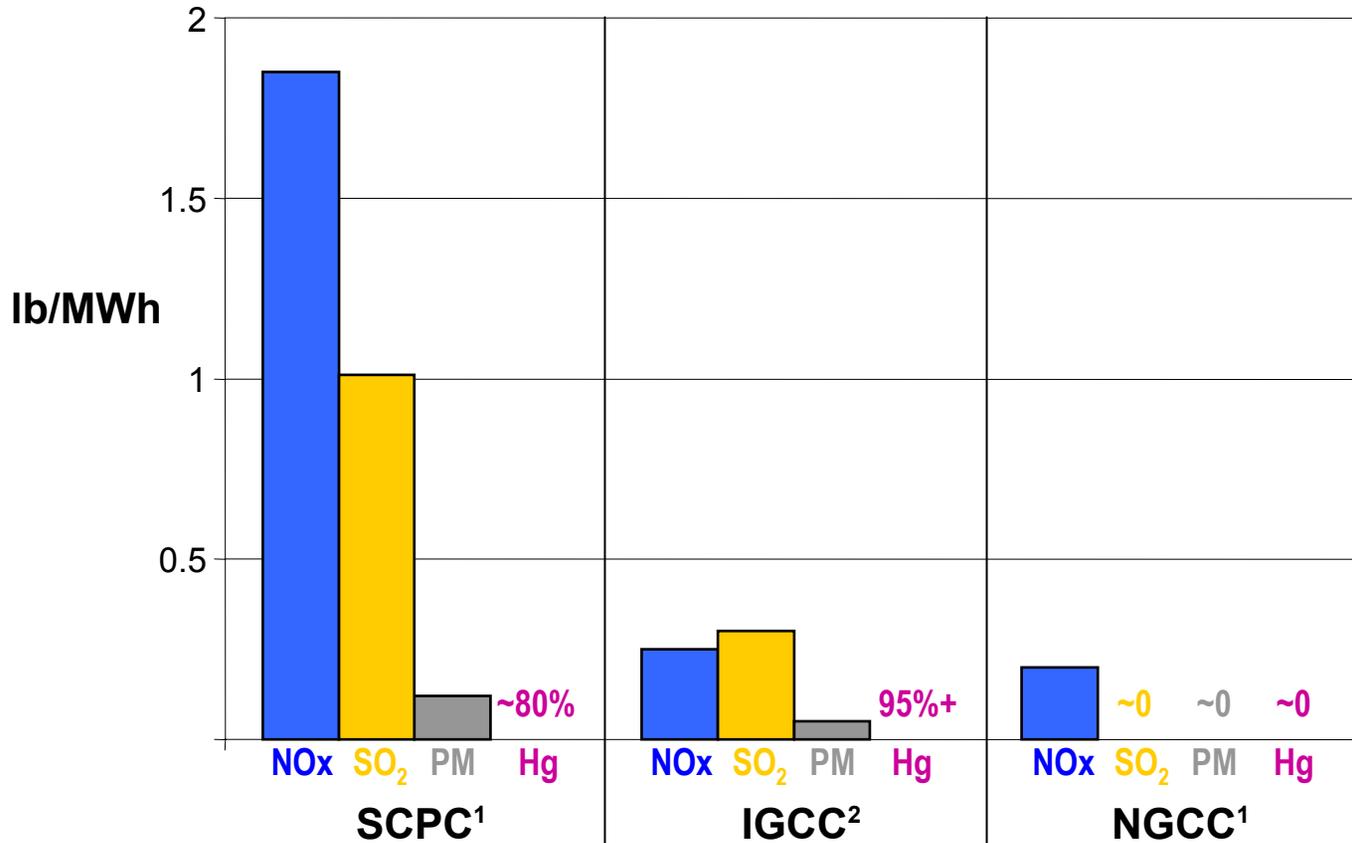


# Broad Support for IGCC

- **DOE** — 25% coal reserves (vs. 2% oil & 3% natural gas)
- **NETL**— invested \$billions in CCT program (2 full-scale IGCC demonstrations)
- **EPA** — sustainable coal utilization by reducing emissions almost to NG
- **Pres Bush** — supports FutureGen, CO<sub>2</sub> sequestration R&D
- **Congressman Barton** — reduce pressure on natural gas prices
- **Environmentalists** — cleaner air and potential for CO<sub>2</sub> sequestration
- **Utilities** — baseload capacity in a carbon constrained world
- **Coal producers** — enhance market share, few coal plants built in last decade
- **NGCC owners** — restore value by refueling to syngas

# Emissions Comparison

## Estimated New Plant Emissions Performance



<sup>1</sup> Based on emissions levels in EPRI/NETL, *Evaluation of Innovative Fossil Fuel Power Plants with CO<sub>2</sub> Removal*, Dec. 2002, SCPC and NGCC 7FA base cases.

<sup>2</sup> Levels proposed for qualification in 3 Party Covenant federal incentive program. Based on performance characteristics provided in NETL, *Major Environmental Aspects of Gasification-Based Power Generation Technologies*, December 2002; and performance estimates from Eastman Chemical Company.

# IGCC Deployment Obstacles

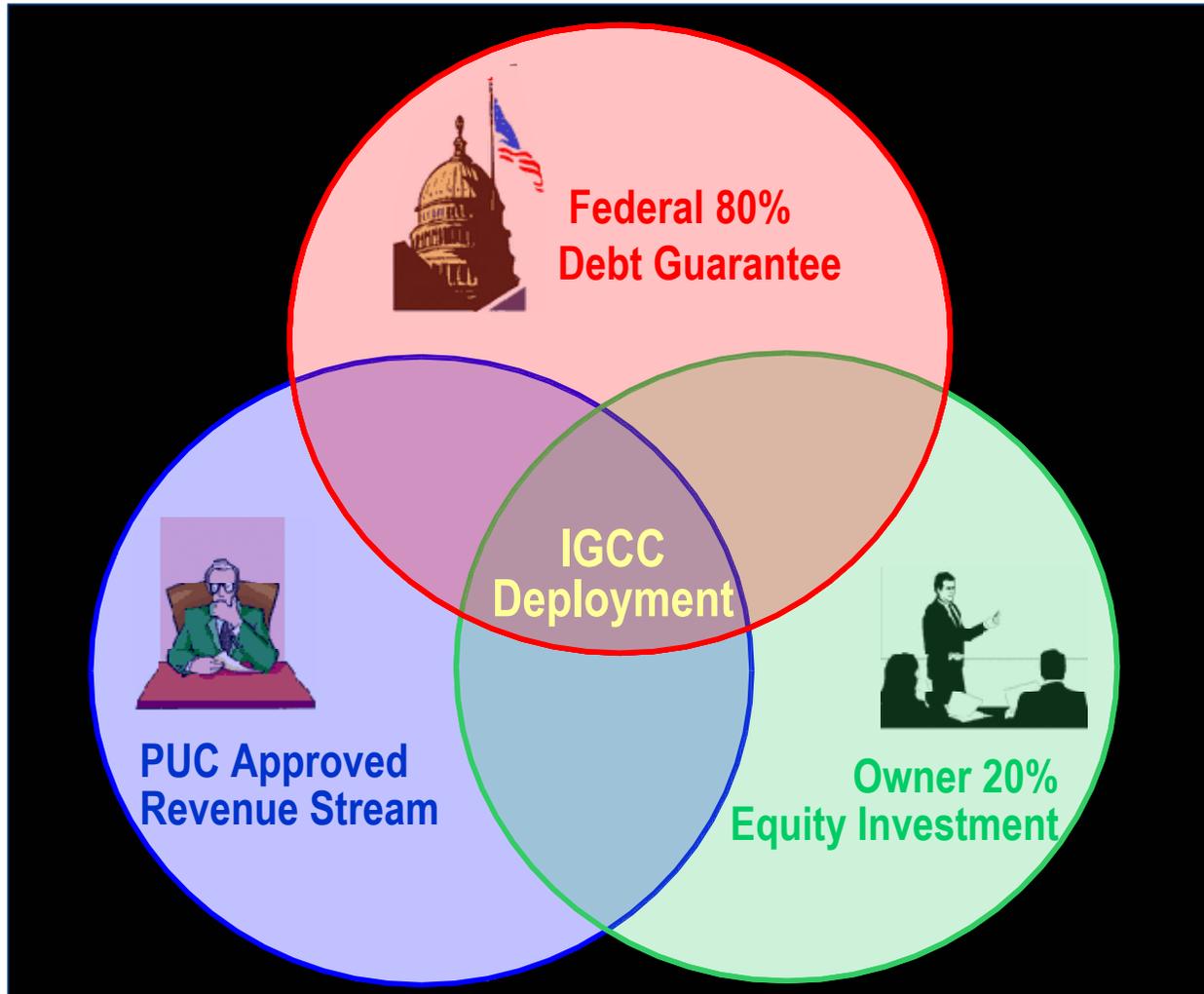
- **Economics**
  - Higher Capital Cost (~20% higher than PC)
  - Higher kWh energy cost
- **Perceived Technology Risks**
  - Construction overruns (EPC wrap??)
  - Reliable performance (limited track record)
- **Declining Credit**
  - S&P utility credit rating from A to BBB (just above junk status)
  - Debt reduction programs
  - Write-offs and 20-30% sales
- **Skeptical Enviros**
  - “Off-coal” opposition and renewable & conservation priority
  - CO<sub>2</sub> sequestration skepticism
  - Many opportunities to intervene and litigate

# IGCC Financing Project Objectives

## → Deploy half-dozen IGCC plants in this decade

- Access to capital
- Share advanced technology risks
- Produce competitively priced energy
- Minimize federal costs

# 3-Party Covenant

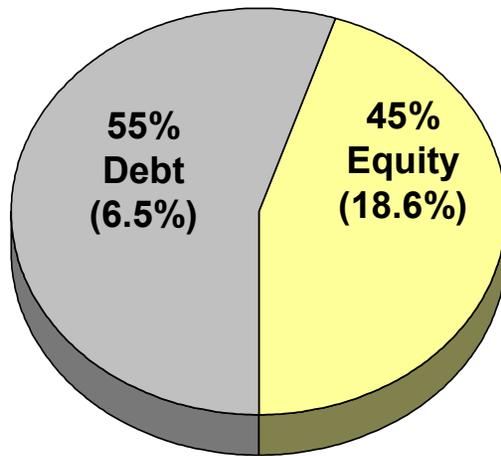


# Roles of 3 Parties

	<b>Provides</b>	<b>Receives</b>
<b>Federal Government</b>	<ul style="list-style-type: none"> <li>-- AAA credit</li> <li>-- Low interest rate</li> <li>-- 80/20 capital structure</li> </ul>	<ul style="list-style-type: none"> <li>-- National security</li> <li>-- Energy/ environmental resolution</li> <li>-- Low risk scoring</li> </ul>
<b>State PUC</b>	<ul style="list-style-type: none"> <li>-- Assured revenue stream</li> <li>-- Prudence review upfront</li> <li>-- Reduce financial risk</li> </ul>	<ul style="list-style-type: none"> <li>-- Clean &amp; reliable power</li> <li>-- Competitive electricity prices</li> <li>-- Jobs (construction &amp; mining)</li> </ul>
<b>Owner</b>	<ul style="list-style-type: none"> <li>-- 20% equity</li> <li>-- Leadership</li> </ul>	<ul style="list-style-type: none"> <li>-- No coal stigma</li> <li>-- 80% non-recourse loan</li> <li>-- Cost recovery (inc. CWIP)</li> </ul>

# 80% debt lowers cost of capital over 30%

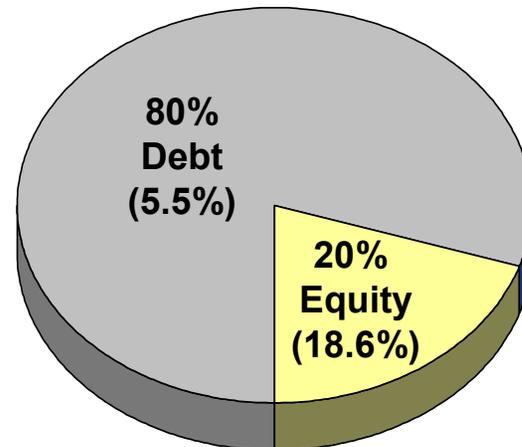
## Traditional Utility Financing



Pre-tax weighted cost of capital:

**11.9%**

## 3Party Covenant



Pre-tax weighted cost of capital:

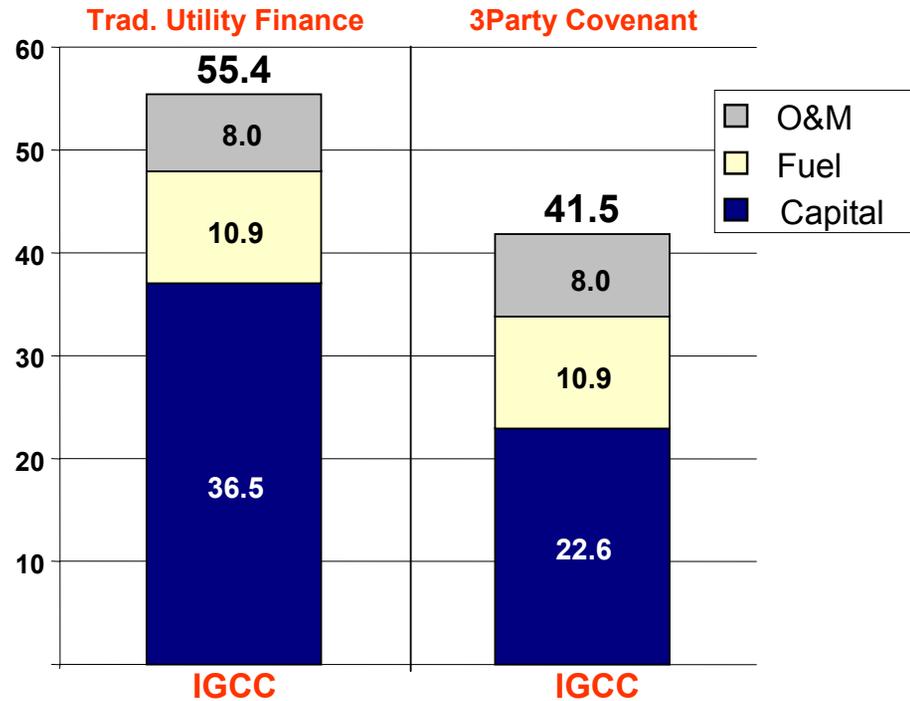
**8.1%**

# IGCC Cost of Energy

\$/MWh

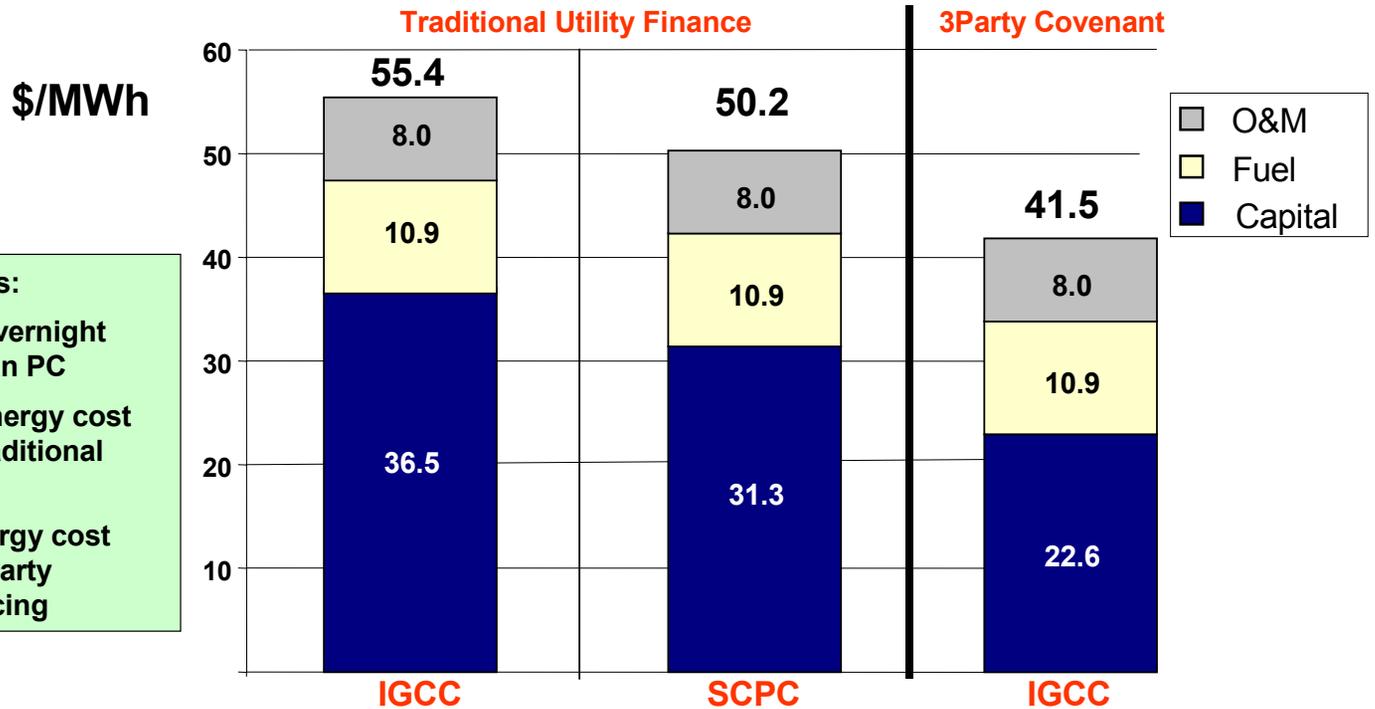
**3Party Covenant:**

- Adds 10% Operating Reserve Fund
- Changes debt fraction & cost
- 38% cost of capital reduction
- 25% energy cost reduction



Overnight Capital Cost (\$/kW)	\$1,400	\$1,400
Fuel Cost (\$/mmBtu)	\$1.25	\$1.25
Capacity Factor	85%	85%
Heat Rate (btu/KWh HHV)	8,700	8,700
Debt Fraction	55%	<b>80%</b>
Debt Cost	6.5%	<b>5.5%</b>
Pre-Tax Equity Return	18.6%	18.6%

# PC vs. IGCC 3Party Covenant Cost of Energy

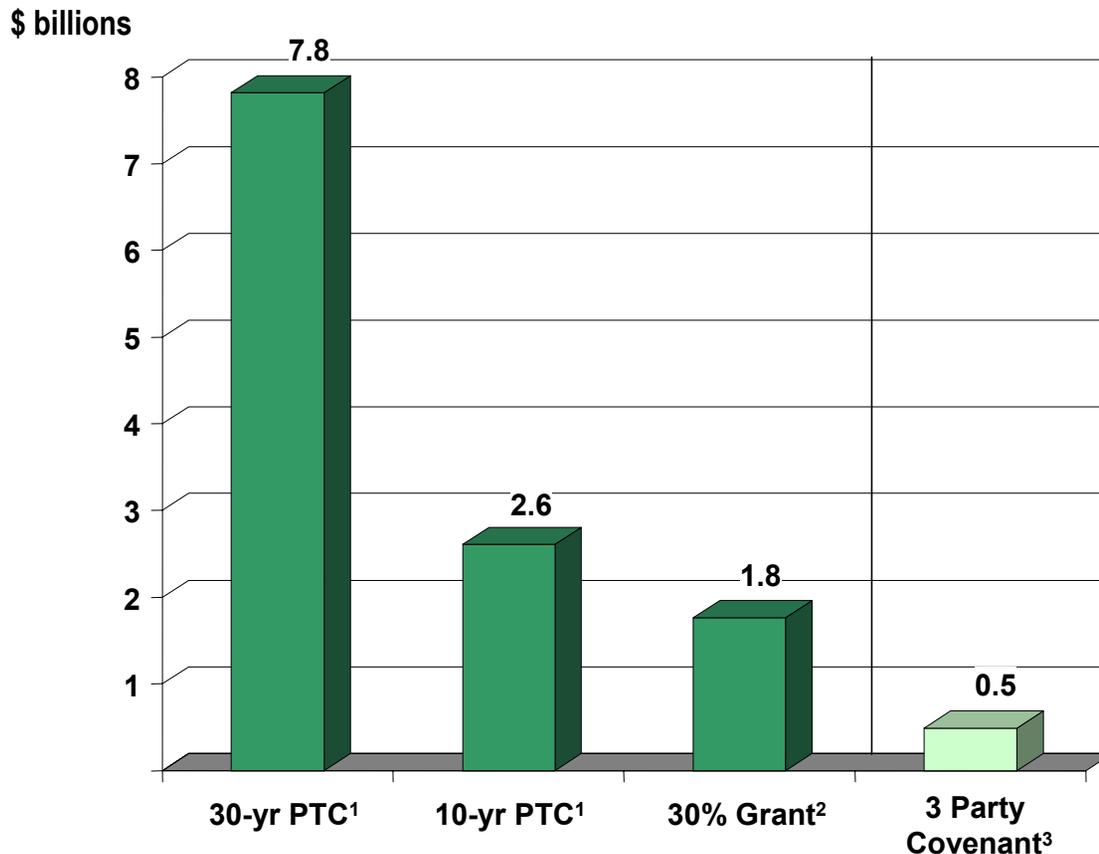


IGCC shown has:  
 -- 17% *higher* Overnight Capital Cost than PC  
 -- 10% *higher* energy cost than PC with traditional financing  
 --17% *lower* energy cost than PC with 3Party Covenant financing

Overnight Capital Cost (\$/kW)	\$1,400	<b>\$1,200</b>	\$1,400
Fuel Cost (\$/mmBtu)	\$1.25	\$1.25	\$1.25
Capacity Factor	85%	85%	85%
Heat Rate (btu/KWh HHV)	8,700	8,700	8,700
Debt Fraction	55%	55%	<b>80%</b>
Debt Cost	6.5%	6.5%	<b>5.5%</b>
Pre-Tax Equity Return	18.6%	18.6%	18.6%

# Minimize Federal Budget Cost

## Budget Cost of 1 cent/kWh equivalent incentive (3,500 MW of IGCC)



<sup>1</sup> PTC = Production Tax Credit equal to 1.0 cent/kWh of generation (10-year PTC program provides significantly less economic benefit than the other programs that provide about 1 cent/kWh over 30 years).

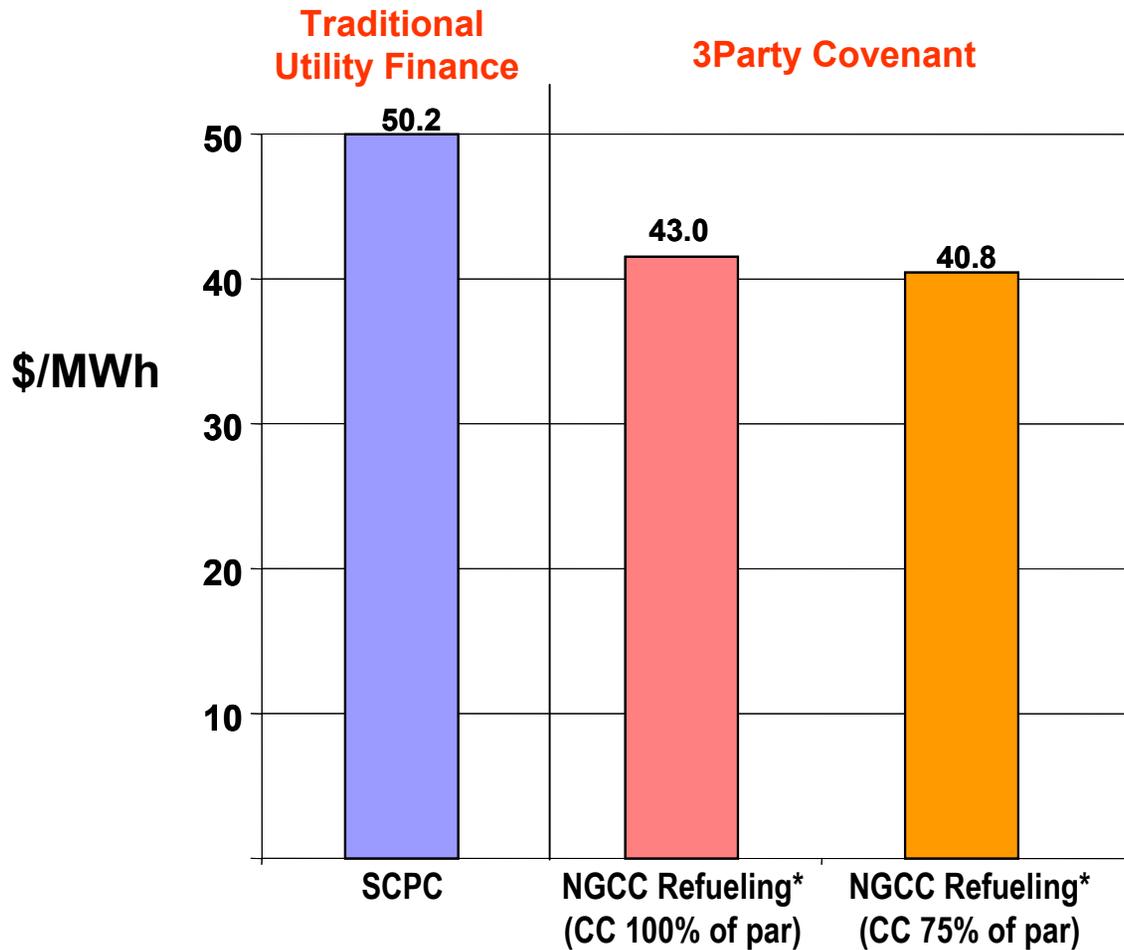
<sup>2</sup> Federal grant equal to 30 percent of total plant investment (equivalent to 0.96 cent/kWh of economic support for 30 years).

<sup>3</sup> Assumes 10 percent scoring of federal guarantees (equivalent to 0.95 cent/kWh of economic support for 30 years).

# NGCC refueling under 3Party Covenant

- **Convert to baseload plant**
  - Establish need for baseload power net of new PC
  - Long-term power purchase agreement
  - Inclusion by PUC in rates
- **New valuation**
  - Baseload vs. cycling
  - 80% vs. 20% operations
  - Potentially par value
- **Financing**
  - 80% federally guaranteed debt
  - Existing plant becomes equity contribution
  - Equity that remains in earns regulated 11.5 after tax return
  - Surplus equity withdrawn

# NGCC Refueling Cost of Energy



\*Assumes 1% efficiency penalty & 5% Overnight Capital Cost penalty in NGCC refueling scenarios vs. Reference IGCC.

# Legislative Components

- **Program Scope**
  - 3,500 MW (about 6 projects)
  - \$5 billion guarantees
  - \$500 million scoring appropriations
  - Accelerate deployment timetable
- **Federally Guaranteed Loan: 80%- AAA- 30yr**
- **Environmental Performance**
  - 99% sulfur reduction with SO<sub>2</sub> emission not to exceed 0.04 lb/mmBtu
  - NO<sub>x</sub> emissions not to exceed 0.025 lb/mmBtu (5 ppm)
  - Particulate stack emissions not to exceed 0.01 lb/mmBtu
  - 95% mercury emissions control
- **DOE technology determination:**
  - Proven technical pathway for CO<sub>2</sub> separation and capture, and for slipstream to produce hydrogen
- **PUC determinations required to achieve low budget scoring**
- **Operating Reserve Fund (10%) and Line of Credit (15%)**
- **Pre-development engineering loans**