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Deploying IGCC in This Decade With 3Party Covenant Financing Volume I

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FOREWORD

These two volumes emanate from fourteen months of research, discussion and countless drafts. The three authors, William Rosenberg, Dwight Alpern, and Michael Walker, conducted meetings with key players, including officials from both the federal and state government, representatives of the power, engineering, coal and chemical industries, environmental groups and academic experts. We are especially grateful for the cooperation of the Carbon Mitigation Initiative at Princeton University and two of its leaders, Robert Socolow and Robert Williams, and for the continuing advice from the MIT Laboratory for Energy and the Environment.

Both of these volumes have been extensively peer reviewed by a team of experts, including faculty at Harvard, Yale, and Princeton. The authors have consulted with officials from the Electric Power Research Institute (EPRI), Center for Clean Air Policy (CCAP), and the National Association of Regulatory Utility Commissioners (NARUC). The authors also benefited from a workshop held at the John F. Kennedy School in February, 2004. Over eighty experts from across the country participated in a discussion on opportunities to overcome the financial and political challenges confronting the deployment and commercialization of Integrated Gasification Combined Cycle technologies (IGCC), (see the ENRP rapporteur's report: “Workshop on Integrated Gasification Combined Cycle: Financing and Deploying IGCC Technologies in this Decade,” #2004-06).

These reports are part of a three-year program in the Kennedy School's Energy Technology Innovation Project (ETIP), a joint effort of the Environment and Natural Resources Program (ENRP) and the Science, Technology and Public Policy Program (STPP). ETIP has fostered extensive work on the obstacles and opportunities for development and utilization of IGCC technologies in China and India, as well as in the United States.

These efforts are stimulated by three policy imperatives: the need to increase the use of indigenous coal supplies and to meet a growing demand for electricity; the need to clean up our air, and reduce the threat of global climate change; and the need to address the nation's energy security. These reports provide a blueprint of how the United States might take the initial steps to commercially deploy IGCC technology to significantly improve our air, economy, and national interest.

We are very grateful for the support of the National Commission on Energy Policy, the Department of Energy, the Environmental Protection Agency, the Hewlett Foundation, the Packard Foundation, the Roy Family Fund, and the hundreds of experts who have generously given the authors the benefit of their advice and counsel.

John Holdren and Henry Lee
Co-chairs, Energy Technology and Innovation Project

REPORT ORGANIZATION

The paper is divided into two volumes. Volume I describes IGCC technology, why it is an important advanced clean coal technology for generating electricity, the hurdles to near-term deployment, the 3Party Covenant financing and regulatory program to stimulate near-term IGCC deployment, and how the 3Party Covenant improves the economics of IGCC technology to make it competitive. Appendix A of Volume I outlines the components of federal legislation that are needed to implement the 3Party Covenant.

Volume II provides a detailed legal analysis of the federal and state authorities and regulatory mechanisms for implementing the 3Party Covenant, including a review of traditional electric utility regulatory systems, the current regulatory systems in 5 specific states, and a model regulatory mechanism for review and approval of IGCC project costs under the 3Party Covenant.

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EXECUTIVE SUMMARY

This paper describes a 3Party Covenant financing and regulatory proposal ("3Party Covenant") aimed at reducing financing costs and providing a technology risk tolerant investment structure to stimulate initial deployment of 3,500 MW (about six 550 MW plants) of Integrated Gasification Combined Cycle (IGCC) coal generation power plants in this decade. The 3Party Covenant is an arrangement between the federal government, state utility commission (state PUC), and equity investor[1] that serves to lower IGCC cost of capital[2] by reducing the cost of debt, raising the debt/equity ratio, minimizing construction financing costs, and allocating financial risk. The 3Party Covenant reduces the cost of capital component of energy costs from new IGCC facilities by approximately 38 percent and the overall cost of energy about 25 percent, making power produced from IGCC technology cost competitive with pulverized coal (PC)[3] and natural gas combined cycle (NGCC) generation.

ES-1. Integrated Gasification Combined Cycle Generation

IGCC is a power generation process that integrates a gasification system with a conventional combustion turbine combined cycle power block. As illustrated in Figure 1-1, the gasification system converts coal (or other solid or liquid feedstocks such as petroleum coke or heavy oils) into a gaseous "syngas," which is made of predominately hydrogen (H_2) and carbon monoxide (CO). The combustible syngas is used to fuel a combustion turbine to generate electricity, and the exhaust heat from the combustion turbine is used to produce steam for a second generation cycle and provide steam to the gasification process.[4]

Despite the worldwide commercial use and acceptance of gasification processes and combined cycle power systems, IGCC is not perceived in the U.S. to have sufficient operating experience to be ready to use in commercial applications.[5] Each major component of IGCC has been broadly utilized in industrial and power generation applications, but the integration of a coal gasification island with a combined cycle power block to produce commercial electricity as a primary output is relatively new and has

---

[1] The "equity investor" is likely to be either an electric utility company (or a municipal utility or rural electric cooperative), or independent power company with a purchase contract with a utility (or a contract with comparable credit rating), that provides the equity for a project.

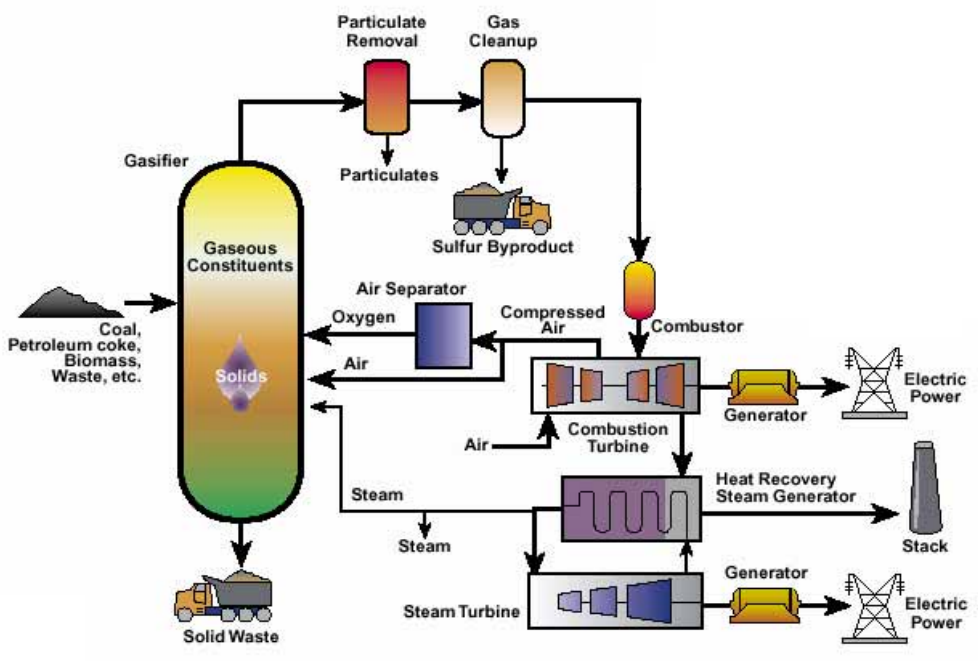
[2] As used in this paper, the term "cost of capital" means debt interest and authorized return on equity.

[3] As used in this paper, the term "PC" or "super-critical PC"means a power generation process that uses a super-critical, pulverized coal-fired boiler incorporating the latest emissions control technologies, including fabric filter baghouses or electrostatic precipitators for particulate control, flue gas desulfurization (FGD) for sulfur dioxide control, and selective catalytic reduction (SCR) to control oxides of nitrogen.

[4] With minor adjustments, combustion turbines designed to operate on natural gas can use syngas. The primary difference that affects the turbine is that syngas has a lower heating value than natural gas, which makes for a larger mass flow of fuel through the turbine that requires different piping and increases turbine output. Natural gas has a heating value of 1,026 btu/ft^3, while syngas has a heating value of 200-300 btu/ft^3.

[5] See David Berg & Andrew Patterson, "IGCC Risk Framework Study," DOE Policy Office, Presentation to Gasification Technology Council, May 20, 2004.

Figure ES-1. IGCC Power Plant



Source: NETL

been demonstrated at only a handful of facilities around the world. The Overnight Capital Cost[6] of the engineering, procurement, and construction (EPC) contract for IGCC is currently estimated to be about 20 percent higher than PC systems[7] and commercial reliability has not yet been established. As a result, investments to build IGCC facilities to generate power have not materialized despite significant public and private sector interest in the technology.

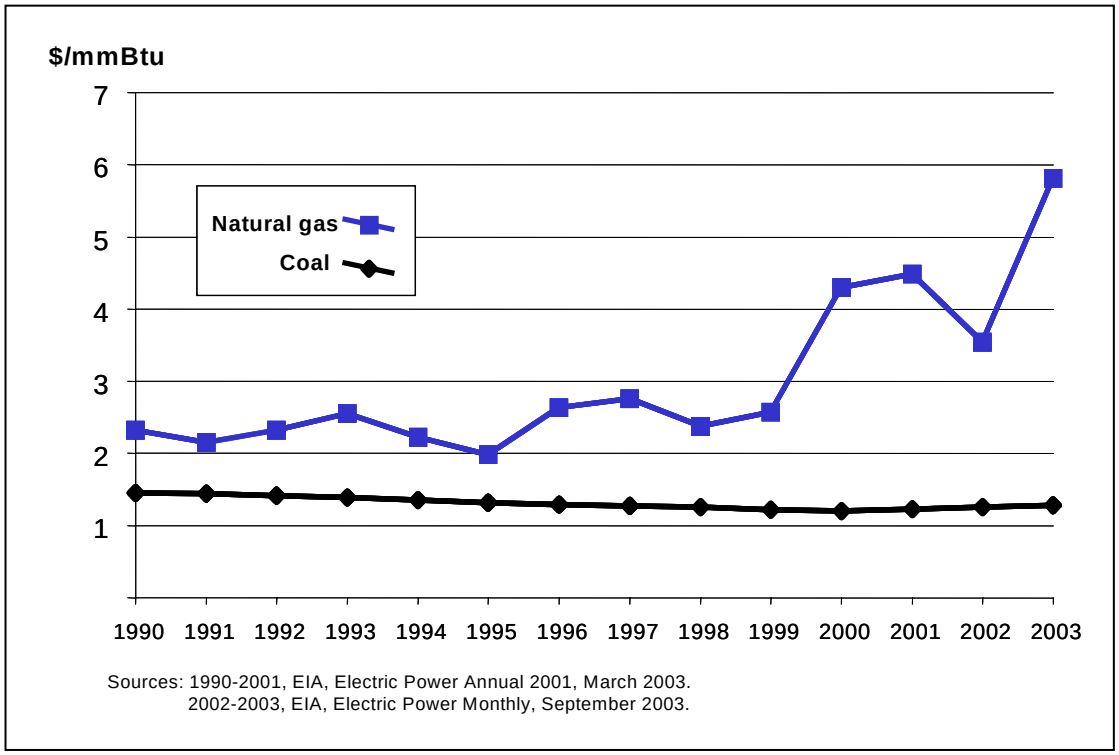
ES-2. Why IGCC

IGCC was selected as the focus of this paper because it is a commercially ready, advanced technology for generating electricity with coal that is widely supported and can substantially reduce air emissions, water consumption, and solid waste production from

[6] As used in this paper, the term "Overnight Capital Cost" means the bare cost of designing and building a power plant, including engineering, procurement, construction and contingencies, but not considering cost of capital.

[7] However, the current market for combustion turbines, a key component of IGCC power plants, is very soft, which may allow for more cost-competitive IGCC than most studies indicate. Completed natural gas combined cycle units and unused turbines that have never been installed are available for purchase at a very substantial discount. According to NETL, there are as many as 50 turbines currently in warehouses that could potentially be used for new power plants.

Figure ES-2. Average Delivered Fuel Prices to Electric Generators



coal power plants.[8] The Department of Energy (DOE) has invested billions of dollars over the last 20 years to support the technology, and there are fully demonstrated and commercially operating plants in the U.S., Europe, and Japan. IGCC also offers the potential of a technical pathway for cost effective separation and capture of carbon dioxide (CO_2) emissions and for co-production of hydrogen. These environmental attributes make it an important technology for enabling the substantial energy, economic, and national security benefits of coal use for electricity generation to be achieved with minimal environmental impact.

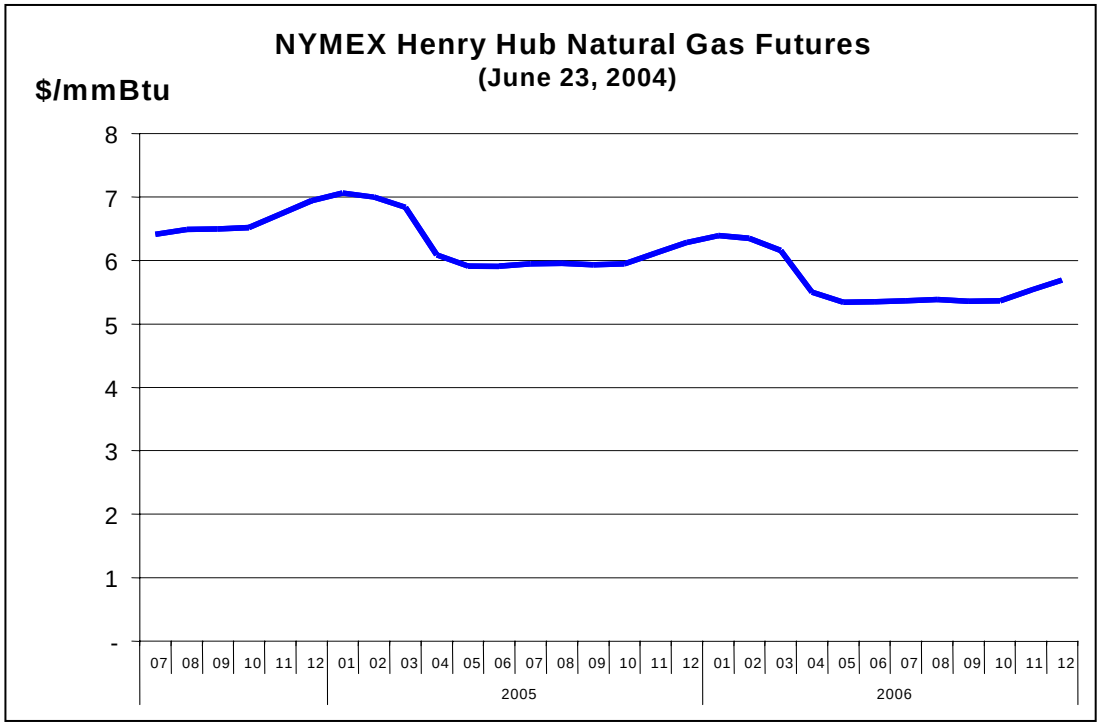
Coal is a vital U.S. energy resource that currently fuels over 50% of U.S. electricity generation. The U.S. has 25 percent of the world's proven coal reserves, more than any other country in the world. This supply enables the U.S. to be a net coal exporter.[9] In contrast, the U.S. has less than 3 percent of world oil and natural gas reserves,[10] imports over 50% of its oil supply (compared to 28 percent just prior to the first Arab Oil

[8] The type of financing program described in this paper could also be effective for other technologies that have similar environmental characteristics.

[9] Estimated recoverable coal reserves in the U.S. are 275 billion tons, which is approximately 25 percent of world reserves and more than a 250-year supply at current consumption (See National Mining Association, "Fast Facts About Coal," http://www.nma.org/statistics, Sept. 9, 2003).

[10] U.S. oil and natural gas reserves are estimated to be less than 2 percent and 3 percent of world totals, respectively. (See EIA, "International Energy Annual 2001," Table 8.1).

Figure ES-3. Henry Hub Natural Gas Futures



Embargo), and is expanding natural gas imports from mid-eastern and other countries through development of liquefied natural gas (LNG) production and transport facilities. [11]

Real coal prices have declined 63 percent since 1980 and real retail electricity prices, which are directly affected by coal prices, have declined 21 percent over the same period.[12] The average price of coal delivered to electric generators in December, 2003 was $1.25/mmBtu, compared to $3.90/mmBtu for petroleum and $5.24/mmBtu for delivered natural gas.[13] As illustrated in Figure ES-2, electric generator natural gas prices have become increasingly volatile in recent years while coal prices have remained relatively stable and slowly declined for the past decade. Coal price stability translates into stable generating costs and stable electricity prices when coal is the dominant generation fuel. Domestic coal, which is geographically dispersed across the country, transported by rail and barge, and can be stockpiled for 30-90 days at generating facilities, is a secure and reliable energy source.

Coal electricity generation can also help relieve pressure on natural gas availability and prices that are adversely affecting other sectors of the economy. Natural gas prices in 2003 were two to three times above historic averages and, as illustrated in Figure ES-3, natural gas futures suggest prices will remain high for at least the next several years.

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[11] See *New York Times*, Oct. 13, 2003, p. W1. See also *New York Times*, Dec. 9, 2003, p. C4.
[12] See EIA, "Annual Energy Review 2002," October 2003, Tables 7.8 and 8.6.
[13] See EIA, "Electric Power Monthly," April 2004, Table ES1.A.

These high natural gas prices caused widespread, adverse impacts on the U.S. economy and economic competitiveness, including significant job losses in manufacturing and chemicals industries.[14] One factor supporting high natural gas prices and price forecasts is the increased demand resulting from construction of new natural gas-fired electric generation. According to EIA, natural gas consumption by electric generators increased 40% between 1997 and 2002 and will increase another 51% by 2025.[15] Coal generation in general, and IGCC in particular (which can be used to refuel natural gas plants to coal), can help reduce pressure on natural gas prices.[16]

For the nation to enjoy the energy and economic advantages of coal generation without risking significant adverse environmental and health impacts, advanced coal generation technologies need to be deployed that address air pollution, climate change, and other environmental concerns associated with traditional coal combustion technologies. IGCC offers the potential for coal generation with significantly improved environmental performance, particularly reduced air emissions, through gasification and removal of impurities prior to combustion. This emissions control method is very different from PC power plants, which achieve virtually all emissions control through combustion and post combustion controls that treat exhaust gases.[17] Because the syngas produced in the gasification process has a greater concentration of pollutants, lower mass flow rate, and higher pressure than stack exhaust gas, emissions control through syngas cleanup is generally more cost effective than post combustion treatment to achieve the same or greater emissions reductions.

For example, there is no single proven technology available today that can uniformly control mercury emissions from PC power plants in a cost-effective manner, while consistently achieving mercury removal levels of 90 percent.[18] In contrast, IGCC power plants have the potential to cost-effectively achieve very high (95-99 percent) mercury

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[14] The economic consequences of high prices are described in the House Speaker's Task Force for Affordable Natural Gas report, which states: "Because domestically produced natural gas is so vital to our nation's energy balance, rising prices make our nation less competitive. When prices rise, factories close. Good, high paying jobs are imported overseas. Today's high natural gas prices are doing just that. We are losing manufacturing jobs in the chemicals, plastics, steel, automotive, glass, fertilizer, fabrication, textile, pharmaceutical, agribusiness and high tech industries." House Energy and Commerce, The Task Force for Affordable Natural Gas, Natural Gas: Our Current Situation (Sept. 30, 2003).

[15] See http://tonto.eia.doe.gov/dnav/ng/hist/n3045us2A.htm; See also EIA, Annual Energy Outlook 2004, Table A-13.

[16] In contrast to natural gas, increased use of coal for electricity generation, has very little impact on other sectors of the economy because coal use in the U.S. is essentially dedicated to electricity generation, with 90 percent of coal consumption in the U.S. attributable to electric generators. See EIA, "Annual Energy Outlook 2003 (AEO 2003)," Table A16, Jan. 2003.

[17] Typical combustion and post-combustion controls required of new PC power plants include Flue Gas Desulfurization (FGD, or "scrubbers") for SO_2 control, low NOx burners and Selective Catalytic Reduction (SCR) for NOx control, and Electro-Static Precipitators (ESP) or fabric filter baghouses for particulate control. These technologies add to the capital cost, size and complexity of new PC power plants and decrease plant efficiency because of their energy consumption.

[18] NETL, "The Cost of Mercury Removal in an IGCC Plant," p. 1, Sept. 2002.

control with established technology.[19] In addition, IGCC technology offers the potential for separating and capturing CO_2 emissions (and producing pure hydrogen) by adding water-gas shift reactors to the syngas treatment system and physical absorption processes to remove CO_2. These processes are commercially proven in industrial processes, and several studies have shown this to be a more cost-effective approach to CO_2 capture[20] with proven technology than capturing CO_2 from the flue gas of a PC boiler.[21]

U.S. leadership in the deployment of IGCC technology also could be very beneficial in steering coal-intensive developing countries, such as China and India, towards more environmentally and climate friendly coal use. Near-term deployment of technology capable of addressing CO_2 emissions is critical to avoid locking in traditional steam coal technology for the 30 to 50 year life of new coal plants for the 1,400 giga-watts of new capacity projected to come on line by 2030.[22]

ES-3. IGCC Deployment

For IGCC to be perceived as mature, reliable, and economic, more commercial experience needs to be gained through deployment. However, in order to attract the investment needed for deployment, the technology needs to be perceived as commercially mature, reliable, and economic. Helping resolve this dilemma through commercial deployment of an initial fleet of IGCC power plants is the principal objective of the 3Party Covenant financing and regulatory program.

High natural gas prices, broad political interest, and a growing need for new base load electricity supplies are creating a window of opportunity for IGCC. Many diverse interests, including coal producers and utilities, state and federal government officials, industrial and residential natural gas consumers, and environmental organizations have expressed support for the technology.

At the same time, there has been a resurgence of proposals for PC coal power plant development, with over 94 new coal plants identified as under development in the U.S. as of February, 2004. As illustrated in Figure ES-4, during the period 2005 to 2015, EIA projects the addition of 57 giga-watts of new coal, nuclear, and combined cycle gas generating capacity to serve electricity demand, which is equivalent to about 100 new

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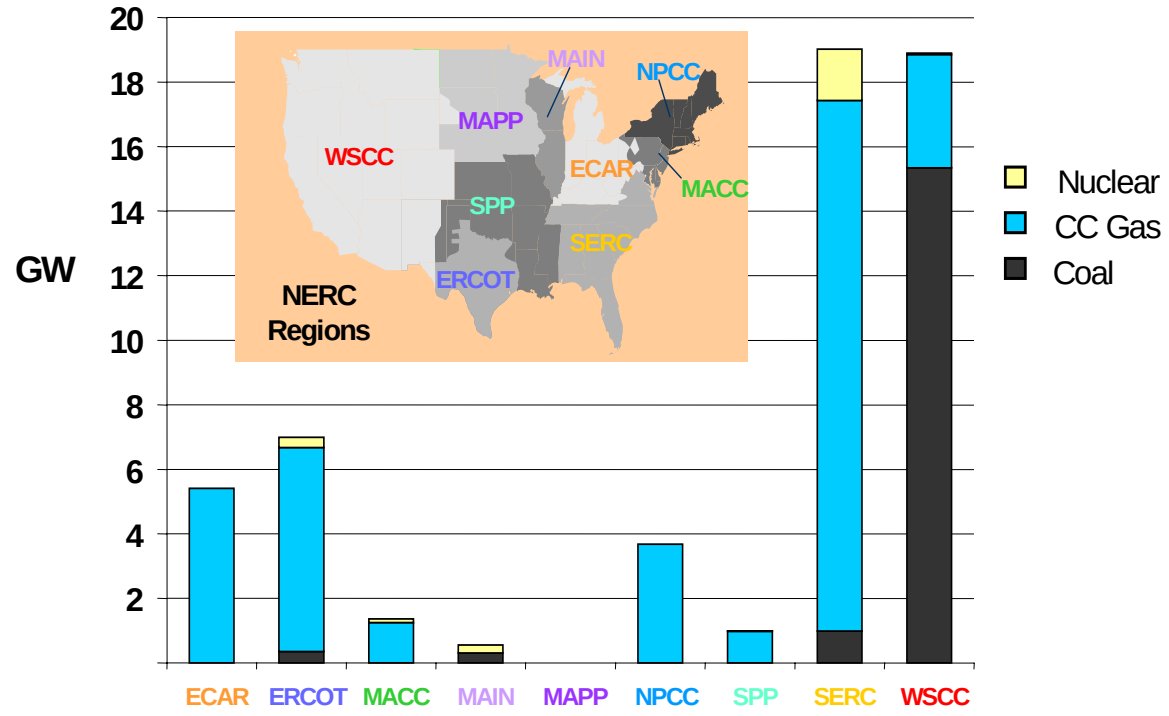
[19] Id.

[20] Although capturing CO_2 is only the first step in controlling it (because it must be sequestered if emissions are to be reduced), most experts agree that extensive research and large-scale demonstration projects are needed on sequestration before a commercial IGCC or other coal power plant would be in a position to sequester its CO_2. Sequestration is not specifically addressed in this paper because it is viewed by the authors as beyond the scope of commercialization of a small initial fleet of IGCC plants, which is the objective of the 3Party Covenant proposal.

[21] See Jeremy David and Howard Herzog, "The Cost of Carbon Capture," 2000; See also DOE—EPRI Report 1000316, Dec. 2000.

[22] See Fridtjof Unander and Carmen Difiglio, International Energy Agency, Energy Technology Policy Division, “Energy and Technology Perspectives: Insights from IEA modeling,” presented at the National Energy Modeling System/Annual Energy Outlook 2003 Conference, Mar. 18, 2003.

Figure ES-4. EIA 2005-2015 Coal, Nuclear, and NGCC Capacity Additions



Source: EIA, Annual Energy Outlook 2004, Supplemental Regional Data, Table 75.

550 MW power plants (average of 10 per year). If current fuel price trends continue, a substantial portion of the new capacity is likely to be coal fueled utilizing PC technology. A window of opportunity exists for IGCC technology to account for an important share of this new capacity and prove its commercial viability in the near term.

In addition, market availability of underutilized NGCC generation assets at discount prices presents an opportunity for cost-effective coal gasification refueling. The combined cycle power block associated with a NGCC power plant is essentially the same as the combined cycle power block needed for an IGCC facility. To convert an existing natural gas turbine to use synthesis gas from a coal gasifier is a minor adjustment estimated to cost only $5 million for a typical 350 MW plant, or roughly $15/kW.[23] This cost is more than made up for by the savings associated with using a financially distressed asset to provide the combined cycle power block for the IGCC plant. Furthermore, for an owner of a distressed NGCC facility, refueling to IGCC means taking a depressed asset facing large write-offs that is operating at only a fraction of its capacity and repositioning it to operate as a base load coal facility that operates at a high (80-90%) capacity factor with close to par valuation. With 3Party Covenant financing,

[23] NETL, "Potential for NGCC Plant Conversion to a Coal-Based IGCC Plant - - A Preliminary Study," May 2004.

the cost of energy from the resulting plant is as much as 19 percent below the cost of energy from a new PC plant (see Figure ES-10 below).

Despite these opportunities, investments to design and build commercial IGCC power plants in the U.S. have not yet materialized due to cost and risk concerns. A 2004 survey by DOE indicates that the three leading risk factors perceived by industry to be associated with IGCC investments are high capital costs, excessive down time, and difficulty with financing.[24] The financing hurdle is made all the more difficult by the fact the electric utility industry today is weaker financially than it has been in the past. A November 2003 analyst report by Standards and Poors indicated that:

> "the average credit rating for the electric utility sector is now firmly in the 'BBB' category, down from the 'A' category three years ago. Furthermore, prospects for credit quality remain challenging, as indicated by rating outlooks, 40 percent of which are negative."[25]

Lower credit ratings make if more difficult and costly for power companies to raise money for large, capital-intensive coal projects (whether PC or IGCC) costing close to a billion dollars. Add the uncertainty of a relatively new generating technology such as IGCC, and financing becomes a serious constraint to deployment.

ES-4. 3Party Covenant Financing and Regulatory Program

The 3Party Covenant is a financing and regulatory program for providing developers of IGCC power plants with ready access to capital at lower cost in an environment that tolerates technology risk. By so doing, the 3Party Covenant addresses the fundamental economic and financial challenges inhibiting IGCC deployment. The program is designed to facilitate development of an initial fleet of commercial IGCC plants this decade to establish the commercial viability of the technology and reduce costs.[26]

As illustrated in Figure ES-5, the 3Party Covenant is a financial and regulatory arrangement among a federal agency, a state PUC (or other utility rate setting body), and an equity investor. Under the 3Party Covenant, the federal government provides AAA credit, the state PUC provides an assured revenue stream to cover cost of capital and protect the federal credit, and the owner provides equity and know-how to build the IGCC project with appropriate guarantees from an EPC firm (which in turn has underlying warranties from equipment vendors). In return, the federal government

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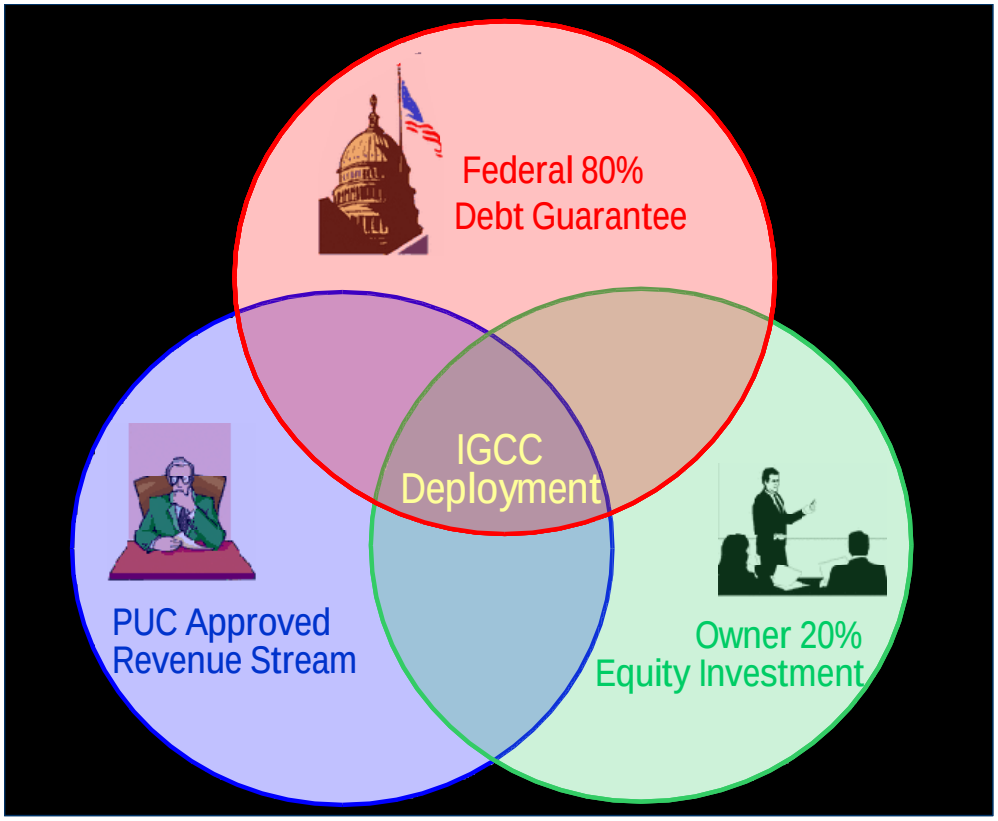
[24] See David Berg & Andrew Patterson, "IGCC Risk Framework Study," DOE Policy Office, Presentation to Gasification Technology Council, May 20, 2004.

[25] Ronald M Baron, *"U.S. Power and Energy Credit Outlook Not Promising; Few Bright Spots,"* Standard & Poors, Nov. 11, 2003.

[26] Public sector support for commercialization of innovative new technologies was identified as an important recommendation of the PCAST Energy R&D Panel in 1997, which recommended among other things "targeted efforts to improve the prospects of commercialization of the fruits of publicly funded energy R&D in specific areas." (See PCAST Energy R&D Panel 1997, *Federal Energy Research & Development for the Challenges of the 21st Century*, Report of the Energy R&D Panel, The President's Committee of Advisors on Science and Technology, Nov., 1997).

Figure ES-5. 3Party Covenant Illustration



stimulates IGCC deployment to support energy, national security, and environmental policy objectives at low federal cost; the state receives competitively priced power, economic development (investment and jobs), and environmental improvement; and the equity investor receives access to non-recourse, low-cost debt, assured equity returns, and an economic base-load power plant.

The three key elements are as follows:

> *Federal Loan Guarantee:* The program for implementing the 3Party Covenant is established through federal legislation authorizing a federal loan guarantee to finance IGCC projects. The terms of the federal guarantee provide for an 80/20 debt to equity financing structure and require that a proposed project obtain from a state PUC an assured revenue stream to cover return of capital, cost of capital, and operating costs. The terms also require the project to capitalize a 10 percent Construction and Operating Reserve Fund, to have appropriate construction guarantees from the EPC firm hired to design and build the plant, and to meet stringent environmental performance specifications. The terms would also enable the project to have available an additional draw on the federally guaranteed debt ("Line of Credit") of up to 15 percent of project Overnight Capital Costs (to be matched with a 20 percent equity contribution when drawn).

State PUC Approval Process: States interested in participating in the program voluntarily opt-in by adopting utility regulatory provisions for state PUC review and approval of IGCC project costs,[27] which in some states will require legislative action to create appropriate enabling authority.

Specifically, a state PUC (or potentially another ratemaking body in the case of a municipal utility or rural electric cooperative), acting under state enabling authority, assures dedicated revenues to qualifying IGCC projects sufficient to cover return of capital (depreciation and amortization), cost of capital (interest and authorized return on equity), taxes, and operating costs (e.g., operation and maintenance, fuel costs, and taxes).[28] The state PUC provides this revenue certainty through utility rates in states with traditional regulation of retail electricity sales, or through non-bypassable wires charges in states with competitive retail electricity sales, by certifying (after appropriate review) that the plant qualifies for cost recovery and establishing rate mechanisms to provide recovery of approved costs, including cost of capital. The certification by the state PUC occurs upfront when the decision to proceed with the project is being made, and the prudence review by the state PUC and cost recovery occur on an ongoing basis starting during construction, which reduces the construction risks borne by the developer, avoids accrual of construction financing expenses, and protects ratepayers.

Equity Investor: The equity investor under the 3Party Covenant is likely to be either an electric utility (or a municipal utility or rural electric cooperative) or an independent power producer that secures a long-term power contract with a utility (or a contract with a comparable credit rating). The investor contributes equity for 20 percent of the Total Plant Investment and negotiates performance guarantees to develop, construct, and operate the IGCC plant. A fair equity return is determined and approved by the state PUC before construction begins.

The 3Party Covenant is distinguished from other federal financing programs because a principal party is a state PUC (or potentially another ratemaking body for a municipal utility or rural electric cooperative), which effectively assures the revenue stream needed to service the federally guaranteed debt. The regulatory body, operating under state enabling law, reviews and approves the IGCC plant proposal upfront, determines the need for power, establishes the mechanism for allocation of project risks and recovery of approved costs, conducts ongoing prudence review during construction and operation, and determines the amount and timing of project revenues. The 3Party Covenant requires states that want to participate to establish a review and approval process that provides for

[27] As used in this report, the term "project costs" refers to all costs associated with building and operating a power plant, including all development costs, capital and financing costs, and operating costs.

[28] Depending on the ownership structure and sales profile (i.e., retail sales versus sales for resale) of the IGCC project, the Federal Energy Regulatory Commission (FERC) may take on some of the role otherwise assigned to the state PUC.

cost recovery assurances to protect the federal loan guarantee before the guarantee becomes effective.

The 3Party Covenant is designed to benefit and protect ratepayers by enabling them to receive lower cost (because of access to lower cost financing)[29] and less polluting power without being required to take excessive risk. Ratepayer risks are mitigated under the 3Party Covenant by EPC contractor construction guarantees (and underlying equipment vendor warranties) required to cover construction risks, 10 percent Construction and Operating Reserve Fund and 15 percent Line of Credit (percentages based on Overnight Capital Costs) to cover construction and operating risks that are the responsibility of the owner, and the state PUC process evaluating the prudence of the IGCC investment decision and operation.[30] It is ultimately up to the state PUC, through a transparent public process, to determine whether the public benefits of building a new IGCC power plant under the 3Party Covenant outweigh the risks to ratepayers.[31] The decision will only be made where the PUC determines that there is a need for new base load power and will entail weighing the future benefits, risks, and cost of 3Party Covenant financed IGCC against the benefits, risks, and costs of conventionally financed alternative base load generation (PC).[32]

Once the state PUC assures revenues to service the federally guaranteed loan, the amount of the loan that must be scored as a federal budget expense is likely to be significantly lower, because risk of default is significantly reduced. The budgetary treatment of federal loan guarantee programs is governed by the Federal Credit Reform Act of 1990 (FCRA). FCRA makes commitments of federal loan guarantees contingent upon prior budget appropriations ("scoring") of enough funds to cover the estimated present value cost associated with the guarantees. The present value cost is based on an estimate of the following cash flows at the time the loan guarantee is disbursed:

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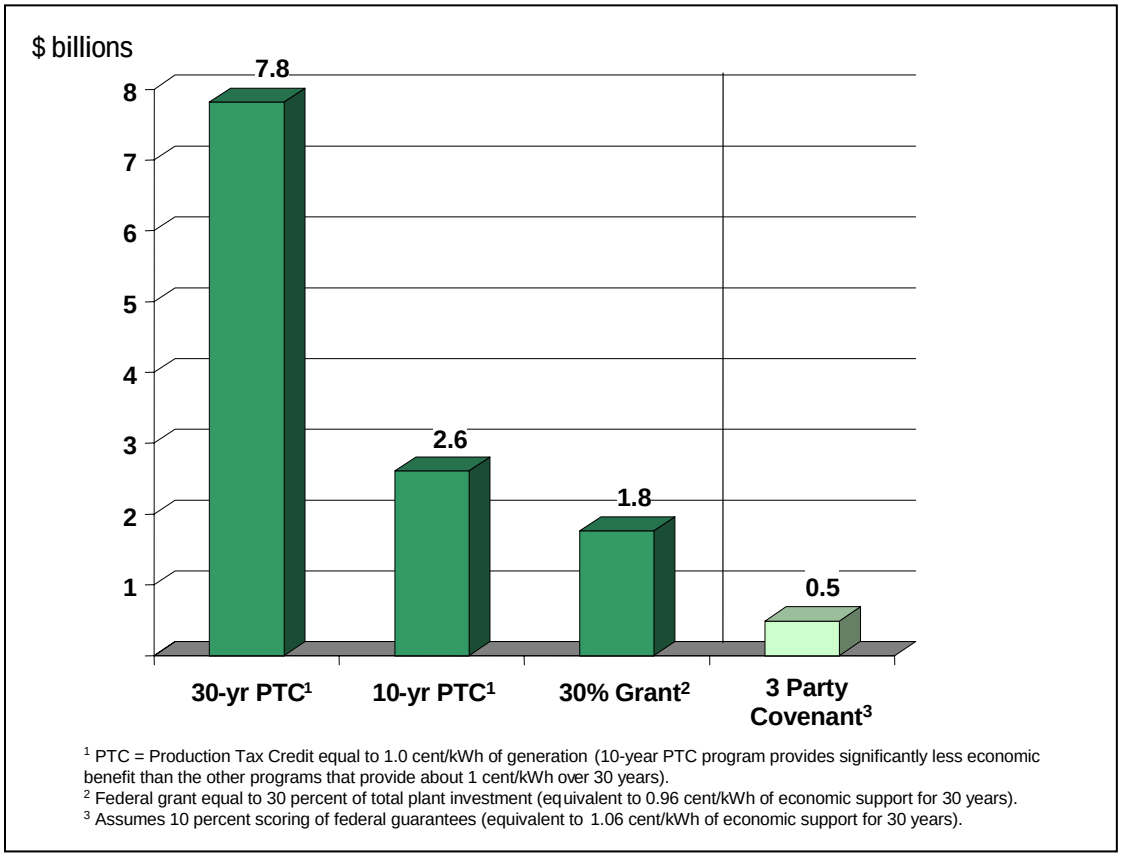
[29] The cost of capital component of energy costs on a capital intensive coal fueled generating plant is typically 60-70% of total energy costs. Substantially lower costs of capital under the 3Party Covenant, as explained in ES-5, reduce the ratepayer supported costs of IGCC to levels competitive with PC.

[30] Use of redundant gasifier capacity, which is assumed in the cost of energy assessment summarized in ES-5 below, also provides protection against operational difficulties that might otherwise reduce plant availability.

[31] This report has not attempted to quantitatively evaluate the costs or risks that ratepayers are being asked to take on, or to quantify the benefits that they will receive. Instead the paper outlines qualitatively how IGCC and the 3Party Covenant benefit ratepayers and quantifies the direct economic savings associated with 3Party Covenant financing. A comprehensive cost/benefit assessment is beyond the scope of the paper, but may be an appropriate future line of investigation.

[32]The cost risks to the ratepayer of a new IGCC plant would also be significantly diluted by the fact that the plant would constitute a small percentage of the total sources of power (generation and purchases) used by a utility. Typical large electric utilities in the U.S. have total sources of power that range between about 50 and 150 million MWh per year. (For example, in 2002 the total sources of power for Cincinnati Gas & Electric were 133 million MWh; Florida Power and Light, 105 million MWh; and PSI Energy, 63 million MWh (see EIA Form 861.) A new 550 MW IGCC facility would generate about 4 million MWh per year if operating at an 85 percent capacity factor. Therefore, in a worse case scenario, if the cost of energy from an IGCC facility ended up 20 percent more than the cost of energy of an alternative PC plant, it would represent a 0.5 to 1.6 percent increase in the overall cost of power procurement by the utility, due to the single plant's relatively small share of the total sources of power.

Figure ES-6. Federal Budget Cost of 1 cent/kWh Support for 3,500 MW of IGCC under Different Policy Approaches



1. Payments by the Government to cover defaults and delinquencies, interest subsidies, or other payments; and
2. Payments to the Government, including origination and other fees, penalties and recoveries.

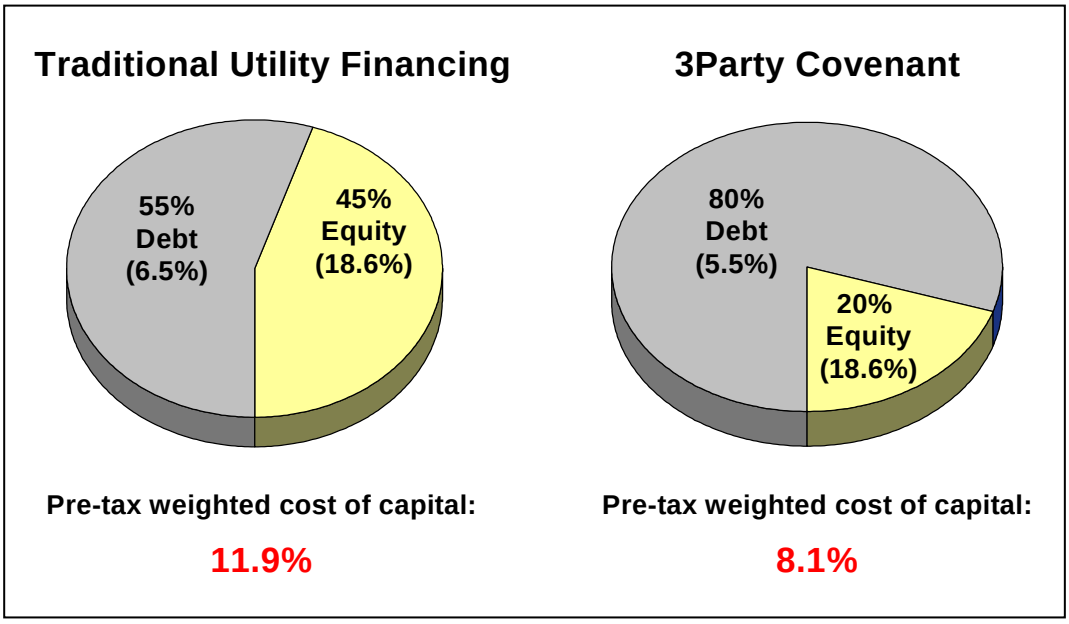
Payments by the Government are estimated based on the dollar amount guaranteed and the risk of loan default. Default risks are typically evaluated by Moody's or Standard & Poors. The risk of default provides for estimation of the expected payment (the risk of default times the amount guaranteed) to make the scoring determination. The Director of the Office of Management and Budget (OMB) is charged with making this determination, but may elect to delegate the OMB's authority to another agency. To the extent the rating agencies and OMB view the 3Party Covenant as reducing the risk of default by providing a state PUC approved revenue stream, the federal budget cost (scoring) of the loan guarantees should be reduced. If loan guarantees under the 3Party Covenant were scored at 10 percent of the principal amount guaranteed, then $5 billion of loan guarantees (enough for about 3,500 MW) would cost the federal budget $500 million.

This budget impact is significantly less than alternative grant or energy production tax credit based incentive programs. As illustrated in Figure ES-6, a one cent/kWh production tax credit provided over a 30 year period (approximately the same economic benefit as provided by the 3Party Covenant) for 3,500 MW of IGCC would cost the federal government $7.8 billion, or sixteen times more than the 3Party Covenant. If provided for only 10 years, the one cent/kWh production tax credit (providing the project significantly less economic benefit than the 3Party Covenant) would still cost $2.6 billion, or more than 5 times more than the 3Party Covenant. Similarly, if a 30 percent federal grant were offered to offset IGCC capital costs, the federal budget cost would be more than 3.5 times more than the budget cost of the 3Party Covenant. The 3Party Covenant loan guarantee approach is significantly less costly to the federal government than these alternative incentive approaches and has the advantage of addressing the major financial obstacles to deployment (e.g., capital availability) that would not be addressed by a production tax credit or grant program.[33]

The 3Party Covenant program reduces the cost of energy from an IGCC power plant approximately 25 percent. The cost of energy reductions result from:

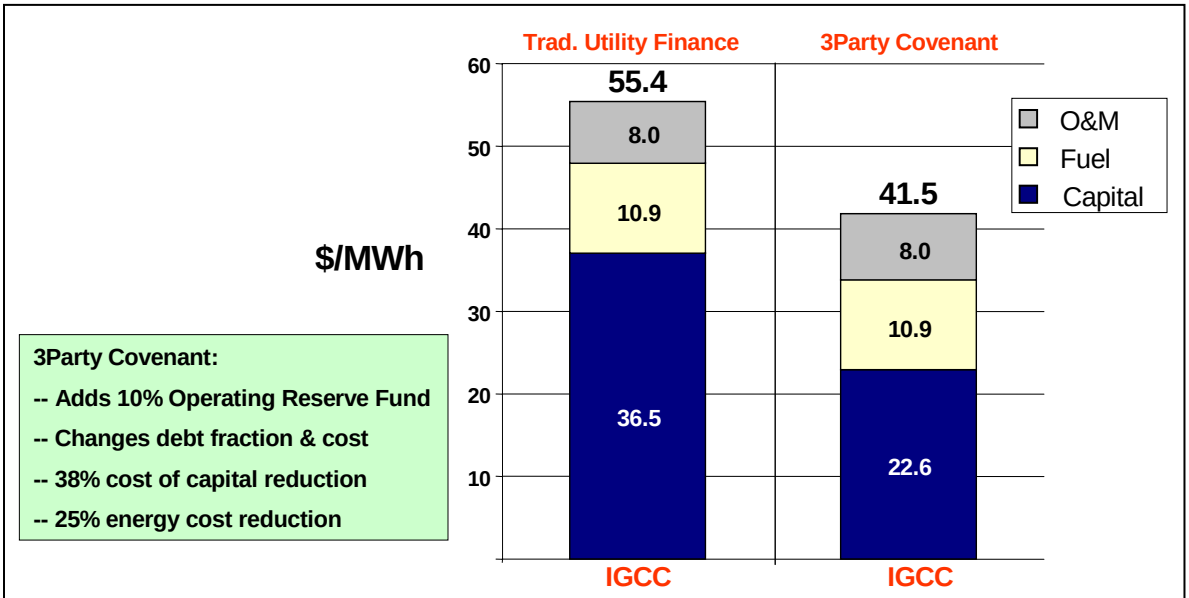
1. Providing for a significantly higher ratio of debt to equity than a traditional utility financing ratio (from 55/45 to 80/20 under the 3Party Covenant).
2. Lowering the cost of debt through the federal loan guarantee, which reduces

Figure ES-7. Cost of Capital Reduction under 3Party Covenant



[33] This is not to suggest that budget cost and capital availability are the only attributes that policy makers should consider. There may be other tradeoffs between a PTC and loan guarantee approach that policy makers may want to weigh, such as the requirements for administering the program and the risks associated with different approaches.

Figure ES-8. 3Party Covenant Impact on IGCC Cost of Energy



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%	**80%**
Debt Cost	6.5%	**5.5%**
Pre-Tax Equity Return	18.6%	18.6%

the interest charge from a typical 6.5 percent for a mid-grade utility bond to the 5.5 percent rate associated with a federal agency bond, in January 2004. Funding construction financing costs on a current basis by adding construction work in progress (CWIP) to the rate base and recovering these financing costs as they are incurred, rather than accruing these financing costs (which typically account for 10-15 percent of Overnight Capital Costs) and recovering them as part of the capital investment.

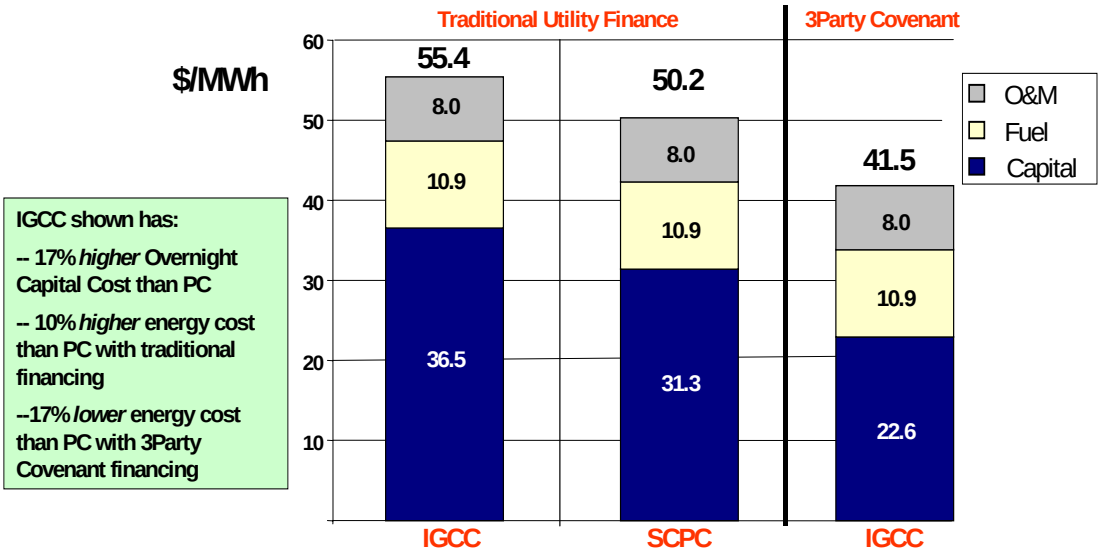
As illustrated in Figure ES-7, these changes reduce the pre-tax, nominal weighted average cost of capital of an IGCC plant over 30 percent from about 12 percent (traditional utility financing) to 8 percent (3Party Covenant). Since the cost of capital accounts for over 60% of the total cost of energy in a capital intensive coal based PC or IGCC, this change in cost of capital (along with the reduction in construction financing costs) reduces the total energy cost about 25 percent.

The impact of the 3Party Covenant is demonstrated by comparing the cost of energy associated with a reference IGCC plant financed under a traditional utility financing scenario, with the same plant financed under the 3Party Covenant. As illustrated in Figure ES-8, the reference IGCC plant financed under traditional utility financing has a

calculated cost of energy of 55.4 $/MWh, while the same plant financed under the 3Party Covenant has a cost of energy of 41.5 $/MWh. The 3Party Covenant reduces the cost of capital component of energy cost 38 percent and energy cost 25 percent. This energy cost reduction occurs despite the addition of a 10 percent capitalized Construction and Operating Reserve Fund ($70 million) in the 3Party Covenant scenario, which is included to ensure that funds are available to cover any cash flow shortfalls in the initial years of operation due to lower than expected plant availability, cost overruns, or other operational problems.

Figure ES-9 illustrates how the 3Party Covenant affects the relative cost of energy of IGCC compared to PC. The figure illustrates the Reference IGCC plant assuming traditional utility financing and under the 3Party Covenant compared to a PC plant built with traditional utility financing. The figure illustrates that the Reference IGCC plant has a 17 percent higher Overnight Capital Cost than the PC plant, which results in a 10 percent higher cost of energy when both are financed traditionally. However, when 3Party Covenant financing is applied to the IGCC plant, its cost of energy is reduced to a level 17 percent below the PC plant. Even if the entire 15 percent Line of Credit available to cover cost overruns is drawn by the project, the cost of energy remains 10 percent below the PC plant.

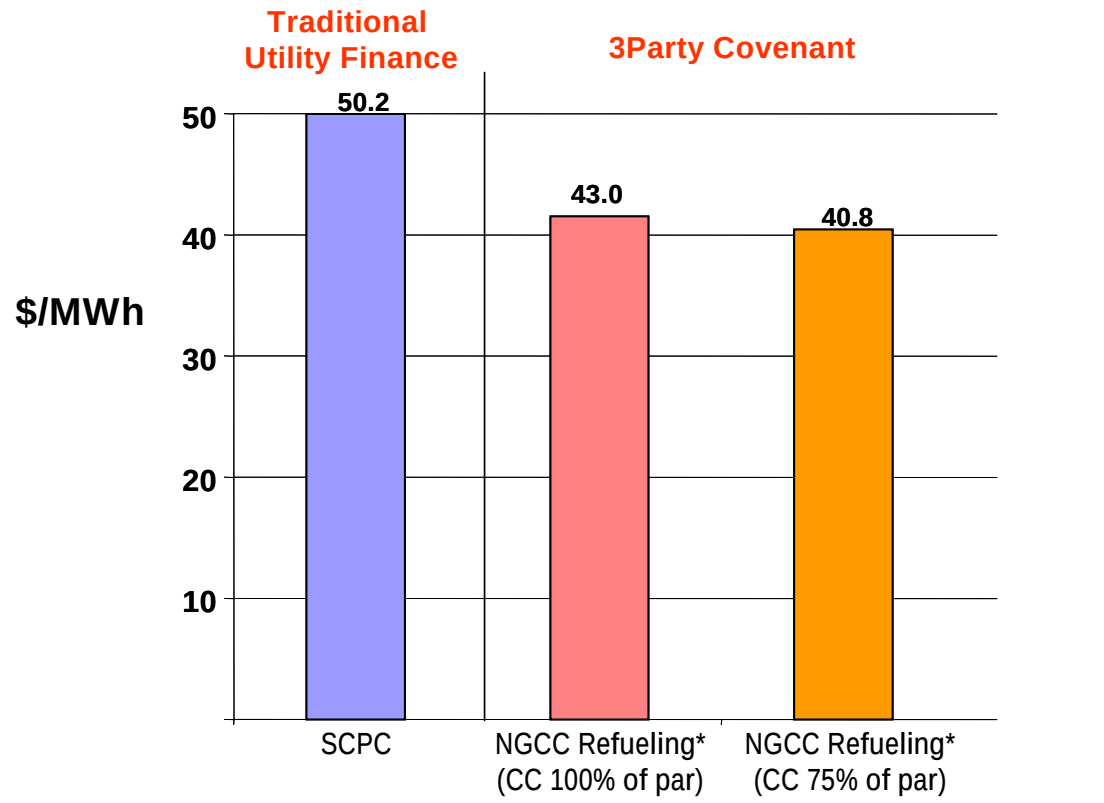
Figure ES-9. IGCC Cost of Energy versus Super-Critical PC



Overnight Capital Cost ($/kW)	$1,400	$1,200	$1,400
Fuel Cost ($/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%	80%
Debt Cost	6.5%	6.5%	5.5%
Pre-Tax Equity Return	18.6%	18.6%	18.6%

Opportunities have recently emerged to create even more favorable IGCC economics by financing the refueling of distressed NGCC assets with coal gasification systems under the 3Party Covenant. Under the reference case IGCC, it is assumed that the gasifier island accounts for about 65 percent of the $1,400/kW EPC cost, or roughly $900/kW and that the combined cycle power block costs about 35 percent, or $500/kW. In a distressed NGCC refueling scenario, the combined cycle power block may be available at a significantly reduced price. If available for refueling at 75 percent of par, the cost is about $375/kW, and at 50 percent of par, it is $250/kW. If these costs are applied as the combined cycle power block component of the IGCC EPC cost, the Overnight Capital Cost is reduced to $1,275/kW and $1,150/kW, respectively (well below the $1,400/kW reference case assumption).

Figure ES-10. Cost of Energy of NGCC Refueling under 3Party Covenant



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

In refueling scenarios, there is likely to be some inefficiency in design and construction of the gasification system and its integration due to retrofit requirements. For example, a $15/kW cost has been suggested by NETL for refitting the combustion turbine. Other costs might include the need for supplemental steam generation or site improvements. In addition, plant integration may be less than would be planned for a facility designed from the outset to be an IGCC, which may result in reduced efficiency. For this analysis, a five percent capital cost and one percent efficiency penalty is incorporated into the NGCC refueling scenarios to address these issues.

Figure ES-10 illustrates the cost of energy achieved in NGCC refueling scenarios assuming the combined cycle power block is contributed to the project at 75 percent of its original par value (assumed to be $500/kW). Figure ES-10 illustrates that combining 3Party Covenant financing and the potential cost savings associated with using existing distressed NGCC assets produces energy at levels below an all-new IGCC and at levels 19 percent below the reference PC plant built with traditional utility financing. Actual project savings will depend on the cost of the distressed asset to the project and the level of additional cost associated with retrofitting the combined cycle power block to work

with a coal gasification system. For example, if the combined cycle power block were contributed to the project at 50% of par, the cost of energy would be about 23 percent below the traditionally financed PC, or $38.7/MWh.

ES-5. Implementation

Implementation of the 3Party Covenant requires federal legislation authorizing loan guarantees for qualifying IGCC projects. Consideration must be given to a number of implementation issues in developing legislation to ensure the program meets IGCC deployment objectives with minimal federal budget impact. Meeting deployment objectives will require determining the desired level of investment (in what timeframe), and ensuring that the economic and financial hurdles that have inhibited IGCC commercial deployment to date are adequately addressed. Section ES-7 below outlines recommended components of federal legislation for implementing the 3Party Covenant to stimulate 3,500 MW of IGCC deployment through authorization of $500 million of budget scoring appropriations to support $5 billion of federal loan guarantees.

The timing of 3Party Covenant implementation is dependent on enactment of federal legislation to establish a loan guarantee program. Proposed energy legislation debated by Congress in 2003 provided significant tax and loan guarantee incentives for clean coal technologies, including IGCC. Ongoing energy policy discussions and wide support for advancing clean coal technologies provide a window of opportunity for near term discussion and implementation. The sooner a program is put in place, the sooner the energy and environmental benefits of IGCC deployment (described in detail in Section 1 of this report) will be realized, a circumstance that should provide strong motivation for lawmakers to consider near-term legislative action.

Implementation of the 3Party Covenant also requires that states establish regulatory mechanisms for review, approval and recovery of IGCC project costs. Section 8 (Volume II) of this report, describes the status of state electric utility regulatory programs in three states with regulated retail electricity service (Indiana, Kentucky and New Mexico) and two states with competitive retail electricity markets (Ohio and Texas) to identify how the different regulatory programs affect 3Party Covenant implementation. Section 9 (Volume II) provides a model state regulatory mechanism for implementing the 3Party Covenant.

ES-6. Components of Federal Legislation for Implementing 3Party Covenant

The outline below describes recommended components of federal legislation to implement the 3Party Covenant. These components are designed to stimulate development of 3,500 MW of IGCC generation with federal loan guarantees of $5 billion. The program is targeted at stimulating deployment of IGCC technology, which is the focus of this paper. This or other incentive programs may be appropriate for IGCC and other advanced coal technologies.

Purpose

Establish a federal loan guarantee program that stimulates deployment of IGCC by reducing cost of capital, apportioning risk, and assisting with pre-development costs in order to:

- Support U.S. energy independence
- Promote homeland security
- Improve coal generation environmental performance
- Increase generation efficiency
- Refuel and revalue billions of dollars of financially distressed and underutilized natural gas combined cycle investments
- Reduce pressure on natural gas prices
- Provide affordable and reliable electricity supplies
- Position the U.S. as a global leader in advanced coal generation technology
- Minimize the burden to the federal budget

Scope

- $500 million appropriations to score up to $5 billion of federal loan guarantees for 3,500 MWs of base load capacity:
    - $450 million for scoring loan guarantees
    - $50 million revolving fund for pre-development engineering loans
    - Loan guarantees may be committed for a period of 10 years beginning with the first fiscal year the program is funded.
- Program shall be implemented through an accelerated rulemaking process to be completed within 12 months of enactment
- Program shall authorize the collection of application or other fees to cover administrative costs as well as insurance fees to the extent such fees are determined to be appropriate by the Secretary

Loan Guarantees

- Up to 80% of total plant Investment
- 30-year term, non-recourse, backed by full faith and credit of U.S. Government
- Owner contributes 20% equity investment

Qualifying Projects

- An IGCC or other coal-fueled power plant technology with the following performance characteristics:
    - Coal accounts for at least 75% of fuel heat input
    - In the case of IGCC, combustion turbine operates on syngas as primary fuel (natural gas or diesel may serve as an emergency back-up fuel only)
    - Design heat rate of 8,700 btu/kWh (HHV) or lower
    - New power plant, repowering of an existing coal power plant, or refueling of an existing natural gas combined cycle power plant
- Emissions Performance:
    - 99% sulfur reduction with SO_2 emission not to exceed 0.04 lb/mmBtu
    - NOx emissions not to exceed 0.025 lb/mmBtu (5 ppm)
    - Particulate emissions from stack not to exceed 0.01 lb/mmBtu
    - 95% mercury emissions control
- Determination by DOE that the technology provides a technical pathway for CO_2 separation and capture and for the co-production of hydrogen slip-streams.
- To minimize federal budget scoring, qualifying projects shall have:
    - 3Party Covenant assured revenue stream through state PUC or other regulatory body providing upfront and ongoing regulatory determinations of prudence of project costs and approvals of pass-through of project costs (reflecting ongoing inclusion of approved capital investments in rate base and inclusion of approved operating costs in the cost of service, or reflecting purchased power costs incurred under a power purchase agreement) under federal and state enabling laws ("Regulatory Determinations"); or
    - Comparable credit (and budget scoring) as that provided by 3Party Covenant Regulatory Determinations, which might be created through insurance, industrial guarantees, or other credit enhancements.
- Projects shall include EPC contractor performance and delivery guarantees (full wrap) for project construction.
- Initial financing shall include a Construction and Operating Reserve Fund of 10 percent of Capital Costs to cover revenue shortfall from startup operations, unscheduled maintenance, etc., and provide Line of Credit for additional draw of up to 15 percent of Capital Costs with an additional minimum matching equity contribution of 20 percent of the amount drawn.

- Secretary shall issue guarantees only for projects with budget scoring that does not exceed 10% of loan principal.
- Secretary shall develop criteria for issuing loan guarantee reservations (commitments prior to closing) for projects that have demonstrated feasibility and meet program qualifications

Pre-development Engineering Loans

- Non-recourse, interest-free loans shall be available for 75% of the cost of developing initial engineering and feasibility evaluations of potential projects
- Developer will be required to provide 25% cash match
- Loans not to exceed $5 million dollars
- Loans to be repaid out of long-term project loan disbursements and placed into a revolving loan fund
- Secretary shall develop criteria for selecting projects to receive Pre-development Engineering Loans, taking into account project timing, feasibility and ability to meet Project Selection Criteria (below)

Project Selection

- Secretary shall establish Project Selection Criteria, including consideration of the following elements:
    - Utilization of diverse coal supplies and types
    - Competitive electricity prices
    - Geographic diversity
    - Project feasibility
    - Financial strength of project
    - Environmental performance