# Wabash River Integrated Methanol and Power Production from Clean Coal Technologies (IMPPCCT)

**Quarterly Technical Progress Report No. 12**

For the Period

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and

Subcontractors: Air Products And Chemicals Inc., The Dow Chemical Company, Dow Corning Corporation, Methanex Corporation, And Siemens Westinghouse Power Corporation

## DISCLAIMER

# ABSTRACT

The Wabash River Integrated Methanol and Power Production from Clean Coal Technologies (IMPPCCT) project is evaluating integrated electrical power generation and methanol production through clean coal technologies. The project is conducted by a multi-industry team lead by Gasification Engineering Corporation (GEC), a company of Global Energy Inc., and supported by Air Products and Chemicals, Inc., Dow Chemical Company, Dow Corning Corporation, Methanex Corporation, and Siemens Westinghouse Power Corporation. Three project phases are planned for execution over several years, including:

I. Feasibility study and conceptual design for an integrated demonstration facility, and for fence-line commercial embodiment plants (CEP) operated at Dow Chemical or Dow Corning chemical plant locations
II. Research, development, and testing to define any technology gaps or critical design and integration issues
III. Engineering design and financing plan to install an integrated commercial demonstration facility at the existing Wabash River Energy Limited (WREL) plant in West Terre Haute, Indiana.

The WREL facility is a project selected and co-funded under the Round IV of the U.S. Department of Energy's (DOE's) Clean Coal Technology Program. In this project, coal and/or other solid fuel feedstocks are gasified in an oxygen-blown, entrained-flow gasifier with continuous slag removal and a dry particulate removal system. The resulting product synthesis gas is used to fuel a combustion turbine generator whose exhaust is integrated with a heat recovery steam generator to drive a refurbished steam turbine generator. The gasifier uses technology initially developed by The Dow Chemical Company (the Destec Gasification Process), and now offered commercially by Global Energy, Inc., as the E-GAS™ technology.

In a joint effort with the DOE, a Cooperative Agreement was awarded under the Early Entrance Coproduction Plant (EECP) solicitation. GEC and an Industrial Consortium are investigating the use of synthesis gas produced by the E-GAS™ technology in a coproduction environment to enhance the efficiency and productivity of solid fuel gasification combined cycle power plants.

The objectives of this effort are to determine the feasibility of an EECP located at a specific site which produces some combination of electric power (or heat), fuels, and/or chemicals from synthesis gas derived from coal, or, coal in combination with some other carbonaceous feedstock. The project's intended result is to provide the necessary technical, economic, and environmental information that will be needed to move the EECP forward to detailed design, construction, and operation by industry.

During the reporting period, a sulfur removal process being commercialized for natural gas application was investigated for polishing the synthesis gas prior to methanol synthesis. Additional changes and transition of key project personnel continued to slow the progress of the project. A no-cost time extension for Phase I of the project to February 7, 2003 was requested by GEC and granted by DOE.

# TABLE OF CONTENTS

# FIGURES



# TABLES

## ACRONYMS AND DEFINITIONS

| Acronym | Description |
|---|---|
| ASU | Air Separation Unit |
| BFW | Boiler Feed-Water |
| BGL | British Gas Lurgi |
| CC | Combined Cycle (plant including only HRSG, CT & ST) |
| CEP | Commercial Embodiment Plant |
| CT | Combustion Turbine |
| CCT | Clean Coal Technologies |
| DCAA | Defense Contract Audit Agency |
| DOE | Department of Energy |
| EECP | Early Entrance Coproduction Plant |
| E-GAS™ | Title of Global Energy, Inc.'s Gasification Process |
| EVA | Energy Ventures Analysis Inc. |
| GEC | Gasification Engineering Corporation |
| GJ | Giga Joule |
| GPMEOH | Gas Phase Methanol |
| GTW | Gas Turbine World |
| HHV | Higher Heating Value in Btu/SCF |
| HRSG | Heat Recovery Steam Generator |
| HTHRU | High Temperature Heat Recovery Unit |
| IGCC | Integrated Gasification Combined Cycle |
| IMPPCCT | Integrated Methanol and Power Production from Clean Coal Technologies |
| KPaa | Kilo Pascals Atmospheric (pressure) |
| KPag | Kilo Pascals Gauge (pressure) |
| LGTI | Louisiana Gasification Technology Incorporated |
| LOX | Liquid Oxygen |
| LPMEOH™ | Liquid Phase Methanol (process) |

| Acronym | Description |
|---|---|
| MAC | Main Air Compressor |
| MDEA | Methyl-Di-Ethanol Amine (solvent) |
| MeOH | Methanol |
| MMBtu | Million British Thermal Units |
| MP | Medium Pressure |
| Mt | Metric Ton |
| MTPD | Metric Ton Per Day |
| MW | Mega Watt |
| NETL | National Energy Testing Laboratory |
| NOAA | National Oceanic and Atmospheric Administration |
| NOx | Oxides of Nitrogen (symbol) |
| NPV | Net Present Value |
| O&M | Operating & Maintenance |
| PPMV | Parts Per Million Volume |
| PSE | Power Systems Engineering |
| RD&T | Research, Development & Test (plan) |
| Q | Heat Flow in MMBtu/Hour |
| SCF | Standard Cubic Foot |
| SFC | Synthetic Fuels Corporation |
| SRC | Steam Raising Converter |
| ST | Steam Turbine |
| SWPC | Siemens Westinghouse Power Corporation |
| Syngas | Synthesis Gas |
| TPD | Tons Per Day |
| WBS | Work Breakdown Structure (activities) |
| WREL | Wabash River Energy Ltd. |

# 1.0 BACKGROUND

## 1.1 E-GAS™ Process Background

The Gasification Engineering Corporation (GEC), a company of Global Energy Inc. headquartered in Houston Texas, develops and markets the E-GAS™ coal gasification process. The E-GAS™ technology is utilized at Global Energy's Wabash River Energy Ltd., (WREL) facility located at Cinergy's Wabash River Generating Station in West Terre Haute, Indiana. Global Energy, Inc. is a privately owned company headquartered in Cincinnati, Ohio.

The E-GAS™ process features an oxygen-blown, continuous-slagging, two-stage, entrained-flow gasifier, which uses natural gas for start-up. Coal or petroleum coke is milled with water in a rod-mill to form slurry. The slurry is combined with oxygen in mixer nozzles and injected into the first stage of the gasifier, which operates at approximately 2600°F and 400 psi. A turnkey, Air Liquide, 2,060-ton/day low-pressure cryogenic distillation facility that WREL owns and operates, supplies oxygen of 95% purity.

In the first stage, slurry fuel undergoes a partial oxidation reaction at temperatures high enough to bring the coal's ash above its melting point. The fluid ash falls through a taphole at the bottom of the first stage into a water quench, forming an inert vitreous slag. The synthesis gas produced by this reaction then flows to the second stage, where additional coal slurry is injected. This coal is pyrolyzed in an endothermic reaction with the hot synthesis gas to enhance the heating value of the synthesis gas and to improve the overall efficiency of the process.

The synthesis gas then flows to the high-temperature heat-recovery unit (HTHRU), essentially a fire tube steam generator, to produce high-pressure saturated steam. After cooling in the HTHRU, particulates in the synthesis gas called char are removed in a hot/dry filter and recycled to the gasifier where the carbon content in the char is converted into synthesis gas. The synthesis gas is further cooled in a series of heat exchangers, is water scrubbed to remove the chloride, and is passed through a catalyst, which hydrolyzes carbonyl sulfide into hydrogen sulfide. Hydrogen sulfide is removed from the synthesis gas using a methyl-di-ethanol-based amine solvent in an absorber/stripper column process. The "sweet" synthesis gas is then moisturized, preheated, and piped over to the power block.

The key elements of the power block are the General Electric MS 7001 FA (GE 7 FA) high-temperature combustion turbine/generator, the heat recovery steam generator (HRSG), and the repowered steam turbine. The GE 7 FA is a dual-fuel turbine (synthesis gas for operations and No. 2 fuel oil for startup) that is capable of generating a nominal 192 MW when firing synthesis gas, about seven percent (7%) higher power production than the same turbine fired on natural gas. The enhanced power production is attributed to the increased mass flows associated with synthesis gas. Steam injection is used for control of nitrogen oxides called NOx within the combustion turbine. The required steam flow is minimal compared to that of conventional systems as the synthesis gas is moisturized at the gasification facility, by recovery of low-level heat in the process. The water consumed in this process is continuously made up at the power block by water treatment systems, which clarify and further treat river water.

The HRSG for this project is a single-drum design capable of superheating 754,000 lb/hr of high-pressure steam at 1010°F, and 600,820 lb/hr of reheat steam at 1010°F when operating on design-basis synthesis gas. The HRSG configuration was specifically optimized to utilize both the gas-turbine exhaust energy and the heat energy made available in the gasification process. The nature of the gasification process in combination with the need for strict temperature and pressure control of the steam turbine led to a great deal of creative integration between the HRSG and the gasification facility. The repowered steam turbine produces 104 MW, which combines with the combustion turbine generator's 192 MW and the system's auxiliary load of approximately 34 MW to yield 262 MW (net) to the Cinergy grid.

The Air Separation Unit (ASU) provides oxygen and nitrogen for use in the gasification process but is not an integral part of the plant thermal balance. The ASU uses services such as cooling water and steam from the gasification facilities and is operated from the gasification plant control room.

The gasification facility produces two commercial by-products during operation. Sulfur, which is ultimately removed as 99.99 percent pure elemental sulfur, is marketed to sulfur users. Slag is targeted as an aggregate in asphalt roads and as structural fill in various types of construction applications. In fact, the roads at the WREL facility have been top-coated with asphalt incorporating slag as the aggregate. Furthermore, at least two surrounding area sites have been audited, approved, and have used WREL generated slag as structural fill under the Solid Waste Management Rules of Indiana. Another beneficial use of the slag by-product is as a fluxing agent during petroleum coke operation as this feed is typically deficient in mineral content required for proper slag fusion and flow. For this use, WREL has retained a reserve supply of slag generated from coal gasification.

The E-GAS™ process flow diagram presented in Figure 1.1.1 illustrates the features and components described in the above text. In Table 1.1.1, the WREL production statistics during the demonstration period of the Clean Coal Technology Program are presented in both English and Metric units. In Table 1.1.2, the WREL thermal performance variables are compared to the process design basis for both coal and petroleum coke feedstocks.

Please refer to the listing in Section 8.1 of this report for additional information on the Wabash River Coal Gasification Plant.

**Figure 1.1.1: E-GAS™ Process Flow Diagram**

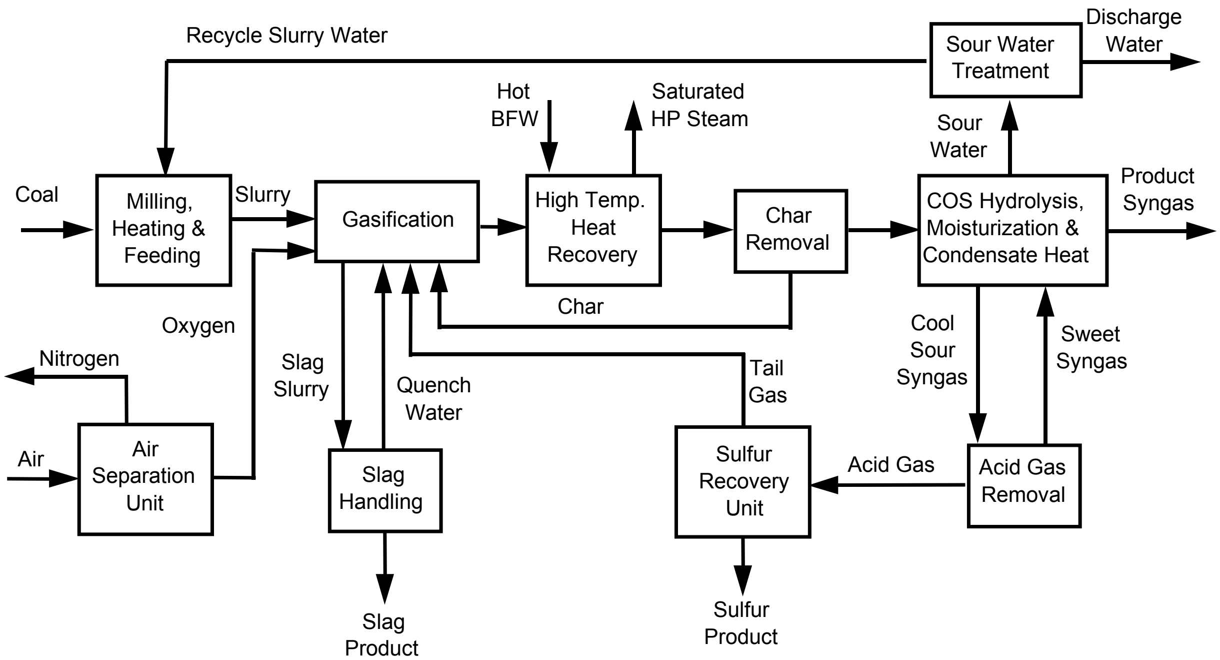


**Table 1.1.1 - WREL Gasification Production Statistics during the Demonstration Period of the Clean Coal Technology Program**

| Production Variable | Production Year | | | | |
|---|---|---|---|---|---|
| | 1996 | 1997 | 1998 | 1999 | 2000 |
| Gasifier Operation, Hrs | 1,902 | 3,885 | 5,279 | 3,496* | 3,406** |
| Dry Synthesis Gas Produced, GJ (MMBtu) | 2,922,015 (2,769,683) | 6,555,626 (6,213,864) | 9,316,716 (8,831,011) | 6,132,874 (5,813,151) | 5,497,588 (5,210,984) |
| Coal Processed, Mt (Tons) | 167,270 (184,381) | 356,368 (392,822) | 500,316 (551,495) | 335,538 (369,862) | 290,034 (319,703) |
| Longest Operating Campaign, (days) | 19 | 46 | 82 | 60 | 104 |

* Three months of production were lost to the GE 7FA compressor failure & repair.
** Three months of production were lost during commercial negotiations required when the WREL Facility transitioned to market-based operation.

**Table 1.1.2: Overall Thermal Performance of Gasification at WREL**

| Performance Feature | Design | Actual Performance | |
|---|---|---|---|
| | | Coal | Coke |
| Nominal Throughput, TPD | 2550 | 2450 | 2000 |
| Synthesis gas Capacity, MMBtu/hr | 1780 | 1690[†] | 1690[†] |
| Combustion Turbine, MW | 192 | 192 | 192 |
| Steam Turbine, MW | 105 | 96 | 96 |
| Aux. Power, MW | 35 | 36 | 36 |
| Net Generation, MW | 262 | 261 | 261 |
| Plant Efficiency, % (HHV) | 37.8 | 39.7 | 40.2 |
| Sulfur Removal Efficiency, % | >98 | >99 | >99 |

[†] Synthesis gas capacity referenced for coal and petroleum coke are the actual quantities fed to the combustion turbine when 192 MW (100%) of power generation occurs.

## 1.2 EECP Background Information

The request for Cooperative Agreement Proposals under the "Early Entrance Coproduction Plant (EECP)," Solicitation Number DE-SC26-99FT40040 was issued on February 17, 1999, by the United States Department of Energy.

The objective of this effort is to determine the feasibility of an EECP located at a specific site which produces some combination of electric power (or heat), fuels, and/or chemicals from synthesis gas derived from coal, or, coal in combination with some other carbonaceous feedstock. The scope of this effort includes:

a. Market analysis to define site-specific product requirements (i.e. products needed by market, market size, and price), process financials, feedstock availability, and feedstock cost;

b. System analysis to define feedstocks, feedstock preparation, conversion to synthesis gas, synthesis gas cleanup, and conversion of synthesis gas to market-identified products;
c. Preliminary engineering design of the EECP facility;
d. Preparation of a research, development, and test (RD&T) plan that addresses the technical uncertainties associated with eventual design, construction, and operation of the EECP;
e. Implementation of RD&T Plan;
f. Revision of the preliminary engineering design; and
g. Preparation of a project financing prospectus for obtaining private sector funding to perform the detailed design, construction, and operation of the EECP.

Efforts under Solicitation No. DE-SC26-99FT40040 must support an EECP that at a minimum:

a. Is a single-train facility of sufficient size to permit scaling to commercial size with minimal technical risk;
b. Provides the capability of processing multiple feedstocks (must be capable of processing coal) and producing more than one product;
c. Is undertaken by an industrial consortium;
d. Reduces risk such that future coproduction plants may be deployed with no government assistance; and
e. Meets or exceeds environmental requirements and discusses the issue of carbon dioxide reduction by one or more routes, which include mitigation, utilization, and sequestration.

Using a focused RD&T Plan, the EECP Project will enhance the development and commercial acceptance of coproduction technology that produces high-value products, particularly those that are critical to our domestic chemical, fuel, and power requirements. The proposed project will resolve critical knowledge and technology gaps on the integration of gasification and downstream processing to coproduce some combination of power, fuels and/or chemicals from coal or coal in combination with other carbonaceous feedstocks. The project's intended result is to provide the necessary technical, financial, and environmental information that will be needed to move the EECP forward to detailed design, construction, and operation by industry.

## 2.0 INTRODUCTION

The Wabash River Integrated Methanol and Power Production from Clean Coal Technologies (IMPPCCT) project is a $4.92 million cooperative agreement between the United States Department of Energy (DOE) and the Gasification Engineering Corporation (GEC) to evaluate the integration of gasification-based electrical generation and methanol production processes to determine the economic and technical feasibility of power/chemicals coproduction. A multi-industry team led by GEC and consisting of Air Products & Chemicals, Inc., Dow Chemical Company, Dow Corning Corporation, Methanex Corporation, and Siemens Westinghouse Power Corporation will perform the IMPPCCT study.

The consortium for the Wabash River IMPPCCT plans to analyze and develop a concept of methanol and power production based on GEC's E-GAS™ Gasification Process utilizing coal and other feedstocks. In a planned three-Phase project, this team plans to review and fully analyze the domestic methanol market, examine the criteria needed and develop a robust financial model to study the economics of full-scale implementation of this gasification-methanol coproduction concept. Potential Dow Chemical and Dow Corning sites for the Commercial Embodiment Plant (CEP) will be examined. Feasibility studies, testing and engineering, and financing of IMPPCCT based on addition of methanol production facilities at the Wabash River Energy Limited (WREL) Gasification Plant in West Terre Haute, Indiana will be developed to enable the commercialization of the gasification-methanol production concept.

The vision of this project is to demonstrate the commercial viability of producing electric power, process energy (steam), and chemicals (methanol) from coal and other hydrocarbon feedstocks to satisfy the demands of at least two types and corresponding sizes of host chemical complexes. An efficient, low capital, integrated facility will convert the feedstock initially to synthesis gas and ultimately to electric power, process energy, and methanol with a series of reliable, commercially proven, and environmentally sound unit operations. The chemical products, required process energy, and at least a portion of the electric power will be delivered to the host chemical complex for further conversion to higher value products. Any products in excess of the requirements of the host chemical complex will be sold through readily accessible distribution networks. The CEP will be technically verified from the IMPPCCT demonstration and commercially verified by an economic model and a project financing prospectus.

## 3.0 EXECUTIVE SUMMARY

The Wabash River Energy Limited (WREL) facility is a project selected and co-funded under Round IV of the U.S. Department of Energy's Clean Coal Technology Program. In this project, coal and/or other solid fuel feedstocks are gasified in an oxygen-blown, entrained-flow gasifier with continuous slag removal and a dry particulate removal system. The resulting product synthesis gas is used to fuel a combustion turbine generator whose exhaust is integrated with a heat recovery steam generator to drive a refurbished steam turbine generator. The gasifier uses technology initially developed by The Dow Chemical Company (the Destec Gasification Process), and now offered commercially by Global Energy, Inc., as the E-GAS™ technology.

The project demonstration was completed in December 1999, having achieved all of its objectives. The facility built for this project is located at Cinergy Corporation's Wabash River Generating Station near West Terre Haute, Indiana.

The Wabash Repowering project successfully demonstrated commercial application of the E-GAS™ coal gasification technology in conjunction with power generation. The combustion turbine generates 192 MW while the repowered steam turbine generates 104 MW. With the system's parasitic load of 34 MW, net power production is 262 MW, which meets the target goal. By the end of the demonstration period of the Clean Coal Technology Program, operating time had exceeded 18,000 hours, with over 5 million MW of power produced. The Wabash facility operates successfully on baseload dispatch in the Cinergy power grid, and continues to operate as a privately owned facility after the demonstration period to supply synthesis gas to Cinergy.

Gasification is an environmentally superior means of utilizing domestic coal resources for power production. It also offers the opportunity to use lower quality, less expensive feedstocks such as petroleum coke. Petroleum coke operation was successfully tested at WREL as early as November 1997. Since August 2000, the facility has been operating on 100% petroleum coke feed. As of October 2002, over 700,000 tons of petroleum coke has been processed, demonstrating the commercial viability of petroleum coke as the principle fuel for gasification.

Sulfur removed from the gasifier's solid feed is recovered and sold, as is the slag byproduct. Sulfur removal exceeds 97% resulting in $SO_X$ emissions of 0.1 lb/million Btu, which is far below regulatory requirements of 1.2 lb/million Btu. Particulate emissions are less than the detectible limit and NOx emissions are 0.15 lb/million Btu, which meets the current target for coal-fired power generation plants. The WREL facility is the cleanest solid fuel based power plants in the world.

In a joint effort with the U.S. Department of Energy (DOE), a Cooperative Agreement titled "Integrated Methanol and Power Production from Clean Coal Technologies" (IMPPCCT), was awarded under the Early Entrance Coproduction Plant (EECP) solicitation to Gasification Engineering Corporation (GEC), a company of Global Energy Inc. An Industrial Consortium led by GEC and supported by Air Products, Dow Chemical, Dow Corning, Methanex, and Siemens Westinghouse is investigating the use of synthesis gas produced by the E-GAS™ technology in a coproduction environment to enhance the efficiency and productivity of solid fuel gasification combined cycle plants.

The objective of this effort is to determine the feasibility of an EECP located at a specific site which produces some combination of electric power (or heat), fuels, and/or chemicals from synthesis gas derived from coal, or, coal in combination with some other carbonaceous feedstock. The sites chosen are the existing WREL facility and greenfield locations within the Dow Chemical and Dow Corning manufacturing complexes. The project's intended result is to provide the necessary technical, financial, and environmental information that will be needed to move the EECP forward to detailed design, construction, and operation by industry.

During this reporting period, a direct sulfur removal process being commercialized for removing low levels of hydrogen sulfide from natural gas was investigated for polishing the synthesis gas in the IMPPCCT project. Initial study showed some promise in the process. Process details as well as capital and operating cost information are being obtained for further evaluation.

Additional changes and transition of key project personnel for the GEC team during the reporting period has continued to slow the progress of the project and hampered the production of project reports. A no-cost time extension for Phase I of the project to February 7, 2003 was requested by GEC and granted by DOE.

For the calendar year period of reporting, total project spending was $16,160.53. The DOE cost share amount invoiced was $12,928.42. As a percentage, approximately 0.8% of the overall Phase I budget of $1,933,628 was spent during the reporting period, while total project spending is about 41.4% of the Phase I budget. The committed DOE funding is 80% of the total budget, or $1,546,902.

# 4.0 ACTIVITIES

## 4.1 Reporting/Personnel Transition Activity

During the reporting period, the GEC team experienced additional turnover of key project personnel. Therefore the overriding activity for this period has been the familiarization of the new team members with the project, procedures, and with the reporting requirements.

## 4.2 Synthesis Gas Contaminant Removal Activity

During this period, review of methods for the removal of contaminants from the product synthesis gas continued. A direct sulfur removal process being commercialized for removing low levels of hydrogen sulfide from natural gas was investigated for polishing the synthesis gas in the IMPPCCT project. Initial study showed some promise in the process. More process details as well as capital and operating cost information are being obtained for further evaluation. The process could be commercially available in the timeframe needed for both the WREL and the CEP IMPPCCT.

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## 5.0 RESULTS AND DISCUSSION

### 5.1 Reporting/Personnel Transition Results

During this period the new project personnel on the GEC team familiarized themselves with the project and all of the requirements that must be met in order to successfully complete Phase I of the project.

### 5.2 Synthesis Gas Contaminant Removal Results

A direct sulfur process for removing low levels of hydrogen sulfide from natural gas that is being commercialized is being evaluated for applicability to the IMPPCCT project. The process is similar to aqueous iron chelate redox processes that convert hydrogen sulfide directly to elemental sulfur. However, it uses a proprietary high-boiling hydrocarbon-based organic solution that does not have the problems, such as foaming and plugging of the equipment by sulfur deposits, encountered in the aqueous iron chelate systems. The organic solution acts only as the carrier and does not take part in the direct sulfur conversion reaction. Therefore it does not have to be regenerated after the elemental sulfur formed is removed from the solution. The solution can also tolerate high carbon dioxide concentrations in the feed gas such as the IMPPCCT synthesis gas, whereas in the aqueous iron chelate systems, sodium bicarbonate precipitates are formed with the carbon dioxide. The process has been pilot tested for natural gas applications. A commercial-scale plant is being started up in a West Texas natural gas production site. The new process is capable of reducing the hydrogen sulfide concentration to less than 4 ppmv. At this low level, use of sacrificial guard beds, such as zinc oxide, to provide the final cleanup of any trace sulfur species would be economical.

Initial investigation of the process looks promising. Additional process performance for synthesis gas feed as well as capital and operating cost has been requested for further evaluation. The process could be commercially available in the timeframe needed for both the WREL and the CEP IMPPCCT.

## 6.0 CONCLUSIONS

Under the guidance of the Project Management Plan, Phase I will be performed by all team members, GEC, Air Products, Methanex, Dow Corning, Siemens Westinghouse, and Dow Chemical. The Phase I focus is on development of the advanced economic model, analysis of the commercialization potential for the gasification to methanol and power coproduction concept for future CEP, and preliminary engineering and environmental work for implementation of the methanol production addition at Wabash River for the IMPPCCT demonstration. GEC has utilized the analysis of potential IMPPCCT feedstocks to the gasification section, developed a preliminary site layout, determined synthesis gas quantities available to IMPPCCT, assessed final synthesis gas cleanup needs, provided the preliminary environmental assessment, reviewed modifications and tie-ins to the existing infrastructure at the WREL site, and worked jointly with Air Products and Methanex to develop the most advantageous economics for IMPPCCT based on either the liquid or gas phase methanol processing units. Air Products has completed the review and application of the LPMEOH™ Process with methanol purification systems resulting in development of the methanol unit process package.

### 6.1 Synthesis Gas Contaminant Removal Conclusions

A newly developed direct sulfur removal process being commercialized for removing low levels of hydrogen sulfide from natural gas was investigated for polishing the synthesis gas in the IMPPCCT project. Sulfur species will poison the catalyst used in methanol synthesis. The direct sulfur removal process investigated is capable of reducing the hydrogen sulfide concentration to less than 4 ppmv. At this low level, use of sacrificial guard beds, such as zinc oxide, to provide the final cleanup of any trace sulfur species would be economical.

Initial investigation of the process looks promising. Additional process performance for synthesis gas feed as well as capital and operating cost has been requested for further evaluation. The process should be commercially available in the timeframe need for both the WREL and the CEP IMPPCCT.

### 6.2 Reporting Conclusions

Activity on completing the reporting requirements should increase during the next period as the new team members gain familiarity with the project.

## 7.0 MILESTONES & PLANS

### 7.1 Plans for Next Reporting Period

Efforts for the team during the next reporting period are expected to primarily concentrate on reporting requirements and delivery of items found within Table 7.2.1. The possibility of consolidating the remaining deliverable reports is being considered and will be discussed with DOE.

### 7.2 Project Schedule and Milestones

Figure 7.2.1 illustrates the original Phase I project milestone map. The blocks shown in full shading are those associated with the critical path to completion of Phase I. Hollow blocks are tasks which support the overall time table and/or result in deliverable items to the DOE. Due to continued resource allocation related issues, implementation of the project is behind schedule. GEC submitted a request for a no-cost time extension for Phase I of the project to February 7, 2003 during the reporting period. The request was granted by DOE.

During the reporting period, the project achieved only minor progress on reporting efforts for the Phase I study of the CEP. The remaining marketing milestones associated with ideal and specific CEP case studies are with only minor exception complete. Most of the continuing efforts dedicated to Phase I of this study will be devoted to CEP analysis and generation of outstanding deliverable items to DOE.

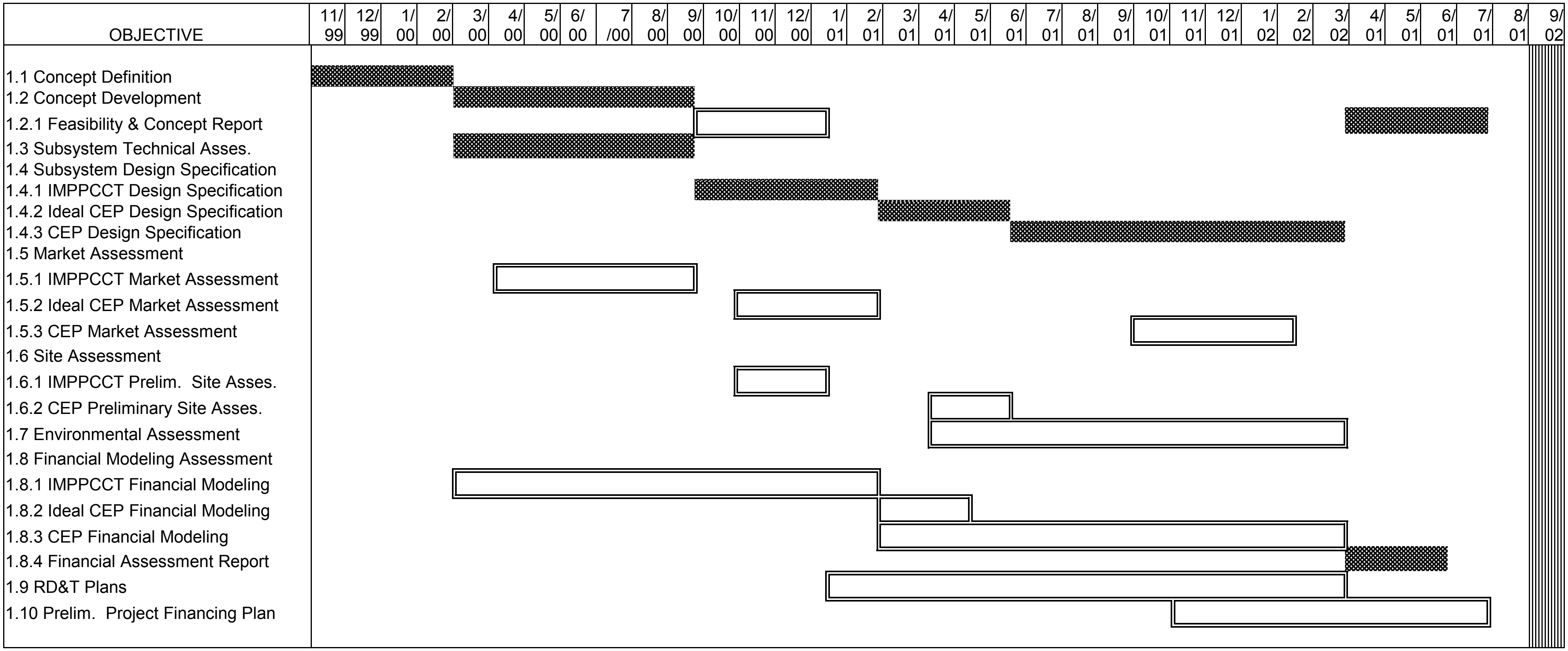
Resulting from the feasibility study work performed under Phase I within Tasks 1 through 10, deliverable reports are required periodically to finalize the obligations of certain tasks. The following Table 7.2.1 lists the specific deliverable requirements of Phase I.

**Table 7.2.1: Phase I Deliverable Requirements by Task**

| **Deliverable Report** | **Due Date** |
|---|---|
| Project Management Plan* | 60 days after executing a cooperative agreement with DOE, ending Task 1.1 |
| Initial Feasibility Report | 60 days after completing Task 1.2 |
| Concept Report | 60 days prior to the end of Phase I, including items from Task 1.2 through Task 1.8 of Phase I |
| Site Analysis Report | 60 days after completing Task 1.6 |
| Economic Analysis | 60 days after completing Task 1.8 |
| Research, Development and Test Plan | 60 days prior to the end of Phase I |
| Preliminary Project Financing Plan | 60 days prior to the end of Phase I |

*Completed

**Figure 7.2.1 : Phase I, IMPPCCT Milestones**



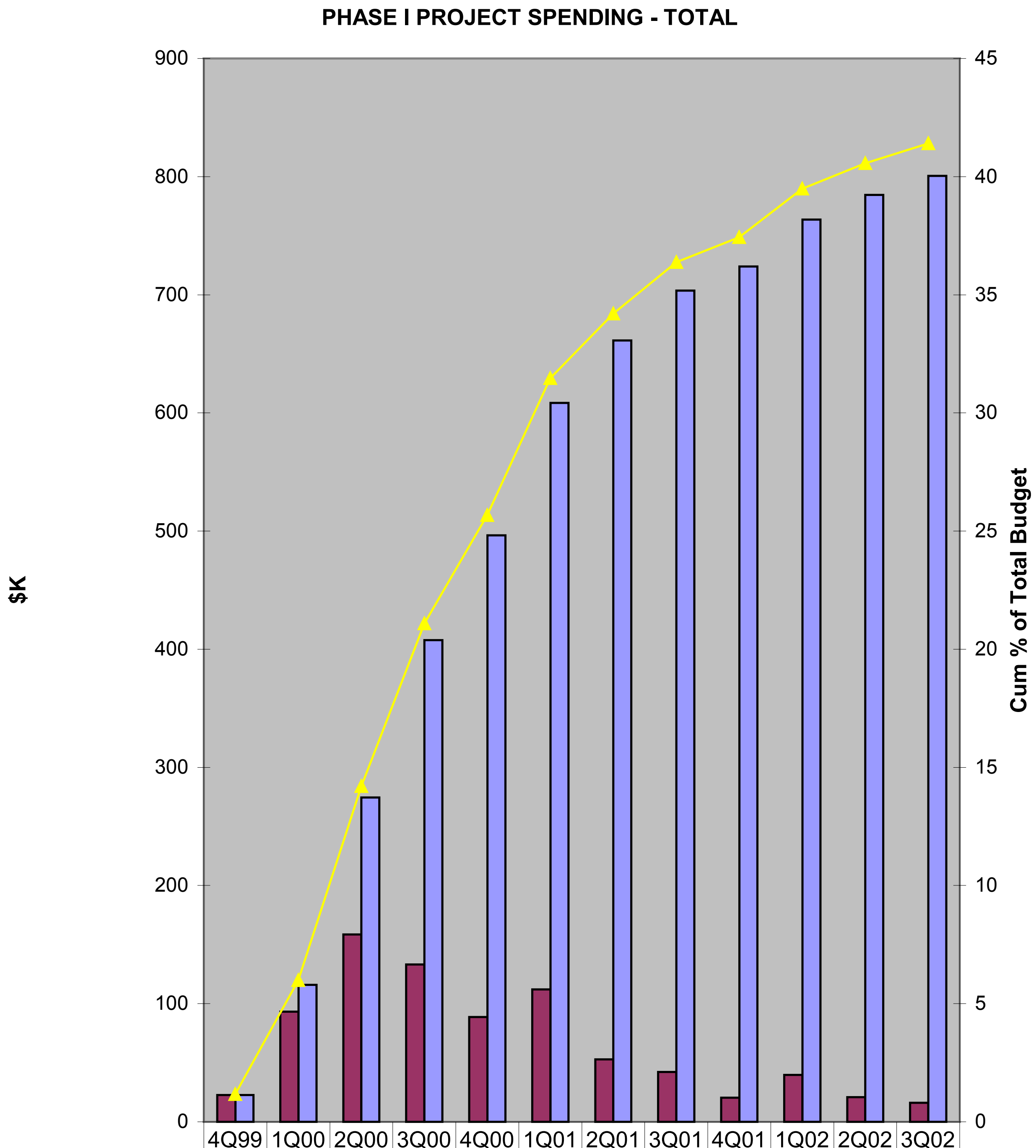

(Solid blocks indicate Critical Path; timing has not been updated for recent time extension granted by DOE)

### 7.3 Project Spending -- Plan and Actuals

For the calendar year period of reporting, total project spending was $16,160.53. The DOE was invoiced for the cost share amount of $12,928.42. As a percentage, approximately 0.8% of the overall Phase I budget of $1,933,628 was spent during the reporting period, while total project spending is about 41.4% of the Phase I budget. The DOE funding is at 80% of the total budget, or $1,546,902.

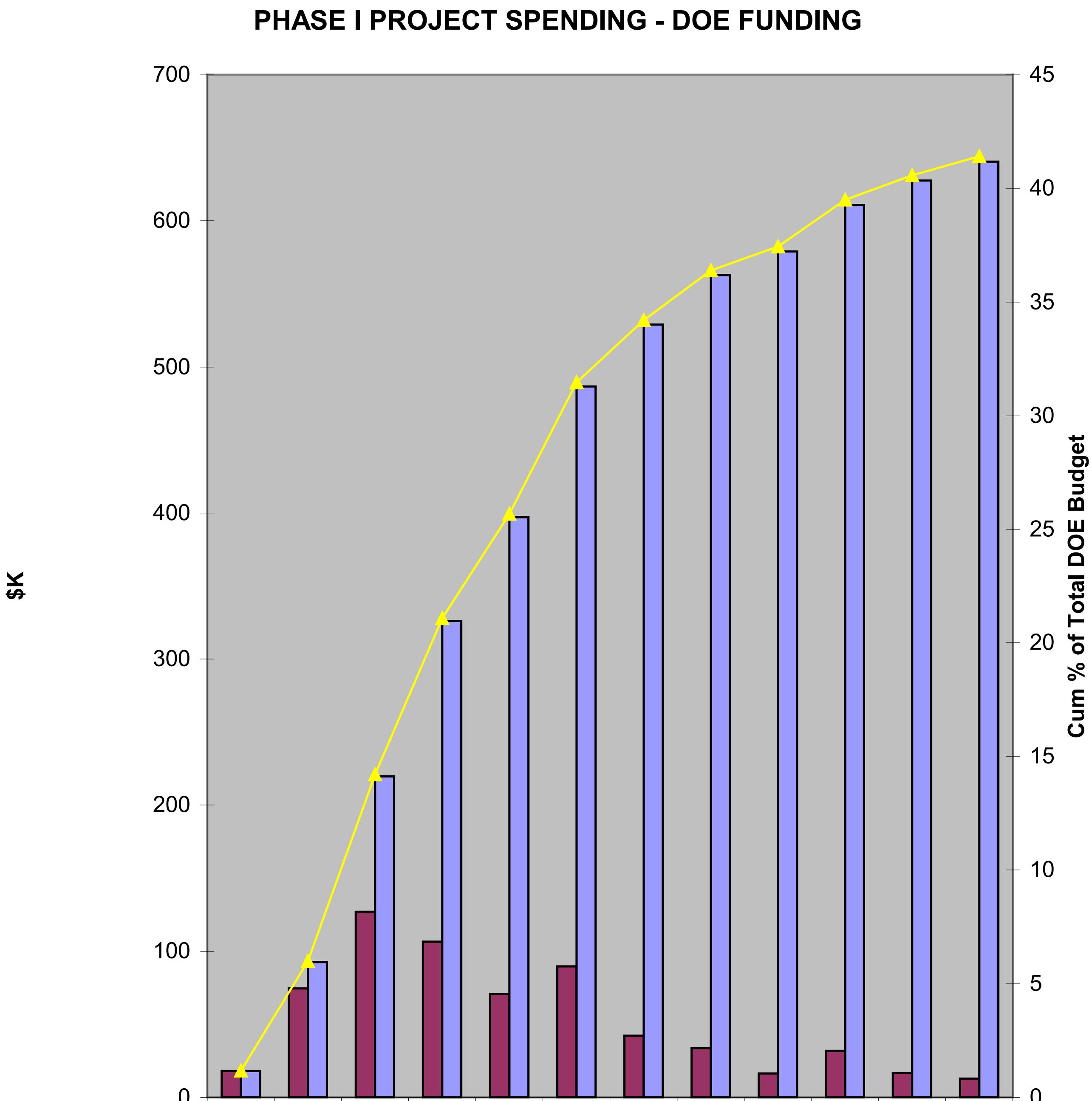
Figure 7.3.1 and Figure 7.3.2 present the actual total spending and spending of DOE cost share respectively for the IMPPCCT Phase I effort. Current spending pattern is far below plan.

**Figure 7.3.1: Phase I Project Spending - Overall**




| | 4Q99 | 1Q00 | 2Q00 | 3Q00 | 4Q00 | 1Q01 | 2Q01 | 3Q01 | 4Q01 | 1Q02 | 2Q02 | 3Q02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $K Spent | 22.6 | 93.3 | 158.6 | 133.1 | 88.7 | 112.1 | 52.9 | 42.1 | 20.4 | 39.7 | 20.8 | 16.2 |
| $K Cum | 22.6 | 115.9 | 274.5 | 407.7 | 496.4 | 608.5 | 661.4 | 703.5 | 723.9 | 763.6 | 784.4 | 800.6 |
| Cum % Spent | 1.2 | 6.0 | 14.2 | 21.1 | 25.7 | 31.5 | 34.2 | 36.4 | 37.4 | 39.5 | 40.6 | 41.4 |

**Figure 7.3.2: Phase I Project Spending – DOE Funding**




| | 4Q99 | 1Q00 | 2Q00 | 3Q00 | 4Q00 | 1Q01 | 2Q01 | 3Q01 | 4Q01 | 1Q02 | 2Q02 | 3Q02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $K Spent | 18.1 | 74.6 | 126.9 | 106.5 | 71.0 | 89.6 | 42.3 | 33.7 | 16.3 | 31.8 | 16.7 | 12.9 |
| $K Cum | 18.1 | 92.7 | 219.6 | 326.1 | 397.1 | 486.8 | 529.1 | 562.8 | 579.1 | 610.9 | 627.6 | 640.5 |
| Cum % Spent | 1.2 | 6.0 | 14.2 | 21.1 | 25.7 | 31.5 | 34.2 | 36.4 | 37.4 | 39.5 | 40.6 | 41.4 |

# 8.0 REFERENCES

## 8.1 Selected References Available via the Internet


1. **"National Energy Policy", issued by the White House in May 2001.** The Wabash River facility and Global Energy received mention in a dedicated sidebar on page 3-6.
   http://www.whitehouse.gov/energy/Chapter3.pdf

2. **"Wabash River Coal Gasification Repowering Project, An Update**", Department of Energy Topical Report No. 20, September 2000, summarizes the history of the Wabash River facility and its construction and four year demonstration under the DOE's Clean Coal Technology program.
   http://www.lanl.gov/projects/cctc/topicalreports/documents/topical20.pdf

3. **"Wabash River Coal Gasification Repowering Project Final Technical Report",** August 2000, 358 pages. This is a very detailed look at the Wabash River facility and its operation 1995-1999.
   http://www.lanl.gov/projects/cctc/resources/pdfs/wabsh/Final%20_Report.pdf

4. **"Gasification Plant Performance and Cost Optimization",** May 2002, (23 MB). The final report of Task 1 of this comprehensive ($2.4 million) study performed by Global Energy, Nexant and Bechtel under subcontract to the DOE to identify cost savings in the next generation of integrated gasification and coproduction facilities utilizing the E-Gas Technology. Detailed cost estimating by Bechtel.
   http://www.netl.doe.gov/coalpower/gasification/projects/systems/docs/40342R01.PDF

5. **"Wabash River Coal Gasification Repowering Project, A DOE Assessment",** January 2002. This is the DOE's official post-project assessment of the Wabash River project.
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6. **"Environmental Benefits of Clean Coal Technologies"** Department of Energy Topical Report No. 18, April 2001. This report describes a variety of processes that are capable of meeting existing and emerging environmental regulations and competing economically in a deregulated electric power marketplace
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7. **"Coproduction of Power, Fuel, and Chemicals"** Department of Energy Topical Report No. 21, September 2001. A description of the production of synthesis gas (syngas) from coal, the production of electricity from combusting a portion of the syngas and conversion of the remaining syngas to high-value fuels and chemicals.
   http://www.lanl.gov/projects/cctc/topicalreports/documents/topical21.pdf

8. **The Gasification Technology Council** maintains a website (www.gasification.org) that includes a library of the papers presented at recent conferences. Papers presented by Global Energy in 2002 & 2001:

   "Wabash River Repowering IGCC Operations and Performance Update Report", October 2002
   http://www.gasification.org/Presentations/2002_papers/GTC02010.pdf

   "Comparative IGCC Cost & performance for Domestic Coals", October 2002
   http://www.gasification.org/Presentations/2002_papers/GTC02018.pdf

   "NOx Control in IGCC Combustion Turbines: Steam vs. Nitrogen", October 2002
   http://www.gasification.org/Presentations/2002_papers/GTC02022.pdf

   "Optimized Petroleum Coke IGCC Coproduction Plant", October 2001
   http://www.gasification.org/98GTC/GTC01018.pdf

   "Environmental Performance of IGCC Repowering for Conventional Coal Power Plants", October 2001
   http://www.gasification.org/98GTC/GTC01037.pdf