CLEAN COAL TECHNOLOGY

DOE/FE-0459-1

Volume 1

Clean Coal Technology Programs: Program Update 2003

Includes Clean Coal Technology Demonstration Program, Power Plant Improvement Initiative, and Clean Coal Power Initiative Projects

As of May 2003

U.S. Department of Energy
Assistant Secretary for Fossil Energy
Washington, DC 20585

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Executive Summary	0	1	2	3	4	5	
Section 1 Role of Clean Coal Technology	0	1	2	3	4	5	
Section 2 Implementation	0	1	2	3	4	5	
Section 3 Funding and Costs	0	1	2	3	4	5	
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Overview

This 2003 annual update of clean coal technology (CCT) demonstration efforts marks a time of shifting emphasis from the Clean Coal Technology Demonstration Program (CCTDP) to the Clean Coal Power Initiative (CCPI) and the transitory Power Plant Improvement Initiative (PPII)—a precursor to CCPI. The CCTDP is nearing completion, with only 5 of 36 projects still ongoing. The CCPI, similar in scope to the CCTDP, is on the verge of implementing activities, following selection of first round projects earlier this year. Projects have begun under the single, focused PPII solicitation issued in 2001.

This annual report is presented in two volumes; *Volume 1—Clean Coal Technology Demonstrations: Program Update 2003* and *Volume 2—Clean Coal Technology Demonstration Program: Completed Projects 2003*. *Volume 1* focuses on ongoing CCTDP, PPII, and CCPI program and project activities and is to be updated annually. *Volume 2* captures results of completed projects as reported in the final reports and is to be updated as final reports are issued on remaining projects.

Volume 1—Clean Coal Technology Demonstrations: Program Update 2003 discusses the programmatic aspects of CCTDP, PPII, and CCPI in chronological order; and presents ongoing, active project information in project fact sheets organized by market sector – environmental control devices, advanced electric power generation, coal processing for clean fuels, and industrial applications. Section 1 first examines the importance of coal; discusses the role CCTDP, PPII, and CCPI play in meeting 21st century energy and environmental demands; reflects on environmental and market drivers; and addresses future CCT directions. Section 2 discusses the principles underlying CCTDP, PPII, and CCPI implementation, the implementation process, and results from each solicitation. Section 3 addresses funding for the CCT demonstrations and associated provisions, the financial status of the CCT programs, and project schedules. Section 4 reviews accomplishments to date under the CCT programs, including commercialization successes, provides sources for CCT information, and summarizes outreach events. Section 5 contains the project fact sheets for the ongoing, active projects.

Volume 2—Clean Coal Technology Demonstration Program: Completed Projects 2003 provides a project fact sheet for each completed project. The project fact sheets offer information on the participants, describe the project and technologies, present key findings, and provide links to more in-depth information. Also provided is a brief background on the CCTDP and associated accomplishments.

Executive Summary

Introduction

The *Clean Coal Technology Programs: Program Update 2003 (Program Update 2003)* addresses all three of the U.S. Department of Energy's (DOE) commercial-scale demonstrations of clean coal technologies (CCTs)—Clean Coal Technology Demonstration Program (CCTDP), Power Plant Improvement Initiative (PPII), and Clean Coal Power Initiative (CCPI). Together, these programs will ensure the nation's energy security and reliability, and protect the environment while using the nation's most abundant energy resource—coal. A separate volume, *Clean Coal Technology Programs: Completed Projects 2003* (*Completed Projects 2003*), includes fact sheets for the completed CCTDP projects. These reports provide a status of the programs since the beginning of fiscal year (FY) 2002 through May 31, 2003.

Programs

CCTDP

The CCTDP, a model of government and industry cooperation, advances DOE's mission to foster a secure and reliable energy system that is environmentally and economically sustainable. With 31 of the 36 active projects completed, the CCTDP has yielded CCTs that meet existing environmental regulations, compete in a competitive electric power marketplace, and provide a technical foundation for meeting future environmental demands.

The CCTDP is providing a portfolio of technologies that will assure that the U.S. recoverable coal reserves of 274 billion tons can continue to supply the nation's energy needs economically and in an environmentally sound manner. At the dawn of the 21st century, many of the CCTs have realized commercial application. Industry now stands ready to respond to the energy and environmental demands of the new century, both domestically and internationally. For existing power plants, the CCTDP provided cost-effective environmental control devices requisite to meeting year 2000 emission requirements for sulfur dioxide (SO_2), nitrogen oxides (NO_x), and particulate matter (PM). Also introduced were a new generation of technologies with the potential to commercially produce electricity and other commodities, and provide efficiencies and environmental performance responsive to emerging regulations and global climate change concerns. The CCTDP took a pollution prevention approach as well, demonstrating technologies that produce clean, coal-based solid and liquid fuels by removing pollutants or their precursors before being used. Lastly, new technologies were introduced into the major coal-using industries to enhance environmental performance. Thanks in part to the CCTDP, coal—abundant, secure, and economical—can continue in its role as a key component in the U.S. and world energy markets.

PPII

The Power Plant Improvement Initiative was established by Congress to provide for the commercial-scale demonstration of technologies to assure the reliability of the nation's energy supply from existing and new electric generating facilities. The single solicitation required participants to offer significant improvements in power plant performance leading to enhanced electric reliability.

Tidd PFBC Demonstration Project (The Ohio Power Company)—1991 Powerplant Award presented by *Power* magazine.

Tampa Electric Integrated Gasification Combined-Cycle Project (Tampa Electric Company)—1997 Powerplant Award presented by *Power* magazine.

CCPI

The Clean Coal Power Initiative is a government/industry partnership to implement the President's National Energy Policy (NEP) recommendation to increase investment in clean coal technology. This recommendation, one of several dealing with electricity, addresses the national challenge of ensuring the reliability of the U.S. electric supply while simultaneously protecting the environment. The goal is to accelerate commercial deployment of advanced technologies to ensure that the United States has clean, reliable, and affordable electricity. As part of this initiative, DOE's Office of Fossil Energy, through its National Energy Technology Laboratory (NETL), solicited applications for cost-shared projects.

The first CCPI (CCPI-I) Program Opportunity Notice (PON) sought projects that would demonstrate advanced coal-based technologies and accelerate their deployment for commercial use. The CCPI-I PON was designed to support the Clear Skies Initiative (CSI) through advanced pollution controls and the Global Climate Change Initiative through efficiency improvements for existing plants. As such, CCPI-I was open to any technology advancement related to coal-based power generation that results in efficiency, environmental, and economic improvements compared to currently available state-of-the-art alternatives. The solicitation was also open to technologies capable of producing any combination of heat, fuels, chemicals or other useful by-products in conjunction with power generation.

Highlights

CCTDP

Since the beginning of FY 2002, the following major events have occurred:

- Demonstration of Advanced Combustion Techniques for a Wall-Fired Boiler completed demonstration operations;
- Commercial-Scale Demonstration of the Liquid Phase Methanol (LPMEOH™) Process completed demonstration operations;
- JEA Large-Scale CFB Combustion Demonstration Project started operations;
- McIntosh Unit 4A PCFB Demonstration Project was terminated; and
- McIntosh Unit 4B Topped PCFB Demonstration Project was terminated.

A list of all the active and completed projects is shown in Exhibit ES-1.

PPII

The Department of Energy developed a PPII PON, incorporating general provisions of the CCTDP (per congressional direction) with some modifications to take into account lessons learned from the CCTDP. The program solicitation was issued on February 6, 2001 and 24 proposals were received on April 19, 2001. On September 28, 2001, a total of eight projects valued at over $110 million were selected for negotiations. Subsequently, two projects were withdrawn. Cooperative agreements have been signed with four of the participants. A list of all the active PPII projects is shown in Exhibit ES-2.

Demonstration of Innovative Applications of Technology for the CT-121 FGD Process Project (Southern Company Services, Inc.)—1994 Powerplant Award presented by *Power* magazine.

CCPI

The CCPI-I PON was issued March 4, 2002; 36 proposals were received by DOE on August 1, 2002; and selections were announced January 15, 2003. Eight projects valued at more than $1.3 billion, including $317 million in federal cost sharing support, were selected by DOE for funding. These projects include three multi-pollutant environmental control demonstrations ($188 million), two advanced power demonstrations ($517 million), two coal processing for clean fuels demonstrations ($634 million), and one industrial co-production applications demonstration ($9 million). Subsequently, one project was withdrawn. Negotiations for the cooperative agreement are underway for the remaining seven projects. A list of all the active CCPI projects is shown in Exhibit ES-3.

Outreach

The Office of Coal and Power Systems (OC&PS) and the National Energy Technology Laboratory (NETL) continued outreach efforts by supporting over 30 conferences, workshops, and trade missions related to CCTs. Five *Clean Coal Today* newsletters, one *Clean Coal Today Newsletter Index*, one *Program Update*, six *Project Performance Summary* reports, and two *Topical Reports* were published promoting the successes of DOE's CCT programs.

Exhibit ES-1
CCTDP Projects

Project and Participant	Location
CCTDP-I	
Development of the Coal Quality Expert™ (ABB Combustion Engineering, Inc. and CQ Inc.)	Homer City, PA
LIMB Demonstration Project Extension and Coolside Demonstration (The Babcock & Wilcox Company)	Lorain, OH
Advanced Cyclone Combustor with Internal Sulfur, Nitrogen, and Ash Control (Coal Tech Corporation)	Williamsport, PA
Enhancing the Use of Coals by Gas Reburning and Sorbent Injection (Energy and Environmental Research Corporation)	Hennepin and Springfield, IL
Tidd PFBC Demonstration Project (The Ohio Power Company)	Brilliant, OH
Advanced Coal Conversion Process Demonstration (Western SynCoal LLC)	Colstrip, MT
Nucla CFB Demonstration Project (Tri-State Generation and Transmission Association, Inc.)	Nucla, CO
JEA Large-Scale CFB Combustion Demonstration Project (JEA)	Jacksonville, FL
CCTDP-II	
SNOX™ Flue Gas Cleaning Demonstration Project (ABB Environmental Systems)	Niles, OH
Demonstration of Coal Reburning for Cyclone Boiler NO_x Control (The Babcock & Wilcox Company)	Cassville, WI
SOx-NOx-Rox Box™ Flue Gas Cleanup Demonstration Project (The Babcock & Wilcox Company)	Dilles Bottom, OH
Cement Kiln Flue Gas Recovery Scrubber (Passamaquoddy Tribe)	Thomaston, ME
Advanced Flue Gas Desulfurization Demonstration Project (Pure Air on the Lake, L.P.)	Chesterton, IN
Demonstration of Advanced Combustion Techniques for a Wall-Fired Boiler (Southern Company Services, Inc.)	Coosa, GA
Demonstration of Innovative Applications of Technology for the CT-121 FGD Process (Southern Company Services, Inc.)	Newnan, GA
Demonstration of Selective Catalytic Reduction Technology for the Control of NO_x Emissions from High-Sulfur, Coal-Fired Boilers (Southern Company Services, Inc.)	Pensacola, FL
180-MWe Demonstration of Advanced Tangentially Fired Combustion Techniques for the Reduction of NO_x Emissions from Coal-Fired Boilers (Southern Company Services, Inc.)	Lynn Haven, FL
CCTDP-III	
Commercial-Scale Demonstration of the Liquid Phase Methanol (LPMEOH™) Process (Air Products Liquid Phase Conversion Company, L.P.)	Kingsport, TN
10-MWe Demonstration of Gas Suspension Absorption (AirPol, Inc.)	West Paducah, KY
Healy Clean Coal Project (Alaska Industrial Development and Export Authority)	Healy, AK
Full-Scale Demonstration of Low-NO_x Cell Burner Retrofit (The Babcock & Wilcox Company)	Aberdeen, OH

Exhibit ES-1 (continued)
CCTDP Projects

Project and Participant	Location
CCTDP-III (continued)	
Confined Zone Dispersion Flue Gas Desulfurization Demonstration (Bechtel Corporation)	Seward, PA
Blast Furnace Granular-Coal Injection System Demonstration Project (Bethlehem Steel Corporation)	Burns Harbor, IN
ENCOAL® Mild Coal Gasification Project (ENCOAL Corporation)	Gillette, WY
Evaluation of Gas Reburning and Low-NO_x Burners on a Wall-Fired Boiler (Energy and Environmental Research Corporation)	Denver, CO
LIFAC Sorbent Injection Desulfurization Demonstration Project (LIFAC–North America)	Richmond, IN
Integrated Dry NO_x/SO_2 Emissions Control System (Public Service Company of Colorado)	Denver, CO
Tampa Electric Integrated Gasification Combined-Cycle Project (Tampa Electric Company)	Mulberry, FL
CCTDP-IV	
Micronized Coal Reburning Demonstration for NO_x Control (New York State Electric & Gas Corporation)	Lansing and Rochester, NY
Milliken Clean Coal Technology Demonstration Project (New York State Electric & Gas Corporation)	Lansing, NY
Piñon Pine IGCC Power Project (Sierra Pacific Power Company)	Reno, NV
Pulse Combustor Design Qualification Test (ThermoChem, Inc.)	Baltimore, MD
Wabash River Coal Gasification Repowering Project (Wabash River Coal Gasification Repowering Project Joint Venture)	West Terre Haute, IN
CCTDP-V	
Clean Coal Diesel Demonstration Project (Arthur D. Little, Inc.)	Fairbanks, AK
Clean Power from Integrated Coal/Ore Reduction (CPICOR™) (CPICOR™ Management Company LLC)	Vineyard, UT
Kentucky Pioneer Energy IGCC Demonstration Project (Kentucky Pioneer Energy, LLC)	Trapp, KY

Exhibit ES-2
PPII Projects

Project and Participant	Location
Achieving NSPS Emission Standards Through Integration of Low-NO_x Burners with an Optimization Plan for Boiler Combustion (Sunflower Electric Power Corporation)	Garden City, KS
Development of Hybrid FLGR/SNCR/SCR Advanced NO_x Control (TIAX, LLC)	To be determined
Greenidge Multi-Pollutant Control Project (CONSOL Energy, Inc.)	Torrey, NY
Demonstration of a Full-Scale Retrofit of the Advanced Hybrid Particulate Collector Technology (Otter Tail Power Company)	Big Stone City, SD
Big Bend Power Station Neural Network-Sootblower Optimization (Tampa Electric Company)	Apollo Beach, FL
Commercial Demonstration of the Manufactured Aggregate Processing Technology Utilizing Spray Dryer Ash (Universal Aggregates, LLC)	King George Co., VA

Exhibit ES-3
CCPI Projects

Project and Participant	Location
Demonstration of Integrated Optimization Software at the Baldwin Energy Complex (NeuCo, Inc.)	Baldwin, IL
TOXECON Retrofit for Mercury and Multi-Pollutant Control on Three 90 MW Coal-Fired Boilers (Wisconsin Electric Power Company)	Marquette, MI
Next Generation CFB Coal Generating Unit (Colorado Springs Utilities)	Fountain, CO
Lignite Fuel Enhancement (Great River Energy)	Underwood, ND
Gilberton Coal-to-Clean Fuels and Power Co-Production Project (WMPI PTY., LLC)	Gilberton, PA
Advanced Multi-Product Coal Utilization By-Product Processing Plant (University of Kentucky Research Foundation)	Ghent, KY
Western Greenbrier Co-Production Demonstration Project (Western Greenbrier Co-Generation, LLC)	Rainelle, WV

Role of Clean Coal Technology

Coal

Coal accounts for over 94 percent of the proven fossil energy reserves in the United States and supplies the bulk of the low-cost, reliable electricity vital to the nation's economy and global competitiveness. In 2001, over half of the nation's electricity was produced with coal, and projections by the U.S. Energy Information Agency (EIA) predict that coal will continue to dominate electric power production well into the first quarter of` the 21st century.

CCTDP

The CCTDP was established to demonstrate the commercial feasibility of CCTs to respond to a growing demand for a new generation of advanced coal-based technologies characterized by enhanced operational, economic, and environmental performance. The first PON (CCTDP-I) for clean coal projects resulted in a broad range of projects being selected in four major product markets—environmental control devices, advanced electric power generation, coal processing for clean fuels, and industrial applications.

The second PON (CCTDP-II) became the centerpiece for satisfying the recommendations contained in the Joint Report of the Special Envoys on Acid Rain (1986). The goal was to demonstrate technologies that could achieve significant reductions in the emissions of precursors of acid rain, namely SO_2 and NO_x. The third PON (CCTDP-III) furthered the goal of CCT-II and added technologies that could produce clean fuel from run-of-mine coal.

The fourth and fifth PONs (CCTDP-IV and CCTDP-V, respectively) recognized emerging energy and environmental issues, such as global climate change and capping SO_2 emissions, and thus focused on technologies that were capable of addressing these issues. The CCTDP-IV PON called for energy efficient, economically competitive technologies capable of retrofitting, repowering, or replacing existing facilities, while at the same time significantly reducing SO_2 and NO_x emissions. The CCTDP-V PON focused on technologies applicable to new or existing facilities that could significantly improve efficiency and environmental performance.

PPII

The Department of Energy has embarked upon PPII to address near-term electricity delivery reliability concerns. The rapid growth in power demand, especially peak demand, coupled with the ongoing restructuring of the electric power industry, has resulted in a real and growing concern over the reliability of the nation's electricity grid. The initiative arose from the brownouts and blackouts of 1999 and 2000 in California and elsewhere. This concern prompted Congress to add $95 million to the Office of Fossil Energy budget for FY 2001 for PPII. The Power Plant Improvement Initiative approved by Congress will have a near-term focus on improving the efficiency and environmental performance of coal-fired power generation. New technologies will be demonstrated that can boost the efficiency of a power plant—increasing the amount of electricity it can generate and reducing air emissions per kilowatt-hour produced. The initiative applies to existing and new coal-based, central power plants.

Congress provided "for a general request for proposals for the commercial scale demonstration of technologies to assure the reliability of the [n]ation's energy supply from existing and new electric generating facilities for which the Department of Energy upon review may provide financial assistance awards . . ." In the act, Congress transferred the funding from previously appropriated CCTDP funding.

Advanced Flue Gas Desulfurization Demonstration Project (Pure Air on the Lake, L.P.)—1993 Powerplant Award presented by *Power* magazine.

CCPI

The Clean Coal Power Initiative implements the NEP recommendation to increase investment in clean coal technology for the purpose of ensuring the reliability of our electric supply while simultaneously protecting our environment. Established in FY 2002, the CCPI is a cost-shared partnership between the government and industry—like the CCTDP and PPII. The goal is to accelerate commercial deployment of advanced technologies to ensure that the United States has clean, reliable, and affordable electricity. The CCPI is designed to be implemented over 10 years with a federal investment totalling $2 billion, and cost-shared by industry at a minimum of 50 percent.

Environmental Drivers

Controlling SO_2 and NO_x emissions were primary environmental drivers for the CCTDP. Environmental drivers for PPII and CCPI included fine particulates less than 2.5 microns in diameter ($PM_{2.5}$); ozone; hazardous air pollutants, primarily mercury; and greenhouse gases. Both PPII and CCPI support new Presidential environmental initiatives like the CSI and the Global Climate

Change Initiative. Furthermore, efforts to reduce regional haze and reduce solid waste are supported by CCTDP, PPII, and CCPI demonstration efforts.

Market Considerations

As electricity generation moves from a regulated industry to a free market, the DOE has kept pace with the changes. Whether the changes are brought about by the federal government through existing or new legislation or by state governments, DOE is demonstrating the first generation of many technologies that will be needed in a competitive power generation market. These new technologies will be far more efficient than existing plants and environmentally benign.

Ensuring Sustainable Economic Growth

It is in the nation's interest to maintain a diverse energy mix to sustain domestic economic growth. The Department of Energy is contributing to this interest by developing and deploying a technology portfolio that enhances the efficient use of the United States' abundant coal resource while simultaneously achieving important environmental goals. The advancements in coal use technology resulting from the CCTDP, PPII, and CCPI will reduce dependence on foreign energy resources and create an international market for these new technologies.

FutureGen

FutureGen, as currently proposed, is a $1 billion venture to build a prototype of the fossil fuel plant of the future. The plant will combine electricity and hydrogen production with the virtual elimination of harmful emissions, including greenhouse gases through sequestration. The FutureGen power plant will serve as the test bed for demonstrating the best technologies the world has to offer. The CCTDP, PPII, and CCPI programs provide the platform for evaluating FutureGen technology candidates. The Department of Energy will ask the power industry to organize a consortium to manage the project and share in the project costs.

Vision 21

For the long term, the Office of Coal & Power Systems (OC&PS) will build upon the solid foundation established by the CCTDP and contributions from PPII and CCPI to meet Vision 21 goals. Vision 21 is a long-term strategic set of objectives to develop the full potential of the nation's abundant fossil fuel resources while addressing regional and global environmental concerns. Vision 21 plants would comprise a portfolio of fuel-flexible systems and modules capable of producing a varied slate of high-value commodities at near-zero emissions of pollutants. Such commodities include clean fuels, chemicals, and electricity, tailored to meet market demands in the 2010-2015 time frame.

Implementation

CCTDP

Implementation Principles

There are 10 guiding principles that have been instrumental in the success of the CCTDP. These principles are:

- Strong and stable financial commitment for the life of a project, including full funding of the government's share of the costs;
- Multiple solicitations spread over a number of years, enabling the CCTDP to address a broad range of national needs with a portfolio of evolving technologies;
- Demonstrations conducted at commercial scale in actual user environments, allowing clear assessment of a technology's commercial potential;
- A technical agenda established by industry, not the government, enhancing commercialization potential;
- Clearly defined roles of government and industry, reflecting the degree of cost-sharing required;
- A requirement for at least 50 percent cost-sharing throughout all project phases, enhancing participants' commitment;
- An allowance for cost growth, but with a ceiling and cost-sharing, recognizing demonstration risk and providing an important check-and-balance system to the program;
- Industry retention of real and intellectual property rights, enhancing commercialization potential;
- A requirement for industry to commit to commercialize the technology, reflecting commercialization goals; and
- A requirement for repayment up to the government's cost-share upon successful commercialization of the technology being demonstrated.

Implementation Process

Public and private sector partnership is integral to the CCTDP process and has been crucial to the program's success. Environmental concerns are publicly addressed through the process instituted under the National Environmental Policy Act (NEPA). Through programmatic environmental assessments (PEAs) and environmental impact statements (PEISs), project-specific environmental assessments (EAs) and environmental impact statements (EISs), and other NEPA documents, the public is able to comment and have its comments addressed before the projects proceed to implementation. In addition, environmental monitoring programs are required for all projects to address non-regulated pollutant emissions.

As to the solicitation process, Congress set the goals for each solicitation. The Department of Energy translated the congressional guidance into performance-based criteria and developed approaches to address "lessons learned" from previous solicitations. The criteria and solicitation procedures were offered for public comment and presented at pre-proposal conferences. The solicitations were objectively evaluated against the pre-established criteria.

Projects are managed by the participants, not the government. However, to protect the public interest, safeguards are implemented to track and monitor project progress and direction. The Department of Energy interacts with the project at key negotiated decision points (budget periods) to approve or disapprove continuance of the project. Also, any changes to cost or other major project changes require DOE approval. In addition to formal project reporting requirements, an outreach program was instituted to make project information available to customers and stakeholders. This *Program Update 2003* is only one of the many public reports made available through the outreach program.

Environmental Provisions

Section 415 (42 U.S.C. §7651n) of the Clean Air Act Amendments of 1990 included two important incentives for clean coal demonstration projects. First, a temporary (less than five years of operation) clean coal technology (CCT) demonstration project is exempted from New Source Performance Standards (NSPS) and exempted from New Source Review (NSR) for pollutants in both attainment and non-attainment areas. However, the project must comply with the State Implementation Plan (SIP) for the state where the project is located and must maintain National Ambient Air Quality Standards (NAAQS). Second, a permanent CCT demonstration that constitutes repowering is exempted from NSPS, and NSR for pollutants in attainment areas, if the potential pollutant emissions will not increase. (Congress has made section 415 applicable to both PPII and CCPI projects.)

Commitment to Commercial Realization

The CCTDP has focused on achieving commercial realization since the program's inception. All five PONs required the potential participants to address the commercial plans and approaches to be used by the participants to achieve full commercialization of the proposed technology. The cooperative agreements contain balanced provisions that provide protection for intellectual property but require the participants to make the technology available under license on a nondiscriminatory basis.

Solicitation Results

Each solicitation was issued as a PON—a solicitation mechanism for cooperative agreements where the program goals and objectives are defined, but the technology is not defined. The procurements followed specific statutory requirements that eventually led to a cooperative agreement between DOE and the participant. The result was a broad spectrum of technologies involving customers and stakeholders from all market segments. In sum, 211 proposals were submitted and 60 of those were selected. As of May 2003, a total of 36 projects have been completed or are currently active. These 36 projects are spread across the nation in 18 states.

Future Implementation Direction

The future direction of the CCTDP focuses on completing the five remaining projects as promptly as possible and assuring the collection, analyses, and reporting of the operational, economic, and environmental performance results that are needed to effect commercialization.

The body of knowledge obtained as a result of the CCTDP is being used in decision making relative to regulatory compliance, forging plans for meeting future energy and environmental demands, and developing the next generation of technologies responsive to ever increasing demands on environmental performance at competitive costs.

Built upon the success of the CCTDP, the two new initiatives—PPII and CCPI—have incorporated many of the implementation principles of the CCTDP. These implementation principles will also reflect lessons learned from the CCTDP to further enhance the return on taxpayer investment.

PPII

The Department of Energy developed a PPII PON, incorporating general provisions of the CCTDP (per congressional direction) with some modifications to take into account lessons learned from the CCTDP.

The PON provided that participants must offer significant improvements in power plant performance leading to enhanced electric reliability. These improvements could be in the form of increasing the efficiency of electricity production, reducing environmental impacts, or increasing cost-competitiveness. The projects also had to be applicable to a large portion of existing plants and of commercial scale in order to be deployed over the early part of the decade.

Specific areas of interest expressed by DOE were:

- Advanced combustion or gasification systems and components;
- Advanced NO_x control technology;
- CO_2 capture, utilization, or sequestration;
- Combustion or gasification system improvements;
- Co-production;
- Fine particulate control;
- Hydrogen chloride control;
- Mercury control;
- Process control systems;
- Repowering;
- Steam cycle improvements; and
- Wet and dry scrubbers for SO_2 control.

With regard to intellectual property rights, there were three main issues that had to be addressed by the participants: commercialization of technology, data rights, and patent rights. For commercialization of technology, there must be a precise definition of the technology envelope and it must address third-party licensing arrangements. For data rights, the participant can protect proprietary technology and data; however, such data must be made available to DOE without limitations.

Patent rights for inventions conceived or first actually reduced to practice under DOE contract are defined by statute and regulation and vary depending on the status of the participant, *e.g.,* large business firm, small business firm, or non-profit organization.

CCPI

The CCPI-I PON sought projects that demonstrated advanced coal-based technologies, and would accelerate their deployment for commercial use. The CCPI-I PON was open to any technology advancement related to coal-based power generation that results in efficiency, environmental, and economic improvement compared to currently available state-of-the-art alternatives. The PON was also open to technologies capable of producing any combination of heat, fuels, chemicals, or other useful byproducts in conjunction with power generation. Prospective participants had to ensure that coal is used for at least 75 percent of the fuel energy input to the process. This will ensure that multiple fuel concepts such as co-firing are not excluded, but the program remains focused on coal-based power generation. Additionally, they had to show the potential for rapid market penetration upon successful demonstration of the technology or concept. The PON was open for application submission for a period of 150 days. The resultant awards are expected to be cooperative agreements.

Total government funding is expected to be between $300–400 million for CCPI-I. The minimum cost share by the industrial participant is 50 percent, and must be at least 50 percent in each budget period. Periods of performance for the projects are expected to be two to six years.

The following examples of areas in which DOE expressed it interest were intended for guidance only and did not exclude other technologies and concepts from consideration in the CCPI-I solicitation:

- Carbon Management and Carbon Reduction
- Combined Heat and Power Systems
- Combustion Concepts
- Environmental Performance
- Gasification Concepts
- Process Control and Instrumentation
- Steam Turbine Modifications

The applicants were required to address the technical merit, project feasibility, commercialization potential, and cost in their CCPI-I proposals. The proposals had to meet the following mandatory requirements:

- The proposed project must be conducted at a facility located in the United States.
- The proposed project must utilize at least 75 percent coal, as measured on a fuel input (Btu) basis.
- The proposed project must be designed for and operated with coal mined in the United States and/or refuse coal sources (*e.g.*, culm and gob) that are derived from U. S. coals.
- The applicant must agree to provide a cost share of at least 50 percent of the cost for the total project and for each budget period.
- The applicant shall identify the proposed site and any alternate sites in the application.
- The proposed project team must be clearly identified and firmly committed to fulfilling its proposed role in the project.
- The applicant must agree to submit a Repayment Agreement.

Funding and Costs

CCTDP

Congress has appropriated a federal budget of over $1.5 billion for the CCTDP. The participants in the 36 completed and active projects will have contributed more than $3.2 billion for a combined commitment of almost $4.8 billion. By law, DOE's contribution cannot exceed 50 percent of the total cost of any project. However, industry has stepped forward and cost-shared an unprecedented 68 percent of the project funding.

Congress has provided CCTDP funding for all five solicitations through appropriation acts and adjustments. Additional activities funded by the CCTDP are the Small Business Innovation Research Program and the Small Business Technology Transfer Program. Funding is also provided for administration and management of the CCTDP. Use of appropriated funds is controlled and monitored using a variety of financial management techniques. The full government cost share specified in the cooperative agreement is considered committed to each project; however, DOE obligates funds for the project in increments by budget period. This procedure reduces the government's financial exposure and assures that DOE fully participates in the decision to proceed with each major phase of project implementation.

As stated above, DOE's contribution cannot exceed 50 percent of the total cost of any project. Participant cost-sharing is required for all phases of the project. The federal government may share in project cost growth (which is a potential for any demonstration project) up to 25 percent of the original project cost, but only at the same cost-share ratio of the original agreement with the participant. The participant's contributions under the cooperative agreement must occur as expenses are incurred and cannot be delayed based on forecasted revenues, proceeds, or royalties. Also, prior investments in facilities by participants cannot count toward the participant's share.

The policy objective of DOE is to recover an amount up to the federal government's financial contribution to each project when a technology is successfully commercialized. A recoupment agreement accompanies each demonstration agreement and stipulates the repayment provisions.

PPII

The PPII was established by the Department of the Interior and Related Agencies Appropriations Act for Fiscal Year 2001 (Public Law 106-291) through the transfer of $95 million in previously appropriated funding for the CCTDP. Federal government commitments will be approximately $47 million with final values determined during negotiations. Private sector sponsors are expected to contribute nearly $58 million, exceeding the 50 percent private sector cost-sharing mandated by Congress. Repayment obligations start after the completion of the demonstration and last for 20 years. In accordance with congressional direction, repayments will be retained by DOE for future projects.

CCPI

Funding provided by appropriations for FY 2002 and FY 2003, along with additional funds available from the PPII, served as the basis for the CCPI-I PON. The selected projects are valued at more than $1.3 billion with a government commitment of approximately $317 million. The projects are in negotiation and the first awards are anticipated in late-2003. DOE funding commitments for the selected CCPI projects represent less than 25 percent of the total estimated costs for the eight selected projects, while participant commitments exceed $1 billion. The two largest projects in terms of total costs have proposed 84 and 90 percent participant funding levels, showing that project participants are willing to be substantial partners in the demonstration of clean coal technologies.

CCPI funds are subject to general provisions similar to those governing the use of CCTDP funds. For repayment, the CCPI-I PON did not designate explicit values or terms in the model repayment agreement, but instead left the details to be defined by the applicant. The applicant-proposed repayment provisions were considered as one of five factors under the commercial potential evaluation criteria used to make project selections. The commercial potential criteria represented 20 percent of the evaluation, with 50 percent based on technical merit and 30 percent on project feasibility. In accordance with congressional direction, funds obtained from repayment provisions will be retained by DOE for future activities.

Accomplishments

Marketplace Commitment

The success of the CCTDP ultimately will be measured by the contribution the technologies make to the resolution of energy, economic, and environmental issues. These contributions can only be achieved if the public and private sectors understand that CCTs can increase the efficiency of energy use and enhance environmental performance at costs that are competitive with alternative energy options. The demonstrations, in conjunction with an aggressive outreach effort, are designed to impart that understanding. Also, the CCTDP is organized from a market perspective with projects placed in four major product lines—environmental control devices, advanced electric power generation, coal processing for clean fuels, and industrial applications. A summary of the number of completed projects by category is shown in Exhibit ES-4.

The first major product line, environmental control devices, is subdivided into three groups—SO_2 control technologies, NO_x control technologies, and multi-pollutant control technologies. Both wet and dry lime- and limestone-based systems were demonstrated to achieve a range of SO_2 capture efficiencies from 50 to 99 percent. All five of the SO_2 control technology demonstrations have been successfully completed.

For NO_x control technologies, two basic approaches were used: (1) combustion modification techniques including low-NO_x burners, overfire air, advanced controls, and reburning systems; and (2) post-combustion techniques using selective catalytic reduction (SCR) and selective non-catalytic reduction (SNCR) systems. These NO_x control techniques were applied in a variety

Exhibit ES-4

Completed Projects by Application Category

Application Category	Number of Projects Completed as of May 31, 2003	Total
Environmental Control Devices		
SO_2 Control Technology	5	5
NO_x Control Technology	7	7
Multi-Pollutant Control Technology	6	6
Advanced Electric Power Generation		
Fluidized-Bed Combustion	2	3
Integrated Gasification Combined-Cycle	3	4
Advanced Combustion/Heat Engines	1	2
Coal Processing for Clean Fuels	3	4
Industrial Applications	4	5
Total	**31**	**36**

of combinations on a diverse group of boilers, which are representative of 99 percent of existing coal-fired boilers. The result of the NO_x control technology demonstrations is a portfolio of technologies that can be applied to the full range of boiler types and used to address today's pressing environmental concerns. All seven NO_x control technology demonstrations have been successfully completed.

All six of the combined multi-pollutant control technology demonstrations have been successfully completed. The demonstrations tested a multiplicity of complementary and synergistic control methods to achieve cost-effective SO_2 and NO_x emission reductions.

The commercial activity of the environmental control technologies can be seen in Exhibit ES-5.

The second major product line, advanced electric power generation, is subdivided into three groups—fluidized-bed combustion (FBC), integrated gasification combined-cycle (IGCC), and advanced combustion/heat engines. These technologies can be used for repowering existing plants and for new plants.

The PC-based software tool CQE™ can be used to determine the complete costs of various fuel options by integrating the effects of fuel purchase decisions on power plant performance, emissions, and power generation costs.

For fluidized-bed combustion, two approaches were used: atmospheric fluidized-bed combustion (AFBC) and pressurized fluidized-bed combustion (PFBC). The two AFBC projects use a circulating-bed, as opposed to a bubbling-bed, operating at atmospheric pressure to generate steam for electricity production. One project is complete and the other project is ongoing. There is one PFBC project in the CCTDP (two other projects were terminated in FY 2003). The completed PFBC project used a bubbling-bed operating at 16 atmospheres to generate steam and drive a gas turbine in a combined-cycle mode.

Three IGCC projects completed operations and a fourth IGCC project is in the design stage. The IGCC projects represent a diversity of gasifier types, cleanup systems, and applications.

Two projects are demonstrating advanced combustion/heat engine technology. One used an entrained (slagging) combustor, and the other uses a heavy duty diesel engine fired on a coal-water fuel. One project is completed and the other project is ongoing.

The commercial activity of these advanced electric power generation projects can be seen in Exhibit ES-6.

For the third major product line, coal processing for clean fuels, there are four projects. Two completed projects used chemical and physical processes to transform raw coal into high-energy-density, environmentally compliant fuels. Another completed project converted coal to methanol from coal-derived synthesis gas. A fourth project in this product line is a software program used to assess the environmental and operational performance of and determine the least-cost option for available coals. All four of the coal processing for clean fuels projects have completed operations, with one of the four in the reporting phase.

The commercial activity of the coal processing for clean fuels projects can be seen in Exhibit ES-7.

Wabash River Coal Gasification Repowering Project (Wabash River Coal Gasification Repowering Project Joint Venture)—1996 Powerplant Award presented by *Power* magazine.

Full-Scale Demonstration of Low-NO_x Cell Burner Retrofit Project (The Babcock & Wilcox Company)—1994 R&D 100 Award presented by *R&D* magazine.

Exhibit ES-5

Commercial Activity—Environmental Control Technologies

Project	Commercial Use
SO_2 Control Technology	
10-MWe Demonstration of Gas Suspension Absorption (AirPol, Inc.)	**Sold domestically and internationally.** GSA market entry was significantly enhanced with the sale of a 50-MWe unit, worth $12.5 million, to the city of Hamilton, Ohio, subsidized by the Ohio Coal Development Office. A sale worth $1.3 million has been made to the U.S. Army for hazardous waste disposal. A GSA system has been sold to a Swedish iron ore sinter plant. Two GSA systems valued at $1.8 million have been sold to Taiwan Sugar Corporation for their oil-fired cogeneration plant. Airpol sold a GSA system valued at $1.5 million to a petroleum coke calciner in India. Other units include a $300,000 GSA system at a municipal waste incinerator in Utah, a $3 million GSA system at a waste incinerator in Holland, and a $500,000 GSA system at a municipal waste incinerator in Minnesota.
Confined Zone Dispersion Flue Gas Desulfurization Demonstration (Bechtel Corporation)	**No sales reported.** CZD/FGD can be used to retrofit existing plants or for new installations at a cost of about one-tenth that of a commercial wet scrubber.
LIFAC Sorbent Injection Desulfurization Demonstration Project (LIFAC–North America)	**Sold domestically and internationally.** The LIFAC system at Richmond Power & Light is the first to be applied to a power plant using high-sulfur (2.0-2.9%) coal. The LIFAC system has been retained for commercial use by Richmond Power & Light at Whitewater Valley Station, Unit No. 2. There are 10 full-scale LIFAC units in operation in Canada, China, Finland, Russia, Japan, and the United States, including 5 projects started before the CCTDP. For three sales in China, the estimated value is $44.6 million.
Advanced Flue Gas Desulfurization Demonstration Project (Pure Air on the Lake, L.P.)	**No sales reported.** The AFGD continues in commercial service at Northern Indiana Public Service Company's Bailly Generating Station. Gypsum produced by the PowerChip® process is being sold commercially. The estimated value for 17 years of continued scrubber operations is $154 million. FLS miljo, a Copenhagen-based licensee, is currently working on a potential $60 million project in Kentucky using the next generation of this technology.
Demonstration of Innovative Applications of Technology for the CT-121 FGD Process (Southern Company Services, Inc.)	**Sold internationally.** Plant Yates continues to operate with the CT-121 scrubber as an integral part of the site's CAAA compliance strategy. There are now 22 CT-121 plants in the planning, construction, or operational phase worldwide. There are 17 CT-121 plants (10 operating on coal) operating in Japan, Australia, Canada, the Czech Republic, Korea, Denmark, Malaysia, and Kuwait. The value of these 17 plants is estimated at $2.03 billion. For the projects in the planning stage, the value is estimated at $880 million.
NO_x Control Technology	
Micronized Coal Reburning Demonstration for NO_x Control (New York State Electric & Gas Corporation)	**No sales reported.** Technology retained for commercial use at the Kodak Park Power Plant.
Demonstration of Coal Reburning for Cyclone Boiler NO_x Control (The Babcock & Wilcox Company)	**No sales reported.** Technology retained for commercial use at Wisconsin Power and Light Company's Nelson Dewey Station.
Full-Scale Demonstration of Low-NO_x Cell Burner Retrofit (The Babcock & Wilcox Company)	**Sold domestically.** Dayton Power & Light has retained the LNCB® for use in commercial service. Seven commercial contracts have been awarded for 196 burners or 5,475 MWe of capacity, valued at $30 million.
Evaluation of Gas Reburning and Low-NO_x Burners on a Wall-Fired Boiler (Energy and Environmental Research Corporation)	**Sold domestically and internationally.** Public Service Company of Colorado, the host utility, decided to retain the low-NO_x burners and the gas-reburning system for immediate use; however, a restoration was required to remove the flue gas recirculation system. Since the CCTDP, the participant has installed or is in the process of installing the gas reburning or the gas reburning-low-NO_x burner technology on 11 boilers representing 2,310 MWe of capacity. Estimated value is over $50 million.

Exhibit ES-5 (continued)

Commercial Activity—Environmental Control Technologies

Project	Commercial Use
NO_x Control Technology (continued)	
Demonstration of Selective Catalytic Reduction Technology for the Control of NO_x Emissions from High-Sulfur, Coal-Fired Boilers (Southern Company Services, Inc.)	**Sold domestically and internationally.** Since the project was initiated, revenues from SCR sales achieved $7.1 billion through 2002.
180-MWe Demonstration of Advanced Tangentially Fired Combustion Techniques for the Reduction of NO_x Emissions from Coal-Fired Boilers (Southern Company Services, Inc.)	**Sold domestically and internationally.** LNCFS™ has been retained at the host site for commercial use. Alstom Power has sold about 67 GWe of LNCFS™ burners. Of this amount, about 49 GWe are equipped with overfire air and 18 GWe are without overfire air. Total sales are estimated at $1.35 billion.
Demonstration of Advanced Combustion Techniques for a Wall-Fired Boiler (Southern Company Services, Inc.)	**Sold domestically and internationally.** The host has retained the technologies for commercial use. Foster Wheeler has equipped 83 boilers with low-NO_x burner technology—a total of over 1,494 burners representing over 26,635 MWe capacity valued at $86 million. Foreign sales make up 35 percent of the commercial market. Twenty-six commercial installations of GNOCIS, the associated artificial intelligence control system, are underway or planned. This represents over 12,000 MWe of capacity.
Multi-Pollutant Control Technology	
SNOX™ Flue Gas Cleaning Demonstration Project (ABB Environmental Systems)	**International use.** The host utility, Ohio Edison, is retaining the SNOX™ technology as a permanent part of the pollution control system at Niles Station to help meet its overall SO_2 and NO_x reduction goals. Five commercial SNOX™ plants are also operating in Japan, Russia, Denmark, The Czech Republic, and Italy.
LIMB Demonstration Project Extension and Coolside Demonstration (The Babcock & Wilcox Company)	**Sold domestically and internationally.** LIMB has been sold to an independent power plant in Canada. Babcock & Wilcox has sales of 2,805 DRB-XCL® burners for 38,284 MWe of capacity (20,291 MW internationally and 17,993 MW domestically). The low-NO_x burners have an estimated value of $388 million.
SOx-NOx-Rox Box™ Flue Gas Cleanup Demonstration Project (The Babcock & Wilcox Company)	**No sales reported.** Commercialization of the technology is expected to develop with an initial larger scale application equivalent to 50-100 MWe. The focus of marketing efforts is being tailored to match the specific needs of potential industrial, utility, and independent power producers for both retrofit and new plant construction. SNRB™ is a flexible technology that can be tailored to maximize control of SO_2, NO_x, particulate, or combined emissions to meet current performance requirements while providing flexibility to address future needs.
Enhancing the Use of Coals by Gas Reburning and Sorbent Injection (Energy and Environmental Research Corporation)	**No sales reported.** Illinois Power has retained the gas-reburning system and City Water, Light & Power has retained the full technology for commercial use. (See Evaluation of Gas Reburning and Low-NO_x Burners on a Wall-Fired Boiler project for a complete understanding of commercial success of the technology.)
Milliken Clean Coal Technology Demonstration Project (New York State Electric & Gas Corporation)	**Sold domestically.** Eight modules of DHR Technologies' Plant Emissions Optimization Advisor (PEOA), with an estimated value of $280,000, have been sold. DHR Technologies, Inc., is no longer in business, and New York State Electric & Gas Corporation owns the PEOA software. ABB Combustion Engineering has modified 116 units representing over 25,000 MWe with LNCFS™ or its derivative TFS 2000™.
Integrated Dry NO_x/SO_2 Emissions Control System (Public Service Company of Colorado)	**Sold domestically.** The technology was retained by Public Service Company of Colorado for commercial service at its Arapahoe Station. Babcock & Wilcox has sales of 2,805 DRB-XCL® burners for 38,284 MWe of capacity (20,291 MW domestically). The low-NO_x burners have an estimated value of $388 million.

Exhibit ES-6

Commercial Activity—Advanced Electric Power Generation Technologies

Project	Commercial Use
Tidd PFBC Demonstration Project (The Ohio Power Company)	**Sold internationally.** The project's success has led Babcock & Wilcox to invest in the technology and acquire domestic licensing rights. Commercial coal-fired ventures abroad include the following: – Vartan in Sweden is operating two P200 units to produce 135 MWe and 224 MWt*; – Escatron in Spain is operating one P200 unit producing 80 MWe*; – Wakamatsu in Japan has retired one P200 unit that produced 71 MWe; – Cottbus in Germany is operating one P200 unit to produce 71 MWe and 40 MWt; – Karita in Japan operates one P800 unit to produce 360 MWe; – Chuoku in Japan to produce 250 MWe; and – Tomato-Atswo plant in Japan to produce 80 MWe. The value of these projects is estimated at $1.35 billion.
Nucla CFB Demonstration Project (Tri-State Generation and Transmission Association, Inc.)	**Sold domestically and internationally.** Since the demonstration, Foster Wheeler Energy Corporation, the technology supplier for the demonstration effort, made sales in Germany, Italy, Poland, Taiwan, China, India, Korea, Thailand, Indonesia, Finland, The Czech Republic, Denmark, Sweden, Austria, Spain, France, Canada, and Switzerland. Domestic sales constitute almost 2 GW and international sales over 6 GW.
Tampa Electric Integrated Gasification Combined-Cycle Project (Tampa Electric Company)	**Sold domestically and internationally.** First greenfield IGCC unit in commercial service. Texaco, Inc., and ASEA Brown Boveri signed an agreement forming an alliance to market IGCC technology in Europe. There are 20 Texaco gasifiers representing 3,871 MW in the development or operation phase at an estimated cost of $2.15 billion. There are 14 Texaco gasifiers representing 7,246 MWe in the planning phase at an estimated cost of $5.12 billion.
Wabash River Coal Gasification Repowering Project (Wabash River Coal Gasification Repowering Joint Venture)	**No sales reported.** First repowered IGCC unit in commercial service and is the world's largest single-train IGCC project in commercial service.
Healy Clean Coal Project (Alaska Industrial Development and Export Authority)	**No sales reported.** TRW is offering licensing of combustor worldwide. Commercial operation tests are ongoing.

* Parallel project with Tidd.

Exhibit ES-7

Commercial Activity—Coal Processing for Clean Fuels Technologies

Project	Commercial Use
Development of the Coal Quality Expert™ (ABB Combustion Engineering and CQ Inc.)	**Sold domestically and internationally.** The Electric Power Research Institute (EPRI) owns the Combustion Engineering software and distributes it to EPRI members for their use. CQ Inc. and Black and Veatch have signed commercialization agreements that give both companies nonexclusive worldwide rights to sell user licenses and offer consulting services that include use of CQE®. More than 22 U.S. utilities, two United Kingdom utilities, and one utility in France have received CQE® through EPRI membership. Two modules of the Acid Rain Advisor valued at $6,000 have been sold. EPRI estimated that the Acid Rain Advisor has saved one U.S. utility about $26 million—more than the total cost of the demonstration project. There have also been two sales of the Windows version of the software (Vista) at an estimated value of $180,000.
ENCOAL® Mild Coal Gasification Project (ENCOAL Corporation)	**Domestic and international sales pending.** In order to determine the viability of potential mild coal gasification plants, five detailed commercial feasibility studies—two Indonesian, one Russian, and two U.S. projects—have been completed.
Commercial-Scale Demonstration of the Liquid Phase Methanol (LPMEOH™) Process (Air Products Liquid Phase Conversion Company, L.P.)	**No sales reported.** Nominal 80,000 gallon/day methanol production being used by Eastman Chemical Company.
Advanced Coal Conversion Process Demonstration (Western SynCoal LLC)	**No sales reported.** Total sales of SynCoal® product exceed 1.9 million tons. Six long-term agreements were in place to purchase the product. One domestic and five international projects have been investigated. Western SynCoal LLC has a joint marketing agreement with Ube Industries of Japan providing Ube non-exclusive marketing rights outside of the United States. Ube is pursuing several projects in Asia.

Exhibit ES-8

Commercial Activity—Industrial Applications Projects

Project	Commercial Use
Cement Kiln Flue Gas Recovery Scrubber feasibility (Passamaquoddy Tribe)	**No sales reported.** The scrubber became a permanent part of the cement plant at the end of the demonstration. A study has been completed for a Taiwanese cement plant.
Blast Furnace Granular-Coal Injection System Demonstration Project (Bethlehem Steel Corporation)	**No sales reported.** Technology remains in commercial service at demonstration site.
Advanced Cyclone Combustor with Internal Sulfur, Nitrogen, and Ash Control (Coal Tech Corporation)	**No sales reported.** While the combustor is not yet fully ready for sale with commercial guarantees, it is believed to have commercial potential. Follow-on work to the CCTDP demonstration was undertaken, which has brought the technology close to commercial introduction.

The fourth and final major product line is industrial applications. This product line is addressing the environmental issues and barriers associated with coal use in industry. There are five diverse projects in this category; four are completed and one is ongoing.

Commercial activity of the industrial application projects can be seen in Exhibit ES-8.

Awards

A list of the award-winning CCTDP projects is shown in Exhibit ES-9.

PPII

The PON was issued on February 6, 2001, and 24 proposals were received on April 19, 2001. On September 28, 2001, a total of eight projects with a combined industry/government value of $110 million were selected for negotiations. Cooperative agreements have been awarded to four participants. Two projects have been withdrawn by the participants. Negotiations are underway with the two remaining participants.

CCPI

The CCPI-I PON was issued on March 4, 2002, and 36 proposals were received on August 1, 2002. On January 15, 2003, DOE announced the selection of eight projects under CCPI-I. Three of the projects are directed at new ways to comply with President Bush's CSI, which calls for dramatic reductions in air pollutants from power plants over the next decade-and-a-half. Three other projects are expected to contribute to the President's Global Climate Change Initiative to reduce greenhouse gases. The remaining two projects will reduce air pollution through coal gasification and multi-pollutant control systems. Subsequently, one project was withdrawn.

Market Communications—Outreach

Outreach has been a hallmark of the CCTDP since its inception. Commercialization of new technologies requires acceptance by a wide range of interests—customers, manufacturers, suppliers, financiers, government, and public interest groups. The CCTDP has aggressively sought to disseminate key information to this full range of customers and stakeholders and to obtain feedback on changing needs. This dissemination of information takes the form of printed media, exhibits, and electronic media. Printed media consist of newsletters, proceedings, technical papers, fact sheets, program updates, and bibliographies. The CCTDP currently uses four traveling exhibits of varying size and complexity that can be updated and tailored to specific forums. Electronic media are available through the World Wide Web.

Feedback is another important part of the outreach effort. From public meetings during the PON process to open houses at demonstration sites, the CCTDP stays in contact with customers and stakeholders. Stakeholder meetings, conferences, workshops, and trade missions are used by the CCTDP to disseminate information and obtain feedback.

Over 30 domestic and international coal-related conferences and workshops were attended or sponsored by OC&PS or NETL since the beginning of FY 2002. All of these events were used to endorse and promote the technologies demonstrated in the CCTDP.

Projects

Introduction

The *Program Update 2003* includes project fact sheets on active CCTDP, PPII, and CCPI projects in various stages of implementation. (The fact sheets for the completed CCTDP projects are contained in a separate volume—*Completed Projects 2003*.) Also included are fact sheets for two recently terminated CCTDP projects, one withdrawn PPII project, and one withdrawn CCPI project to aid readers in following the status of the CCT programs.

The CCTDP, PPII, and CCPI project fact sheets are organized by market sector rather than program to better enable stakeholders to see the scope of activity in key areas of interest. These market sectors are: (1) environmental control devices for existing and new power plants; (2) advanced electric power generation for repowering existing plants and providing new generation capacity; (3) coal processing for clean fuels to convert the nation's vast coal resources to clean fuels; and (4) industrial applications for coal and coal by-products. A list of the active projects is shown in Exhibit ES-10 organized by market sector and in Exhibit ES-11, organized alphabetically by participant.

Technology Overview

Advanced NO_x controls provide the means to meet NO_x emission caps proposed under the CSI; EPA's "SIP Call" source emission rates of 0.15 lb/10^6 Btu for 22 states and the District of Columbia; and revised National Ambient Air Quality Standards (NAAQS) for ozone and $PM_{2.5}$, which impacts NO_x because it is a precursor to both. Technologies include:

Exhibit ES-9

Award-Winning CCTDP Projects

Project and Participant	Award
Full-Scale Demonstration of Low-NO_x Cell Burner Retrofit (The Babcock & Wilcox Company)	1994 R&D 100 Award presented by *R&D* magazine to the U.S. Department of Energy for development of the low-NO_x cell burner.
Evaluation of Gas Reburning and Low-NO_x Burners on a Wall-Fired Boiler; Enhancing the Use of Coals by Gas Reburning and Sorbent Injection (Energy and Environmental Research Corporation)	1997 J. Deane Sensenbaugh Award presented by the Air and Waste Management Association to the U.S. Department of Energy, Gas Research Institute, and U.S. Environmental Protection Agency for the development and commercialization of gas-reburning technology.
Advanced Flue Gas Desulfurization Demonstration Project (Pure Air on the Lake, L.P.)	1993 Powerplant Award presented by *Power* magazine to Northern Indiana Public Service Company's Bailly Generating Station.
	1992 Outstanding Engineering Achievement Award presented by the National Society of Professional Engineers.
Demonstration of Innovative Applications of Technology for the CT-121 FGD Process (Southern Company Services, Inc.)	1995 Design Award presented by the Society of Plastics Industries in recognition of the mist eliminator.
	1994 Powerplant Award presented by *Power* magazine to Georgia Power's Plant Yates. Co-recipient was the U.S. Department of Energy.
	1994 Outstanding Achievement Award presented by the Georgia Chapter of the Air and Waste Management Association.
	1993 Environmental Award presented by the Georgia Chamber of Commerce.
Tidd PFBC Demonstration Project (The Ohio Power Company)	1992 National Energy Resource Organization award for demonstration of energy-efficient technology.
	1991 Powerplant Award presented by *Power* magazine to American Electric Power Company's Tidd project. Co-recipient was The Babcock & Wilcox Company.
Tampa Electric Integrated Gasification Combined-Cycle Project (Tampa Electric Company)	1997 Powerplant Award presented by *Power* magazine to Tampa Electric's Polk Power Station.
	1996 Association of Builders and Contractors Award presented to Tampa Electric for quality of construction.
	1993 Ecological Society of America Corporate Award presented to Tampa Electric for its innovative siting process.
	1993 Timer Powers Conflict Resolution Award presented to Tampa Electric by the state of Florida for the innovative siting process.
	1991 Florida Audubon Society Corporate Award presented to Tampa Electric for the innovative siting process.
Wabash River Coal Gasification Repowering Project (Wabash River Coal Gasification Repowering Project Joint Venture)	1996 Powerplant Award presented by *Power* magazine to CINergy Corp./PSI Energy, Inc.
	1996 Engineering Excellence Award presented to Sargent & Lundy upon winning the 1996 American Consulting Engineers Council competition.
Development of the Coal Quality Expert™ (ABB Combustion Engineering, Inc. and CQ Inc.)	In 1996 recognized by then Secretary of Energy Hazel O'Leary and EPRI President Richard Balzhiser as the best of nine DOE/EPRI cost-shared utility R&D projects under the Sustainable Electric Partnership Program.
JEA Large-Scale CFB Combustion Demonstration Project (JEA)	2002 Powerplant Award presented by *Power* magazine to JEA.

- Low-NO_x burners and reburning systems that limit NO_x formation by staging the introduction of air in the combustion process (combustion modification);
- SCR, SNCR, and other chemical processes that act upon and reduce NO_x already formed (post-combustion processes); and
- Oxygen-enhanced combustion that displaces a portion of the air with oxygen in low-NO_x burners.

Mercury controls address proposed CSI targets and anticipated U.S. Environmental Protection Agency (EPA) regulations regarding mercury emissions from coal-based power generation, which represents roughly one-third of U.S. mercury emissions. Technologies include:

- Sorbents and oxidizing agents to transform mercury to a solid for removal along with fly ash in electrostatic precipitators (ESP) or fabric filter dust collectors (FFDC);
- Oxidizing agents in conjunction with wet flue gas desulfurization (FGD) scrubbers to capture mercury in the sulfate by-products; and
- Real-time measurement of mercury species and total mercury for mercury control and validation.

Particulate-matter controls respond to revised NAAQS for $PM_{2.5}$, for primary particulate matter (fly ash) and acid aerosols that can cause localized plume opacity, visibility impairment, and have been linked to human health impacts. Acid aerosols are required to be reported under the Toxic Release Inventory. Secondary $PM_{2.5}$ emissions, formed chemically in the atmosphere by precursors such as NO_x and SO_2, were addressed previously. Technologies include:

- ESP/FFDC hybrids to leverage the best features of both;
- Flue gas preconditioning to enhance ESP performance;
- Concentration of particulate matter at ESP outlets for recycle;
- Alkaline injection for sulfur trioxide (SO_3) acid aerosol precursor control; and
- Continuous SO_3 analyzers for process control and validation.

Coal utilization by-product (CUB) efforts provide the knowledge and technology needed to increase utilization of CUBs from the current 30 percent usage to 50 percent. Landfill space is limited, and NO_x and mercury controls impact CUB quality and raise questions regarding environmental acceptability. Technology and knowledge targets include:

- Characterizing the fate of mercury and other trace metals in CUBs;
- Novel applications to expand CUB use; and
- Separation technology to remove carbon and associated mercury from CUBs to enhance sales value.

Advanced power systems address Global Climate Change Initiative, CSI, and Hydrogen Production Initiative by enhancing power generation efficiency, producing near-zero pollutant emissions, and providing for hydrogen separation and carbon dioxide (CO_2) capture and sequestration. Technologies include:

- IGCC systems that convert coal to a clean synthesis gas (syngas) amenable to use by gas turbines and advanced fuel cells, conversion to chemicals and clean transportation fuels, and separation into hydrogen and CO_2; and transform residual gases and solids into salable by-products.
- CFB combustion systems that utilize low-grade fuels and waste materials to generate power at high efficiency and very low emissions, without the parasitic power drain of add-on environmental controls.

Coal liquefaction enhances energy security by converting coal into clean transportation fuels and chemicals. Coal gasification-derived syngas is converted into synthetic hydrocarbon liquids via a catalytic chemical process known as Fischer Tropsch (FT) synthesis. The FT Process can be manipulated to produce an array of products that are virtually free of sulfur and nitrogen pollutants.

Exhibit ES-10

Project Fact Sheets by Application Category

Project	Participant	Solicitation/Status
Environmental Control Devices		
Combustion Initiative for Innovative Cost-Effective NO_x Reduction	Alliant Energy Corporate Services, Inc.	PPII/withdrawn
Achieving NSPS Emission Standards Through Integration of Low-NO_x Burners with an Optimization Plan for Boiler Combustion	Sunflower Electric Power Corporation	PPII/design
Development of Hybrid FLGR/SNCR/SCR Advanced NO_x Control	TIAX, LLC	PPII/negotiation
Greenidge Multi-Pollutant Control Project	CONSOL Energy, Inc.	PPII/negotiation
Demonstration of a Full-Scale Retrofit of the Advanced Hybrid Particulate Collector Technology	Otter Tail Power Company	PPII/operational
Big Bend Power Station Neural Network-Sootblower Optimization	Tampa Electric Company	PPII/construction
Commercial Demonstration of the Airborne Process	LG&E Energy Corporation	CCPI-I/withdrawn
Demonstration of Integrated Optimization Software at the Baldwin Energy Complex	NeuCo, Inc.	CCPI-I/negotiation
TOXECON Retrofit for Mercury and Multi-Pollutant Control on Three 90 MW Coal-Fired Boilers	Wisconsin Electric Power Company	CCPI-I/negotiation
Advanced Electric Power Generation		
McIntosh Unit 4A PCFB Demonstration Project	City of Lakeland, Lakeland Electric	CCTDP-III/terminated
McIntosh Unit 4B Topped PCFB Demonstration Project	City of Lakeland, Lakeland Electric	CCTDP-V/terminated
JEA Large-Scale CFB Combustion Demonstration Project	JEA	CCTDP-I/operational
Next Generation CFB Coal Generating Unit	Colorado Springs Utilities	CCPI-I/negotiation
Kentucky Pioneer Energy IGCC Demonstration Project	Kentucky Pioneer Energy, LLC	CCTDP-V/design
Clean Coal Diesel Demonstration Project	TIAX, LLC	CCTDP-V/design
Coal Processing for Clean Fuels		
Lignite Fuel Enhancement	Great River Energy	CCPI-I/negotiation
Gilberton Coal-to-Clean Fuels and Power Co-Production Project	WMPI PTY., LLC	CCPI-I/negotiation
Advanced Coal Conversion Process Demonstration*	Western Syncoal LLC	CCTDP-I/reporting
Industrial Applications		
Clean Power from Integrated Coal/Ore Reduction (CPICOR™)	CPICOR™ Management Company LLC	CCTDP-V/design
Commercial Demonstration of the Manufactured Aggregate Processing Technology Utilizing Spray Dryer Ash	Universal Aggregates, LLC	PPII/construction
Advanced Multi-Product Coal Utilization By-Product Processing Plant	University of Kentucky Research Foundation	CCPI-I/negotiation
Western Greenbrier Co-Production Demonstration Project	Western Greenbrier Co-Generation, LLC	CCPI-I/negotiation

* Completed demonstration operations.

Exhibit ES-11

Project Fact Sheets by Participant

Participant	Project	Location
Alliant Energy Corporate Services, Inc.	Combustion Initiative for Innovative Cost-Effective NO_x Reduction	Sheboygen, WI
Colorado Springs Utilities	Next Generation CFB Coal Generating Unit	Fountain, CO
CONSOL Energy, Inc.	Greenidge Multi-Pollutant Control Project	Torrey, NY
CPICOR™ Management Company LLC	Clean Power from Integrated Coal/Ore Reduction (CPICOR™)	Vineyard, UT
Great River Energy	Lignite Fuel Enhancement	Underwood, ND
JEA	JEA Large-Scale CFB Combustion Demonstration Project	Jacksonville, FL
Kentucky Pioneer Energy, LLC	Kentucky Pioneer Energy IGCC Demonstration Project	Trapp, KY
Lakeland, City of, Lakeland Electric	McIntosh Unit 4A PCFB Demonstration Project	Lakeland, FL
Lakeland, City of, Lakeland Electric	McIntosh Unit 4B Topped PCFB Demonstration Project	Lakeland, FL
LG&E Energy Corporation	Commercial Demonstration of the Airborne Process	Carrollton, KY
NeuCo, Inc.	Demonstration of Integrated Optimization Software at the Baldwin Energy Complex	Baldwin, IL
Otter Tail Power Company	Demonstration of a Full-Scale Retrofit of the Advanced Hybrid Particulate Collector Technology	Big Stone City, SD
Sunflower Electric Power Corporation	Achieving NSPS Emission Standards Through Integration of Low-NO_x Burners with an Optimization Plan for Boiler Combustion	Garden City, KS
Tampa Electric Company	Big Bend Power Station Neural Network-Sootblower Optimization	Apollo Beach, FL
TIAX, LLC	Clean Coal Diesel Demonstration Project	Fairbanks, AK
TIAX, LLC	Development of Hybrid FLGR/SNCR/SCR Advanced NO_x Control	TBD
Universal Aggregates, LLC	Commercial Demonstration of the Manufactured Aggregate Processing Technology Utilizing Spray Dryer Ash	King George Co., VA
University of Kentucky Research Foundation	Advanced Multi-Product Coal Utilization By-Product Processing Plant	Ghent, KY
Western Greenbrier Co-Generation, LLC	Western Greenbrier Co-Production Demonstration Project	Rainelle, WV
Western SynCoal LLC	Advanced Coal Conversion Process Demonstration	Colstrip, MT
Wisconsin Electric Power Company	TOXECON Retrofit for Mercury and Multi-Pollutant Control on Three 90 MW Coal-Fired Boilers	Marquette, MI
WMPI PTY., LLC	Gilberton Coal-to-Clean Fuels and Power Co-Production Project	Gilberton, PA

1. Role of Clean Coal Technology

Introduction

The role of clean coal technology (CCT) in energy has evolved from the Clean Coal Technology Demonstration Program (CCTDP) begun in fiscal year (FY) 1985 to the Power Plant Improvement Initiative (PPII) in FY 2001 to the Clean Coal Power Initiative (CCPI) in FY 2002. These efforts have built upon sound fundamental principles to achieve government/industry partnerships that are models of cooperation for all government agencies. Discussed below are the importance of coal, domestically and internationally, and the respective roles of CCTDP, PPII, and CCPI in ensuring that coal-based systems meet 21st century energy and environmental demands. Also examined are the environmental drivers for clean coal technologies, market considerations, sustainable growth, and finally future directions in CCT.

Coal

Coal is recognized as an essential element in the U.S. energy policy for the foreseeable future because of the following:

- The location, magnitude, and characteristics of the coal resource base are well understood.
- The technology and skilled labor base to safely and economically extract, transport, and use coal are available.
- A multi-billion dollar infrastructure is in place to gather, transport, and deliver this valuable energy commodity to serve the domestic and international marketplace.
- Coal is used to produce over half of the nation's electric power and is vital to industrial processes, such as steel and cement production, as well as industrial power.
- This abundant fossil energy resource is secure within the nation's borders and relatively invulnerable to disruptions because the coal industry's production is dispersed and flexible, the delivery network is vast, and the stockpiling capability is great.
- Coal is the fuel of necessity in many lesser developed economies, which provides export opportunities for U.S.-developed, coal-based technologies.

Coal, which accounts for over 94 percent of the proven fossil energy reserves in the United States, supplies the bulk of the low-cost, reliable electricity vital to the nation's economy and global competitiveness. According to the U.S. Department of Energy's (DOE) Energy Information Administration (EIA) *Annual Energy Review 2001* (November 2002) (*AER2001*), coal was used to produce over 51 percent of the nation's electricity in 2001. The EIA projections count on coal continuing to dominate electric power production, at least through 2025 (the end of the forecast period). In the *Annual Energy Outlook 2003* (January 2003) (*AEO2003*), EIA estimates 1,350 million tons of coal will generate an estimated 2,736 billion kilowatt-hours, or almost half of all electricity generated in 2025. The EIA coal consumption projection is 0.7 percent higher than the previous year's estimate (for comparable years) due to a projected increase in the demand for coal-based electricity by almost 2.4 percent and an almost 8 percent increase in new coal-based capacity from the previous estimate.

While the CCTDP, PPII, and CCPI respond to domestic needs for competitive clean coal-based technology, they also position the U.S. industry to compete in a burgeoning power market abroad. Electricity continues to be the most rapidly growing form of energy consumption in the world. Projections from EIA's *International Energy Outlook 2003* (May 2003) (*IEO2003*) show electricity demand rising from 13.9 trillion kilowatt-hours in 2001 to 24.7 trillion kilowatt-hours in 2025. The strongest growth is projected for the coal-dependent developing countries of Asia, in particular China and India. This growth not only represents a tremendous economic opportunity, but an environmental opportunity to reduce global carbon emissions through the application of highly efficient clean coal technologies. In 2025, coal is projected to remain the leading fuel for electricity generation worldwide, accounting for 31 percent of the world's electricity fuel market. In 2001, the United States accounted for 40 percent of all coal used for electricity generation, while China and India together accounted for 27 percent.

CCTDP

Over the past quarter century, both nationally and internationally, the energy picture has been one of continual change, including the oil embargoes of the 1970s and the environmental debates of the 1980s. The 1990s brought about more changes in response to required emission reductions for acid rain precursors, initiation of more stringent nitrogen oxides (NO_x) standards for ozone nonattainment areas, tighter standards on fine particulates, the beginning of electric utility restructuring, and concern about global warming.

The immediate challenge was to meet escalating domestic demands for electric power and to assuage asso-

ciated electricity delivery reliability concerns. This challenge came at a time when natural gas prices were extremely volatile and environmental regulations were becoming increasingly stringent.

The CCTDP, begun in fiscal year 1985, has responded to the many changes experienced through the 1990s. Adjustments to meet changing national needs were enabled by spacing a series of five competitive solicitations from 1986 to 1992. The CCTDP has provided a strong technical foundation for responding to the challenges now emerging in the energy market.

The CCTDP is implemented through unique cost-shared government/industry partnerships that allow each party to best apply its expertise and carry out appropriate roles. The magnitude of the projects and extent of industry participation in the CCTDP is unprecedented. Almost $4.8 billion is being expended, with industry and state governments investing two dollars for every federal government dollar invested. New technologies to reduce the emissions of acid rain precursors, namely sulfur dioxide (SO_2) and NO_x, are now in the marketplace and are being used by electric power producers and heavy industry. Advanced electric power generation systems that generate electricity with greater efficiency and fewer environmental consequences are now operating using the nation's most plentiful fossil energy resource—coal.

The ability of coal and coal technologies to respond to the nation's need for low-cost, reliable electricity hinges on the ability to meet two central requirements: (1) environmental performance requirements established in current and emerging laws and regulations, and (2) operational and economic performance requirements consistent with competition in the era of utility restructuring. The CCTDP is responding to these requirements by producing a portfolio of advanced coal-based technologies that will enable coal to retain its prominent role in the nation's power generation future. Furthermore, advanced technologies emerging from the CCTDP will also enhance coal's competitive position in the industrial and fuel sectors. For example, technology advances in steel making, involving direct use of coal, will reduce the cost of production while greatly improving environmental performance. Also, coal could increase its market share in the industrial sector through cogeneration (steam and electricity) and coproduction of products (clean fuels and chemicals). For example, integrated gasification combined-cycle (IGCC) technology can co-produce electricity and clean fuels from coal.

While the CCTDP responds to domestic needs for competitive and clean coal-based technology, it also positions U.S. industry to compete in a burgeoning power market abroad. Electricity continues to be the most rapidly growing form of energy consumption in the world.

The environmentally sound and competitive performance of modern coal technologies has evolved through many years of industry and government research, development, and demonstration (RD&D). The programs were pursued to assure that the U.S. recoverable coal reserves of 274 billion tons, which represent a secure, low-cost energy source, could continue to supply the nation's energy needs economically and in an environmentally acceptable manner.

During the 1970s and early 1980s, many of the government-sponsored technology demonstrations focused on synthetic fuels production technology. Under the Energy Security Act of 1980, the Synthetic Fuels Corporation (SFC) was established for the purpose of reducing the U.S. vulnerability to disruptions of crude oil imports.

The SFC's purpose was accomplished by encouraging the private sector to build and operate synthetic fuel production facilities that would use abundant domestic energy resources, primarily coal and oil shale. The strategy was for the SFC to be primarily a financier of pioneer commercial and near-commercial scale facilities. The goal of the SFC was to achieve production capacities of 500,000 barrels per day of synthetic fuels by 1987 and 2 million barrels per day by 1992, at an estimated cost of $8.8 billion.

By 1985, the market drivers for synthetic fuels dissolved as oil prices declined, world oil supplies stabilized, and a short-term supply buffer was provided by the Strategic Petroleum Reserve. In 1986, Congress responded to the decline of private-sector interest in the production of synthetic fuels in light of these market conditions. Public Law 99-190, the Department of the Interior and Related Agencies Appropriations Act for Fiscal Year 1986, abolished the SFC and transferred project management to the U.S. Department of Treasury.

The CCTDP was initiated in October 1984. Public Law 98-473, Joint Resolution Making Continuing Appropriation for Fiscal Year 1985 and Other Purposes, provided $750 million from the Energy Security Reserve to be deposited in a separate account in the U.S. Treasury entitled The Clean Coal Technology Reserve. The nation moved from an energy policy based on synthetic fuels production to a more balanced policy. This policy established that the nation should have an adequate supply of energy, maintained at a reasonable cost, and consistent with environmental, health, and safety objectives. Energy stability, security, and strength were the foundations for this policy.

Congress recognized that the continued viability of coal as a source of energy was dependent on the demonstration and commercial application of a new generation of advanced coal-based technologies characterized by enhanced operational, economic, and environmental performance. The CCTDP was established to demonstrate the commercial feasibility of clean coal technology applications in response to that need. In 1986, DOE issued the first solicitation (CCTDP-I) for clean coal technology projects. The CCTDP-I solicitation resulted in a broad range of projects being selected in four major product markets—environmental control devices, advanced electric power generation, coal processing for clean fuels, and industrial applications.

In 1987, the CCTDP became the centerpiece for satisfying the recommendations contained in the Joint Report of the Special Envoys on Acid Rain (1986). A Presidential initiative launched a five-year, nearly

$5-billion U.S. government/industry effort to curb precursors to acid rain formation—SO_2 and NO_x. Thus, the second solicitation (CCTDP-II), issued in February 1988, provided for the demonstration of technologies that were capable of achieving significant emission reductions in SO_2, NO_x, or both, from existing power plants. These technologies were to be more cost-effective than current technologies and capable of commercial deployment in the 1990s. In May 1989, DOE issued a third solicitation (CCTDP-III) with essentially the same objective as the second, but additionally encouraged technologies that would produce clean fuels from run-of-mine coal.

The next two solicitations recognized emerging energy and environmental issues, such as global climate change and capping of SO_2 emissions, and thus focused on seeking highly efficient, economically competitive, and low-emission technologies. Specifically, the fourth solicitation (CCTDP-IV), released in January 1991, had as its objective the demonstration of energy-efficient, economically competitive technologies capable of retrofitting, repowering, or replacing existing facilities while achieving significant reductions in SO_2 and NO_x emissions. In July 1992, DOE issued the fifth and final solicitation (CCTDP-V) to provide for demonstration projects that significantly advanced the efficiency and environmental performance of technologies applicable to new or existing facilities. As a result of these five solicitations, a total of 60 government/industry cost-shared projects were selected, of which 36, valued at almost $4.8 billion, have either been successfully completed or remain active in the CCTDP.

The success of the government/industry CCTDP is directly attributable to its responsiveness to public and private sector needs to reduce environmental emissions and maximize economic and efficient energy production. The CCTDP is strengthening the economy, enhancing energy security and reliability, and reducing the vulnerability of the economy to global energy market shocks.

PPII

The PPII was established in FY 2001 by Congress in Public Law 106-291, Department of the Interior and Related Agencies Appropriations Act for Fiscal Year 2001. The act provided "for a general request for proposals for the commercial scale demonstration of technologies to assure the reliability of the [n]ation's energy supply from existing and new electric generating facilities for which the Department of Energy upon review may provide financial assistance awards . . . ." In the act, Congress transferred $95 million for this purpose from previously appropriated CCTDP funding. Congress also applied the principles of the CCTDP to PPII to ensure success of the program.

The roots of PPII lie in the blackouts and brownouts of 1999 and 2000 and increasing concerns over the adequacy of the nation's power supplies as a whole. Several parts of the United States, including the West Coast and parts of the Northeast, had experienced rolling blackouts and brownouts in the previous two years caused in large part by sharp rises in demand for electricity and lagging construction of new power plants.

A total of eight projects were selected in the PPII solicitation. As of May 2003, two projects were withdrawn, four have been awarded cooperative agreements, and two are still in negotiations.

CCPI

The CCPI is a government/industry partnership to implement the President's National Energy Policy (NEP) recommendation to increase investment in clean coal technology. This recommendation, one of several dealing with electricity, addresses the national challenge of ensuring the reliability of our electric supply while simultaneously protecting our environment. The CCPI was established in fiscal year 2002 by Congress in Public Law 107-63, Department of Interior and Related Agencies Appropriations Act for Fiscal Year 2002. The CCPI is a cost-shared partnership between the government and industry that implements the NEP recommendation to "fund research in clean coal technology." The goal is to accelerate commercial deployment of advanced technologies to ensure the United States has clean, reliable, and affordable electricity.

In the appropriation, Congress explicitly stated that the CCPI funds were to be expended in accordance with prior congressional guidance in prior clean coal technology appropriations. Further, Congress stated that CCPI projects will be governed by the same laws and regulations as the CCTDP. Congress did, however, expand the repayment provisions to include international sales and specified that the repayments be retained by DOE for future RD&D projects.

The first CCPI solicitation (CCPI-I) sought projects that would demonstrate advanced coal-based technologies and accelerate their deployment for commercial use. The CCPI-I was designed to support the President's proposed Clear Skies Initiative (CSI) through advanced pollution controls and the Global Climate Change Initiative through efficiency improvements for existing plants. As such, CCPI-I was open to any technology advancement related to coal-based power generation that results in efficiency, environmental, and economic improvement compared to currently available state-of-the-art alternatives. The solicitation was also open to technologies capable of producing any combination of heat, fuels, chemicals or other useful byproducts in conjunction with power generation. Building on lessons learned from the CCTDP, specific provisions of the CCPI Round I solicitation included:

- Minimum of 50 percent cost-sharing by industry participants.

- Site guarantees were required prior to award.
- 75 percent of fuel input for projects must be U.S. coal.
- Public abstracts must be submitted that include information on project costs, schedules, and principal entities.
- Communication plans must be submitted to show approaches for technology transfer.
- Repayment plans must be developed by the participant and evaluated for merit by DOE.
- Non-DOE experts may be used to review technical proposals.
- Projects may be eligible for exemptions from New Source Review (NSR) and New Source Performance Standards (NSPS).
- Funding is provided for a project definition phase, which allows time and partial funding to finalize financing and National Environmental Policy Act (NEPA) review.
- Evaluations were based on technical merit (50%), project feasibility (30%), and commercial potential (20%).

The CCPI-I was issued March 4, 2002; 36 proposals were received by DOE on August 1, 2002; and 8 selections were announced January 15, 2003. Eight projects valued at more than $1.3 billion, including $317 million in federal cost sharing support, were selected by DOE for funding. These projects include three multi-pollutant environmental control demonstrations ($188 million), two advanced power demonstrations ($517 million), two coal processing for clean fuels demonstrations ($634 million), and one industrial applications demonstration ($9 million). Cooperative agreement negotiations are ongoing with seven of the projects, while one project was withdrawn.

The second CCPI solicitation (CCPI-II) is scheduled for Fall 2004. Round II will continue to support the CSI and Global Climate Change Initiative, with emphasis on:

- Clean, high-efficiency next-generation coal-based power systems, *e.g.*, integrated gasification combined-cycle; and
- Carbon sequestration, *i.e.*, carbon dioxide (CO_2) capture, recycle, and storage.

Subsequent rounds are scheduled on a two-year cycle to support advanced technology in the research and development pipeline.

Environmental Drivers

Soot and Smog

In July 1997, under Title I of the CAAA, EPA issued final rules revising the primary and secondary NAAQS for particulate matter (PM) and ozone (O_3) (commonly referred to as "soot and smog" regulations).

The soot provisions addressed ambient air concentrations of particulate matter in the respirable range of 2.5 millionths of a meter (microns) in diameter or less ($PM_{2.5}$). Previous fine particulate standards dealt with airborne material in the inhalable range of 10 microns in diameter or less (PM_{10}). The $PM_{2.5}$ standard affects primary sources such as fly ash, carbon soot, and acid mists (aerosols) and secondary sources such as ammonium sulfates and nitrates from precursor SO_2 and NO_x gases. Monitoring to ascertain $PM_{2.5}$ attainment is ongoing, with designations of non-attainment expected by 2003–2004. State Implementation Plans (SIPs) for compliance are expected by 2007–2008, with compliance by 2013–2014.

The ozone standards in turn impact NO_x emissions because NO_x is a precursor to ozone formation. As an interim measure, EPA issued a rulemaking in response to recommendations of a 37-state Ozone Transport Assessment Group (OTAG). The rulemaking, in the form of a "SIP Call," required 22 eastern states and the District of Columbia to reduce NO_x emissions according to specified amounts (budgets) by May 2003. Subsequently, the rule was amended to extend the compliance deadline to May 2004. The expected emission limits for power plants is 0.15 lb/10^6 Btu, which generally requires relatively expensive selective catalytic reduction (SCR) technology. Under the general provisions of the ozone NAAQS provisions, SIPs are expected by 2003, with compliance ranging from 2003–2018 depending on the air quality in a particular area.

A major thrust of the PPII and CCPI is development of cost-effective technology to comply with the soot and smog provisions. To do so requires a step beyond CCTDP technologies, using the technology base established in CCTDP.

Hazardous Air Pollutants

Hazardous Air Pollutant Monitoring

Under Title III of the CAAA, EPA is responsible for determining the hazards to public health posed by 189 hazardous air pollutants (HAPs), and is required to perform a

Hazardous air pollutants were measured at the Babcock & Wilcox Company's Demonstration of Coal Reburning for Cyclone Boiler NO_x Control at Nelson Dewey Station.

study of HAPs to determine the public health risks that are likely to occur as a result of power plant emissions. To address this issue, DOE implemented a program with industry to monitor HAPs emissions at CCTDP project sites. Objectives of the HAPs monitoring are to (1) improve the quality of HAPs data being gathered, and (2) monitor a broader range of plant configurations and emissions control equipment. As a result of this program, 20 CCTDP projects are monitoring or have monitored HAPs, with 15 having completed monitoring by May 2003 (see Appendix C, Exhibit C-7).

In a parallel effort begun in January 1993, EPA, with the participation of DOE under the Coal Research and Development Program, the Electric Power Research Institute (EPRI), and the Utility Air Regulatory Group (UARG), began an emissions data collection program using state-of-the-art sampling and analysis techniques. Emissions data were collected from eight utilities representing nine process configurations, several of which were CCTDP projects. These utilities represented different coal types, process configurations, furnace types, and pollution control methods. The report, *A Comprehensive Assessment of Toxic Emissions from Coal-Fired Power Plants: Phase I Results from the U.S. Department of Energy Study*, was released in September 1996 and provided the raw data from the emissions testing. The second phase of the DOE/EPRI effort involved sampling at other sites, including the CCTDP's Wabash River, Tampa Electric, and Sierra Pacific integrated gasification combined-cycle (IGCC) projects.

In another DOE study, HAPs data were collected from 16 power plants and reported in *Summary of Air Toxics Emissions Testing at Sixteen Utility Plants*. The report, issued in July 1996, provides an assessment of HAPs measured in the coal, across the major pollution control devices, and emitted from the stack. The results of the HAPs program significantly have mitigated concerns about a broad range of HAPs emissions from coal-fired power generation, and focused attention on mercury (Hg).

Mercury

Following up on the October 1996 EPA report to Congress, *Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units—Interim Final Report* (final report was issued February 1998), the *Mercury Study Report to Congress*, issued December 1997, estimates that U.S. industrial sources were responsible for releasing 158 tons of mercury into the atmosphere in 1994 and 1995. The EPA estimates that 87 percent of those emissions originated from combustion sources such as waste and fossil fuel facilities, 10 percent from manufacturing facilities, 2 percent from area sources, and 1 percent from other sources. The EPA also identified four specific categories that account for about 80 percent of the total anthropogenic sources: coal-fired power plants, 33 percent; municipal waste incinerators, 18 percent; commercial and industrial boilers, 18 percent; and medical waste incinerators, 10 percent.

Wabash River was one of the sites where DOE and EPRI collected HAPs data.

In December 2000, EPA decided to develop regulations for mercury emissions. In anticipation of the regulations, PPII and CCPI specifically encouraged projects that address mercury emissions from existing plants. Many of the selected projects involve demonstration of technologies emerging from DOE-sponsored R&D efforts begun in the late 1990s.

Global Climate Change Initiative

The CCTDP had its roots in the reduction of acid rain precursors and was responsive to the recommendations contained in the *Joint Report of the Special Envoys on Acid Rain*, as discussed earlier. Moreover, as concerns over global climate change emerged, the CCTDP began to emphasize demonstration of advanced electric power generation technology capable of achieving significantly higher efficiency than conventional systems, thus reducing carbon emissions.

For example, achieving the Office of Fossil Energy's long-term efficiency of 60 percent would result in approximately 40 percent less carbon emissions than a conventional coal-fired unit burning the same carbon content feedstock. There are four IGCC demonstration projects in the CCTDP, representing a diversity of gasifier types and cleanup systems. These projects are pioneering this environmentally friendly technology, which in addition to lower carbon emissions, boasts very low SO_2 and NO_x emissions. The IGCC technology offers flexibility in that new plants can be constructed in modules as demand dictates.

On February 14, 2002, the President announced the Global Climate Change Initiative. The President committed the United States to an aggressive new strategy to cut greenhouse gas intensity by 18 percent over the next ten years. The initiative puts the United States on a path to slow the growth of greenhouse gas (GHG) emissions, and—as the science justifies—to stop, and then reverse that growth.

Three CCPI projects are expected to contribute to the Global Climate Change Initiative to reduce greenhouse gases. Two of the projects will reduce CO_2, a primary GHG, by boosting the fuel use efficiency of power plants. The third project will demonstrate a potential alternative to conventional portland cement manufacturing, a large emitter of CO_2.

Carbon Sequestration Leadership Forum

On February 27, 2003, the Secretary of Energy and the Under Secretary of State for Global Affairs announced that the United States is taking the lead in forming an ambitious new international effort to advance carbon capture and storage technology as a way to reduce greenhouse gas emissions. The two departments outlined plans for creating the Carbon Sequestration Leadership Forum, which will bring together ministerial-level representatives to discuss the growing body of scientific research and emerging technologies for permanently isolating CO_2 and other GHG from the atmosphere.

The Carbon Sequestration Leadership Forum will focus on development of carbon capture and storage technologies as a means to accomplishing long-term stabilization of greenhouse gas levels in the atmosphere. This initiative is designed to improve carbon capture and storage technologies through coordinated research and development with international partners and private industry.

Three types of cooperation are currently envisioned within the framework of the forum: data gathering, information exchange, and joint projects. Data gathered from participating countries will be aggregated, summarized, and distributed to all of the forum's participants. Joint projects will be identified by member nations with the forum serving as a mechanism for bringing together government and private sector representatives from member countries.

Clear Skies Initiative

On February 14, 2002, the President announced the Clear Skies Initiative. The initiative cuts power plant emissions of the three worst air pollutants—NO_x, SO_2, and Hg—by approximately 70 percent by 2018. The initiative will improve air quality using a market-based "cap-and-trade" program based on the CAAA's acid rain program. The Clear Skies Initiative is a primary driver for the CCPI. Numerous multi-pollutant control technology projects were selected in CCPI-I.

Regional Haze

In July 1999, EPA published a new rule calling for long-term protection of, and improvement in, visibility for 156 national parks and wilderness areas across the country. Many environmental groups believe coal-fired power plants are a source of regional haze in the national parks and wilderness areas.

During the period 2003-2008, states are required to establish goals for improving visibility in each of these 156 areas and adopt emission-reduction strategies for the period extending to 2018. States have flexibility to set these goals based upon certain factors, but as part of the process, they must consider the rate of progress needed to reach natural visibility conditions in 60 years. Coal-fired power plants are likely targets for new controls to reduce regional haze.

Solid Waste

Coal utilization by-products (CUB), the solid waste from power plants, represent a potentially valuable resource as construction materials and soil amendments. But in 2001, only 39 million tons of the approximately 130 million tons of CUBs generated were recycled. The primary hurdle to increased CUB use has been questions raised as to potential environmental impact and liability associated with their use.

The CCTDP went a long way toward addressing the issue of solid waste by demonstrating scrubbers that produced commercial-grade gypsum in lieu of sludge, which required excessive land use for disposal. Both PPII and CCPI are addressing the CUB use issue, particularly from the standpoint of reducing mercury and NO_x control impacts on CUB utilization.

Market Considerations

When the CCTDP started in 1985, the electric utility industry was highly regulated. The major uncertainty was the breadth and depth of environmental regulatory requirements that would be imposed on the industry. Even this uncertainty was mitigated by the fact that the environmental control costs could be passed through to the consumer if approved by the state regulatory commission. As long as the utility made prudent investments in plant and equipment, its economic future was fairly stable and predictable. Most industry observers assumed that coal and nuclear energy would carry the burden of baseload generation, oil would be phased out, and natural gas would be used for meeting peak load requirements.

By mid-1997, the picture was entirely different—the utility industry was in the midst of a major restructuring to accommodate a competitive marketplace. Under utility restructuring, power generators must assume the risk for new capacity additions. The relatively low capital cost and short lead times for natural gas-based systems make them the preferred option for the foreseeable future. As a result, projections now call for natural gas to be the fuel of choice for new capacity additions through 2025. During the same period, nuclear-based capacity is projected to decline and coal-based capacity is projected to increase moderately.

Under retail deregulation, end users are not required to purchase power from their local utility company, but instead may purchase power from generators or marketers located in other states and regions of the country. In this competitive market environment, power is priced according to market conditions, not necessarily according to generation costs.

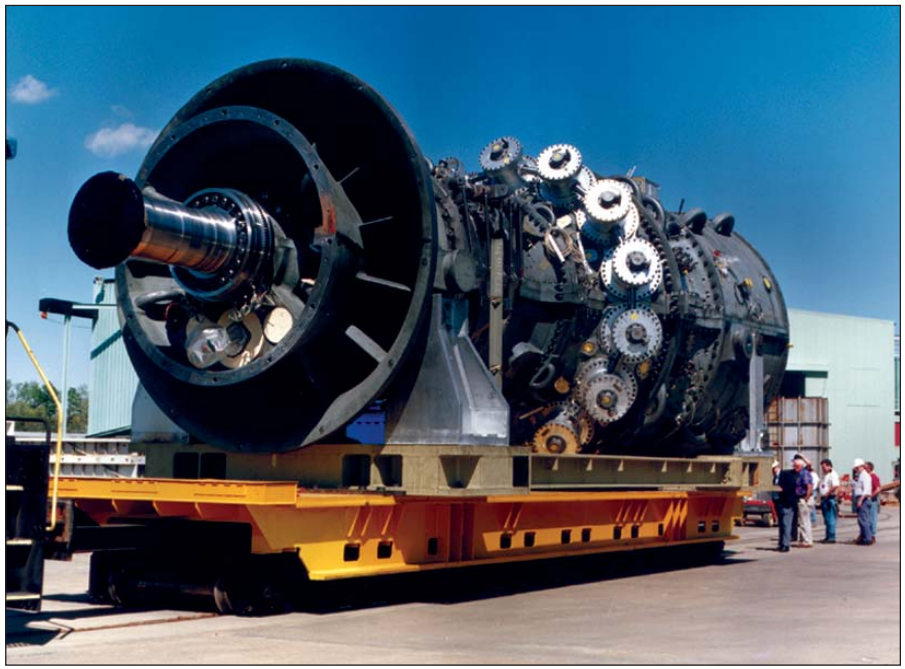
Advancement in the technology of electricity production is another factor that has had an impact on restructuring. Nonutility generators have taken advantage of these advances, such as aero-derived gas turbines, to generate electricity cheaper than can be achieved using conventional fossil steam or nuclear generators. The new technologies are often more efficient, less environmentally obtrusive, and can be installed in a very short period of time in capacity modules closely matching the load growth curves.

These factors have had a pronounced effect on the utility market for coal and clean coal technology. A comparison of 1985 and 2003 energy projections for coal, natural gas, and oil, which is shown in Exhibit 1-1, illustrates the magnitude of the change that restructuring is causing, as well as environmental regulations discussed previously. According to EIA's *AEO2003*, coal is projected to maintain its lead in the production of electricity in 2010 at almost 52 percent; however, that is down from 60 percent when the CCTDP started. The differential has been, for the most part, made up by the growth in natural gas-powered generation.

Industry restructuring and competition will impact coal and coal technologies for the foreseeable future. As of March 2003, restructuring is active in 17 states and the District of Columbia, delayed in 5 states, suspended in 1 state, and not active in 27 states. Utilities are expected to improve their operating efficiencies by using existing plants at higher capacity factors. Contributing to increased capacity factors is a projected drop in generating capacity, not only from nuclear plant retirements, but also from fossil-fueled plant retirements. EIA predicts that nearly 46 GW of new coal-fired capacity is expected to come on line between 2000 and 2020 (a 47 percent increase from the previous year's estimate). In the forecast period through 2025, a total of 74 GW of new coal-fired capacity is expected to come on line, accounting for over 17 percent of capacity expansion. During this time, new, highly efficient, low-emissions power systems will enter the power production markets. New concepts to reduce delivered electricity prices will likely be employed. Examples include minemouth plants that reduce or eliminate the coal transportation cost component in power production. Also, cogeneration and coproduction systems will be available, which allow the consumer's cost of electricity potentially to be reduced by the profitability of co-products.

Ensuring Sustainable Economic Growth

It is in the national interest to maintain a multi-fuel energy mix to sustain national economic growth. Coal is a key component of national energy security because of its affordability, availability, and abundance within the nation's borders. The domestic coal resources are large enough to supply U.S. needs for more than 250 years at current rates of production. The Department of Energy's strategy includes the development and deployment of a technology portfolio that enhances the efficient use of this coal resource while assuring that national and global environmental goals are achieved.



General Electric's Advanced Turbine System combustion turbine.

The United States is increasingly dependent on imported oil as lower average prices had resulted in decreased domestic oil production capacity for 13 years. That trend was broken in 1995 by an oil production capacity increase of 0.4 million barrels per day. In 2001, net petroleum imports were 10.6 million barrels per day, or 54 percent of domestic consumption. The *AEO2003* reference case for 2025 calls for net imports of 18.6 million barrels per day of crude and refined products, which represents more than 63 percent of the total forecasted supply.

Also, natural gas imports are expected to grow from 15.5 percent of total gas consumption in 2000 to 22.4 percent in 2025. These imports are primarily from Canada, which does not represent a supply stability problem. Other sources of imports include liquefied natural gas (LNG) from Trinidad and Tobago, Algeria, and Japan. United States coal consumption is 1,060 million tons/year, which is equivalent to approximately 10.5 million barrels of oil per day, and equates to $84 billion per year using 2001 average import crude oil prices. The Department of Energy's clean coal technology demonstrations will provide the technologies that will enable coal to continue as a major component in the nation's economy while achieving the environmental quality that society demands. Coal-related jobs are dispersed through the mining, transportation, manufacturing, utility, and supporting industries.

A U.S. coal conversion industry could directly reduce the nation's dependency on imported oil. The Department of Energy is responding to this opportunity through development and demonstration of coal liquefaction production, Fischer-Tropsch synthesis, and hydrogen production.

On an international basis, the prospects for coal have declined somewhat, but coal still represents a major source of energy throughout the world by contributing almost a quarter of the world's energy needs. Highlights of the EIA's *IEO2003* projections for coal are as follows:

- World coal use has been in a period of generally slow growth since the 1980s, and the trend is expected to continue through the forecast period. The projected slow growth in coal consumption, averaging 1.5 percent per year through 2025, suggests that coal will account for a shrinking share of world energy consumption. The coal share of total energy consumption is projected to fall from 24 percent in 2001 to 22 percent by 2025.
- Substantial declines in coal use are projected for Western Europe and the Eastern Europe/Former Soviet Union (EE/FSU) countries, where natural gas (and in the case of France, nuclear power) is increasingly being used for electricity generation and for other uses in the industrial and buildings sectors.
- In developing Asia, especially in China and India, coal continues to dominate many fuel markets. As very large countries in terms of both population and land mass, and with ample domestic coal resources, China and India are projected to account for 75 percent of the total expected increase in coal use worldwide (on a Btu basis). Coal's share of electricity production in China is now 72 percent and is projected to rise to 73 percent in 2025. Over the same period, coal's share of India's electricity market is expected to remain dominant, but decline from 72 percent in 2001 to 63 percent in 2025.
- Almost 55 percent of the coal consumed worldwide is used for electricity generation, and its role in the future is expected to be primarily as a fuel for power generation, and secondarily as an energy source in a few key industrial sectors, such as steelmaking.
- Where coal is used in the industrial, residential, and commercial sectors, other energy sources—primarily natural gas—are expected to gain market share. One exception is China, where coal continues to be the most widely used fuel in the country's rapidly growing industrial sector, reflecting China's abundant coal reserves and limited access to other sources of energy.
- Consumption of coking coal is projected to decline slightly in most regions of the world as a result of technological advances in steelmaking, increasing output from electric arc furnaces, and continuing replacement of steel by other materials in end-use applications.

This international market provides opportunities for U.S. technology suppliers, developers, architect/engineers, and other U.S. firms to capitalize on the advantages gained through experiences in the CCTDP. However, aggressive action is needed, as other governments are recognizing the enormous economic benefits that their economies can enjoy if their manufacturers capture a greater share of this market.

Beyond the current programs, DOE activities are aimed at creating a favorable export climate for U.S. coal and coal technology. These efforts include (1) improving the visibility of U.S. firms and their products by establishing an information clearinghouse and closer liaison with U.S. representatives in other countries, (2) strengthening interagency coordination of federal programs pertinent to these exports, and (3) improving current programs and policies for facilitating the financing of coal-related projects abroad.

Future Directions

FutureGen

On February 27, 2003, the Secretary of Energy announced plans for the United States to build a prototype of the fossil fuel power plant of the future—FutureGen. FutureGen is a cost-shared $1 billion venture with private sector and international partners that will combine electricity and hydrogen production with the virtual total elimination of harmful emissions, including greenhouse gases through sequestration. The

FutureGen power plant will serve as the test bed for demonstrating the best technologies the world has to offer. The Department of Energy will ask the power industry to organize a consortium to manage the project and share in the project costs. Current plans call for the plant to be designed and built over the next five years, then operated for at least five years beyond that.

Virtually every aspect of the FutureGen plant will be based on cutting-edge technology. The federal government will ask the industrial consortium to design a plant that will turn coal into a hydrogen-rich gas, rather than burning it directly. The hydrogen could then be combusted in a turbine or used in a fuel cell to produce clean electricity, or it could be fed to a refinery to help upgrade petroleum products. In the future, the plant could become a model hydrogen-production facility to supply a new fleet of hydrogen-powered cars and trucks.

Common air pollutants such as SO_2 and NO_x would be cleaned from the coal gases and converted to usable byproducts such as fertilizers and soil enhancers. Mercury pollutants would also be removed. Carbon dioxide would be captured and sequestered in deep underground geologic formations.

Carbon sequestration will be one of the primary features that will set the FutureGen plant apart from other electric power projects. Engineers will design into the plant advanced capabilities to capture the carbon dioxide in a form that can be sequestered. The initial goal will be to capture at least 90 percent of the plant's carbon dioxide. Once captured, the carbon dioxide will be injected deep underground, perhaps into the brackish reservoirs that lie thousands of feet below the surface of much of the United States, or potentially into oil or gas reservoirs, or into unmineable coal seams or basalt formations. Once entrapped in these formations, the greenhouse gas would be permanently isolated from the atmosphere.

The plant would be sized to generate approximately 275 megawatts of electricity, roughly equivalent to an average mid-size coal-fired power plant. The prototype plant would be a stepping stone toward a future coal-fired power plant that not only would be emission-free but would operate at unprecedented fuel efficiencies.

Vision 21

The Department of Energy is providing the foundation needed to build a future generation of fossil energy-based power systems capable of meeting the energy and environmental demands of the 21st century. The hardware and attendant databases serve as platforms for power, environmental, and fuels systems that together can meet the long-term goals of the Office of Fossil Energy's Coal & Power Systems Program. These "Vision 21" goals are delineated in Exhibit 1-2. The expected result is a suite of technology modules capable of using a broad range of fuels (coal; biomass; and forestry, agricultural, municipal, and refinery wastes) to produce a varied slate of high-value commodities (electricity, steam, clean fuels, and chemicals) at greater than 60 percent efficiency and near-zero emissions.

First-generation systems emerging from the CCTDP, PPII, and CCPI programs provide or will provide (1) the knowledge base from which to launch commercial systems, which will experience increasingly improved cost and performance over time through design refinement; and (2) platforms on which to test new components,

Exhibit 1-1

Comparison of Energy Projections for Electric Generators

	Electricity Sales (10^9 kWh/yr)			Coal Consumption (10^6 tons/yr)			Gas Consumption[a] (10^{12} ft^3/yr)			Oil Consumption[a] (10^6 barrels/yr)		
	NEPP 1985	AEO 2003	% Δ	NEPP 1985	AEO 2003	% Δ	NEPP 1985	AEO 2003	% Δ	NEPP 1985	AEO 2003	% Δ
1995	3,018	3,026[b]	0.27	924	958[b]	3.7	3.0	3.37[b]	12	256	110[b]	-52
2010	4,176	4,101	-1.80	1,355	1,123	-17.1	1.7	6.80	300	146	69	-53

NEPP 1985: *National Energy Policy Plan Projections to 2010*, U.S. Department of Energy, December 1985.

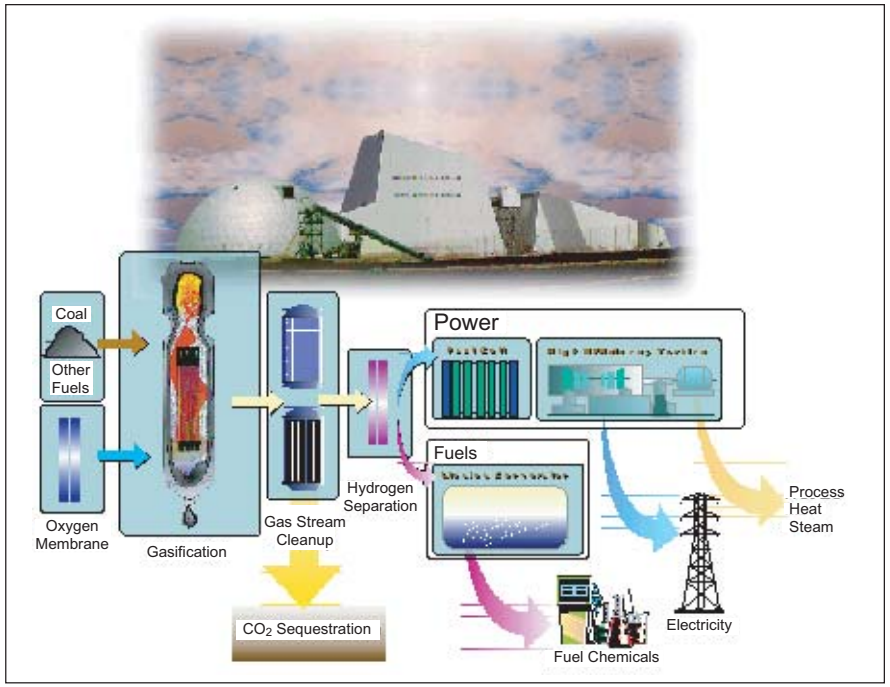
AEO 2002: *Annual Energy Outlook 2003 with Projections to 2025*, Energy Information Agency, January 2003.

% **Δ** = percent difference between the two projections.

[a] Consumption by electric generators excluding cogenerators.

[b] Actuals from *Annual Energy Outlook 1998*, December 1997.

which will result in jumps in cost and performance. Examples of new components include advanced particulate filtration, sulfur and alkali removal, air separation membranes, high-temperature heat exchangers, artificial intelligence-based controls and sensors, and CO_2 and hydrogen separation technologies. A strategy of the Vision 21 effort is to develop and spin off such key components to mitigate the risk and cost of integrating the technologies into power, environmental, and fuel system modules.



Vision 21 modules can be combined in a variety of configurations. One example, shown above, incorporates modules to produce a variety of energy products.

Exhibit 1-2
Vision 21 Objectives

Efficiency—Electricity Generation	Coal-based systems 60% (HHV); natural gas-based systems 75% (LHV) with no credit for cogenerated steam.[a]
Efficiency—Combined Heat & Power	Overall thermal efficiency above 85% (HHV); also meets efficiency goals for electricity.[a]
Efficiency—Fuels Plant Only	Fuel utilization efficiency of 75% (LHV) when producing coal-derived fuels.[a]
Environmental	Near-zero emissions of sulfur, nitrogen oxides, particulate matter, trace elements, and organic compounds; 40-50% reduction in CO_2 emissions by efficiency improvement; 100% reduction with sequestration.
Costs	Cost of electricity 10% lower than conventional systems; Vision 21 plant products cost-competitive with market clearing prices.
Timing	Major spinoffs such as improved gasifiers, advanced combustors, high-temperature filters and heat exchangers, and gas separation membranes begin by 2006; designs for most Vision 21 subsystems and modules available by 2012; Vision 21 modules available for commercial plant designs available by 2015.

[a] The efficiency goal for a plant co-feeding coal and natural gas will be calculated on a pro-rata basis. Likewise, the efficiency goal for a plant producing both electricity and fuels will be calculated on a pro-rata basis

2. Implementation

Introduction

The implementation principles of the Clean Coal Technology Demonstration Program (CCTDP), Power Plant Improvement Initiative (PPII), and Clean Coal Power Initiative (CCPI) have been built upon the lessons learned from each successive solicitation. A discussion of the implementation of each of these three programs follows.

CCTDP

The CCTDP founding principles and implementing process resulted in one of the most successful cost-shared government/industry partnerships forged to respond to critical national needs. Through five nationwide competitions, a total of 60 government/industry cost-shared projects were selected, of which 36, valued at almost $4.8 billion, either have been completed or remain active as of May 2003. For the 36 projects, the industry cost-share is an unprecedented 68 percent. Thirty-one of the 36 projects have completed operations. The balance are moving forward, with operational testing under way for one project. The remaining projects are either in the design or construction phase.

Over the nine-year period (1986–1995) of soliciting and awarding projects, the thrust of the environmental concerns relative to coal use has changed. Nevertheless, the implementing process allowed the program to remain responsive to the changing needs. The result is a portfolio of technologies and a database of technical and cost information that will enable coal to remain a major contributor to the U.S. energy mix without being a threat to the environment. This result will ensure the secure, low-cost energy that is requisite to a healthy economy well into the 21st century.

Success of the CCTDP is measured by the degree to which the operational, environmental, and economic performance of a technology can be projected for commercial applications. Decision makers must have a sufficient database to project performance and assess risk for commercial introduction and deployment of new technologies. This need for information was a driving force in establishing the principles that created the foundation for the implementation process. The government role is non-traditional, moving away from a command-and-control approach to a performance-based approach, where the government sets performance objectives and industry responds with its ideas and is allowed broad latitude in technical management of the projects. This approach encourages technology innovation and cost-sharing. Industry and the public play major roles in the process, reflecting their respective roles in moving technologies into the marketplace.

Implementation Principles

The principles underlying the CCTDP were developed after much study of previous government demonstration programs, assessing both positive and negative results. The principles represent a composite of incentives and checks and balances that allows all participants to best apply their expertise and resources. These guiding principles are outlined below.

- **A strong and stable financial commitment exists for the life of the projects.** Full funding for the government's share of selected projects was appropriated by Congress at the start of the program. This up-front commitment has been vital to getting industry's response in terms of quantity and quality of proposals received and the achievement of 68 percent cost-sharing.
- **Multiple solicitations spread over a number of years enabled the program to address a broad range of national needs with a portfolio of evolving technologies.** Allowing time between solicitations enabled Congress to adjust the goals of the program to meet changing national needs, provided the U.S. Department of Energy (DOE) time to revise the implementation process based on lessons learned in prior solicitations, and provided industry the opportunity to develop better projects and more confidently propose evolving technologies.
- **Demonstrations are conducted at commercial scale in actual user environments.** Typically, a technology is constructed at commercial scale with full system integration, reflective of its intended commercial configuration, and operated as a commercial facility or installed on an existing commercial facility. This enables the technology's performance potential to be judged in the intended commercial environment.
- **The technical agenda is determined by industry and not the government.** Based on goals established by Congress and policy guidance received, DOE set definitive performance objectives and performance-based evaluation criteria against which proposals would be judged. Industry was given the flexibility to use its expertise and innovation to define the technology and proposed project in response to the objectives and criteria. The Department of Energy selected the projects that best met the evaluation criteria.
- **Roles of the government and industry are clearly defined and reflect the degree of cost-sharing required.** The government plays a significant role up

front in structuring the cooperative agreements to protect public interests. This includes negotiating definitive performance milestones and decision points throughout the project. Once the project begins, the industrial participant is responsible for technical management, while the government oversees the project through aggressive monitoring and engages in implementation only at decision points. Continued government support is assured as long as project milestones and the terms and conditions of the original cooperative agreement continue to be met.

- **At least 50 percent cost-sharing by industry is required throughout all project phases.** Industry's cost-share was required to be tangible and directly related to the project, with no credit for previous work. By sharing essentially in each dollar expended along the way, on at least an equal basis, industry's commitment to fulfilling project objectives was strengthened.
- **Allowance for cost growth provides an important check-and-balance feature to the program.** Statutory provisions allow for additional financial assistance beyond the original agreement in an amount up to 25 percent of DOE's original contribution. Such financial assistance, if provided, must be cost-shared by the industrial participant at no less than the cost-share ratio of the original cooperative agreement. This statutory provision recognizes the risk involved in first-of-a-kind demonstrations by allowing for cost growth. At the same time, it recognizes the need for the industrial participant's commitment to share cost growth and limits the government's exposure.
- **Industry retains real and intellectual property rights.** The level of cost-sharing warrants the industrial participant retaining intellectual and real property rights and removes potential constraints to commercialization. Industry would otherwise be reluctant to come forward with technologies developed to the point of demonstration, relinquishing their competitive position.
- **Industry must make a commitment to commercialize the technology.** Consistent with program goals, the industrial participant is required to make the technology available on a nondiscriminatory basis, under reasonable terms and conditions, to all U.S. companies that seek to use the technology. While the technology owner is not forced to divulge know-how to a competitor, the technology must be made available to potential domestic users on reasonable commercial terms.
- **Upon successful commercialization of the technology, repayment up to the government's cost-share is required.** The repayment obligation occurs only upon successful commercialization of the technology. It is limited to the government's level of cost-sharing and the 20-year period following the demonstration.

In summary, these principles provide built-in checks and balances to ensure that the industry and government roles are appropriate and that the government serves as a risk-sharing partner without impeding industry from using its expertise and getting the technology into the marketplace.

Implementation Process

Significant public and private sector involvement was integral to the process leading to technology demonstration and critical to program success. Even before engaging in a solicitation, a public process was instituted under the National Environmental Policy Act (NEPA) to review the environmental impacts. A programmatic environmental impact assessment (PEIA), followed by a programmatic environmental impact statement (PEIS), was prepared. Public comment and resolution of comments were required prior to proceeding with the program.

As to the solicitation process, Congress set the goals for each solicitation in the enabling legislation and report language (see Appendix A for legislative history and Appendix B for program implementation history). The Department of Energy translated the congressional guidance and direction into performance-based criteria, and developed approaches to address lessons learned from previous solicitations. Before proceeding with a solicitation, however, an outline of the impending solicitation and attendant issues and options was presented in a series of regional public meetings to obtain feedback. The public meetings were structured along the lines of workshops to facilitate discussion and obtain comments from the broadest range of interests. Comments from the public meetings then were used in preparing a draft solicitation, which in turn was issued for public comment. Comments received were formally resolved prior to solicitation issuance.

To aid proposers, preproposal conferences were held for the purpose of clarifying any aspects of the solicitation. Further, every attempt was made in the solicitation to impart a clear understanding of what was being sought, how it would be evaluated, and what contractual terms and conditions would apply. A section of the solicitation was devoted to helping potential proposers determine technology eligibility, and numerical quantification of the evaluation criteria was provided. The solicitation also contained a model cooperative agreement with the key relevant contractual terms and conditions.

Project selection and negotiation leading to award were conducted under stringent rules carrying criminal penalties for noncompliance. Proposals were evaluated and projects negotiated strictly against and within the criteria and terms and conditions established in the solicitation. In the spirit of NEPA, information required and evaluated included project-specific environmental, health, safety, and socioeconomic aspects of project implementation.

Upon project award, another public process was engaged to ensure that all site-specific environmental concerns were addressed. The National Environmental Policy Act requires that a rigorous environmental assessment be conducted to address all potential environmental, health, safety, and socioeconomic impacts associated with the project. The findings can precipitate a more formal environmental impact statement (EIS) process, or

the findings can remain as an environmental assessment (EA) along with a finding of no significant impact (FONSI). During the EIS process, public meetings are held for the purpose of disclosing the intended project activities, with emphasis on potential environmental, health, safety, and socioeconomic impacts, and planned mitigating measures. Comments are sought and must be resolved before the project can proceed. This process has led to additional actions taken by the industrial participants beyond the original project scope. To facilitate the NEPA process, DOE encouraged environmental data collection through cost-sharing during the negotiation period contingent upon project award.

Because of the environmental nature of the CCTDP, DOE took a proactive posture in following the principles of NEPA. Environmental concerns were aggressively addressed and the public engaged prior to major expenditure of public funds. Furthermore, DOE required that an in-depth environmental monitoring plan (EMP) be prepared, fully assessing potential pollutant emissions, both regulated and unregulated, and defining the data to be collected and the methods for collection. All cooperative agreements required preparation of environmental monitoring reports that provide results of the monitoring activities. As environmental issues emerged, every effort was made to address them directly with the understanding that commercial technology acceptance hinged on satisfying users and the public as to acceptable environmental performance. Appendix C reviews the proactive environmental stance taken by the program, further delineates the NEPA process, and provides the status of key actions.

Projects are managed by the participants, not the government. However, public interests are protected by requiring defined periods of performance referred to as budget periods, throughout the project. Budget periods are keyed to major decision points. A set amount of funds is allotted to each budget period, along with performance criteria to be met before receiving funds for the next budget period. These criteria are contained in project evaluation plans (PEPs). Progress reports and meetings during budget periods serve to keep the government informed. At the decision points, progress against PEPs is formally evaluated, as is the PEP for the next budget period. Financial data is also examined to ensure the participants' capability to continue required cost-sharing. Failure to perform as expected results in greater government involvement in the decision making process. Proposal of major project changes precipitates not only in-depth programmatic assessment, but legal and procurement review as well. Decisions regarding continuance into succeeding budget periods, any increase in funding, or major project changes require the approval of DOE's Assistant Secretary of Fossil Energy.

Beyond the formal process associated with the solicitations, parallel efforts were conducted to inform stakeholders of ongoing events, results, and issues and to engage them in discussion on matters pertinent to ensuring that the program remained responsive to needs. A continuing dialog was facilitated by direct involvement in the projects of a large number of utilities, technology suppliers, and states, as well as key industry-based research organizations (*e.g.*, the Electric Power Research Institute and Gas Research Institute). This was accompanied by executive seminars designed to enhance communications with the utility, independent power producer, regulatory, insurance underwriter, and financial sectors. The approach was to identify those sectors where inputs were missing and then structure seminars to provide information on the program and obtain the executives' perspectives and suggestions for enhancing program performance. Furthermore, a periodic clean coal conference was instituted to serve as a forum for reporting project progress and results and discussing issues affecting the outcome of the CCTDP. And, an outreach program was put in place to ensure that needed information was prepared and disseminated in the most efficient manner, leveraging a variety of domestic and international conferences, symposia, and workshops. These activities are discussed in further detail in Section 4.

The NEPA process assured environmental acceptability of the Healy Clean Coal Project on the border of Denali National Park in Alaska.

During implementation of the CCTDP, many precedent-setting actions were taken and many innovations were used by both the public and private sectors to overcome procedural problems, create new management systems and controls, and move toward accomplishment of shared objectives. The experience developed in dealing with complex business arrangements of multimillion dollar clean coal technology projects is a significant asset that has contributed greatly to the CCTDP's success—an asset of value to other programs seeking to forge government/industry partnerships. To document lessons learned, *Clean Coal Technology Program Lessons Learned* was published in July 1994. This report documents the knowledge acquired over the course of the CCTDP through the completion of five solicitations. The report was based on the belief that it is of mutual advantage to the private and public sectors to identify those factors thought to contribute to the program's success and to point out pitfalls encountered and corrective actions taken.

Subsequent to issuance of the *Lessons Learned* document in July 1994, other issues arose that indicated further improvement in program implementation was

warranted. Several projects required relocation, new partners, and redesign more than once in order to move forward. These delays resulted in federal resources being underused for some time. Also, repayment has not reached expected levels, which prompted preparation of a *Repayment Lessons Learned* document in 1997. The Department of Energy has attempted to address these issues in the CCPI solicitation issued in March 2002; for example, by making international sales subject to repayment provisions. These improvements reflect the principles outlined in the President's Management Agenda, including the Research and Development Investment Criteria.

Environmental Provisions

Section 415 (42 U.S.C. §7651n) of the Clean Air Act Amendments of 1990 included two important incentives for clean coal demonstration projects. First, a temporary (less than five years of operation) clean coal technology (CCT) demonstration project is exempted from New Source Performance Standards (NSPS) and exempted from New Source Review (NSR) for pollutants in both attainment and non-attainment areas. However, the project must comply with the State Implementation Plan (SIP) for the state where the project is located and must maintain National Ambient Air Quality Standards (NAAQS). Second, a permanent CCT demonstration that constitutes repowering is exempted from NSPS, and NSR for pollutants in attainment areas, if the potential pollutant emissions will not increase. (Congress has made section 415 applicable to both PPII and CCPI projects.)

Commitment to Commercial Realization

The CCTDP has been committed to commercial realization since its inception. The significant environmental, operational, and economic benefits of the technologies being demonstrated in the program will be realized when the technologies achieve widespread commercial success. The importance attached to commercial realization of clean coal technologies is highlighted in Senate Report 99-82, which contains the following recommendation for project evaluation criteria: "[t]he project must demonstrate commercial feasibility of the technology or process and be of commercial scale or of such size as to permit rapid commercial scale-up."

The commitment to commercial realization recognizes the complementary but distinctive roles of the technology owner and the government. It is the technology owner's role to retain and use the information and experience gained during the demonstration and to promote the use of the technology in the domestic and international marketplaces. The detailed operational, economic, and environmental data and the experience gained during the demonstration are vital to efforts to commercialize the technology. The government's role is to capture, assess, and transfer operational, economic, and environmental information to a broad spectrum of the private sector and international community. The information must be sufficient to allow potential commercial users to confidently screen the technologies and to identify those meeting operational requirements. The importance of commercial realization is confirmed by the requirement in the solicitations and cooperative agreements that the project participant must pursue commercialization of the technology after successful demonstration.

Each of the five solicitations contained requirements for the project proposals to include a discussion of the commercialization plans and approaches to be used by the participants. The proposer was required to discuss the following topics:

- The critical factors required to achieve commercial deployment, such as financing, licensing, engineering, manufacturing, and marketing;
- A timetable identifying major commercialization goals and schedule for completion;
- Additional requirements for demonstration of the technology at other operational scales, as well as significant planned parallel efforts to the demonstration project, that may affect the commercialization approach or schedule; and
- The priority placed by senior management on accomplishing the commercialization effort and how the project fits into the various corporations' business, marketing, or energy utilization strategies.

The cooperative agreement contains three mechanisms to ensure that the demonstrated technology can be replicated by responsible firms while protecting the pro-

Pressurized fluidized-bed combustion, like that demonstrated at Ohio Power Company's Tidd Plant, is starting to see global commercialization.

prietary commercial position of the technology owner. These three mechanisms are:

- The commercialization clause requires the technology owner to meet U.S. market demands for the technology on a nondiscriminatory basis (this clause "flows down" from the project participant to the project team members and contractors);
- The clauses concerning rights to technical data deal with the treatment of data developed jointly in the project as well as data brought into the project; and
- The patent clause affords protection for new inventions developed in the project.

In addition to ensuring implementation of the above project-specific mechanisms, the government role also includes disseminating the operational, environmental, and economic performance information on the technologies to potential customers and stakeholders. To carry out this role, a CCT Outreach Program was established to perform the following functions:

- Make the public and local, state, and federal government policy makers aware of the CCTs and their operational, economic, and environmental benefits;
- Provide potential domestic and foreign users of the technologies with the information needed for decision making;
- Inform financial institutions and insurance underwriters about the advancements in technology and associated risk mitigation to increase confidence; and
- Provide customers and stakeholders opportunities for feedback on program direction and information requirements.

Specific accomplishments of the CCT Outreach Program are discussed in Section 4.

Solicitation Results

Each solicitation was issued as a Program Opportunity Notice (PON)—a solicitation mechanism for cooperative agreements where the program goals and objectives are defined but the technology is not. Proposals for demonstration projects consistent with the objectives of the PON were submitted to DOE by specific deadlines. DOE evaluated, selected, and negotiated projects strictly within the bounds of the PON provisions. Award was made only after Congress was allowed 30 in-session days to consider the projects as outlined in a Comprehensive Report to Congress issued after each solicitation.

Exhibit 2-1 summarizes the results of solicitations. Exhibit 2-2 identifies the projects currently in the CCTDP and the solicitation under which the projects were selected. Appendix B provides a summary of the procurement history and a chronology of project selection, negotiation, restructuring, and completion or termination. Project sites are mapped in Exhibits 2-3 through 2-6, which indicate the geographic locations of projects by application category.

The resultant projects have achieved broad-based support. Team members for the projects include more than 50 utilities; more than 45 technology suppliers; and more than 20 engineering, construction, or consulting firms. Other team members include the Electric Power Research Institute, the Gas Research Institute, numerous state and local agencies and authorities, industrial manufacturers, and one Native American tribe.

The contributions of the selected projects to domestic and international energy and environmental needs are significant. These contributions include:

- Completing demonstration and proving commercial viability of a suite of cost-effective SO_2 and NO_x control options capable of achieving moderate (50 percent) to deep (70–95 percent) emission reductions for the full range of coal-fired boiler types;
- Providing the database and operating experience requisite to making atmospheric fluidized-bed combustion a commercial technology at utility scale;
- Completing demonstration of a number of coal processes to produce high-energy-density, low-sulfur solid fuels and clean liquids from a range of coal types;
- Laying the foundation for the next generation of technologies to meet the energy and environmental demands of the 21st century—three IGCC plants are in operation or have completed operations at three separate utilities; and successful demonstration of pressurized fluidized-bed combustion at 70 MWe; and
- Demonstrating significant efficiency and pollutant emission reduction enhancements in steel making, advanced combustion for combined sulfur dioxide (SO_2)/nitrogen oxides (NO_x)/particulate matter (PM) control for industrial and small utility boilers, and innovative SO_2 control for waste elimination in cement production.

Exhibit 2-1

CCTDP Selection Process Summary

Solicitation	PON Issued	Proposals Submitted	Projects Selected	Projects in CCTDP as of May 31, 2003
CCTDP-I	February 17, 1986	51	17	8
CCTDP-II	February 22, 1988	55	16	9
CCTDP-III	May 1, 1989	48	13	11
CCTDP-IV	January 17, 1991	33	9	5
CCTDP-V	July 6, 1992	24	5	3
Total		211	60	36

Exhibit 2-2

Clean Coal Technology Demonstration Program Projects

Project and Participant	Location
CCTDP-I	
Development of the Coal Quality Expert™ (ABB Combustion Engineering, Inc. and CQ Inc.)	Homer City, PA
LIMB Demonstration Project Extension and Coolside Demonstration (McDermott Technology, Inc.)	Lorain, OH
Advanced Cyclone Combustor with Internal Sulfur, Nitrogen, and Ash Control (Coal Tech Corporation)	Williamsport, PA
Enhancing the Use of Coals by Gas Reburning and Sorbent Injection (Energy and Environmental Research Corporation)	Hennepin and Springfield, IL
Tidd PFBC Demonstration Project (The Ohio Power Company)	Brilliant, OH
Advanced Coal Conversion Process Demonstration (Western SynCoal LLC)	Colstrip, MT
Nucla CFB Demonstration Project (Tri-State Generation and Transmission Association, Inc.)	Nucla, CO
JEA Large Scale CFB Combustion Demonstration Project (JEA)	Jacksonville, FL
CCTDP-II	
SNOX™ Flue Gas Cleaning Demonstration Project (ABB Environmental Systems)	Niles, OH
Demonstration of Coal Reburning for Cyclone Boiler NO_x Control (The Babcock & Wilcox Company)	Cassville, WI
SOx-NOx-Rox Box™ Flue Gas Cleanup Demonstration Project (The Babcock & Wilcox Company)	Dilles Bottom, OH
Cement Kiln Flue Gas Recovery Scrubber (Passamaquoddy Tribe)	Thomaston, ME
Advanced Flue Gas Desulfurization Demonstration Project (Pure Air on the Lake, L.P.)	Chesterton, IN
Demonstration of Advanced Combustion Techniques for a Wall-Fired Boiler (Southern Company Services, Inc.)	Coosa, GA
Demonstration of Innovative Applications of Technology for the CT-121 FGD Process (Southern Company Services, Inc.)	Newnan, GA
Demonstration of Selective Catalytic Reduction Technology for the Control of NO_x Emissions from High-Sulfur, Coal-Fired Boilers (Southern Company Services, Inc.)	Pensacola, FL
180-MWe Demonstration of Advanced Tangentially Fired Combustion Techniques for the Reduction of NO_x Emissions from Coal-Fired Boilers (Southern Company Services, Inc.)	Lynn Haven, FL
CCTDP-III	
Commercial-Scale Demonstration of the Liquid Phase Methanol (LPMEOH™) Process (Air Products Liquid Phase Conversion Company, L.P.)	Kingsport, TN
10-MWe Demonstration of Gas Suspension Absorption (AirPol, Inc.)	West Paducah, KY
Healy Clean Coal Project (Alaska Industrial Development and Export Authority)	Healy, AK
Full-Scale Demonstration of Low-NO_x Cell Burner Retrofit (The Babcock & Wilcox Company)	Aberdeen, OH

Exhibit 2-2 (continued)

Clean Coal Technology Demonstration Program Projects

Project and Participant	Location
CCTDP-III (continued)	
Confined Zone Dispersion Flue Gas Desulfurization Demonstration (Bechtel Corporation)	Seward, PA
Blast Furnace Granular-Coal Injection System Demonstration Project (Bethlehem Steel Corporation)	Burns Harbor, IN
ENCOAL® Mild Coal Gasification Project (ENCOAL Corporation)	Gillette, WY
Evaluation of Gas Reburning and Low-NO_x Burners on a Wall-Fired Boiler (Energy and Environmental Research Corporation)	Denver, CO
LIFAC Sorbent Injection Desulfurization Demonstration Project (LIFAC–North America)	Richmond, IN
Integrated Dry NO_x/SO_2 Emissions Control System (Public Service Company of Colorado)	Denver, CO
Tampa Electric Integrated Gasification Combined-Cycle Project (Tampa Electric Company)	Mulberry, FL
CCTDP-IV	
Micronized Coal Reburning Demonstration for NO_x Control (New York State Electric & Gas Corporation)	Lansing and Rochester, NY
Milliken Clean Coal Technology Demonstration Project (New York State Electric & Gas Corporation)	Lansing, NY
Piñon Pine IGCC Power Project (Sierra Pacific Power Company)	Reno, NV
Pulse Combustor Design Qualification Test (ThermoChem, Inc.)	Baltimore, MD
Wabash River Coal Gasification Repowering Project (Wabash River Coal Gasification Repowering Project Joint Venture)	West Terre Haute, IN
CCTDP-V	
Clean Coal Diesel Demonstration Project (Arthur D. Little, Inc.)	Fairbanks, AK
Clean Power from Integrated Coal/Ore Reduction (CPICOR™) (CPICOR™ Management Company LLC)	Vineyard, UT
Kentucky Pioneer Energy IGCC Demonstration Project (Kentucky Pioneer Energy, LLC)	Trapp, KY

Exhibit 2-3

Geographic Locations of CCTDP Projects—Environmental Control Devices

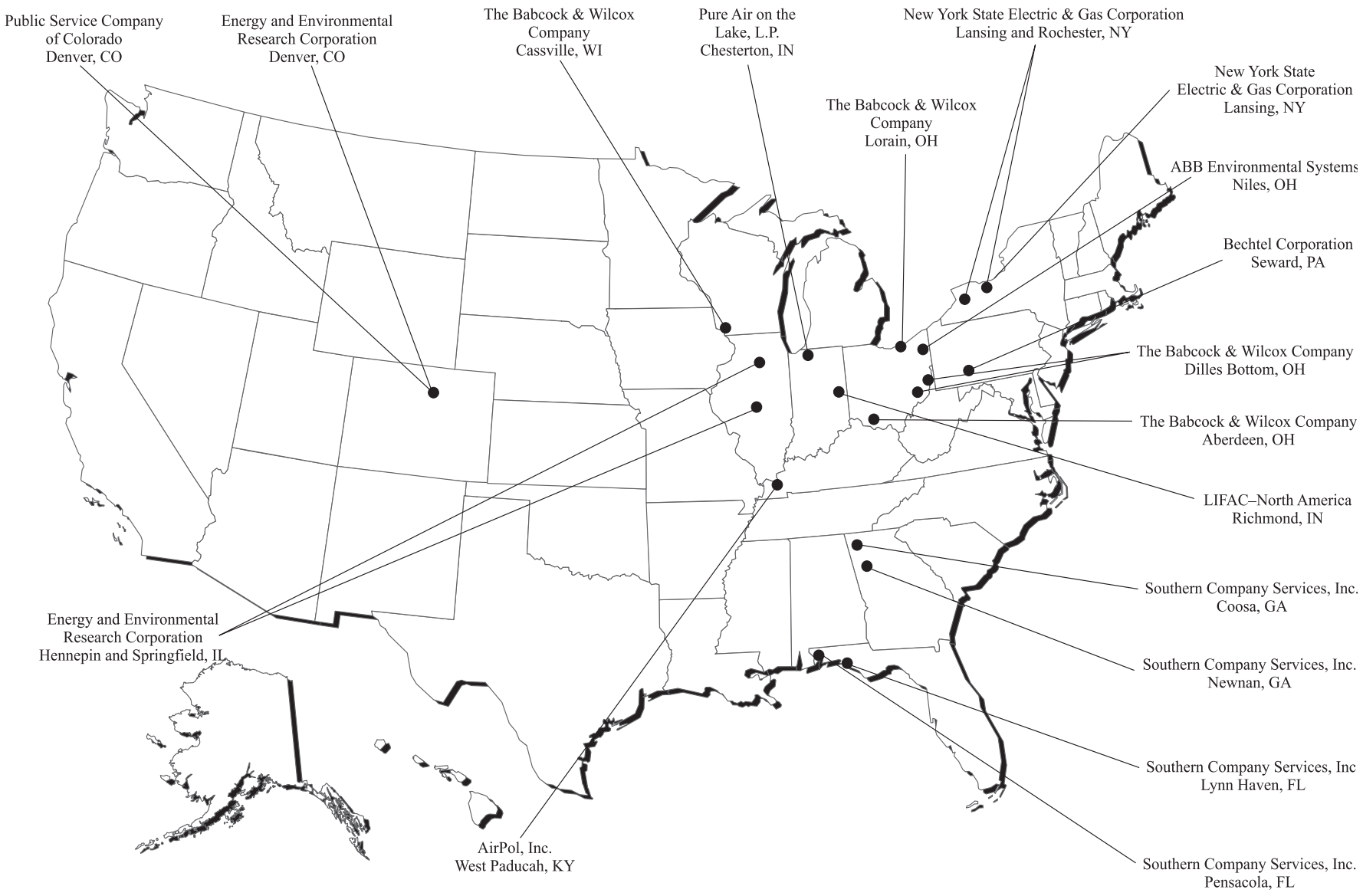


Exhibit 2-4

Geographic Locations of CCTDP Projects—Advanced Electric Power Generation

Exhibit 2-5

Geographic Locations of CCTDP Projects—Coal Processing for Clean Fuels

Exhibit 2-6

Geographic Locations of CCTDP Projects—Industrial Applications

Future Implementation Direction

The future implementation direction of the CCTDP focuses on completing the existing projects as promptly as possible and assuring the collection, analysis, and reporting of the operational, economic, and environmental performance results that are needed to promote commercialization.

The body of knowledge obtained as a result of the CCTDP demonstrations is being used in immediate decision making relative to regulatory compliance, forging plans for meeting future energy and environmental demands, and developing the next generation of technology responsive to ever-increasing demands on environmental performance at competitive costs. An expanded portfolio of information will be forthcoming to make it easier for stakeholders and customers to sift through the already enormous amount of data resulting from the demonstrations.

A *Comprehensive Report to Congress* was issued after each solicitation for each selected project.

Efforts will continue toward refining the effectiveness of the program in responding to customer and stakeholder needs. Toward that end, as needs change, forums will be sought to obtain feedback, particularly in view of utility restructuring, continued environmental concerns, and a burgeoning foreign market. Objectives are to ensure that CCTDP efforts are fully leveraged and that follow-on efforts under the Office of Coal and Power Systems (OC&PS) Research, Development, and Demonstration Program are appropriate.

Two new initiatives arising out of the President's *National Energy Policy*—PPII and CCPI—will use many of the same implementation principles as the CCTDP. These initiatives will also build upon lessons learned in the CCTDP.

PPII

The Department of Energy developed a PPII solicitation, incorporating general provisions of the CCTDP (per congressional direction) with some modifications to take into account lessons learned from the CCTDP. The program solicitation was issued on February 6, 2001 and 24 proposals were received on April 19, 2001. On September 28, 2001, a total of eight projects valued at over $110 million were selected for negotiations. Subsequently, two projects were withdrawn. Exhibit 2-7 lists the six active projects and Exhibit 2-8 shows the locations.

Solicitation

The solicitation provided that participants must offer significant improvements in power plant performance leading to enhanced electric reliability. These improvements could be in the form of increasing the efficiency of electricity production, reducing environmental impacts, or increasing cost-competitiveness.

The projects also had to be applicable to a large portion of existing plants and of commercial scale in order to be deployed over the early part of the decade.

Specific areas in which DOE expressed interest were:

- Advanced combustion or gasification systems and components;
- Advanced NO_x control technology;
- Carbon dioxide (CO_2) capture, utilization, or sequestration;
- Combustion or gasification system improvements;
- Co-production;
- Fine particulate control;
- Hydrogen chloride control;
- Mercury (Hg) control;
- Process control systems;
- Repowering;
- Steam cycle improvements; and
- Wet and dry scrubbers for SO_2 control.

The proposals were evaluated on the technical merits of the proposed technology (40 percent), commercial viability and market potential of the proposed technology (30 percent), and management approach and capabilities of the project team (30 percent). Along with the technical merit, DOE considered the participant's funding and financial proposal; DOE budget constraints; environmental, health, and safety implications; and program policy factors.

Other implementing provisions provided that title to property lies with the participant, *i.e.*, project sponsor. Like the CCTDP, participants are required to provide at least a 50 percent cost-share, and DOE could provide up to 25 percent funding for cost growth, if cost-shared by the participant at no less than the original cooperative agreement. The solicitation further required that 75 percent of the direct labor costs, including subcontract labor, come from the United States.

Potential participants were required to submit a business plan with their proposal. This plan had to be specific to the proposed project and show a management decision to commit funds for the project. The plan had to address competition for funds, both internal and external. Finally, the plan had to convince DOE that expenditures of public monies on the proposed project would be a wise investment, *i.e.*, that the effort would result in commercialization of a technology that served a public purpose and it would not have been commercialized absent federal dollars.

Potential participants also needed to submit an Environmental Information Volume (EIV). The Department of Energy uses the EIV to perform a project-specific review of environmental issues pertinent to each proposed project prior to selection and a more detailed site-specific review required under NEPA after selection.

Intellectual Property Rights

With regard to intellectual property rights, there were three main issues that had to be addressed by the participants—commercialization of technology, data rights, and patent rights. For commercialization of technology, there must be a precise definition of the technology envelope and third-party licensing arrangements must be addressed. For data rights, the participant can protect proprietary technology and data; however, such data must be made available to DOE without limitations. Patent rights for inventions conceived or first actually reduced to practice under DOE contract are defined by statute and regulation and vary depending on the status of the participant, *e.g.*, large business firm, small business firm, or non-profit organization.

CCPI

The Clean Coal Power Initiative is a government/industry partnership to implement the President's *National Energy Policy (NEP)* recommendation to increase investment in clean coal technology. This recommendation, one of several dealing with electricity, addresses the national challenge of ensuring the reliability of the U.S. electric supply while simultaneously protecting the environment. The CCPI is a cost-shared partnership between the government and industry to demonstrate advanced coal-based, power generation technologies. The goal is to accelerate commercial deployment of advanced technologies to ensure that the United States has clean, reliable, and affordable electricity. As part of this initiative, DOE's Office of Fossil Energy, through its National Energy Technology Laboratory (NETL), solicited applications for cost-shared projects.

Round I Solicitation

The CCPI Round I (CCPI-I) solicitation sought projects that: demonstrated advanced coal-based technologies; and would accelerate their deployment for commercial use. The CCPI-I was open to any technology advancement related to coal-based power generation that results in efficiency, environmental, and economic improvement compared to currently available state-of-the-art alternatives. The solicitation was also open to technologies capable of producing any combination of heat, fuels, chemicals, or other useful byproducts in conjunction with power generation. Prospective participants had to ensure that coal is used for at least 75 percent of the fuel energy input to the process. This will

Exhibit 2-7

Power Plant Improvement Initiative Projects

Project and Participant	Location
Achieving NSPS Emission Standards Through Integration of Low-NO_x Burners with an Optimization Plan for Boiler Combustion (Sunflower Electric Power Corporation)	Garden City, KS
Development of Hybrid FLGR/SNCR/SCR Advanced NO_x Control (TIAX, LLC)	TBD
Greenidge Multi-Pollutant Control Project (CONSOL Energy, Inc.)	Torrey, NY
Demonstration of a Full-Scale Retrofit of the Advanced Hybrid Particulate Collector Technology (Otter Tail Power Company)	Big Stone City, SD
Big Bend Power Station Neural Network-Sootblower Optimization (Tampa Electric Company)	Apollo Beach, FL
Commercial Demonstration of the Manufactured Aggregate Processing Technology Utilizing Spray Dryer Ash (Universal Aggregates, LLC)	King George Co., VA

Exhibit 2-8

Geographic Locations of PPII Projects

ensure that multiple fuel concepts such as co-firing are not excluded, but the program remains focused on coal-based power generation. Additionally, they had to show the potential for rapid market penetration upon successful demonstration of the technology or concept. The solicitation was open for application submission for a period of 150 days. The resultant awards are expected to be cooperative agreements.

It is anticipated that a number of cooperative agreements will result from the solicitation. Total government funding is expected to be between $300–$400 million. The minimum cost share by the industrial participant is 50 percent, and must be at least 50 percent in each budget period. Periods of performance for the projects are expected to be two to six years. Each project will be broken into phases: Phase I-Project Definition (optional), Phase II-Design, Phase III-Construction, and Phase IV-Demonstration.

CCPI-I Topic Areas

The following descriptions are examples of potential interest areas that were intended for guidance only and did not exclude other technologies and concepts from consideration in the CCPI-I solicitation.

Carbon Management and Carbon Reduction. Electric power generation represents one of the largest CO_2 emitters in the United States. Roughly one-third of the United States' carbon emissions come from power plants. Electricity generation is expected to grow, and fossil fuels will continue to be the dominant fuel source. Consequently, an important focus of the CCPI is carbon management and carbon reduction from coal-based power generation facilities. Technologies related to improved carbon management and the reduction of CO_2 emissions from coal-based power plants were strongly encouraged.

Combined Heat and Power Systems. Combined heat and power (CHP) systems produce electricity and usable thermal energy (typically steam) from a single primary energy source. The CHP systems attempt to optimize the thermal efficiency of a plant by using thermal energy that is otherwise wasted in producing electricity. The CHP systems offer the potential to achieve a greater level of overall energy efficiency, reduce coal usage, lower energy costs, and reduce carbon emissions.

Combustion Concepts. The combustion system (*e.g.*, boiler and steam generator system) represents one of the major causes for unscheduled downtime and performance derating in coal-fired power plants. The wear and tear on the heat transfer surfaces of combustion systems can cause unplanned outages, result in major repairs to critical components, and result in poor steam quality and reduced steam generation. In addition to improvements to existing combustion systems, emerging combustion systems such as advanced fluidized-bed combustion should be considered. Emerging combustion systems can provide fuel flexibility for co-firing, provide more stable performance over a wider range of operating conditions, and result in reduced emissions compared to conventional combustion systems. Areas of interest included, but were not limited to: low-emission boiler systems, new burner/boiler designs, advanced fluidized-bed combustion systems, advanced slagging combustion systems, and advanced moving bed combustion technologies/ combustion systems.

Environmental Performance. Technologies that improve the overall environmental performance of coal-based power systems (*e.g.*, pulverized coal and integrated gasification combined-cycles (IGCC)) are critical to coal's continued contribution to the nation's energy mix. Of specific interest in this topic area were low-cost technologies for reducing emissions of Hg, NO_x, SO_2, particulate matter (PM), and acid gases (*e.g.*, sulfur trioxide (SO_3), hydrogen fluoride (HF), and hydrogen chloride (HCl)). Multi-pollutant control strategies that take advantage of synergistic effects on multiple pollutants were of particular interest. Additionally, water and byproduct (*e.g.*, fly ash, gasification residues) use, treatment, and disposal strategies are becoming increasingly important issues in coal-based power generation. Technologies related to water conservation (*e.g.*, advanced cooling systems) were also encouraged.

Gasification Concepts. Advanced coal-based gasification technologies are entering the commercial market for utility, refinery, and other applications. These technologies can provide improved efficiency and reduced emissions. However, costs tend to be higher and availability lower compared to conventional technologies. These technologies also offer the potential for co-production of valuable products that can lead to improved economics and enhanced market opportunities. Areas of interest included, but were not limited to: new gasifier developments; improved economics; improved particulate control technologies (*e.g.*, candle filters or other filtration media); advanced chemical contaminant control technologies that are capable of achieving near-zero emissions levels of SO_x, NO_x, Hg, chlorides, and other hazardous air pollutants (HAPS) (*e.g.*, selective catalytic reduction (SCR), warm gas cleaning, and multi-contaminant control); advanced gas separation technologies for the production of oxygen, hydrogen, and CO_2 (*e.g.*, membranes); and co-production concepts to produce value-added products in lieu of disposal.

Process Control and Instrumentation. Outdated process control systems and instrumentation have a major impact on plant performance. Emerging supervisory control and data acquisition (SCADA) systems can improve plant efficiency, reduce emissions, and result in less unscheduled downtime for most plant components compared to many antiquated control systems currently in use. Additionally, new control systems provide substantial diagnostic capabilities that often extend the life of plant components. Topic areas included, but were not limited to, advanced digital control systems, emerging instrumentation and sensors, SCADA optimization systems, and plant diagnostic systems.

Steam Turbine Modifications. Problems with steam turbine generators represent a large source of reduced generation capability in coal-fired power plants. Emerging improvements/modifications to steam turbine generators can increase electricity output while leading to

improved availability and reliability. Areas of interest included, but were not limited to, new turbine blade designs, new turbine blade materials, reduced droplet formation/blade erosion, and new generator diagnostics.

Mandatory Requirements

The CCPI-I project has to meet the following mandatory requirements:

- The proposed project must be conducted at a facility located in the United States.
- The proposed project must utilize at least 75 percent coal, as measured on a fuel input (Btu) basis.
- The proposed project must be designed for and operated with coal mined in the United States and/or refuse coal sources (*e.g.*, culm and gob) that are derived from U.S. coals.
- The applicant must agree to provide a cost share of at least 50 percent of the cost for the total project and for each budget period.
- The applicant shall identify the proposed site and any alternate sites in the application.
- The proposed project team must be clearly identified and firmly committed to fulfilling its proposed role in the project.
- The applicant must agree to submit a Repayment Agreement.
- The application must be signed by a responsible official of the proposing organization authorized to contractually bind the organization to the performance of the Cooperative Agreement in its entirety.
- The application must be consistent with the objectives of the solicitation.
- The application must contain sufficient technical, management, financial, cost, and commercialization information to enable its comprehensive evaluation.

Failure to meet one or more of these mandatory requirements would result in rejection of the application at the preliminary evaluation phase. Applications passing the preliminary evaluation were subject to a comprehensive evaluation in accordance with the evaluation criteria described below.

Proposal Requirements

The applicants were required to address the technical merit, project feasibility, commercialization potential, and cost in their CCPI-I proposals.

Technical Merit. The applicant had to provide a description of the proposed project including, but not limited to, discussions and supporting evidence that address the following topics:

- Scientific and engineering approach of the proposed demonstration to the objectives of the solicitation.
- Process concept and how it operates (including preliminary process flow diagrams with major equipment items and energy and material balances around each major process unit and the overall plant.
- Important process chemistry and engineering concepts must be included.
- Readiness of the technology for demonstration at the size proposed.
- Attributes of the device or module being proposed, such as environmental performance, efficiency of operation, or expectations of low-cost producibility.
- Principles of operation, engineering analysis, and process data to support the technology claims.
- Potential benefits relative to commercial technology that the proposed technology offers including, improved performance (such as output, heat rate/efficiency and availability), improved plant reliability, improved environmental performance, and reduced cost.
- Major exit streams to the environment that would be impacted by this technology.

Project Feasibility. The applicant had to do the following:

- Identify the proposed site and any alternate sites in the application.
- Defend the degree to which the site is appropriate for the demonstration including availability and access to water, power transmission, coal transportation, facilities and equipment infrastructure, and permits.
- Document relevant prior or current corporate experience related to proposed demonstration technology and scale-up and demonstration of technology.
- Show responsibilities and lines of authority among the various project team members.
- Provide letters of commitment from all proposed team members.
- Describe the credentials, capabilities, and experience of key personnel by including resumes, and other information including the roles of key personnel and percentages of their time devoted to the proposed project.
- Provide a Statement of Work, Test Plan, and milestone schedule showing major decision points.

Commercialization Potential. To demonstrate the commercial viability and market potential of the proposed project, the applicant had to:

- Provide a marketing plan to show how the applicant will realize the full commercialization of the proposed technology.
- Provide quantitative analysis of the applicability of the proposed technology, subsystem, component, or module in the existing or new coal-fired power generation market.
- Show how the scale of the proposed demonstration is of the appropriate size for commercial acceptance.
- Describe the credentials, capabilities, and experience of the applicant to achieve broad deployment of the technology.
- Identify potential spin-off products, sub-systems, components, and modules that may result from the completion of the proposed effort.
- Provide a detailed analysis of the proposed repayment agreement showing the sources and amount of projected repayment for each year of the repayment period.

Cost. The applicant had to provide sufficient evidence to demonstrate its financial capability to fund, or obtain funding, for the non-federal share of the proposed project costs. In addition, the applicant had to provide a budget and supporting documentation that will reflect the estimated costs to be incurred in support of the proposed effort to be conducted as described in the technical application.

The applicant had to address two major areas: (1) funding and financial information and (2) budget information. The information to be provided in the funding and financial section included a funding plan, a financial business plan, financial statements, financial commitments, and a financial management system. The information to be provided in the budget section included the budget form, supporting cost detail, and royalty information.

Technical Application Evaluation Criteria

The technical evaluation was conducted to determine the merits of the technical application with regard to the potential success of the project, the potential for future commercial applications, and the extent to which it meets the objectives of the solicitation, as evidenced by the quality, conciseness, and completeness of the application. Technical applications submitted in response to CCPI-I were evaluated and numerically scored against the technical evaluation criteria listed below.

Criterion 1: Technical Merit (50%). The technical application was evaluated to determine overall technical merit of the proposed approach and the ability of the project to achieve the technical objectives of the solicitation.

Criterion 2: Project Feasibility (30%). The technical application was evaluated to determine the potential for a successful demonstration of the proposed technology.

Criterion 3: Commercialization Potential (20%). The technical application was evaluated to determine the potential of the proposed technology to be commercialized and to allow the government to recoup its share of project cost.

Cost Application Evaluation Criteria

Criterion 1: Funding and Financial Information. The funding and financial evaluation, which was adjectively rated, was conducted to determine the: (1) adequacy and completeness of the proposed funding/business plan to fund the project; (2) financial condition and capability of proposed funding sources to provide the non-federal share of project costs; (3) priority placed by management on financing the project; and (4) adequacy of the applicant's financial management system.

Criterion 2: Budget Information. The budget evaluation, which was not point scored, was conducted to determine the: (1) reasonableness, allowability, and allocability of the proposed cost and the proposed cost share; (2) completeness and adequacy of the supporting documentation for the cost estimate; and, (3) applicant's understanding of the project objectives by ensuring all work elements included in the statement of work (SOW) have associated costs, and that all cost elements in the proposed budget have corresponding work elements included in the SOW.

Project Selections

On January 15, 2003, DOE announced the selection of eight projects under CCPI-I. Subsequently, one project was withdrawn by the participant. Exhibit 2-9 lists the seven remaining projects and Exhibit 2-10 shows the locations.

Exhibit 2-9

Clean Coal Power Initiative Projects

Project and Participant	Location
Demonstration of Integrated Optimization Software at the Baldwin Energy Complex (NeuCo, Inc.)	Baldwin, IL
TOXECON Retrofit for Mercury and Multi-Pollutant Control on Three 90 MW Coal-Fired Boilers (Wisconsin Electric Power Company)	Marquette, MI
Next Generation CFB Coal Generating Unit (Colorado Springs Utilities)	Fountain, CO
Lignite Fuel Enhancement (Great River Energy)	Underwood, ND
Gilberton Coal-to-Clean Fuels and Power Co-Production Project (WMPI PTY., LLC)	Gilberton, PA
Advanced Multi-Product Coal Utilization By-Product Processing Plant (University of Kentucky Research Foundation)	Ghent, KY
Western Greenbrier Co-Production Demonstration Project (Western Greenbrier Co-Generation, LLC)	Rainelle, WV

Exhibit 2-10

Geographic Locations of CCPI Projects

3. Funding and Costs

CCTDP

Introduction

Congress has appropriated $2.2 billion for the Clean Coal Technology Demonstration Program (CCTDP). These funds have been committed to demonstration projects selected through five competitive solicitations. As of May 31, 2003, the CCTDP consisted of 36 active or completed projects. These 36 projects have resulted in a combined commitment by the federal government and the private sector of nearly $4.8 billion. The Department of Energy's (DOE) cost-share for these projects exceeds $1.5 billion, or approximately 32 percent of the total. The project participants (*i.e.*, the non-federal-government participants) are providing the remaining $3.2 billion, or 68 percent of the total. Exhibit 3-1 summarizes the total costs of active projects and cost-sharing between DOE and project participants. The data used to prepare this section are based on the 36 projects that were active as of May 31, 2003.

Program Funding

General Provisions

In the CCTDP, the federal government's contribution cannot exceed 50 percent of the total cost of any individual project. The federal government's funding commitments and other terms of federal assistance are represented in a cooperative agreement negotiated for each project in the program. Each project also has an agreement for the federal government to recoup up to the full amount of the federal government's contribution. This approach enables taxpayers to benefit from commer-

Exhibit 3-1

CCTDP Project Costs and Cost-Sharing
(Dollars in Thousands)

	Total Project Costs	%	Cost-Share Dollars DOE[b]	Cost-Share Dollars Participants	Cost-Share Percent DOE	Cost-Share Percent Participants
Subprogram						
CCTDP-I	844,363	18	239,640	604,723	28	72
CCTDP-II	318,577	6	139,229	179,348	44	56
CCTDP-III	1,138,741	24	483,665	655,076	42	58
CCTDP-IV	950,429	20	439,063	511,366	46	54
CCTDP-V	1,545,374	32	251,374	1,294,000	16	84
Total[a]	4,797,484	100	1,552,971	3,244,513	32	68
Application Category						
Advanced Electric Power Generation	2,458,061	51	916,004	1,542,057	37	63
Environmental Control Devices	620,110	13	252,866	367,244	41	59
Coal Processing for Clean Fuels	431,810	9	192,029	239,781	44	56
Industrial Applications	1,287,503	27	192,072	1,095,431	15	85
Total[a]	4,797,484	100	1,552,971	3,244,513	32	68

[a] Totals may not add due to rounding.
[b] DOE share does not include $117,701,000 obligated for withdrawn projects and audit expenses.

cially successful projects. This is in addition to the benefits derived from the demonstration and commercial deployment of technologies that improve environmental quality and promote the efficient use of the nation's coal resources.

The project participant has primary responsibility for the project. The federal government monitors project activities, provides technical advice, and assesses progress by periodically reviewing project performance with the participant. The federal government also participates in decision making at major project junctures negotiated into the cooperative agreement. Through these activities, the federal government ensures the efficient use of public funds in the achievement of individual project and overall program objectives.

Congress has provided program funding through appropriation acts and adjustments. (See Appendix A for legislative history and excerpts from the relevant funding legislation.)

Exhibit 3-2 presents the allocation of appropriated CCTDP funds (after adjustment) and the amount available for each solicitation. Additional activities funded by CCTDP appropriations are the Small Business Innovation Research (SBIR) Program, the Small Business Technology Transfer (STTR) Program, and program direction. The SBIR Program implements the Small Business Innovation Development Act of 1982 and provides a role for small, innovative firms in selected research and development (R&D) areas. The STTR Program implements the Small Business Technology Transfer Act of 1992 that establishes a pilot program and funding for small business concerns performing cooperative R&D efforts.

Exhibit 3-2

Relationship Between Appropriations and Subprogram Budgets for the CCTDP

(Dollars in Thousands)

Appropriation Enacted	Subprogram	Adjusted Appropriations	SBIR & STTR Budgets[a]	Program Direction Budget	Projects Budget
P.L. 99-190	CCTDP-I	380,590	4,902	144,757	230,931
P.L. 100-202	CCTDP-II	473,939	6,781	32,512	434,646
P.L. 100-446	CCTDP-III	541,298	6,906	22,548	511,844
P.L. 101-121[b]	CCTDP-IV	332,000	7,065	25,000	299,935
P.L. 101-121[b]	CCTDP-V	450,000	5,427	25,000	419,573
Total		2,177,827	31,081	249,817	1,896,929

[a] Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Programs.

[b] P.L. 101-121 was revised by P.L. 101-512, 102-154, 102-381, 103-138, 103-332, 104-6, 104-208, 105-18, 105-83, 105-277, 106-113, 106-291, 107-63, and 108-7.

The program direction budget provides for the management and administrative costs of the program and includes federal employees' salaries, benefits, and travel, site support services, and services provided by national laboratories and private firms.

Availability of Funding

Although all funds necessary to implement the entire CCTDP were appropriated by Congress prior to FY1990, the legislation also directed that these funds be made available (*i.e.*, apportioned) to DOE on a time-phased basis. Exhibit 3-3 depicts this apportionment of funding to DOE. Exhibit 3-3 also shows the program's yearly funding profile by appropriations act and by subprogram. Funds can be transferred among subprogram budgets to meet project and program needs.

Use of Appropriated Funds

There are five key financial terms used by the government to track the status and use of appropriated funds: (1) budget authority, (2) commitments, (3) obligations, (4) costs, and (5) expenditures. The definition of each of these terms is given below.

- Budget Authority. This is the legal authorization created by legislation (*i.e.*, an appropriations act) that permits the federal government to obligate funds.
- Commitments. Within the context of the CCTDP, a commitment is established when DOE selects a project for negotiation. The commitment amount is equal to DOE's share of the project costs contained in the cooperative agreement.
- Obligations. The cooperative agreement for each project establishes funding increments, referred to as budget periods. The cooperative agreement defines the tasks to be performed in each budget period. An obligation occurs in the beginning of each budget period and establishes the incremental amount of federal funds available to the participant

Exhibit 3-3

Annual CCTDP Funding by Appropriations and Subprogram Budgets

(Dollars in Thousands)

Fiscal Year	1986–94	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total[d]
Adjusted Appropriations[a]												
P.L. 99-190	397,600			(17,000)								380,600
P.L. 100-202	574,997				(101,000)	(40,000)	9,962	14,980	15,000			473,939
P.L. 100-446	574,998						(156,000)	156,000	(33,700)			541,298
P.L. 101-121[b]	450,000	18,000	50,000	(91,000)				(162,000)	26,990	(47,000)	87,000	331,990
P.L. 101-121[b]	225,000	19,121	100,000	105,879								450,000
Total	2,222,595	37,121	150,000	(2,121)	(101,000)	(40,000)	(146,038)	8,980	8,290	(47,000)	87,000	2,177,827
Subprogram Budgets												
CCTDP-I Projects	387,231	(18,000)	(18,000)	(33,000)	(15,000)	(14,900)	(14,400)	(14,000)	(14,000)	(15,000)		230,931
CCTDP-II Projects	535,704				(101,000)	(40,000)	9,962	14,980	15,000			434,646
CCTDP-III Projects	545,544						(156,000)	156,000	(33,700)			511,844
CCTDP-IV Projects	419,388	17,622	48,925	(91,000)				(162,000)	27,000	40,000		299,935
CCTDP-V Projects	197,125	18,719	97,850	105,879						(87,000)	87,000	419,573
Projects Subtotal	2,084,992	18,341	128,775	(18,121)	(116,000)	(54,900)	(160,438)	(5,020)	(5,700)	(62,000)	87,000	1,896,929
Program Direction	110,527	18,000	18,000	16,000	15,000	14,900	14,400	14,000	13,990	15,000		249,817
Fossil Energy Subtotal	2,195,519	36,341	146,775	(2,121)	(101,000)	(40,000)	(146,038)	8,980	8,290	(47,000)	87,000	2,146,746
SBIR & STTR[c]	27,076	779	3,225									31,081
Total[d]	2,222,595	37,121	150,000	(2,121)	(101,000)	(40,000)	(146,038)	8,980	8,290	(47,000)	87,000	2,177,827

[a] Shown are appropriations less amounts sequestered under the Gramm-Rudman-Hollings Deficit Reduction Act.

[b] Shown is the fiscal year apportionment schedule of P.L. 101-121 as revised by P.L. 101-512, 102-154, 102-381, 103-138, 103-332, 104-6, 104-208, 105-18, 105-83, 105-277, 106-113, 106-291, 107-63, and 108-7.

[c] Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Programs.

[d] Totals may not appear to add due to rounding.

for use in performing tasks as defined in the cooperative agreement.

- Costs. A request for payment submitted by the project participant to the federal government for reimbursement of tasks performed under the terms of the cooperative agreement is considered a cost. Costs are equivalent to a bill for payment or invoice.
- Expenditures. Expenditures represent payment amounts to the project participant from checks drawn upon the U.S. Treasury.

The full government cost-share specified in the cooperative agreement is considered committed to each project. However, DOE obligates funds for the project in increments. Most projects are subdivided into several time and funding intervals, or budget periods. The number of budget periods is determined during negotiations and is incorporated into the cooperative agreement. DOE obligates sufficient funds at the beginning of each budget period to cover the government's cost-share for that period. This procedure limits the government's financial exposure and assures that DOE fully participates in the decision to proceed with each major phase of project implementation.

The overall financial profile for the CCTDP is presented in Exhibit 3-4. The graph shows actual performance for FY1986 through May 31, 2003, and DOE estimates for the remainder of the Program. Excluded from the graph are SBIR and STTR funds, as these are used and tracked separately from the CCTDP. The financial projections presented in Exhibit 3-4 are based on individual project schedules and budget periods as defined in the cooperative agreements and modifications. The negative Budget Authority values shown in Exhibit 3-4 result from the rescission or deferral of funds as required by the annual appropriations bills.

The financial status of the CCTDP through May 31, 2003, is presented by subprogram in Exhibit 3-5. SBIR and STTR funds are included in this exhibit to account for all funding. Exhibit 3-5 also indicates the apportionment sequence as modified by Public Law 108-7. These values represent the amount of budget authority available for the CCTDP.

Project Funding, Costs, and Schedules

Information for individual projects, including funding and the status of key milestones, is provided in Section 5. An overview of project schedules and funding is presented in Exhibits 3-6 and 3-7.

CCTDP Cost-Sharing

A characteristic feature of the CCTDP is the cooperative funding agreement between the participant and the federal government referred to as cost-sharing. This cost-sharing approach, as implemented in the CCTDP, was introduced in Public Law 99-190, An Act Making Appropriations for the Department of the Interior and Related Agencies for the Fiscal Year Ending September 30, 1986, and for Other Purposes. General concepts and requirements of the cost-sharing principle as applied to the CCTDP include the following elements:

- The federal government may not finance more than 50 percent of the total costs of a project;
- Cost-sharing by the project participants is required throughout the project (design, construction, and operation);
- The federal government may share in project cost growth (within the scope of work defined in the original cooperative agreement) up to 25 percent of the originally negotiated government share of the project;
- The participant's cost-sharing contribution must occur as project expenses are incurred and cannot be offset or delayed based on prospective project revenues, proceeds, or royalties; and
- Investment in existing facilities, equipment, or previously expended R&D funds are not allowed for the purpose of cost-sharing.

Exhibit 3-4

CCTDP Financial Projections as of May 31, 2003

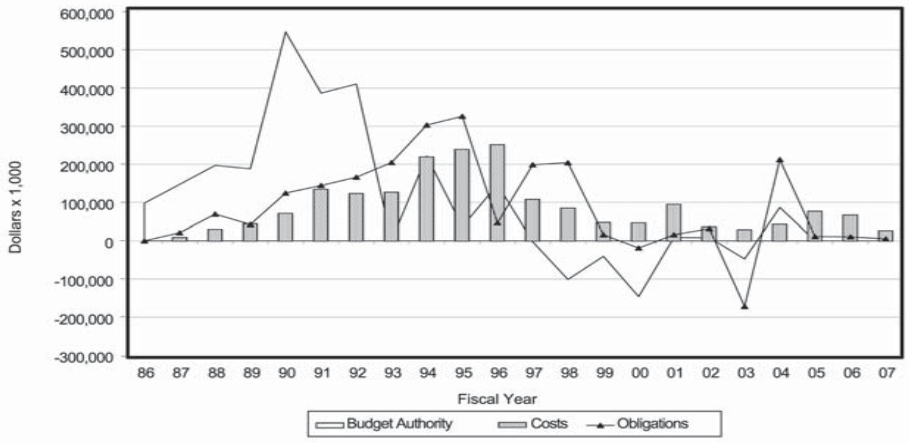


Exhibit 3-5

Financial Status of the CCTDP as of May 31, 2003

(Dollars in Thousands)

Subprogram	Appropriations Allocated to Subprogram[b]	Apportioned to Date	Committed to Date	Obligated to Date	Cost to Date
CCTDP-I	230,931	230,931	257,124	257,124	254,142
CCTDP-II	434,646	434,646	165,369	165,369	165,320
CCTDP-III	511,844	511,844	510,507	510,507	505,964
CCTDP-IV	299,935	299,935	478,018	478,018	476,770
CCTDP-V	419,573	332,573	259,654	60,982	38,414
Projects Subtotal	1,896,929	1,809,929	1,670,672	1,472,000	1,440,610
SBIR & STTR[a]	31,081	31,081	31,081	31,081	31,081
Program Direction	249,817	249,817	249,817	246,948	243,158
Total	2,177,827	2,090,827	1,951,570	1,750,029	1,714,849

[a] Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Programs

[b] Totals may not appear to add due to rounding

Apportionment Sequence FY	Annual	Cumulative
1986	99,400	99,400
1987	149,100	248,500
1988	199,100	447,600
1989	190,000	637,600
1990	554,000	1,191,600
1991	390,995	1,582,595
1992	415,000	1,997,595
1993	0	1,997,595
1994	225,000	2,222,595
1995	37,121	2,259,716
1996	150,000	2,409,716
1997	(2,121)	2,407,595
1998	(101,000)	2,306,595
1999	(40,000)	2,266,595
2000	(146,038)	2,120,557
2001	8,980	2,129,537
2002	8,290	2,137,827
2003	(47,000)	2,090,827
2004	87,000	2,177,827

Exhibit 3-6

CCTDP Schedules by Application Category

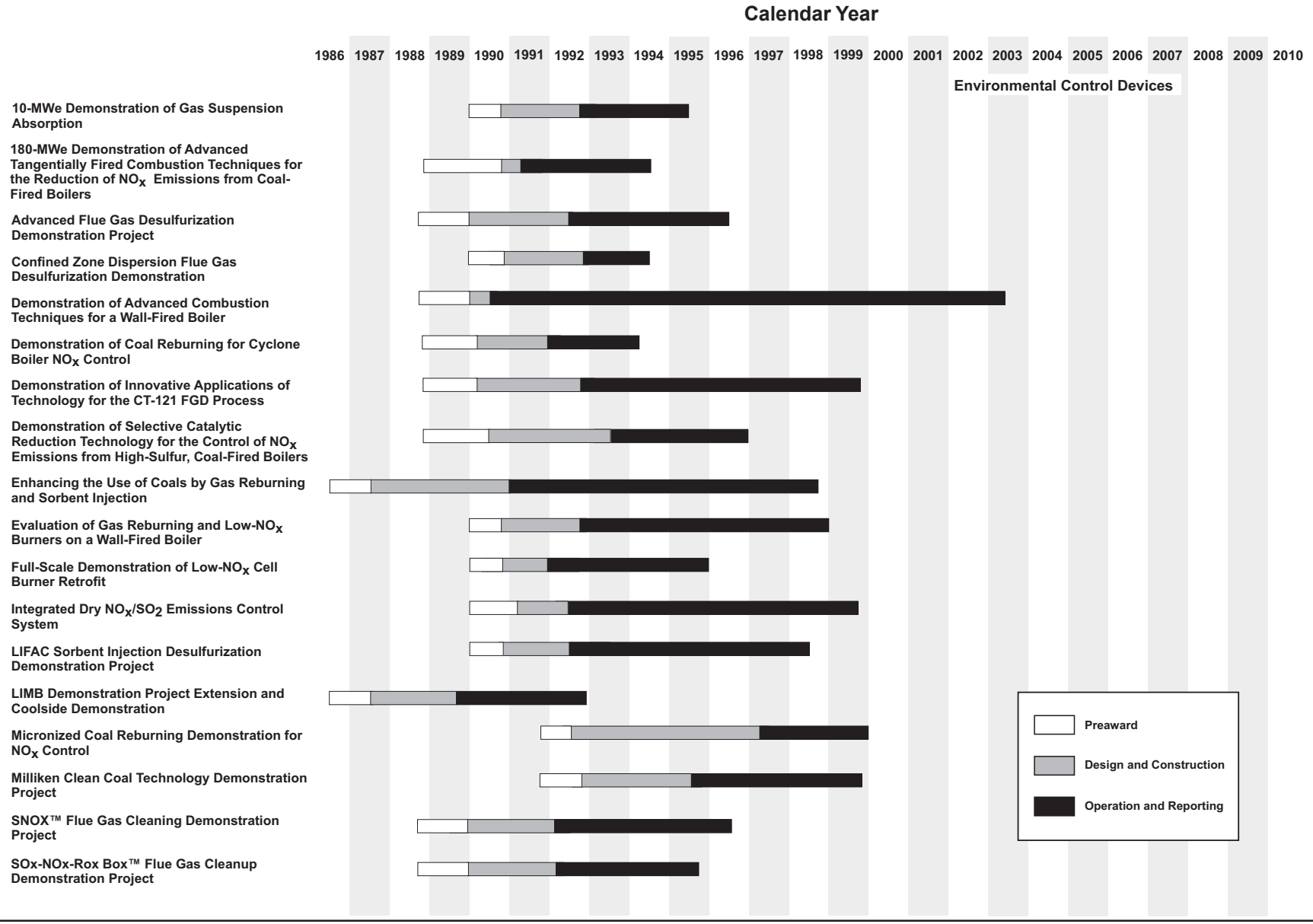


Exhibit 3-6 (continued)

CCTDP Schedules by Application Category

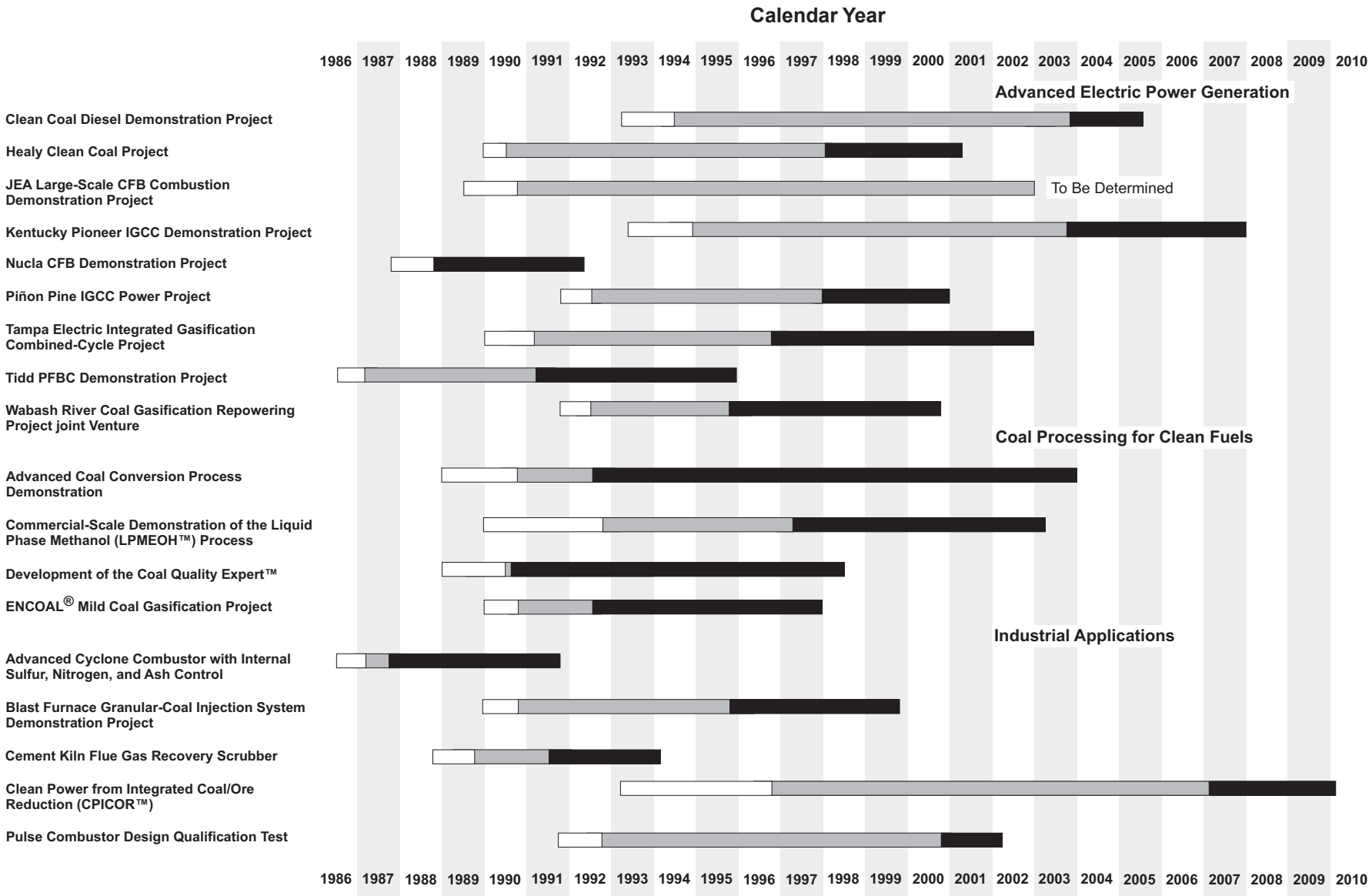


Exhibit 3-7
CCTDP Funding by Application Category

Project	DOE	%	Participant	%	Total
Environmental Control Devices					
SO_2 Control Technologies					
10-MWe Demonstration of Gas Suspension Absorption	2,315,259	30.0	5,401,930	70.0	7,717,189
Confined Zone Dispersion Flue Gas Desulfurization Demonstration	5,205,800	50.0	5,205,800	50.0	10,411,600
LIFAC Sorbent Injection Desulfurization Demonstration Project	10,636,864	49.7	10,756,908	50.3	21,393,772
Advanced Flue Gas Desulfurization Demonstration Project	63,913,200	42.1	87,794,698	57.9	151,707,898
Demonstration of Innovative Applications of Technology for the CT-121 FGD Process	21,085,211	49.0	21,989,785	51.0	43,074,996
Subtotal SO_2 Control Technology	103,156,334	44.0	131,149,121	56.0	234,305,455
NO_x Control Technologies					
Demonstration of Advanced Combustion Techniques for a Wall-Fired Boiler	6,553,526	41.3	9,300,374	58.7	15,853,900
Demonstration of Coal Reburning for Cyclone Boiler NO_x Control	6,340,787	46.5	7,305,822	53.5	13,646,609
Full-Scale Demonstration of Low-NO_x Cell Burner Retrofit	5,442,800	48.5	5,790,592	51.5	11,233,392
Evaluation of Gas Reburning and Low-NO_x Burners on a Wall-Fired Boiler	8,895,790	50.0	8,911,468	50.0	17,807,258
Micronized Coal Reburning Demonstration for NO_x Control	2,701,011	29.7	6,395,475	70.3	9,096,486
Demonstration of Selective Catalytic Reduction Technology for the Control of NO_x Emissions from High-Sulfur, Coal-Fired Boilers	9,406,673	40.5	13,823,056	59.5	23,229,729
180-MWe Demonstration of Advanced Tangentially Fired Combustion Techniques for the Reduction of NO_x Emissions from Coal-Fired Boilers	4,149,383	48.5	4,404,282	51.5	8,553,665
Subtotal NO_x Control Technology	43,489,970	43.7	55,931,069	56.3	99,421,039
Combined SO_2/NO_x Control Technologies					
SNOX™ Flue Gas Cleaning Demonstration Project	15,719,200	50.0	15,719,208	50.0	31,438,408
LIMB Demonstration Project Extension and Coolside Demonstration	7,591,655	39.3	11,719,378	60.7	19,311,033
SOx-NOx-Rox Box™ Flue Gas Cleanup Demonstration Project	6,078,402	45.8	7,193,219	54.2	13,271,621
Enhancing the Use of Coals by Gas Reburning and Sorbent Injection	18,747,816	49.9	18,841,139	50.1	37,588,955
Milliken Clean Coal Technology Demonstration Project	45,000,000	28.4	113,607,807	71.6	158,607,807
Integrated Dry NO_x/SO_2 Emissions Control System	13,082,653	50.0	13,082,653	50.0	26,165,306
Subtotal Combined SO_2/NO_x Control Technologies	106,219,726	37.1	180,163,404	62.9	286,383,130
Total Environmental Controls	252,866,030	40.8	367,243,594	59.2	620,109,624

Exhibit 3-7 (continued)

CCTDP Funding by Application Category

Project	DOE	%	Participant	%	Total
Advanced Electric Power Generation					
Fluidized-Bed Combustion					
JEA Large-Scale CFB Combustion Demonstration Project	74,733,833	24.2	234,362,679	75.8	309,096,512
Tidd PFBC Demonstration Project	66,956,993	35.3	122,929,346	64.7	189,886,339
Nucla CFB Demonstration Project	17,130,411	10.7	142,919,538	89.3	160,049,949
Subtotal Fluidized-Bed Combustion	158,821,237	24.1	500,211,563	75.9	659,032,800
Integrated Gasification Combined-Cycle					
Kentucky Pioneer Energy IGCC Demonstration Project	78,086,357	18.1	353,846,225	81.9	431,932,582
Piñon Pine IGCC Power Project	167,956,500	50.0	167,956,500	50.0	335,913,000
Tampa Electric Integrated Gasification Combined-Cycle Project	150,894,223	49.8	152,394,223	50.2	303,288,446
Wabash River Coal Gasification Repowering Project	219,100,000	50.0	219,100,000	50.0	438,200,000
Subtotal Integrated Gasification Combined-Cycle	616,037,080	40.8	893,296,948	59.2	1,509,334,028
Advanced Combustion/Heat Engines					
Clean Coal Diesel Demonstration Project	23,818,000	50.0	23,818,000	50.0	47,636,000
Healy Clean Coal Project	117,327,000	48.5	124,731,000	51.5	242,058,000
Subtotal Advanced Combustion/Heat Engines	141,145,000	48.7	148,549,000	51.3	289,694,000
Total Advanced Electric Power Generation	916,003,317	37.3	1,542,057,511	62.7	2,458,060,828
Coal Processing for Clean Fuels					
Commercial-Scale Demonstration of the Liquid Phase Methanol (LPMEOH™) Process	92,708,370	43.4	120,991,630	56.6	213,700,000
Advanced Coal Conversion Process Demonstration	43,125,000	40.8	62,575,000	59.2	105,700,000
Development of the Coal Quality Expert™	10,863,911	50.0	10,882,093	50.0	21,746,004
ENCOAL® Mild Coal Gasification Project	45,332,000	50.0	45,332,000	50.0	90,664,000
Total Coal Processing for Clean Fuels	192,029,281	44.5	239,780,723	55.5	431,810,004
Industrial Applications					
Clean Power from Integrated Coal/Ore Reduction (CPICOR™)	149,469,242	14.0	916,335,758	86.0	1,065,805,000
Pulse Combustor Design Qualification Test	4,306,027	50.0	4,306,027	50.0	8,612,054
Blast Furnace Granular-Coal Injection System Demonstration Project	31,824,118	16.4	162,477,672	83.6	194,301,790
Advanced Cyclone Combustor with Internal Sulfur, Nitrogen, and Ash Control	490,122	49.8	494,272	50.2	984,394
Cement Kiln Flue Gas Recovery Scrubber	5,982,592	33.6	11,817,408	66.4	17,800,000
Total Industrial Applications	192,072,101	14.9	1,095,431,137	85.1	1,287,503,238
Grand Total	**1,552,970,729**	**32.4**	**3,244,512,965**	**67.6**	**4,797,483,694**

As previously discussed, Exhibit 3-1 summarizes the cost-sharing status by subprogram and by application category for the active or completed projects. In the advanced electric power generation category, which accounts for 51 percent of total project costs, participants are contributing 63 percent of the funds. Cost-sharing by participants for environmental control devices, coal processing for clean fuels, and industrial applications categories is 59 percent, 56 percent, and 85 percent, respectively. For the overall program, participants are contributing 68 percent of the total funding, or nearly $1.7 billion more than the federal government.

Recovery of Government Outlays (Recoupment)

The policy objective of DOE is to recover an amount up to the government's financial contribution to each project. Participants are required to submit a plan outlining a proposed schedule for recovering the government's financial contribution. The solicitations have featured different sets of recoupment rules.

Under the first solicitation, CCTDP-I, repayment was derived from revenue streams that include net revenue from operation of the demonstration plant beyond the demonstration phase and the commercial sale, lease, manufacture, licensing, or use of the demonstrated technology. In the second solicitation, CCTDP-II, repayment was limited to revenues realized from the future commercialization of the demonstrated technology. The government's share would be 2 percent of gross equipment sales and 3 percent of the royalties realized on the technology subsequent to the demonstration.

The third solicitation, CCTDP-III, repayment formula was adjusted to 0.5 percent of equipment sales and 5 percent of royalties. Limited grace periods were allowed on a project-by-project basis. A waiver on repayment may be sought from the Secretary of Energy if the project participant determines that a competitive disadvantage would result in either the domestic or international marketplace. The recoupment provisions for the fourth, CCTDP-IV, and the fifth, CCTDP-V, solicitations were identical to those in CCTDP-III.

As of May 31, 2003, six participants have made $1,866,675 in payments to the federal government under the terms of the repayment agreements: Nucla CFB Demonstration Project (Tri-State Generation and Transmission Association, Inc.); Full-Scale Demonstration of Low-NO_x Cell Burner Retrofit (The Babcock & Wilcox Company); Development of the Coal Quality Expert™ (ABB Combustion Engineering, Inc. and CQ Inc.); 10-MWe Demonstration of Gas Suspension Absorption (AirPol, Inc.); Advanced Flue Gas Desulfurization Demonstration Project (Pure Air on the Lake, L.P.); and Wabash River Coal Gasification Repowering Project.

In September 1997, the CCTDP office issued a report entitled *Recoupment Lessons Learned—Clean Coal Technology Demonstration Program*. The report: (1) reviewed the lessons learned on recoupment during the implementation of the CCTDP; (2) addressed recommended actions set forth in General Accounting Office (GAO) Report RCED-92-17, GAO Report RCED-96-141, and Inspector General Audit Report IG-0391 relative to recoupment; and (3) provided input into DOE deliberations on recoupment policy.

PPII

The Power Plant Improvement Initiative (PPII) was established by appropriations made for Fiscal Year 2001 (Public Law 106-291) through a transfer of $95 million in previously appropriated funding for the CCTDP. Funds were committed to demonstration projects from a single solicitation issued February 6, 2001. From twenty-four applications, eight projects were selected for negotiation on September 26, 2001. As of May 31, 2003, two projects have withdrawn from negotiations, four projects have signed cooperative agreements, and two projects are continuing with negotiations. No additional solicitations are planned and unused funds are intended for use under the Clean Coal Power Initiative (CCPI).

The DOE funding commitments for the four projects under contract total $17.4 million. Including the two projects in negotiation, the government funding commitment is nearly $47 million. For the six active projects, participants have committed to funding 55 percent of the $104.5 million total project costs. Exhibit 3-8 summarizes the overall financial status of the PPII as of May 31, 2003. Exhibit 3-9 summarizes the funding commitments for the individual projects.

The PPII funds are subject to similar general provisions governing the use of CCTDP funds. One difference is the inclusion of repayment obligations on foreign sales and licenses in the terms of the model repayment agreement. For the model agreement, the repayment amount is determined as one-half of one percent of gross equipment sales and leases plus five percent of royalty and licensing fees based on foreign and domestic sales. A grace period of up to five years or ten percent of sales and licenses may be negotiated. Participants can propose alternative approaches to repayment, but those approaches must generate equal or greater amounts than the model repayment provisions. For example, a participant could pay a percentage of net revenues from continued operation of the project after completion of the demonstration period. In accordance with congressional direction, funds obtained from repayment provisions will be retained by DOE for future activities.

Exhibit 3-8

Financial Status of PPII and CCPI as of May 31, 2003

(Dollars in Thousands)

	Available Funding				Committed to Date	Obligated to Date	Cost to Date
	Fiscal Year						
	2001	2002	2003	Total			
PPII Projects	93,843			93,834	46,874	15,143	8,282
CCPI Projects		144,565	144,565	289,130	317,229	0	0
Program Support	948	1,500	1,500	3,948	3,948	2,020	1,011
SBIR & STTR[a]		3,935	3,935	7,870	7,870	7,870	7,870
Other Adjustments	209[b]			209			
Total	**95,000**	**150,000**	**150,000**	**395,000**	**375,921**	**25,033**	**17,163**

[a] Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Programs.

[b] General Rescission under P.L. 106–291.

CCPI

The CCPI supports the *National Energy Policy* (NEP) recommendation to increase investment in clean coal technology. The CCPI is a cost-shared partnership between government and industry to demonstrate advanced coal-based technologies with the goal of accelerating commercial deployment of promising technologies to ensure the nation has clean, reliable, and affordable electricity.

Funding provided by appropriations for Fiscal Year 2002 and 2003, along with additional funds available from the PPII, served as the basis for the first CCPI solicitation. On March 4, 2002, the CCPI solicitation was issued and was open to any technology advancement related to coal-based power generation that resulted in efficiency, environmental, and economic improvement compared to currently available state-of-the-art alternatives. The solicitation was also open to technologies capable of producing any combination of heat, fuels, chemicals or other useful byproducts with power generation. On January 15, 2003, DOE announced the selection of eight projects from thirty-six proposals. The selected projects are valued at more than $1.3 billion with a government commitment of approximately $317 million. Subsequently, one CCPI was withdrawn by the participant. The remaining projects are in negotiation, and the first awards are anticipated in summer 2003.

The DOE funding commitments for the selected CCPI projects represent less than 25 percent of the total estimated costs for the eight projects, while participant commitments exceed $1 billion. The two largest projects in terms of total costs have proposed 84 and 90 percent participant funding levels, showing that project participants are willing to be substantial partners in the demonstration of clean coal technologies.

Exhibit 3-8 summarizes the overall financial status of the CCPI as of May 31, 2003. Provided negotiations lead to award of the remaining seven projects, surplus funds from the PPII will be used to fulfill the government's financial commitment to the projects. Exhibit 3-9 summarizes the proposed funding commitments for the individual projects.

CCPI funds are subject to similar general provisions governing the use of CCTDP funds. For repayment, the first CCPI solicitation did not designate explicit values or terms in the model repayment agreement, but instead left the details to be defined by the applicant. The applicant-proposed repayment provisions were considered as one of five factors under the commercial potential evaluation criteria used to make project selections. In accordance with congressional direction, funds obtained from repayment provisions will be retained by DOE for future activities.

Exhibit 3-9

PPII and CCPI Project Funding[a]

Project	DOE	%	Participant	%	Total
Power Plant Improvement Initiative					
Development of Hybrid FLGR/SNCR/SCR Advanced NO_x Control	14,957,658	49.0	15,556,053	51.0	30,513,711
Greenidge Multi-Pollutant Control Project	14,500,000	44.2	18,300,000	55.8	32,800,000
Demonstration of a Full-Scale Retrofit of the Advanced Hybrid Particulate Collector Technology	6,490,585	48.6	6,862,703	51.4	13,353,288
Achieving NSPS Through Integration of Low-NO_x Burners with an Optimized Plan for Boiler Combustion	2,796,326	48.0	3,085,349	52.0	5,881,675
Big Bend Power Station Neural Network-Sootblower Optimization	905,013	38.0	1,476,601	62.0	2,381,614
Commercial Demonstration of the Manufactured Aggregate Processing Technology Utilizing Spray Dryer Ash	7,224,000	36.9	12,357,734	63.1	19,581,734
Total PPII	46,873,582	44.8	57,638,440	55.2	104,512,022
Clean Coal Power Initiative	17,415,924				
Next Generation CFB Coal Generating Unit	30,000,000	10.0	271,504,011	90.0	301,504,011
Lignite Fuel Enhancement	11,000,000	50.0	11,000,000	50.0	22,000,000
Commercial Demonstration of the Airborne Process[b]	31,122,268	25.9	89,004,301	74.1	120,126,569
Demonstration of Integrated Optimization Software at the Baldwin Energy Complex	8,388,104	45.0	10,252,127	55.0	18,640,231
Advanced Multi-Product Coal Utilization By-Product Processing Plant	4,450,163	49.9	4,466,576	50.1	8,916,739
Western Greenbrier Co-Production Demonstration Project	107,499,859	50.0	107,499,861	50.0	214,999,720
TOXECON Retrofit for Mercury and Multi-Pollutant Control on Three 90 MW Coal-Fired Boilers	24,768,312	50.0	24,768,312	50.0	49,536,624
Gilberton Coal-to-Clean Fuels and Power Co-Production Project	100,000,000	16.3	512,000,000	83.7	612,000,000
Total CCPI	317,228,706	23.5	1,030,495,188	76.5	1,347,723,894

[a] Projects shown in italics are in negotiation.

[b] Project has been withdrawn by the participant after May 31, 2003.

4. Accomplishments

Introduction

Since the start of fiscal year (FY) 2002, there has been a great deal of activity within the Department of Energy's (DOE) clean coal technology (CCT) programs. Within the Clean Coal Technology Demonstration Program (CCTDP), two projects have completed operations, one project started operations, and two projects were terminated. Within the Power Plant Improvement Initiative (PPII), four projects have been awarded cooperative agreements and one project was withdrawn (another project had been withdrawn in FY2001). And within the Clean Coal Power Initiative (CCPI), eight projects were selected for award and one project was withdrawn.

CCTDP

Overview of Events

Since the beginning of FY 2002, the following major events occurred:

- Demonstration of Advanced Combustion Techniques for a Wall-Fired Boiler completed demonstration operation;
- Commercial-Scale Demonstration of the Liquid Phase Methanol (LPMEOH™) Process completed demonstration operation;
- JEA Large-Scale CFB Combustion Demonstration Project started operations;
- McIntosh Unit 4A PCFB Demonstration Project was terminated; and
- McIntosh Unit 4B Topped PCFB Demonstration Project was terminated.

Overview of Outreach

The success of the CCTDP ultimately will be measured by the contribution the technologies make to the resolution of energy, economic, and environmental issues. These contributions can only be achieved if the public and private sectors understand that clean coal technologies can increase the efficiency of energy use and enhance environmental quality at costs that are competitive with other energy options.

The CCTDP has continued efforts to define and understand the potential domestic and international markets for clean coal technologies. Domestically, this activity requires a continuing dialogue with electric utility executives, public utility commissioners, and financial institutions. Also required are analyses of the effect that regional electric capacity requirements, environmental compliance strategies, and electric utility restructuring have on the demand for clean coal technologies. Internationally, activities include participating in international conferences and workshops, furnishing information on clean coal technologies, and providing technical support to trade agencies, trade missions, and financial organizations.

Since the beginning of FY 2002, the CCTDP staff participated in over 30 domestic and international events involving users and vendors of clean coal technologies, regulators, financiers, environmental groups, and other public and private institutions. Five issues of the *Clean Coal Today* newsletter were published in the same period, along with the seventh annual edition of the *Clean Coal Today Index*, which cross-references all

Some new publications produced during Fiscal Year 2001.

articles published in the newsletter. Five *Project Performance Summary* documents were issued—the *Wabash River Coal Gasification Repowering Project*; *Integrated Dry NO_x/SO_2 Emissions Control System*; *Demonstration of Innovative Applications of Technology for the CT-121 FGD Process*; *Milliken Clean Coal Technology Demonstration Project*; and *Demonstration of Selective Catalytic Reduction for the Control of NO_x Emissions From High-Sulfur, Coal-Fired Boilers*.

Also, two *Clean Coal Technology Topical Report* documents were issued: The *JEA Large-Scale CFB Combustion Demonstration Project* and *Software Systems in Clean Coal Demonstration Projects*. The Department of Energy also continued coverage of the program by publishing the *Clean Coal Technology Demonstration Program: Program Update 2001*.

Accomplishments—Environmental Control Devices

All environmental control device projects are now completed. The completed demonstrations proved commercial viability of a suite of cost-effective SO_2 and NO_x control options for the full range of coal-fired boiler types. Risk was significantly mitigated in successfully applying the technologies commercially, because of the extensive databases and attendant predictive models developed through the demonstrations. Also, projects were leveraged to provide input in formulating NO_x control requirements under the CAAA and to evaluate the impact of emerging issues, such as air toxics, on the existing boiler population and control options. Extensive air toxics testing was performed in conjunction with 10 of the environmental control projects. To a great extent, the technologies were retained for commercial service at the demonstration sites, and many technology suppliers have realized commercial sales.

SO_2 Control Technologies. All five SO_2 control technology demonstrations are completed, evaluating three basic approaches to address the diverse coal-fired boiler population: (1) sorbent injection, (2) gas-suspension absorption, and (3) advanced flue gas desulfurization.

- Two low-capital-cost sorbent injection systems, sponsored by LIFAC–North America and Bechtel Corporation, demonstrated SO_2 capture efficiencies in the range of 50 to 70 percent. These systems hold particular promise for the older, smaller units, particularly those with space constraints.
- A moderate-capital-cost gas-suspension-absorption system, sponsored by AirPol, Inc., demonstrated SO_2 capture efficiencies in the range of 60 to 90 percent. The system has particular applicability to the small- to mid-range units with some space limitations.
- Two advanced flue gas desulfurization (AFGD) systems, sponsored by Pure Air on the Lake, L.P. and Southern Company Services, having somewhat higher capital costs than the other approaches, demonstrated SO_2 capture efficiencies in the range of 90 to 95 percent. These systems are primarily applicable to the larger, newer units that have space available.

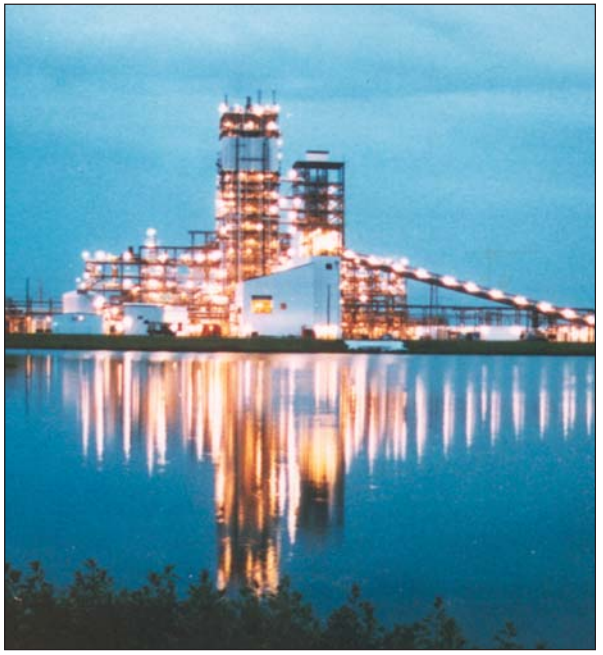
The AFGD projects redefined the state-of-the-art in scrubber technology by proving that a single absorber module of advanced design could process large volumes of flue gas and provide the required availability and reliability. This single-module design, without the usual spares, combined with integration of functions within the absorber module and use of high-throughput designs, nearly halved capital cost and space requirements. The AFGD testing also established that wallboard-grade gypsum could be produced in lieu of solid waste; wastewater discharge could be eliminated; and, by mitigating corrosion, fiberglass-reinforced-plastic fabrication could eliminate process steps (e.g., prequenching for chloride removal and flue gas reheat).

The AFGD demonstration by Southern Company Services using Chiyoda CT-121 showed that the system could significantly enhance particulate control. Pure Air on the Lake, L.P. introduced an innovative business concept whereby the company builds, owns, and operates scrubbers as a contracted service to a utility. The arrangement relieves utilities of the burden of ownership and operation.

NO_x Control Technology. All seven NO_x control technology demonstrations are completed. Testing was conducted on the four major boiler types (wall-fired, tangentially fired, cyclone-fired, and cell-burner boilers), representing over 90 percent of the coal-fired boiler population; however, applicability extends to all boiler types.

Typically, NO_x emission reductions achieved for the various approaches were:

- Low-NO_x burners and OFA: 37 to 68 percent
- Reburning systems: 29 to 67 percent
- SNCR systems: 30 to 50 percent
- SCR systems: 80 to 90+ percent
- Advanced controls: 10 to 15 percent



The Tampa IGCC plant at night.

The database developed during Southern Company Services' evaluation of NO_x control on wall-fired and tangentially fired boilers at Plant Smith and Plant Hammond, respectively, was used by the U.S. Environmental Protection Agency (EPA) in formulating NO_x provisions under the CAAA. ABB Combustion Engineering's LNCFS™ proved effective for tangentially fired boilers and realized commercial acceptance, as did Foster Wheeler's Controlled Flow/Split Flame and Babcock & Wilcox's DRB-XCL® low-NO_x burners for wall-fired boilers. The Babcock & Wilcox Company's low-NO_x cell burner, LNCB®, provided an effective low-cost plug-in NO_x control system for cell-burner boilers, which are known for their inherently high NO_x emissions.

Integration of neural-network systems into digital boiler controls, such as the Generic NO_x Control Intelligent System (GNOCIS) installed at Plant Hammond, demonstrated effective optimization of parameters for NO_x control and boiler performance under load-following operations.

The Babcock & Wilcox Company's coal reburning technology proved not only to be an effective way to control NO_x on cyclone boilers, but a means to avoid derating cyclone boilers when switching to low-sulfur, low-rank western coals. Energy and Environmental Research Corporation's use of gas reburning, applicable to all boiler types, introduced an alternative to SCR for high NO_x emission reduction, particularly when used with low-NO_x burners.

In another project, comparative analyses were conducted on a range of SCR catalysts using high-sulfur U.S. coals, providing needed insight into the environmental and economic performance potential of SCR. Other SCR systems and selective non-catalytic reduction (SNCR) systems were demonstrated in conjunction with combined SO_2/NO_x control technologies.

Multi-Pollutant Control Technologies. All seven of the multi-pollutant control technology demonstrations are completed. The demonstrations evaluated a multiplicity of complementary and synergistic control methods to achieve cost-effective SO_2 and NO_x emissions reductions.

A catalytic process developed by Haldor Topsoe a/s, SNOX™, consistently achieved 95 and 94 percent SO_2 and NO_x reductions, respectively. The process also demonstrated excellent particulate control, while producing a salable by-product in lieu of a solid waste.

In a project sponsored by Public Service Company of Colorado, the complementary use of low-NO_x burners with SNCR resulted in NO_x emission reductions of greater than 80 percent. The SNCR process interacted synergistically with sorbent injection to reduce ammonia slip and lower NO_x emissions. Sodium-based sorbent injection achieved 70 percent SO_2 removal at high sorbent utilization rates.

New York State Electric & Gas Corporation (NYSEG) evaluated an advanced flue gas desulfurization system, the S-H-U scrubber process. The S-H-U process, an advanced formic acid-enhanced wet limestone scrubbing process, demonstrated a 98 percent SO_2 capture efficiency. In conjunction with the S-H-U- process, NYSEG also evaluated micronized coal as a reburn fuel using close-coupled reburning techniques and deep-staged combustion incorporated into ABB Combustion Engineering, Inc.'s LNCFS™ burners. DHR Technologies supplied a plant optimization control system known as the Plant Emission Optimization Advisor or PEOA™, which has been sold to a number of users in the power industry.

The Babcock & Wilcox Company's SOx-NOx-Rox Box™, an integration of a newly developed high-temperature fabric-filter bag (for baghouse installations) with SCR and sorbent injection, proved to be an easily installed, highly efficient control system for SO_2, NO_x, and particulates. Typical performance was 80–90 percent SO_2 removal, 90 percent NO_x removal, and 99.9 percent particulate removal.

Limestone injection multistage burner (LIMB) and coolside demonstrations proved that sorbent injection methods could achieve up to 70 percent SO_2 reduction. The Babcock & Wilcox DRB-XCL® advanced low-NO_x burners reduced NO_x emissions by 40–50 percent.

Energy and Environmental Research Corporation's demonstration of gas reburning and sorbent injection showed that: (1) NO_x reductions greater than 60 percent could be achieved with only 13 percent natural gas heat input, and (2) SO_2 removal of over 55 percent could be achieved by using special sorbents.

Accomplishments—Advanced Electric Power Generation

Pollution control was the priority early in the CCTDP. This program emphasis included technologies that could effectively repower aging plants faced with the need to both control emissions and respond to growing power demands. Repowering is an important option because existing power generation sites have significant value and warrant investment because the infrastructure is in place, and siting new plants represents a major undertaking. This recognition led to early awards of three key repowering projects—two ACFB projects and a PFBC project.

As the CCTDP unfolded, a number of energy and environmental issues combined to change the emphasis toward seeking high-efficiency, low-emission power generation technologies for both repowering

Milliken Station served as the host for two CCTDP projects demonstrating advanced environmental controls.

and new power generation. This emphasis was deemed essential to enable coal to fulfill its projected contribution to the nation's energy mix well into the 21st century. Environmental issues included a growing concern over greenhouse gas emissions, capping of SO_2 emissions, increasing attention to NO_x in ozone nonattainment areas, and recognizing fine particulate emissions (respirable particulates) as a significant health threat. These issues prompted follow-on projects in PFBC, initiation of projects in IGCC, and projects in advanced combustion and heat engines.

Fluidized-Bed Combustion. The Tri-State Generation and Transmission Association, Inc.'s Nucla Station repowering project provided the database and operating experience requisite to making ACFB a commercial technology option at utility scale. At 110 MWe, the Nucla ACFB unit was more than 40 percent larger than any other ACFB at that time. Up to 95 percent SO_2 removal was achieved during the 15,700 hours of demonstration, and NO_x emissions averaged a very low 0.18 lb/10^6 Btu. The thrust of this effort was to fully evaluate the environmental, operational, and economic performance of ACFB. As a result, the most comprehensive database on ACFB technology available at the time was developed. Based on this knowledge, commercial units were offered and built.

While the Nucla project established commercial acceptance of ACFB at moderate utility capacities, a second CCT demonstration project, located in Jacksonville, Florida, is carrying on where Nucla left off. JEA (formerly Jacksonville Electric Authority) has built and is operating a 300-MWe plant, which has the distinction of being the largest ACFB in the world, as well as one of the cleanest.

Today, every major U.S. boiler manufacturer offers an ACFB in its product line. There are now more than 120 fluidized-bed combustion boilers of varying capacities operating in the United States, and the technology has made significant market penetration abroad.

Through the Ohio Power Company's repowering of the Tidd Plant (70 MWe), the potential of pressurized fluidized-bed combustion (PFBC) as a high-efficiency, low-emission technology was established, and the foundation was laid for commercialization. This was the first utility-scale PFBC system in the United States. Efforts were focused on fully evaluating the performance potential. Over 11,400 hours of operation, the technology successfully demonstrated SO_2 removal efficiencies up to 95 percent with very high sorbent utilization (calcium-to-sulfur molar ratio of 1.5), and NO_x emissions in the range of 0.15 to 0.33 lb/10^6 Btu.

The Tidd Plant PFBC was one of the first-generation 70-MWe P200 units installed in the early 1990s. Others were built and operated in Sweden, Spain, and Japan. ABB Stal, the technology supplier, uses a "bubbling" fluidized-bed design, which is characterized by low fluidization velocities and use of an in-bed heat exchanger. And, a "second generation" P200 PFBC with freeboard-firing is operating in Cottbus, Germany.

Integrated Gasification Combined-Cycle. Three of four IGCC projects are completed. They represent a diversity of gasifier types, cleanup systems, and applications. PSI Energy's 262-MWe Wabash River Coal Gasification Repowering Project began operation in November 1995, completed demonstration operations in December 1999, and now operates in commercial service. The unit, which is the world's largest single-train IGCC, operated on coal for over 15,000 hours and processed more than 1.5 million tons of coal to produce over 23 trillion Btu of syngas and 4 million MWh of electricity. The unit has achieved monthly production levels of one trillion Btu of syngas on several occasions.

The 250-MWe Tampa Electric Integrated Gasification Combined-Cycle Project began commercial operation in September 1996, completed demonstration operations in September 2001, and now operates in commercial service. The gasifier has accumulated over 29,000 hours of operation and produced over 8.6 million MWh of electricity on syngas. Tests have included evaluation of various coal types on system performance.

The Sierra Pacific Power Company's (SPPC) 99-MWe Piñon Pine IGCC Power Project at SPPC's Tracy Station began operations in January 1998, and completed demonstration operations in January 2001. The combined-cycle continues in commercial service. The GE Frame 6FA, the first of its kind in the world, performed well. The system achieved steady-state gasifier operation for short periods, but experienced difficulty with sustained operations.

The Kentucky Pioneer Energy IGCC Demonstration Project, which is in the design stage, will offer yet another gasifier design and include the testing of a fuel cell operated on syngas from the coal gasifier. This will provide valuable data for design of an integrated gasification fuel cell (IGFC) system. IGFC has the potential to achieve efficiencies up to 52 percent. To advance the schedule, the fuel cell portion of this project has been relocated to the Wabash IGCC site.

Commercial configurations resulting from the current IGCC demonstrations will typically have efficiencies at least 20 percent greater than conventional coal-fired systems (with like CO_2 emission reductions), remove 90 to 99 percent of the SO_2, reduce NO_x emissions below NSPS, reduce particulate emissions to negligible levels, and produce salable by-products from solid residues as opposed to waste.

Advanced Combustion/Heat Engines. Two projects are demonstrating advanced combustion/heat engine technology. The completed Healy Clean Coal Project demonstrated TRW's entrained (slagging) combustor combined with Babcock & Wilcox's spray-dryer absorber using sorbent recycle. Results from environmental compliance testing showed very low emissions—0.245 lb/10^6 Btu for NO_x, 0.038 lb/10^6 Btu for SO_2, and 0.0047 lb/10^6 Btu for particulates. Permit levels are 0.35 lb/10^6 Btu for NO_x, 0.086 lb/10^6 Btu for SO_2, and 0.02 lb/10^6 Btu for particulates because of the plant's proximity to a national park.

The Clean Coal Diesel Demonstration Project is evaluating a heavy duty diesel engine operating on a low-rank

coal-water fuel. The demonstration plant is expected to achieve 41 percent efficiency, and future commercial designs are expected to reach 48 percent efficiency.

Accomplishments—Coal Processing for Clean Fuels

All four projects in the coal processing for clean fuels category completed operations and three have submitted final reports. Projects in this category include physical and chemical processes that can be used to transform the abundant U.S. coal reserves into economic, environmentally compliant solid and liquid fuels and feedstocks. The solid products from coal processing are largely designed to be readily transportable; high in energy density; and low in sulfur, ash, and moisture. The liquid products are designed to be suitable as transportation and stationary power generation fuels, or as chemical feedstocks. Both solid and liquid products, and the processes that produce them, have substantial market potential both domestically and internationally.

The ENCOAL and Western SynCoal LLC projects are breaking down the barrier to using the nation's vast low-sulfur but low-energy-density western coal resources. The resultant fuels have particular application domestically for CAAA compliance and internationally for Pacific Rim energy markets.

ENCOAL's solid fuel product has an energy density of about 11,000 Btu per pound, and the sulfur content averages 0.36 percent. ENCOAL's liquid fuel product can substitute for No. 6 fuel oil or serve as a chemical feedstock. During the demonstration, over 83,500 tons of solid fuel was shipped to seven customers in six states, as well as 203 tank cars of liquid product to eight customers in seven states. Five commercial feasibility studies have been completed—two for Indonesia, one for Russia, and two for U.S. projects.

The Western SynCoal LLC project demonstrated another route to producing high-quality fuel from low-rank coals. The advanced coal conversion process (ACCP) upgrades low-rank coal to produce a low-sulfur (as low as 0.3 percent sulfur) SynCoal® product having a heating value of about 12,000 Btu per pound. During the demonstration, over 2.8 million tons of raw coal were processed to produce almost 1.9 million tons of SynCoal® product. Six agreements were in place to purchase the product.

Air Products Liquid Phase Conversion Company, L.P. demonstrated the LPMEOH™ process to produce methanol from coal-derived synthesis gas. The LPMEOH™ process has been developed to enhance integrated gasification combined-cycle power generation facilities by co-producing a clean-burning storable liquid fuel from coal-derived synthesis gas. The production of dimethyl ether (DME) as a mixed co-product with methanol was also demonstrated. Methanol and DME may be used as a low-SO_2, low-NO_x alternative liquid fuel, a feedstock for the synthesis of chemicals, or as a new oxygenate fuel additive. Since startup, the LPMEOH™ demonstration unit produced over 103 million gallons of methanol, all of which was accepted by Eastman Chemical Company for use in downstream chemical processing. During the period 1998 through 2000, availability of the unit exceeded 99 percent.

Three IGCC plants have completed operations: Tampa Electric (top), Piñon Pine (middle), and Wabash River (bottom).

ABB Combustion Engineering, Inc. and CQ Inc. developed the PC-based software, Coal Quality Expert™ (CQE™), to assist utilities in assessing the environmental and operational performance of their systems for the available range of coal fuels to determine the least-cost option. The CQE™ software has been distributed to over 25 utility members of EPRI and is being marketed commercially worldwide. Two U.S. utilities also have been licensed to use copies of the CQE™ stand-alone Acid Rain Advisor.

Accomplishments—Industrial Applications

The CCTDP is addressing the environmental issues and barriers associated with coal use in industrial applications. Four of five projects are completed in this area.

Historically, production of steel has been dependent upon coke. Coke making, however, is an inherently large producer of hazardous air pollutants. Also, cement production often relies on coal fuel because production costs are largely driven by fuel costs. Because of its stable low price, coal is an attractive substitute for oil and gas in industrial boilers, but concerns over increased SO_2 and NO_x emissions and boiler tube fouling have impeded coal use.

Under a project with Bethlehem Steel Corporation, British Steel's blast furnace granular-coal injection (BFGCI) technology demonstrated that 0.96 pounds of coke can be substituted for every pound of coal injected directly into a blast furnace where emissions from coal combustion are effectively controlled in the process.

CPICOR™ Management Company LLC is in the design stage for demonstrating direct iron ore reduction

and smelting of iron oxides using coal in lieu of coke. This would reduce the need for coke, which results in large amounts of pollutants during its production.

The Passamaquoddy Tribe successfully demonstrated a unique recovery scrubber that uses cement kiln dust, otherwise disposed of as waste, to remove 90 percent of the SO_2, produce fertilizer and distilled water, and convert the kiln dust to feedstock with no waste generated.

Coal Tech Corporation moved closer to commercializing a combustor for industrial boilers that slags the ash in the combustor to prevent boiler tube fouling, controls NO_x (70 to 80 percent reduction) through staged combustion, and controls SO_2 (90 percent) with sorbent injection.

ThermoChem, Inc. has recently completed demonstration of its multiple resonance tube pulse combustor.

Accomplishments—General

After 15 years, the CCTDP is nearing completion, but several important ongoing projects have yet to make their contribution. There are also a number of institutional successes associated with the CCTDP. For example, the General Accounting Office has described the CCTDP as one of the most successful government/industry partnerships. Congress has recognized the success of the CCTDP and has adapted the program's general principles to the PPII and CCPI. The Department of Energy has adapted the same principles to other programs.

Commensurate with CCTDP commercialization goals, the majority of the projects involve demonstrations at commercial scale, providing the opportunity for the participants to continue operation of the demonstrated technologies as part of their strategy to comply with the Clean Air Act.

With government serving as a risk-sharing partner, industry funding has been leveraged to:

- Create jobs,
- Improve the environment,
- Reduce the cost of compliance with environmental regulations,
- Reduce the cost of electricity generation,
- Improve power generation efficiencies, and
- Position U.S.-based industry to export innovative services and equipment.

Reflecting the marketplace commitment, the CCTDP projects are organized within four major product lines—environmental control devices, advanced electric power generation, coal processing for clean fuels, and industrial applications.

Commercialization

The domestic market for advanced SO_2 control technology is not yet fully developed. To date, domestic utilities have largely invested in fuel switching for SO_2 control and procuring and banking SO_2 allowances, rather than making capital investments in SO_2 control technologies. Also, the utilities are awaiting the outcome of fine particulate matter 2.5 microns and smaller ($PM_{2.5}$) and other regulatory actions that may significantly impact SO_2 compliance requirements. Similarly, there has been no domestic market for advanced technologies that combine high capture efficiency for SO_2, NO_x, and particulate matter (PM).

After being proven as a viable technology in early CCTDP projects, low-NO_x burners enabled utilities to meet the January 2000 Clean Air Act Amendment emission requirements for NO_x. Until recently, the more aggressive, deeper control measures, such as coal and gas reburning, and SCR technologies were applied only sparingly, but are coming into play as utilities are forced to comply with new, more stringent requirements. The U.S. Energy Information Administration (EIA) estimates that 23 gigawatts of scrubber capacity will be in place by 2020.

The domestic market has not been conducive to the introduction of advanced coal-based power generation technologies. Uncertainty in the domestic power markets due to utility restructuring and increasingly stringent emission standards have combined with relatively low natural gas prices to discourage investments in coal plants. Successfully demonstrated technologies like IGCC and PFBC have realized commercial sales but mostly overseas.

The market is changing. Increasing demand for electric power generation, rising natural gas prices, and the increasing importance being placed on fuel diversity are placing a premium on retaining existing coal-fired electric capacity and making coal-based power generation a solid option for capacity additions. For

SO_2 control technologies: AirPol (left), CT-121 (center), and LIFAC (right).

the existing plants, investments will likely be made in the control measures needed to meet emissions compliance requirements.

For capacity additions, only advanced coal-based power generation systems, such as IGCC, PFBC, and derivative technologies, can meet projected emission standards and address concerns over global climate change.

There have been commercialization successes to date in the CCTDP. The commercial sales status for CCTDP technologies by functional application are presented in Exhibits 4–1 to 4–6.

Summary

Combined, the technologies associated with the CCTDP have already yielded sales totaling over $24.3 billion. Additional sales of these and other technologies are being actively pursued, with a pending sales value of $11.4 billion.

Awards

The projects in the CCTDP have won numerous awards from news, professional, and non-profit organizations. A listing of those awards is contained in Exhibit 4-7. In addition, the CCT Compendium has been awarded the APEX2003 Award for Excellence and featured in the July 2002 National Science Digital Library Scout Report for Math, Engineering, and Technology.

PPII

In 2001, the coal-fueled power industry responded enthusiastically to the first new government competition for clean coal technology projects in more than eight years. In a limited competition to advanced clean coal technologies that was the precursor to the new CCPI, DOE received 24 proposals for projects totaling nearly $535 million, $251 million of which was requested from the federal government. The Department of Energy offered $95 million for the initial competition called the Power Plant Improvement Initiative. The private sector must at least match the government's share. Proposed projects would be sited in at least 15 states (some proposers did not designate a site). The Secretary of Energy proclaimed that "[t]his country will have a much stronger, more reliable electric industry if we keep coal in the power mix. New technology is the way to do that, and these proposals tell us that the power industry agrees." The initiative is intended to share the risks of these unproven technologies with the expectation that the first-of-a-kind demonstrations will spur other power companies to replicate the new technologies. The initiative was included by Congress in DOE's fiscal year 2001 appropriations bill.

The PPII focus is on technologies to enable coal-based plants to meet tougher environmental standards and improve efficiency and reliability. Mercury control is an area of environmental emphasis in PPII, added since implementation of CCTDP.

A panel of technical, procurement and legal experts at NETL evaluated the candidate projects using criteria such as the proposed technology's readiness, the management approach, cost considerations, environment, health and safety benefits, and the technology's potential for being replicated in commercial markets. The selections were announced in September 2001. Four awards have been made to date.

CCPI

The Clean Coal Power Initiative builds on the accomplishments of the CCTDP and PPII. Much has changed since the last CCTDP projects were selected in 1993; in particular tighter air emission standards, growth in electricity consumption, and emerging new technologies.

The CCTDP was put into place in the mid-1980s as a response to increasing concerns over acid rain, and especially the impact of acid rain pollutants drifting into the Northeast and across the U.S. border into Canada. Midway through the program, Congress passed the CAAA, which set rigid new pollution standards for SO_2 and NO_x emissions. Since the CAAA was enacted, even more stringent environmental standards have emerged—most of which directly affect coal-burning power plants. These include standards for ozone, particulate matter, and potentially mercury.

The United States is becoming increasingly electrified. During the coming years, the United States faces a surge in the demand for electric power that is likely to exceed all expectations. Today's best forecasts indicated that over the next 20 years, electricity demand in the United States will increase by 45 percent. The estimated growth rate will require the equivalent or constructing more than 1,300 new power plants—about 65 each year. The nation has not experienced that type of capacity growth in the last 15 years. Moreover, this could be a conservative estimate. The rise of the digital economy has led to increases in power demand. Throughout the 1990s, for example, actual electricity consumption far outstripped the best projections—driven largely by the energy-hungry information economy.

The computer revolution since the mid-1990s has also played an important role in the development of new power plant technologies. New computer-aided control systems, running off neural networks and artificial intelligence, could make it possible to fine-tune combustion processes to their peak efficiency—not only boosting the amount of electricity an existing plant can generate but also helping it to reduce air emissions.

New technologies are being developed to control pollutants like mercury and ultra-fine particulates and aerosols. When CCTDP projects were selected, there was no requirement to reduce these types of pollutants. Moreover,

Exhibit 4-1

Commercial Activity—SO_2 Control Technology

Project	Commercial Use
10-MWe Demonstration of Gas Suspension Absorption (AirPol, Inc.)	**Sold domestically and internationally.** GSA market entry was significantly enhanced with the sale of a 50-MWe unit, worth $12.5 million, to the city of Hamilton, Ohio, subsidized by the Ohio Coal Development Office. A sale worth $1.3 million has been made to the U.S. Army for hazardous waste disposal. A GSA system has been sold to a Swedish iron ore sinter plant. Two GSA systems valued at $1.8 million have been sold to Taiwan Sugar Corporation for their oil-fired cogeneration plant. Airpol sold a GSA system valued at $1.5 million to a petroleum coke calciner in India. Other units include a $300,000 GSA system at a municipal waste incinerator in Utah, a $3 million GSA system at a waste incinerator in Holland, and a $500,000 GSA system at a municipal waste incinerator in Minnesota.
Confined Zone Dispersion Flue Gas Desulfurization Demonstration (Bechtel Corporation)	**No sales reported.** CZD/FGD can be used to retrofit existing plants or for new installations at a cost of about one-tenth that of a commercial wet scrubber.
LIFAC Sorbent Injection Desulfurization Demonstration Project (LIFAC–North America)	**Sold domestically and internationally.** The LIFAC system at Richmond Power & Light is the first to be applied to a power plant using high-sulfur (2.0-2.9%) coal. The LIFAC system has been retained for commercial use by Richmond Power & Light at Whitewater Valley Station, Unit No. 2. There are 10 full-scale LIFAC units in operation in Canada,China, Finland, Russia, Japan, and the United States, including 5 projects started before the CCTDP. For three sales in China, the estimated value is $44.6 million.
Advanced Flue Gas Desulfurization Demonstration Project (Pure Air on the Lake, L.P.)	**No sales reported.** The AFGD continues in commercial service at Northern Indiana Public Service Company's Bailly Generating Station. Gypsum produced by the PowerChip® process is being sold commercially. The estimated value for 17 years of continued scrubber operations is $154 million. FLS miljo, a Copenhagen-based licensee, is currently working on a potential $60 million project in Kentucky using the next generation of this technology.
Demonstration of Innovative Applications of Technology for the CT-121 FGD Process (Southern Company Services, Inc.)	**Sold internationally.** Plant Yates continues to operate with the CT-121 scrubber as an integral part of the site's CAAA compliance strategy. There are now 22 CT-121 plants in the planning, construction, or operational phase worldwide. There are 17 CT-121 plants (10 operating on coal) operating in Japan, Australia, Canada, the Czech Republic, Korea, Denmark, Malaysia, and Kuwait. The value of these 17 plants is estimated at $2.03 billion. For the projects in the planning stage, the value is estimated at $880 million.

Exhibit 4-2

Commercial Activity—NO_x Control Technology

Project	Commercial Use
Micronized Coal Reburning Demonstration for NO_x Control (New York State Electric & Gas Corporation)	**No sales reported.** Technology retained for commercial use at Kodak Park Power Plant.
Demonstration of Coal Reburning for Cyclone Boiler NO_x Control (The Babcock & Wilcox Company)	**No sales reported.** Technology retained for commercial use at Wisconsin Power and Light Company's Nelson Dewey Station.
Full-Scale Demonstration of Low-NO_x Cell Burner Retrofit (The Babcock & Wilcox Company)	**Sold domestically.** Dayton Power & Light has retained the LNCB® for use in commercial service. Seven commercial contracts have been awarded for 196 burners or 5,475 MWe of capacity, valued at $30 million.
Evaluation of Gas Reburning and Low-NO_x Burners on a Wall-Fired Boiler (Energy and Environmental Research Corporation)	**Sold domestically and internationally.** Public Service Company of Colorado, the host utility, decided to retain the low-NO_x burners and the gas-reburning system for immediate use; however, a restoration was required to remove the flue gas recirculation system. Since the CCTDP, the participant has installed or is in the process of installing the gas reburning or the gas reburning-low-NO_x burner technology on 11 boilers representing 2,310 MWe of capacity. Estimated value is over $50 million.
Demonstration of Selective Catalytic Reduction Technology for the Control of NO_x Emissions from High-Sulfur, Coal-Fired Boilers (Southern Company Services, Inc.)	**Sold domestically and internationally.** Since the project was initiated, revenues from SCR sales achieved $7.1 billion through 2002.
180-MWe Demonstration of Advanced Tangentially Fired Combustion Techniques for the Reduction of NO_x Emissions from Coal-Fired Boilers (Southern Company Services, Inc.)	**Sold domestically and internationally.** LNCFS™ has been retained at the host site for commercial use. Alstom Power has sold about 67 GWe of LNCFS™ burners. Of this amount, about 49 GWe are equipped with overfire air and 18 GWe are without overfire air. Total sales are estimated at $1.35 billion.
Demonstration of Advanced Combustion Techniques for a Wall-Fired Boiler (Southern Company Services, Inc.)	**Sold domestically and internationally.** The host has retained the technologies for commercial use. Foster Wheeler has equipped 83 boilers with low-NO_x burner technology—a total of over 1,494 burners representing over 26,635 MWe capacity valued at $86 million. Foreign sales make up 35 percent of the commercial market. Twenty-six commercial installations of GNOCIS, the associated artificial intelligence control system, are underway or planned. This represents over 12,000 MWe of capacity.

Exhibit 4-3

Commercial Activity—Multi-Pollutant Control Technology

Project	Commercial Use
SNOX™ Flue Gas Cleaning Demonstration Project (ABB Environmental Systems)	**International use.** The host utility, Ohio Edison, is retaining the SNOX™ technology as a permanent part of the pollution control system at Niles Station to help meet its overall SO_2 and NO_x reduction goals. Five commercial SNOX™ plants are also operating in Japan, Russia, Denmark, The Czech Republic, and Italy.
LIMB Demonstration Project Extension and Coolside Demonstration (The Babcock & Wilcox Company)	**Sold domestically and internationally.** LIMB has been sold to an independent power plant in Canada. Babcock & Wilcox has sales of 2,805 DRB-XCL® burners for 38,284 MWe of capacity (20,291 MW internationally and 17,993 MW domestically). The low-NO_x burners have an estimated value of $388 million.
SOx-NOx-Rox Box™ Flue Gas Cleanup Demonstration Project (The Babcock & Wilcox Company)	**No sales reported.** Commercialization of the technology is expected to develop with an initial larger scale application equivalent to 50-100 MWe. The focus of marketing efforts is being tailored to match the specific needs of potential industrial, utility, and independent power producers for both retrofit and new plant construction. SNRB™ is a flexible technology that can be tailored to maximize control of SO_2, NO_x, particulate, or combined emissions to meet current performance requirements while providing flexibility to address future needs.
Enhancing the Use of Coals by Gas Reburning and Sorbent Injection (Energy and Environmental Research Corporation)	**No sales reported.** Illinois Power has retained the gas-reburning system and City Water, Light & Power has retained the full technology for commercial use. (See Evaluation of Gas Reburning and Low-NO_x Burners on a Wall-Fired Boiler project for a complete understanding of commercial success of the technology.)
Milliken Clean Coal Technology Demonstration Project (New York State Electric & Gas Corporation)	**Sold domestically.** Eight modules of DHR Technologies' Plant Emissions Optimization Advisor (PEOA), with an estimated value of $280,000, have been sold. DHR Technologies, Inc., is no longer in business and New York State Electric & Gas Corporation owns the PEOA software. ABB Combustion Engineering has modified 116 units representing over 25,000 MWe with LNCFS™ or its derivative TFS 2000™.
Integrated Dry NO_x/SO_2 Emissions Control System (Public Service Company of Colorado)	**Sold domestically.** The technology was retained by Public Service Company of Colorado for commercial service at its Arapahoe Station. Babcock & Wilcox has sales of 2,805 DRB-XCL® burners for 38,284 MWe of capacity (20,291 MW domestically). The low-NO_x burners have an estimated value of $388 million.

Exhibit 4-4

Commercial Activity—Advanced Electric Power Generation

Project	Commercial Use
Tidd PFBC Demonstration Project (The Ohio Power Company)	**Sold internationally.** The project's success has led Babcock & Wilcox to invest in the technology and acquire domestic licensing rights. Commercial coal-fired ventures abroad include the following: – Vartan in Sweden is operating two P200 units to produce 135 MWe and 224 MWt*; – Escatron in Spain is operating one P200 unit producing 80 MWe*; – Wakamatsu in Japan has retired one P200 unit that produced 71 MWe; – Cottbus in Germany is operating one P200 unit to produce 71 MWe and 40 MWt; – Karita in Japan operates one P800 unit to produce 360 MWe; – Chuoku in Japan to produce 250 MWe; and – Tomato-Atswo plant in Japan to produce 80 MWe. The value of these projects is estimated at $1.35 billion.
Nucla CFB Demonstration Project (Tri-State Generation and Transmission Association, Inc.)	**Sold domestically and internationally.** Since the demonstration, Foster Wheeler Energy Corporation, the technology supplier for the demonstration effort, made sales in Germany, Italy, Poland, Taiwan, China, India, Korea, Thailand, Indonesia, Finland, The Czech Republic, Denmark, Sweden, Austria, Spain, France, Canada, and Switzerland. Domestic sales constitute almost 2 GW and international sales over 6 GW.
Tampa Electric Integrated Gasification Combined-Cycle Project (Tampa Electric Company)	**Sold domestically and internationally.** First greenfield IGCC unit in commercial service. Texaco, Inc. and ASEA Brown Boveri signed an agreement forming an alliance to market IGCC technology in Europe. There are 20 Texaco gasifiers representing 3,871 MW in the development or operation phase at an estimated cost of $2.15 billion. There are 14 Texaco gasifiers representing 7,246 MWe in the planning phase at an estimated cost of $5.12 billion.
Wabash River Coal Gasification Repowering Project (Wabash River Coal Gasification Repowering Joint Venture)	**No sales reported.** First repowered IGCC unit in commercial service and is the world's largest single-train IGCC Project in commercial service.
Healy Clean Coal Project (Alaska Industrial Development and Export Authority)	**No sales reported.** TRW is offering licensing of combustor worldwide. Commercial operation tests are ongoing.

* Parallel project with Tidd.

Exhibit 4-5
Commercial Activity—Coal Processing for Clean Fuels

Project	Commercial Use
Development of the Coal Quality Expert™ (ABB Combustion Engineering and CQ, Inc.)	**Sold domestically and internationally.** The Electric Power Research Institute (EPRI) owns the Combustion Engineering software and distributes it to EPRI members for their use. CQ Inc. and Black and Veatch have signed commercialization agreements that give both companies nonexclusive worldwide rights to sell user licenses and offer consulting services that include use of CQE®. More than 22 U.S. utilities, two United Kingdom utilities, and one utility in France have received CQE® through EPRI membership. Two modules of the Acid Rain Advisor valued at $6,000 have been sold. EPRI estimated that the Acid Rain Advisor has saved one U.S. utility about $26 million—more than the total cost of the demonstration project. There have also been two sales of the Windows version of the software (Vista) at an estimated value of $180,000.
ENCOAL® Mild Coal Gasification Project (ENCOAL Corporation)	**Domestic and international sales pending.** In order to determine the viability of potential mild coal gasification plants, five detailed commercial feasibility studies—two Indonesian, one Russian, and two U.S. projects—have been completed.
Commercial-Scale Demonstration of the Liquid Phase Methanol (LPMEOH™) Process (Air Products Liquid Phase Conversion Company, L.P.)	**No sales reported.** Nominal 80,000 gallon/day methanol production being used by Eastman Chemical Company.
Advanced Coal Conversion Process Demonstration (Western SynCoal LLC)	**No sales reported.** Total sales of SynCoal® product exceed 1.9 million tons. Six long-term agreements were in place to purchase the product. One domestic and five international projects have been investigated. Western SynCoal LLC has a joint marketing agreement with Ube Industries of Japan providing Ube non-exclusive marketing rights outside of the United States. Ube is pursuing several projects in Asia.

Exhibit 4-6
Commercial Activity—Industrial Applications

Project	Commercial Use
Cement Kiln Flue Gas Recovery Scrubber (Passamaquoddy Tribe)	**No sales reported.** The scrubber became a permanent part of the cement plant at the end of the demonstration. A feasibility study has been completed for a Taiwanese cement plant.
Blast Furnace Granular-Coal Injection System Demonstration Project (Bethlehem Steel Corporation)	**No sales reported.** Technology remains in commercial service at demonstration site.
Advanced Cyclone Combustor with Internal Sulfur, Nitrogen, and Ash Control (Coal Tech Corporation)	**No sales reported.** While the combustor is not yet fully ready for sale with commercial guarantees, it is believed to have commercial potential. Follow-on work to the CCTDP demonstration was undertaken, which has brought the technology close to commercial introduction.

Exhibit 4-7
Award-Winning CCTDP Projects

Project and Participant	Award
Full-Scale Demonstration of Low-NO_x Cell Burner Retrofit (The Babcock & Wilcox Company)	1994 R&D 100 Award presented by *R&D* magazine to the U.S. Department of Energy for development of the low-NO_x cell burner.
Evaluation of Gas Reburning and Low-NO_x Burners on a Wall-Fired Boiler; Enhancing the Use of Coals by Gas Reburning and Sorbent Injection (Energy and Environmental Research Corporation)	1997 J. Deane Sensenbaugh Award presented by the Air and Waste Management Association to the U.S. Department of Energy, Gas Research Institute, and U.S. Environmental Protection Agency for the development and commercialization of gas-reburning technology.
Advanced Flue Gas Desulfurization Demonstration Project (Pure Air on the Lake, L.P.)	1993 Powerplant Award presented by *Power* magazine to Northern Indiana Public Service Company's Bailly Generating Station.
	1992 Outstanding Engineering Achievement Award presented by the National Society of Professional Engineers.
Demonstration of Innovative Applications of Technology for the CT-121 FGD Process (Southern Company Services, Inc.)	1995 Design Award presented by the Society of Plastics Industries in recognition of the mist eliminator.
	1994 Powerplant Award presented by *Power* magazine to Georgia Power's Plant Yates. Co-recipient was the U.S. Department of Energy.
	1994 Outstanding Achievement Award presented by the Georgia Chapter of the Air and Waste Management Association.
	1993 Environmental Award presented by the Georgia Chamber of Commerce.
Tidd PFBC Demonstration Project (The Ohio Power Company)	1992 National Energy Resource Organization award for demonstration of energy-efficient technology.
	1991 Powerplant Award presented by *Power* magazine to American Electric Power Company's Tidd project. Co-recipient was The Babcock & Wilcox Company.
Tampa Electric Integrated Gasification Combined-Cycle Project (Tampa Electric Company)	1997 Powerplant Award presented by *Power* magazine to Tampa Electric's Polk Power Station.
	1996 Association of Builders and Contractors Award presented to Tampa Electric for quality of construction.
	1993 Ecological Society of America Corporate Award presented to Tampa Electric for its innovative siting process.
	1993 Timer Powers Conflict Resolution Award presented to Tampa Electric by the state of Florida for the innovative siting process.
	1991 Florida Audubon Society Corporate Award presented to Tampa Electric for the innovative siting process.
Wabash River Coal Gasification Repowering Project (Wabash River Coal Gasification Repowering Project Joint Venture)	1996 Powerplant Award presented by *Power* magazine to CINergy Corp./PSI Energy, Inc.
	1996 Engineering Excellence Award presented to Sargent & Lundy upon winning the 1996 American Consulting Engineers Council competition.
Development of the Coal Quality Expert™ (ABB Combustion Engineering, Inc. and CQ Inc.)	In 1996 recognized by then Secretary of Energy Hazel O'Leary and EPRI President Richard Balzhiser as the best of nine DOE/EPRI cost-shared utility R&D projects under the Sustainable Electric Partnership Program.
JEA Large-Scale CFB Combustion Demonstration Project	2002 Powerplant Award presented by *Power* magazine to JEA.

NO_x emission requirements were far less stringent than those resulting from revised NAAQS for ozone; and utilization of coal wastes was not a CCTDP emphasis.

To meet these new challenges, a new suite of technologies are needed. On January 15, 2003, DOE announced the selection of eight projects under CCPI-I. Three of the projects are directed at new ways to comply with the President's Clear Skies Initiative (CSI), which calls for dramatic reductions in air pollutants from power plants over the next decade-and-a-half. Three other projects are expected to contribute to President Bush's Climate Change initiative to reduce greenhouse gases. The remaining two projects will reduce air pollution through coal gasification and multi-pollutant control systems. Subsequent to the selection, one CCPI project related to CSI was withdrawn by the participant.

Market Communications—Outreach

Outreach has been a hallmark of the CCTDP since its inception. The Department of Energy recognized early on that commercialization of technology requires acceptance by a range of interests including: technology users; equipment manufacturers; suppliers and users of raw materials and products; financial institutions and insurance underwriters; government policy makers, legislators, and regulators; and public interest groups. Requisite to acceptance is an outreach program to provide these customers and stakeholders with both program and project information and to seek, on a continuing basis, feedback on program direction and information requirements. An ongoing outreach program has aggressively sought to disseminate key information to the full range of customers and stakeholders and to obtain feedback on changing needs. The effort has recognized the need to highlight environmental, operational, and economic performance characteristics of clean coal technologies and to redesign information packages as customers and stakeholders, and their respective needs, change with the market. Specific objectives of the outreach program include the following:

- Achieving public and government awareness of advanced coal-using technologies as viable energy options;
- Providing potential technology users, both foreign and domestic, with information that is timely and relevant to their decision making process;
- Providing policy makers, legislators, and regulators with information about the advantages of clean coal technologies;
- Informing financial institutions and insurance underwriters that clean coal technologies are viable options; and
- Providing forums and opportunities for feedback on program direction and information requirements.

Information Sources

A variety of publications and information access media exist and are being improved upon as program and marketplace events unfold. Information is currently distributed to over 4,000 customers and stakeholders. The following provides a brief synopsis of the publications and information transfer mechanisms currently in place.

Clean Coal Technology Programs: Program Update provides an annual summary of program and project progress, accomplishments, and financial status along with a historical backdrop and program role relative to current policy.

Clean Coal Technology Demonstration Program: Completed Projects provides a summary of completed projects in the CCTDP.

Clean Coal Today newsletter offers its readers a quarterly look at clean coal technologies and related issues, highlighting key events, updating project status, and listing the latest publications and upcoming events.

Project Performance Summary documents provide synopses of completed projects, highlighting each project's operational, environmental, and economic performance. Eighteen have been published so far.

Topical Report documents capture projects at critical junctures and highlight particular technological advantages, project plans, and expected outcomes. Twenty-one have been published so far.

The National Technical Information Service (NTIS) serves as the federal government's central source for the sale of scientific, technical, engineering, and related business information produced by or for the U.S. government. The NTIS has many of the CCTDP technical reports.

CCTDP Bibliography of Publications, Papers, and Presentations periodically updates the key materials available on the technologies demonstrated under the CCTDP.

The Investment Pays Off periodically takes a market-based view of the success of clean coal technologies by virtue of commercial sales and relevance of ongoing activities to projected market needs.

CCTDP—Lessons Learned documents the lessons learned in soliciting, selecting, and awarding projects and implementing the program.

CCT Compendium is an electronic database incorporating clean coal technology publications that can be accessed on the Internet (http://www.lanl.gov/projects/cctc/).

Exhibits provide a means through graphics, photos, broadcast videos, and interactive videos to convey program messages at a variety of forums, and serve as focal points for distribution of literature and discussion of the program and information needs. There are currently four exhibits of varying sizes and complexity that are updated and modified, as necessary, to convey the appropriate message for specific forums.

The Home Page of DOE's Office of Fossil Energy (FE) provides the primary Internet gateway to extensive information on DOE's Fossil Energy Program and to relevant World Wide Web links (http://www.fe.doe.gov). The NETL Home Page has information on the laboratory's research efforts (http://www.netl.doe.gov/).

Exhibit 4-8 summarizes how the above publications can be obtained and information sources can be accessed.

Publications

The following publications were issued since the start of fiscal year 2002 by the CCTDP.

- *Clean Coal Technology Demonstration Program: Program Update 2001*
- *Clean Coal Today*: Winter 2001, Spring 2002, Summer 2002, Fall/Winter 2002, and Spring 2003.
- *Clean Coal Today Index*
- *Project Performance Summary—Demonstration of Innovative Applications of Technology for the CT-121 FGD Process*
- *Project Performance Summary—Integrated Dry NO_x/SO_2 Emissions Control System*
- *Project Performance Summary—Milliken Clean Coal Technology Demonstration Project*
- *Project Performance Summary—Wabash River Coal Gasification Repowering Project*
- *Project Performance Summary—Demonstration of Selective Catalytic Reduction for the Control of NO_x Emissions from High-Sulfur, Coal-Fired Boilers*
- *Topical Report—The JEA Large-Scale CFB Combustion Demonstration Project*
- *Topical Report—Software Systems in Clean Coal Demonstration Projects*

Information Access

The Department of Energy continues to expand its Web site to provide information on federal fossil energy programs and serve as a gateway to other related information throughout the United States and the world. Once into the DOE Web site, users can obtain general information and follow links to increasingly detailed information, ultimately accessing specific data on individual projects and facilities. Hyperlinks allow users to move seamlessly between DOE headquarters and field sites. Users can also access technical abstracts and reports maintained by DOE's Office of Scientific and Technical Information (OSTI) at Oak Ridge, Tennessee. The gateway links to more than a hundred energy-related Web sites operated by private companies, trade associations, and other agencies worldwide.

Furthermore, the Fossil Energy International Activities site on the World Wide Web has been expanded with the addition of new country pages. Many of the existing country pages have also been upgraded, with new hyperlinks to business- or energy-related information sources. An innovation at the Fossil Energy International Activities Web site is a series of newly created Country Energy Overviews. Each overview, individualized for a particular country, includes a status summary of that country's energy infrastructure, energy and environmental policies, and privatization efforts. Fifteen country pages are now available. The Uniform Resource Locator (URL) for the Fossil Energy International main page is http://www.fe.doe.gov/international and can be accessed via the "International" link on the Fossil Energy Home Page (http://www.fe.doe.gov).

In February 1998, DOE established a new information resource on the Internet. The Clean Coal Technology Compendium, sponsored by the Office of Fossil Energy and the National Energy Technology Laboratory (NETL), is dedicated to making the maximum use of information derived from clean coal technology programs. The compendium is designed to emphasize ease of use, and contains a broad collection of different types of data and information, making it applicable to the needs of both managers and engineers. For example, one can access the latest *Clean Coal Technology Demonstration Program: Program Up-*

Exhibit 4-8

How to Obtain CCTDP Information

Media	Description and Action
Clean Coal Today	Subscription to quarterly newsletter—Send name and address to U.S. Department of Energy, FE-24, Washington, DC 20585.
Fossil Energy Home Page	Primary gateway to extensive information on DOE's Fossil Energy Program and to relevant Web links—On the Internet, access http://www.fe.doe.gov and use menu and/or search options.
National Energy Technology Laboratory	Information on NETL's research is available at http://www.netl.doe.gov/
CCT Compendium	On the Internet, access http://www.lanl.gov/projects/cctc/.
Clean Coal Technology Programs: Program Update and other publications	U.S. Department of Energy, FE-20 Washington, DC 20585
National Technical Information Service	U.S. Department of Commerce 5285 Port Royal Road, Springfield, VA 22161

date and *Topical Reports* published periodically on individual CCT projects. The CCT Compendium is accessible via the Internet at http://www.lanl.gov/projects/cctc/.

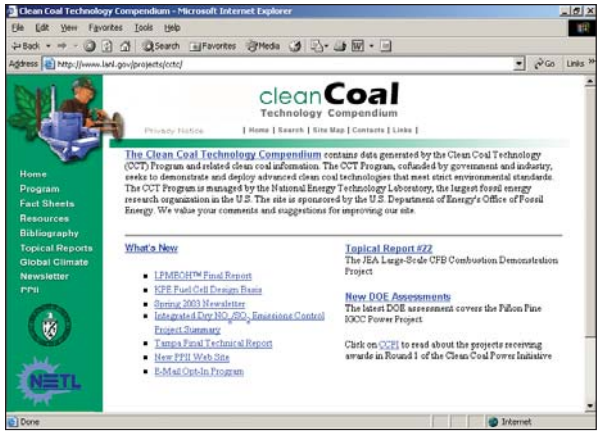
Information Dissemination and Feedback

A number of mechanisms are used to disseminate program information to customers and stakeholders and obtain feedback from them on specific issues, program direction, and information requirements. The following provides a brief outline of the mechanisms.

Public Meetings were routinely held over the course of the acquisition phase of the Clean Coal Technology Programs to solicit input on procurement actions. Subsequently, project participants have been holding open houses for the public, providing tours of demonstration facilities, and publicizing projects through groundbreaking and dedication ceremonies.

Stakeholder Meetings bring together key stakeholder organizations for the purpose of coordinating programs, where appropriate, and discussing pertinent issues and implementation strategies to address issues and outreach needs. Such stakeholder organizations include the Electric Power Research Institute (EPRI), Gas Research Institute (GRI), Coal Utilization Research Council (CURC), Center for Energy & Economic Development (CEED), Council of Industrial Boiler Owners (CIBO), Clean Coal Technology Coalition, and National Mining Association (NMA).

Conferences and Workshops bring together targeted audiences to review and discuss topics of interest, document discussions and findings, and provide recommendations, as appropriate. Trade Missions are a subset of these and differ only in that the thrust is international in character with the purpose of promoting the export of U.S. technology and services. The outreach program has participated in over 250 technical conferences, workshops, and trade missions since 1991.



The CCT Compendium is a new source of information on the CCTDP.

Conferences, Workshops, and Trade Missions—FY 2002

The following highlights some of the conferences, workshops, and trade missions supported by FE's Office of Coal and Power Systems (OC&PS) and National Energy Technology Laboratory (NETL) during FY 2002. More information on these events can be found in the *Clean Coal Today* newsletters, which are posted on the *CCT Compendium* listed in Exhibit 4-8. References to the specific edition of the *Clean Coal Today* are contained in a parenthetical at the end of each discussion.

Conferences

Conference on Zero Emissions Technologies for Power Generation. The Conference on Zero Emissions Technologies for Power Generation was held in New Orleans, Louisiana, in October 2001, and was sponsored by DOE, International Energy Agency (IEA) Working Party on Fossil Fuels (WPFF), and the U.K. Department of Trade and Industry. Attendees saw the development of zero emission technologies such as FE's Vision 21 concept as a critical global task. Vision 21 would provide the technology basis for integrated ultra-clean plants for producing electricity and opportunity products including clean transportation fuels, high-value chemicals, syngas, and hydrogen. Zero emissions technologies, which apply to all fossil fuels, could range from industrial clusters that strive to use outputs from one system as inputs to other systems (see discussion below on Thailand eco industrial parks) to such advanced clean coal processes as IGCC and hybrids, and enhanced oil recovery using CO_2 from energy conversion processes. (*Clean Coal Today*, Summer 2002.)

Clean Coal and Power Conference. The FE Clean Coal and Power Conference, held in Washington, D.C., on November 19–20, 2001, emphasized coal's role in providing domestic energy security and being key to electrification in developing countries where economic progress could be expected to promote social and political stability. Attendees stressed the dangers of over-reliance on natural gas and the importance of coal in the fuel mix. They emphasized coal's continually improving environmental performance, its role as an energy price stabilizer and vital baseload fuel, and were optimistic about its prospects. The conference, formerly called the Clean Coal Conference, was once again co-sponsored by DOE, CEED, NMA, EPRI, and CIBO.

In his introductory remarks, the Acting Assistant Secretary for FE (ASFE) traced the evolution of the government role towards acceptance of the cost-share principle with private funding often exceeding the government share. He noted the President's stated commitment to clean coal technologies will be based on a solid track record of achievements under the CCTDP. The Acting ASFE stated his belief that future RD&D in coal technology will produce even more advanced pollution controls capable of removing mercury and ultra-fine particles and other criteria pollutants; CO_2 sequestration integral to the overall energy cycle; and liquid fuels technologies producing value-added products. (*Clean Coal Today*, Winter 2001.)

The Vice Chairman of the World Energy Council gave the keynote speech noting that two billion people worldwide lack access to commercial energy and that a "Marshall Plan" is needed to transfer energy technology to poor countries. (*Clean Coal Today*, Winter 2001.)

International Committee on Coal Research. Representatives from FE participated in the 26th meeting of the International Committee on Coal Research (ICCR) in October 2001 in Strasbourg, France. Representatives from 14 countries meet annually to determine the current status of coal research and development (R&D) activities, and to identify promising areas for research collaboration.

The U.S. delegation proposed use of DOE's Power Systems Development Facility (PSDF), in Wilsonville, Alabama, to sponsor international tests of instruments and sensors for measuring particulate loading. PSDF would also host an on-site workshop on computational fluid dynamics (CFD) and operational issues related to gas filtration.

New Zealand is looking into hydrogen from coal for use in fuel cells, microturbines and other engines. Research involves hydrogen as a transportation fuel, resolving infrastructure and gas storage issues, perfecting fuel cell technology and developing distributed generation models. Increased use of hydrogen is seen as a way to reduce greenhouse gas emissions. In New Zealand, industry is required to negotiate with the government to achieve specific emissions reductions. If these are not effective, New Zealand indicated it would impose carbon taxes.

Japan has a four-phase energy strategy, with the last phase (2020–2030) assumed to be a zero-emission, hydrogen era based on coal. Japan sees promise in dimethyl ether (DME) synthesis technology as a source of clean hydrogen from coal. Another method would produce hydrogen via a reaction between coal and supercritical water. (*Clean Coal Today*, Winter 2001.)

Unburned Carbon (UBC) on Utility Fly Ash Conference. On May 14–16, 2002, NETL sponsored two specialty conferences in Pittsburgh, Pennsylvania, focusing on reducing pollution generated by electric power plants. The conferences featured "Unburned Carbon (UBC) on Utility Fly Ash," and "Selective Catalytic Reduction and Selective Non-Catalytic Reduction for NO_x Control." This marked the eighth year for the UBC Conference and it was successful in bringing together a wide range of representatives from industry and government. The UBC Conference drew 155 registrants. The two conferences drew 60 international attendees, representing 14 countries.

The NO_x reduction required to meet Title IV requirements of the Clean Air Act Amendments of 1990 (CAAA) is being achieved through widespread use of low-NO_x burners (LNBs). However, use of these burners results in the production of excess UBC, which is also referred to as loss-on-ignition (LOI). This high level of UBC reduces boiler efficiency and can render fly ash unsalable. The issue of UBC mitigation continues to be an issue addressed by the annual conferences.

The Deputy Secretary of DOE, Francis Blake, addressed the Clean Coal and Power Conference plenary session.

A vice-president for EPRI discussed five basic issues facing the electric power generating industry: (1) enhancing the basic power infrastructure, (2) building a robust generation portfolio, (3) capturing and utilizing or sequestering carbon dioxide, (4) improving the customer-managed service network, and (5) developing a global energy strategy.

The results of a study on high-carbon fly ash, while site-specific, indicated that a reduction in UBC levels of approximately 50 percent (for a reduction from 8.8 percent to 4.1 percent in UBC) can be achieved by combustion modification. Other highlights of the UBC conference included the results of studies of multi-pollutant controls at coal-fired power plants through process modeling; an analysis of carbon burnout for specific coals through CFD; use of high-LOI fly ash (greater than 20 percent UBC) to replace shale in cement manufacture to increase clinker (raw cement) production and reduce fuel consumption; use of CFD to study detailed mechanisms of coal combustion; and the effects of high-LOI fly ash on electrostatic precipitators. A commercial carbon burnout process is producing 18,000 tons of salable fly ash per month while recovering a heating value from the UBC equivalent to 1.5 tons of coal per hour. Power plant application of a combination of high velocity overfire air and SNCR has reduced NO_x by 45 percent while having minimal effect on carbon monoxide and LOI. It was also shown that high-LOI fly ash performs well as a binder for iron ore pelletization, steel mill desulfurization slag, and foundry molds. (*Clean Coal Today*, Summer 2002.)

Selective Catalytic Reduction and Selective Non-Catalytic Reduction for NO_x Control Conference. The 6th SCR/SNCR conference drew 371 registrants. The SCR/SNCR conference included 40 oral presentations and 17 poster presentations, addressing emissions regulations, economics of NO_x emissions reduction, emissions trading, risk issues in commercial applications of NO_x reduction technologies, non-coal applications, commercial implementation of SCR and SNCR processes, and chemical reagent considerations. Also discussed were alternative NO_x control technologies, including selective autocata-

lytic reduction, integration of coal gasification and reburning, and oxygen enhanced combustion for NO_x control. Of great interest to power generators is the potential of multi-pollutant emission controls, including not only NO_x and SO_2, but also mercury and CO_2.

Several power generating companies reported successful operation of SCR and SNCR units, including meeting performance targets for at least one year's service. Special attention to design details is required to insure proper mixing of chemical reagents with the flue gas. Of particular concern is maintaining the correct balance of reagent to NO_x in the flue gas to minimize formation of ammonium bisulfate, a sticky substance that can plug downstream heat exchangers. It has also been found that traces of sulfur trioxide, formed by oxidation of SO_2 in the flue gas, can lead to visible plumes from the stacks. In some cases, this problem is alleviated by injection of magnesium oxide into the flue gas. Several speakers reported that certain components in coal feeds, especially calcium, arsenic and mercury, have significant effects on SCR catalyst performance, requiring careful testing and selection of catalysts for particular coals. A number of companies have developed sophisticated strategies for catalyst regeneration and replacement to minimize overall operating costs. (*Clean Coal Today*, Summer 2002.)

Working Party on Fossil Fuels Meeting. The WPFF met in Paris on May 6–7, 2002 and was chaired by FE's Director of Coal and Power Import and Export. A major objective of the WPFF is to implement a new strategic plan—Vision for the 21st Century: Zero Emissions Technologies for Energy Security, Environmental Protection, and Economic Development—that was designed to raise the profile of this important R&D area. The WPFF completed a technology status report on zero emissions technologies in May 2002.

The strategic plan focuses on communications, collaboration in development and deployment, cooperation to improve existing power plants, and energy safety and security. The strategy also incorporates cooperation with non-member nations such as China and India that have an extensive base of low-performing fossil fuel plants.

The Office of Fossil Energy has been an active member of WPFF since it was founded in 1974. The WPFF advises the IEA Committee on Energy Research and Technology on technology issues, trends, and R&D programs in fossil fuels and electricity system issues, and has grown to a membership of 25 industrialized countries. The WPFF administers seven implementing agreements, which facilitate cooperation among IEA members in specific fossil energy R&D areas. (*Clean Coal Today*, Summer 2002.)

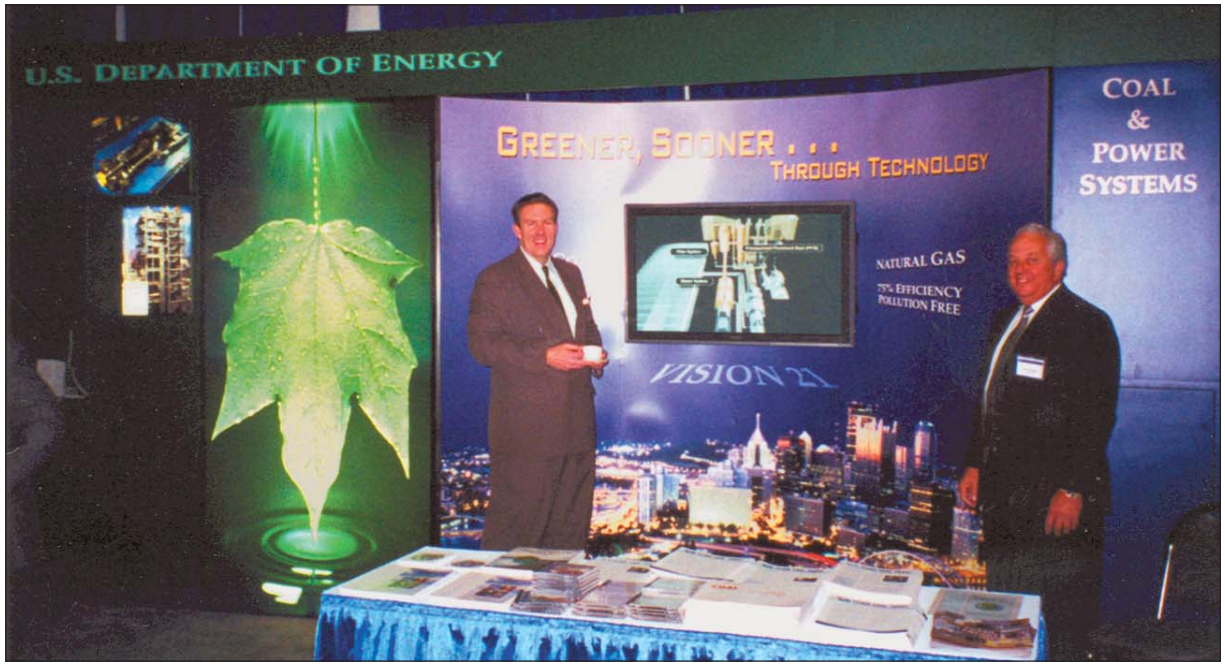
Workshops

Evolution of Combustion Technology to Support National Energy Needs Workshop. On January 14–16, 2002, in Orlando, Florida, NETL organized a workshop, "Evolution of Combustion Technology to Support National Energy Needs." The workshop built a consensus on the engineering R&D needs to overcome various barriers to combustion technologies that can provide the nation with an environmentally superior, affordable, and dependable supply of coal-based electric power.

Equipment suppliers, architect/engineering (A/E) firms, utilities, universities, and oxygen system suppliers all attended. Facilitated group discussions solicited stakeholder input to NETL's planning process for the Advanced Combustion Technologies Program.

The group did a survey about overall barriers to coal combustion today, using the questions asked of a similar group at a 1992 conference. As shown in Exhibit 4-9, environmental issues are seen to be more critical barriers today than they were 10 years ago. The possibility of more stringent regulation was only one vote short of being voted the most significant barrier of all.

The Coal & Power Systems exhibit at the Clean Coal and Power Conference in Washington, D.C.



Following the survey, breakout sessions were organized to address:

- R&D needs for advanced combustion systems including circulating fluidized-bed, cyclones, other slagging furnaces, and oxygen-enhanced combustion modes.
- R&D needs to meet the DOE Vision 21 goals of 60 percent efficiency of coal-fired power plants and near-zero emissions of stack gas pollutants, and specific R&D needs to support CCPI.
- R&D needs for pressurized hot gas clean-up, materials issues and risks for supercritical and ultra-supercritical steam cycles, and design improvements needed for the balance-of-plant of advanced combustion systems.

Workshop participants were supportive of the current NETL combustion program, agreed on the importance of the planned CCPI demonstrations, and hoped that projects would be funded for supercritical and ultra-supercritical cycles for atmospheric circulating fluidized-bed combustion, pressurized and hybrid systems, and pulverized coal combustion systems.

Attendees also stressed the importance of R&D in oxygen and oxygen-enhanced combustion, and the development of a multi-pollutant collection device for hot gas filtration and cleanup. They also recommended investigating various system options and assessing the economic and market opportunities for coal-fired peaking units. (*Clean Coal Today*, Spring 2002.)

Clean Coal Technology Forum: Roadmap to the Future. This Capitol Hill workshop was held on May 20, 2002, to provide up-to-the-minute information regarding congressional and DOE support of the federal clean coal programs. The workshop coincided with the release of the CURC Clean Coal Technology Roadmap, which provides a basis for discussion of coal-fired power generation research and development needs.

Exhibit 4-9

Perceptions of Barriers to Coal Combustion Have Changed—Ranked from High to Low

HIGH

Kentucky Workshop, August 1992	Orlando Workshop, January 2002
– Capital Cost	– Capital Cost
– Recent Oil and Gas Prices	– Possibility of More Stringent Regulation
– Operating Costs	– Financial Risk (new)
– Possibility of More Stringent Regulation	– Time for Environmental Permitting
– Space Limitations	– Recent Oil and Gas Prices
– Gas Cleanup Equipment Costs	– Cost of Obtaining Environmental Permits
– Solid Waste Disposal	– Gas Cleanup Equipment Costs
– Flexibility (fuel, operational)	– Operating Costs
– Automation & Controls Cost	– Solid Waste Disposal
– Time for Environmental Permitting	– Flexibility (fuel, operational)
– Lack of Experienced Operators	– Transportation Costs

LOW

Attendees at the UBC specialty conference hosted by NETL.

The workshop was co-hosted by such leading voices as EPRI, NMA, National Rural Electric Cooperative Association, American Public Power Association, Edison Electric Institute (EEI), and United Mine Workers of America. (*Clean Coal Today*, Summer 2002.)

Clean Energy Opportunities in China Workshop. In September 2002, the U.S./China Energy and Environmental Technology Center (EETC) hosted a workshop and plant tours, both in Pennsylvania, with the purpose of promoting information exchange between U.S. and Chinese coal researchers, technology developers, and vendors. The EETC was established in 1997, and is run jointly by Tsinghua and Tulane Universities, with funding from DOE. The EETC mission is to enhance the competitiveness of U.S. clean coal technology equipment and services.

The "Clean Energy Opportunities in China" workshop was held on September 6, 2002 at Lehigh University. U.S. presentations included coal preparation, flue gas desulfurization (FGD), limestone sourcing and processing, CFB combustion, and IGCC. Of particular interest were the issues associated with expanding China's coal-fired generation capacity base, improving the emissions performance of Chinese plants, and satisfying the Beijing Green Olympics program. China will likely invest billions of dollars to improve Beijing's air quality in preparation for the Olympics.

Chinese participants discussed the overall need to restructure the country's utility industry in the wake of the dismantling of the China State Power Corporation. Ultimately, generators may have to compete in the power market. Necessary investment in the power sector and coal preparation could total some tens of billions of dollars, representing a significant potential U.S. export market.

In a separate activity, EETC hosted plant tours for representatives of the Zhejiang Provincial Energy Group (ZPEG) and the China Coal Research Institute (CCRI) to promote U.S. technologies and explain business practices and eco-industrial development with clean coal technologies.

The group visited the Homer City Coal Cleaning Plant to view a facility using dense medium cyclones, and the Greystone Materials processing plant to show the processing of limestone for desulfurization and discuss the American practice of identifying resources of stones for cost-effective operation.

The group also toured the eco-industrial complex of Waste Management Processors, Inc. (WMPI) and its affiliates, Gilberton Power Company (GPC)—host site for a CCPI project—and Schuylkill Energy Resources (SER). Both of these facilities serve as hosts for a unique set of eco-industrial businesses, which produce useful materials from coal by-products.

The WMPI presentation included developments in the production of concrete products from CFB ash and preparation plant refuse. The group also discussed the utilization of CFB ash and bio-solids to re-vegetate environmentally damaged land.

The group was hosted by the Hunlock Station of UGI Corporation, a Pennsylvania-based electric and gas utility. Hunlock features a 50-MW pulverized coal plant designed for anthracite firing, as well as a recently installed combustion turbine plant. The Hunlock plant is capable of firing a wide range of fuels, including bituminous coal and fuel recovered from anthracite coal waste. The UGI Corporation has developed an efficient low-cost fuels and operations management system capable of being responsive to increasingly stringent emissions regulations.

Following the plant tours, the group was hosted by the UGI Electric Division for discussions on the business implications of a deregulated utility market. PJM Interconnect LLC (the Mid-Atlantic Regional Independent System Operator (ISO)) discussed its evolution and ISO systems and the Pennsylvania Public Utility Commission gave a presentation on Pennsylvania's successful electric utility deregulation program. (*Clean Coal Today*, Fall/Winter 2002.)

Trade Missions

IEAT "Eco-Industrial" Program. The Office of Fossil Energy, in cooperation with the Southern States Energy Board and the US-Asia Environmental Partnership, is working with the Industrial Estates Authority of Thailand (IEAT) to include the unique environmental capabilities of U.S. clean coal technologies in the IEAT "Eco-Industrial" program. The IEAT operates 29 industrial estate complexes and five of these are involved in the IEAT pilot Eco-Industrial program. The complexes, which house a variety of tenant industries, are envisioned as a somewhat "closed loop" system, with wastes from one process used as input to another process, thus providing supplemental fuel and eliminating environmental liabilities associated with these materials. Thailand has expressed interest in maintaining fuel diversity through coal use, and the use of clean coal technologies can assist in this arena while creating unique opportunities in the IEAT Eco-Industrial program.

There are several areas where U.S. practice can be adapted to the Thai situation. In the United States, both CFB and IGCC technologies have provided a low-cost method of recovering environmentally benign energy from refinery wastes. One particular opportunity could be offered by co-firing refinery waste gases and other refinery byproducts, such as petroleum coke, with coal in a CFB combustor.

The Map Ta Phut refinery and petrochemical complex in Thailand is designated for "eco" conversion. Construction of 1,400 MW of coal-fired power capacity at the Map Ta Phut site is currently stalled due to environmental concerns. Representatives from FE have visited the complex and other sites to explore clean coal technology opportunities.

While coal-fired power plants using older technologies are subject to significant environmental opposition (and are difficult to permit), CFB technologies purchased from U.S. vendors have been installed at Thai industrial complexes. The 300-MW CoCo3 plant at Map Ta Phut includes two coal-fired CFB boilers and a paper complex in Tha Toom has two coal-fired CFBs. (*Clean Coal Today*, Summer 2002.)

Coal Advisory Group Meeting. The first meeting of the Coal Advisory Group (CAG), established under the Indo-U.S. Bilateral Energy Consultations, was held in Kolkata, India, April 2–5, 2002. The CAG was established to serve as a forum for identifying and carrying out collaborative projects of mutual benefit in the coal sector. India has vast reserves of high-ash coal and seeks foreign R&D as well as foreign investment to promote cleaner use of coal.

The open round table discussion brought together 45 experts, including representatives from India's Ministry of Coal; Ministry of Power; National Thermal Power Corporation; the Confederation of Indian Industries; Bharat Heavy Electric, Ltd.; as well as other corporate and government participants. The U.S. delegation was represented by industrial associations, government, and academia. Areas of interest included coal washing and cleaning, fly ash utilization and disposal, coal mining and associated environmental issues, and ways to facilitate investment decisions by the private sector.

The meeting included site visits to the Singrauli and Piparwar coal regions to look at an opencast mine, a coal beneficiation plant, and a thermal power plant with an associated fly ash disposal system.

As one meeting outcome, FE agreed to provide a model business plan for developing a coal washery project. (*Clean Coal Today*, Summer 2002.)

IGCC Briefings Under U.S.-China Protocol. As a project under the U.S.-China Protocol signed in August 2001, IGCC briefings took place in summer 2002. The Tampa Electric IGCC Project and DOE's PSDF Facility in Wilsonville, Alabama hosted the 11-member Chinese delegation, which included staff from the State Power Corp., Shandong Power Group (SPG), Huabei Design Institute, Thermal Power Research Institute, the Ministry of Science and Technology, and the Yantai Power Group. The group viewed presentations by Tampa Electric Company, Southern Company Services, Chevron/Texaco, and General Electric Company.

The briefings were timely because China had issued a solicitation for bids for an IGCC unit for the 300- to 400-MW Yantai project in Shandong Province, and the delegation acquired information helpful in evaluating U.S. technology bids. The Chinese government has authorized two IGCC operations, but a second would depend on the success of Yantai. Construction of the Yantai IGCC is expected to begin in spring 2003 and should be completed two years later. The Chinese visitors expressed particular interest in building their own IGCC simulator, using U.S. technology, for training operators on site.

Following the DOE-sponsored briefings, the Chinese delegation visited Bechtel Corp., in Houston, Texas, and EPRI in Palo Alto, California. (*Clean Coal Today*, Fall/Winter 2002.)

Other Events

Other FY2002 events supported by DOE included:

- The Turbine Power Systems Conference and Condition Monitoring Workshop held February 25–27, 2002, along with Short Course on Gas Turbine Technology (February 28–March 1), in Galveston, Texas, sponsored by NETL.
- The Clearwater Conference—the 27th International Technical Conference on Coal Utilization & Fuel Systems held March 4–7, 2002, in Clearwater, Florida, sponsored by the Coal Technology Association working closely with the American Society of Mechanical Engineers, DOE, and NETL.
- The $PM_{2.5}$ and Electric Power Generation: Recent Findings and Implications Conference held April 9–10, 2002, in Pittsburgh, Pennsylvania, sponsored by DOE and NETL.
- The 3rd Annual Small Business Conference held May 19–22, 2002, in Orlando, Florida, sponsored by NETL.
- The University Coal Research/Historically Black Colleges and Universities & Other Minority Institutions Program Review Meeting held June 4–5, 2002, in Pittsburgh, Pennsylvania sponsored by NETL.
- The Air Quality III: Mercury, Trace Elements and Particulate Matter Conference held September 9–12, 2002, in Arlington, Virginia sponsored by DOE, EPRI, University of North Dakota's Energy & Environmental Research Center, and others as collaborating sponsors.
- The 5th International Symposium on Gas Cleaning at High Temperature held September 17–20, 2002, in Morgantown, West Virginia.
- The 19th Annual International Pittsburgh Coal Conference held September 23–27, 2002, in Pittsburgh, Pennsylvania sponsored by the University of Pittsburgh, with participation of DOE among others.

Conferences, Workshops, and Trade Missions—FY 2003

The following highlights some of the conferences, workshops, and trade missions supported by OC&PS and NETL during FY 2003 through May 31, 2003.

Conferences

Conference of Parties of the United Nations Framework on Climate Change. India's Centre for Power Efficiency and Environmental Protection (CenPEEP) received the 2002 Climate Technology Award for its accomplishments in promoting climate-friendly technologies in developing countries, and specifically reducing greenhouse gas emissions from coal-fired power generation in India. The award was presented at the eighth session of the Conference of Parties (COP) of the United Nations Framework on Climate Change (COP 8), held in late October 2002 in New Delhi, India. The CenPEEP was established by India's National Thermal Power Corporation (NTPC) to implement the Efficient Power Generation component of the Greenhouse Gas Pollution Prevention (GEP) project, an initiative of the U.S. Agency for International Development. The CenPEEP is an active partner in NETL climate change mitigation activities.

Under the GEP project, NETL provides technical assistance and training support to CenPEEP in a variety of areas including mine-mouth coal washeries, main backfilling of coal-derived ash and evaluation of IGCC technology. (*Clean Coal Today*, Fall/Winter 2002.)

Multiphase Flow Executive Committee Annual Meeting. DOE is a signatory to the IEA Implementing Agreement on Multiphase Flow (MPF) Sciences. The Executive Committee gathered at NETL in September 2002 for

its annual meeting to exchange information and coordinate complementary research tasks. Australia, Canada, Mexico, Norway, and the United Kingdom are co-participants with the United States.

Multiphase flow is any mass flow phenomenon associated with obtaining energy from fossil fuels wherein some combination of solids, liquids, and gases is involved. Improved knowledge of MPF can lead to more efficient and cost-effective energy production, transportation, and end-use technologies. Emphasis has been on granular material flows, theory, and computer codes for modeling, and advanced instrumentation for measuring and characterizing flow behavior.

Delegates at the meeting had an opportunity to see a demonstration of the NETL-developed MFIX computational fluid dynamics code for the simulation of heavily loaded gas-particle flows, and specifically fluidized beds. The MFIX development also has been supported by DOE's Multiphase Fluid Dynamics Research Consortium, operating under the DOE Office of Energy Efficiency and Renewable Energy's Office of Industrial Technology.

Also of interest to the visitors was the Cold Flow CFB unit, where validation experiments are performed to improve reliability and accuracy of computer models needed for new fluid-bed process design and optimization. The cold flow unit is capable of simulating fully integrated operations common to many advanced coal-fired power systems, such as advanced PFBC, and IGCC plants. NETL's objective is to further the development of CFB systems through validation of computational fluid dynamics models, analysis of existing plants, optimization of plant operations, and evaluation of new designs. (*Clean Coal Today*, Fall/Winter 2002.)

International Conference on Air Quality—Mercury, Trace Elements, and Particulate Matter. This three-day conference was spearheaded by the University of North Dakota's Energy and Environmental Research Center (UNDEERC), and provided 400 attendees with important information on regulatory controls, and the state of science and control technology for these key pollutants. Co-sponsors were DOE, EPA, NETL, and EPRI. UNDEERC is a not-for-profit, "business within a university," with expertise in advanced energy systems and prevention of air, water, and soil pollution.

The conference featured much discussion on available mercury control technologies (no method is considered fully commercial). Most mercury control processes are "co-control," where mercury is removed with other pollutants such as SO_2 and NO_x. A representative of EPA's Clean Air Markets Division presented an overview of multi-pollutant technologies, including activated coke, SCR/wet flue gas desulfurization (FGD), and electro-catalytic oxidation. The EPA representative identified dry scrubbers, advanced dry FGD, wet FGD/wet electrostatic precipitators (ESP), and combined mercury/SO_2 sorbents, such as activated carbon injection, for SO_2 and mercury removal.

The NETL director cited various uncertainties in mercury control technology development. Emissions are influenced by a wide range of factors: coal type, mercury content and speciation of the coal, power plant configuration, and existing flue gas emissions controls. Studies have shown a wide variability in mercury emissions from plants that, on the surface, appear quite similar. The director noted that carbon injection into electrostatic precipitators (ESPs) (used in 80 percent of U.S. power plants versus the 20 percent using fabric filter baghouses) could cause overload problems because most ESPs already operate at design limits. The director also noted that low-rank coals tend to emit flue gases with high concentrations of difficult-to-remove elemental mercury. She further spoke of the general need to resolve by-product mercury contamination issues and develop automated continuous emissions monitors to determine whether controls are working. The director outlined results of FE's short-term field tests. The most promising for the short-term appears to be activated carbon injection into a fabric filter. NETL is planning a solicitation for longer-duration SCR testing to fully understand the questions about SCR involving size of the vessel and age of the catalyst, other balance-of-plant issues, mercury speciation and removal from low-rank coals, and mercury capture resulting from a larger selection of current and future air pollution control device configurations. In contrast, major $PM_{2.5}$ issues discussed were health effects and regional haze, rather than technology readiness. (*Clean Coal Today*, Fall/Winter 2002.)

The PSDF facility in Wilsonville, Alabama.

Workshops

New Zealand's National Hydrogen Workshop. The FE Fuel Cell Product Manager participated in this workshop in Wellington, New Zealand on February 28, 2003. He met with ministry officials and other sponsors and presented a paper on the DOE stationary fuel cell program.

New Zealand is developing a roadmap to transition to a hydrogen economy and is welcoming input from outside experts.

The preliminary results of a study by Unitec (affiliated with Stanford University), a company hired by New Zealand to help develop a Hydrogen Plan for the gov-

ernment to consider, are expected to show that New Zealand's eight billion tons of known coal resources on the South Island should couple with DOE's FutureGen concepts as key components of any New Zealand hydrogen economy. This coal resource could be used in power plant configurations that use IGCC or solid oxide fuel cells (SOFCs) and other technologies to produce both hydrogen and electric power.

The Unitec study will be examining present and advanced technologies to produce hydrogen from coal. The report is expected to rely on a study conducted for DOE by Mitretek. That report showed that hydrogen can be produced from coal with current gasification technology at about 64 percent efficiency (HHV basis) for an estimated cost of production in the range $6.50–7.00/10^6 Btu. If hydrogen is produced in an advanced gasification coproduction facility that also generates electric power, the production costs of the co-produced hydrogen can be reduced significantly depending on the value of the power.

Mark Williams, the FE Fuel Cell Product Manager at the New Zealand National Hydrogen Workshop.

The Mitretek study concluded that the greatest potential for reducing the production cost of hydrogen from coal is in configurations that include SOFCs. (*Clean Coal Today*, Spring 2003.)

Electric Utilities and Water Workshop. The overarching goal of the IEP program is to develop advanced technology to enhance the environmental performance of the existing fleet of coal-fired power plants.

The first large forum for stakeholder input on water issues affecting NETL's Existing Plants (IEP) program was a workshop held in July 2002, "Electric Utilities and Water: Emerging Issues and R&D Needs." The workshop, co-sponsored by NETL, Los Alamos National Laboratory, and Sandia National Laboratory, brought together 55 representatives from government, the electric utility and coal industries, EPA, EPRI, academia, state agencies, energy commissions, and research organizations.

A number of specific research opportunities were identified in breakout sessions as good candidates for concerted public/private research:

- Advanced wet-cooling and dry-cooling systems, including novel wet-dry hybrids and exotic systems (such as ocean cooling or cryogenic cooling);
- Improved intake structure protection equipment;
- Improved and/or advanced water treatment technologies;
- Data development and testing of nontraditional sources of cooling water for power plants, including underground mine pools, industrial and municipal wastewater, and coalbed methane-produced water;
- Novel technology for treating/upgrading nontraditional water for use by power plants;
- Pilot-scale projects demonstrating water-quality trading and carbon capture/sequestration, coupled with mine land reclamation;
- Watershed models to aid in water-use planning and regulatory development; and
- Potential beneficial uses for discharge waters from power plants, such as waste heat for aquaculture or process heating. (*Clean Coal Today*, Spring 2003.)

Trade Missions

People's Republic of China. In November 2002, the ASFE, together with a U.S. delegation, made his first visit to the People's Republic of China (PRC) to promote activities under the protocol signed in April 2000 by FE and the PRC's Ministry of Science and Technology (MOST). The productive three-day visit resulted in the ASFE signing two new agreements under the protocol. The ASFE met with several Chinese leaders including the Vice Mayor of the Beijing Municipal Government to discuss the potential role of clean coal technology in achieving the environmental objectives established for the 2008 Olympics, which will be held in that city.

The ASFE's visit involved the signing of an important new Annex II, for cooperation in the area of clean fuels, which includes coal conversion, advanced separation processes/innovative coal preparation, co-production of chemicals and power, and ultra-clean transportation fuels such as hydrogen. Four annexes already had been signed in the areas of power systems, energy and environmental technology, climate change, and oil and gas.

One activity envisioned under the new agreement is a pre-feasibility study for a polygeneration project proposed by the Yan Zhou Mining Group, which could produce power and clean fuels. A direct liquefaction project proposed by the Shenhua Group Corporation, Ltd. is also in progress.

A new Annex III (oil and gas) task agreement on coalbed methane was signed. Coalbed methane is plentiful in the PRC, but technology for developing the resource is lacking. Advanced technologies for prospecting, and for identifying the location of resources are of immediate interest.

In terms of protocol activities for the future, MOST officials suggested to the ASFE the drafting of a Clean Energy Action Plan for developing clean technologies under Annex IV, Energy and Environmental Technologies. MOST also suggested discussing an Energy Security Action Plan to be drafted under Annex III, Oil and Gas. China is particularly concerned about the vulnerability of its liquid fuels supply and sees the importance of a synfuels and oil storage strategy. (*Clean Coal Today*, Spring 2003.)

Other Events

Other FY 2003 events supported by DOE include:

- The International Conference on Clean Coal Technologies for Our Future held October 21–23, 2002, in Sardinia, Italy, sponsored by DOE, Assessorato all'Industria Regione Autonoma della Sardegna, and Enel Produzione.
- The 2002 Fuel Cell Seminar held November 18–21, 2002, in Palm Springs, California, sponsored by NETL.
- Valuing Externalities Workshop held February 20–21, 2003, in McLean, Virginia, sponsored by NETL.
- The Gas Turbines for a National Energy Infrastructure conference held February 26–27, 2003, in Arlington, Virginia, sponsored by NETL.
- The 4th Annual Solid State Energy Conversion Alliance Workshop held April 15–16, 2003, in Seattle, Washington, sponsored by NETL.
- The Second National Conference on Carbon Sequestration held May 5–8, 2003, in Alexandria, Virginia, sponsored by DOE and NETL.
- The 3rd Annual DOE/U.N. Hybrid Conference and Workshop held May 13–15, 2003, in Newport Beach, California, sponsored by DOE and NETL.

Participants at the "Valuing Externalities Workshop" included researchers and policy makers from the private, academia, and government sectors.

5. Projects

Introduction

This section provides fact sheets on active clean coal technology (CCT) projects in various stages of implementation. Also included are two recently terminated Clean Coal Technology Demonstration Program (CCTDP) projects, one withdrawn Power Plant Improvement Initiative (PPII) project, and one withdrawn Clean Coal Power Initiative (CCPI) project to aid readers in following the status of the CCT programs.

The CCTDP, PPII, and CCPI project fact sheets are organized by market sector rather than program to better enable stakeholders to see the scope of activity in key areas of interest. These market sectors are: (1) environmental control devices for existing and new power plants; (2) advanced electric power generation for repowering existing plants and providing new generation capacity; (3) coal processing for clean fuels to convert the nation's vast coal resources to clean fuels; and (4) industrial applications for coal and coal by-products.

All fact sheets but one present available project information in two pages. The two-page fact sheets are for projects that have not completed operation. They present information on project participants, describe the projects and technology, lay out planned schedules, characterize project status and accomplishments; and address potential commercial applications. Four-page fact sheets are used for projects having completed operation, as in the case of one CCTDP project presented in this section, but have not completed final reporting. In place of characterizing project status and accomplishments, four-page fact sheets provide key findings and sufficient project discussion to establish a context for the findings. Projects are not considered complete and information final, however, until issuance of the final technical report.

All project fact sheets contain schematics of the demonstrated technology to help convey understanding. The portion of the process or facility central to the demonstration is demarcated by a shaded area. To prevent the release of project-specific information of a proprietary nature, the schematics are highly simplified to illustrate the concept only.

Technology Overview

The following overviews some of the major technology areas and underlying drivers that are the current focus of CCPI and PPII, as well as the remaining CCTDP projects.

Environmental Control Devices

Advanced NO_x Controls. Advanced nitrogen oxide (NO_x) controls provide the means to meet: NO_x emission caps proposed under the Clear Skies Initiative (CSI); EPAs "SIP Call" source emission rates of 0.15 lb/10^6 Btu for 22 states and the District of Columbia; and revised National Ambient Air Quality Standards (NAAQS) for ozone and fine particulate matter ($PM_{2.5}$), which impacts NO_x because it is a precursor to both. Technologies include:

- Low-NO_x burners and reburning systems that limit NO_x formation by staging the introduction of air in the combustion process (combustion modification);
- Selective catalytic reduction (SCR), and selective non-catalytic reduction (SNCR), and other chemical processes that act upon and reduce NO_x already formed (post-combustion processes); and
- Oxygen-enhanced combustion that displaces a portion of the air with oxygen in low-NO_x burners.

Low-NO_x burners (1) limit the amount of air available in the initial stages of combustion when fuel-bound nitrogen is volatilized, (2) lengthen the flame to avoid hot spots, (3) are integrated with overfire air to complete combustion in a cooler zone, and (4) leverage neural network controls for optimum load-following performance. Reburning systems inject fuel into combustion products to strip oxygen away from the NO_x and introduce overfire air to complete combustion. SCR and SNCR use ammonia/urea to transform NO_x into nitrogen and water. SCR typically requires an array of catalysts in a reactor vessel to operate at post-boiler application temperatures, whereas SNCR simply involves ammonia/urea injection in the boiler. Oxygen-enhanced combustion enables deeper staging through increased combustion efficiency and reduces available nitrogen.

Mercury Controls. Mercury controls address proposed CSI targets and anticipated EPA regulations regarding mercury emissions from coal-based power generation, which represents roughly one-third of U.S. mercury emissions. Technologies include:

- Sorbents and oxidizing agents to transform mercury to a solid for removal along with fly ash in electrostatic precipitators (ESP) or fabric filter dust collectors (FFDC);
- Oxidizing agents in conjunction with wet flue gas desulfurization (FGD) scrubbers to capture mercury in the sulfate by-products; and

- Real-time measurement of mercury species and total mercury for mercury control and validation.

Solid sorbents adsorb the mercury and are then removed in either an electrostatic precipitator (ESP) or fabric filter dust collector (FFDC). Oxidizing agents or mechanisms convert vapor-state elemental mercury to a solid-state mercury oxide that can be captured in ESPs, FFDCs, or wet FGDs. For plants equipped with wet FGDs, the oxidizing agent can be incorporated with the scrubber slurry used for sulfur capture. The mercury captured in the FGD by-product, often wallboard, is chemically bound and precluded from re-release. Mercury instrumentation and controls measure the mercury species (elemental and oxidized) entering the control device and the total mercury entering the stack.

Particulate Matter Controls. Particulate-matter controls respond to revised NAAQS for $PM_{2.5}$ for primary particulate matter (fly ash) and acid aerosols that can cause localized plume opacity, visibility impairment, and have been linked to human health impacts. Acid aerosols are required to be reported under the Toxic Release Inventory. Secondary $PM_{2.5}$ emissions, formed chemically in the atmosphere by precursors such as NO_x and SO_2, are addressed under Advanced NO_x Control. Technologies include:

- ESP/FFDC hybrids to leverage the best features of both;
- Flue gas preconditioning to enhance ESP performance;
- Concentration of particulate matter at ESP outlets for recycle;
- Alkaline injection for sulfur trioxide (SO_3) acid aerosol precursor control; and
- Continuous SO_3 analyzers for process control and validation.

ESPs electrically charge particulate matter for capture on collection plates. FFDCs use fabric filter bags that receive and collect particulate matter on the outside surface and are pulsed internally with jets of air to disengage the collected particulate. Preconditioning agents either lower resistivity or induce agglomeration of incoming particulate matter. Alkaline injection converts SO_2 and SO_3 acid precursors into readily captured sulfate particulate and neutralizes other acid gases, such as hydrochloric and hydrofluoric acids. SO_3 analyzers measure input and output levels for control and validation.

Advanced Electric Power Generation

Advanced Power Systems. Advanced electric power generation addresses Global Climate Change, Clear Skies, and Hydrogen Fuel Initiatives by enhancing power generation efficiency, producing near zero pollutant emissions, and providing for hydrogen separation and carbon dioxide (CO_2) capture and sequestration. Technologies include:

- Integrated gasification combined-cycle (IGCC) systems that: convert coal to a clean synthesis gas (syngas) amenable to use by gas turbines and advanced fuel cells, conversion to chemicals and clean transportation fuels, and separation into hydrogen and CO_2; and transform residual gases and solids into salable by-products.
- Circulating fluidized-bed (CFB) combustion systems that utilize low-grade fuels and waste materials to generate power at high efficiency and with very low emissions, without the parasitic power drain of add-on environmental controls.

IGCC uses a gasifier to convert hydrocarbon feedstocks into largely gaseous components by applying heat under pressure in the presence of steam. Partial oxidation of the feedstock, typically with pure oxygen, provides the heat. Together the heat and pressure break the bonds between feedstock constituents and precipitate chemical reactions, producing syngas — primarily hydrogen and carbon monoxide. Minerals in the feedstock (ash), separated in the gasifier, are largely salable. Sulfur emerges from the gasifier primarily as hydrogen sulfide, which is easily converted to either a pure sulfur or sulfuric acid by-product.

The CFBs use jets of air to support combustion, effectively mix feedstocks with sulfur dioxide (SO_2) absorbents, and entrain the mixture. The entrained mixture is transported to a cyclone that separates the solids from the flue gas. Hot separated solids are returned to the CFB combustor. Relatively clean flue gas goes to a heat exchanger to produce steam for a steam turbine. The mixing and recycling action of the CFB allows high combustion efficiency at temperatures below the thermal NO_x formation temperature and achieves high-efficiency SO_2 capture through lengthy and direct sorbent/SO_2 contact.

Coal Processing for Clean Fuels

Coal liquefaction. Coal liquefaction enhances energy security by converting our nation's most abundant, stable priced energy resource into clean transportation fuels and chemicals. Coal gasification-derived syngas is converted into synthetic hydrocarbon liquids via a catalytic chemical process known as Fischer Tropsch (FT) synthesis. The FT Process can be manipulated to produce an array of products that are virtually free of sulfur and nitrogen pollutants.

Industrial Applications

Coal Utilization By-Products (CUB). CUBs efforts provide the knowledge and technology needed to increase utilization of CUBs from the current 30 percent usage to 50 percent. Landfill space is limited and NO_x and mercury controls impact CUB quality and raise questions regarding environmental acceptability. Technology and knowledge targets include:

- Characterizing the fate of mercury and other trace metals in CUBs;
- Novel applications to expand CUB use; and
- Separation technology to remove carbon and associated mercury from CUBs to enhance sales value.

CUB characterization addresses what happens to the mercury and other trace elements contained in the CUBs

when used in various applications (i.e., the potential for leaching or volatilization). Novel applications include use as construction and structural materials and agricultural supplements. Separation technologies use physical and chemical processes adopted from coal beneficiation practices.

Project Fact Sheets

An index to project fact sheets by application category is provided in Exhibit 5-1. An index by participant is provided in Exhibit 5-2. Ongoing projects in each category appear first, followed by projects having completed operations. Within these breakdowns, projects are listed alphabetically by participant. In addition, Exhibit 5-1 indicates the solicitation under which the project was selected; its status as of May 31, 2003; and the page number for each fact sheet. Exhibit 5-2 lists the projects alphabetically by participant and provides project location and page numbers. A map of the active projects is shown in Exhibit 5-3. A key to interpreting the milestone charts is provided in Exhibit 5-4.

An appendix containing contact information for all of the projects is provided as Appendix D. A list of acronyms used in this document is provided as Appendix E.

Exhibit 5-1
Project Fact Sheets by Application Category

Project	Participant	Solicitation/Status
Environmental Control Devices		
Combustion Initiative for Innovative Cost-Effective NO_x Reduction	Alliant Energy Corporate Services, Inc.	PPII/withdrawn
Achieving NSPS Emission Standards Through Integration of Low-NO_x Burners with an Optimization Plan for Boiler Combustion	Sunflower Electric Power Corporation	PPII/design
Development of Hybrid FLGR/SNCR/SCR Advanced NO_x Control	TIAX, LLC	PPII/negotiation
Greenidge Multi-Pollutant Control Project	CONSOL Energy, Inc.	PPII/negotiation
Demonstration of a Full-Scale Retrofit of the Advanced Hybrid Particulate Collector Technology	Otter Tail Power Company	PPII/operational
Big Bend Power Station Neural Network-Sootblower Optimization	Tampa Electric Company	PPII/construction
Commercial Demonstration of the Airborne Process	LG&E Energy Corporation	CCPI-I/withdrawn
Demonstration of Integrated Optimization Software at the Baldwin Energy Complex	NeuCo, Inc.	CCPI-I/negotiation
TOXECON Retrofit for Mercury and Multi-Pollutant Control on Three 90 MW Coal-Fired Boilers	Wisconsin Electric Power Company	CCPI-I/negotiation
Advanced Electric Power Generation		
McIntosh Unit 4A PCFB Demonstration Project	City of Lakeland, Lakeland Electric	CCTDP-III/terminated
McIntosh Unit 4B Topped PCFB Demonstration Project	City of Lakeland, Lakeland Electric	CCTDP-V/terminated
JEA Large-Scale CFB Combustion Demonstration Project	JEA	CCTDP-I/operational
Next Generation CFB Coal Generating Unit	Colorado Springs Utilities	CCPI-I/negotiation
Kentucky Pioneer Energy IGCC Demonstration Project	Kentucky Pioneer Energy, LLC	CCTDP-V/design
Clean Coal Diesel Demonstration Project	TIAX, LLC	CCTDP-V/design
Coal Processing for Clean Fuels		
Lignite Fuel Enhancement	Great River Energy	CCPI-I/negotiation
Gilberton Coal-to-Clean Fuels and Power Co-Production Project	WMPI PTY., LLC	CCPI-I/negotiation
Advanced Coal Conversion Process Demonstration	Western Syncoal LLC	CCTDP-I/reporting
Industrial Applications		
Clean Power from Integrated Coal/Ore Reduction (CPICOR™)	CPICOR™ Management Company LLC	CCTDP-V/design
Commercial Demonstration of the Manufactured Aggregate Processing Technology Utilizing Spray Dryer Ash	Universal Aggregates, LLC	PPII/construction
Advanced Multi-Product Coal Utilization By-Product Processing Plant	University of Kentucky Research Foundation	CCPI-I/negotiation
Western Greenbrier Co-Production Demonstration Project	Western Greenbrier Co-Generation, LLC	CCPI-I/negotiation

Exhibit 5-2

Project Fact Sheets by Participant

Participant	Project	Location	Page
Alliant Energy Corporate Services, Inc.	Combustion Initiative for Innovative Cost-Effective NO_x Reduction	Sheboygan, WI	5-10
Colorado Springs Utilities	Next Generation CFB Coal Generating Unit	Fountain, CO	5-36
CONSOL Energy, Inc.	Greenidge Multi-Pollutant Control Project	Torrey, NY	5-16
CPICOR™ Management Company LLC	Clean Power from Integrated Coal/Ore Reduction (CPICOR™)	Vineyard, UT	5-54
Great River Energy	Lignite Fuel Enhancement	Underwood, ND	5-44
JEA	JEA Large-Scale CFB Combustion Demonstration Project	Jacksonville, FL	5-34
Kentucky Pioneer Energy, LLC	Kentucky Pioneer Energy IGCC Demonstration Project	Trapp, KY	5-38
Lakeland, City of, Lakeland Electric	McIntosh Unit 4A PCFB Demonstration Project	Lakeland, FL	5-30
Lakeland, City of, Lakeland Electric	McIntosh Unit 4B Topped PCFB Demonstration Project	Lakeland, FL	5-32
LG&E Energy Corporation	Commercial Demonstration of the Airborne Process	Carrollton, KY	5-22
NeuCo, Inc.	Demonstration of Integrated Optimization Software at the Baldwin Energy Complex	Baldwin, IL	5-24
Otter Tail Power Company	Demonstration of a Full-Scale Retrofit of the Advanced Hybrid Particulate Collector Technology	Big Stone City, SD	5-18
Sunflower Electric Power Corporation	Achieving NSPS Emission Standards Through Integration of Low-NO_x Burners with an Optimization Plan for Boiler Combustion	Garden City, KS	5-12
Tampa Electric Company	Big Bend Power Station Neural Network-Sootblower Optimization	Apollo Beach, FL	5-20
TIAX, LLC	Clean Coal Diesel Demonstration Project	Fairbanks, AK	5-40
TIAX, LLC	Development of Hybrid FLGR/SNCR/SCR Advanced NO_x Control	TBD	5-14
Universal Aggregates, LLC	Commercial Demonstration of the Manufactured Aggregate Processing Technology Utilizing Spray Dryer Ash	King George Co., VA	5-56
University of Kentucky Research Foundation	Advanced Multi-Product Coal Utilization By-Product Processing Plant	Ghent, KY	5-58
Western Greenbrier Co-Generation, LLC	Western Greenbrier Co-Production Demonstration Project	Rainelle, WV	5-60
Western SynCoal LLC	Advanced Coal Conversion Process Demonstration	Colstrip, MT	5-48
Wisconsin Electric Power Company	TOXECON Retrofit for Mercury and Multi-Pollutant Control on Three 90 MW Coal-Fired Boilers	Marquette, MI	5-26
WMPI PTY., LLC	Gilberton Coal-to-Clean Fuels and Power Co-Production Project	Gilberton, PA	5-46

Exhibit 5-3

Geographic Locations of Active CCT Projects

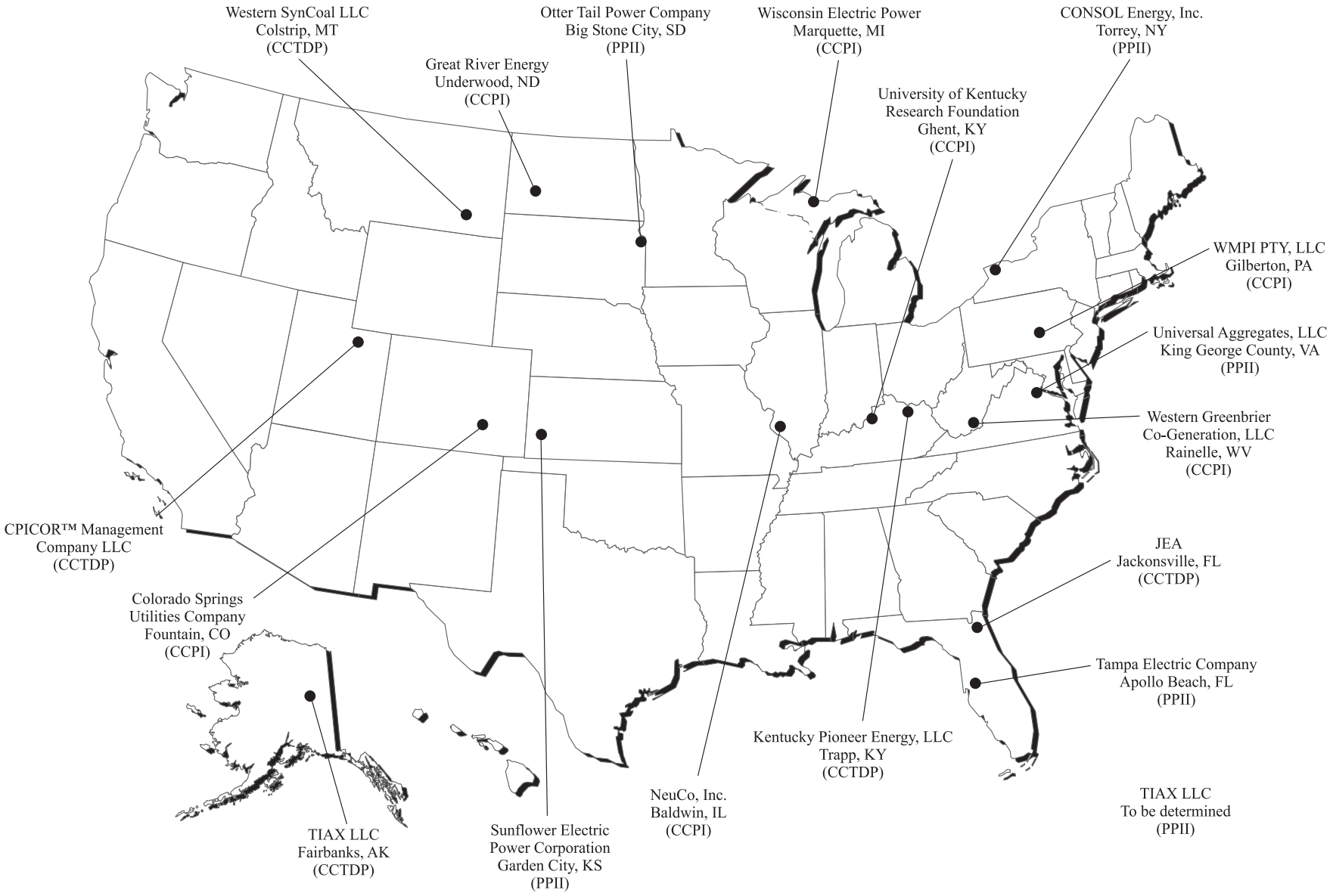


Exhibit 5-4

Key to Milestone Charts in Fact Sheets

Each fact sheet contains a bar chart that highlights major milestones—past and planned. The bar chart shows a project's duration and indicates the time period for three general categories of project activities—preaward, design and construction, and operation and reporting. The key provided below explains what is included in each of these categories.

Preaward

Includes preaward briefings, negotiations, and other activities conducted during the period between DOE's selection of the project and award of the cooperative agreement.

Design and Construction

Includes the NEPA process, permitting, design, procurement, construction, preoperational testing, and other activities conducted prior to the beginning of operation of the demonstration.

MTF	Memo-to-file
CX	Categorical exclusion
EA	Environmental assessment
EIS	Environmental impact statement

Operation and Reporting

Begins with startup and includes operational testing, data collection, analysis, evaluation, reporting, and other activities to complete the demonstration project.

Environmental Control Devices

Combustion Initiative for Innovative Cost-Effective NO_x Reduction

Project Withdrawn

Participant

Alliant Energy Corporate Services, Inc.

Additional Team Members

Wisconsin Power & Light Co.—Host

Reaction Engineering International—modeling

Electric Power Research Institute—technology supplier

Locations

Sheboygan, Sheboygan County, WI (Wisconsin Power & Light's Edgewater Generating Station, Unit No. 4)

Technology

Combustion Initiative modifications for cyclone coal-fired boiler technology using a Computational Fluid Dynamic (CFD) System Model to reduce NO_x emissions, which include a redesign of the cyclone re-entry throats, an upgrade of the gravimetric feeder controls, and chemical reagent injection.

Plant Capacity/Production

330 MW

Coal

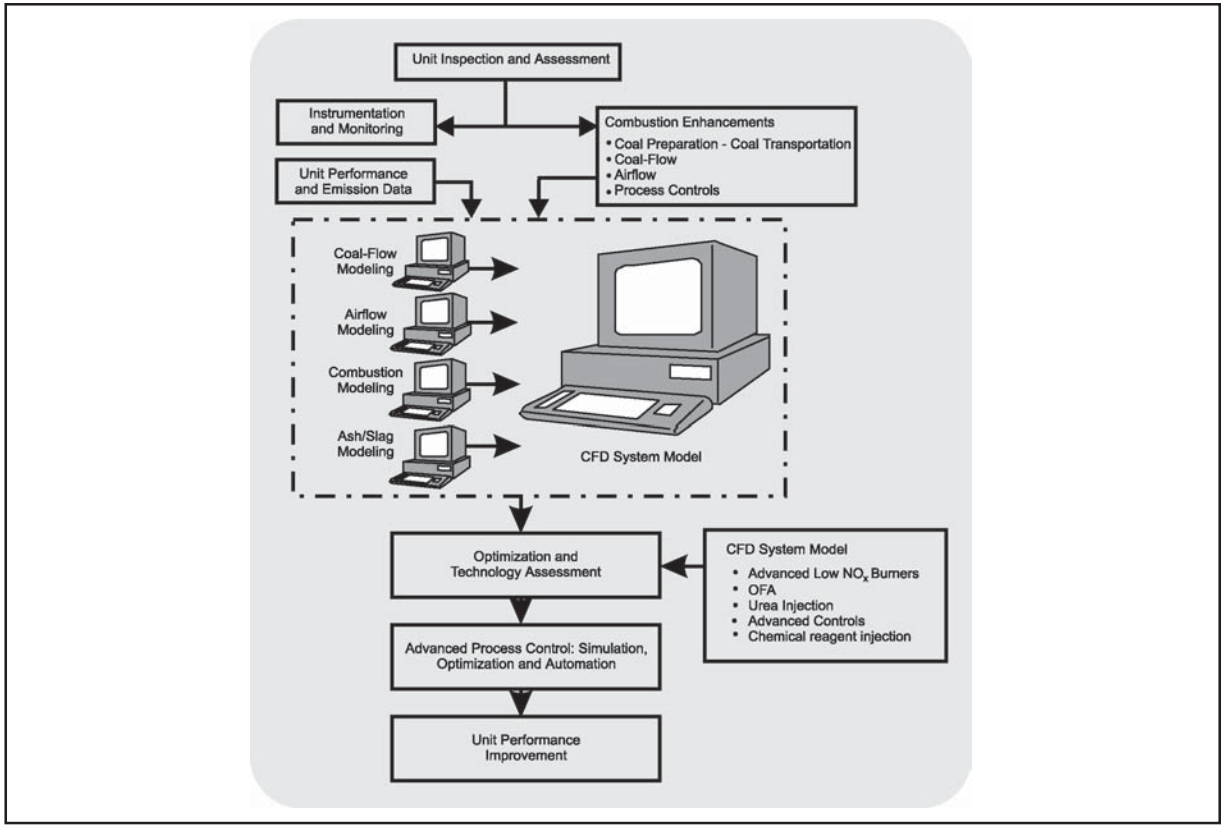
Powder River Basin coal (85%) and Kicker coal (15%)

Project Funding

Total	$7,397,718	100%
DOE	3,698,859	50
Participant	3,698,859	50

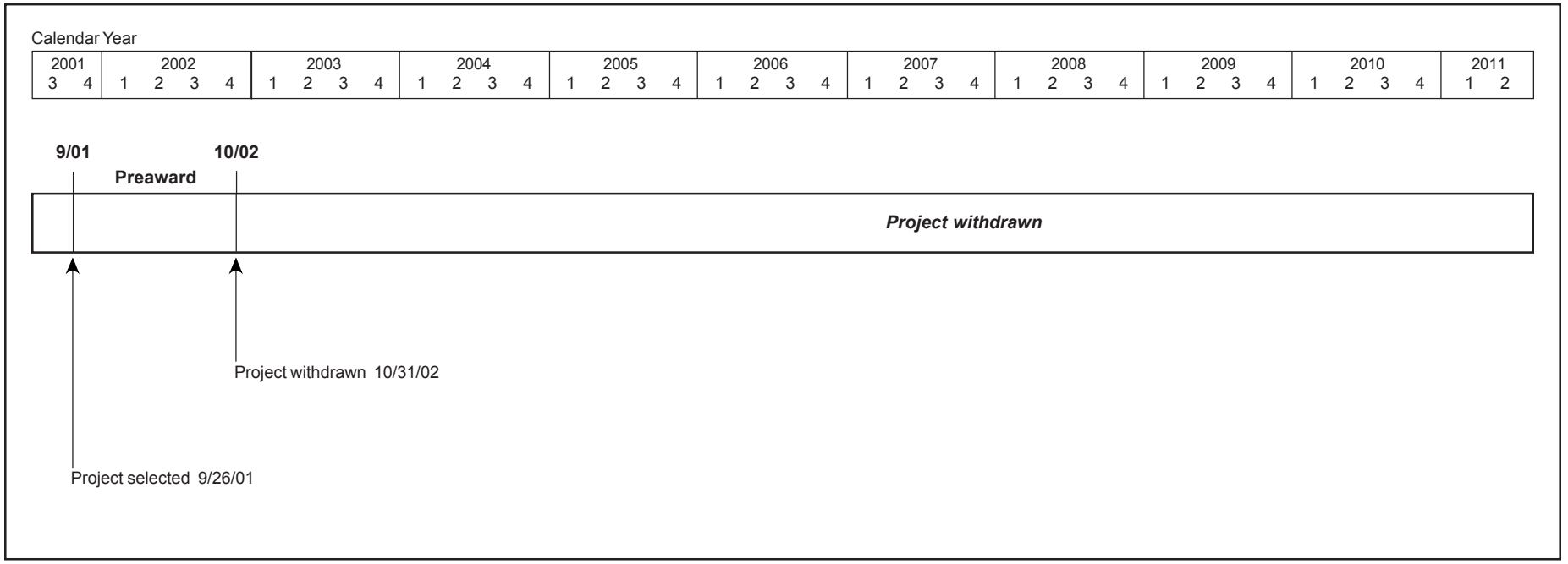
Project Objective

To achieve the same, stringent nitrogen-oxide-emissions reductions as selective catalytic reduction (SCR) at a fraction of the capital cost and with drastically lower operation and maintenance costs. Participant uses a computational modeling approach, its Combustion Initiative, to optimize overall power plant NO_x performance. The Combustion Initiative will attempt to hold NO_x emissions to 0.15 lb/10^6 Btu from a 340-MW cyclone boiler. Cyclone boilers are especially prone to high NO_x emissions; this demonstration could help establish a target baseline for combustion-stage NO_x reductions on cyclone boilers.



Technology/Project Description

The Combustion Initiative is a method that starts with developing a deep understanding of the combustion and related processes in each piece of equipment and in the power plant as a whole. The second step is to push the envelope for existing NO_x control technologies through re-engineering and modeling. The use of computational modeling as a tool is key to optimizing the system performance and maximizing the use of emission reduction technologies. The Combustion Initiative method results in the potential to reduce NO_x emissions to 0.15 lb/10^6 Btu or below, without the use of SCR technology.



Project Status/Accomplishments

The project was selected for award on September 26, 2001. The Department of Energy selected this project for a partial award for demonstration on a cyclone boiler only. On October 30, 2002, Alliant Energy withdrew its proposal due to a re-evaluation of its NO_x reduction program.

Alliant Energy had proposed, through its Wisconsin Power & Light Company subsidiary, to demonstrate the reduction of NO_x emissions using the Combustion Initiative method on three of the main coal-fired boiler types in the United States: tangentially fired, cyclone-fired, and wall-fired units. The three units included Edgewater Generating Station Unit No. 4 (cyclone) and Unit No. 5 (wall-fired) in Sheboygan, Wisconsin, and Columbia Generating Station Unit No. 2 (tangentially fired) in Portage, Wisconsin. Better thermal efficiency means that less fuel will be needed to produce energy, which saves money and reduces stress on equipment. Improved reliability helps keep customers' lights on, even as demand grows throughout the region. Finally, when costs are minimized, shareowners experience increased earnings.

The ability to reach these low NO_x emission levels has been demonstrated in the pilot-scale work that Alliant Energy has conducted at its M.L. Kapp Station in Iowa. This facility lowered its NO_x emissions from 0.35 lb/10^6 Btu to 0.15 lb/10^6 Btu using the Combustion Initiative Method.

Commercial Applications

Alliant Energy's Combustion Initiative is a science- and technology-driven approach to lowering emissions and improving the performance of coal-fired power plants. Through research and development, the company is finding innovative ways to reduce emissions, increase thermal efficiency, and improve plant reliability. This technology has potential application to all 89 cyclone-fired boilers, having an installed capacity of 27,600 MWe. If successfully demonstrated, the relatively low capital cost of the CFD-based technology and the high potential NO_x reduction should result in significant market penetration.

The Wisconsin Department of Natural Resources (WDNR) has designated Sheboygan as a "Primary Ozone Control Region." The Edgewater site is located within this region. The WDNR regulations call for reduction of NO_x emissions from utility boilers during the May through September "ozone season." Under these regulations, the Edgewater site is required to reduce NO_x emissions to 0.33 lb/10^6 Btu by 2003 and to continue to progressively reduce emissions to 0.28 lb/10^6 by 2008.

Achieving NSPS Emission Standards Through Integration of Low-NO_x Burners with an Optimization Plan for Boiler Combustion

Participant
Sunflower Electric Power Corporation

Additional Team Members
Electric Power Research Institute—cofunder

Foster Wheeler Energy Corporation—technology supplier

GE Energy and Environmental Research Corp.—technology supplier

Location
Garden City, Finney County, KS (Sunflower Electric's Holcomb Station, Unit No. 1)

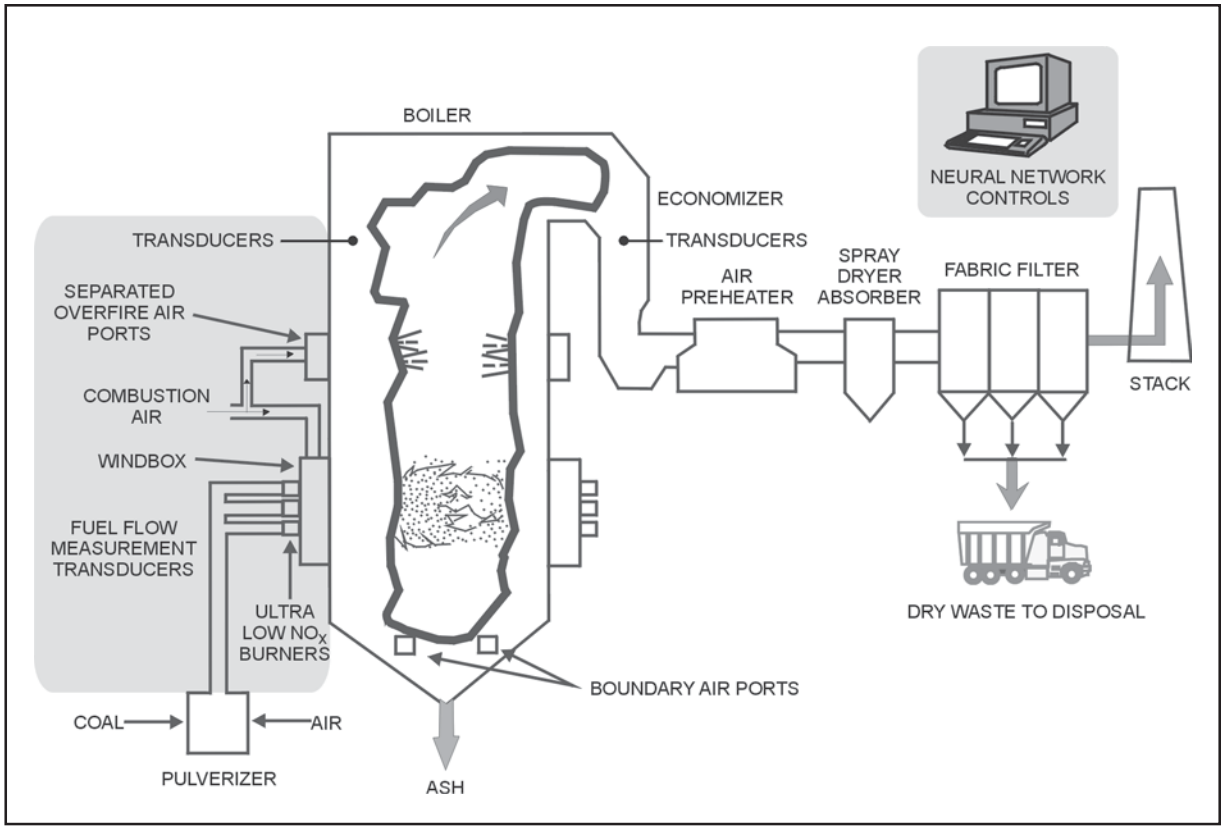
Technology
Ultra-low NO_x burners with other combustion-stage controls

Plant Capacity/Production
360 MW

Coal
Subbituminous coals

Project Funding

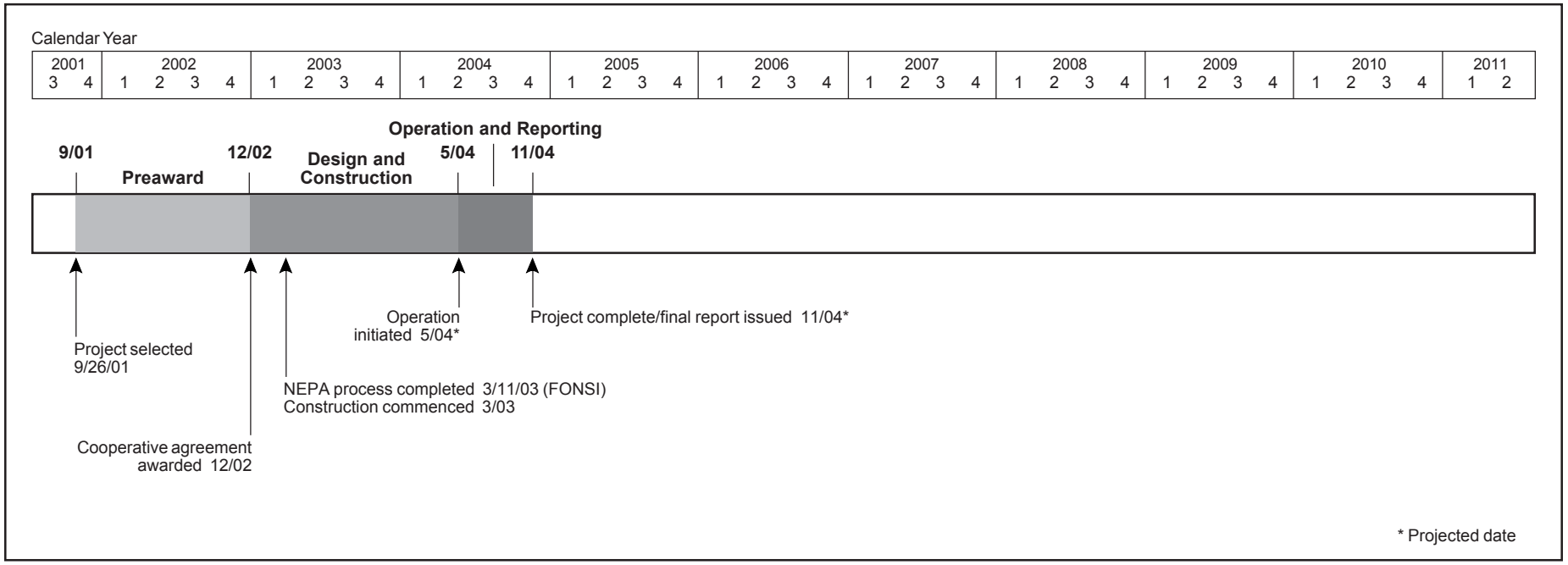
Total	$5,881,675	100%
DOE	2,796,326	48
Participant	3,085,349	52



Project Objective
To demonstrate low-NO_x burners with other combustion-stage controls with the goal to reduce NO_x emissions to 0.15–0.22 lb/10^6 Btu and simultaneously increase power output by 7 MW, demonstrating a concept that has never been illustrated in plants using subbituminous coals, including those from the Powder River Basin (PRB).

Technology/Project Description
Low-NO_x Burners (LNB) have been in development since the late 1970s and are in general use on many steam-electric generating units. Increasing demands for overall reductions in NO_x emissions have continued to put pressure on manufacturers to improve burner design. The existing low-NO_x burners were modified. When used with separated overfire air (SOFA) they have been found capable of reducing emission rates to very near the current New Source Performance Standards (NSPS) level of 0.15 lb/10^6 Btu.

To further reduce NO_x emissions, the participant will employ five elements: (1) low NO_x burners, (2) separated overfire air, (3) fuel flow measurement transducers, (4) fuel/air balancing, and (5) advanced network controls.



Project Status/Accomplishments

The project was selected for award on September 26, 2001. The cooperative agreement was awarded on December 17, 2002. DOE issued the Environmental Assessment in March 2003 and signed the Finding of No Significant Impact (FONSI) on March 11, 2003. Construction began immediately and some of the equipment is already in place.

The full application of the five elements proposed herein have never been demonstrated in plants firing subbituminous coals, especially those from Wyoming's PRB. Likewise, there are no other wall-fired units on which owners have sought to fully explore the technology proposed to its fullest potential. The inclusion of the very latest in distributed control systems, proposed for this unit in 2003, make this location ideal for integration with the proposed elements. The unit on which this technology will be applied has among the very best availabilities and performance histories for boilers of its type. It was placed in commercial operation in 1983 and is equipped with the latest SO_2 scrubber and fabric filter for particulate matter. When completed, this will be among the cleanest non-SCR-equipped coal-fired units in the United States. The Sunflower LNB/SOFA integrated system would be installed in three distinct phases to demonstrate the synergistic effect of layering NO_x control technologies.

Phase I, Advanced Monitoring/Coal Flow Measurement, would demonstrate the effectiveness of control upgrades with respect to NO_x control and thermal efficiency, with minimal impact from physical modification of the boiler. During this phase, instruments capable of measuring coal flow within individual coal conduits would be installed. Limited changes would be made to the plants' computing and control systems.

Phase II, Low-NO_x Burner Modifications/Coal Flow Control, would demonstrate the effectiveness of low-cost modifications to the existing, first-generation low-NO_x burners for the reduction of NO_x emissions. Modifications to the existing pulverizer classifiers would permit automated fuel balancing among all burners and would include the installation of new burner tips and a better means of controlling air flow on individual burners.

Phase III, Advanced Overfire Air/DCS Integration, would demonstrate deeper NO_x control competitive to SCR installation with the addition of an overfire air system that would be coupled with the existing Phase I and II modifications to optimize system performance. Final combustion control integration with a new combustion control system (a contemporaneous improvement not included as a part of this project) would maximize potential NO_x reductions.

Commercial Applications

There are as many as 30 units for which this technology can be deployed that will be able to meet the current NSPS level. A further 60 units will be able to establish significant reductions, to levels of about 0.22 lb/10^6 Btu. This choice of equipment, if enabled in a timely fashion, will allow a reduction in the number of SCRs being installed, thereby reducing the overall consumer cost; will reduce the outage duration necessary for completion, thereby improving the electric system reliability; and will conserve the critical pool of skilled labor needed to accomplish this work.

Development of Hybrid FLGR/ SNCR/SCR Advanced NO_x Control

Participant
TIAX, LLC (acquired the research contracts of Arthur D. Little, Inc.)

Additional Team Members
Fuel Tech—equipment supplier

Location
To be determined

Technology
A hybrid of Fuel-Lean Gas Reburn/Selective Non-Catalytic Reduction, and Selective Catalytic Reduction

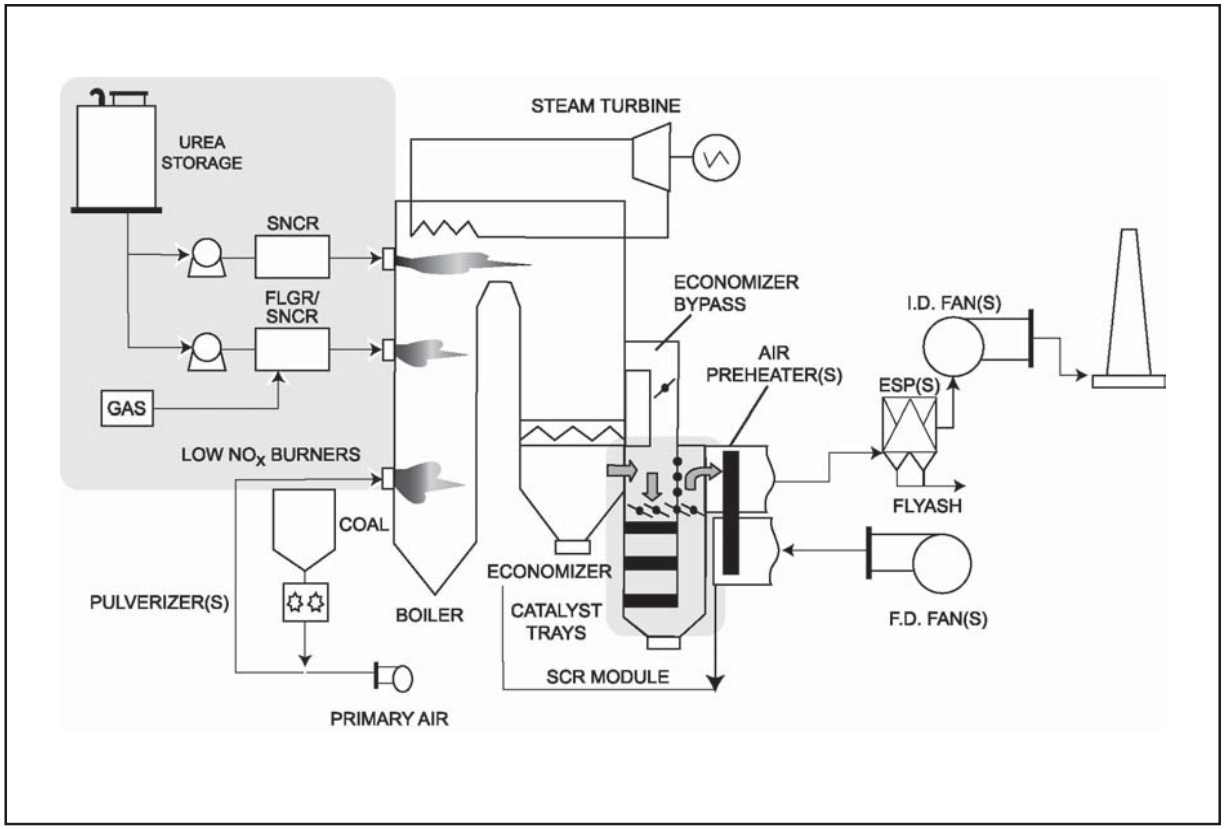
Plant Capacity/Production
To be determined

Coal
Eastern Bituminous Coal

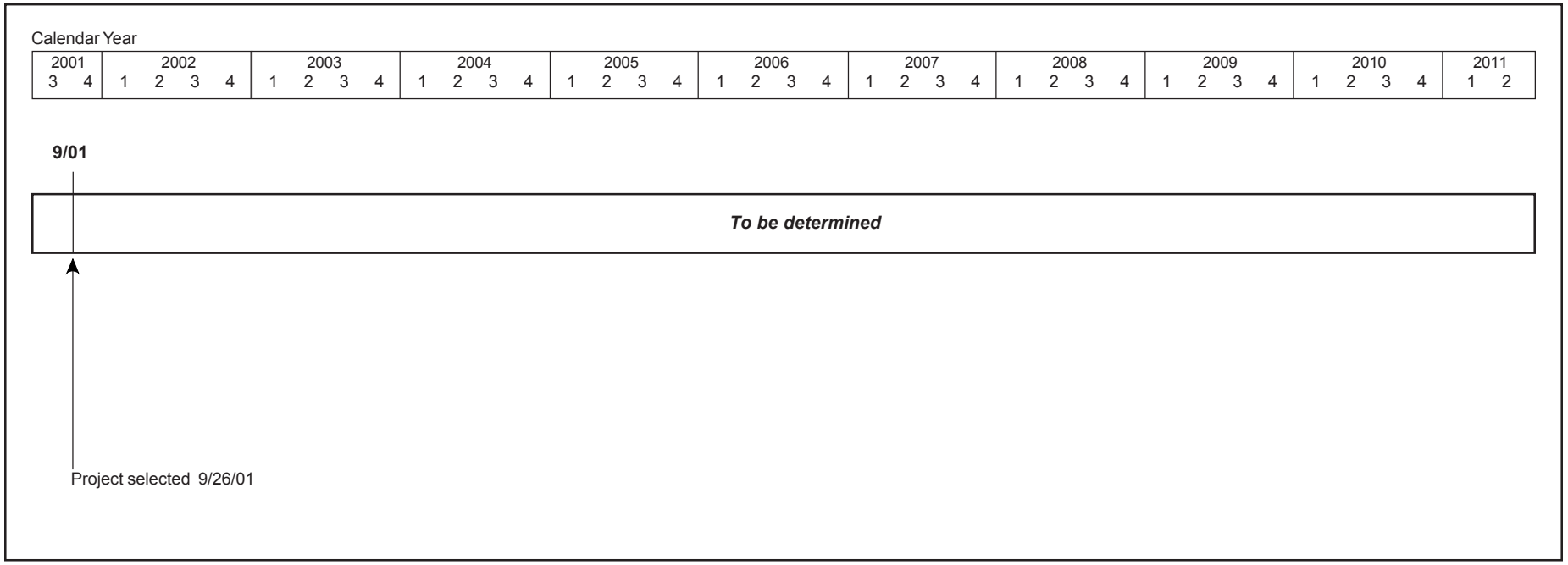
Project Funding

Total	$30,513,711	100%
DOE	14,957,658	49
Participant	15,556,053	51

Project Objective
To develop and demonstrate a hybrid system composed of lower-cost components from three established NO_x-reduction systems that can function as stand-alone units or as an integrated, optimized, single-control system. Using Fuel-Lean Gas Reburn/Selective Non-Catalytic Reduction (FLGR/SNCR), Selective Non-Catalytic Reduction (SNCR), and Selective Catalytic Reduction (SCR) systems, the hybrid seeks to lower NO_x emissions to 0.15 lb/10^6 Btu at lower costs than conventional SCR, a comparatively expensive, effective way to curb NO_x.



Technology/Project Description
The three components in the hybrid system are FLGR/SNCR, SNCR, and compact SCR. They have been developed individually, but have not been developed and optimized as a hybrid control system. The objectives of this project are to demonstrate the hybrid system as a lower cost alternative to SCR to achieve 0.15 lb/10^6 Btu emission levels, and to operate the hybrid system to improve performance and reduce compliance costs to enhance operation in system-wide dispatch in the deregulated market.



Project Status/Accomplishments

The project was selected for award on September 26, 2001. Originally, Orion Power's Avon Lake Unit No. 9 near Cleveland, Ohio, was to be the host site. However, in February 2002, Orion Power was bought out by Reliant Energy, which decided in April 2002 not to pursue the project. TIAX, LLC, which acquired the research contracts of Arthur D. Little, Inc. (ADL) during ADL's bankruptcy proceedings in early 2002, has identified other potential sites and is proceeding to develop revised cost estimates. The schedule will be finalized when a new site is selected and the cooperative agreement is signed.

Commercial Applications

Coal-fired power boiler operators are facing a dual challenge to remain competitive while adapting to deregulation and to impending stringent NO_x controls. The NO_x control technologies available to coal-fired operators are not optimized for this new set of challenges. Under deregulation, the optimum control techniques need to have a low capital cost and cost-effective NO_x reduction over a wide operational range so that the performance of each unit in the system can be optimized to allow maximum revenue dispatch. The increased flexibility is needed to allow each boiler and the integrated system to respond competitively to market conditions. Current reliance on selective catalytic reduction, with the associated high capital cost, will not typically give a utility sufficient dispatch flexibility to maximize competitiveness. Projections indicate that 30% of coal-fired boilers are going to be retrofitted with SCR. For the balance of units, power generators are looking for lower cost, more flexible means to design their units for competitive dispatch dictated by regional cost and environmental criteria.

Greenidge Multi-Pollutant Control Project

Participant
CONSOL Energy, Inc.

Additional Team Members
AES Greenidge, LLC—host

Environmental Elements Corporation (EEC)—technology supplier

Foster Wheeler Energy Corporation (FWEC)—technology supplier

AEP Pro Serv—construction coordinator

Location
Torrey, Yates County, NY (AES' Greenidge Unit No. 4)

Technology
Single-bed Selective Catalytic Reduction in combination with low-NO_x combustion technology to control NO_x and a circulating dry scrubber with carbon injection to control SO_2, mercury, and acid gases

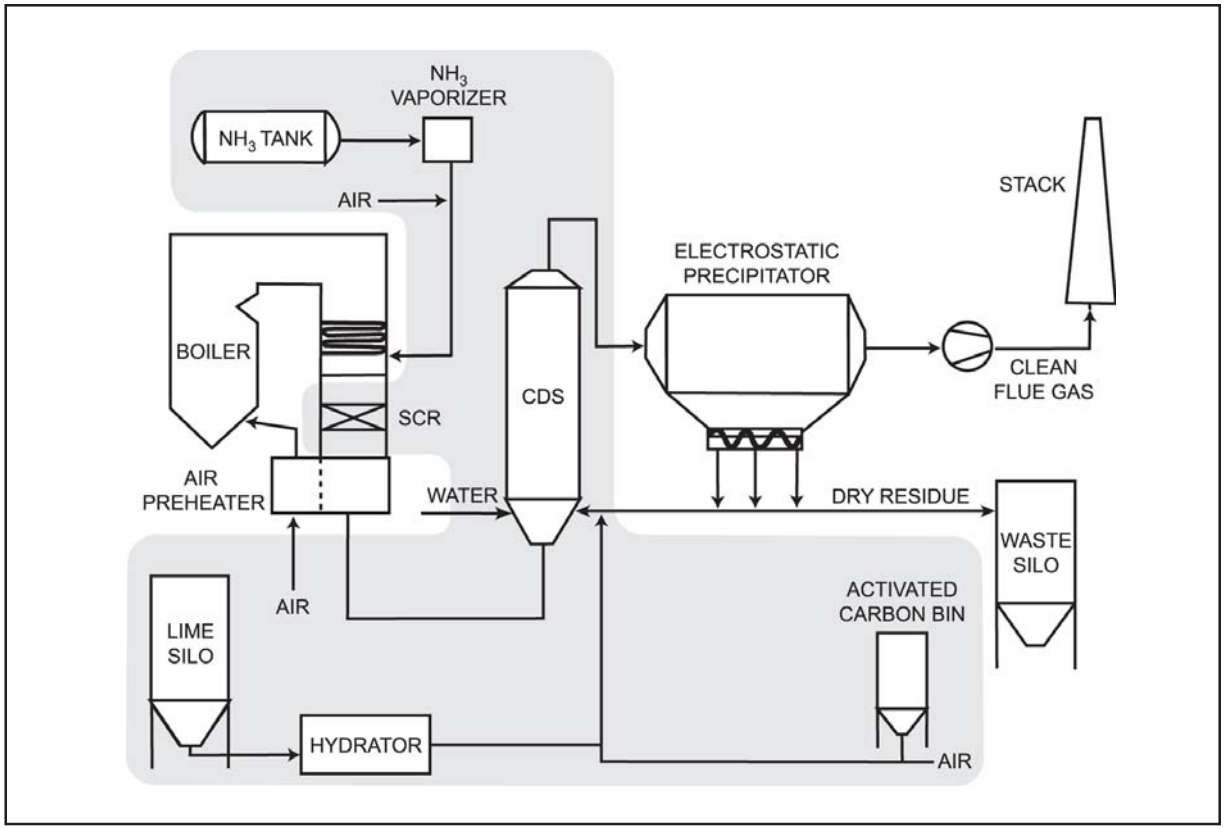
Plant Capacity/Production
104 MW

Coal
Bituminous coal (<2% sulfur) co-fired with up to 10% biomass

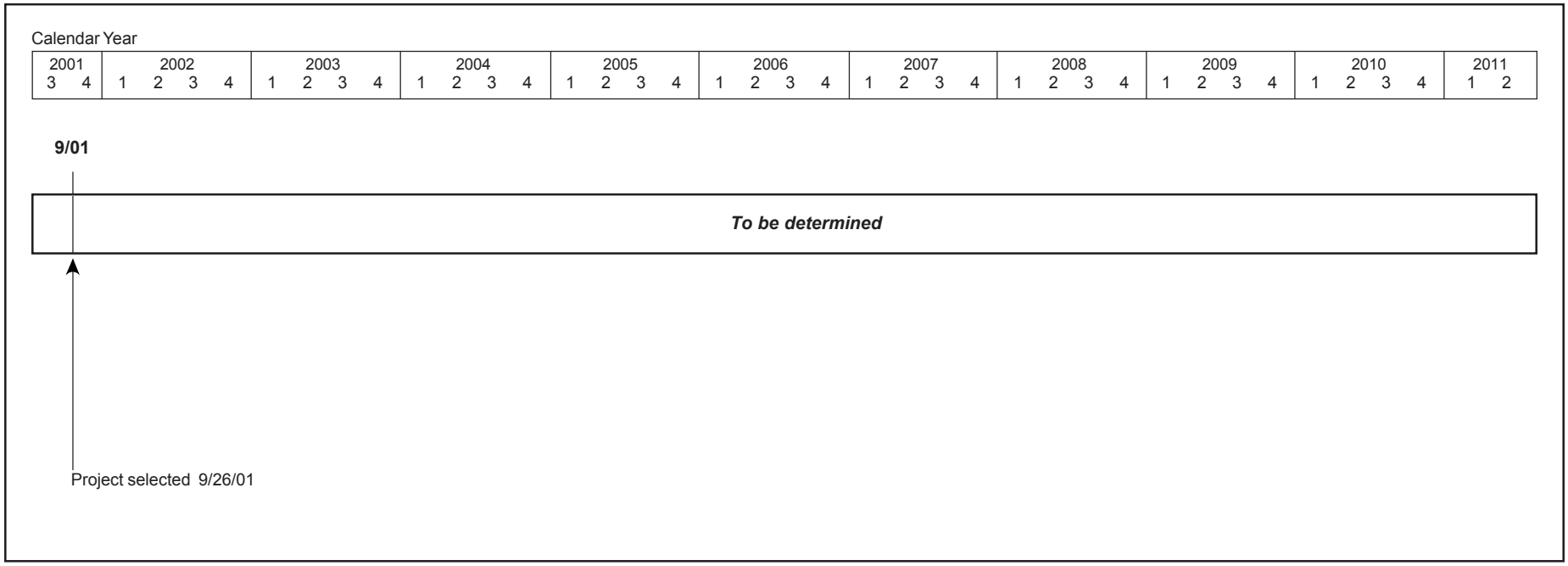
Project Funding

Total	$32,800,000	100%
DOE	14,500,000	44
Participant	18,300,000	56

Project Objective
To demonstrate a multi-pollutant-control system that can cost effectively reduce NO_x, SO_2, acidic gas, and mercury from smaller coal plants. This project would be the first to demonstrate (1) NO_x reductions to 0.122 lb/10^6 Btu using single bed, in-duct Selective Catalytic Reduction (SCR) combined with a low-NO_x combustion technology on a unit burning coal and biomass, (2) 95% SO_2 removal using a Circulating Dry Scrubber (CDS) from Environmental Elements Corp. on a coal-fired boiler, (3) 90% mercury reduction in the CDS, and (4) more than 95% acid gas (sulfur trioxide (SO_3), hydrochloric (HCl), and hydrofluoric (HF) acids) removal in the CDS.



Technology/Project Description
The single-bed, in-duct SCR, in combination with low-NO_x combustion technology, can achieve 60% NO_x reduction for about one-third the capital cost and one-fourth the operating and maintenance cost of a full SCR or Selective Non-Catalytic Reduction (SNCR) system on a 104-MW unit. The capital cost of the CDS system is projected to be less than half that of a conventional flue gas desulfurization (FGD) system. Operating and maintenance costs are less for the CDS system. Activated carbon injection into the CDS unit is projected to use 5 to 10 times less carbon than direct injection into the flue gas duct for a given level of mercury control, because the carbon has a greater average contact time in the CDS bed than in the flue gas duct. Reducing the carbon feed rate results in substantial mercury control cost savings. The CDS system will reduce acid gases (SO_3, HCl, HF) by more than 95%, with the additional benefits of reducing plume visibility and secondary particulate formation. Acid gases must be reported to EPA as part of the Toxic Release Inventory (TRI). The project will also include an evaluation of the impact of biomass co-firing (5–10% of the heat input) on the performance of the SCR and CDS systems.



Project Status/Accomplishments

The project was selected for award on September 26, 2001. Contract negotiations are continuing. The schedule will be finalized when contract negotiations are complete.

The goal of the proposed project is to demonstrate substantial improvements in mercury, SO_3 and fine particulate control, and substantial reductions in the cost for NO_x and SO_2 control, compared to conventional technologies when applied to the large number of smaller coal-fired generating units in the U.S. This project will produce operating and maintenance cost data, reliability and availability data, and process performance data so that generators will accept the risk of installing multi-pollutant control on smaller coal-fired units. Ultimately, the successful demonstration of these technologies will help to ensure the future availability of low-cost electricity from a significant fraction of the U.S. coal-fired generating fleet.

Commercial Applications

Greenidge Unit No. 4 is representative of 492 coal-fired electricity generating units in the United States with capacities of 50–300 MWe. These smaller units, almost one quarter of the U.S. coal-fired generating capacity, are increasingly vulnerable to fuel switching or retirement as a result of more stringent state and federal environmental regulations. The proposed project will demonstrate the commercial readiness of an emissions control system that is particularly suited, because of its low capital and maintenance costs, to meet the requirements of this large group of smaller existing electricity generating units.

Demonstration of a Full-Scale Retrofit of the Advanced Hybrid Particulate Collector Technology

Participant
Otter Tail Power Company

Additional Team Members
Montana-Dakota Utilities—co-host

NorthWestern Public Service—co-host

W.L. Gore & Associates, Inc.—licensee and filter bag provider

Energy and Environmental Research Center (University of North Dakota)—concept developer

Location
Big Stone City, Grant County, SD (Montana-Dakota Utilities and NorthWestern Public Service's Big Stone Power Plant)

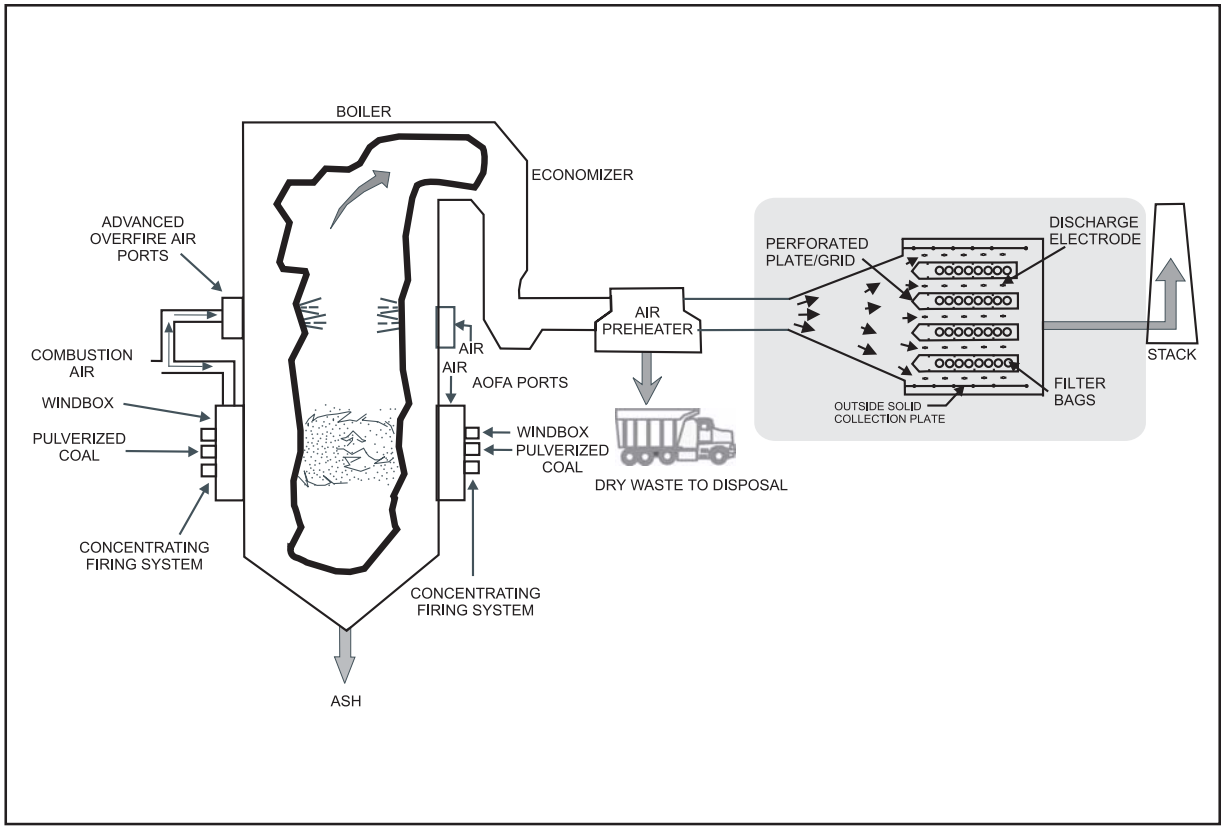
Technology
Advanced Hybrid™ (formerly known as Advanced Hybrid Particulate Collector)

Plant Capacity/Production
450 MW

Coal
Low-sulfur coal

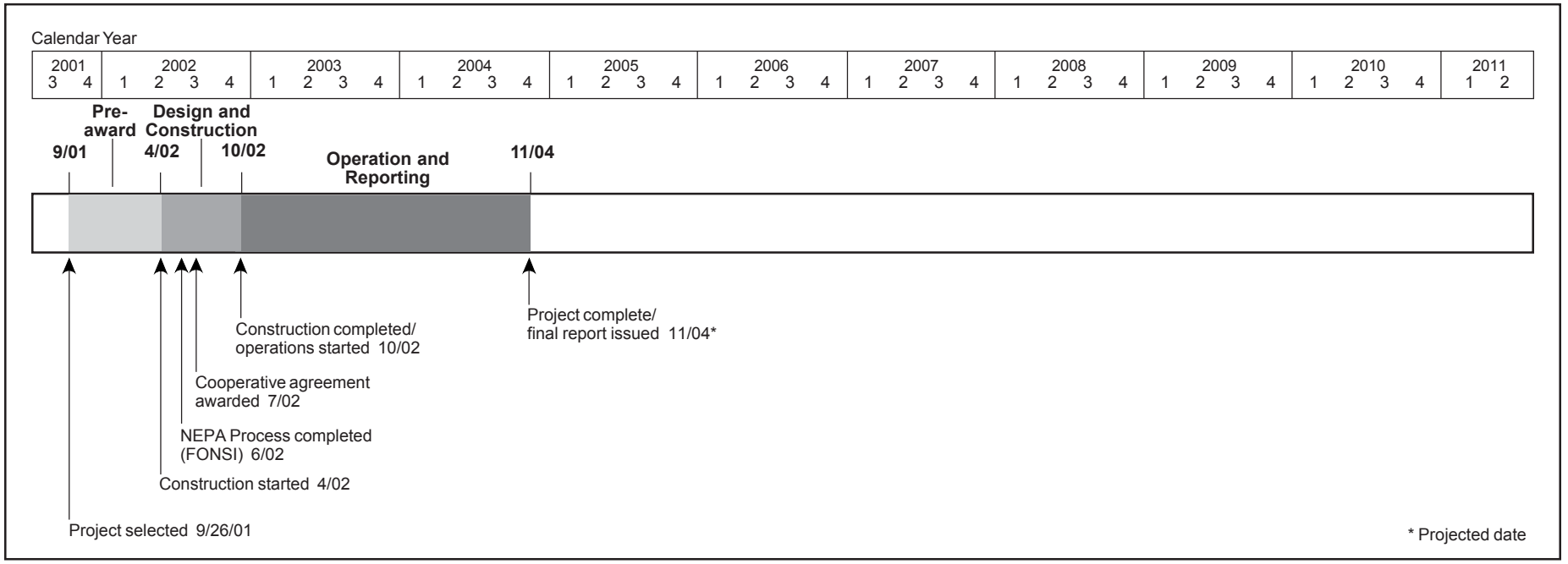
Project Funding

Total	$13,353,288	100%
DOE	6,490,585	49
Participant	6,862,703	51



Project Objective
To demonstrate, in a full-scale application, a hybrid technology that raises the particulate matter capture of coal plants up to 99.99% by integrating fabric filtration and electrostatic precipitation (ESP) in a single unit. The Advanced Hybrid™ overcomes the problem of excessive fine particle emissions that escape collection in ESPs and the reentrainment of dust in baghouses. The overall goal of the project is to demonstrate the Advanced Hybrid™ concept in a full-scale application. Specific objectives are to demonstrate ultra-low fine particulate emissions, low pressure drop, overall reliability of the technology and, eventually, long-term bag life.

Technology/Project Description
The Advanced Hybrid™ combines the best features of ESPs and baghouses in an entirely novel manner. The Advanced Hybrid™ concept combines fabric filtration and electrostatic precipitation in the same housing, providing major synergism between the two methods, both in the particulate collection step and in transfer of dust to the hopper. The Advanced Hybrid™ provides ultra-high collection efficiency, overcoming the problem of excessive fine-particle emissions with conventional ESPs, and solves the problem of reentrainment and re-collection of dust in conventional baghouses.



Project Status/Accomplishments

The project was selected for award on September 26, 2001. A cooperative agreement was awarded July 2, 2002. The NEPA process was completed with the issuance of the Environmental Assessment in June 2002 and the FONSI on June 11, 2002. Construction commenced in July 2002 and was completed in October 2002. Start-up was completed on October 25, 2002.

The first six months of operation showed very good particulate removal efficiency, but at a higher than anticipated pressure drop. Performance testing has shown that the average collection efficiency of the Advanced Hybrid™ is 99.997%. The outlet dust loading is almost two orders of magnitude lower than the guarantee limit of 0.002 grains per actual cubic feet. Operations are continuing with the goal of reducing the overall operating cost, including pressure drop.

Commercial Applications

With new requirements to control respirable particulate matter (less than 2.5 microns in diameter; $PM_{2.5}$), the Advanced Hybrid™ is a superior technology not only for new installations but as a retrofit technology as well. The Advanced Hybrid™ combines a high particulate collection efficiency, with a small footprint and potential economic advantages. Given the age and performance level of many existing ESPs, there is a great and immediate need for this type of retrofit technology. This technology has potential application to all of the more than 1,000 coal-fired units. However, space and other site-specific constraints come in to play to preclude 100% applicability.

The Advanced Hybrid™ is economically competitive with ESPs and baghouses for meeting current standards. For meeting a possible stricter fine-particle standard or 99.99% control of total particulates, the Advanced Hybrid™ is the economic choice over either ESPs or baghouses by a wide margin.

Big Bend Power Station Neural Network-Sootblower Optimization

Participant
Tampa Electric Company

Additional Team Members
Pegasus Technology, Inc.—technology supplier

Location
Apollo Beach, Hillsborough County, FL (Tampa Electric's Big Bend Power Station)

Technology
Neural-network sootblowing system in conjunction with advanced controls and instruments

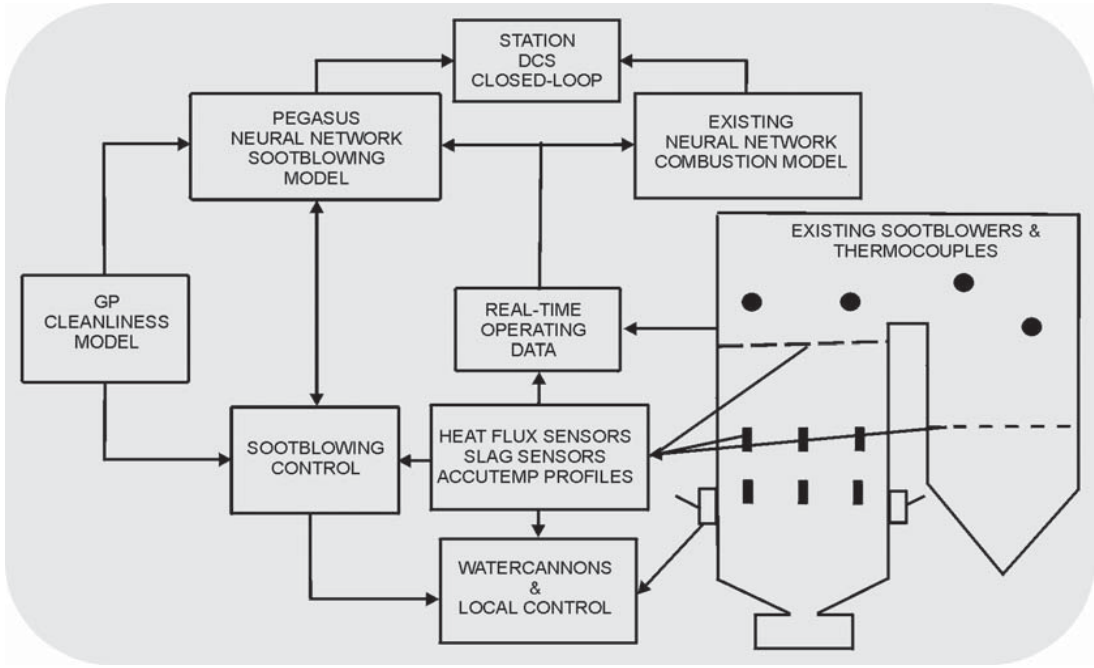
Plant Capacity/Production
445 MW

Coal
Unknown

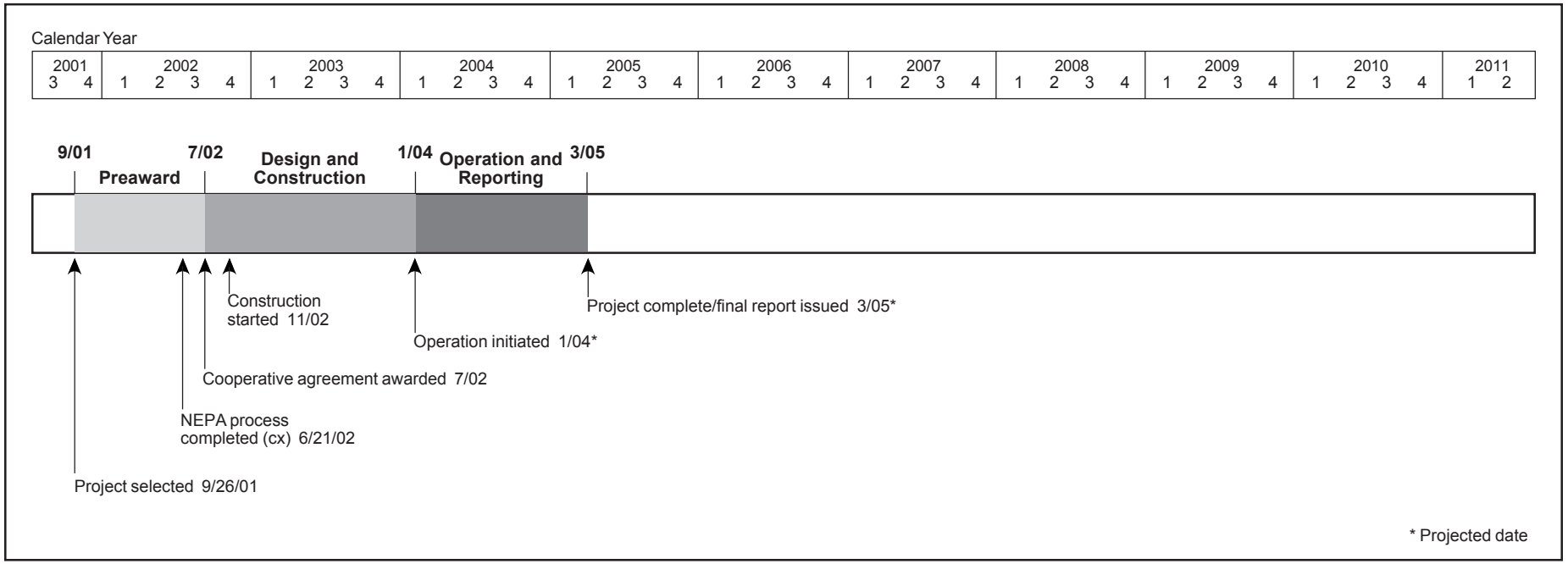
Project Funding

Total	$2,381,614	100%
DOE	905,013	38
Participant	1,476,601	62

Project Objective
To control boiler fouling on a 445-MWe unit by using a neural-network sootblowing system in conjunction with advanced controls and instruments. Ash and slag deposition compromise plant efficiency by impeding the transfer of heat to the working fluid. This leads to higher fuel consumption and higher air emissions, especially NO_x. This project is expected to reduce NO_x by 30%, improve heat rate by 2% and reduce particulate matter (PM) emissions by 5%.



Technology/Project Description
The intent of this project is to apply a neural network intelligent sootblowing system in conjunction with state-of-the-art controls and instruments to optimize the operation of a utility boiler and systematically control boiler fouling. This optimization process is targeted to reduce total NO_x generation by up to 30%, improve heat rate by up to 2%, and reduce PM emissions by up to 5%. As compared to competing technologies, this could be an extremely cost-effective technology, which has the ability to be readily and easily adapted to virtually any pulverized coal boiler.



Project Status/Accomplishments

The project was selected for award on September 26, 2001. The cooperative agreement was awarded July 9, 2002 and the NEPA process was completed with a categorical exclusion issued on June 21, 2002. Construction started in November 2002 and operation is projected to start in January 2004.

Commercial Applications

One problem that exists with the combustion of coal is the formation and deposition of ash and slag within the boilers which adversely affects the rate at which heat is transferred to the working fluid, which in the case of electric generators is water/steam. The fouling of the boiler leads to poor efficiencies because heat which could normally be transferred to the working fluid remains in the flue gas stream and exits to the environment without beneficial use. This loss in efficiency translates to higher consumption of fuel for equivalent levels of electric generation, hence more gaseous emissions are also produced. Another less obvious problem exists with fouling of various sections of the boiler relating to the intensity of peak temperatures within and around the combustion zone.

Total NO_x generation is primarily a function of both fuel- and thermal-NO_x production. Fuel-NO_x, which generally comprises 20–40% of the total NO_x generated, is predominantly influenced by the levels of oxygen present, while thermal-NO_x, which comprises the balance, is a function of temperature. As the fouling of the boiler increases and the rate of heat transfer decreases, peak temperatures increase as does thermal NO_x production.

Due to the composition of coal, particulate matter is also a by-product of coal combustion. Modern day utility boilers are usually fitted with electrostatic precipitators to aid in the collection of PM. Although extremely efficient, these devices are sensitive to rapid changes in inlet mass concentration as well as total mass loading. Traditionally, utility boilers are equipped with devices known as soot-blowers, that use steam, water, or air to dislodge particulates and clean the surfaces within the boiler and are operated based upon established rules or the operator's judgment. Without extreme care and due diligence, excessive soot can overload an ESP resulting in high levels of PM being released. This technology has potential application to all of the more than 1,000 coal-fired units.

Commercial Demonstration of the Airborne Process

Project withdrawn

Participant
LG&E Energy Corporation

Additional Team Members
Kentucky Utilities—host

Babcock & Wilcox Company—technology supplier

USFilter—technology supplier

Airborne Pollution Control—technology supplier

Location
Carrollton, Carroll County, Kentucky (LG&E's Ghent Unit No. 2)

Technology
"Airborne Process" integrated environmental control technologies

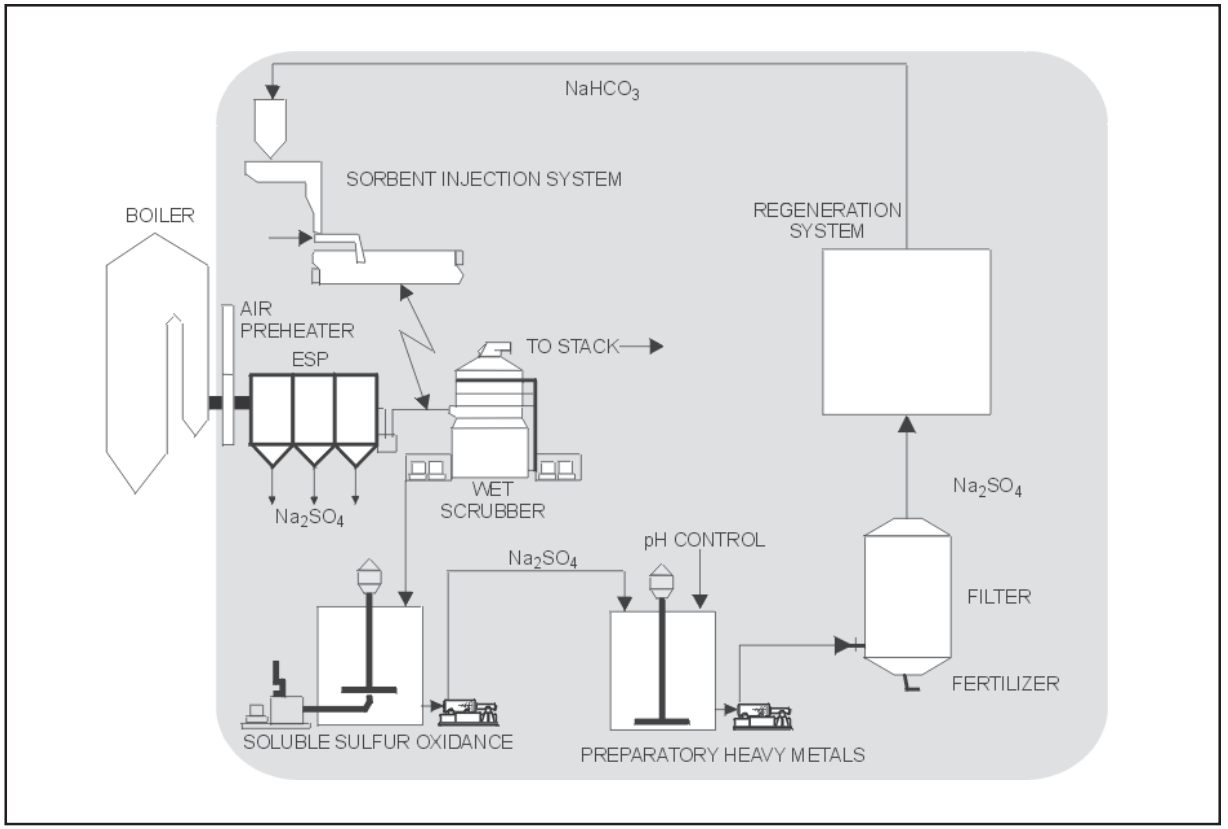
Plant Capacity/Production
524 MW

Coal
Eastern Kentucky Bituminous (3.6% sulfur)

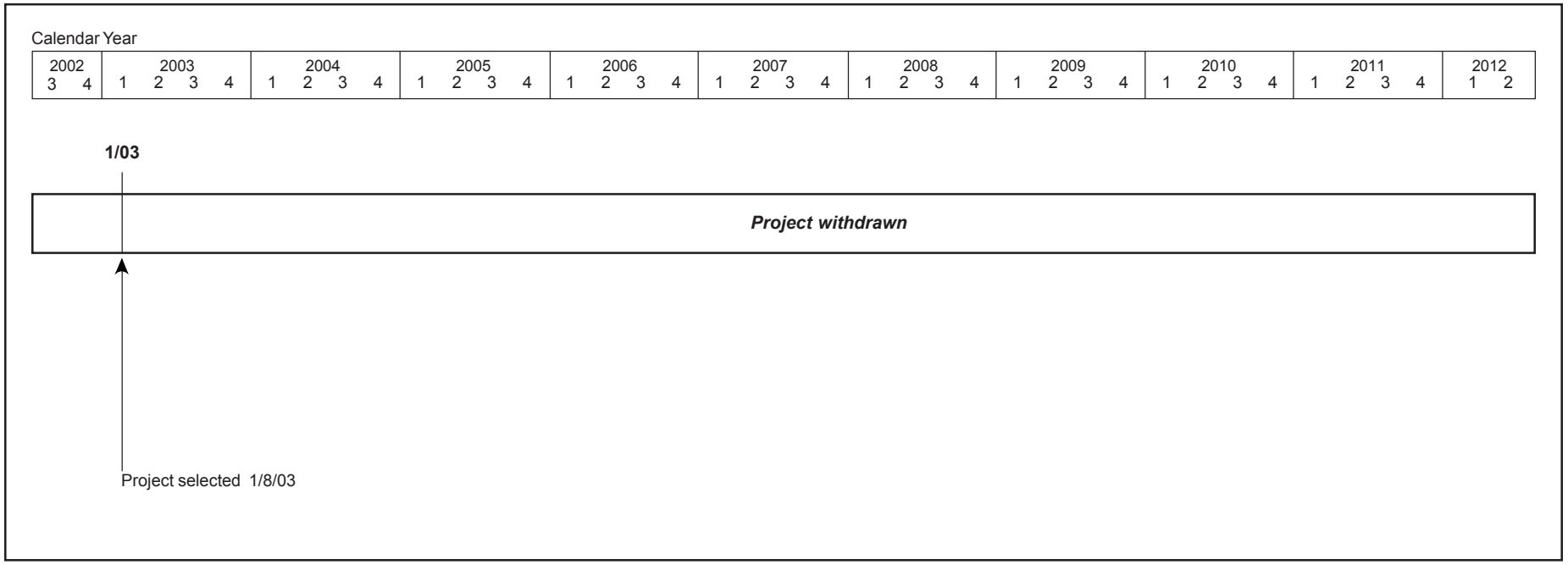
Project Funding

Total	$120,126,569	100%
DOE Share	$ 31,122,268	26
Participant	$ 89,004,301	74

Project Objective
To demonstrate cost-effective, advanced emission control technologies integrated with existing emissions control equipment for multi-pollutant emissions abatement while providing a highly desired, valuable fertilizer by-product. The goal of the "Airborne Process" is to remove 99.5% of the sulfur dioxide (SO_2), 90% of the sulfur trioxide (SO_3), 90% of the nitrogen oxides (NO_x), and 90% of the mercury (Hg) across the total system, while turning the by-products into a high-quality, valuable granular fertilizer that will produce a revenue stream while yielding stack emissions that will be lower than other coal-fired units currently in service.



Technology/Project Description
The Airborne Process employs a proprietary method of sodium bicarbonate ($NaHCO_3$) regeneration. The sodium sulfate (Na_2SO_4) by-product (the end product after scrubbing of flue gas emissions has occurred) is regenerated into two end products. The first product is sodium bicarbonate for re-use in the scrubbing process, with the second being fertilizer which can be sold, therefore eliminating disposal costs and producing a revenue source.



Project Status/Accomplishments

The project was selected for award on January 8, 2003 and the cooperative agreement was under negotiation. However, LG&E Energy Corporation decided to withdraw the project.

LG&E Energy was to host this project as well as serve as the prime contractor. The Babcock & Wilcox Company (B&W), USFilter, and Airborne Pollution Control were to provide the technical and project management resources throughout the four-year project, including design, installation, start-up and testing. Airborne Pollution Control holds the patents for the granulation process. B&W, USFilter, and Airborne Pollution Control were to provide the hardware for the dry sorbent injection and sodium-based scrubbing system, regeneration system, and fertilizer production system respectively.

Installation and start-up was to be followed by a three-month field test phase. This test program was to focus on multi-pollution emission reductions and production of the valuable fertilizer. The test program was also supposed to demonstrate the availability of the Airborne Process with the objective of achieving a commercial level of availability beginning with the first year of commercial operation.

Commercial Applications

The Airborne Process can be widely applied in the near-term to satisfy the emissions reduction needs for retrofits into existing plants that are currently unscrubbed as well as for new coal-based installations. Compared to other cleaning solutions, this regeneration process reduces operating costs, reduces waste, eliminates landfill use and generates a profit for the utility. A patented granulation process is the method by which the ammonium sulfate by-product is turned into a high-quality fertilizer.

Demonstration of Integrated Optimization Software at the Baldwin Energy Complex

Participant
NeuCo, Inc.

Additional Team Members
Dynegy Midwest Generation—host

Location
Baldwin, Randolph County, Illinois (Dynegy Midwest Generation's Baldwin Energy Complex)

Technology
Advanced optimization software, building on NeuCo's ProcessLink™ technology

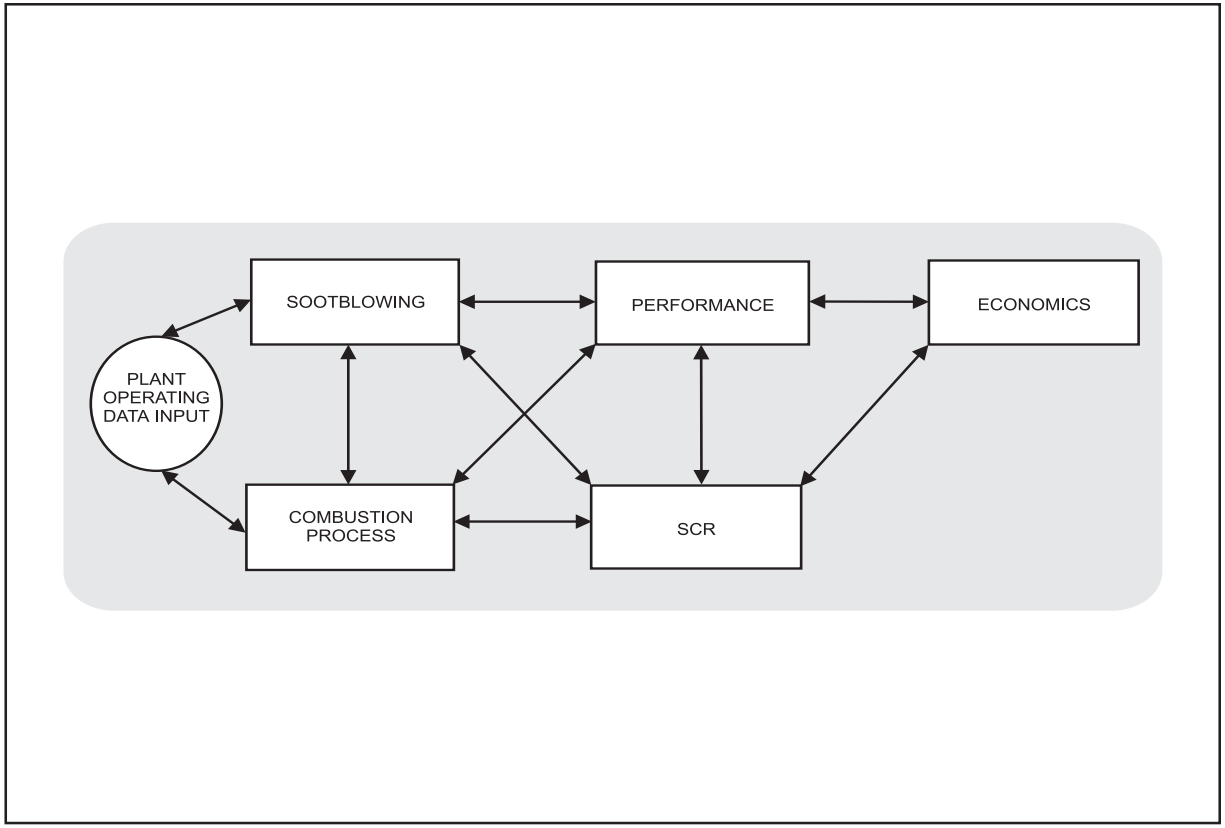
Project Capacity/Production
1,768 MW

Coal
Powder River Basin

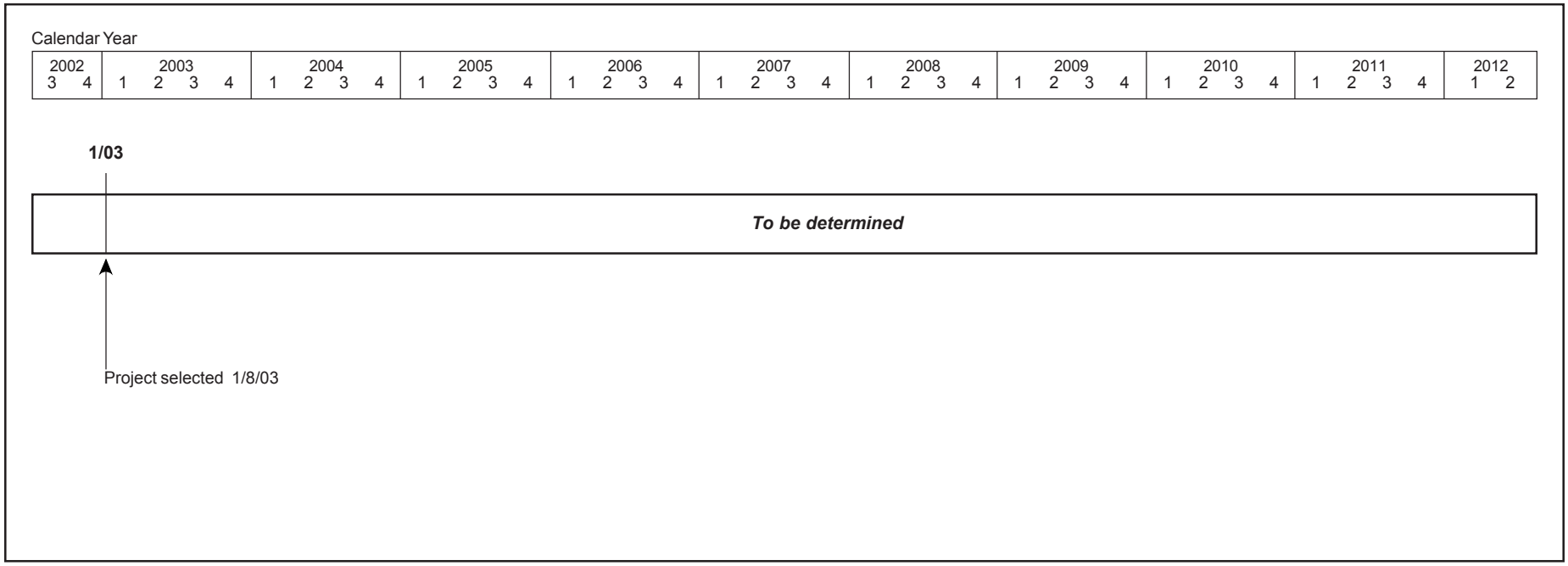
Project Funding

Total	$18,640,231	100%
DOE Share	$ 8,388,104	45
Participant	$10,252,127	55

Project Objective
To design, develop, and demonstrate integrated on-line optimization systems that will address combustion, soot-blowing, selective catalytic reduction (SCR) operations, overall unit thermal performance, and plant-wide profit optimization in order to reduce nitrogen oxides (NO_x) by 5%, increase efficiency by 1.5%, and improve reliability and availability to boost production by 1.5%.



Technology/Project Description
The ProcessLink™ technology platform includes neural networks, genetic algorithms, and fuzzy logic techniques from which to comprehensively apply optimization techniques to a variety of systems within coal power plants through existing control technologies and then link these systems to each other. It also supports the development of integrative optimization solutions, which use system-specific optimization applications as data sources and actuators.



Project Status/Accomplishments

The project was selected for award on January 8, 2003. Negotiations are underway and a cooperative agreement is expected by mid- to late-2003. The project duration is expected to be four years.

The increases in fuel efficiency (heat rate reduction) will also provide commensurate reductions in greenhouse gases, mercury, and particulates. These solutions will build on NeuCo's ProcessLink™ technology platform. The proposed work will demonstrate closed-loop combustion optimization for cyclone boilers and integrate the newly developed solutions with combustion optimization at all three of the plant's nominal 600-MW coal-fired units (two cyclone-fired units with selective catalytic reduction and one tangentially fired unit with low-NO_x burners).

Commercial Applications

When completed, this project will demonstrate the applicability of integrating an on-line optimization system with power plant operations to increase the thermal efficiency of the plant, hence reducing emissions of CO_2, increasing fuel efficiency, and increasing overall reliability while achieving a corresponding reduction of airborne emissions. The increases in fuel efficiency will also provide commensurate reductions in mercury and particulates. As plant complexity increases through retrofit and repowering applications, the introduction of new technologies, and plant modifications, this integrated process optimization approach can be an important tool that supports a plant operator's control objectives and links them to corporate objectives of increased efficiency and lower emissions.

TOXECON Retrofit for Mercury and Multi-Pollutant Control on Three 90 MW Coal-Fired Boilers

Participant
Wisconsin Electric Power Company

Additional Team Members
ADA-ES—collaborator

Cummins & Barnard—collaborator

Electric Power Research Institute (EPRI)—technology supplier

Environmental Elements Corp.—collaborator

Location
Marquette, Marquette County, Michigan (Wisconsin Electric's Presque Isle Power Plant Unit Nos. 7, 8, and 9)

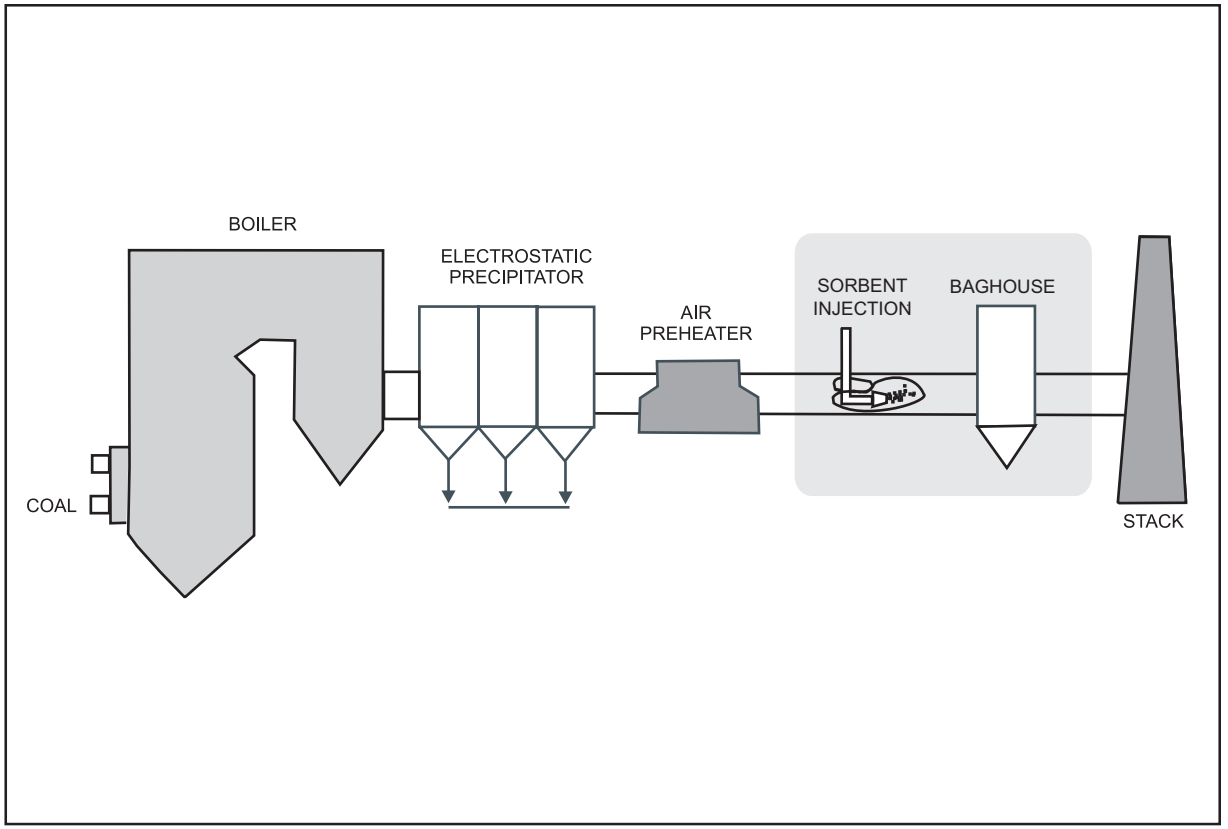
Technology
EPRI's patented TOXECON sorbent injection process

Project Capacity/Production
3 x 90 MW

Coal
Powder River Basin

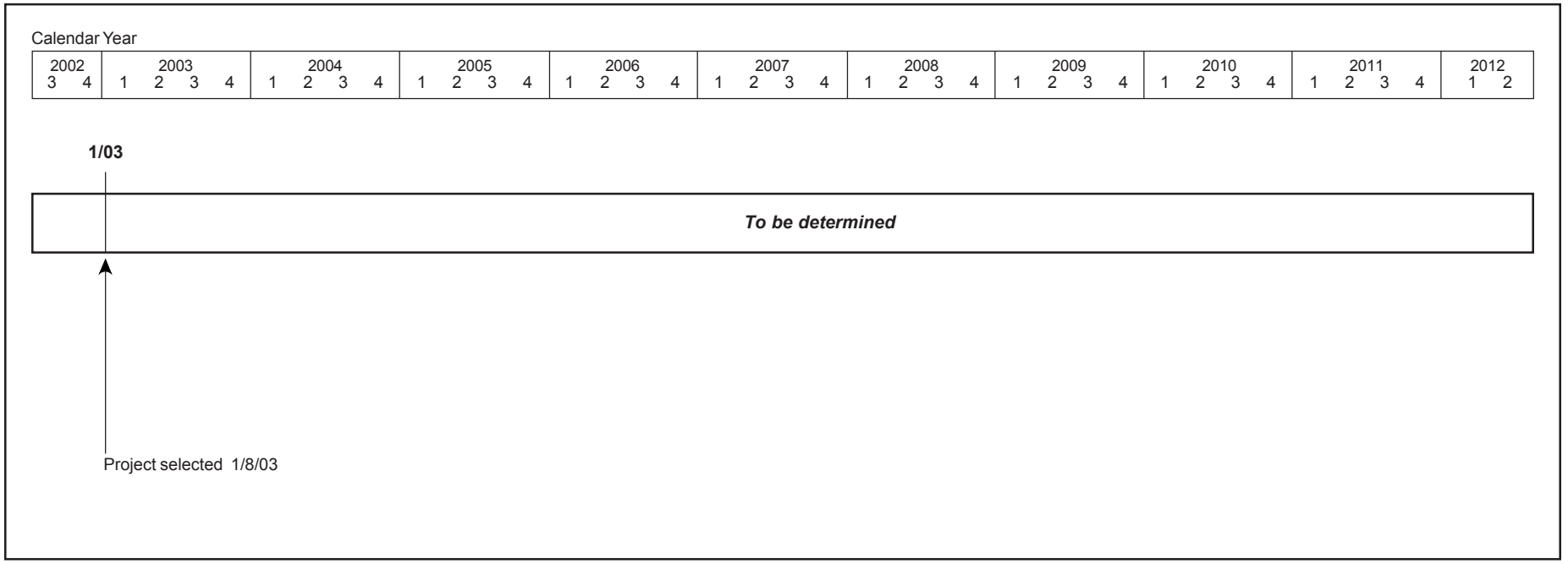
Project Funding

Total	$49,536,624	100%
DOE Share	$24,768,312	50
Participant	$24,768,312	50



Project Objective
To demonstrate EPRI's patented TOXECON process, which injects sorbents into a pulse-jet baghouse installed downstream of the existing particulate matter (PM) control device for mercury (Hg), other air toxics, sulfur dioxide (SO_2), and nitrogen oxides (NO_x) control. Specific objectives are to achieve 90% Hg removal through injection of activated carbon into the flue gas stream, increase PM collection efficiency, determine the viability of sorbent injection for up to 70% SO_2 control and trim control of NO_x, recover 90% of Hg captured in the sorbent, achieve 100% fly ash utilization, advance reliability of Hg continuous emission monitors, and successfully integrate the entire system.

Technology / Project Description
The activated carbon and other sorbents will be delivered into the flue gases between the primary PM control device and the new baghouse. Injection of activated carbon in this manner has distinct advantages over direct injection of activated carbon into an electrostatic precipitator (ESP), which depends on in-flight adsorption of mercury by sorbent particles, whereas in a baghouse both in-flight and fixed-bed capture occur as the flue gas passes through the filter cake on the fabric filter. TOXECON generally has lower carbon injection rates, and has higher capture efficiencies in some cases than direct injection into an ESP. In addition, injection downstream of the primary PM control device does not contaminate fly ash with carbon, allowing for sale and use of the fly ash by-product.



Project Status/Accomplishments

This project was selected for award on January 8, 2003. Negotiations are underway, and a cooperative agreement is expected in mid- to late-2003.

The TOXECON configuration allows for separate treatment, disposal, or sale of ash collected in the primary PM control device. It is expected that when completed in 2008, this technology demonstration project will reduce Hg emissions by 90% and result in capture of about 97 pounds of mercury per year that would otherwise have been emitted to the environment from the three units combined. The multi-pollutant control strategy could be expected to reduce the already low SO_2 and NO_x emissions at the plant by an additional 70% and 30%, respectively, resulting in capture of 4,020 tons per year of SO_2 and 1,470 tons per year of NO_x. In addition, emission of PM would be reduced by 32 tons per year.

Short-term, large-scale testing of activated carbon injection in flue gases has shown that Hg capture results averaged from 87–90% with a carbon injection rate of 1.5 pounds per million cubic feet of flue gas. Additional testing over longer periods is needed to determine the impact of carbon injection on fabric filter bag life, cleaning frequency, and particulate collection efficiency. Powder River Basin (PRB) coal, like that fired at the Presque Isle plant, has a high percentage of elemental, as opposed to oxidized, mercury. Activated carbon is known to capture elemental mercury, the most challenging species of mercury to capture. Other test results have shown that sodium-based products can achieve 30% to 70% reduction in SO_2 emissions, but at normal flue gas temperatures calcium-based products are not effective. Sodium based sorbents have also reduced NO_x by 10% to 20%. A HCl removal efficiency of 50% has been documented with injection of sodium-based sorbents.

Commercial Applications

The technology can be incorporated into systems that currently employ cold-side ESPs, as well as hot-side ESPs as primary PM control devices. Injection of sorbents will take place downstream of the air heater in systems employing hot-side ESPs, such as the Presque Isle Plant, where relatively cool temperatures below 350 °F allow absorption of Hg by activated carbon. TOXECON is one of the few mercury control technologies that can be applied to systems employing a hot-side ESP because temperatures are generally too high in the ESP to allow for absorption upstream or in the ESP.

A primary benefit of this project is its potential as a low-cost option for dramatic, deep cleaning of plant air emissions, especially those of mercury. The project's successful implementation will help provide an approach for segments of the power-generating industry to achieve timely compliance with future mercury regulations.

This technology may prove to be the primary Hg control choice for western coals and the only choice for units burning any coal type with a hot-side ESP. Thus, the TOXECON process has application at unscrubbed power plants burning coals with hot-side ESPs (18 GW), plants burning western, sub-bituminous coals with cold-side ESPs (68 GW), and plants burning bituminous coals with cold-side ESPs (81 GW). Using TOXECON to control SO_2 and NO_x further enhances its attractiveness for improved environmental control.

Advanced Electric Power Generation

McIntosh Unit 4A PCFB Demonstration Project

Project Terminated

Participant

City of Lakeland, Lakeland Electric

Additional Team Members

Foster Wheeler Corporation—supplier of pressurized circulating fluidized-bed (PCFB) combustor and heat exchanger; engineer

Siemens Westinghouse Power Corporation—supplier of hot gas filter, gas turbine, and steam turbine

Location

Lakeland, Polk County, FL (Lakeland Electric's McIntosh Power Station, Unit No. 4)

Technology

Foster Wheeler's PCFB technology integrated with Siemens Westinghouse's hot gas particulate filter system (HGPFS) and power generation technologies

Plant Capacity/Production

137 MWe (net)

Coal

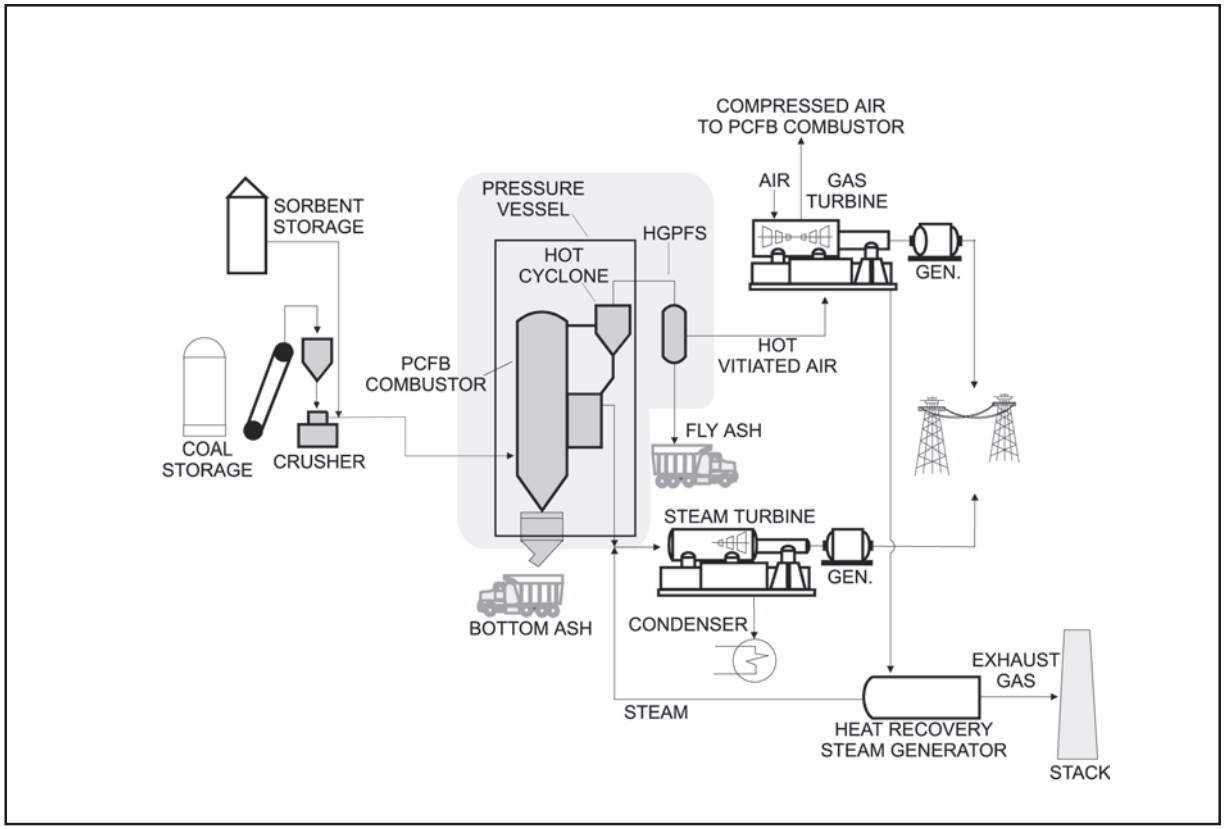
Eastern Kentucky and high-ash, high-sulfur bituminous coals

Project Funding

Total	$186,588,000	100%
DOE	93,252,864	50
Participant	93,335,136	50

Project Objective

To demonstrate Foster Wheeler's PCFB technology coupled with Siemens Westinghouse's ceramic candle type HGPFS and power generation technologies, which represent a cost-effective, high-efficiency, low-emissions means of adding generating capacity at greenfield sites or in repowering applications.

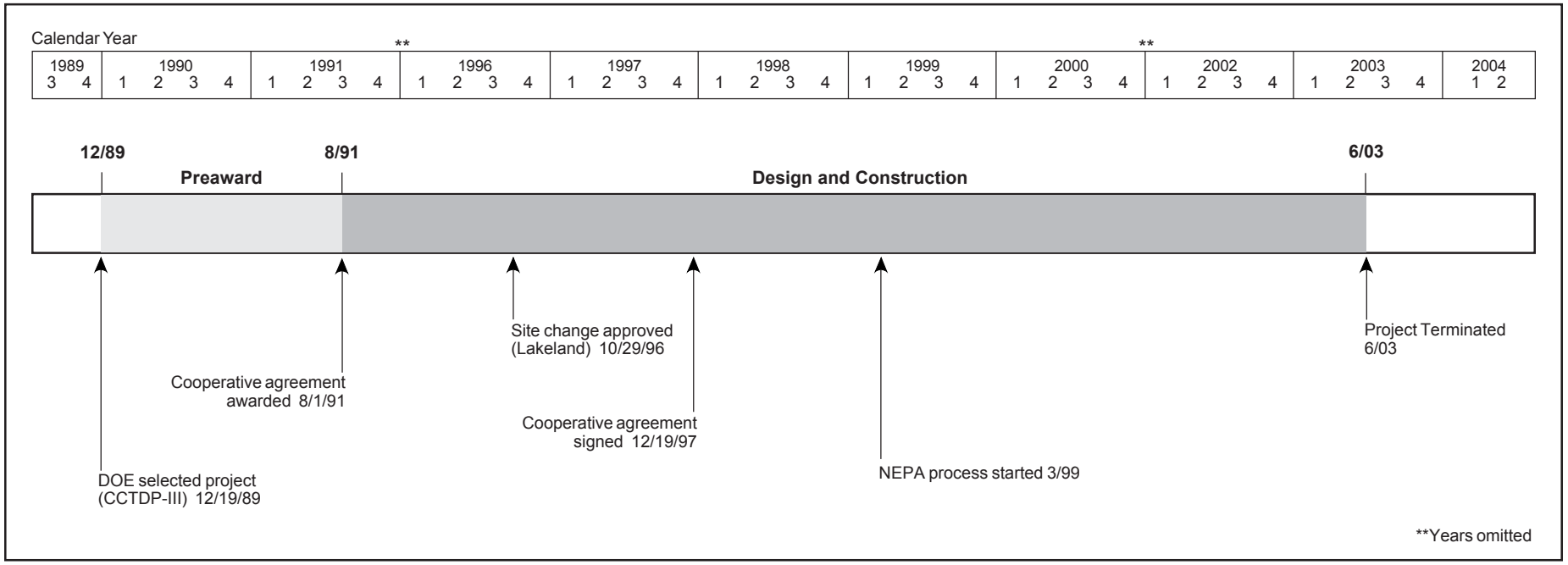


Technology/Project Description

In the first of the two Lakeland Electric projects, McIntosh Unit No. 4A would have been constructed with a PCFB combustor adjacent to the existing Unit No. 3 (see also McIntosh Unit 4B Topped PCFB Demonstration Project).

Coal and limestone are mixed and fed into the combustion chamber. Combustion takes place at a temperature of approximately 1,560–1,600 °F and a pressure of about 200 psig. The resulting flue gas and fly ash leaving the combustor pass through a cyclone and ceramic candle type HGPFS where the particulates are removed. The hot gas leaving the HGPFS is expanded through a Siemens V64.3 gas turbine. The gas inlet temperature of less than 1,650 °F allows for a simplified turbine shaft and blade-cooling system. The hot gas leaving the gas turbine passes through a heat recovery steam generator (HRSG). Heat recovered from both the combustor and HRSG is used to generate steam to power a reheat steam turbine. Approximately 5–10% of the power is derived from the gas turbine, with the steam turbine contributing the balance. The project also includes an atmospheric fluidized-bed unit that can be fired on coal or char from the carbonizer and will replace the PCFB unit during times of PCFB unavailability, allowing various modes of operation.

The projected net heat rate for the system is approximately 9,480 Btu/kWh (HHV), which equates to an efficiency greater than 36%. Environmental attributes include *in-situ* sulfur removal of 95%, NO_x emissions less than 0.3 lb/10^6 Btu, and particulate matter discharge less than 0.03 lb/10^6 Btu. Solid waste will increase slightly as compared to conventional systems, but the dry material is readily disposable or potentially usable.



Project Status/Accomplishments

The project resulted from a restructuring of the DMEC-1 PCFB Demonstration Project awarded under CCTDP-III. On December 19, 1997, a Cooperative Agreement modification was signed implementing the project restructuring from DMEC-1 to the City of Lakeland. The Lakeland City Council gave approval in April 1998 for the 10-year plan of Lakeland Electric (formerly Department of Electric & Water Utilities), which included this project. However, the project was on hold while technical and economic issues were resolved. The issues could not be resolved and this project was terminated.

Commercial Applications

The project would have served to demonstrate the PCFB technology for widespread commercial deployment and would have included the first commercial application of hot gas particulate cleanup and would have been one of the first to use a non-ruggedized gas turbine in a pressurized fluidized-bed application.

The combined-cycle PCFB system permits the combustion of a wide range of coals, including high-sulfur coals, and would compete with the pressurized bubbling-bed fluidized-bed system. The PCFB technology can be used to repower or replace conventional power plants. Because of modular construction capability, PCFB generating plants permit utilities to add economical increments of capacity to match load growth or to repower plants using existing coal- and waste-handling equipment and steam turbines. Another advantage for repowering applications is the compactness of the equipment due to pressurized operation, which reduces space requirements per unit of energy generated.

McIntosh Unit 4B Topped PCFB Demonstration Project

Protect Terminated

Participant

City of Lakeland, Lakeland Electric

Additional Team Members

Foster Wheeler Corporation—supplier of carbonizer; engineer

Siemens Westinghouse Power Corporation—supplier of topping combustor and high-temperature filter

Location

Lakeland, Polk County, FL (Lakeland Electric's McIntosh Power Station, Unit No. 4)

Technology

Fully integrated second-generation PCFB technology with the addition of a carbonizer island that includes Siemens Westinghouse's multi-annular swirl burner (MASB) topping combustor

Plant Capacity/Production

103-MWe (net) addition to the 137-MWe (net) McIntosh 4A project

Coal

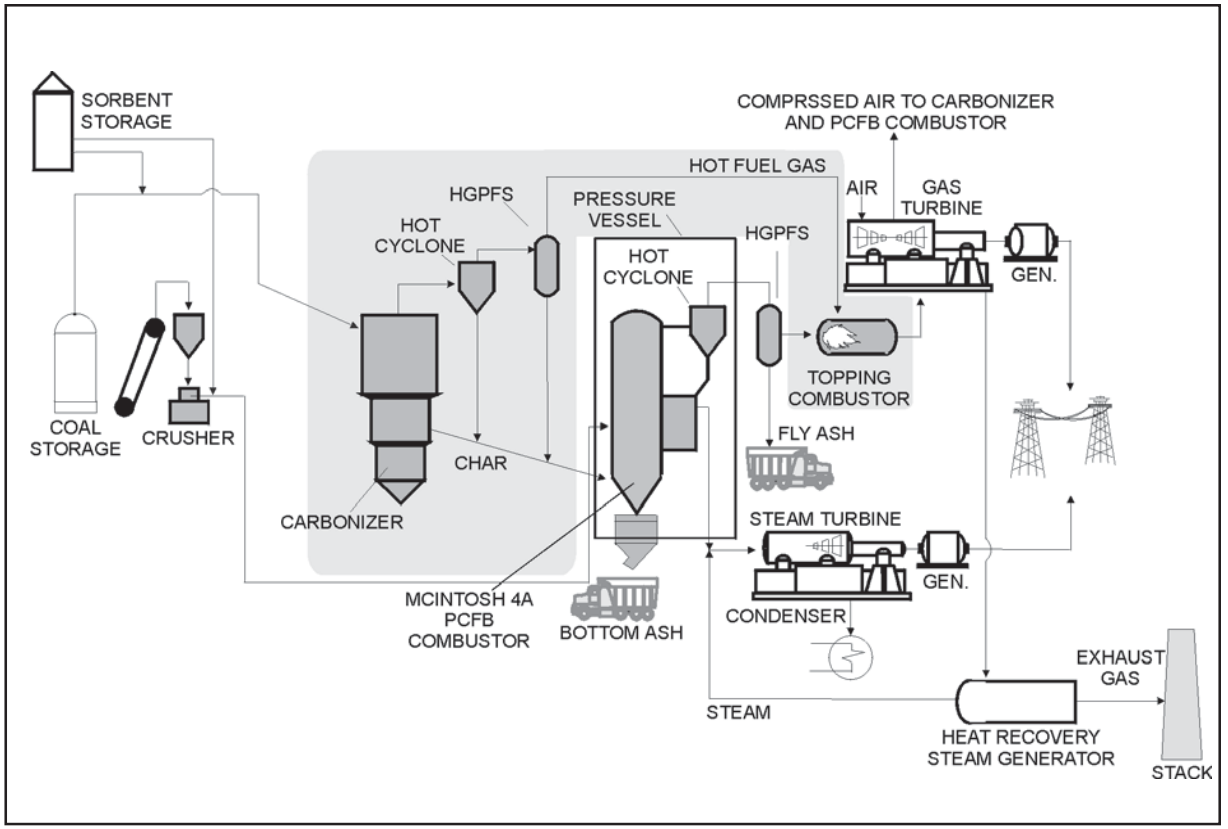
Eastern Kentucky and high-ash, high-sulfur bituminous coals

Project Funding

Total	$219,635,546	100%
DOE	109,608,507	50
Participant	110,027,039	50

Project Objective

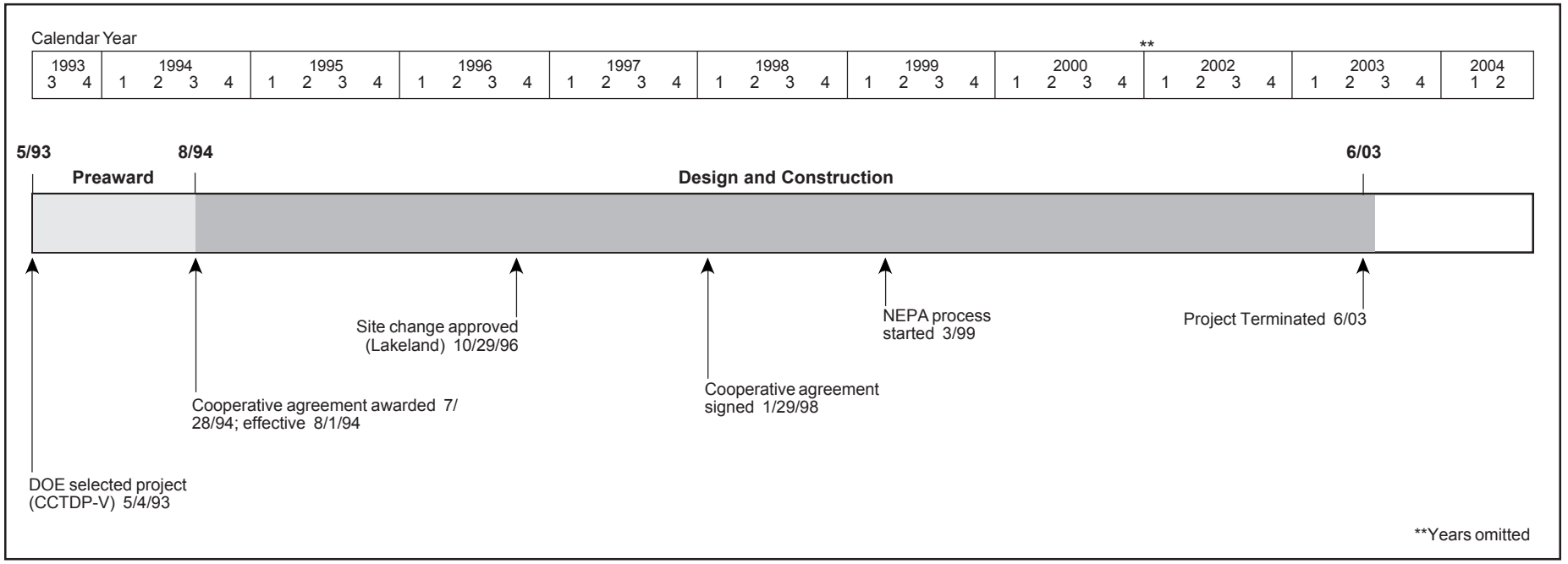
To demonstrate topped PCFB technology in a fully commercial power generation setting, thereby advancing the technology for future plants that will operate at higher gas turbine inlet temperatures and will be expected to achieve cycle efficiencies in excess of 45%.



Technology/Project Description

The project involved the addition of a carbonizer island to the PCFB demonstrated in the McIntosh 4A project. Dried coal and limestone are fed via a lock hopper system to the carbonizer with part of the gas turbine discharge air. The coal is partially gasified at about 1,750–1,800 ºF to produce syngas and char solids streams. The limestone is used to absorb sulfur compounds generated during the mild gasification process. After cooling the syngas to about 1,200 ºF, the char and limestone entrained with the syngas are removed by a hot gas particulate filter system (HGPFS). The char and limestone are then transferred to the PCFB combustor for complete carbon combustion and limestone utilization. The hot, cleaned, filtered syngas is then fired in the MASB topping combustor to raise the turbine inlet temperature to approximately 2,350 °F. The gas is expanded through the turbine, cooled in a heat recovery steam generator, and exhausted to the stack. The net impact of the addition of the topping cycle is an increase in both power output and efficiency. The coal and limestone used in McIntosh 4B are the same as those used in McIntosh 4A.

The 240-MWe (net) plant was expected to have a heat rate of 8,406 Btu/kWh (40.6% efficiency, HHV). The design SO_2 capture efficiency rate was 95%. Particulate and NO_x emissions were expected to be 0.02 lb/10^6 Btu and 0.17 lb/10^6 Btu, respectively. In the final configuration, the gas turbine would have produced 58 MWe and the steam turbine would have produced 207 MWe, while plant auxiliaries would have consumed about 25 MWe.



Project Status/Accomplishments

The project resulted from a restructuring of the Four Rivers Energy Modernization Project awarded under the fifth CCTDP solicitation. The Four Rivers project was to demonstrate the integration of a carbonizer (gasifier) and topping combustor (topping cycle) with the PCFB technology. By using a phased approach, Lakeland Electric would be able to demonstrate both PCFB (McIntosh 4A) and topped PCFB (McIntosh 4B) technologies at one plant site.

On January 29, 1998, a Cooperative Agreement modification was signed implementing the project restructuring from Four Rivers Energy Partners to the City of Lakeland. The Lakeland City Council gave approval in April 1998 for the 10-year plan of Lakeland Electric (formerly Department of Electric & Water Utilities), which included this project. However, the project was on hold while technical and economic issues were resolved. The issues could not be resolved and this project was terminated.

Commercial Applications

The commercial version of the topped PCFB technology would have a greenfield net plant efficiency of 45% (which equates to a heat rate approaching 7,500 Btu/kWh, HHV). In addition to higher plant efficiencies, the plant would (1) have a cost of electricity that was projected to be 20% lower than that of a conventional pulverized coal-fired plant with flue gas desulfurization, (2) meet emission limits allowed by the New Source Performance Standard (NSPS), (3) operate economically on a wide range of coals, and (4) be amenable to shop fabrication. The benefits of improved efficiency included reduced cost for fuels and a reduction in CO_2 emissions.

The commercial version of the topped PCFB technology has other environmental attributes, which include *in-situ* sulfur retention that can meet 95% removal requirements, NO_x emissions that will meet or exceed NSPS, and particulate matter discharge of approximately 0.03 lb/10^6 Btu. Although the system will generate a slight increase in solid waste compared to conventional systems, the material is a dry, readily disposable, and potentially usable material.

JEA Large-Scale CFB Combustion Demonstration Project

Participant
JEA (formerly Jacksonville Electric Authority)

Additional Team Members
Foster Wheeler Energy Corporation—technology supplier

Location
Jacksonville, Duval County, FL (JEA's Northside Station, Unit No. 2)

Technology
Foster Wheeler's atmospheric circulating fluidized-bed (ACFB) combustor

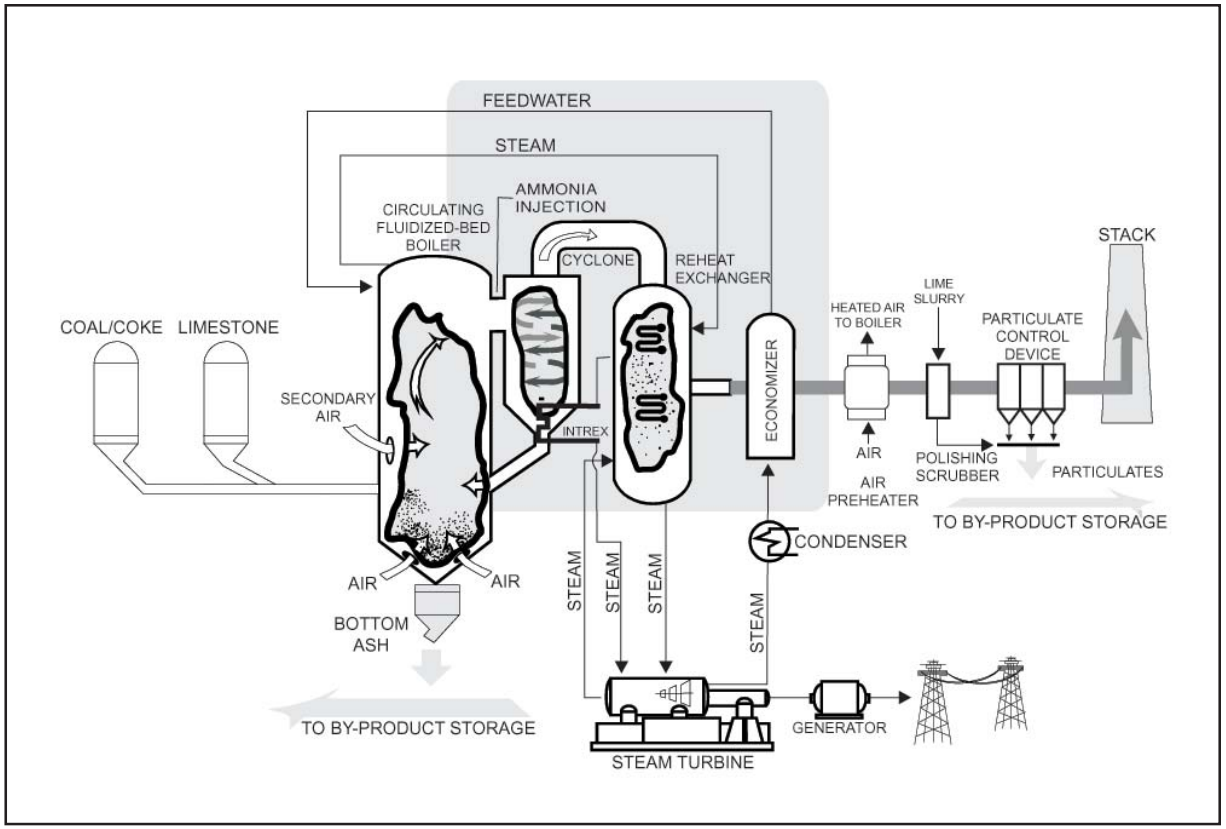
Plant Capacity/Production
297.5 MWe (gross), 265 MWe (net)

Coal
Eastern bituminous, 3.39% sulfur (design)

Project Funding

Total	$309,096,512	100%
DOE	74,733,633	24
Participant	234,362,679	76

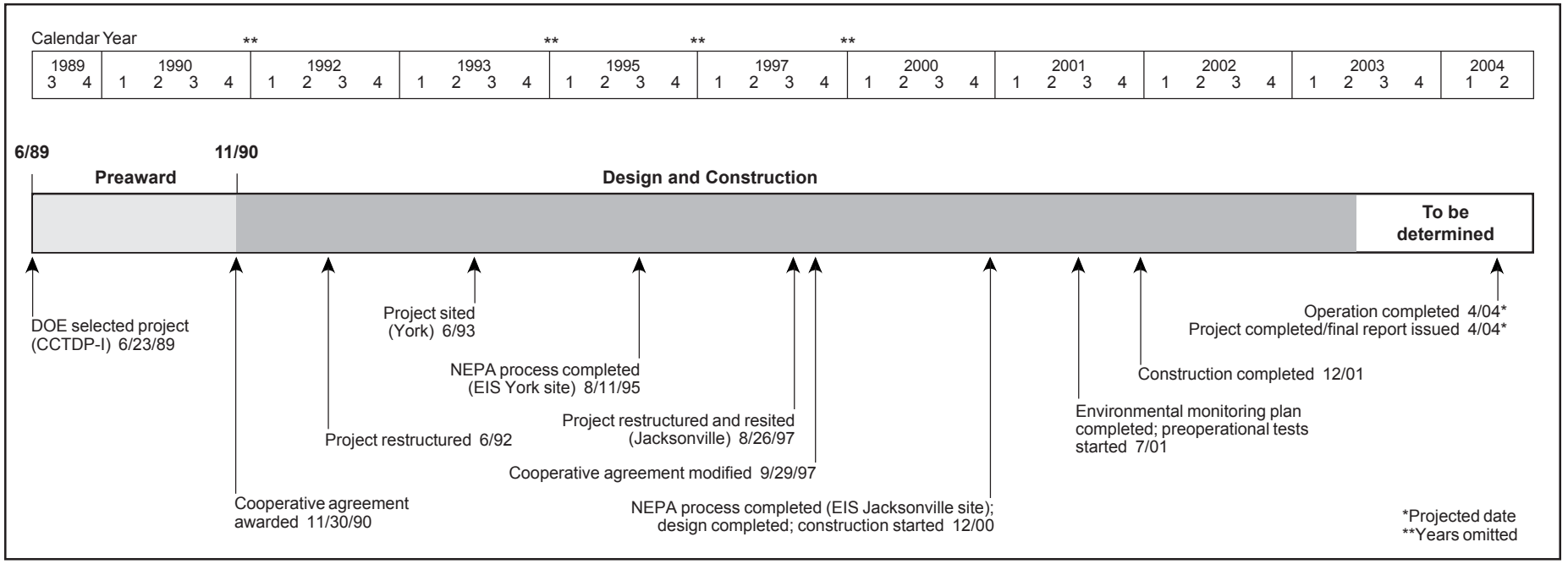
Project Objective
To demonstrate ACFB at 297.5 MWe gross (265 MWe net) representing a scale-up from previously constructed facilities; to verify expectations of the technology's economic, environmental, and technical performance; to provide potential users with the data necessary for evaluating a large-scale ACFB as a commercial alternative; to accomplish greater than 90% SO_2 removal; and to reduce NO_x emissions by 60% when compared with conventional technology.



Technology/Project Description
A circulating fluidized-bed combustor, operating at atmospheric pressure, will be retrofitted into Unit No. 2 of the Northside Station. In this process coal or the secondary fuel (petroleum coke), primary air, and a solid sorbent (such as limestone), are introduced into the lower part of the combustor where initial combustion occurs. As the coal particles decrease in size due to combustion, they are carried higher in the combustor when secondary air is introduced. As the coal particles continue to be reduced in size, the coal, along with some of the sorbent, is carried out of the combustor, collected in a cyclone separator, and recycled to the lower portion of the combustor. Primary sulfur capture is achieved by the sorbent in the bed. However, additional SO_2 capture is achieved through the use of a polishing scrubber to be installed ahead of the particulate control equipment.

Steam is generated in tubes placed along the combustor's walls and superheated in tube bundles placed downstream of the particulate separator to protect against erosion. The system will produce approximately 2 x 10^6 lb/hr of main steam at about 2,500 psig and 1,005 ºF, and 1.73 x 10^6 lb/hr of reheat steam at 600 psig and 1,005 ºF. The steam will be used in an existing 297.5-MWe (nameplate) steam turbine.

The heat rate for the retrofit plant is expected to be approximately 9,950 Btu/kWh (34% efficiency; HHV). Expected environmental performance is 0.15 lb/10^6 Btu for SO_2 (98% reduction), 0.09 lb/10^6 Btu for NO_x, and 0.011 lb/10^6 Btu for total particulates (0.011 lb/10^6 Btu for PM_{10}).



Project Status/Accomplishments

The project was successfully resited to Jacksonville, Florida after York County Energy Partners and Metropolitan Edison Company terminated activities on the ACFB project in September 1996. On August 26, 1997, DOE approved the transfer of the ACFB Clean Coal Project from York, Pennsylvania to Jacksonville, Florida. On September 29, 1997, DOE signed a modified cooperative agreement with JEA to cost-share refurbishment of the first (Unit No. 2) of two units at Northside Generating Station.

The National Environmental Policy Act process was completed when the Record of Decision was issued on December 7, 2000. The facility was dedicated on October 14, 2002. The operation and reporting period has been delayed and a new scheduled has not been set.

Following a two-week unscheduled outage, Unit No. 2 was returned to service on January 8, 2003. The unit was taken offline on January 28, 2003, to repair external tube leaks on one of the cyclones. On February 11, 2003, the fuel was switched to an 80/20 blend of petcoke/coal. The unit operated on the 80/20 blend for six weeks without experiencing an unscheduled outage. A planned 22-day outage started on April 1, 2003, to incorporate modifications and upgrades necessary to prepare the unit for the summer peak period. The work items included the repair of the INTREX™ inlet expansion joint from the cyclone and the INTREX™ outlet refractory shielding pillows. The schedule for the demonstration operations is yet to be determined.

The project moves atmospheric fluidized-bed combustion technology to the larger sizes of utility boilers typically considered in capacity additions and replacements. The nominal 300-MWe demonstration unit in the JEA project will be more than double the size of the Nucla unit (110-MWe). Features include an INTREX™ integrated recycle heat exchanger in the furnace, steam-cooled cyclones, a parallel pass reheat control, an SO_2 polishing scrubber, and a fabric filter for particulate control.

The project received *Power* magazine's 2002 Power Plant Award. The Florida Engineering Society awarded JEA's project manager the Technical Achievement Award 2002 for his work on the project.

Commercial Applications

The ACFB technology has good potential for application in both the industrial and utility sectors, whether for use in repowering existing plants or in new facilities. Also, ACFB is attractive for both baseload and load-following power applications because it can be efficiently turned down to 25% of full load. While the efficiency of ACFB is on par with conventional pulverized coal-fired plants, the advantage of ACFB is that coal of any sulfur or ash content can be used, and any type or size unit can be repowered. In repowering applications, an existing plant area is used, and coal- and waste-handling equipment, as well as steam turbine equipment, is retained, thereby extending the life of the plant.

In its commercial configuration, ACFB technology offers several potential benefits when compared with conventional pulverized coal-fired systems: lower capital costs; reduced SO_2 and NO_x emissions at lower costs; higher combustion efficiency; a high degree of fuel flexibility (including use of renewable fuels); and dry, granular solid by-product material that is easily disposed of or potentially salable.

Next Generation CFB Coal Generating Unit

Participant
Colorado Springs Utilities, an enterprise of the City of Colorado Springs

Additional Team Members
Foster Wheeler Power Group, Inc.—technology supplier

Location
Fountain, El Paso County, Colorado (Colorado Springs Utilities' Ray D. Nixon Power Plant)

Technology
Foster Wheeler circulating fluidized-bed (CFB) combustion system and advanced selective non-catalytic reduction (SNCR)

Plant Capacity/Production
150 MW

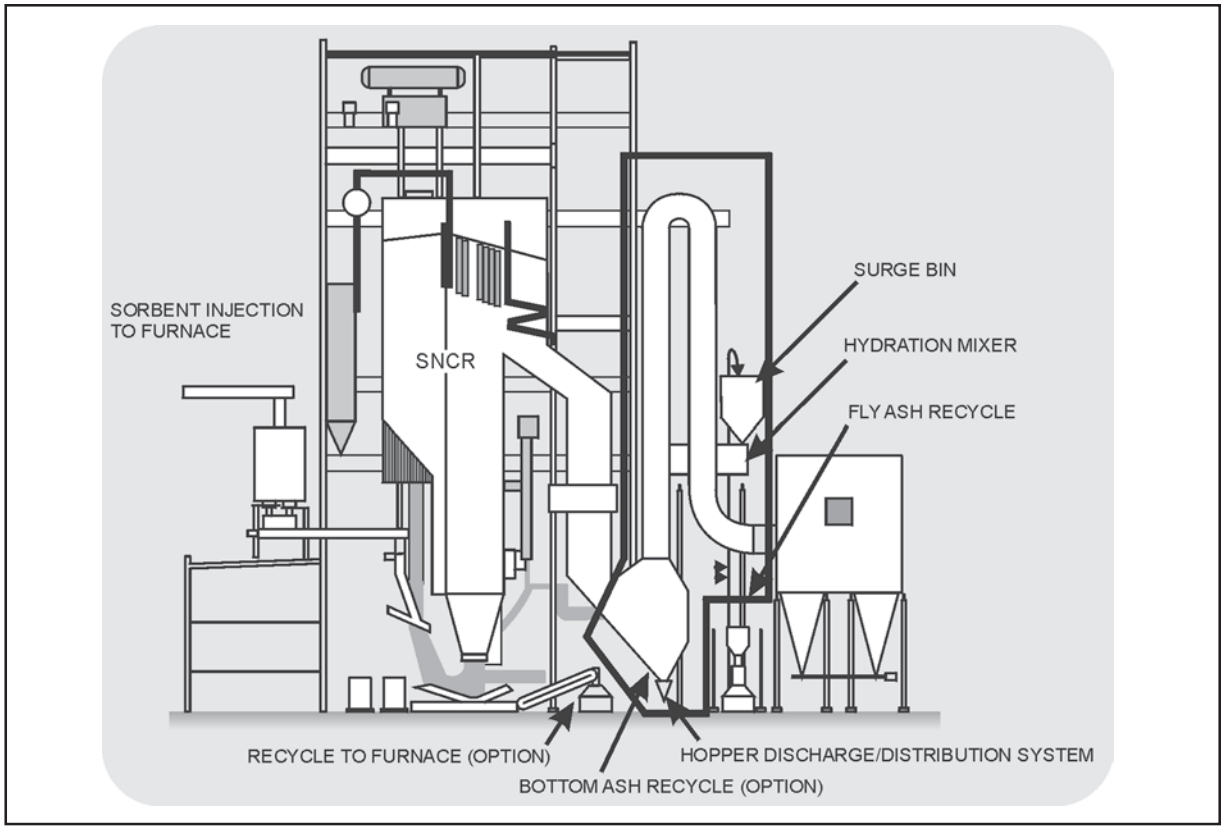
Coal
Sub-Bituminous Powder River Basin (PRB)

PRB blended with coal waste, biomass, petroleum coke

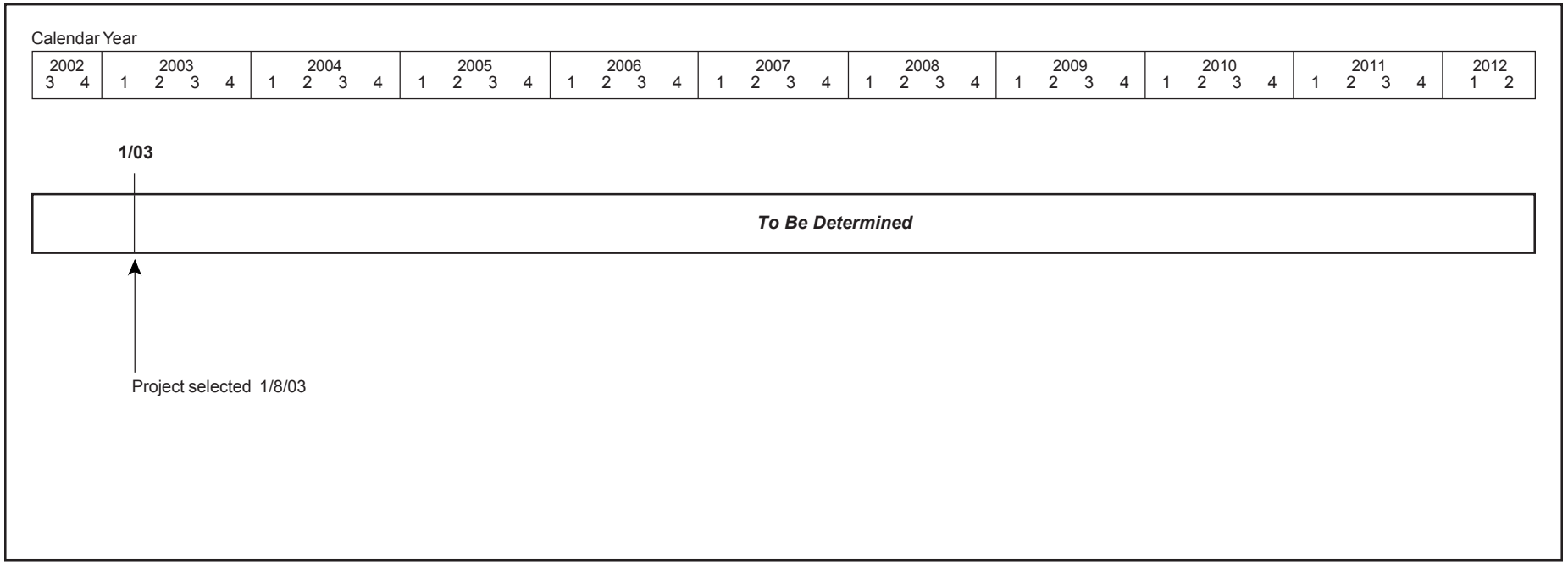
Project Funding

Total	$301,504,011	100%
DOE Share	$ 30,000,000	10
Participant	$271,504,011	90

Project Objective
To demonstrate an advanced low-emission CFB combustion system that is expected to achieve 96–98% sulfur removal, while reducing limestone consumption to less than half of conventional CFB systems. The system also features an integrated trace metal control system that can remove up to 90% of mercury, lead, and other metals, as well as virtually all acid gases in the flue gas.



Technology/Project Description
For nitrogen oxides (NO_x), the system features an advanced staged-combustion process coupled with an advanced SNCR system that can reduce stack NO_x levels to those achievable only with higher cost selective catalytic reduction (SCR) technology. For sulfur oxides (SO_x), the design features a three-stage approach to achieve the highest sulfur capture with the lowest limestone consumption. Unlike other processes, the limestone fed to the furnace is the only source of reagent added for sulfur removal. To improve reliability and lower cost, the design features an advanced integrated solids separator system integrated into the traditional furnace structure instead of traditional cyclones.



Project Status/Accomplishments

The project was selected for award on January 8, 2003. Negotiations are underway and the cooperative agreement is expected to be awarded mid- to late-2003. The project is expected to last about six years.

Commercial Applications

This demonstration project offers the opportunity for a low-cost advanced emissions control system applicable to a variety of coals and other fuels for CFBs. The system is predicted to achieve low levels of NO_x (0.04 lb/10^6 Btu with Powder River Basin coal) using an advanced selective non-catalytic reduction system, very-high sulfur control at 96–98 percent reductions using a three-stage collection system to substantially reduce limestone as compared to more conventional CFBs, and a trace metal emissions control system with potential to remove up to 90 percent of mercury contained in the fuel feed. This demonstration project will also use a suite of fuels including Powder River Basin subbituminous, Illinois and Pittsburgh eastern bituminous, waste coal and biomass/woodwaste while achieving high levels of emissions control. If successful, this unit would become the cleanest coal-fired electric power plant in the country and could eliminate hazardous forest deadwood biomass (important to local efforts in wildfire management). The plant includes a dry cooling tower to minimize water use (an increasingly important consideration in power plant design). Colorado Springs is one of the fastest growing cities in the region and will benefit by lower power costs from using clean coal technology. The project incorporates an advanced control system (including mercury control) that will be applicable to new and some existing CFB units and will demonstrate fuel flexibility for western and eastern coals as well as waste coals. Co-firing with biomass supports effective carbon management objectives as well.

Kentucky Pioneer Energy IGCC Demonstration Project

Participant
Kentucky Pioneer Energy, LLC

Additional Team Members
Fuel Cell Energy, Inc. (formerly Energy Research Corporation)—molten carbonate fuel cell designer and supplier, and cofunder

Location
Trapp, Clark County, KY (East Kentucky Power Cooperative's Smith site)

Technology
Integrated gasification combined-cycle (IGCC) using a BG/L (formerly British Gas/Lurgi) slagging fixed-bed gasification system coupled with Fuel Cell Energy's molten carbonate fuel cell (MCFC)

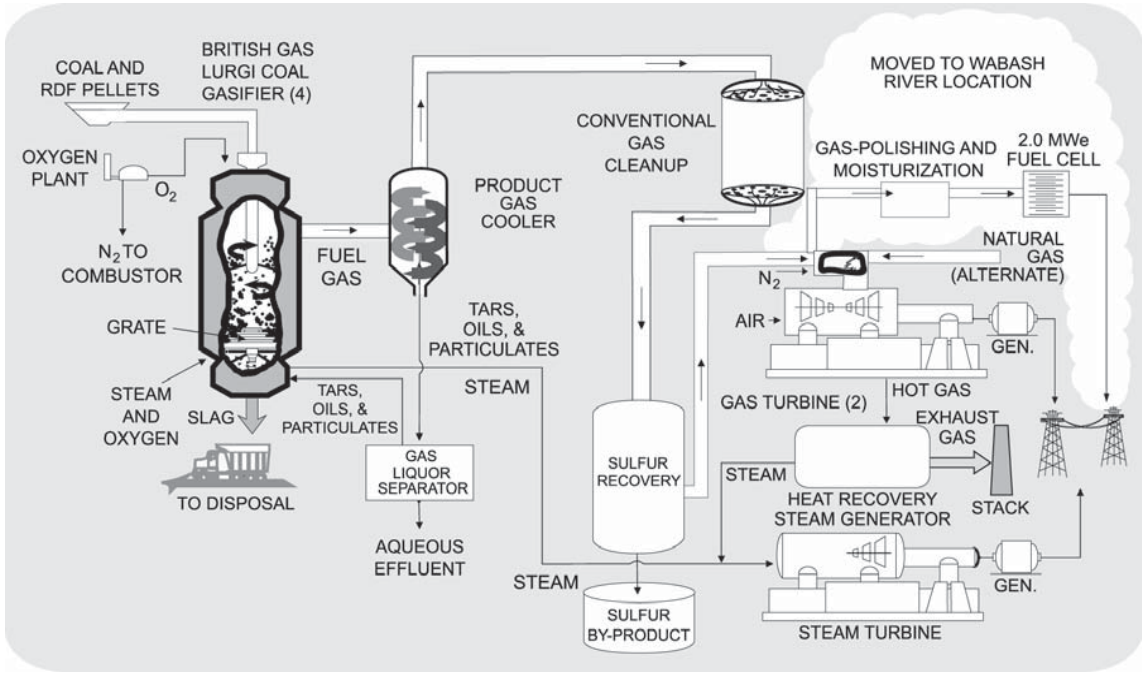
Plant Capacity/Production
580 MWe (gross); 540 MWe (net) IGCC; 2.0 MWe MCFC

Coal
High-sulfur Kentucky bituminous coal and pelletized refuse-derived fuel (RDF)

Project Funding

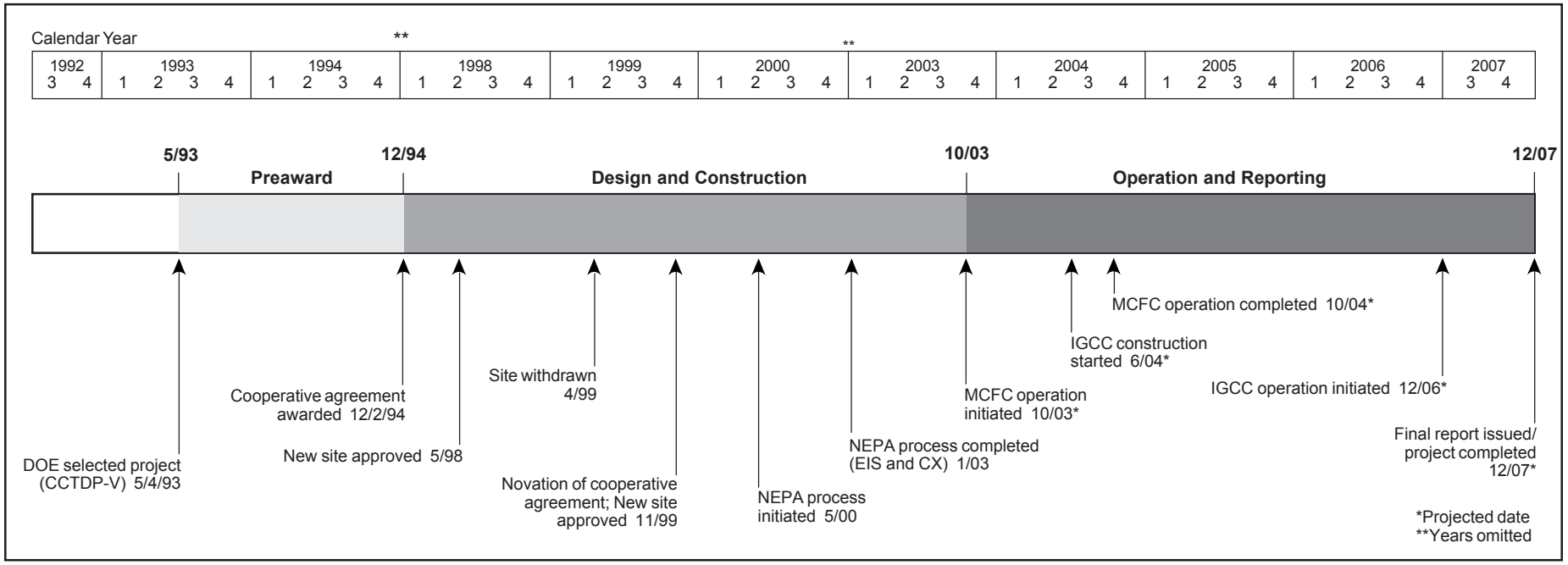
Total	$431,932,714	100%
DOE	78,086,357	18
Participant	353,846,225	82

Project Objective
To demonstrate and assess the reliability, availability, and maintainability of a utility-scale IGCC system using a high-sulfur bituminous coal and refuse-derived fuel (RDF) blend in an oxygen-blown, fixed-bed, slagging gasifier and the operability of a molten carbonate fuel cell fueled by coal gas.



Technology/Project Description
The four BG/L gasifiers are supplied with steam, oxygen, limestone flux, and a coal and pelletized RDF. During gasification, the oxygen and steam react with the coal and limestone flux to produce a coal-derived fuel gas rich in hydrogen and carbon monoxide. Raw fuel gas exiting the gasifier is washed and cooled. Hydrogen sulfide and other sulfur compounds are removed. Elemental sulfur is reclaimed and sold as a by-product. Tars, oils, and dust are recycled to the gasifier. Instead of ash, the inorganic components in the feedstock are reduced to a non-leaching silica matrix that will be used as a synthetic aggregate. The resulting clean, medium-Btu fuel gas fires two gas turbines. Operation will commence on 100% coal with slowly increasing levels of RDF throughout the demonstration. This method will allow the development of a database of plant performance at various levels of RDF feed.

The MCFC, which has been relocated to another site, is composed of a molten carbonate electrolyte sandwiched between porous anode and cathode plates. Fuel (desulfurized, heated medium-Btu fuel gas) and steam are fed continuously into the anode; CO_2-enriched air is fed into the cathode. Chemical reactions produce direct electric current, which is converted to alternating current with an inverter.



Project Status/Accomplishments

On May 8, 1998, DOE conditionally approved Ameren Services Company (merger of Union Electric Co. and Central Illinois Public Service Co.) as an equity partner and host site provider subject to completing specific business and teaming milestones. The new project site to be provided by Ameren was at its Venice Station Plant in Venice, Illinois. On April 30, 1999, Ameren Services Company withdrew from the project for economic and business reasons.

In May 1999, Global Energy USA Limited (Global), sole owner of Kentucky Pioneer Energy, LLC (KPE), expressed interest in acquiring the project and providing a host site at East Kentucky Power Cooperative's Smith Site in Clark County, Kentucky. Subsequently, Global negotiated all the necessary documents with DOE and Clean Energy Partners, L.P. (CEP) to acquire the project. In November 1999, the cooperative agreement was novated and the new site was approved.

The NEPA process for the IGCC plant was completed with the Record of Decision being issued on January 29, 2003. The NEPA process for the fuel cell was completed with the issue of a categorical exclusion on September 30, 2002.

The heat rate of the IGCC demonstration facility is projected to be 8,560 Btu/kWh (40% efficiency) and the commercial embodiment of the system has a projected heat rate of 8,035 Btu/kWh (42.5% efficiency). These efficiencies represent a greater than 20% reduction in emissions of CO_2 when compared with a conventional pulverized coal plant equipped with a scrubber. The SO_2 emissions from the IGCC system are expected to be less than 0.1 lb/10^6 Btu (99% reduction); and NO_x emissions less than 0.15 lb/10^6 Btu (90% reduction).

The fuel cell portion of the project has been relocated to Global Energy's Wabash site and was dedicated in August 2003. The fuel cell will be operated on coal-derived syngas. The move will advance the MCFC demonstration by two years.

Commercial Applications

The IGCC system being demonstrated in this project is suitable for both repowering applications and new power plants. The technology is expected to be adaptable to a wide variety of potential market applications because of several factors. First, the BG/L gasification technology has successfully used a wide variety of U.S. coals. Also, the highly modular approach to system design makes the BG/L-based IGCC and MCFC competitive in a wide range of plant sizes. In addition, the high efficiency and excellent environmental performance of the system are competitive with or superior to other fossil-fuel-fired power generation technologies.

Clean Coal Diesel Demonstration Project

Participant
TIAX, LLC (acquired the research contracts of Arthur D. Little, Inc.)

Additional Team Members
University of Alaska at Fairbanks (UAF)—host and cofunder

Fairbanks Morse Engine—diesel engine technology vendor

Gatliff Coal Company—coal supplier

Usibelli Coal Mine, Inc.—coal supplier

Location
Fairbanks, AK (University of Alaska facility)

Technology
Fairbanks Morse coal-fueled diesel engine

Plant Capacity/Production
6.4 MWe (net)

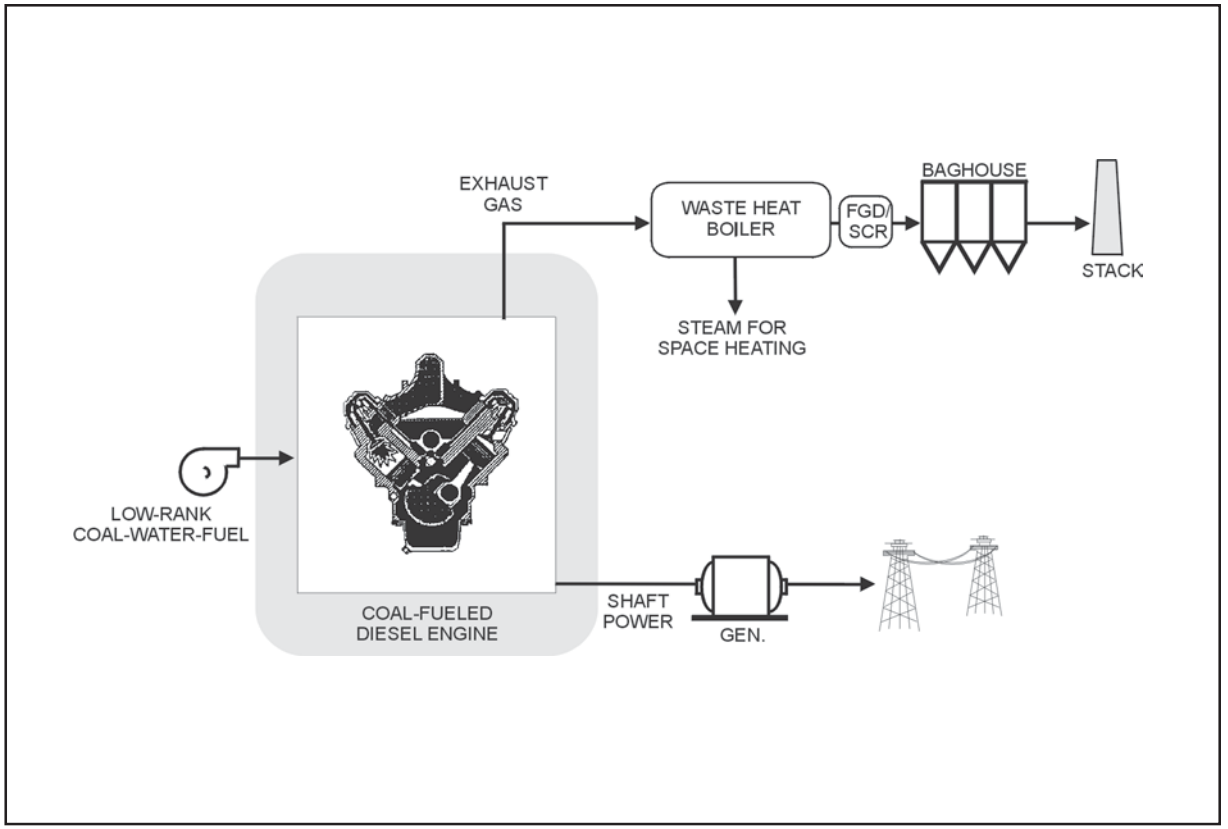
Coal
Kentucky bituminous and Alaskan subbituminous

Project Funding

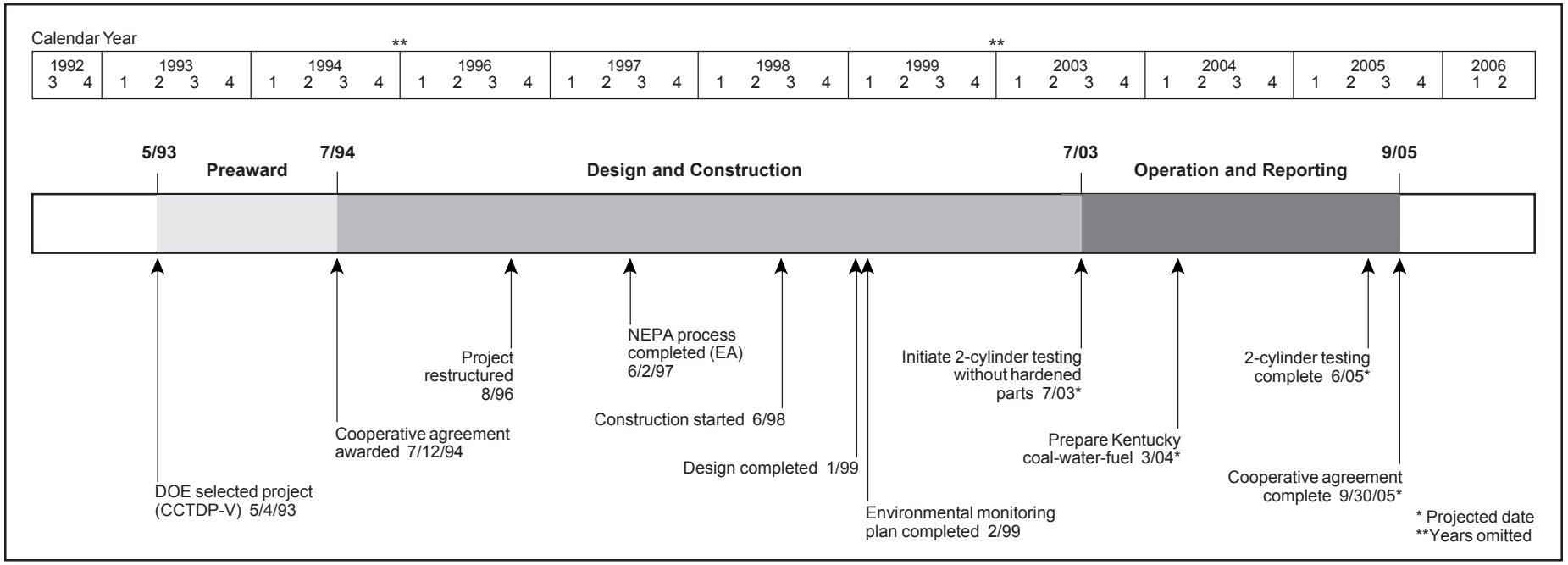
Total	$47,636,000	100%
DOE	23,818,000	50
Participant	23,818,000	50

Project Objective
To prove the design, operability, durability of a coal diesel engine during 1,000 hours of operation on coal water fuel.

Technology/Project Description
The Clean Coal Diesel Demonstration Project, as originally conceived, was to use a coal-water-fuel (CWF) slurry to operate an 18-cylinder diesel engine at the University of Alaska Fairbanks (UAF). Primarily because no coal slurry processor could be identified in Alaska to provide the necessary fuel to operate the UAF 18-cylinder engine, the scope of the project was modified. The new project scope includes 1,000 hours of testing on a two-cylinder engine in Wisconsin using a Kentucky coal source for slurry fuel. The two-cylinder engine in Wisconsin is identical to the 18-cylinder engine in Alaska in nearly every respect except for the number of cylinders. The two engines have identical horsepower per cylinder, emissions per cylinder, fueling rate per cylinder, wear rates, exhaust flow per cylinder, *etc*.



Initial tests will be conducted primarily on Kentucky bituminous CWF from the Gatliff Coal Company and on Alaskan subbituminous CWF from Usibelli Coal Mine, Inc. The clean coal diesel technology is expected to have very low NO_x and SO_2 emission levels. The 2-cylinder engine will first operate without hardened parts as an acceptance test for the CWF formulation and special fuel injectors. This initial operation will serve to define engine operation parameters, such as air preheat, number and size of injector tip holes, timing of start of injection, amount of diesel fuel pilot, and timing of diesel fuel pilot. After initial testing, the 2-cylinder engine will be modified to add hardened parts and operated on Kentucky bituminous CWF for 12 hours per day for a total of 1000 hours. The testing will be conducted in a series of four 250-hour tests, between which Fairbanks Morse Engine will inspect engine parts. Simultaneously, UAF will prepare the 18-cylinder diesel engine for future CWF operation by modifying the cooling system, modifying the injectors, adding selective catalytic reduction (SCR), and installing hardened parts. The 18-cylinder diesel engine testing will establish a baseline for NO_x and particulate emissions on diesel fuel and provide additional data for operation with hardened parts.



Project Status/Accomplishments

Overall project system design was completed in early 1999. The 18-cylinder diesel engine arrived on site at UAF in January 1999 and was mounted in the engine house in late February. In October 1999, the engine, after being connected to the generator, was operated on diesel fuel to ensure it would function coupled with the generator. In May 2000, total system startup was attempted on diesel fuel. The SCR system for the diesel was tested in August 2000 and achieved 90% reduction in NO_x emissions, which was within contract specifications. Since August 15, 2000, the diesel has been supplying all of the university's power requirements on fuel oil.

Testing was temporarily halted because the Goodrich Corp. division that operates the test facility, Engineered Industrial Products (which included Fairbanks Morse Engine), was spun off as a separate business now owned by EnPro Industries. As a result, the scope of the project was revised and the focus shifted to the 2-cylinder diesel engine as the optimal way to meet the demonstration project's objectives.

Commercial Applications

The U.S. diesel market is projected to exceed 60,000 MWe (over 7,000 engines) through 2020. The worldwide market is 70 times the U.S. market. The technology is particularly applicable to distributed power generation in the 5- to 20-MWe range, using indigenous coal in developing countries.

The net effective heat rate for the mature diesel system is expected to be 6,830 Btu/kWh (48% efficiency), which makes it very competitive with similarly sized coal- and fuel oil-fired installations. Environmental emissions from commercial diesel systems should be reduced to levels between 50% and 70% below NSPS. The estimated installation cost of a mature commercial unit is approximately $1,300/kW.

Coal Processing for Clean Fuels

Lignite Fuel Enhancement

Participant
Great River Energy (GRE)

Additional Team Members
Electric Power Research Institute—collaborator

Lehigh University—collaborator

Barr Engineering—collaborator

Falkirk Mining and Couteau Properties—collaborator

Location
Underwood, McLean County, North Dakota (GRE's Coal Creek Station)

Technology
High-moisture coal enhancement by incrementally drying using waste heat

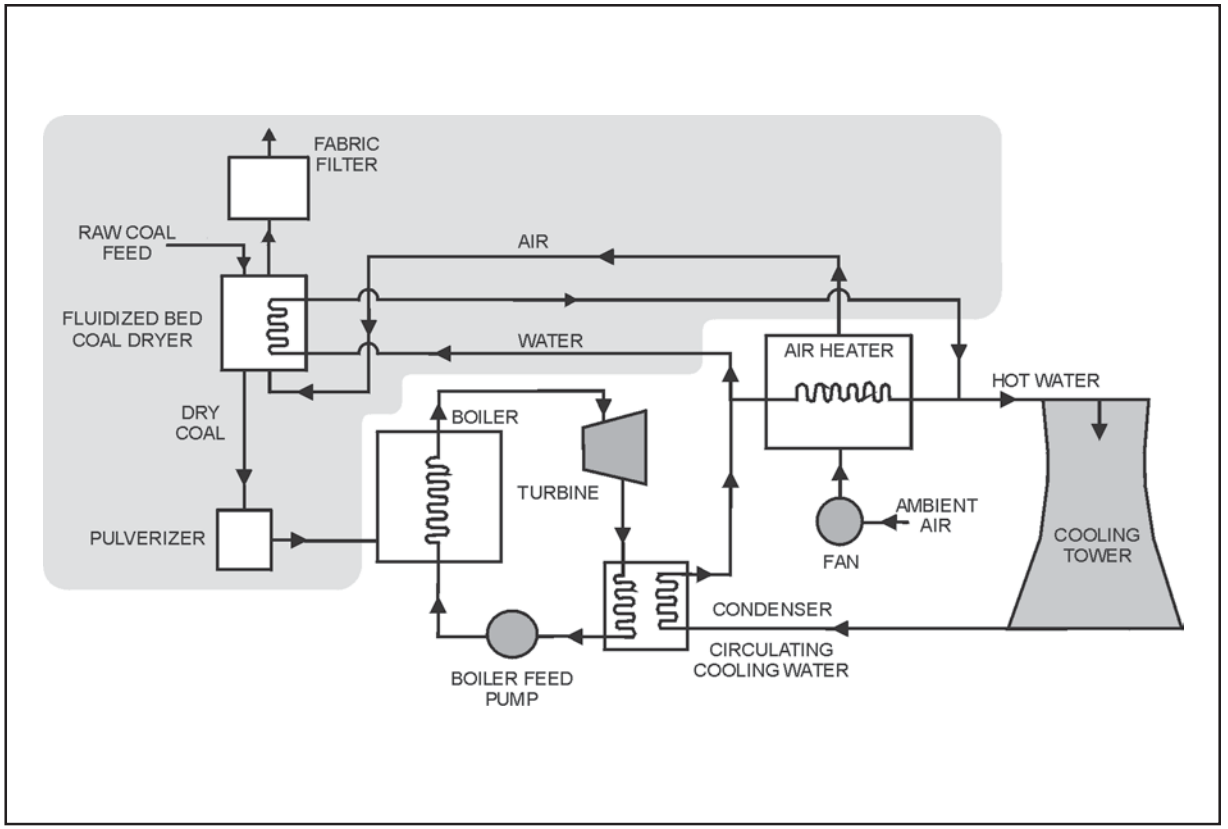
Plant Capacity/Production
546 MW

Coal
Lignite

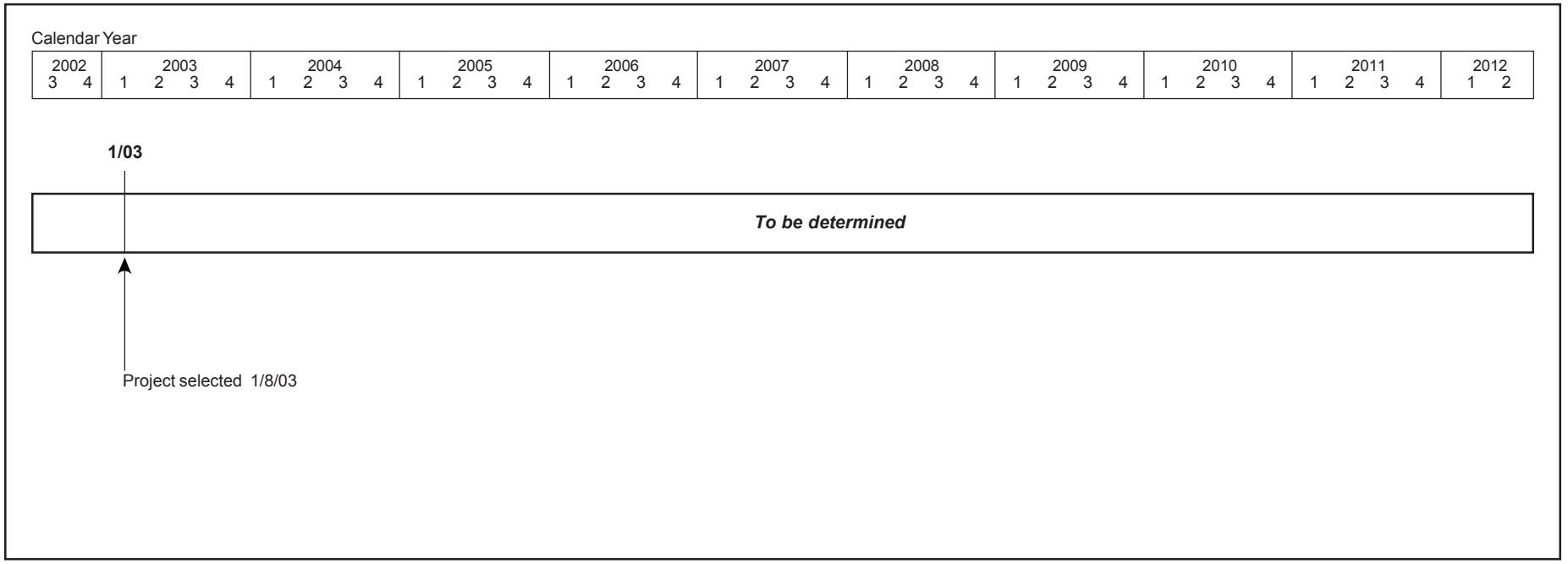
Project Funding

Total	$22,000,000	100%
DOE Share	$11,000,000	50
Participant	$11,000,000	50

Project Objective
To demonstrate a 5 to 15 percentage point reduction in lignite moisture content (about 1/4 the total moisture content) by incremental drying using waste heat from the power plant in order to significantly enhance the value of lignite as a fuel in electrical generation power plants within the next five years.



Technology/Project Description
Although current lignite power plants are designed to burn high-moisture coals, a 5 to 15 percentage point reduction in moisture content will result in significant improvements. The benefits of reduced-moisture-content lignite will be demonstrated at the GRE Coal Creek Station. A phased approach will be used. In the first phase, a full-scale prototype dryer module will be designed and built to support operation of a single pulverizer on one of the 546-MW units at the Coal Creek Station. Following successful demonstration of the dryer and the performance improvements as a result of the dryer, GRE will design, construct, and perform full-scale, long-term operational testing of a full suite of dryer modules for full operation of the unit on incrementally dried coal.



Project Status/Accomplishments

This project was selected for award on January 8, 2003. Negotiations are currently in progress. The cooperative agreement is expected to be issued in late-2003. The project duration is expected to be slightly over three years.

Commercial Applications

This project offers a novel concept for using low-value, often underutilized heat normally available in power plants, to increase the plant's efficiency, reduce pollution, and improve economics. When demonstrated, this technology could be applied to increase the generating capacity, efficiency, and cost-effectiveness of other units that burn high-moisture coal. Currently in the United States, there are 29 operating plants using lignite coal (15.3 GW) and more than 150 plants burning Powder River Basin (PRB) coals (more than 150 GW), both with inherently high moisture content. Application of this technology could result in a reduction in the emissions from coal-fired power plants because the plants will require less of the dried coal to produce the equivalent amount of power. For example, in this project, the moisture in the lignite would be lowered from 38% to 29.5% and is estimated to yield a 2.8% efficiency improvement with an attendant benefit of reducing carbon dioxide, sulfur dioxide, and mercury emissions per unit electricity output. This technology could potentially increase the efficiency of plants running on PRB and lignite which represents slightly more than half of the coal electrical generation capacity in the United States.

Gilberton Coal-to-Clean Fuels and Power Co-Production Project

Participant
WMPI PTY., LLC

Additional Team Members
Nexant, Inc.—collaborator

Shell Global Solutions B.V., U.S.—collaborator

Uhde GmbH.—Engineer, technology supplier, and constructor

SASOL Technology Ltd.—collaborator

Location
Gilberton, Schuylkill County, Pennsylvania

Technology
Shell gasifier and Fischer-Tropsch (FT) synthesis

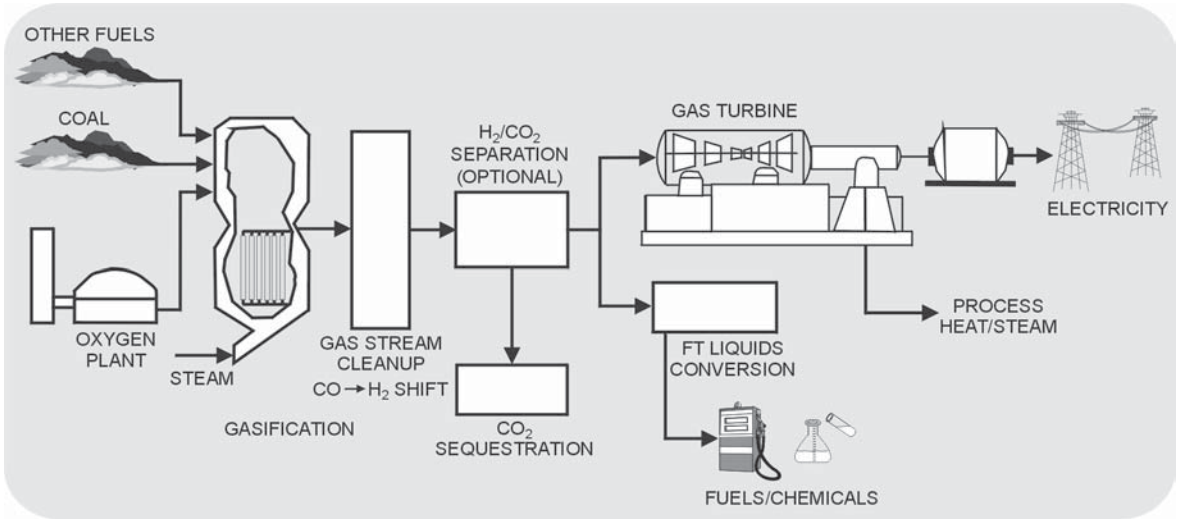
Project Capacity/Production
5,038 bbls/day of ultra-clean fuels and 41 MWe

Coal
Coal-derived wastes, such as anthracite culm

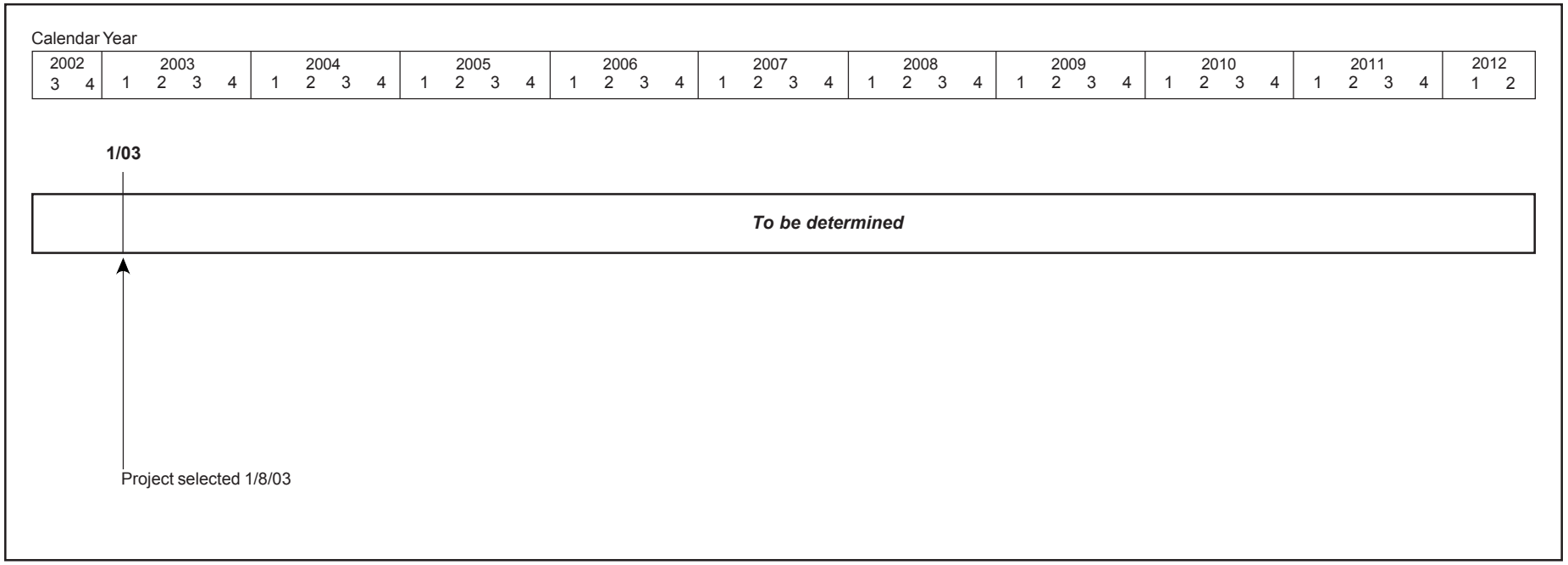
Project Funding

Total	$612,000,000	100%
DOE Share	$100,000,000	16
Participant	$512,000,000	84

Project Objective
To demonstrate gasification of coal wastes to produce a synthesis gas, and in turn electric power, steam, and clean liquid fuels.



Technology/Project Description
The plant will gasify the coal wastes to produce a synthesis gas of hydrogen and carbon monoxide using Shell's oxygen blown gasifier. A portion of the synthesis gas from the gasification process will be converted into synthetic hydrocarbon liquids via a catalytic chemical process known as FT synthesis. The FT naphtha, kerosene, and diesel fuels, being virtually free of sulfur, nitrogen, and aromatics, are superior to their conventional petroleum counterparts in both end-use and environmental properties. The FT naphtha can either be upgraded to a high-octane, clean reformulated gasoline (RFG) or used as sulfur-free onboard reforming feed for hydrogen fuel-cell-powered vehicle applications. The FT kerosene has a low smoke point and potential application as a niche-market jet fuel. FT diesel fuel has a high Cetane Number and offers reduced particulate matter, NO_x, hydrocarbon and CO emissions. Other by-products include sulfur and a vitrified material that has a variety of industrial uses.



Project Status/Accomplishments

This project was selected for award on January 8, 2003. Negotiations are currently in progress. The cooperative agreement is expected to be issued by late-2003. The project duration is expected to be six years.

Work is continuing on preparing the Environmental Impact Statement. The public scoping meeting was held on May 5, 2003. Other preaward activities, such as securing project financing, preparing an estimate for the lump sum turnkey price, and characterization of the feedstock, are also underway.

Commercial Applications

A primary benefit of this project is that it applies clean coal technology to address a long-standing environmental reclamation issue associated with the mining and production of coal. This project offers a unique integration of several key technologies to, for the first time, convert 4,700 tons/day of coal waste materials (referred to as anthracite culm in this case) into 41 MWe of clean electric power and over 5,000 barrels per day of ultra-clean transportation fuels. This project will process about 1.0 million tons per year of coal waste materials from the Gilberton site. It has been estimated that from past coal mining operation, about 200–300 million tons of this material can be found across Pennsylvania alone. A similar amount is present in Illinois. If successful, this technology could be applied in many regions of the country enabling reclamation of lands where coal wastes are currently stockpiled and significantly reduce waste disposal activities from operating coal mines. The transportation fuels produced will be in the form of ultra-clean, high-cetane diesel fuel from the FT process and contain no sulfur or aromatics. The FT naphtha can be upgraded to clean-burning reformulated gasoline. FT naphtha is also an excellent feedstock for steam cracking for olefin production, or as onboard reforming feed for fuel cell powered vehicles. The proposed process scheme is very flexible. It can use coal, coal wastes, petroleum coke, and biomass alone, or as a blended feedstock to make synthesis gas that can be converted into a variety of beneficial products such as electricity, process heat, transportation fuels and other chemical feedstocks. The combination of the Shell gasifier and the use of the Rectisol™ process will remove contaminants from the plant's effluent to very low levels. In fact, this stream will be concentrated in carbon dioxide and offers an opportunity for carbon management options beyond this demonstration project. The gross plant efficiency is estimated to be about 45 percent, based on the total energy input and considering the energy value of all the plant's products. The project will bring this country one step closer to energy independence by demonstrating the ability to economically convert domestic waste coal and low-value energy resources into high-value products in an environmentally sound manner. If successful, this project is of sufficient scale to reduce technical, business, and financial risks, clearing the way for subsequent applications.

Advanced Coal Conversion Process Demonstration

Demonstration Operations Completed

Participant

Western SynCoal LLC (formerly Rosebud SynCoal Partnership; a subsidiary of Montana Power Company's Energy Supply Division)

Additional Team Members

None

Location

Colstrip, Rosebud County, MT (adjacent to Western Energy Company's Rosebud Mine)

Technology

Western SynCoal LLC's Advanced Coal Conversion Process for upgrading low-rank subbituminous and lignite coals

Plant Capacity/Production

45 tons/hr of SynCoal® product

Coal

Powder River Basin subbituminous (Rosebud Mine), 0.5–1.5% sulfur, plus tests of other subbituminous coals and lignites

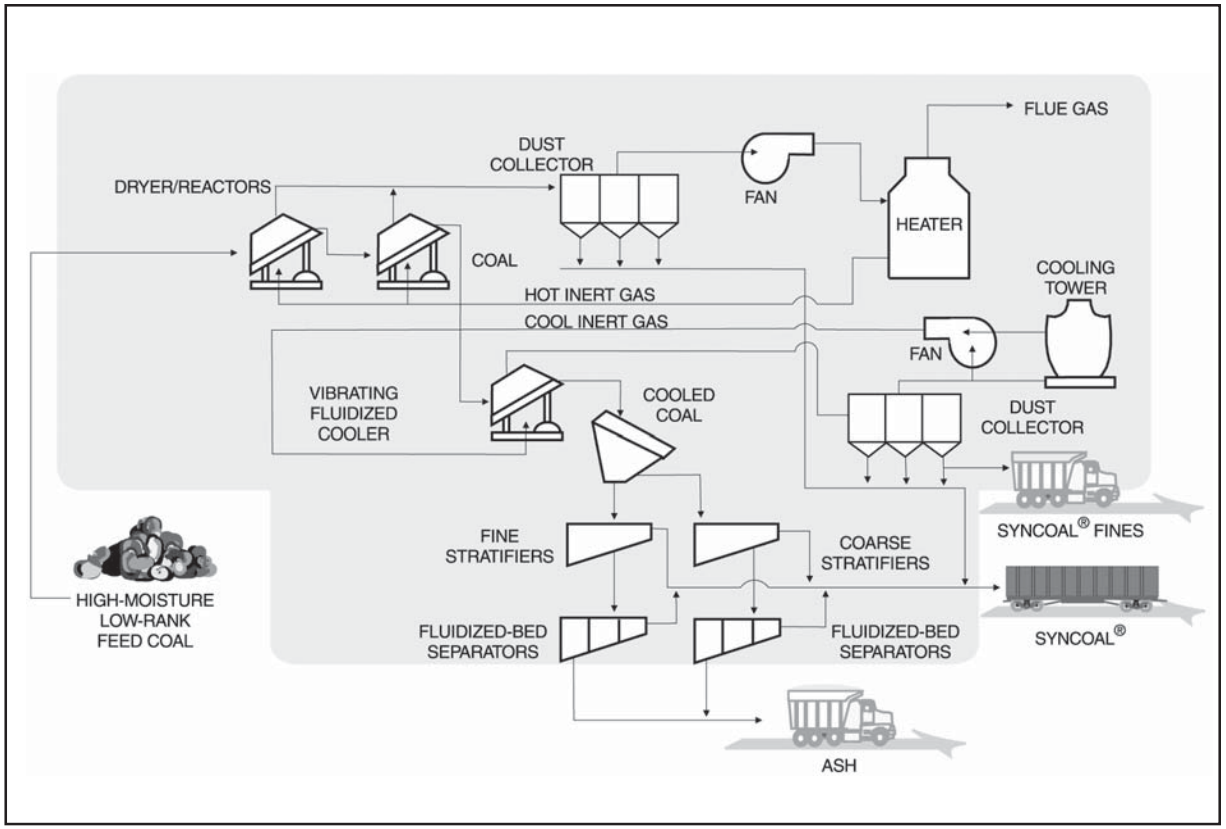
Project Funding

Total	$105,700,000	100%
DOE	43,125,000	41
Participant	62,575,000	59

Project Objective

To demonstrate Western SynCoal LLC's Advanced Coal Conversion Process (ACCP) to produce SynCoal®, a stable coal product having a moisture content as low as 1%, sulfur content as low as 0.3%, and heating value up to 12,000 Btu/lb.

SynCoal is a registered trademark of the Rosebud SynCoal Partnership.

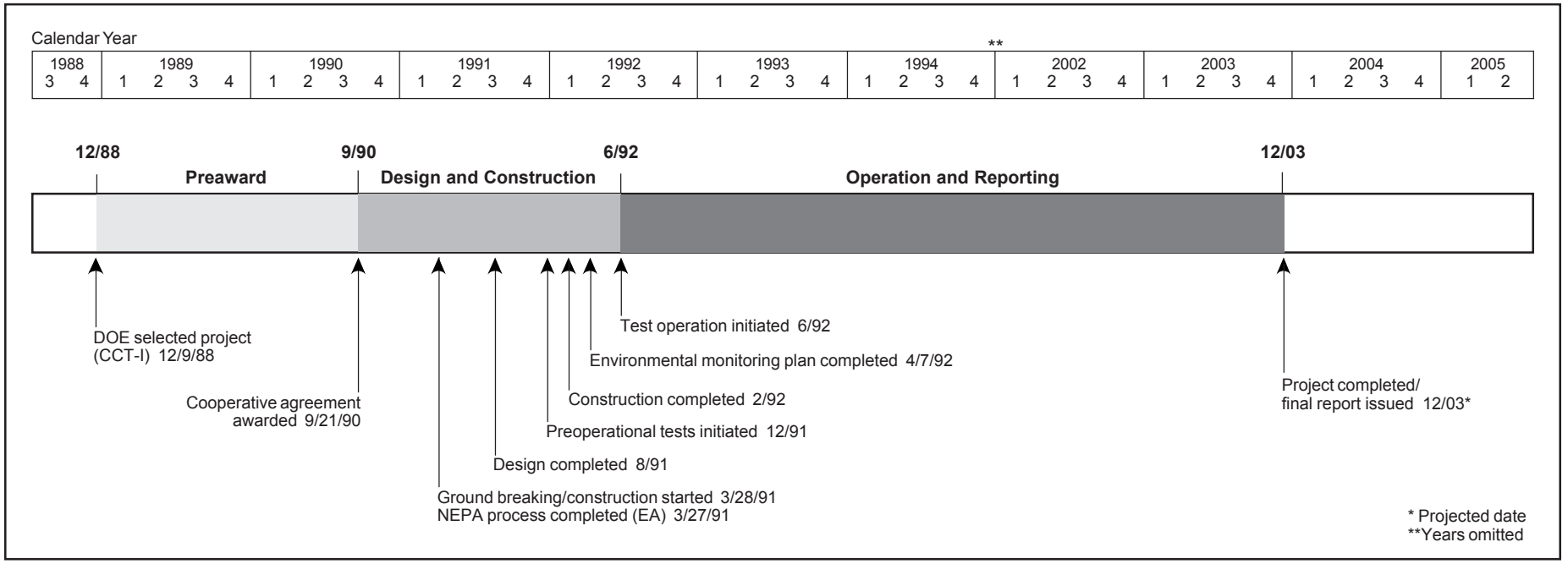


Technology/Project Description

The process demonstrated is an advanced thermal coal conversion process coupled with physical cleaning techniques to upgrade high-moisture, low-rank coals to produce a high-quality, low-sulfur fuel. The raw coal is screened and fed to a vibratory fluidized-bed reactor where surface moisture is removed by heating with hot combustion gas. Coal exits this reactor at a temperature slightly higher than that required to evaporate water and flows to a second vibratory reactor where the coal is heated to nearly 600 °F. This temperature is sufficient to remove chemically bound water, carboxyl groups, and volatile sulfur compounds. In addition, a small amount of tar is released, partially sealing the dried product. Particle shrinkage causes fracturing, destroys moisture reaction sites, and liberates the ash-forming mineral matter.

The coal is then cooled to less than 150 °F by contact with an inert gas in a vibrating fluidized-bed cooler. The cooled coal is sized and fed to deep-bed stratifiers where air pressure and vibration separate mineral matter, including much of the pyrite, from the coal, thereby reducing the sulfur content of the product. The low specific gravity fractions are sent to a product conveyor while heavier fractions go to fluidized-bed separators for additional ash removal.

The fines handling system consolidates the coal fines that are produced throughout the ACCP facility. The fines are gathered by screw conveyors and transported by drag conveyors to a bulk cooling system. The cooled fines are blended with the coarse product, stored in a 250-ton capacity bin until loaded into pneumatic trucks for off-site sales, or returned to the mine pit.



Results Summary

Operational

- During the life of the ACCP project, over 2.8 million tons of raw coal was processed to produce almost 1.9 million tons of SynCoal® products, which included regular, fines, blends, DSE treated, and special characteristic SynCoal® shipped to various customers.
- The product produced was exceptionally close to the design basis product from a chemical standpoint, but did not allow for conventional bulk handling from a physical standpoint due to instability (spontaneous heating) and dustiness.

Environmental

- The measured emissions of PM from the process stack were 0.0259 gr/dscf (2.563 lb/hr) with a limit of 0.031 gr/dscf.
- The measured emissions of NO_x were 4.50 lb/hr (54.5 ppm) compared with a vendor estimated limit of 7.95 lb/hr for controlled emissions and 11.55 lb/hr for uncontrolled emissions.
- The measured emissions of CO were 9.61 lb/hr (191.5 ppm) compared with a vendor estimated limit of 6.46 lb/hr for controlled emissions and 27.19 lb/hr for uncontrolled emissions.
- The measured emissions of SO_2 were 0.227 lb/hr (2.0 ppm) compared with a vendor estimated limit of 7.95 lb/hr for controlled emissions and 20.27 lb/hr for uncontrolled emissions.
- The measured emissions of total hydrocarbons were 2.93 lb/hr (37.1 parts per million).
- The measured emissions of hydrogen sulfide were 0.007 lb/hr (0.12 parts per million).

Economic

- Economic data are not available.

Project Summary

This project demonstrated an advanced, thermal, coal upgrading process, coupled with physical cleaning techniques, that was designed to upgrade high-moisture, low-rank coals to a high-quality, low-sulfur fuel, registered as the SynCoal® process. The coal was processed through three stages (two heating stages followed by an inert cooling stage) of vibrating fluidized-bed reactors that remove chemically bound water, carboxyl groups, and volatile sulfur compounds. After thermal upgrading, the coal is processed in vibrating pneumatic stratifiers to separate the pyrite-rich coal refuse from the SynCoal® product.

The 45-ton-per-hour unit is located adjacent to a unit train load-out facility at Western Energy Company's Rosebud coal mine near Colstrip, Montana. The demonstration plant was sized at about one-tenth the projected throughput of a projected commercial facility.

Operational Performance

During the life of the ACCP project, over 2.9 million tons of raw coal was processed to produce almost 2.0 million tons of SynCoal® products, which include regular, fines, blends, dust stabilization enhancement (DSE) treated, and special characteristic SynCoal® shipped to various customers. See Exhibit 5-4 for annual statistics from the ACCP plant. The plant posted a perfect worker safety record with no lost time accidents during the entire nine years of operation. When operation ended in 2001, the ACCP had been supplying six commercial customers with SynCoal®.

The product produced has been exceptionally close to the design basis product from a chemical standpoint, but was not acceptable for conventional bulk handling and storage due to instability (spontaneous heating) and dustiness. Due to the instability, SynCoal® had to be stored with an inert gas or in tightly sealed vessels to prevent air infiltration. A CO_2 inert storage system was developed and installed for silo storage of SynCoal®. A significant amount of work has gone into addressing the instability issue. In conjunction with ENCOAL LLC and Amax Coal Company, Western SynCoal researched the effects of different environments and treatments on low-rank coal composition. Specific objectives were to study the explosivity and flammability limits of dust from the conversion process and to identify the causes of spontaneous heating of upgraded coal products. At the time activities were suspended, the development efforts were focused on the use of the Aeroglide Tower Reactor design.

The Aeroglide reactor represents a novel method of allowing process gases to contact the solids in a mechanically gentle environment. Solids are fed to the unit and flow, assisted only by gravity, downward through a system of baffles that gently mix the solids during the migration of the solids from the inlet to the outlet. The flow is controlled using a mass flow discharge valve. Rows of baffles are configured perpendicular to each successive row. Process gases are introduced using alternate horizontally configured baffles and distributed into the solids uniformly. Process gases migrate to adjacent baffles and exit the process bed of solids. The Aeroglide reactor was configured to rehydrate processed SynCoal®, remove the heat of reaction, and partially oxidize the product in an effort to promote product stability. This process scheme was intended to modify the characteristics of the final SynCoal® product allowing traditional transportation techniques to be employed. Results of the testing were promising, but not conclusive.

With regard to the operational performance of the SynCoal® product, three different feedstocks were tested at the ACCP facility—North Dakota lignite, Knife River lignite, and Amax subbituminous coal. Approximately 190 tons of the SynCoal® product produced with the North Dakota lignite was burned at the 250-MWe cyclone-fired Milton R. Young Power Plant Unit No. 1. Testing showed dramatic improvement in cyclone combustion, improved slag tapping, and a 13% reduction in boiler air flow requirements. In addition, boiler efficiency

Exhibit 5-4
ACCP Annual Production Rates

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Total
Raw Coal Processed (tons)	28,686	157,421	371,447	479,621	369,652	395,450	163,272	419,296	441,379	112,931	2,939,235
Availability (%)	18	50	65	78	65	66	28	70	73	54	58
Forced Outage Rate (%)	68	24	26	13	21	26	8	15	14	36	23
Avg. Feed Rate (ton/hr)	21.1	35.8	64.8	70.1	64.3	68.0	66.0	68.4	69.0	73.0	63.3
SynCoal® Shipped (tons)	5,566	57,927	208,428	315,688	238,766	250,070	97,575	288,650	291,604	76,649	1,811,124

Note: 163,106 tons of fines sold in July 1997.

increased from 82% to over 86%, and the total gross heat rate improved by 123 Btu/kWh.

At the Colstrip plant with two coal-fired power plants, baseline testing at the start of the demonstration indicated that the 330-MWe Unit No. 2 was typically producing 2.9 MWe (net) less than Unit No. 1, a sister unit of comparable capacity. In late Spring 1999, Unit No. 1 was overhauled, resulting in an increase in its average output of 7 MWe (net). With this increase in output, the overhauled Unit No. 1 would have produced 5.4 MWe more than Unit No. 2. However, for the days that SynCoal® was used, Unit No. 2 out-produced the overhauled Unit No. 1 by an average of 7.3 MWe—285.7 MWe versus 278.4 MWe (net)—with 15.0% of the total heat input coming from SynCoal. Furthermore, SynCoal® can be credited for actual 1999 SO_2 emissions reductions for Unit No. 2 of approximately 430 tons, or an 8% reduction, and NO_x emissions reductions of approximately 826 tons, or a 19% reduction, when compared with Unit No. 1 emissions.

Environmental Performance

Western SynCoal originally assumed that SO_2 emissions would have to be controlled by injecting chemical sorbents into the ductwork. Preliminary data indicated that the addition of chemical injection sorbent was not necessary to control SO_2 emissions under the operating conditions.

The coal-cleaning area's fugitive dust was controlled by placing hoods over the fugitive dust sources conveying the dust-laden air to fabric filters. The bag filters effectively removed coal dust from the air before discharge. The Montana Department of Health and Environmental Sciences completed stack tests on the east and west baghouse outlet ducts and the first-stage drying gas baghouse stack in 1993.

A stack emissions survey was conducted in May 1994. The survey determined the emissions of particulates, sulfur dioxide, oxides of nitrogen, carbon monoxide, total hydrocarbons, and hydrogen sulfide from the process stack. The results are shown in Exhibit 5-5.

Economic Performance

Economic data are not available.

Commercial Applications

ACCP has the potential to enhance the use of low-rank western subbituminous and lignite coals. SynCoal® is a viable compliance option for meeting SO_2 emission reduction requirements. SynCoal® is an ideal supplemental fuel for plants seeking to burn western low-rank coals, because the ACCP allows a wider range of low-sulfur raw coals without derating the units.

The project was able to prove the value of SynCoal® through the seven commercial customers serviced during the last few years of operation. The customers represented utility, industrial, and metallurgical applications.

The ACCP has the potential to convert inexpensive, low-sulfur, low-rank coals into valuable carbon-based reducing agents for many metallurgical applications. Furthermore, SynCoal® enhances cement and lime production and provides a value-added bentonite product.

Contacts

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References

Technical Progress Reports (1991–2000). Western SynCoal LLC. April 2001, January 2001, November 1999, February 1999, August 1998, May 1997, February 1995, December 1993, and February 1992.

Exhibit 5-5
ACCP Stack Emissions Survey Results

	Limit	Measured
Particulate Matter	0.031 gr/dscf	0.0259 gr/dscf 2.563 lb/hr
Nitrogen Oxides	7.95 lb/hr[a] 11.55 lb/hr[b]	4.50 lb/hr 54.5 ppm
Carbon Monoxide	6.46 lb/hr[a] 27.19 lb/hr[b]	9.61 lb/hr 191.5 ppm
Sulfur Dioxide	7.95 lb/hr[a] 20.27 lb/hr[b]	0.227 lb/hr 2.0 ppm
Total Hydrocarbons as Propane (Less Methane and Ethane)	NA	2.93 lb/hr 37.1 ppm
Hydrogen Sulfide	NA	0.007 lb/hr 0.12 ppm

[a] Estimated controlled emissions based on vendor information.
[b] Estimated uncontrolled emissions based on vendor information.

Industrial Applications

Clean Power from Integrated Coal/Ore Reduction (CPICOR™)

Participant
CPICOR™ Management Company LLC (a limited liability company composed of subsidiaries of the Geneva Steel Company)

Additional Team Members
Geneva Steel Holdings corporation—cofunder, constructor, host, and operator of unit

Location
Vineyard, Utah County, UT (Geneva Steel Co.'s mill)

Technology
HIsmelt® direct iron-making process

Plant Capacity/Production
3,300 ton/day liquid iron production and 296 MW (gross) of electricity

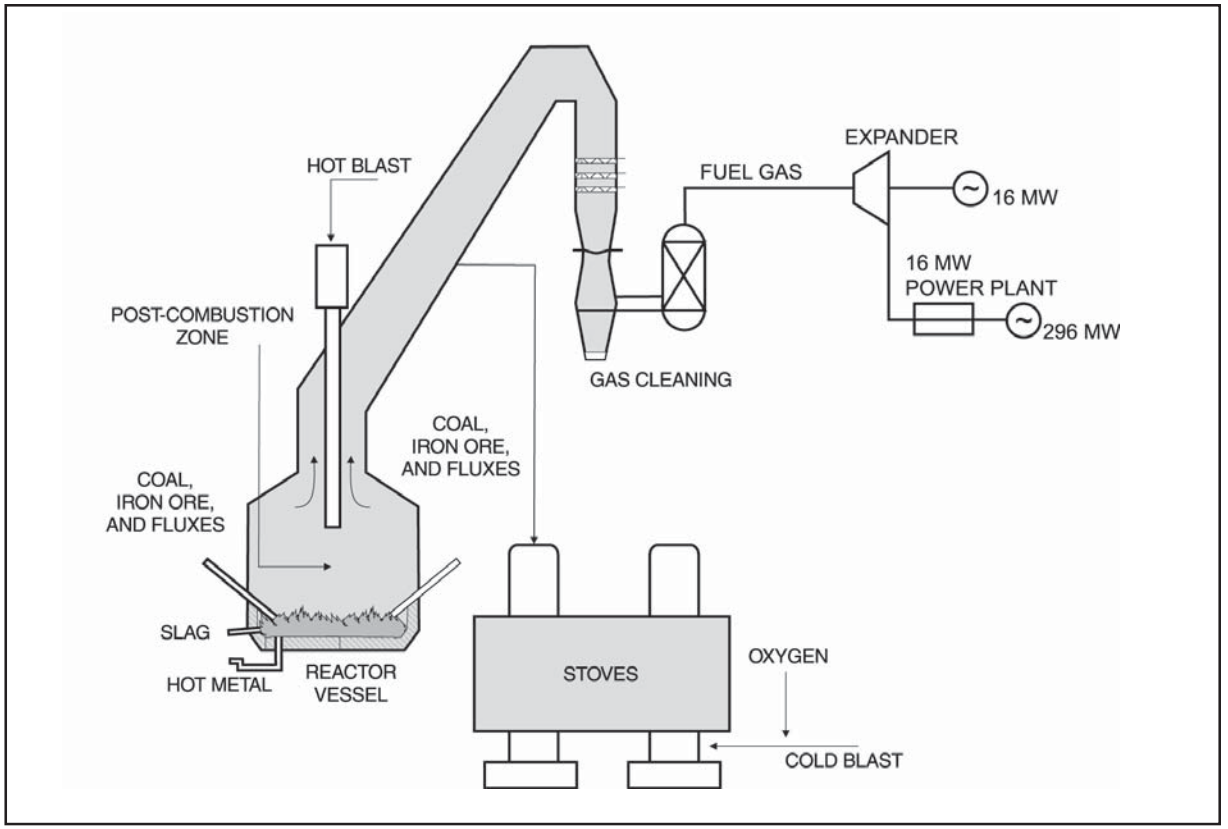
Coal
Bituminous, 0.5% sulfur

Project Funding

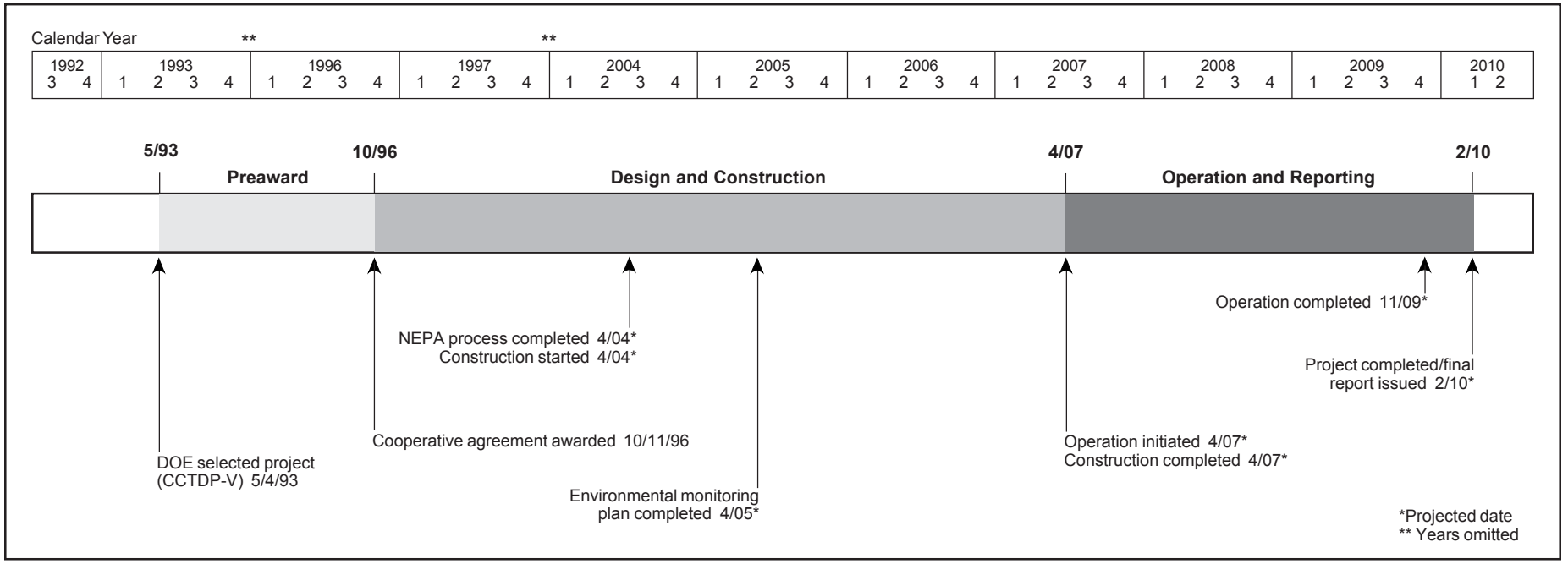
Total	$1,065,805,000	100%
DOE	149,469,242	14
Participant	916,335,758	86

Project Objective
To demonstrate the integration of direct iron making with the coproduction of electricity using various U.S. coals in an efficient and environmentally responsible manner.

Technology/Project Description
The HIsmelt® process is based on producing hot metal and slag from iron ore fines and non-coking coals. The heart of the process is producing sufficient heat and maintaining high heat transfer efficiency in the post-combustion zone above the reaction zone to reduce and smelt iron oxides. The HIsmelt® process uses a vertical smelt reduction reactor, which is a closed molten bath vessel, into which iron ore fines, coal, and fluxes are injected. The coal is injected into the bath where carbon is dissolved rapidly. The carbon reacts with O_2 (from the iron ore) to form CO and metallic iron. Injection gases and evolved CO entrain and propel droplets of slag and molten iron upward into the post-combustion zone. The iron reduction reaction in the molten bath is endothermic; therefore, additional heat is needed to sustain the process and maintain hot metal temperature. This heat is generated by post-combusting the CO and hydrogen from the bath with an O_2-enriched hot air blast from the central top lance. The heat is absorbed by the slag and molten iron droplets, which are returned to the bath by gravity. Droplets in contact with the gas in the post-combustion zone absorb heat, but are shrouded during the descent by ascending reducing gases, which, together with bath carbon, prevent unacceptable levels of FeO in the slag. The molten iron collects in the bottom of the bath and is continuously tapped from the reactor through a fore-hearth, which maintains a constant level of iron in the reactor. Slag, which is periodically tapped through a conventional blast furnace-type tap hole, is used to coat and control the internal cooling system and reduce the heat loss. Reacted gases, mainly N_2, CO_2, CO, H_2, and H_2O, exit the vessel. After scrubbing, the cleaned gases will be passed through an expander and then combusted to produce electricity. The cleaned gases can also be used to pre-heat and partially reduce incoming iron ore.



HIsmelt is a registered trademark of HIsmelt Corporation Pty Limited.



Project Status/Accomplishments

The cooperative agreement was awarded on October 11, 1996. CPICOR™ analyzed the global assortment of new direct iron-making technologies to determine which technology would be most adaptable to western U.S. coals and raw materials. Originally, the COREX® process appeared suitable for using Geneva's local raw materials; however, lack of COREX® plant data on 100% raw coals and ores prevented its application in this demonstration. Thus, CPICOR™ chose to examine alternatives. The processes evaluated included: AISI direct iron-making, DIOS, Romelt, Tecnored, Cyclonic Smelter, and HIsmelt®. The HIsmelt® process appears to offer good economic and operational potential, as well as the prospect of rapid commercialization. CPICOR™ has completed testing of two U.S. coals at the HIsmelt® pilot plant near Perth, Australia.

Project definition, preliminary design, and environmental permitting are ongoing. On July 28, 1999, DOE issued a Notice of Intent to prepare an Environmental Impact Statement for the project. A NEPA public scoping meeting was held in Provo, Utah on July 15, 1999.

On February 1, 1999, Geneva Steel Company (CPICOR™ Management Company's parent corporation) filed a voluntary petition for bankruptcy under Chapter 11 of the United States Bankruptcy Code in the U.S. Bankruptcy Court for the District of Utah. Geneva Steel emerged from Chapter 11 bankruptcy in early 2001 with a restructured balance sheet that enables full participation in this demonstration project.

On January 25, 2002, Geneva Steel LLC filed a voluntary petition under Chapter 11 of the United States Bankruptcy Code. The filing in the United States Bankruptcy Court for Utah, Central Division, was required by the company's secured lenders as a condition to providing continued access to cash proceeds from the sale of inventory and the collection of accounts receivable. Without such access, Geneva Steel would not have sufficient liquidity to continue its activities and protect its facilities.

CPICOR™ has issued several major contracts for the engineering design of the project. HIsmelt Plc. will perform all preliminary engineering required for Phase I of the project. Lurgi Metallurgy will assist in the design of the direct iron making process, with Rio Tinto (the parent company of HIsmelt Plc.) providing funding support. Lurgi will also provide engineering services for the cogeneration process, including investigation of a turbo expander for power generation.

Commercial Applications

The HIsmelt® technology is a direct replacement for existing blast furnace and coke-making facilities with additional potential to produce steam for power production. Of the existing 79 coke oven batteries, half are 30 years of age or older and are due for replacement or major rebuilds. There are about 60 U.S. blast furnaces, all of which have been operating for more than 10 years, with some originally installed up to 90 years ago. HIsmelt® represents a viable option as a substitute for conventional iron-making technology.

The HIsmelt® process is ready for demonstration. Two pilot plants have been built, one in Germany in 1984 and one in Kwinana, Australia in 1991. Through test work in Australia, the process has been proven—operational control parameters have been identified and complete computer models have been successfully developed and proven.

Commercial Demonstration of the Manufactured Aggregate Processing Technology Utilizing Spray Dryer Ash

Participant
Universal Aggregates, LLC (a joint venture between CONSOL Energy, Inc. and SynAggs, Inc.)

Additional Team Members
CONSOL Energy, Inc.—development and engineering

P.J. Dick, Inc.—project management and construction

SynAggs, LLC—marketing

Location
King George County, VA (Birchwood Power Facility)

Technology
Aggregate manufacturing plant using by-products from spray dryer flue gas desulfurization (FGD) scrubbers

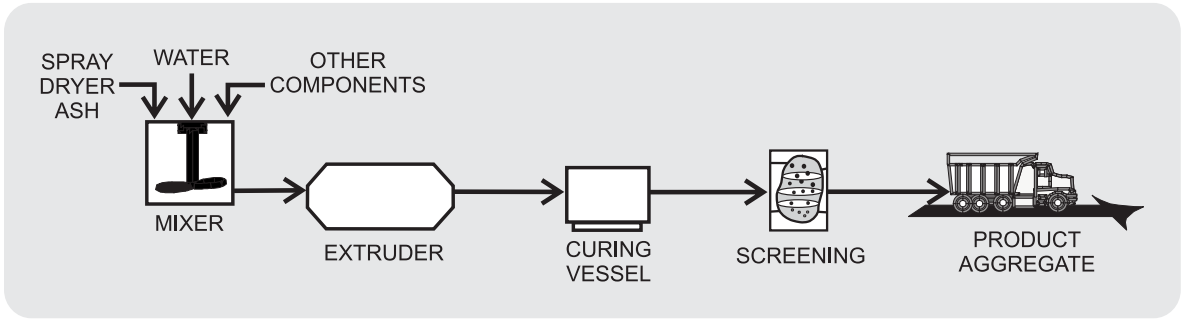
Plant Capacity/Production
150,000 tons/year of lightweight aggregate

Coal
Bituminous, 0.9% sulfur

Project Funding

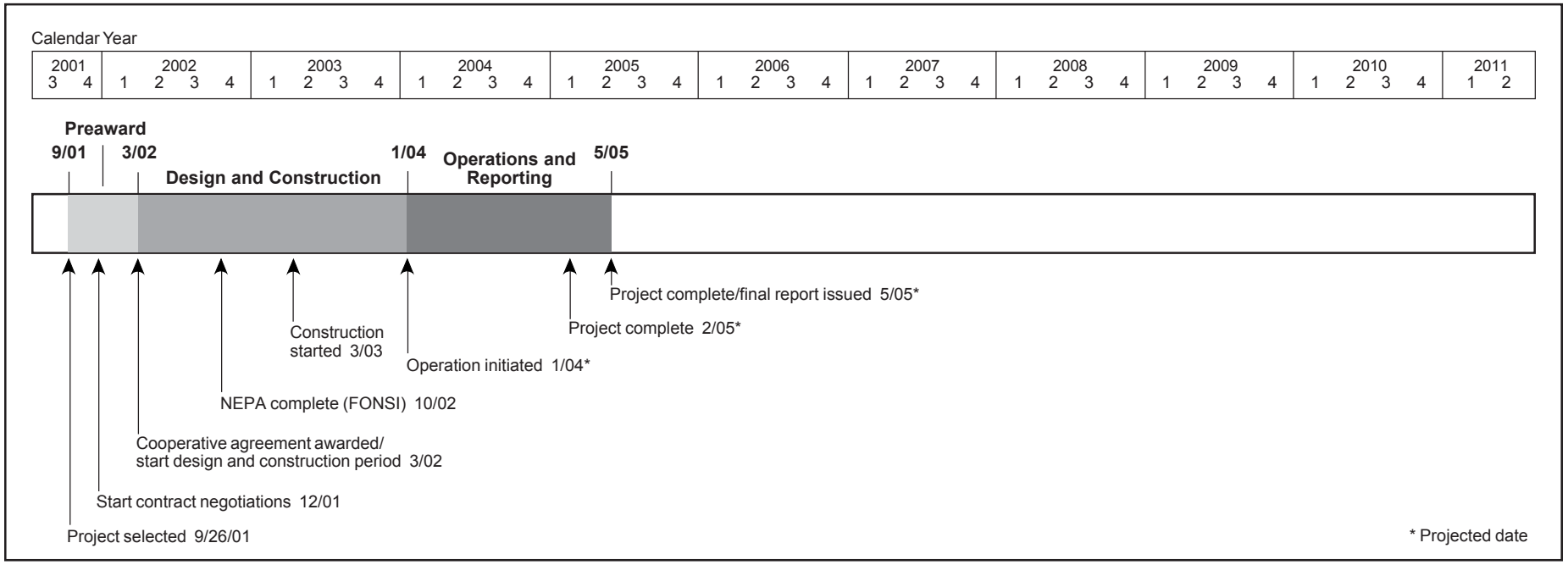
Total	$19,581,734	100%
DOE	7,224,000	37
Participant	12,357,734	63

Project Objective
Universal Aggregates LLC will design, build, and operate an aggregate manufacturing plant that converts 115,000 tons/year of spray dryer by-products into 167,000 tons/year of lightweight aggregate that can be used in the manufacture of masonry blocks or lightweight concrete.



Technology/Project Description
Flue gas desulfurization systems, used to lower sulfur emissions from coal plants, often produce a type of sludge that is landfilled; only 18% of FGD residue is recycled. Much of that 18% pertains to recycling by-products from wet FGD systems or scrubbers. Universal Aggregates' process can be used to recycle the by-products from wet or dry scrubbers. This would reduce plant disposal costs while reducing the environmental drawbacks of landfilling.

The Birchwood facility will transform 115,000 tons/year of spray dryer by-products that are currently being disposed of in an off-site landfill into 167,000 tons/year of a useful product: lightweight aggregates that can be used to manufacture lightweight masonry blocks or lightweight concrete.



Project Status/Accomplishments

The project was selected for award on September 26, 2001. The cooperative agreement was awarded on November 25, 2002. The National Environmental Policy Act process was completed on October 2, 2002, with the issuance of a Finding of No Significant Impact. Start of construction was approved by DOE on March 24, 2003. The plant will begin operation in 2004.

Commercial Applications

There are currently twenty-one spray dryer facilities operating in the United States that produce an adequate amount of spray dryer by-product to economically justify the installation of a lightweight aggregate manufacturing facility. Industry sources believe that as additional scrubbing is required, dry FGD technologies will be the technology of choice. Letters from potential lightweight aggregate customers indicate that there is a market for the product once the commercialization barriers are eliminated by this demonstration project.

Advanced Multi-Product Coal Utilization By-Product Processing Plant

Participant
University of Kentucky Research Foundation

Additional Team Members
LG&E Energy Corporation—collaborator

University of Kentucky Center for Applied Energy Research (CAER)—collaborator

Location
Ghent, Carroll County, Kentucky (Kentucky Utilities Company's Ghent Power Station)

Technology
University of Kentucky CAER's hydraulic classification froth flotation process

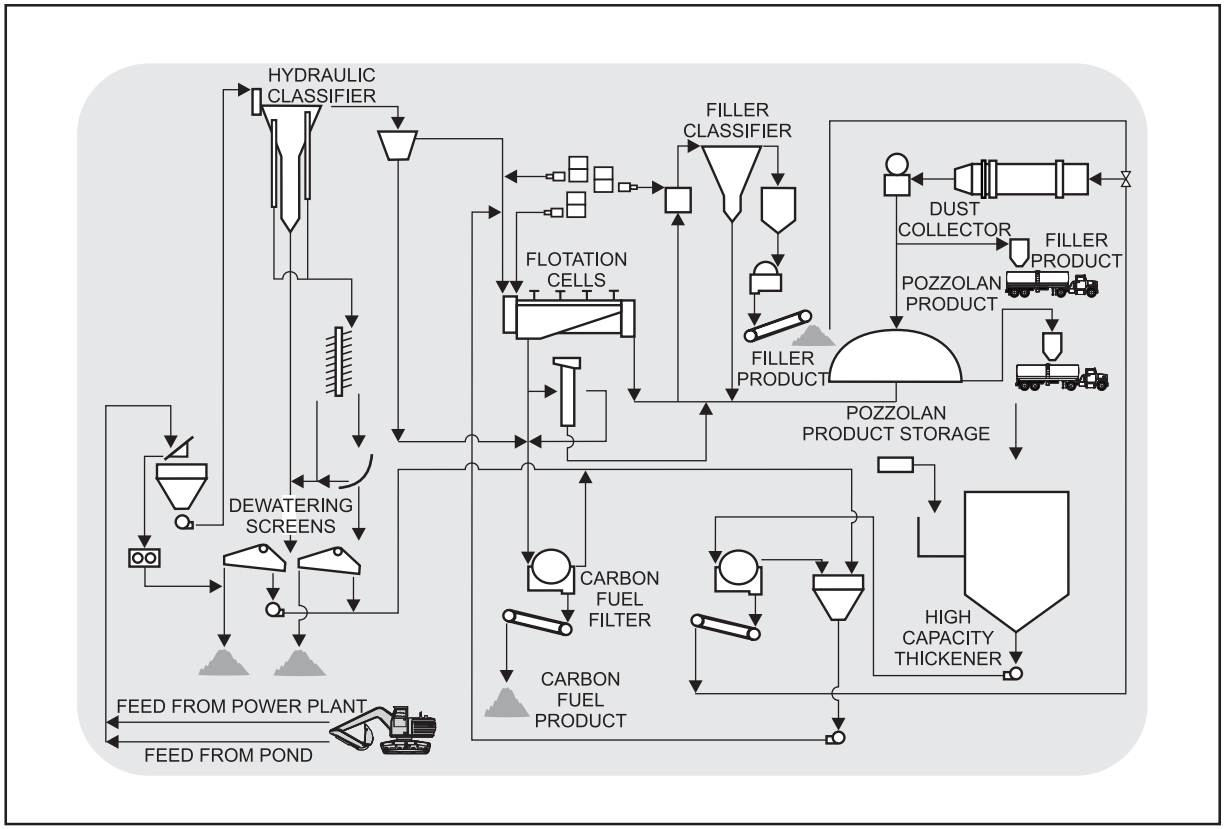
Project Capacity/Production
800 tons per day of coal ash input

Coal
Pittsburgh coal

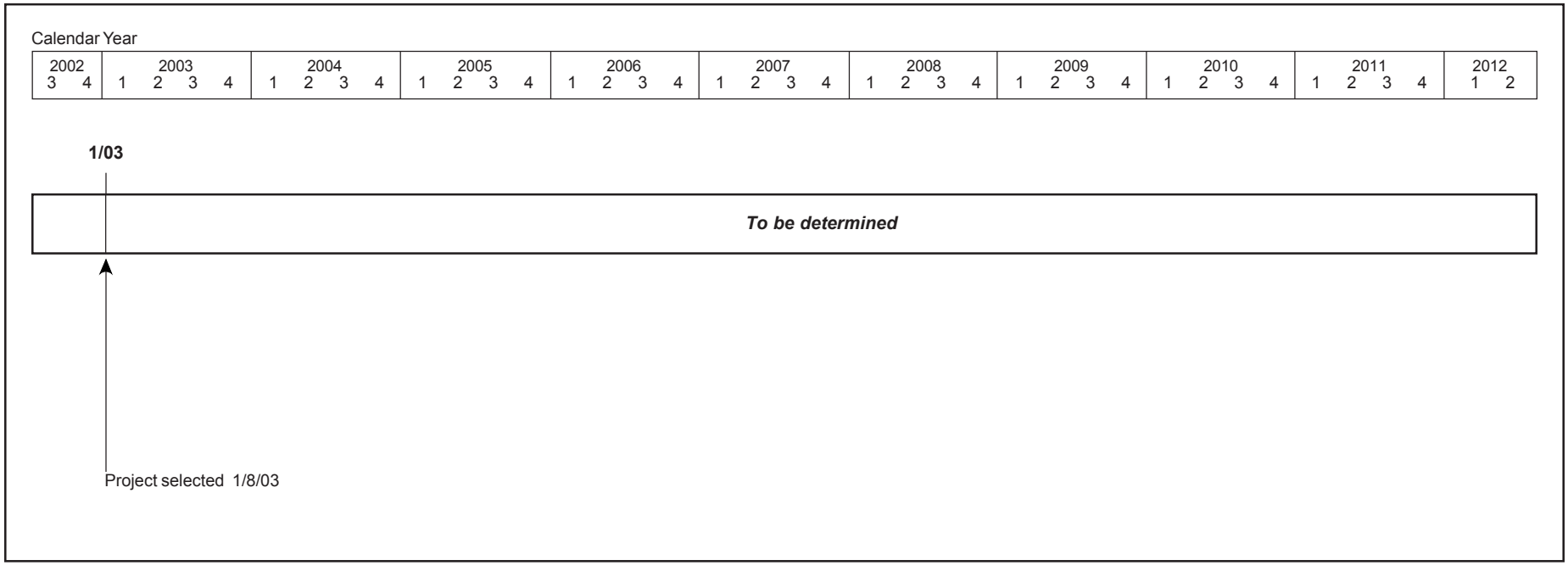
Project Funding

Total	$8,916,739	100%
DOE Share	$4,450,163	50
Participant	$4,466,576	50

Project Objective
To demonstrate an advanced coal ash beneficiation processing plant at the 2,200-MW Ghent Power Plant that will produce (1) pozzolan (cementitious material), high-grade, lightweight aggregate; (2) graded fill sand; (3) high-quality polymeric filler; and (4) recycled carbon fuel.



Technology/Project Description
The process is based upon a hydraulic classification and froth flotation technology developed at the University of Kentucky CAER. The technology can process ash stored in disposal ponds or directly from the plant. Raw feed is classified into a pozzolan stream (-200 mesh) and a coarse stream (+200 mesh). The coarse materials are further classified and concentrated into a sand product and coarse carbon product by spiral concentrators. The fine pozzolan stream is treated with a reagent system, the fine carbon removed via froth flotation, and the pozzolan concentrated, filtered, and dried. A small stream from the froth cell is further processed hydraulically to produce a fine particle suitable for use in a number of applications, including a polymer additive.



Project Status/Accomplishments

The project was selected for award on January 8, 2003. Negotiations are currently underway. The cooperative agreement is expected to be awarded by late-2003. The estimated project duration is about four years.

Commercial Applications

Throughout the United States, many coal-fired power plants utilize ash-settling ponds and in many cases are required to pay for offsite landfill disposal. This project addresses the use of all of the coal utilization by-products from the plant to produce salable and valued products. Finding a beneficial use of these materials will reduce the need for the creation of new ash settling ponds and extend the life of existing ponds.

One of the important benefits associated with this project is that the 156,000 tons per year of high-quality pozzolan, to be produced from coal by-products, will displace an equivalent amount of portland cement. Manufacturing portland cement results in release of approximately 1 ton of CO_2 per ton of cement produced. As such, this project represents a potential greenhouse gas offset. Cement making currently releases about 47 million tons per year of CO_2 in the U.S., making it one of the highest generators of CO_2 of any industrial process. Therefore, utilization of existing coal ash for this purpose offers a new pathway for reducing future CO_2 emissions related to the production of cement.

Western Greenbrier Co-Production Demonstration Project

Participant
Western Greenbrier Co-Generation, LLC

Additional Team Members
Alstom Power, Inc.—technology supplier

Hazen Research, Inc.—technology supplier

Parsons E&C—turn-key constructor

Hazen Research Labs—Technology Supplier

Midway Environmental Associates—Technology Supplier

Location
Rainelle, Greenbrier County, West Virginia

Technology
Alstom Power fluidized-bed combustion and WoodBrik™ technology

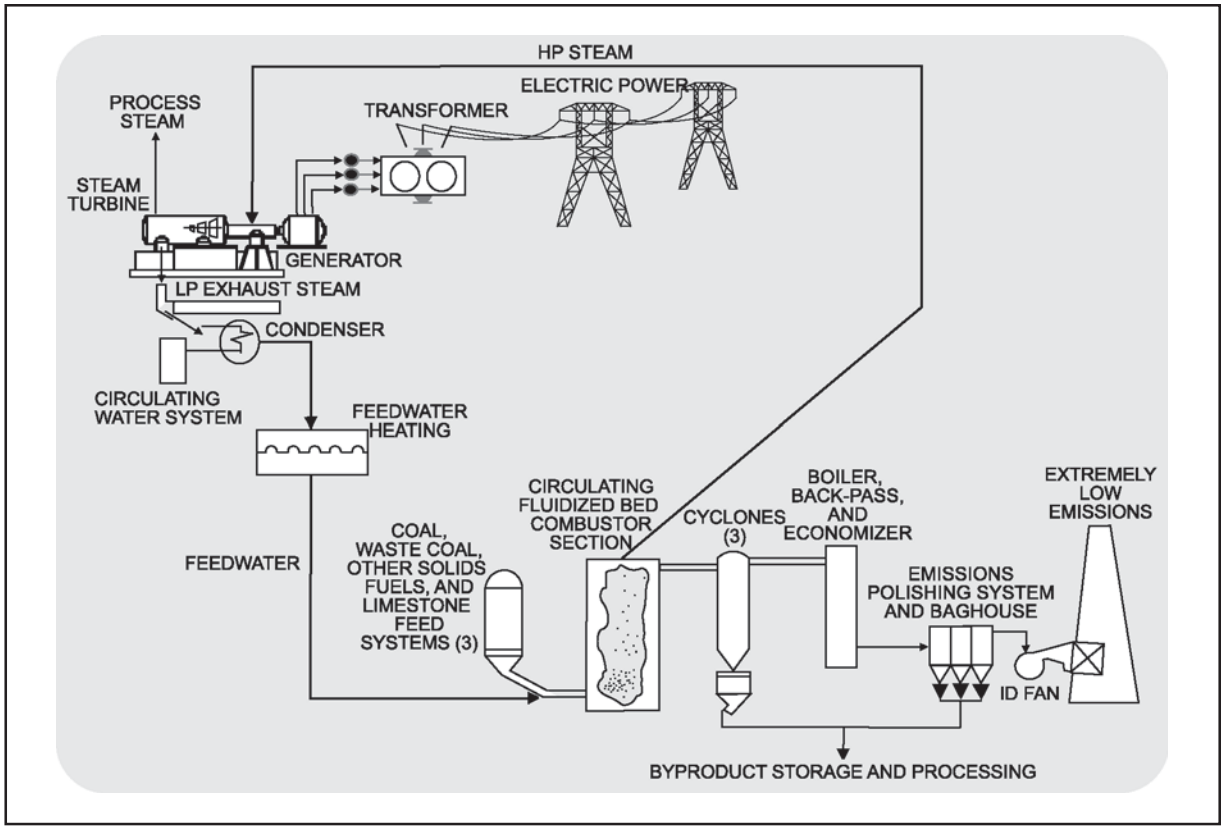
Project Capacity/Production
85 MW and structural bricks

Coal
Bituminous waste

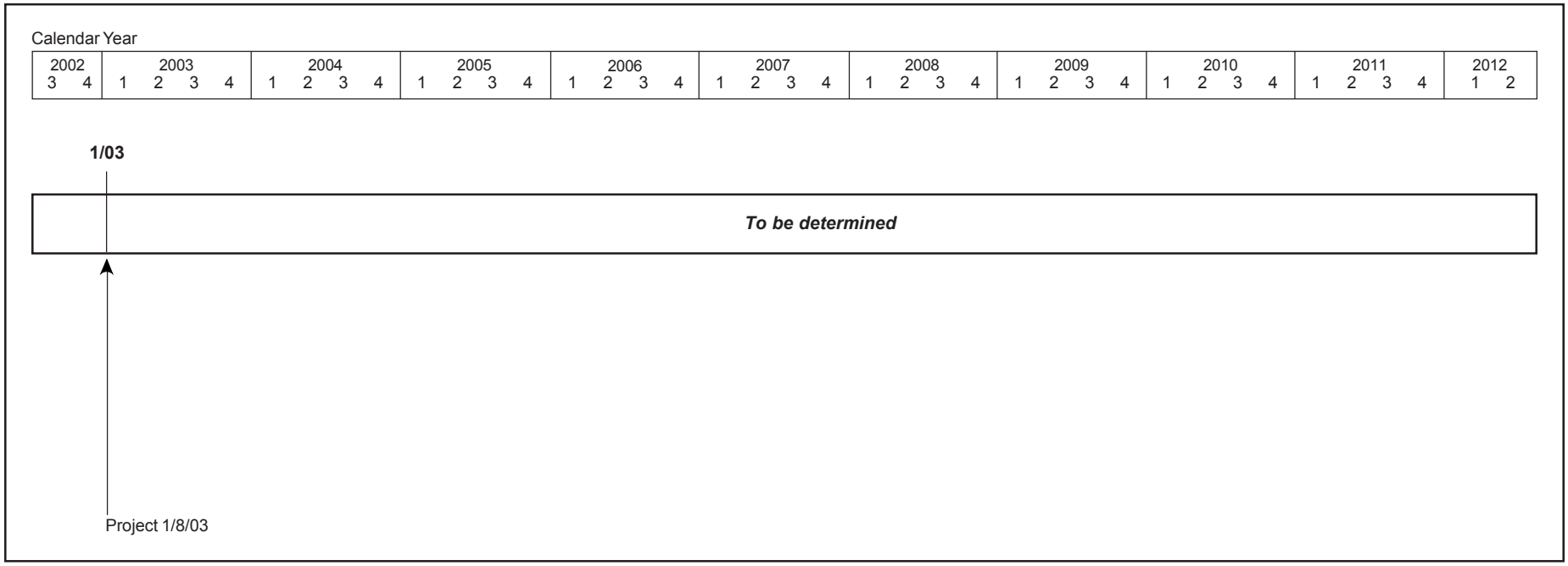
Project Funding

Total	$215,000,000	100%
DOE Share	$107,500,000	50
Participant	$107,500,000	50

Project Objective
To demonstrate integrated co-production of 85 MW of power and simultaneous manufacture of structural bricks certified to meet insulation and load-bearing specification requirements, or to produce Class "C" fly ash for concrete applications.



Technology/Project Description
The co-generating power plant uses a novel circulating fluidized bed combustion (CFB) type of boiler incorporating an inverted cyclone to raise steam to power a conventional steam turbine generator. The CFB boiler island is expected to allow a 30–40% smaller footprint, and reduction in steel tonnage by up to 60% as compared to a conventional CFB system. The plant will burn waste coal from a 4 million ton waste coal pile at Anjean and other regional sources. Ash produced from the coal combustion is divided into two streams. Bottom ash and a small portion of the fly ash is collected and returned to the waste coal pile. The mildly alkaline nature of the ash assists in neutralizing the acid runoff from the wastepile, thus alleviating a significant environmental problem. Most of the fly ash is calcined in a kiln, with added limestone, to convert it to a chemical and physical form that renders it useful for production of structural building products or Class "C" fly ash for concrete applications. A particular patented product, Woodbrik™, has been selected for co-production at the Western Greenbrier Co-Generation facility. The Woodbrik™ is manufactured from converted ash and wood waste into building blocks. The power plant is envisioned to be an anchor tenant in a planned environmentally balanced industrial park (Eco-Park), which will build on the synergistic relationship to the clean-coal power generation system. Steam generated in the boiler or heat from the power plant closed loop cooling system would be used to supply other tenants in the Eco-Park.



Project Status/Accomplishments

The project was selected for award on January 8, 2003. Negotiations are currently underway. The cooperative agreement is expected to be awarded late-2003. The project is expected to last less than two years.

Commercial Applications

A primary benefit of this project is the application of clean coal technologies to improve industrial ecology by employing advanced multi-pollutant control systems, addressing environmental remediation of coal wastes, and using coal, coal wastes and by-products to produce power, process heat and other industrial products. This project offers a unique integration of technologies to convert 1,610 tons/day of coal waste materials that resulted from past mining operations, commonly referred to as "gob," and 220 tons/day of freshly mined coal, into 75 MW of electricity, 20,000 pounds/hour of steam for industrial use and district heating, 300 tons/day of structural bricks and 970 tons/day of alkaline ash material suitable for use in remediating acid mine drainage. If successful, this technology and integrated approach could be applied to many regions of the country to reclaim contaminated land where waste coal is currently stockpiled and to significantly reduce waste disposal activities from operating coal mines. For example, West Virginia alone contains about 400 million tons of waste coal. The advanced compact CFB power plant incorporates SO_x, NO_x, particulate, and mercury missions controls and reduces the standard "footprint" of such plants by 40%. The compact nature of the new system will also reduce structural steel and related construction costs for the boiler system by up to 60%. In addition, the simplified construction process planned for the boiler is expected to result in safer construction practices and a shortened construction time. Employing a Rankine steam cycle for energy conversion (thermal to electricity), this boiler's targeted reheat steam cycle configuration (1,800 psig/1,000 °F/1,000 °F) is deemed aggressive for a power plant of this size, particularly one that uses waste feedstocks. This plant attempts to maximize power generation efficiency, reduce CO_2 emissions, and conserve water resources, while co-producing steam for commercial and industrial uses.

Aside from the novel power plant design, the project will convert coal waste and other refuse into valuable products, including the production of 75 MW of electricity, alkaline ash for environmental remediation, steam for industrial uses (hardwood drying) and district heating, and co-production of structural bricks. This demonstration will also result in high-quality, long-term employment at the power plant and the related "Eco-Park." Successful integration of these technologies and the development of this facility can serve as a model for other state and local governments interested in remediating similar refuse sites in the United States and abroad.

Appendix A. Historical Perspective, Legislative History, and Public Laws

CCTDP Historical Perspective

There were a number of key events that prompted creation of the Clean Coal Technology Demonstration Program (CCTDP) and impacted its focus over the course of the five solicitations. The roots of the CCTDP can be traced to the acid rain debates of the early 1980s, culminating in U.S. and Canadian envoys recommending a five-year, $5 billion U.S. effort to curb precursors to acid rain formation—sulfur dioxide (SO_2) and nitrogen oxides (NO_x). This recommendation was adopted and became a presidential initiative in March 1987.

As a part of the response to the recommendations of the *Special Envoys on Acid Rain* in April 1987, the President directed the Secretary of Energy to establish a panel to advise the President on innovative clean coal technology activities. This panel was the Innovative Control Technology Advisory Panel. As a part of the panel's activities, the state and federal incentive subcommittee prepared a report, *Report to the Secretary of Energy Concerning Commercialization Incentives*, that addressed actions that states could take to provide incentives for demonstrating and deploying clean coal technologies. The panel determined that demonstration and deployment should be managed through both state and federal initiatives.

In the same time frame, the Vice President's Task Force on Regulatory Relief (later referred to as the Presidential Task Force on Regulatory Relief) was established. Among other things, the task force was asked to examine incentives and disincentives for the commercial realization of new clean coal technologies. The task force also examined cost-effective emissions reduction measures that might be inhibited by various federal, state, and local regulations. The task force recommended that preference be given to projects located in states that offer certain regulatory incentives to encourage such technologies. This recommendation was accepted and became part of the project selection considerations beginning with CCTDP-II.

Initial CCTDP emphasis was on controlling SO_2 and NO_x emissions from existing coal-based power generators. Approaches demonstrated through the program were coal processing to produce clean fuels, combustion modification to control emissions, postcombustion cleanup of flue gas, and repowering with advanced power generation systems. These early efforts (projects resulting from the first three solicitations) produced a suite of cost-effective compliance options available today to address acid rain concerns.

As the CCTDP evolved, work began on drafting what was to become the Clean Air Act Amendments of 1990 (CAAA). Through a dialog with the U.S. Environmental Protection Agency (EPA) and Congress, the program was able to remain responsive to shifts in environmental emphasis. Also, projects in place enabled CAAA architects to have access to real-time data on emission control capabilities while structuring proposed acid rain regulations under Title IV of the CAAA.

Aside from acid rain, there was an emerging issue in the area of hazardous air pollutants (HAPs), also referred to as air toxics. Title III of the CAAA listed 189 airborne compounds subject to control, including trace elements and volatile and semi-volatile compounds. To assess the impacts on coal-based power generation, CCTDP projects were leveraged to obtain data through an integrated effort among the U.S. Department of Energy (DOE), EPA , the Electric Power Research Institute (EPRI), and the Utility Air Regulatory Group. Through this effort, concerns about HAPs relative to coal-based power generation have been significantly mitigated, enabling focus on but a few flue gas constituents. Also, because NO_x is a precursor to ozone formation, the presence of NO_x in ozone nonattainment areas, even at low levels, became an issue. This precipitated action in the CCTDP to include technologies capable of deep NO_x reduction in the portfolio of technologies sought.

In the course of the last two solicitations of the CCTDP, a number of energy and environmental considerations combined to change the emphasis toward seeking high-efficiency, very-low-emission power generation technology. Energy demand projections in the United States showed the need for continued reliance on coal-based power generation, with significant growth required into the 21st century. The CAAA, however, capped SO_2 emissions at year 2000 levels, and NO_x continued to receive increased attention relative to ozone nonattainment. Furthermore, particulate emissions were coming under increased scrutiny because of correlations with lung disorders and the tendency for toxic compounds to adhere to particulate matter. Added to these concerns was

the growing concern over global warming, and more specifically, the carbon dioxide (CO_2) produced from burning fossil fuels. Coal became a primary target because of its high carbon-to-hydrogen ratio relative to natural gas, resulting in somewhat higher CO_2 emissions per unit of energy produced. However, coal is the fuel of choice (if not necessity) for many developing countries where projected growth in electric power generation is the greatest. The path chosen to respond to these considerations was to pursue advanced power generation systems that could provide major enhancements in efficiency and control SO_2, NO_x, and particulates without introducing external parasitic control devices. (Increased efficiency translates to less coal consumption per unit of energy produced.) As a result, a number of advanced power generation projects were undertaken, representing pioneer efforts recognized throughout the world.

CCTDP Legislative History

The legislation authorizing the CCTDP is found in Public Law 98-473, Joint Resolution Making Continuing Appropriations for Fiscal Year 1985 and for Other Purposes. Title I set aside $750 million of the congressionally rescinded $5.375 billion of the Synthetic Fuels Corporation into a special U.S. Treasury account entitled the "Clean Coal Technology Reserve." This account was dedicated to "conducting cost-shared clean coal technology projects for the construction and operation of facilities to demonstrate the feasibility of future commercial applications of such technology." Title III of this act directed the Secretary of Energy to solicit statements of interest in and proposals for clean coal projects. In keeping with this mandate, DOE issued a program announcement, which resulted in the receipt of 176 proposals representing both domestic and international projects with a total estimated cost in excess of $8 billion.

After this significant initial expression of interest in clean coal demonstration projects, Public Law 99-190, enacted December 1985, appropriated $400 million to conduct cost-shared demonstration projects. Of the total appropriated funds, approximately $387 million was made available for cost-shared projects to be selected through a competitive solicitation, or Program Opportunity Notice (PON), referred to as CCTDP-I. (The remaining funds were required for program direction and the legislatively mandated Small Business Innovation Research Program [SBIR] and Small Business Technology Transfer Program [STTR].)

In a manner similar to the initiation of CCTDP-I, Congress again directed DOE to solicit information from the private sector in the Department of the Interior and Related Agencies Appropriations Act for FY1987 (Public Law 99-591, enacted October 30, 1986). The information received was to be used to establish the level of potential industrial interest in another solicitation, this time involving clean coal technologies capable of retrofitting, repowering, or modernizing existing facilities. Projects were to be cost-shared, with industry sharing at least 50 percent of the cost. As a result of the solicitation, a total of 39 expressions of interest were received by DOE in January 1987.

On March 18, 1987, the President announced the endorsement of the recommendations of the Special Envoys on Acid Rain, including a $2.5 billion government share of funding for industry/government demonstrations of innovative control technology over a five year period. The Secretary of Energy stated that the department would ask Congress for an additional $350 million in FY1988 and an advanced appropriation of $500 million in FY1989. Additional appropriations of $500 million would be requested in fiscal years 1990, 1991, and 1992. This request was made by the President on April 4, 1987.

Public Law 100-202, enacted December 22, 1987, as amended by Public Law 100-446, appropriated a total of $575 million to conduct CCTDP-II. About $536 million was for projects, with the remainder for program direction and the SBIR and STTR programs.

The Department of the Interior and Related Agencies Appropriations Act for FY1989 (Public Law 100-446, enacted September 27, 1988) provided $575 million for necessary expenses associated with clean coal technology demonstrations in the CCTDP-III solicitation. Of the total funding, about $546 million was made available for cost-sharing projects, with the remainder for program direction and the SBIR and STTR programs. The act continued the requirement that proposals must demonstrate technologies capable of retrofitting or repowering existing facilities. The statute also authorized the use of Tennessee Valley Authority power program funds as a source of nonfederal cost-sharing, except if provided by annual appropriations acts. In addition, funds borrowed by Rural Electrification Administration (now Rural Utilities Service) electric cooperatives from the Federal Financing Bank became eligible as cost-sharing in the CCTDP-III solicitation, except if provided by annual appropriations.

In the Department of the Interior and Related Agencies Appropriations Act of 1990 (Public Law 101-121, enacted October 23, 1989), Congress provided $600 million for the CCTDP-IV solicitation. CCTDP-IV, according to the act, "shall demonstrate technologies capable of replacing, retrofitting, or repowering existing facilities and shall be subject to all provisos contained under this head in Public Laws 99-190, 100-202 and 100-446 as amended by this Act." About $563 million was made available for federal cofunding of projects selected in CCTDP-IV, with the remainder for program direction and the SBIR and STTR programs.

In Public Law 101-121, enacted October 23, 1989, Congress also provided $600 million for the CCTDP-V solicitation. CCTDP-V, according to the act, "shall be subject to all provisos contained under this head in Public Laws 99-190, 100-202 and 100-446 as amended by this Act." Approximately $568 million was made available for federal cofunding of projects to be selected in this solicitation, with the remainder again for program direction and the SBIR and STTR programs.

Subsequent acts (Public Laws 101-164, 101-302, 101-512, and 102-154) modified the schedule for issuing CCTDP-IV and/or CCTDP-V PONs and selecting projects. In Public Law 101-512, Congress directed DOE to issue the PON for CCTDP-IV not later than February 1, 1991, with selections to be made within 8 months. In Public Law 102-154, Congress directed DOE to issue the CCTDP-V PON not later than July 6, 1992, with selections to be made within 10 months. This later act also directed that CCTDP-V proposals should advance significantly the efficiency and environmental performance of coal-using technologies and be applicable to either new or existing facilities.

Public Laws 101-164, 101-302, 101-512, 103-138, and 103-332 adjusted the rate at which funds were to be made available to the program.

The CCTDP funds have been further adjusted through sequestering requirements of the Gramm-Rudman-Hollings Deficit Reduction Act as well as rescissions. Sequestering reduced CCTDP appropriations as follows:

- $2,028 was sequestered from the $575 million appropriated by Public Law 100-446, as amended by Public Law 101-164.
- $455 was sequestered from the $1.2 billion appropriated by Public Law 101-121, as amended by Public Laws 101-512, 102-154, 102-381, 103-138, 103-332, 104-6, 104-208, and 105-18.

Rescissions have reduced CCTDP appropriations as follows:

- $200 million was rescinded by Public Law 104-6.
- $123 million was rescinded by Public Law 104-208.
- $17 million was rescinded by Public Law 105-18.
- $101 million was rescinded by Public Law 105-83.
- $38,000 was rescinded by Public Law 106-113 (general reduction).

In 1998, $40 million of the CCTDP funds were deferred by Public Law 105-277. Funds were to be restored over a three year period beginning October 1, 1999. Again in 1999, Congress deferred program funds. In Public Law 106-113, Congress deferred $156,000,000 until October 1, 2000. And in Public Law 107-63, Congress deferred $40,000,000 until October 1, 2002. In 2003, in Public Law 108-7, Congress deferred $87,000,000 until October 1, 2003.

Exhibit A-1 lists all the key legislation relating to the CCTDP and provides a summary of provisions relating to program funding as well as program implementation. At the end of this appendix are funding provisions excerpted from appropriations and other relevant funding-related acts.

Exhibit A-1
CCTDP Legislative History

Public Law	Date Enacted	CCTDP Round	Program Funding	Implementation Provisions
98-473	10/12/84	Initiation of CCTDP informational solicitation	Rescinded $750 million of $5.375 billion from the Energy Security Reserve (Synthetic Fuels Corporation) to be deposited in a U.S. Treasury Department account entitled "Clean Coal Technology Reserve" for conducting cost-shared clean coal technologies (CCT) projects for the construction and operation of facilities to demonstrate the feasibility for future commercial application of such technology, without fiscal year limitation, subject to subsequent annual appropriation.	Title III required publication of a notice soliciting statements of interest in and proposals for projects employing emerging CCTs. A report to Congress was required no later than 4/15/85.
99-88	8/15/85	CCTDP-I	Deferred $1.6 million for obligation until 10/1/85.	Conference Report (H. Rep. 99-236) concurred with CCT project guidelines contained in Senate Report 99-82, with certain modifications.

Exhibit A-1 (continued)
CCTDP Legislative History

Public Law	Date Enacted	CCTDP Round	Program Funding	Implementation Provisions
99-190	12/19/85	CCTDP-I	Conference Report (H. Rep. 99-450) agreed to a $400-million CCTDP as described under the U.S. Treasury Department Energy Security Reserve, with the request for proposals to be for the full $400 million.	Required a PON (CCTDP-I) to be issued and projects to be selected no later than 8/1/86. Project cost-sharing provisions were detailed.
99-591	10/30/86	Second informational solicitation	(Contained no funding provisions for CCTDP.)	Title II required publication of a notice soliciting statements of interest in, and informational proposals for projects employing emerging CCTs capable of retrofitting, repowering, or modernizing existing facilities. A report to Congress was required no later than 3/6/87.
100-202	12/22/87	CCTDP-II	Appropriated $50 million for FY beginning 10/1/87 until expended and $525 million for FY beginning 10/1/88 until expended.	Required a request for proposals (CCTDP-II) to be issued no later than 60 days following enactment, for emerging CCTs capable of retrofitting or repowering existing facilities. Extended project selection from 120 days to 160 days after receipt of proposals. Provided for cost-sharing of preaward costs for preparation and submission of environmental data upon signing of the cooperative agreement. Conference Report (H. Rep. 100-498) provided that project cost-sharing funds be made available to nonutility as well as utility applications. No funds were made available for new, stand-alone applications. H. Rep. Report 100-171 and Senate Report 100-165 outlined provisions for participant to repay government contributions.
100-446	9/27/88	CCTDP-III	Made available $575 million on 10/1/89 until expended. Pub. L. 100-202 was amended by striking $525 million and inserting $190 million for FY beginning 10/1/88 until expended, $135 million for fiscal year beginning 10/1/89 until expended, and $200 million for FY beginning 10/1/90 until expended, provided that outlays for FY89 resulting from use of funds appropriated under Pub. L. 100-202, as amended, did not exceed $15.5 million.	Request for proposals (CCTDP-III) to be issued by 5/1/89 for emerging CCTs capable of retrofitting or repowering existing facilities. Proposals were to be due 120 days after issuance of the PON; projects were to be selected no later than 120 days after receipt of proposals. Funds borrowed by REA electric cooperatives from the Federal Financing Bank were made eligible as cost-sharing. Funds derived by the Tennessee Valley Authority from its power program were deemed allowable as cost-sharing except if provided by annual appropriations acts.
101-45	6/30/89	CCTDP-III	Funds appropriated for FY1989 were made available for a third solicitation.	Project selections for the third solicitation were to be made not later than 1/1/90.
101-121	10/23/89	CCTDP-IV and CCTDP-V	Made available $600 million on 10/1/90 until expended and for $600 million on 10/1/91 until expended. Pub. L. 100-446 was amended by striking $575 million and inserting $450 million	Two solicitations (CCTDP-IV and CCTDP-V) to be issued, one each appropriation, to demonstrate technologies capable of replacing, retrofitting, or repowering existing facilities,

Exhibit A-1 (continued)
CCTDP Legislative History

Public Law	Date Enacted	CCTDP Round	Program Funding	Implementation Provisions
101-121 (continued)	10/23/89	CCTDP-IV and CCTDP-V	to be made available on 10/1/89 until expended and $125 million to be made available on 10/1/90. Unobligated balances excess to the needs of the procurement for which they originally were made available may be applied to other procurements for which requests for proposals had not yet been issued, except that no supplemental, backup, or contingent selection of projects could be made over and above the projects originally selected.	subject to all provisos contained in Pub. L. 99-190, 100-202, and 100-446 as amended. The PON (CCTDP-IV) using funds becoming available on 10/1/90 was to be issued by 6/1/90, with selections made by 2/1/91. The PON (CCTDP-V) using funds becoming available on 10/1/91 was to be issued no later than 9/1/91, with selections made by 5/1/92.
101-164	11/21/89	CCTDP-IV and CCTDP-V	Appropriation for FY1990 was amended by striking $450 million and inserting $419 million and by striking $125 million and inserting $156 million.	Solicitations could not be conducted prior to ability to obligate funds. Repayment provisions for CCTDP-IV and CCTDP-V were to be the same as for CCTDP-III.
101-302	5/25/90	CCTDP-IV and CCTDP-V	Obligation of funds previously appropriated for CCTDP-IV and was deferred until 9/1/91.	
101-512	11/5/90	CCTDP-IV and CCTDP-V	Pub. L. 101-121 was amended by striking $600 million made available on 10/1/90 until expended and $600 million made available on 10/1/91 until expended and inserting $600 million made available as follows: $35 million on 9/1/91, $315 million on 10/1/91, and $250 million on 10/1/92, all sums remaining until expended, for use in conjunction with a separate general request for proposals, and $600 million made available as follows: $150 million on 10/1/91, $225 million on 10/1/92, and $225 million on 10/1/93, all sums remaining until expended, for use with a separate general request for proposals.	The CCTDP-IV solicitation was to be issued not later than 2/1/91. The CCTDP-V PON was to be issued not later than 3/1/92. Project selections were to be made within eight months of PON's issuance. Repayment provisions were to be the same as for CCTDP-III. Provisions were included to provide protections for trade secrets and proprietary information. Conference Report (H. Rep. 101-971) recommends changes to program policy factors.
102-154	11/13/91	CCTDP-V	Pub. L. 102-512 was amended by striking $150 million on 10/1/91 and $225 million on 10/1/92 and inserting $100 million on 10/1/91 and $275 million on 10/1/92.	The CCTDP-V PON was delayed to not later than 7/6/92, with selection to be made within 10 months (extended by two months). The PON was to be for projects that advance significantly the efficiency and environmental performance of coal-using technologies and be applicable to either new or existing facilities. Conference Report (H. Rep. 102-256) stated expectations that the CCTDP-V solicitation would be conducted under the same general types of criteria as CCTDP-IV, principally modified only to (1) include the wider range of eligible technologies or applications; (2) adjust technical criteria to consider allowable development activities, strengthen criteria for nonutility demonstrations, and adjust commercial performance criteria for additional facilities and technologies with regard to aspects of general energy efficiency and environmental performance; and

Exhibit A-1 (continued)
CCTDP Legislative History

Public Law	Date Enacted	CCTDP Round	Program Funding	Implementation Provisions
102-154 (continued)	11/13/91	CCTDP-V		(3) clarify and strengthen cost and finance criteria, particularly with regard to development activities. Funding was allowed for project-specific development activities for process performance definition, component design verification, materials selection, and evaluation of alternative designs on a cost-shared basis up to a limit of 10 percent of the government share of project cost. Development activities eligible for cost-sharing included limited modifications to existing facilities for project-related testing but not construction of new facilities.
102-381	10/5/92		Pub. L. 101-512 was amended by striking $250 million on 10/1/92 and inserting $150 million on 10/1/93 and $100 million on 10/1/94; and by striking $275 million on 10/1/92 and $225 million on 10/1/93 and inserting $250 million on 10/1/93 and $250 million on 10/1/94.	
102-486	10/24/92		(Contained no funding provisions for CCTDP.)	Section 1301—Coal RD&D and Commercial Applications Programs (Title XIII; Subtitle A) authorized DOE to conduct programs for RD&D and commercial applications of coal-based technologies. Secretary of Energy was directed to submit to Congress (1) a report that included, among other things, recommendations regarding the manner in which the cost-sharing demonstrations conducted pursuant to the Clean Coal Program (Pub. L. 98-473) might be modified and extended in order to ensure the timely demonstration of advanced coal-based technologies and (2) periodic status reports on the development of advanced coal-based technologies and RD&D and commercial application attributes.
103-138	11/11/93		Pub. L. 101-512 was amended by striking $150 million on 10/1/93 and $100 million on 10/1/94 and inserting $100 million on 10/1/93, $100 million on 10/1/94, and $50 million on 10/1/95; and by striking $250 million on 10/1/93 and $250 million on 10/1/94 and inserting $125 million on 10/1/93, $275 million on 10/1/94, and $100 million on 10/1/95.	

Exhibit A-1 (continued)
CCTDP Legislative History

Public Law	Date Enacted	CCTDP Round	Program Funding	Implementation Provisions
103-332	9/30/94		Pub. L. 101-512 was amended by striking $100 million on 10/1/94 and $50 million on 10/1/95 and inserting $18 million on 10/1/94, $100 million on 10/1/95, and $32 million on 10/1/96; and by striking $275 million on 10/1/94 and $100 million on 10/1/95 and inserting $19.121 million on 10/1/94, $100 million on 10/1/95, and $255.879 million on 10/1/96.	An amount not to exceed $18 million available in FY1995 may be used for administrative oversight of the CCTDP.
104-6	4/10/95		Of funds available for obligation in FY1996, $50 million was rescinded. Of the funds to be made available for obligation in FY1997, $150 million was rescinded.	
104-134[a]	4/26/96			Conference Report (H. Rep. 104-402 to accompany H.R. 1977) allowed for the use of up to $18 million in CCTDP funds for program administration.
104-208[b]	9/30/96		Conference Report (H. Rep. 104-863 to accompany H.R. 3610) noted rescission of $123 million for FY1997 or prior years.	House and Senate committees did not object to use of up to $16 million in available funds for administration of the CCTDP in FY1997 (H. Rep. 104-625 and Senate 104-319 to accompany H.R. 3662).
105-18	6/12/97		Of funds made available for obligation in FY1997 or prior years, $17 million was rescinded.	
105-83	11/14/97		Of funds made available for obligation in FY1997 or priors, $101 million was rescinded.	
105-277	10/21/98		Of funds made available for obligation in prior years, $40 million was deferred.	Conference Report allowed $14.9 million in CCTDP funds for program administration.
106-113	11/29/99		Of funds made available for obligation in prior years, $156 million was deferred. $38,000 was rescinded as a result of the general reduction.	Conference Report did not object to the use of up to $14.4 million in CCTDP funds for program administration.
106-291	10/11/00		Of funds made available for obligation in prior years, $67 million was deferred. Another $95 million was transferred to the Power Plant Improvement Initiative.	Conference Report (H. Rep. 106–406) did not object to the use of up to $14.4 million in CCTDP funds for program administration.
107-63	11/5/01		Of the funds made available for obligation in prior years, $40,000,000 was deferred.	
108-7	2/20/03		Of the funds made available for obligation in prior years, $87,000,000 was deferred.	

[a] H.R. 3019, which became Pub. L. 104-134, replaced H.R. 1977.
[b] H.R. 3610, which became Pub. L. 104-208, replaced H.R. 3662.

PPII Historical Perspective

The roots of this program lie in the blackouts and brownouts of 1999 and 2000. The Power Plant Improvement Initiative (PPII) is an outgrowth of congressional direction provided in the fiscal year 2001 appropriations to DOE's fossil energy research program. Funding was added for the program following increasing concerns over the adequacy of the nation's power supplies. Several parts of the United States, including the West Coast and parts of the Northeast, had experienced rolling blackouts and brownouts in the previous two years caused in large part by sharp rises in demand for electricity and lagging construction of new power plants.

Eligible projects include technologies that boost the efficiencies of currently operating power plants—generating more megawatts from the same amount of fuel—or that lower emissions and allow plants to stay in operation in compliance with environmental standards. The program was also open to technologies that improve the economics and overall performance of coal-fired power plants.

Private sector proposers must at least match the government funding. Proposed technologies must be mature enough to be commercialized within the next few years, and the cost-shared demonstrations must be large enough to show that the technology is viable for commercial use.

PPII Legislative History

The legislation authorizing PPII is found in Public Law 106-291, Department of the Interior and Related Agencies Appropriations Act, 2001. Under the act, $95,000,000 was transferred from funds appropriated in prior years under the CCTDP and made available for a general request for proposals for the commercial-scale demonstration of technologies to assure the reliability of the nation's energy supply from existing and new electric generating facilities. The funds provided were to be spent only in accordance with the provisions governing the use of funds contained in the CCTDP under which they were originally appropriated. Provisions for recoupment are identical to CCTDP-III except that repayments from the sale or licensing of technologies shall be from both domestic and foreign transactions, and the repayments are retained for future projects. Congress provided that any project approved under PPII shall be considered a Clean Coal Technology Demonstration Project, for the purposes of Chapters 51, 52, and 60 of title 40 of the Code of Federal Regulations.

In Public Law 107-63, Congress provided that funds excess to the needs of the PPII procurement be made available for the Clean Coal Power Initiative (CCPI).

Exhibit A-2 lists all the key legislation relating to PPII and provides a summary of provisions relating to program funding as well as program implementation.

Exhibit A-2
PPII Legislative History

Public Law	Date Enacted	Program Funding	Implementation Provisions
106-291	10/11/00	Made available $95,000,000 derived by transfer from funds appropriated in prior years from the CCTDP for a general request for proposals for the commercial scale demonstration of technologies to assure the reliability of the Nation's energy supply from existing and new electric generating facilities for which the Department of Energy upon review may provide financial assistance awards.	
107-63	11/5/01	Provided that funds excess to the needs of the Power Plant Improvement Initiative procurement provided for in Public Law 106-291 shall be made available for the Clean Coal Power Initiative provided for in Public Law 107-63.	

CCPI Historical Perspective

The CCPI was designed to respond to tighter air emission standards, the growth in electricity consumption, and emerging new technologies. With emerging air emission regulations dealing with ozone, particulate matter (PM), and mercury, new technologies are needed to provide consistent, reliable, low-cost energy while meeting these standards. Electricity demand is forecasted to increase by 45 percent over the next 20 years. The rising growth rate will require the construction of more than 1,300 new power plants. Driven by the rise in the digital economy, higher quality electricity is in greater demand than ever before. New technologies coming from the computer revolution are playing an ever-increasing role in the development of new power plant technologies. Neural networks and artificial intelligence can be used to fine-tune operations and increase efficiency at coal-fired power plants. New environmental control technologies could reduce fine particulates and mercury to previously unattainable levels. To meet the challenges of tighter air emission standards, the growth in electricity consumption, and emerging new technologies, Congress appropriated funds for CCPI.

CCPI Legislative History

The legislation authorizing CCPI is found in Public Law 107-63, Department of Interior and Related Agencies Appropriations Act for Fiscal Year 2002. Under the act, $150,000,000 was made available for a request for proposals for a Clean Coal Power Initiative providing for competitively awarded research, development, and demonstration projects to reduce the barriers to continued and expanded coal use. Congress specified that no CCPI project could be selected for which sufficient funding was not available to provide for the total project. Also, funds are to be expended in accordance with the provisions governing the use of funds contained under the heading "Clean Coal Technology" in prior appropriations.

Congress specified certain changes to the repayment provisions. Specifically, DOE could include provisions for repayment of government contributions to individual projects in an amount up to the government contribution to the project on terms and conditions that are acceptable to DOE, including repayments from sale and licensing of technologies from both domestic and foreign transactions. (In the CCTDP, repayment had been limited to domestic transactions.) Also, repayments are being retained by DOE for future coal-related research, development and demonstration projects.

As with PPII, Congress specified that any technology selected under CCPI shall be considered a "Clean Coal Technology," and any project selected under CCPI shall be considered a "Clean Coal Technology Project," for the purposes of *42 U.S.C. 7651n,* and Chapters 51, 52, and 60 of title 40 of the Code of Federal Regulations.

In 2003, Congress appropriated another $150,000,000 for CCPI in Public law 108-7. There were no changes in the implementing provisions.

Exhibit A-3 lists all key legislation relating to CCPI and provides a summary of provisions relating to program implementation. Following this section are funding provisions excerpted from appropriations.

Exhibit A-3
CCPI Legislative History

Public Law	Date Enacted	Program Funding	Implementation Provisions
107-63	11/5/01	Made available $150,000,000, after coordination with the private sector, for a request for proposals for a Clean Coal Power Initiative providing for competitively-awarded research, development, and demonstration projects to reduce the barriers to continued and expanded coal use107-63. Provided that funds excess to the needs of the Power Plant Improvement Initiative procurement provided for in Public Law 106-291 shall be made available for the Clean Coal Power Initiative provided for in Public Law 107-63.	No project may be selected for which sufficient funding is not available to provide for the total project. Funds shall be expended in accordance with the provisions governing the use of funds contained under the heading "Clean Coal Technology" in prior appropriations. Provisions for repayment of government contributions to individual projects in an amount up to the government contribution including repayments from sale and licensing of technologies from both domestic and foreign transactions. Repayments shall be retained by DOE for future coal-related research, development and demonstration projects. Any technology selected under this program shall be considered a Clean Coal Technology, and any project selected under this program shall be considered a Clean Coal Technology Project, for the purposes of *42 U.S.C. 7651n,* and Chapters 51, 52, and 60 of title 40 of the Code of Federal Regulations: Up to 4 percent of program direction funds available to the National Energy Technology Laboratory may be used to support Department of Energy activities not included in this account.
108-7	2/20/03	Made available $150,000,000, after coordination with the private sector, for a request for proposals for a Clean Coal Power Initiative providing for competitively-awarded research, development, and demonstration projects to reduce the barriers to continued and expanded coal use.	

Public Laws—CCTDP, PPII, and CCPI

Public Law 99-190

Public Law 99-190, 99 Stat. 1251 (1985)

Clean Coal Technology

Within 60 days following enactment of this Act [Dec. 19, 1985] the Secretary of Energy shall, pursuant to the Federal Nonnuclear Energy Research and Development Act of 1974 *(42 U.S.C. 5901, et seq.*), issue a general request for proposals for clean coal technology projects for which the Secretary of Energy upon review may provide financial assistance awards. Proposals for clean coal technology projects under this section shall be submitted to the Department of Energy within 60 days after issuance of the general request for proposals. The Secretary of Energy shall make any project selections no later than August 1, 1986: Provided, That the Secretary may vest fee title or other property interests acquired under cost-shared clean coal technology agreements in any entity, including the United States: Provided further, That the Secretary shall not finance more than 50 per centum of the total costs of a project as estimated by the Secretary as of the date of award of financial assistance: Provided further, That cost-sharing by project sponsors is required in each of the design, construction, and operating phases proposed to be included in a project: Provided further, That financial assistance for costs in excess of those estimated as of the date of award of original financial assistance may not be provided in excess of the proportion of costs borne by the Government in the original agreement and only up to 25 per centum of the original financial assistance: Provided further, That revenues or royalties from prospective operation of projects beyond the time considered in the award of financial assistance, or proceeds from prospective sale of the assets of the project, or revenues or royalties from replication of technology in future projects or plants are not cost-sharing for the purposes of this appropriation: Provided further, That other appropriated Federal funds are not cost-sharing for the purposes of this appropriation: Provided further, That existing facilities, equipment, and supplies, or previously expended research or development funds are not cost-sharing for the purposes of this appropriation, except as amortized, depreciated, or expensed in normal business practice.

	House	Senate	Conference
Fiscal year:			
1988	$50,000,000	$350,000,000	$50,000,000
1989	200,000,000	500,000,000	525,000,000
1990	100,000,000	_____	_____
Total	**350,000,000**	**850,000,000**	**575,000,000**

Conference Report (H.R. Conf. Rep. No. 450, 99th Cong., 1st Sess. [1985])

Clean Coal Technology

The managers have agreed to a $400,000,000 Clean Coal Technology program as described under the Department of the Treasury, Energy Security Reserve. Bill language is included which provides for the selection of projects no later than August 1, 1986. Within that period, a general request for proposals must be issued within 60 days and proposals must be submitted to the Department within 60 days after issuance of the general request for proposals. Language is also included allowing the Secretary of Energy to vest title in interests acquired under agreements in any entity, including the United States, and delineating cost-sharing requirements. Funds for these activities and projects are made available to the Clean Coal Technology program in the Energy Security program.

It is the intent of the managers that contributions in the form of facilities and equipment be considered only to the extent that they would be amortized, depreciated or expensed in normal business practice. Normal business practice shall be determined by the Secretary and is not necessarily the practice of any single proposer. Property which has been fully depreciated would not receive any cost-sharing value except to the extent that it has been in continuous use by the proposer during the calendar year immediately preceding the enactment of this Act. For this property, a fair use value for the life of the project may be assigned. Property offered as a cost-share by the proposer that is currently being depreciated would be limited in its cost-share value to the depreciation claimed during the life of the demonstration project. Furthermore, in determining normal business practice, the Secretary should not accept valuation for property sold, transferred, exchanged, or otherwise manipulated to acquire a new basis for depreciation purposes or to establish a rental value in circumstances which would amount to a transaction for the mere purpose of participating in this program.

The managers agree that, with respect to cost-sharing, tax implications of proposals and tax advantages available to individual proposers should not be considered in determining the percentage of Federal cost-sharing. This is consistent with current and historical practices in Department of Energy procurements.

It is the intent of the managers that there be full and open competition and that the solicitation be open to all markets utilizing the entire coal resource base. However,

projects should be limited to the use of United States mined coal as the feedstock and demonstration sites should be located within the United States.

The managers agree that no more than $1,500,000 shall be available in FY1986 and $2,000,000 each year thereafter for contracting, travel and ancillary costs of the program, and that manpower costs are to be funded under the fossil energy research and development program.

The managers direct the Department, after projects are selected, to provide a comprehensive report to the Congress on proposals received.

The managers also expect the request for proposals to be or the full $400,000,000 program, and not only for the first $100,000,000 available in fiscal year 1986.

Public Law 100-202

Public Law 100-202, 101 Stat. 1329-1 (1987)

Clean Coal Technology

For necessary expenses of, and associated with, Clean Coal Technology demonstrations pursuant to 42 U.S.C. 5901 *et seq.*, $50,000,000 are appropriated for the fiscal year beginning October 1, 1987, and shall remain available until expended, and $525,000,000 are appropriated for the fiscal year beginning October 1, 1988, and shall remain available until expended.

No later than sixty days following enactment of this Act, the Secretary of Energy shall, pursuant to the Federal Nonnuclear Energy Research and Development Act of 1974 (42 U.S.C. 5901 *et seq.*), issue a general request for proposals for emerging clean coal technologies which are capable of retrofitting or repowering existing facilities, for which the Secretary of Energy upon review may provide financial assistance awards. Proposals under this section shall be submitted to the Department of Energy no later than ninety days after issuance of the general request for proposals required herein, and the Secretary of Energy shall make any project selections no later than one hundred and sixty days after receipt of proposal: Provided, That projects selected are subject to all provisos contained under this head in Public Law 99-190: Provided further, That pre-award costs incurred by project sponsors after selection and before signing an agreement are allowable to the extent that they are related to (1) the preparation of material requested by the Department of Energy and identified as required for the negotiation; or (2) the preparation and submission of environmental data requested by the Department of Energy to complete National Environmental Policy Act requirements for the projects: Provided further, That pre-award costs are to be reimbursed only upon signing of the project agreement and only in the same ratio as the cost-sharing for the total project: Provided further, That reports on projects selected by the Secretary of Energy pursuant to authority granted under the heading "Clean coal technology" in the Department of the Interior and Related Agencies Appropriations Act, 1986, as contained in Public Law 99-190, which are received by the Speaker of the House of Representatives and the President of the Senate prior to the end of the first session of the 100th Congress shall be deemed to have met the criteria in the third proviso of the fourth paragraph under the heading "Administrative provision, Department of Energy" in the Department of the Interior and Related Agencies Appropriations Act, 1986, as contained in Public Law 99-190, upon expiration of 30 calendar days from receipt of the report by the Speaker of the House of Representatives and the President of the Senate.

Conference Report (H.R. Conf. Rep. No. 498, 100th Cong., 1st Sess. [1987])

Clean Coal Technology

Appropriates $575,000,000 for clean coal technology instead of $350,000,000 as proposed by the House and $850,000,000 as proposed by the Senate. The comparison by year is as follows:

Bill language, proposed by the House, which would have prohibited using grants has been deleted. The managers agree that project funding is expected to be based on cooperative agreements, but that grants might be applicable to support work also funded from this account.

The managers agree to deleted Senate language providing personnel floors for Clean Coal Technology. The managers further agree that the budget estimates for personnel and contract support are to be followed. The agreement included 58 new positions above current employment floors for the fossil energy organization and 30 positions within the floors. Out of clean coal technology funds, up to $3,980,000 is for fiscal year 1988 personnel-related costs and up to $16,520,000 is for all contract costs needed to make project selections and complete negotiations for both clean coal procurements. Contract costs necessary to monitor approved projects should be requested in the fiscal year 1989 budget. Increases above to those amount are subject to reprogramming procedures. No funds other than personnel related costs for the 30 positions included in the program direction are to be provided from the fossil energy research and development account.

The length of time for selection of projects by the Secretary of Energy has been extended from 120 days to 160 days based on experience from the original clean coal procurement. Once projects have been selected

the Secretary should establish project milestones and guidelines for project negotiations in order to expedite the negotiation process to the extent feasible.

The managers agree that the funds provided are available for non-utility applications as well as for utility applications.

The managers agree that no funds are provided for the demonstration of clean coal technologies which are intended solely for new, stand alone, applications. The Senate had proposed up to 25% of the funds be available for this purpose.

Bill language has been included which provides that reports on projects selected in the first round of clean coal procurements that are received before the end of the first session of the 100th Congress will satisfy reporting requirements 30 calendar days after receipt by Congress. This provision applies to a maximum of two project reports.

Public Law 100-446

Public Law 100-446, 102 Stat. 1774 (1988)

Clean Coal Technology

For necessary expenses of, and associated with, Clean Coal Technology demonstrations pursuant to 42 U.S.C. 5901 *et seq.*, $575,000,000 shall be made available on October 1, 1989, and shall remain available until expended: Provided, That projects selected pursuant to a general request for proposals issued pursuant to this appropriation shall demonstrate technologies capable of retrofitting or repowering existing facilities and shall be subject to all provisions contained under this head in Public Laws 99-190 and 100-202 as amended by this Act.

The first paragraph under this head in Public Law 100-202 is amended by striking "and $525,000,000 are appropriated for the fiscal year beginning October 1, 1988" and inserting "$190,000,000 are appropriated for the fiscal year beginning October 1, 1988, and shall remain available until expended, $135,000,000 are appropriated for the fiscal year beginning October 1, 1989, and shall remain available until expended, and $200,000,000 are appropriated for the fiscal year beginning October 1, 1990": Provided, That outlays in fiscal year 1989 resulting from the use of funds appropriated under this head in Public Law 100-202, as amended by this Act, may not exceed $15,500,000: Provided further, That these actions are taken pursuant to section 202(b)(1) of Public law 100-119 (2 U.S.C. 909).

For the purposes of the sixth proviso under this head in Public Laws 99-190, funds derived by the Tennessee Valley Authority from its power program are hereafter not to be precluded from qualifying as all or part of any cost-sharing requirement, except to the extent that such funds are provided by annual appropriations Acts: Provided, That unexpended balances of funds made available in the "Energy Security Reserve" account in the Treasury for the Clean Coal Technology Program by the Department of the Interior and Related Agencies Appropriations Acts, 1986, as contained in section 101(d) of Public Law 99-190, shall be merged with this account: Provided further, That for the purposes of the sixth proviso in Public Law 99-190 under this heading, funds provided under section 306 of Public Law 93-32 shall be considered non-Federal: Provided further, That reports on projects selected by the Secretary of Energy pursuant to authority granted under the heading "Clean coal technology" in the Department of the Interior and Related Agencies Appropriations Act, 1986, as contained in Public Law 99-190, which are received by the Speaker of the House of Representatives and the President of the Senate prior to the end of the second session of the 100th Congress shall be deemed to have met the criteria in the third proviso of the fourth paragraph under the heading "Administrative provisions, Department Energy" in the Department of the Interior and Related Agencies Appropriations Act, 1986, as contained in Public Law 99-190, upon expiration of 30 calendar days from receipt of the report by the Speaker of the House of Representatives and the President of the Senate.

Conference Report (H.R. Conf. Rep. No. 862, 100th Cong., 2nd Sess. [1988])

Clean Coal Technology

Amendment No. 131: Reported in technical disagreement. The managers on the part of the House will offer a motion to recede and concur in the amendment of the Senate with an amendment as follows:

In lieu of the matter proposed by said amendment insert the following: For necessary expenses of, and associated with, Clean Coal Technology demonstrations pursuant to 42 U.S.C. 5901 et seq., $575,000,000 shall be made available on October 1, 1989, and shall remain available until expended: Provided, That projects selected pursuant to a general request for proposals issued pursuant to this appropriation shall demonstrate technologies capable of retrofitting or repowering existing facilities and shall be subject to all provisos contained under this head in Public Laws 99-190 and 100-202 as amended by this Act.

The managers on the part of the Senate will move to concur in the amendment of the House to the amendment of the Senate. The amendment provides $575,000,000 in fiscal year 1990 for a third Clean Coal Technology procurement as proposed by the Senate, and clarifies that the procurement is for retrofit and repowering technologies and is subject to the cost-sharing provisions of the previous two procurements.

The managers agree that a request for proposals should be issued by May 1, 1989, with proposals due no later than 120 days after issuance of the request for proposals, and that the Secretary of Energy should make project selections no later than 120 days after receipt of proposals.

Amendment No. 132: Reported in technical disagreement. The managers on the part of the House will offer a motion to recede and concur in the amendment of the Senate with an amendment as follows:

Restore the matter stricken by said amendment, amended to read as follows: The first paragraph under this head in Public Law 100-202 is amended by striking "and $525,000,000 are appropriated for the fiscal year beginning October 1, 1988" and inserting "$190,000,000 are appropriated for the fiscal year beginning October 1, 1988, and shall remain available until expended, $135,000,000 are appropriated for the fiscal year beginning October 1, 1989, and shall remain available until expended, and $200,000,000 are appropriated for the fiscal year beginning October 1, 1990": Provided, That outlays in fiscal year 1989 resulting from the use of funds appropriated under this head in Public Law 100-202, as amended by this Act, may not exceed $15,500,000: Provided further, That these actions are taken pursuant to section 202(b)(1) of Public Law 100-119 (2 U.S.C. 909).

The managers on the part of the Senate will move to concur in the amendment of the House to the amendment of the Senate. The amendment changes the availability of $525,000,000 originally made available for fiscal year 1989 in Public Law 100-202 by making $190,000,000 available in 1989, $135,000,000 available in 1990, and $200,000,000 available in 1991 and also provides an outlay ceiling in fiscal year 1989. The House had proposed $100,000,000 in fiscal year 1989, $225,000,000 in fiscal year 1990, and $200,000,000 in fiscal year 1989, $225,000,000 in fiscal year 1990, and $200,000,000 in fiscal year 1991, and the Senate struck the House language.

Both of these changes are necessary because of budget allocation constraints, but neither action has an effect on the execution of the Clean Coal program, or on the Congress' overall support for the program, as is evidenced by additional appropriations provided for a third procurement of technologies.

The managers agree that administrative contract expenses may be incurred up to the budget level of $9,820,000, but caution that close control of such expenditures is necessary to assure that the outlay ceiling provided will be sufficient to cover project costs.

Amendment No. 133: Modifies public law citation as proposed by the Senate.

Amendment No. 134: Reported in technical disagreement. The managers on the part of the House will offer a motion to recede and concur in the amendment of the Senate which clarifies that funds borrowed by REA Electric Cooperatives from the Federal Financing Bank are eligible as cost-sharing in the clean coal technology program.

Amendment No. 135: Reported in technical disagreement. The managers on the part of the House will offer a motion to recede and concur in the amendment of the Senate which specifies clean coal projects may proceed 30 calendar days after receipt by Congress of required reports, provided the reports are received prior to the end of the 100th Congress.

Public Law 101-45

Public Law 101-45, 103 Stat. 97 (1989)

Clean Coal Technology

Notwithstanding any other provision of law, funds originally appropriated under this head in the Department of the Interior and Related Agencies Appropriations Act, 1989, shall be available for a third solicitation of clean coal technology demonstration projects, which projects are to be selected by the Department not later than January 1, 1990.

Public Law 101-121

Public Law 101-121, 103 Stat. 701 (1989)

Clean Coal Technology

For necessary expenses of, and associated with, Clean Coal Technology demonstrations pursuant to 42 U.S.C. 5901 *et seq.*, $600,000,000 shall be made available on October 1, 1990, and shall remain available until expended, and $600,000,000 shall be made available on October 1, 1991, and shall remain available until expended: Provided, That projects selected pursuant to a separate general request for proposals issued pursuant to each of these appropriations shall demonstrate technologies capable of replacing, retrofitting or repowering existing facilities and shall be subject to all provisos contained under this head in Public Laws 99-190, 100-202, and 100-446 as amended by this Act: Provided further, That the general request for proposals using funds becoming available on October 1, 1990, under this paragraph shall be issued no later than June 1, 1990, and projects resulting from such a solicitation must be selected no later than February 1, 1991: Provided further, That the general request for proposals

using funds becoming available on October 1, 1991, under this paragraph shall be issued no later than September 1, 1991, and projects resulting from such a solicitation must be selected no later than May 1, 1992.

The first paragraph under this head in Public Law 100-446 is amended by striking "$575,000,000 shall be made available on October 1, 1989" and inserting "$450,000,000 shall be made available on October 1, 1989, and shall remain available until expended, and $125,000,000 shall be made available on October 1, 1990": Provided, That these actions are taken pursuant to section 202(b)(1) of Public Law 100-119 (2 U.S.C. 909).

With regard to funds made available under this head in this and previous appropriations Acts, unobligated balances excess to the needs of the procurement for which they originally were made available may be applied to other procurements for which requests for proposals have not yet been issued: Provided, That for all procurements for which project selections have not been made as of the date of enactment of this Act no supplemental, backup, or contingent selection of projects shall be made over and above projects originally selected for negotiation and utilization of available funds: Provided further, That reports on projects selected by the Secretary of Energy pursuant to authority granted under this heading which are received by the Speaker of the House of Representatives and the President of the Senate less than 30 legislative days prior to the end of the first session of the 101st Congress shall be deemed to have met the criteria in the third proviso of the fourth paragraph under the heading "Administrative provisions, Department of Energy" in the Department of the Interior and Related Agencies Appropriations Act, 1986, as contained in Public Law 99-190, upon expiration of 30 calendar days from receipt of the report by the Speaker of the House of Representatives and the President of the Senate or at the end of the session, whichever occurs later.

Conference Report (H.R. Conf. Rep. No. 264, 101st Cong., 1st Sess. [1989])

Clean Coal Technology

Amendment No. 112: Reported in technical disagreement. The managers on the part of the House will offer a motion to recede and concur in the amendment of he Senate which adds the word "replacing" to the definition of clean coal technology. The managers agree that the inclusion of "replacing" for clean coal IV and V is intended to cover the complete replacement of an existing facility if because of design or site specific limitations, repowering or retrofitting of the plant is not a desirable option.

Amendment No. 113: Appropriates $450,000,000 for fiscal year 1990 for clean coal technology instead of $500,000,000 as proposed by the House and $325,000,000 as proposed by he Senate. This appropriation along with $125,000,000 provided for fiscal year 1991 in Amendment 114 fully funds the third round of clean coal technology projects. The managers agree that additional manpower is required, particularly at the Department's Energy Technology Centers, in order to manage adequately the increased workload from the accumulation of active clean coal technology projects and the inclusion of additional procurements in this bill. Although a legislative floor is not included, the managers agree that at least eighty personnel will be required in addition to the approximately thirty FTE's now included in the fossil energy research and development appropriation. The managers agree further that funds from the fossil energy research and development appropriation should not be used to pay the cost of more than the equivalent FTE's paid under that account in fiscal year 1989.

Amendment No. 114: Reported in technical disagreement. The managers on the part of the House will offer a motion to recede and concur in the amendment of the Senate with an amendment as follows:

In lieu of the matter stricken and inserted by said amendment, insert: and shall remain available until expended, and $125,0000,000.

The managers on the part of the Senate will move to concur in the amendment of the House to the amendment of the Senate. The amendment provides $125,000,000 in fiscal year 1991 for the third clean coal technology procurement instead of $75,000,000 as proposed by the House and $100,000,000 as proposed by the Senate.

Amendment No 115: Deletes Senate proposed appropriation of $150,000,000 for fiscal year 1992 for clean coal technology. The House proposed no such appropriation.

Amendment No. 116: Restores House language stricken by the Senate which prohibits the use of supplemental, backup, or contingent project selections in clean coal technology procurements.

Amendment No. 117: Restores the word "further" stricken by the Senate.

Public Law 101-164

Public Law 101-164, 103 Stat. 1109 (1989)

Clean Coal Technology

The second paragraph under this head contained in the Act making appropriations for the Department of the Interior and Related Agencies for the fiscal year ending September 30, 1990, is amended by striking "$450,000,000" and inserting "$419,000,000" and by striking "$125,000,000" and inserting "$156,000,000".

Conference Report (H.R. Conf. Rep. No. 315, 101st Cong.) 1st Sess. [1989])

The managers have agreed to reduce the funds appropriated by the Energy and Water Development Appropriations Act for Fiscal Year 1990 (Public Law 101-101) for the "Nuclear Waste Disposal Fund" by $46,000,000. This reduction will make funds available for the drug prevention effort.

The managers have agreed to reductions to the Interior and Related Agencies Appropriations Act for Fiscal Year 1990 (Public Law 101-121) in order to accommodate additional drug related appropriations.

The reductions are in three areas. The new budget authority for Clean Coal Technology of $450,000,000 for fiscal year 1990 is reduced by $31,000,000 with this same amount added to the advance appropriation for fiscal year 1991. With this change the new amount for fiscal year 1990 is $419,000,000 while fiscal year 1991 increases to $156,000,000. The second area of change is the imposition of an outlay ceiling on Strategic Petroleum Reserve oil acquisition. Outlays will be reduced from an estimated $169,945,000 to $147,125,000 and will decrease the fill rate from approximately 50,000 barrels per day to approximately 46,000 or 47,000 barrels per day. The third reduction relates to the Pennsylvania Avenue Development Corporation. The borrowing authority is reduced from $5,000,000 to $100,000.

The conference agreement includes bill language reducing the amount of funds transferred from trust funds to the Health Care Financing Administration Program Management account by $32,000,000 from $1,917,172,000 to $18,851,712,000. This reduction, along with the outlays reserved from the regular 1990 Labor, Health and Human Services, and Education appropriations bill, will be sufficient to support the subcommittee's share of the cost of anti-drug abuse funding. The conferees intend that the reduction in trust fund transfers be associated with activities to implement catastrophic health insurance, where funding needs may be diminished.

Public Law 101-302

Public Law 101-302, 104 Stat. 213 (1990)

Clean Coal Technology

Funds previously appropriated under this head for clean coal technology solicitations to be issued no later than June 1, 1990, and no later than September 1, 1991, respectively, shall not be obligated until September 1, 1991: Provided, That the aforementioned solicitations shall not be conducted prior to the ability to obligate these funds: Provided further, That pursuant to section 202(b) of the Balanced Budget and Emergency Deficit Control Reaffirmation Act of 1987, this action is a necessary (but secondary) result of a significant policy change: Provided further, That for the clean coal solicitations identified herein, provisions included for the repayment of government contributions to individual projects shall be identical to those included in the Program Opportunity Notice (PON) for Clean Coal Technology III (CCTDP-III) Demonstration Projects (solicitation number DE-PSO1-89 FE 61825), issued by the Department of Energy on May 1, 1989.

Conference Report (H.R. Conf. Rep. No. 493, 101st Cong., 2nd Sess. [1990])

Clean Coal Technology

Amendment No. 89: Reported in technical disagreement. The managers on the part of the House will offer a motion to recede and concur in the amendment of the senate with an amendment as follows:

In lieu of the matter proposed by said amendment insert:

Department of Energy
Clean Coal Technology

Funds previously appropriated under this head for clean coal technology solicitations to be issued no later than June 1, 1990, and no later than September 1, 1991, respectively, shall not be obligated until September 1, 1991: Provided, That the aforementioned solicitations shall not be conducted prior to the ability to obligate these funds: Provided further, That pursuant to section 202 (b) of the Balanced Budget and Emergency Deficit Control reaffirmation /Act of 1987 this action is a necessary (but secondary) result of a significant policy change: Provided further, That for the clean coal solicitations identified herein, provisions included for the repayment of government contributions to individual projects shall be identical to those included in the Program Opportunity Notice (PON) for Clean Coal Technology III (CCTDP-III) Demonstration Projects (solicitation number DE-PS01-89 FE 61825), issued by the Department of Energy on May 1, 1989.

The managers on the part of the Senate will move to concur in the amendment of the House to the amendment of the Senate.

The amendment delays the fourth and fifth clean coal technology solicitations as proposed by the Senate and specifies that, when issued, these solicitations must use repayment provisions used successfully in the third solicitation. This provision was included in the House introduced bill (H.R. 4828) and modifies a Senate amendment to the original Dire Emergency Supplemental.

The managers agree that changes to the clean air bill, proposed by a House authorizing committee, that would modify the Clean Coal Technology program must be resolved before a reasonable solicitation can be issued. The proposed delay will allow such resolution.

The managers have added language to ensure that provisions dealing with the repayment of government provided

funds will remain the same as the third round of procurements. These provisions were developed over a four year period based on experience of previous procurements and negotiations, and input from industrial participants, Congress, and the managers of the program. They appear to be working well.

Based on the long-term experience, and the clear fact that implementation of this type of technology will become even more important with passage of clean air legislation, the managers reject proposals put forth by the Department of Energy to increase rates substantially. Such proposals, while they might increase the recovery of government-provided funds over periods of up to 20 years, might also act as a deterrent to industrial participation in the program, which is already over 50 percent cost-shared by industry. The purpose of the program is to accelerate the introduction of clean uses of coal in a more efficient manner in compliance with stringent new air quality standards, not the provision of investment returns to the Government at the expense of nascent markets.

Public Law 101-512

Public Law 101-512, 104 Stat. 1915 (1990)

Clean Coal Technology

The first paragraph under this head in Public Law 101-121 is amended by striking "$600,000,000 shall be made available on October 1, 1990, and shall remain available until expended, and $600,000,000 shall be made available on October 1, 1991, and shall remain available until expended" and inserting "$600,000,000 shall be made available as follows: $35,000,000 on September 1, 1991, $315,000,000 on October 1, 1991, and $250,000,000 on October 1, 1992, all such sums to remain available until expended for use in conjunction with a separate general request for proposals, and $600,000,000 shall be made available as follows: $150,000,000 on October 1, 1991, $225,000,000 on October 1, 1992, and $225,000,000 on October 1, 1993, all such sums to remain available until expended for use in conjunction with a separate general request for proposals": Provided, That these actions are taken pursuant to section 202(b)(1) of Public Law 100-119 *(2 U.S.C. 909):* Provided further, That a fourth general request for proposals shall be issued not later than February 1, 1991, and a fifth general request for proposals shall be issued not later than March 1, 1992: Provided further, That project proposals resulting from such solicitations shall be selected not later than eight months after the date of the general request for proposals: Provided further, That for clean coal solicitations required herein, provisions included for the repayment of government contributions to individual projects shall be identical to those included in the Program Opportunity Notice (PON) for Clean Coal Technology III (CCTDP-III) Demonstration Projects (solicitation number DE-PS01-89 FE 61825), issued by the Department of Energy on May 1, 1989: Provided further, That funds provided under this head in this or any other appropriations Act shall be expended only in accordance with the provisions governing the use of such funds contained under this head in this or any other appropriations Act.

With regard to funds made available under this head in this and previous appropriations Acts, unobligated balances excess to the needs of the procurement for which they originally were made available may be applied to other procurements for use on projects for which cooperative agreements are in place, within the limitations and proportions of Government financing increases currently allowed by law: Provided, That the Department of Energy, for a period of up to five (5) years after completion of the operations phase of a cooperative agreement may provide appropriate protections, including exemptions from subchapter II of chapter 5 of title 5, United States Code, against the dissemination of information that results from demonstration activities conducted under the Clean Coal Technology Program and that would be a trade secret or commercial or financial information that is privileged or confidential if the information had been obtained from and first produced by a non-Federal party participating in a Clean Coal Technology project: Provided further, That, in addition to the full-time permanent Federal employees specified in section 303 of Public Law 97-257, as amended, no less than 90 full-time Federal employees shall be assigned to the Assistant Secretary for Fossil Energy for carrying out the programs under this head using funds available under this head in this and any other appropriations Act and of which 35 shall be for PETC and 30 shall be for METC: Provided further, That reports on projects selected by the Secretary of Energy pursuant to authority granted under this heading which are received by the Speaker of the House of Representatives and the President of the Senate less than 30 legislative days prior to the end of the second session of the 101st Congress shall be deemed to have met the criteria in the third proviso of the fourth paragraph under the heading " Administrative provisions, Department of Energy" in the Department of the Interior and Related Agencies Appropriations Act, 1986, as contained in Public Law 99-190, upon expiration of 30 calendar days from receipt of the report by the Speaker of the House of Representatives and the President of the Senate or at the end of the session, whichever occurs later.

Conference Report (H.R. Conf. Rep. No. 971, 101st Cong., 2nd Sess. [1990])

Clean Coal Technology

Amendment No. 142: Provides $35,000,000 for clean coal technology on September 1, 1991 as proposed by the House instead of $100,000,000 as proposed by the Senate. This amendment and Amendment No. 143 shift the availability of $65,000,000 from fiscal year 1991 to fiscal year 1992.

Amendment No. 143: Provides $315,000,000 for clean coal technology on October 1, 1991 as proposed by the House instead of $250,000,000 as proposed by the Senate. This amendment and Amendment No. 142 shift the availability of $65,000,000 from fiscal year 1991 to fiscal year 1992.

Amendment No. 144: Provides dates for two solicitations for clean coal technology as proposed by the Senate. The date for CCTDP-IV is amended to February 1, 1991 from January 1, 1991. The date for CCTDP-V is not changed from the Senate date of March 1, 1992.

The managers have agreed to a February 1, 1991 date for the next solicitation to enable the Department to publish a draft solicitation for comment by interested parties. It is expected that there will be changes to evaluation criteria and other factors that make it imperative that potential proposers have an opportunity to comment on the content of the solicitation.

The managers urge the Department to include potential benefits to remote, import-dependent sites as a program policy factor in evaluating proposals. The Department should also consider projects which can provide multiple fuel resource options for regions which are more than seventy-five percent dependent on one fuel form for total energy requirements.

Amendment No. 145: Requires selection of projects within eight months of the requests for proposals required by Amendment No. 144 as proposed by the Senate. The House had no such provision.

Amendment No. 146: Requires repayment of government contributions to projects under conditions identical to the most recent clean coal solicitation as proposed by the Senate. The House had no such provision.

Amendment No. 147: Provides that funds for clean coal technology may be expended only under conditions contained in appropriations Acts. The Senate language had prohibited geographic restrictions on the expenditure of funds. The House had no such provision. The managers direct that no preferential consideration be given to any project referenced explicitly or implicitly in other legislation.

The managers agree to delete bill language dealing with geographic restrictions based on such restrictions being deleted from clean air legislation.

Amendment No. 148: Earmarks employees to two fossil energy technology centers as proposed by the Senate. The House had no such provision. The managers agree that the earmarks for PETC and METC are minimum levels and may be increased as necessary.

The managers agree that no more than the current 30 full-time equivalent positions from fossil energy research and development may be used in the clean coal program in fiscal year 1991.

Public Law 102-154

Public Law 102-154, 105 Stat. 990 (1991)

Clean Coal Technology

The first paragraph under this head in Public Law 101-512 is amended by striking the phrase "$150,000,000 on October 1, 1991, $225,000,000 on October 1, 1992" and inserting "$100,000,000 on October 1, 1991, $275,000,000 on October 1, 1992".

Notwithstanding the issuance date for the fifth general request for proposals under this head in Public Law 101-512, such request for proposals shall be issued not later than July 6, 1992, and notwithstanding the proviso under this head in Public Law 101-512 regarding the time interval for selection of proposals resulting from such solicitation, project proposals resulting from the fifth general request for proposals shall be selected not later than ten months after the issuance date of the fifth general request for proposals: Provided, That hereafter the fifth general request for proposals shall be subject to all provisos contained under this head in previous appropriations Acts unless amended by this Act.

Notwithstanding the provisos under this head in previous appropriations Acts, projects selected pursuant to the fifth general request for proposals shall advance significantly the efficiency and environmental performance of coal-using technologies and be applicable to either new or existing facilities: Provided, That budget periods may be used in lieu of design, construction, and operating phases for cost-sharing calculations: Provided further, That the Secretary shall not finance more than 50 per centum of the total costs of any budget period: Provided further, That project specific development activities for process performance definition, component design verification, materials selection, and evaluation of alternative designs may be funded on a cost-shared basis up to a limit of 10 per centum of the Government's share of project cost: Provided further, That development activities eligible for cost-sharing may include limited modifications to existing facilities for project related testing but do not include construction of new facilities.

With regard to funds made available under this head in this and previous appropriations Acts, unobligated balances excess to the needs of the procurement for which they originally were made available may be applied to other procurements for use on projects for which cooperative agreements are in place, within the limitations and proportions of Government financing increases currently allowed by law: Provided, That hereafter, the Department of Energy, for a period of up to five years after completion of the operations phase of a cooperative agreement may provide appropriate protections, including exemptions from subchapter II of chapter 5 of title 5, United States Code, against the dissemination of information that results from demonstration activities conducted under the Clean Coal Technology Program and that would be a trade secret or commercial or financial information that is privileged or confidential if the information had been obtained from and first produced by a non-Federal party participating in a Clean Coal Technology project: Provided further, That hereafter, in addition to the full-time permanent Federal employees specified in section 303 of Public Law 97-257, as amended, no less than 90 full-time Federal employees shall be assigned to the Assistant Secretary for Fossil Energy for carrying out the programs under this head using funds available under this head in this and any other appropriations Act and of which not less than 35 shall be for PETC and not less than 30 shall be for METC: Provided further, That hereafter reports on projects selected by the Secretary of Energy pursuant to authority granted under this heading which are received by the Speaker of the House of Representatives and the President of the Senate less than 30 legislative days prior to the end of each session of Congress shall be deemed to have met the criteria in the third proviso of the fourth paragraph under the heading "Administrative provisions, Department of Energy" in the Department of the Interior and Related Agencies Appropriations Act, 1986, as contained in Public Law 99-190, upon expiration of 30 calendar days from receipt of the report by the Speaker of the House of Representatives and the President of the Senate or at the end of the session, whichever occurs later.

Conference Report (H.R. Conf. Rep. No. 256, 102nd Cong., 1st Sess. [1991])

Clean Coal Technology

Amendment No. 165: Reported in technical disagreement. The managers on the part of the House will offer a motion to recede and concur in the amendment of the Senate with an amendment as follows:

In lieu of the matter stricken and inserted by said amendment insert:

Notwithstanding the issuance date for the fifth general request for proposals under this head in Public Law 101-512, such request for proposals shall be issued not later than July 6, 1992, and notwithstanding the proviso under this head in Public Law 101-512 regarding the time interval for selection of proposals resulting from such solicitation, project proposals resulting from the fifth general request for proposals shall be selected not later than ten months after the issuance date of the fifth general request for proposals: Provided, That hereafter the fifth general request for proposals.

The managers on the part of the Senate will move to concur in the amendment of the House to the amendment of the Senate.

The amendment changes the issuance date for the fifth general request for proposals to July 6, 1992 instead of March 1, 1992 as proposed by the House and August 10, 1992 as proposed by the Senate and the allowable length of time from issuance of the request for proposals to selection of projects to ten months. The amendment also deletes Senate proposed bill language pertaining to a sixth general request for proposals as discussed below.

The managers agree that the additional two months in the procurement process for the fifth round of proposals should include an additional month to allow for the preparation of proposals by the private sector, and up to an additional month for Department of Energy review and evaluation of proposals when compared to the process for the fourth round.

The managers have agreed to delete bill language regarding a sixth round of proposals, but agree that funding will be provided for a sixth round based on unobligated and unneeded amounts that may become available from the first five rounds. The report from the Secretary on available funds, which was originally in the Senate amendment, is still a requirement and such report should be submitted to the House and Senate Committees on Appropriations not later than May 1, 1994. Based on that report, the funding, dates and conditions for the sixth round will be included in the fiscal year 1995 appropriation.

The managers expect that the fifth solicitation will be conducted under the same general types of criteria as the fourth solicitation principally modified only (1) to include the wider range of eligible technologies or applications; (2) to adjust technical criteria to consider allowable development activities, to strengthen criteria for non-utility demonstrations, and to adjust commercial performance criteria for additional facilities and technologies with regard to aspects of general energy efficiency and environmental performance; and (3) to clarify and strengthen cost and finance criteria particularly with regard to development activities.

Amendment No. 166: Restores House language deleted by the Senate which refers to a fifth general request for proposals. The Senate proposed language dealing with both a fifth and a sixth round.

Amendment No. 167: Reported in technical disagreement. The managers on the part of the House will offer

a motion to recede and concur in the amendment of the Senate which directs the Secretary of Energy to reobligate up to $44,000,000 from the fourth round of Clean Coal Technology proposals to a proposal ranked highest in its specific technology category by the Source Evaluation Board if other than the highest ranking project in that category was selected originally by the Secretary, and if such funds become unobligated and are sufficient to fund such projects. This amendment would earmark such funds, if they become available, to a specific project not chosen in the Department of Energy selection process for the fourth round of Clean Coal Technology.

Amendment No. 168: Technical amendment which deletes House proposed punctuation and numbering as proposed by the Senate.

Amendment No. 169: Deletes House proposed language which made unobligated funds available for procurements for which requests for proposals have not been issued.

Amendment No. 170: Reported in technical disagreement. The managers on the part of the House will offer a motion to recede and concur in the amendment of the Senate which adds "not less than" to employment floor language for PETC as proposed by the Senate. The House had no such language.

Amendment No. 171: Reported in technical disagreement. The managers on the part of the House will offer a motion to recede and concur in the amendment of the Senate which adds "not less than" to employment floor language for METC as proposed by the Senate. The House had no such language.

Public Law 102-381

Public Law 102-381, 106 Stat. 1374 (1992)

Clean Coal Technology

The first paragraph under this head in Public Law 101-512, as amended, is further amended by striking the phrase "and $250,000,000 on October 1, 1992" and inserting "$150,000,000 on October 1, 1993, and $100,000,000 on October 1, 1994" and by striking the phrase "$275,000,000 on October 1, 1992, and $225,000,000 on October 1, 1993" and inserting "$250,000,000 on October 1, 1993, and $250,000,000 on October 1, 1994".

Public Law 103-138

Public Law 103-138, 107 Stat. 1379 (1993)

Clean Coal Technology

The first paragraph under this head in Public Law 101-512, as amended, is further amended by striking the phrase "$150,000,000 on October 1, 1993, and $100,000,000 on October 1, 1994" and inserting "$100,000,000 on October 1, 1993, $100,000,000 on October 1, 1994, and $50,000,000 on October 1, 1995" and by striking the phrase "$250,000,000 on October 1, 1993, and $250,000,000 on October 1, 1994" and inserting "$125,000,000 on October 1, 1993, $275,000,000 on October 1, 1994, and $100,000,000 on October 1, 1995".

Public Law 103-332

Public Law 103-332, 108 Stat. 2499 (1994)

Clean Coal Technology

The first paragraph under this head in Public Law 101-512, as amended, is further amended by striking the phrase "$100,000,000 on October 1, 1994, and $50,000,000 on October 1, 1995" and inserting "$18,000,000 on October 1, 1994, $100,000,000 on October 1, 1995, and $32,000,000 on October 1, 1996"; and by striking the phrase "$275,000,000 on October 1, 1994, and $100,000,000 on October 1, 1995" and inserting "$19,121,000 on October 1, 1994, $100,000,000 on October 1, 1995, and $255,879,000 on October 1, 1996": Provided, That not to exceed $18,000,000 available in fiscal year 1995 may be used for administrative oversight of the Clean Coal Technology program.

Public Law 104-6

Public Law 104-6, 109 Stat. 73 (1995)

Clean Coal Technology (Rescission)

Of the funds made available under this heading for obligation in fiscal year 1996, $50,000,000 are rescinded and of the funds made available under this heading for obligation in fiscal year 1997, $150,000,000 are rescinded: Provided, That funds made available in previous appropriations Acts shall be available for any ongoing project regardless of the separate request for proposal under which the project was selected.

Public Law 104-134

Conference Report (H.R. Conf. Rep. No. 402, 104th Cong., 1st Sess. [1995])

The managers do not object to the use of up to $18,000,000 in clean coal technology program funds for administration of the clean coal program.

Public Law 104-208

Public Law 104-208, 110 Stat. 3009 (1996)

Clean Coal Technology (Rescission)

Of the funds made available under this heading for obligation in fiscal year 1997 or prior years, $123,000,000 are rescinded: Provided, That funds made available in previous appropriations Acts shall be available for any ongoing project regardless of the separate request for proposal under which the project was selected.

Conference Report (H.R. Conf. Rep. No. 863, 104th Cong., 2nd Sess., [1996])

Clean Coal Technology (Rescission)

Of the funds made available under this heading for obligation in fiscal year 1997 or prior years, $123,000,000 are rescinded: Provided, That funds made available in previous appropriations Acts shall be available for any ongoing project regardless of the separate request for proposal under which the project was selected.

Senate Report (S. Rep. No. 319, 104th Cong., 2nd Sess. [1996])

The Committee does not object to the use of up to $16,000,000 in available funds for administration of the clean coal program in fiscal year 1997.

House Report (H.R. Rep. No. 625, 104th Cong., 2nd Sess. [1996])

The Committee does not object to the use of up to $16,000,000 in available funds for administration of the clean coal program in fiscal year 1997.

Public Law 105-18

Public Law 105-18, 111 Stat. 158 (1997)

Clean Coal Technology (Rescission)

Of the funds made available under this heading for obligation in fiscal year 1997 or prior years, $17,000,000 are rescinded: Provided, That funds made available in previous appropriations Acts shall be available for any ongoing project regardless of the separate request for proposal under which the project was selected.

Public Law 105-83

Public Law 105-83, 111 Stat. 37 (1997)

Of the funds made available under this heading for obligation in fiscal year 1997 or prior years, $101,000,000 are rescinded: Provided, That funds made available in previous appropriations Acts shall be available for any ongoing project regardless of the separate request for proposal under which the project was selected.

Public Law 105-277

Public Law 105-277, 112 Stat. 2681 (1998)

Clean Coal Technology (Deferral)

Of the funds made available under this heading for obligation in prior years, $10,000,000 of such funds shall not be available until October 1, 1999; $15,000,000 shall not be available until October 1, 2000; and $15,000,000 shall not be available until October 1, 2001: Provided, That funds made available in previous appropriations Acts shall be available for any ongoing project regardless of the separate request for proposal under which the project was selected.

Conference Report (H.R. Conf. Rep. No. 825, 105th Cong. 2nd Sess. [1998])

Clean Coal Technology

The conference agreement provides for the deferral of $40,000,000 in previously appropriated funds for the clean coal technology program as proposed by the Senate. The House did not propose to defer funding. The Committees agree that $14,900,000 may be used for administration of the clean coal technology program.

Public Law 106-113

Public Law 106-113, 113 Stat. 1501 (1999)

Clean Coal Technology (Deferral)

Of the funds made available under this heading for obligation in prior years, $156,000,000 shall not be available until October 1, 2000: Provided, That funds made available in previous appropriations Acts shall be

available for any ongoing project regardless of the separate request for proposal under which the project was selected.

Conference Report (H.R. Rep. No. 406, 106th Cong., 1st Sess. [1999])

Clean Coal Technology (Deferral)

The conference agreement provides for the deferral of $156,000,000 in previously appropriated funds for the clean coal technology program as proposed by the Senate instead of a deferral of $256,000,000 as proposed by the House. The managers agree that up to $14,400,00 may be used for program direction.

Public Law 106-291

Public Law 106-291, 114 Stat. 922 (2000)

Clean Coal Technology (Deferral)

Of the funds made available under this heading for obligation in prior years, $67,000,000 shall not be available until October 1, 2001: Provided, That funds made available in previous appropriations Acts shall be available for any ongoing project regardless of the separate request for proposal under which the project was selected.

Fossil Energy Research and Development (including transfers of funds)

For necessary expenses in carrying out fossil energy research and development activities, under the authority of the Department of Energy Organization Act (Public Law 95-91), including the acquisition of interest, including defeasible and equitable interests in any real property or any facility or for plant or facility acquisition or expansion, and for conducting inquiries, technological investigations and research concerning the extraction, processing, use, and disposal of mineral substances without objectionable social and environmental costs (30 U.S.C. 3, 1602, and 1603), performed under the minerals and materials science programs at the Albany Research Center in Oregon $ 540,653,000, to remain available until expended, of which $ 12,000,000 for oil technology research shall be derived by transfer from funds appropriated in prior years under the heading "Strategic Petroleum Reserve, SPR Petroleum Account" and of which $ 95,000,000 shall be derived by transfer from funds appropriated in prior years under the heading "Clean Coal Technology", such funds to be available for a general request for proposals for the commercial scale demonstration of technologies to assure the reliability of the Nation's energy supply from existing and new electric generating facilities for which the Department of Energy upon review may provide financial assistance awards: Provided, That the request for proposals shall be issued no later than one hundred and twenty days following enactment of this Act, proposals shall be submitted no later than ninety days after the issuance of the request for proposals, and the Department of Energy shall make project selections no later than one hundred and sixty days after the receipt of proposals: Provided further, That no funds are to be obligated for selected proposals prior to September 30, 2001: Provided further, That funds provided shall be expended only in accordance with the provisions governing the use of funds contained under the heading under which they were originally appropriated: Provided further, That provisions for repayment of government contributions to individual projects shall be identical to those included in the Program Opportunity Notice (Solicitation Number DE-PS01-89FE61825), issued by the Department of Energy on May 1, 1989, except that repayments from sale or licensing of technologies shall be from both domestic and foreign transactions: Provided further, That such repayments shall be deposited in this account to be retained for future projects: Provided further, That any project approved under this program shall be considered a Clean Coal Technology Demonstration Project, for the purposes of Chapters 51, 52, and 60 of title 40 of the Code of Federal Regulations: Provided further, That no part of the sum herein made available shall be used for the field testing of nuclear explosives in the recovery of oil and gas: Provided further, That up to 4 percent of program direction funds available to the National Energy Technology Laboratory may be used to support Department of Energy activities not included in this account.

Public Law 107-63

Public Law 107-63, 115 Stat. 414 (2001)

Clean Coal Technology (Deferral)

Of the funds made available under this heading for obligation in prior years, $40,000,000 shall not be available until October 1, 2002: Provided, That funds made available in previous appropriations Acts shall be available for any ongoing project regardless of the separate request for proposal under which the project was selected.

Fossil Energy Research and Development (Including Transfer of Funds)

For necessary expenses in carrying out fossil energy research and development activities, under the authority of the Department of Energy Organization Act (Public Law 95-91), including the acquisition of interest, including defeasible and equitable interests in any

real property or any facility or for plant or facility acquisition or expansion, and for conducting inquiries, technological investigations and research concerning the extraction, processing, use, and disposal of mineral substances without objectionable social and environmental costs (30 U.S.C. 3, 1602, and 1603), $616,490,000, to remain available until expended, of which $11,000,000 is to begin a 7-year project for construction, renovation, furnishing, and demolition or removal of buildings at National Energy Technology Laboratory facilities in Morgantown, West Virginia and Pittsburgh, Pennsylvania; and for acquisition of lands, and interests therein, in proximity to the National Energy Technology Laboratory, and of which $33,700,000 shall be derived by transfer from funds appropriated in prior years under the heading 'Clean Coal Technology', and of which $150,000,000 and such sums as may be appropriated in fiscal year 2003 are to be made available, after coordination with the private sector, for a request for proposals for a Clean Coal Power Initiative providing for competitively-awarded demonstrations of commercial scale technologies to reduce the barriers to continued and expanded coal use: Provided, That the request for proposals shall be issued no later than 120 days following enactment of this Act, proposals shall be submitted no later than 150 days after the issuance of the request for proposals, and the Department of Energy shall make project selections no later than 160 days after the receipt of proposals: Provided further, That no project may be selected for which sufficient funding is not available to provide for the total project: Provided further, That funds shall be expended in accordance with the provisions governing the use of funds contained under the heading 'Clean Coal Technology' in prior appropriations: Provided further, That the Department may include provisions for repayment of Government contributions to individual projects in an amount up to the Government contribution to the project on terms and conditions that are acceptable to the Department including repayments from sale and licensing of technologies from both domestic and foreign transactions: Provided further, That such repayments shall be retained by the Department for future coal-related research, development and demonstration projects: Provided further, That any technology selected under this program shall be considered a Clean Coal Technology, and any project selected under this program shall be considered a Clean Coal Technology Project, for the purposes of 42 U.S.C. Sec. 7651n, and Chapters 51, 52, and 60 of title 40 of the Code of Federal Regulations: Provided further, That funds excess to the needs of the Power Plant Improvement Initiative procurement provided for under this heading in Public Law 106-291 shall be made available for the Clean Coal Power Initiative provided for under this heading in this Act: Provided further, That no part of the sum herein made available shall be used for the field testing of nuclear explosives in the recovery of oil and gas: Provided further, That up to 4 percent of program direction funds available to the National Energy Technology Laboratory may be used to support Department of Energy activities not included in this account.

Public Law 108-7

Public Law 108-7, 117 Stat. 11 (2003)

Clean Coal Technology (Deferral)

Of the funds made available under this heading for obligation in prior years, $87,000,000 shall not be available until October 1, 2003: Provided, That funds made available in previous appropriations Acts shall be available for any ongoing project regardless of the separate request for proposal under which the project was selected.

Fossil Energy Research and Development

For necessary expenses in carrying out fossil energy research and development activities, under the authority of the Department of Energy Organization Act (Public Law 95-91), including the acquisition of interest, including defeasible and equitable interests in any real property or any facility or for plant or facility acquisition or expansion, and for conducting inquiries, technological investigations and research concerning the extraction, processing, use, and disposal of mineral substances without objectionable social and environmental costs *(30 U.S.C. 3,* 1602, and 1603), $624,900,000, to remain available until expended, of which $4,000,000 is to continue a multi-year project for construction, renovation, furnishing, and demolition or removal of buildings at National Energy Technology Laboratory facilities in Morgantown, West Virginia and Pittsburgh, Pennsylvania; and of which $150,000,000 are to be made available, after coordination with the private sector, for a request for proposals for a Clean Coal Power Initiative providing for competitively-awarded research, development, and demonstration projects to reduce the barriers to continued and expanded coal use: Provided, That no project may be selected for which sufficient funding is not available to provide for the total project: Provided further, That funds shall be expended in accordance with the provisions governing the use of funds contained under the heading "Clean Coal Technology" in prior appropriations: Provided further, That the Department may include provisions for repayment of Government contributions to individual projects in an amount up to the Government contribution to the project on terms and conditions that are acceptable to the Department including repayments from sale and licensing of technologies from both domestic and foreign transactions: Provided further, That such repayments shall be retained by the Department for future coal-related research, development and demonstration projects: Provided further, That

any technology selected under this program shall be considered a Clean Coal Technology, and any project selected under this program shall be considered a Clean Coal Technology Project, for the purposes of *42 U.S.C. 7651n,* and Chapters 51, 52, and 60 of title 40 of the Code of Federal Regulations: Provided further, That no part of the sum herein made available shall be used for the field testing of nuclear explosives in the recovery of oil and gas: Provided further, That up to 4 percent of program direction funds available to the National Energy Technology Laboratory may be used to support Department of Energy activities not included in this account.

Appendix B. Program History

CCTDP Solicitation History

The objective of the CCTDP-I solicitation, issued February 17, 1986, was to seek cost-shared projects to demonstrate the feasibility of clean coal technologies for commercial applications. The Clean Coal Technology Demonstration Program (CCTDP) Program Opportunity Notice (PON) elicited 51 proposals. Nine projects were selected and 14 projects were placed on a list of alternatives in the event negotiations on the original 9 projects were unsuccessful; 8 alternative projects were eventually selected as replacement projects. Projects were selected from the list of alternatives on three separate occasions.

The CCTDP-II PON, issued February 22, 1988, solicited cost-shared, innovative clean coal technology projects to demonstrate technologies that were capable of being commercialized in the 1990s, more cost-effective than current technologies, and capable of achieving significant reductions in SO_2 and/or NO_x emissions from existing coal-burning facilities, particularly those that contribute to transboundary air pollution. The CCTDP-II PON was the first solicitation implementing the recommendations of the U.S. and Canadian Special Envoys' report on acid rain. The U.S. Department of Energy (DOE) received 55 proposals and selected 16 as best furthering the goals and objectives of the PON (no alternatives were selected).

The objective of the CCTDP-III PON, issued May 1, 1989, was to solicit cost-shared clean coal technology projects to demonstrate innovative, energy-efficient technologies capable of being commercialized in the 1990s. These technologies were to be capable of (1) achieving significant reductions in emissions of SO_2 and/or NO_x from existing facilities to minimize environmental impacts, such as transboundary and interstate air pollution; and/or (2) providing for future energy needs in an environmentally acceptable manner. DOE received 48 proposals and selected 13 projects as best furthering the goals and objectives of the PON.

The CCTDP-IV PON, issued January 17, 1991, solicited proposals to conduct cost-shared clean coal technology projects to demonstrate innovative, energy-efficient, economically competitive technologies. These technologies were to be capable of (1) retrofitting, repowering, or replacing existing facilities while achieving significant reductions in the emissions of SO_2, NO_x, or both, and/or (2) providing for future energy needs in an environmentally acceptable manner. A total of 33 proposals were submitted in response to the PON. Nine projects were selected.

The objective of the CCTDP-V PON, issued July 6, 1992, was to solicit proposals to conduct cost-shared demonstration projects that significantly advance the efficiency and environmental performance of coal-using technologies and are applicable to either new or existing facilities. In response to the solicitation, DOE received proposals for 24 projects and selected 5 projects.

CCTDP Selection and Negotiation History

The following is a history of the selection and negotiations for the CCTDP Projects.

July 1986

Nine projects were selected under CCTDP-I (14 alternative projects selected to replace any selected projects if negotiations were unsuccessful).

March 1987

DOE signed cooperative agreements with two CCTDP-I participants, Coal Tech Corporation (Advanced Cyclone Combustor with Internal Sulfur, Nitrogen, and Ash Control) and The Ohio Power Company (Tidd PFBC Demonstration Project).

June 1987

DOE signed a cooperative agreement with CCTDP-I participant, The Babcock & Wilcox Company (now McDermott Technology, Inc.) (LIMB Demonstration Project Extension and Coolside Demonstration).

July 1987

DOE signed a cooperative agreement with CCTDP-I participant, Energy and Environmental Research Corporation (Enhancing the Use of Coals by Gas Reburning and Sorbent Injection).

September 1987
General Electric Company withdrew its proposal (Integrated Coal Gasification Steam Injection Gas Turbine Demonstration Plants with Hot Gas Cleanup).

October 1987
Weirton Steel Corporation withdrew its proposal, Direct Iron Ore Reduction to Replace Coke Oven/Blast Furnace for Steelmaking, from further consideration.

Four more CCTDP-I projects were selected: Colorado-Ute Electric Association, Inc. (Nucla CFB Demonstration Project); TRW, Inc. (Advanced Slagging Coal Combustor Utility Demonstration Project); Minnesota Department of Natural Resources (COREX Ironmaking Demonstration Project); and Foster Wheeler Power Systems, Inc. (Clean Energy IGCC Demonstration Project).

December 1987
DOE signed cooperative agreements with two more CCTDP-I participants, Ohio Ontario Clean Fuels, Inc., (Prototype Commercial Coal/Oil Coprocessing Project) and Energy International, Inc. (Underground Coal Gasification Demonstration Project).

January 1988
DOE signed a cooperative agreement with The M.W. Kellogg Company and Bechtel Development Company for a CCTDP-I project, The Appalachian IGCC Demonstration Project.

September 1988
Sixteen projects were selected under CCTDP-II.

November 1988
DOE signed a cooperative agreement with CCTDP-I participant, TRW, Inc. (Advanced Slagging Coal Combustor Utility Demonstration Project).

December 1988
Negotiations were terminated with Minnesota Department of Natural Resources (COREX Ironmaking Demonstration Project) under CCTDP-I.

DOE selected three more CCTDP-I projects: ABB Combustion Engineering, Inc. and CQ Inc. (Development of the Coal Quality Expert™); Western Energy Company (formerly Rosebud SynCoal Partnership, now Western SynCoal LLC; Advanced Coal Conversion Process Demonstration); and United Coal Company (Coal Waste Recovery Advanced Technology Demonstration).

June 1989
The City of Tallahassee CCTDP-I project, ACFB Repowering, was selected from the alternative list.

The M.W. Kellogg Company and Bechtel Development Company withdrew their CCTDP-I project, Clean Energy IGCC Demonstration Project.

September 1989
United Coal Company withdrew its CCTDP-I project, Coal Waste Recovery Advanced Technology Demonstration.

November 1989
DOE signed a cooperative agreement with CCTDP-II participant, Bethlehem Steel Corporation (Innovative Coke Oven Gas Cleaning System for Retrofit Applications).

Combustion Engineering, Inc., (CCTDP-II) withdrew its Postcombustion Sorbent Injection Demonstration Project.

December 1989
Thirteen projects were selected under CCTDP-III.

DOE signed cooperative agreements with five CCTDP-II participants: ABB Combustion Engineering, Inc. (SNOX™ Flue Gas Cleaning Demonstration Project); The Babcock & Wilcox Company (SO_x-NO_x-Rox Box™ Flue Gas Cleanup Demonstration Project); Passamaquoddy Tribe (Cement Kiln Flue Gas Recovery Scrubber); Pure Air on the Lake, L.P. (Advanced Flue Gas Desulfurization Demonstration Project); and Southern Company Services, Inc. (Demonstration of Advanced Combustion Techniques for a Wall-Fired Boiler).

Energy International, Inc., withdrew its CCTDP-I project, Underground Coal Gasification Demonstration Project.

February 1990
Foster Wheeler Power Systems, Inc., withdrew its CCTDP-I proposal, Clean Energy IGCC Demonstration Project.

April 1990
DOE signed cooperative agreements with three CCTDP-II participants: The Appalachian Power Company (PFBC Utility Demonstration Project); The Babcock & Wilcox Company (Demonstration of Coal Reburning for Cyclone Boiler NO_x Control); and Southern Company Services, Inc. (Demonstration of Innovative Applications of Technology for the CT-121 FGD Process).

June 1990
DOE signed cooperative agreements with the co-participants of one CCTDP-I project, ABB Combustion Engineering, Inc. and CQ Inc. (Development of the Coal Quality Expert™), and with two CCTDP-II participants: Southern Company Services, Inc. (Demonstration of Selective Catalytic Reduction Technology for the Control of NO_x Emissions from High-Sulfur, Coal-Fired Boilers) and TransAlta Resources Investment Corporation (LNS Burner for Cyclone-Fired Boilers Demonstration Project).

September 1990

DOE signed cooperative agreements with one CCTDP-I participant, Western Energy Company (formerly Rosebud SynCoal Partnership, now Western SynCoal LLC) (Advanced Coal Conversion Process Demonstration); one CCTDP-II participant, Southern Company Services, Inc. (180-MWe Demonstration of Advanced Tangentially Fired Combustion Techniques for the Reduction of NO_x Emissions from Coal-Fired Boilers); and one CCTDP-III participant, ENCOAL Corporation (ENCOAL® Mild Coal Gasification Project).

Negotiations were terminated with CCTDP-II participant, Southwestern Public Service Company (Nichols CFB Repowering Project).

October 1990

DOE signed cooperative agreements with four CCTDP-III participants: AirPol, Inc. (10-MWe Demonstration of Gas Suspension Absorption); The Babcock & Wilcox Company (Full-Scale Demonstration of Low-NO_x Cell Burner Retrofit); Bechtel Corporation (Confined Zone Dispersion Flue Gas Desulfurization Demonstration); and Energy and Environmental Research Corporation (Evaluation of Gas Reburning and Low-NO_x Burners on a Wall-Fired Boiler).

November 1990

DOE signed cooperative agreements with one CCTDP-I participant, The City of Tallahassee (Arvah B. Hopkins Circulating Fluidized-Bed Repowering Project; now JEA and the JEA Large-Scale CFB Combustion Demonstration Project); one CCTDP-II participant, ABB Combustion Engineering, Inc. (Combustion Engineering IGCC Repowering Project); and two CCTDP-III participants, Bethlehem Steel Corporation (Blast Furnace Granular-Coal Injection System Demonstration Project) and LIFAC–North America (LIFAC Sorbent Injection Desulfurization Demonstration Project).

December 1990

Negotiations terminated with CCTDP-II participant, Otisca Industries, Ltd. (Otisca Fuel Demonstration Project) and CPICOR™.

March 1991

DOE signed cooperative agreements with three CCTDP-III participants: MK-Ferguson Company (now NOXSO Corporation) (Commercial Demonstration of the NOXSO SO_2/NO_x Removal Flue Gas Cleanup System); Public Service Company of Colorado (Integrated Dry NO_x/SO_2 Emissions Control System); and Tampa Electric Company (formerly Clean Power Cogeneration Limited Partnership; now Tampa Electric) (Integrated Gasification Combined-Cycle Project).

TRW, Inc., withdrew its CCTDP-I project (Advanced Slagging Coal Combustor Utility Demonstration Project).

April 1991

DOE signed a cooperative agreement with CCTDP-III participant, Alaska Industrial Development and Export Authority (Healy Clean Coal Project).

June 1991

DOE withdrew its sponsorship of the Ohio Ontario Clean Fuels, Inc., CCTDP-I project, Prototype Commercial Coal/Oil Coprocessing Plant.

August 1991

DOE signed a cooperative agreement with CCTDP-III participant, DMEC-1 Limited Partnership (formerly Dairyland Power Cooperative) (PCFB Demonstration Project).

TransAlta Resources Investment Corporation withdrew its CCTDP-II project, LNS Burner for Cyclone-Fired Boilers Demonstration Project.

September 1991

Nine projects were selected under CCTDP-IV.

Coal Tech Corporation's CCTDP-I project, Advanced Cyclone Combustor with Internal Sulfur, Nitrogen, and Ash Control, final reports issued and project completed.

April 1992

Tri-State Generation and Transmission Association, Inc.'s (formerly Colorado-Ute Electric Association, Inc.) CCTDP-I project, Nucla CFB Demonstration Project, final reports issued and project completed.

June 1992

The City of Tallahassee project (CCTDP-I) was restructured and transferred to York County Energy Partners, L.P. (York County Energy Partners Cogeneration Project).

July 1992

DOE signed cooperative agreements with two CCTDP-IV participants: Tennessee Valley Authority (now New York State Electric & Gas Corporation) (Micronized Coal Reburning Demonstration for NO_x Control on a 175-MWe Wall-Fired Unit); and the Wabash River Coal Gasification Repowering Project Joint Venture (Wabash River Coal Gasification Repowering Project).

August 1992

DOE signed a cooperative agreement with CCTDP-IV participant, Sierra Pacific Power Company (Piñon Pine IGCC Power Project).

Cordero Mining Company withdrew from negotiations for its CCTDP-IV project, Cordero Coal-Upgrading Demonstration Project.

At the participant's request, Union Carbide Chemicals and Plastics Company, Inc. (CCTDP-IV) was granted an extension of one year to the DOE deadline for completing negotiations of its Demonstration of the Union Carbide CANSOLV™ System at the Alcoa Generating Corporation Warrick Power Plant.

October 1992

DOE signed cooperative agreements with one CCTDP-III participant, Air Products and Chemicals, Inc. (Commercial-Scale Demonstration of the Liquid Phase Methanol [LPMEOH™] Process) and with four CCTDP-IV participants: Custom Coals International (Self-Scrubbing Coal™: An Integrated Approach to Clean Air); New York State Electric & Gas Corporation (Milliken Clean Coal Technology Demonstration Project); TAMCO Power Partners (Toms Creek IGCC Demonstration Project); and ThermoChem, Inc. (Pulse Combustor Design Qualification Test).

November 1992

The Babcock & Wilcox Company's (now McDermott Technology, Inc.) CCTDP-I project, LIMB Demonstration Project Extension and Coolside Demonstration, final reports issued and project completed.

May 1993

Five projects were selected under CCTDP-V: Four Rivers Energy Partners, L.P. (Four Rivers Energy Modernization Project; (formerly Calvert City Advanced Energy Project, now McIntosh Unit 4B Topped PCFB Demonstration Project); Duke Energy Corporation (Camden Clean Energy Demonstration Project); Centerior Energy Corporation, on behalf of CPICOR™ Management Company LLC (Clean Power from Integrated Coal/Ore Reduction [CPICOR™]); Arthur D. Little, Inc. (Clean Coal Combined-Cycle Project; formerly Demonstration of Coal Diesel Technology at Easton Utilities; now Clean Coal Diesel Demonstration Project); and Pennsylvania Electric Company (Warren Station Externally Fired Combined-Cycle Demonstration Project).

July 1993

Union Carbide Chemicals and Plastics Company, Inc., withdrew its CCTDP-IV proposal, Demonstration of the Union Carbide CANSOLV™ System at the Alcoa Generating Corporation Warrick Power Plant.

February 1994

The Passamaquoddy Tribe's CCTDP-III project, Cement Kiln Flue Gas Recovery Scrubber, final reports issued and project completed.

March 1994

The Babcock & Wilcox Company's CCTDP-II project, Demonstration of Coal Reburning for Cyclone Boiler NO_x Control, final reports issued and project completed.

June 1994

DOE signed a cooperative agreement with CCTDP-V participant, Arthur D. Little, Inc. (Coal Diesel Combined-Cycle Project).

Southern Company Services' CCTDP-III project, 180-MWe Demonstration of Advanced Tangentially Fired Combustion Techniques for the Reduction of NO_x Emissions from Coal-Fired Boilers, final reports issued and project completed.

Bechtel Corporation's CCTDP-III project, Confined Zone Dispersion Flue Gas Desulfurization Demonstration, final reports issued and project completed.

August 1994

DOE signed cooperative agreements with two CCTDP-V participants, Four Rivers Energy Partners, L.P. (Four Rivers Energy Modernization Project); and Pennsylvania Electric Company (Warren Station Externally-Fired Combined-Cycle Demonstration Project).

The CCTDP-III project, Commercial Demonstration of the NOXSO SO_2/NO_x Removal Flue Gas Cleanup System, was relocated and transferred to NOXSO Corporation.

September 1994

The Air Products and Chemicals CCTDP-III project, Commercial-Scale Demonstration of the Liquid Phase Methanol (LPMEOH™) Process, was transferred to Air Products Liquid Phase Conversion Company, L.P.

December 1994

DOE signed a cooperative agreement with CCTDP-V participant, Clean Energy Partners Limited Partnership (formerly Duke Energy Corporation; Clean Energy IGCC Demonstration Project; now Kentucky Pioneer IGCC Demonstration Project).

March 1995

TAMCO Power Partner's CCTDP-IV project, Toms Creek IGCC Demonstration Project, was not granted a further extension and the project was concluded.

April 1995

Bethlehem Steel Corporation's CCTDP-II project, Innovative Coke Oven Gas Cleaning System for Retrofit Applications, was terminated by mutual agreement with DOE because coke production was suspended at the demonstration facility.

June 1995

AirPol, Inc.'s CCTDP-II project, 10-MWe Demonstration of Gas Suspension Absorption, final reports issued and project completed.

September 1995
The Babcock & Wilcox Company's CCTDP-II project, SO_x-NO_x-Rox Box™ Flue Gas Cleanup Demonstration Project, final reports issued and project completed.

December 1995
The Tennessee Valley Authority and New York State Electric & Gas Corporation finalized an agreement to allow the project, Micronized Coal Reburning Demonstration for NO_x Control, to be conducted at both Milliken Station in Lansing, NY and Eastman Kodak Company in Rochester, NY.

The Babcock & Wilcox Company's CCTDP-II project, Full-Scale Demonstration of Low-NO_x Cell Burner Retrofit, final reports issued and project completed.

The Ohio Power Company's CCTDP-I project, Tidd PFBC Demonstration Project, final reports issued and project completed.

May 1996
The ABB Combustion Engineering, Inc. CCTDP-II project, Combustion Engineering IGCC Repowering Project, was concluded.

June 1996
Pure Air on the Lake's CCTDP-II project, Advanced Flue Gas Desulfurization Project, final reports issued and project completed.

August 1996
The Arthur D. Little, Inc., CCTDP-V project was restructured and retitled as the Clean Coal Diesel Demonstration Project.

September 1996
The Appalachian Power Company CCTDP-II project, PFBC Utility Demonstration Project, was concluded.

October 1996
DOE signed a cooperative agreement with CCTDP-V participant, CPICOR™ Management Company LLC (Clean Power from Integrated Coal/Ore Reduction [CPICOR™]).

November 1996
Southern Company Services' CCTDP-II project, Demonstration of Selective Catalytic Reduction Technology for the Control of NO_x Emissions from High-Sulfur, Coal-Fired Boilers, final reports issued and project completed.

December 1996
ABB Environmental Systems' CCTDP-II project, SNOX™ Flue Gas Cleaning Demonstration Project, final reports issued and project completed.

May 1997
The Pennsylvania Electric Company CCTDP-V project, Warren Station Externally Fired Combined-Cycle Demonstration Project, was concluded.

September 1997
DOE modified the cooperative agreement for JEA's (formerly Jacksonville Electric Authority) CCTDP-I project, JEA Large-Scale CFB Combustion Project (formerly The City of Tallahassee project, then the York County Energy Partners project).

December 1997
ENCOAL Corporation's CCTDP-III project, ENCOAL® Mild Coal Gasification Project, final reports issued and project completed.

DOE signed a new cooperative agreement for the restructured City of Lakeland's CCTDP-III project, McIntosh Unit 4A PCFB Demonstration Project (formerly the DMEC-1 Limited Partnership project).

January 1998
DOE signed a new cooperative agreement for the restructured City of Lakeland's CCTDP-III project, McIntosh Unit 4B Topped PCFB Demonstration Project (formerly the Four Rivers Energy Partners, L.P. project).

April 1998
LIFAC–North America's CCTDP-III project, LIFAC Sorbent Injection Desulfurization Demonstration Project, final reports issued and project completed.

June 1998
Southern Company Services' CCTDP-II project, Demonstration of Innovative Applications of Technology for the CT-121 FGD Process, final reports issued and project completed.

The ABB Combustion Engineering, Inc. and CQ Inc.'s CCTDP-I project, Development of the Coal Quality Expert™, final reports issued and project completed.

September 1998
Energy and Environmental Research Corporation's CCTDP-I project, Enhancing the Use of Coals by Gas Reburning and Sorbent Injection, final reports issued and project completed.

DOE signed a revised cooperative agreement for the restructured ThermoChem Inc.'s CCTDP-IV project, Pulse Combustor Design Qualification test.

October 1998
Energy and Environmental Research Corporation's CCTDP-III project, Evaluation of Gas Reburning and Low-NO_x Burners on a Wall-Fired Boiler, final reports issued and project completed.

September 1999
Energy and Environmental Research Corp.'s CCTDP-I project, Enhancing the Use of Coals by Gas Reburning and Sorbent Injection, final report issued and project completed.

DOE signed a revised cooperative agreement for Southern Company Services, Inc.'s CCTDP-II project, Demonstration of Advanced Combustion Techniques for a Wall-Fired Boiler, extending the project.

October 1999
Southern Company Services, Inc.'s CCTDP-II project, Demonstration of Innovative Applications of Technology for the CT-121 FGD Process, final report issued and project completed.

New York State Electric & Gas Corporation's CCTDP-IV project, Milliken Clean Coal Technology Demonstration Project, final report issued and project completed.

Bethlehem Steel Corporation's CCTDP-III project, Blast Furnace Granular-Coal Injection System Demonstration Project, final report issued and project completed.

December 1999
New York State Electric & Gas Corporation's CCTDP-IV project, Micronized Coal Reburning Demonstration for NO_x Control, final report issued and project completed.

NOXSO Corporation's project, Commercial Demonstration of the NOXSO SO_2/NO_x Removal Flue Gas Cleanup System, was terminated.

January 2000
Custom Coals International's CCTDP-IV project, Self-Scrubbing Coal™ : An Integrated Approach to Clean Air, was terminated.

February 2000
Public Service Company of Colorado's CCTDP-III project, Integrated Dry NO_x/SO_2 Emissions Control System, final report issued and project completed.

September 2000
Wabash River Coal Gasification Repowering Project Joint Venture's CCTDP-IV project, Wabash River Coal Gasification Repowering Project, final report issued and project completed.

January 2001
Sierra Pacific Power Company's CCTDP-IV project, Piñon Pine IGCC Power Project, final report issued and project completed.

June 2001
Western SynCoal LLC's CCTDP-I project, Advanced Coal Conversion Process Demonstration, final report issued and project completed.

December 2002
Tampa Electric Company's CCTDP-III project, Tampa Electric Integrated Gasification Combined-Cycle Project, final report issued and project completed.

April 2003
Southern Company Services, Inc.'s CCTDP-II project, Demonstration of Advanced Combustion Techniques for a Wall-Fired Boiler, final report issued and project completed.

June 2003
Air Products Liquid Phase Conversion Company, L.P.'s, CCTDP--III project, Commercial-Scale Demonstration of the Liquid Phase Methanol (LPMEOH™) Process, final report issued and project completed.

July 2003
DOE terminated The City of Lakeland's CCTDP-III project (McIntosh Unit 4A PCFB Demonstration Project) and CCTDP-V project (McIntosh Unit 4B Topped PCFB Demonstration Project).

PPII Solicitation History

The Department of Energy developed the PPII solicitation taking lessons learned from the CCTDP solicitations with some modifications. The PON was issued on February 6, 2001 seeking projects that offer significant improvements in power plant performance leading to enhanced electric reliability. On April 19, 2001, DOE received 24 proposals. Eight projects were selected.

PPII Selection and Negotiation History

The following is a history of the selection and negotiations for PPII.

September 2001
Eight projects were selected under PPII.

March 2002
DOE signed a cooperative agreement with Universal Aggregates, LLC (Commercial Demonstration of the Manufactured Aggregate Processing Technology Utilizing Spray Dryer Ash).

March 2002
Tampa Electric Company withdraws one of its proposals (Polk Power Station Plant Improvement Project).

June 2002
DOE signed a cooperative agreement with two PPII participants: Otter Tail Power Company (Demonstration of a Full-Scale Retrofit of the Advanced Hybrid Particulate Collector Technology) and Tampa Electric Company (Big Bend Power Station Neural Network-Sootblower Optimization).

December 2002
DOE signed a cooperative agreement with Sunflower Electric Power Corp. (Achieving NSPS Emission Standards Through Integration of Low-NO_x Burners with an Optimization Plan for Boiler Combustion).

April 2003
Alliant Energy Corporate Services, Inc. withdrew its proposal, Combustion Initiative for Innovative Cost-Effective NO_x Reduction.

CCPI Solicitation History

The Department of Energy developed the first CCPI solicitation (CCPI-I) taking lessons learned from the CCTDP solicitations with some modifications, including modifications directed by Congress. The PON was issued on March 4, 2002, seeking advanced coal-based power generation technologies that result in efficiency, environmental, and economic improvements over state-of-the-art alternatives. On August 1, 2002, DOE received 36 proposals. Eight projects were selected. Planning for CCPI-II is now underway.

CCPI Selection and Negotiation History

The following is a history of the selection and negotiations for CCPI.

January 2003
Eight projects were selected under CCPI-I.

July 2003
LG&E Energy Corporation withdraws its proposal (Commercial Demonstration of the Airborne Process).

Appendix C. CCTDP Environmental Aspects

Introduction

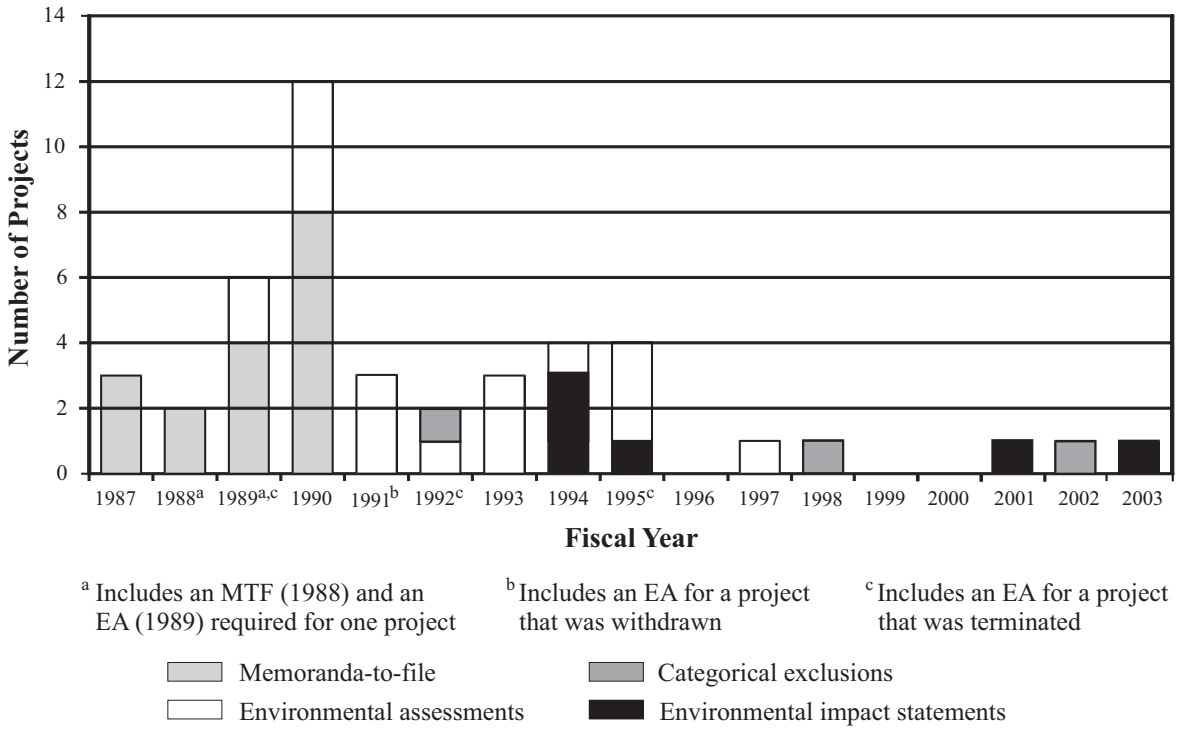
The U.S. Department of Energy (DOE) employs a three-step process to ensure that the Clean Coal Technology Demonstration Program (CCTDP) and its projects comply with the procedural requirements of the National Environmental Policy Act (NEPA), and the regulations for NEPA compliance promulgated by the Council on Environmental Quality (CEQ) (40 CFR Parts 1500–1508) and by DOE (10 CFR Part 1021). This process includes (1) preparation of a programmatic environmental impact statement (PEIS) in 1989; (2) preparation of preselection, project-specific environmental reviews; and (3) preparation of postselection, site-specific NEPA documentation. Several types of NEPA documents have been used in the CCTDP, including memoranda-to-file (MTF; discontinued as of September 30, 1990), environmental assessments (EA), and environmental impact statements (EIS). The Department of Energy's NEPA regulations also provide for categorical exclusions (CX) for certain classes of actions.

Exhibit C-1 shows the progress made through May 31, 2003, to complete NEPA reviews of projects in the CCTDP. By May 31, 2003, NEPA reviews were completed for 35 of the 36 CCTDP projects remaining in the program. Two NEPA reviews were completed for two projects: (1) Enhancing the Use of Coals by Gas Reburning and Sorbent Injection—a MTF was completed for the Hennepin site and an EA for the Lakeside site; (2) Kentucky Pioneer Energy IGCC Demonstration—an EIS for the Trapp, Kentucky, site and a CX for the West Terre Haute, Indiana, site.

From 1987 through May 31, 2003, NEPA requirements were satisfied with a CX for 2 projects, MTFs for 17 projects, EAs for 18 projects and EISs for 6 projects (actions exceed 35 because of project terminations, withdrawals, and restructuring).

For each project cofunded by DOE under the CCTDP, the industrial participant is required to develop an environmental monitoring plan (EMP) that will ensure operational compliance and that significant technical and environmental data are collected and disseminated. Data to be collected include compliance data to meet federal, state, and local requirements and performance data to aid in future commercialization of the technology.

Exhibit C-1
NEPA Reviews Completed as of May 31, 2003



The Role of NEPA in the CCTDP

NEPA was initially enacted in 1969 as Public Law 91-190 and is codified at 42 U.S.C. §4321 *et seq*. The applicability of NEPA to the CCTDP is encapsulated in the following provision (Section 102):

[A]ll agencies of the Federal Government shall—. . .

(C) include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on—

i. the environmental impact of the proposed action,

ii. any adverse environmental effects which cannot be avoided should the proposal be implemented,

iii. alternatives to the proposed action,

iv. the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

v. any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented. . . .

(E) study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources[.]

Through NEPA, Congress created the CEQ, which has promulgated regulations that ensure compliance with the Act.

Compliance with NEPA

In November 1989, a PEIS was completed for the CCTDP. This PEIS addressed issues such as potential global climatic modification and the ecological and socioeconomic impacts of the CCTDP. The PEIS evaluated the following two alternatives:

- "No action," which assumed that conventional coal-fired technologies with conventional flue gas desulfurization controls would continue to be used, and
- "Proposed action," which assumed that successfully demonstrated clean coal technologies would undergo widespread commercialization by the year 2010.

In preselection project-specific environmental reviews, DOE evaluates the environmental aspects of each proposed demonstration project. Reviews are provided to the Source Selection Official for consideration in the project selection process. The site-specific environmental, health, safety, and socioeconomic issues associated with each proposed project are examined during the NEPA review. As part of the comprehensive evaluation prior to selecting projects, the strengths and weaknesses of each proposal are compared with the environmental evaluation criteria. To the maximum extent possible, the environmental impacts of each proposed project and practical mitigating measures are considered. Also, a list of necessary permits is prepared, to the extent known; these are permits that would need to be obtained in implementing the proposed project.

Upon selection, project participants are required to prepare and submit additional environmental information. This detailed site- and project-specific information is used, along with independent information gathered by DOE, as the basis for site-specific NEPA documents that are prepared by DOE for each selected project. These NEPA documents are prepared, considered, and published in full conformance with CEQ and DOE regulations for NEPA compliance.

Categorical Exclusions

"Subpart D—Typical Classes of Actions" of the DOE NEPA regulations provides for categorical exclusions as a class of actions that DOE has determined do not individually or cumulatively have a significant effect on the human environment. Two projects, the Micronized Coal Reburning Demonstration for NO_x Control and the Pulse Combustor Design Qualification Test, were determined to be covered by a categorical exclusion in August 1992 and November 1998, respectively.

Memoranda-to-File

The MTF was established when DOE's NEPA guidelines were first issued in 1980. The MTF was intended for circumstances when the expected impacts of the proposed action were clearly insignificant, yet the action had not been specified as a categorical exclusion from NEPA documentation. The use of the MTF was terminated as of September 30, 1990. Exhibit C-2 lists the 17 projects for which an MTF was prepared.

Environmental Assessments

An EA has the following three functions:

1. To provide sufficient evidence and analysis for determining whether a proposed action requires preparation of an EIS or a finding of no significant impact (FONSI);

Exhibit C-2
Memoranda-to-File Completed

Project and Participant	Completed
CCTDP-I	
Development of the Coal Quality Expert™ (ABB Combustion Engineering, Inc. and CQ Inc.)	4/27/90
LIMB Demonstration Project Extension and Coolside Demonstration (McDermott Technology, Inc.)	6/2/87
Advanced Cyclone Combustor with Internal Sulfur, Nitrogen, and Ash Control (Coal Tech Corporation)	3/26/87
Nucla CFB Demonstration Project (Colorado-Ute Electric Association, Inc.; now Tri-State Generation and Transmission Association, Inc.)	4/18/88
Enhancing the Use of Coals by Gas Reburning and Sorbent Injection (Hennepin site) (Energy and Environmental Research Corporation)	5/9/88
Tidd PFBC Demonstration Project (The Ohio Power Company)	3/5/87
CCTDP-II	
SNOX™ Flue Gas Cleaning Demonstration Project (ABB Environmental Systems)	1/31/90
SOx-NOx-Rox Box™ Flue Gas Cleanup Demonstration Project (The Babcock & Wilcox Company)	9/22/89
Demonstration of Advanced Combustion Techniques for a Wall-Fired Boiler (Southern Company Services, Inc.)	5/22/89
Demonstration of Selective Catalytic Reduction Technology for the Control of NO_x Emissions from High-Sulfur, Coal-Fired Boilers (Southern Company Services, Inc.)	8/16/89
180-MWe Demonstration of Advanced Tangentially Fired Combustion Techniques for the Reduction of NO_x Emissions from Coal-Fired Boilers (Southern Company Services, Inc.)	7/21/89
CCTDP-III	
10-MWe Demonstration of Gas Suspension Absorption (AirPol, Inc.)	9/21/90
Full-Scale Demonstration of Low-NO_x Cell Burner Retrofit (The Babcock & Wilcox Company)	8/10/90
Confined Zone Dispersion Flue Gas Desulfurization Demonstration (Bechtel Corporation)	9/25/90
Evaluation of Gas Reburning and Low-NO_x Burners on a Wall-Fired Boiler (Energy and Environmental Research Corporation)	9/6/90
LIFAC Sorbent Injection Desulfurization Demonstration Project (LIFAC–North America)	10/2/90
Integrated Dry NO_x/SO_2 Emissions Control System (Public Service Company of Colorado)	9/27/90

2. To aid an agency's compliance with NEPA when no EIS is necessary, *i.e.*, to provide an interdisciplinary review of proposed actions, assess potential impacts, and identify better alternatives and mitigation measures; and
3. To facilitate preparation of an EIS when one is necessary.

An EA's contents are determined on a case-by-case basis and depend on the nature of the action. If appropriate, a DOE EA also includes any floodplain or wetlands assessment that has been prepared, and may include analyses needed for other environmental determinations.

If an agency determines on the basis of an EA that it is not necessary to prepare an EIS, a FONSI is issued. Council on Environmental Quality regulations describe the FONSI as a document that briefly presents the reasons why an action will not have a significant effect on the human environment and for which an EIS therefore will not be prepared. The FONSI includes the EA, or a summary of it, and notes any other related environmental documents. The CEQ and DOE regulations also provide for notification of the public that a FONSI has been issued. Also, DOE provides copies of the EA and FONSI to the public on request.

Exhibit C-3 lists the 18 projects for which an EA has been prepared. The exhibit includes EAs for one project that was subsequently withdrawn from the program—TransAlta Resources Investment Corporation's Low-NO_x/SO_2 Burner Retrofit for Utility Cyclone Boilers project—and three that were terminated—ABB Combustion Engineering's Combustion Engineering IGCC Repowering Project, Bethlehem Steel Corporation's Innovative Coke Oven Gas Cleaning System for Retrofit Applications, and Pennsylvania Electric's Warren Station Externally-Fired Combined-Cycle Demonstration Project.

Exhibit C-3
Environmental Assessments Completed as of May 31, 2003

Project and Participant	Completed
CCTDP-I	
Enhancing the Use of Coals by Gas Reburning and Sorbent Injection (Lakeside site) (Energy and Environmental Research Corporation)	6/25/89
Advanced Coal Conversion Process Demonstration (Western SynCoal LLC)	3/27/91
CCTDP-II	
Combustion Engineering IGCC Repowering Project (ABB Combustion Engineering, Inc.) (project terminated)	3/27/92
Demonstration of Coal Reburning for Cyclone Boiler NO_x Control (The Babcock & Wilcox Company)	2/12/91
Innovative Coke Oven Gas Cleaning System for Retrofit Applications (Bethlehem Steel Corporation) (project terminated)	12/22/89
Cement Kiln Flue Gas Recovery Scrubber (Passamaquoddy Tribe)	2/16/90
Advanced Flue Gas Desulfurization Demonstration Project (Pure Air on the Lake, L.P.)	4/16/90
Demonstration of Innovative Applications of Technology for the CT-121 FGD Process (Southern Company Services, Inc.)	8/10/90
Low-NO_x/SO_2 Burner Retrofit for Utility Cyclone Boilers (TransAlta Resources Investment Corporation) (project withdrawn)	3/21/91
CCTDP-III	
Commercial-Scale Demonstration of the Liquid Phase Methanol (LPMEOH™) Process (Air Products Liquid Phase Conversion Company, L.P.)	6/30/95
Blast Furnace Granular-Coal Injection System Demonstration Project (Bethlehem Steel Corporation)	6/8/93
ENCOAL® Mild Coal Gasification Project (ENCOAL Corporation)	8/1/90
Commercial Demonstration of the NOXSO SO_2/NO_x Removal Flue Gas Cleanup System (NOXSO Corporation)	6/26/95
CCTDP-IV	
Self-Scrubbing Coal™: An Integrated Approach to Clean Air (Custom Coals International)	2/14/94
Milliken Clean Coal Technology Demonstration Project (New York State Electric & Gas Corporation)	8/18/93
Warren Station Externally Fired Combined-Cycle Demonstration Project (Pennsylvania Electric Company) (Warren Station site) (project terminated)	5/18/95
Wabash River Coal Gasification Repowering Project (Wabash River Coal Gasification Repowering Project Joint Venture)	5/28/93
CCTDP-V	
Clean Coal Diesel Demonstration Project (Arthur D. Little, Inc.)	6/2/97

Environmental Impact Statements

The primary purpose of an EIS is to serve as an action-forcing device to ensure that the policies and goals defined in NEPA are infused into the programs and actions of the federal government. An EIS contains a full and fair discussion of all significant environmental impacts. The EIS should inform decision makers and the public of reasonable alternatives that would avoid or minimize adverse impacts or enhance the quality of the human environment.

The CEQ regulations state that an EIS is to be more than a disclosure document; it is to be used by federal officials in conjunction with other relevant material to plan actions and make decisions. Analysis of alternatives is to encompass those alternatives to be considered by the ultimate decision maker, including a complete description of the proposed action. In short, the EIS is a means of assessing the environmental impacts of a proposed DOE action (rather than justifying decisions already made), prior to making a decision to proceed with the proposed action. Consequently, before a record of decision (ROD) is issued, DOE may not take any action that would have an adverse environmental effect or limit the choice of reasonable alternatives. As seen in Exhibit C-4, the EISs for three projects were completed in 1994. In 1995, DOE issued a ROD on the EIS prepared for the York County Energy Partners project located in York County, Pennsylvania. This project has been restructured, and a new NEPA compliance document for the JEA project site was completed in fiscal year 2000, and the ROD was issued in fiscal year 2001.

NEPA Actions in Progress

Exhibit C-5 lists the status of the only CCTDP project for which the NEPA process has not yet been completed.

Exhibit C-4
Environmental Impact Statements Completed as of May 31, 2003

Project and Participant	Completed
CCTDP-I	
York County Energy Partners Cogeneration Project (York County, PA site) (York County Energy Partners, L.P.) (project relocated)	8/11/95
JEA Large-Scale CFB Combustion Demonstration Project (JEA)	11/29/00
CCTDP-III	
Healy Clean Coal Project (Alaska Industrial Development and Export Authority)	3/10/94
Tampa Electric Integrated Gasification Combined-Cycle Project (Tampa Electric Company)	8/17/94
CCTDP-IV	
Piñon Pine IGCC Power Project (Sierra Pacific Power Company)	11/8/94
CCTDP-V	
Kentucky Pioneer Energy IGCC Demonstration Project (Kentucky Pioneer Energy, LLC)	1/29/03

Note: Completion is the date DOE issued a record of decision.

Exhibit C-5
NEPA Reviews in Progress as of May 31, 2003

Project and Participant	Status
CCTDP-V	
Clean Power from Integrated Coal/Ore Reduction (CPICOR™) (CPICOR™ Management Company LLC)	EIS planned

Environmental Monitoring

CCTDP project participants are required to develop and implement an environmental monitoring plan (EMP) that addresses both compliance and supplemental monitoring. Exhibit C-6 lists the status of EMPs for all 38 projects in the CCTDP. The EMP is intended to ensure collection and dissemination of the significant technology-, project-, and site-specific environmental data necessary for evaluation of impacts upon health, safety, and the environment. Further, the data are used to characterize and quantify the environmental performance of the technology in order to evaluate its commercialization and deployment potential. In addition to collecting regulatory compliance data, further monitoring is required to fulfill the following:

- Ensure that emissions, ambient levels of pollutants, and environmental impacts do not exceed expectations projected in the NEPA documents,
- Identify any need for corrective action,
- Verify the implementation of any mitigative measure that may have been identified in a mitigation action plan pursuant to the provisions of an EA or EIS, and
- Provide the essential data on the environmental performance of the technology needed to evaluate the potential impact of future commercialization, including the ability of the technology to meet requirements of the Clean Air Act and the 1990 amendments.

The objective of the CCTDP's environmental monitoring efforts is to ensure that, when commercially available, clean coal technologies will be capable of responding fully to air toxics regulations that emerge from the CAAA, and to the maximum extent possible, are in the vanguard of cost-effective solutions to concerns about public health and safety related to coal use.

Air Toxics

Title III of the CAAA lists known hazardous air pollutants (HAPs) and, among other things, calls for the EPA to establish categories of sources that emit these pollutants. Exploratory analyses suggest that HAPs may be released by conventional coal-fired power plants and, presumably, by plants using clean coal technologies. It is expected that emissions standards will be proposed for the electric-power-production-source categories. However, there are many uncertainties as to which HAPs will be regulated, their prevalence in various types and sources of coal, and their nature and fate as functions of combustion characteristics and the particular clean coal technology used.

The CCTDP recognized the importance of monitoring HAPs in achieving widespread commercialization in the late 1990s and beyond. For all projects with existing cooperative agreements, DOE sought to include HAPs monitoring. A total of 20 projects contain provisions for monitoring HAPs.

The CCTDP-V Program Opportunity Notice (PON) acknowledged the importance of HAPs throughout the solicitation, including them as an aspect of proposal evaluation. The PON addressed the control of air toxics as an environmental performance criterion. Also, in the instructions on proposal preparation, the PON directed proposers as follows:

> With respect to emission of air toxics, Proposers should consider . . . the particular elements and compounds [listed in Table 5-1 of the PON, "Specific Air Toxics to be Monitored"]. Proposers should present any information known concerning the reduction of emissions of these toxics by [the proposed] technology. Some of the toxics for which the proposed technology may offer control are likely unregulated in the target market at present. The significance and importance of the additional control afforded by the proposed technology for the continued use of coal should be explained. An example of this kind would be one or more particular air toxic compounds controlled by a technology meant for use in power generation.

The CCTDP-V PON also stipulates that information on air toxics be presented in the environmental information required by DOE. Exhibit C-7 lists the 20 projects that provide for HAPs monitoring. Eleven of these projects have completed the HAPs monitoring requirements. The objective of the HAPs monitoring program is to improve the quality of HAPs data being gathered and to monitor a broader range of plant configurations and emissions control equipment.

The CCTDP is coordinating with organizations such as the Electric Power Research Institute (EPRI) and the Ohio Coal Development Office in activities focused on HAPs monitoring and analysis. Further, under the DOE Coal R&D Program, two reports summarizing the source, distribution, and fate of HAPs from coal-fired power plants were published in 1996. A report released in July 1996, *Summary of Air Toxics Emissions Testing at Sixteen Utility Plants,* provided assessment of HAPs measured in the coal, across the major pollution control devices, and the HAPs emitted from the stack. A second report, *A Comprehensive Assessment of Toxics Emissions from Coal-Fired Power Plants: Phase I Results from the U.S. Department of Energy Study,* was released in September 1996

Exhibit C-6
Status of Environmental Monitoring Plans for CCTDP Projects as of May 31, 2003

Project and Participant	Status
CCTDP-I	
Development of the Coal Quality Expert™ (ABB Combustion Engineering, Inc. and CQ Inc.)	Completed 7/31/90
LIMB Demonstration Project Extension and Coolside Demonstration (McDermott Technology, Inc.)	Completed 10/19/88
Advanced Cyclone Combustor with Internal Sulfur, Nitrogen, and Ash Control (Coal Tech Corporation)	Completed 9/22/87
Nucla CFB Demonstration Project (Colorado-Ute Electric Association, Inc.; now Tri-State Generation and Transmission Association, Inc.)	Completed 2/27/88
Enhancing the Use of Coals by Gas Reburning and Sorbent Injection (Energy and Environmental Research Corporation)	Completed 10/15/89 (Hennepin) Completed 11/15/89 (Lakeside)
Tidd PFBC Demonstration Project (The Ohio Power Company)	Completed 5/25/88
Advanced Coal Conversion Process Demonstration (Western SynCoal LLC)	Completed 4/7/92
JEA Large-Scale CFB Combustion Demonstration Project (JEA)	Completed 7/01
CCTDP-II	
SNOX™ Flue Gas Cleaning Demonstration Project (ABB Environmental Systems)	Completed 10/31/91
Demonstration of Coal Reburning for Cyclone Boiler NO_x Control (The Babcock & Wilcox Company)	Completed 11/18/91
SOx-NOx-Rox Box™ Flue Gas Cleanup Demonstration Project (The Babcock & Wilcox Company)	Completed 12/31/91
Cement Kiln Flue Gas Recovery Scrubber (Passamaquoddy Tribe)	Completed 3/26/90
Advanced Flue Gas Desulfurization Demonstration Project (Pure Air on the Lake, L.P.)	Completed 1/31/91
Demonstration of Advanced Combustion Techniques for a Wall-Fired Boiler (Southern Company Services, Inc.)	Completed 9/14/90
Demonstration of Innovative Applications of Technology for the CT-121 FGD Process (Southern Company Services, Inc.)	Completed 12/18/90
Demonstration of Selective Catalytic Reduction Technology for the Control of NO_x Emissions from High-Sulfur, Coal-Fired Boilers (Southern Company Services, Inc.)	Completed 3/11/93
180-MWe Demonstration of Advanced Tangentially Fired Combustion Techniques for the Reduction of NO_x Emissions from Coal-Fired Boilers (Southern Company Services, Inc.)	Completed 12/27/90

Exhibit C-6 (continued)
Status of Environmental Monitoring Plans for CCTDP Projects as of May 31, 2003

Project and Participant	Status
CCTDP-III	
Commercial-Scale Demonstration of the Liquid Phase Methanol (LPMEOH™) Process (Air Products Liquid Phase Conversion Company, L.P.)	Completed 8/29/96
10-MWe Demonstration of Gas Suspension Absorption (AirPol, Inc.)	Completed 10/2/92
Healy Clean Coal Project (Alaska Industrial Development and Export Authority)	Completed 4/11/97
Full-Scale Demonstration of Low-NO_x Cell Burner Retrofit (The Babcock & Wilcox Company)	Completed 8/9/91
Confined Zone Dispersion Flue Gas Desulfurization Demonstration (Bechtel Corporation)	Completed 6/12/91
Blast Furnace Granular-Coal Injection System Demonstration Project (Bethlehem Steel Corporation)	Completed 12/23/94
ENCOAL® Mild Coal Gasification Project (ENCOAL Corporation)	Completed 5/29/92
Evaluation of Gas Reburning and Low-NO_x Burners on a Wall-Fired Boiler (Energy and Environmental Research Corporation)	Completed 7/26/90
LIFAC Sorbent Injection Desulfurization Demonstration Project (LIFAC–North America)	Completed 6/12/92
Integrated Dry NO_x/SO_2 Emissions Control System (Public Service Company of Colorado)	Completed 8/5/93
Tampa Electric Integrated Gasification Combined-Cycle Project (Tampa Electric Company)	Completed 5/96
CCTDP-IV	
Micronized Coal Reburning Demonstration for NO_x Control (New York State Electric & Gas Corporation)	Completed 8/97
Milliken Clean Coal Technology Demonstration Project (New York State Electric & Gas Corporation)	Completed 12/1/94
Piñon Pine IGCC Power Project (Sierra Pacific Power Company)	Completed 10/31/96
Wabash River Coal Gasification Repowering Project (Wabash River Coal Gasification Repowering Project Joint Venture)	Completed 7/9/93
Pulse Combustor Design Qualification Test (ThermoChem, Inc.)	Completed 12/00
CCTDP-V	
Clean Coal Diesel Demonstration Project (Arthur D. Little, Inc.)	Completed 2/99
Clean Power from Integrated Coal/Ore Reduction (CPICOR™) (CPICOR™ Management Company LLC)	On hold
Kentucky Pioneer Energy IGCC Demonstration Project (Kentucky Pioneer Energy, LLC)	To be determined

Exhibit C-7
Status of CCTDP Projects Monitoring Hazardous Air Pollutants as of May 31, 2003

Application Category	Participant	Project	Status
Environmental Control Devices	ABB Environmental Systems	SNOX™ Flue Gas Cleaning Demonstration Project	Completed
	AirPol, Inc.	10-MWe Demonstration of Gas Suspension Absorption	Completed
	The Babcock & Wilcox Company	Demonstration of Coal Reburning for Cyclone Boiler NO_x Control	Completed
	The Babcock & Wilcox Company	SOx-NOx-Rox Box™ Flue Gas Cleanup Demonstration Project	Completed
	New York State Electric & Gas Corporation	Milliken Clean Coal Technology Demonstration Project	Completed
	Public Service Company of Colorado	Integrated Dry NO_x/SO_2 Emissions Control System	Completed
	Pure Air on the Lake, L.P.	Advanced Flue Gas Desulfurization Demonstration Project	Completed
	Southern Company Services, Inc.	Demonstration of Advanced Combustion Techniques for a Wall-Fired Boiler	Completed
	Southern Company Services, Inc.	Demonstration of Innovative Applications of Technology for the CT-121 FGD Process	Completed
	Southern Company Services, Inc.	180-MWe Demonstration of Advanced Tangentially Fired Combustion Techniques for the Reduction of NO_x Emissions from Coal-Fired Boilers	Completed
Advanced Electric Power Generation	Arthur D. Little, Inc.	Clean Coal Diesel Demonstration Project	Planned
	Kentucky Pioneer Energy, LLC	Kentucky Pioneer Energy IGCC Demonstration Project	Planned
	The Ohio Power Company	Tidd PFBC Demonstration Project	Completed
	Sierra Pacific Power Company	Piñon Pine IGCC Power Project	Completed
	Tampa Electric Company	Tampa Electric Integrated Gasification Combined-Cycle Project	Completed
	Wabash River Coal Gasification Repowering Project Joint Venture	Wabash River Coal Gasification Repowering Project	Completed
	JEA	JEA Large-Scale CFB Combustion Demonstration Project	Planned
Coal Processing for Clean Fuels	ENCOAL Corporation	ENCOAL® Mild Coal Gasification Project	Completed
Industrial Applications	CPICOR™ Management Company LLC	Clean Power from Integrated Coal/Ore Reduction (CPICOR™)	Planned

and provided the raw data from the emissions testing. Emissions data were collected from 16 power plants, representing nine process configurations, operated by eight different utilities; several power plants were sites for CCTDP projects. The power plants represented a range of different coal types, process configurations, furnace types, and pollution control methods.

The second phase of the DOE/EPRI effort currently in progress is sampling at other sites, including the CCTDP's Wabash River IGCC project. Further, the results from the first phase will be used to determine what configuration and coal types require further assessment.

In October 1996, EPA submitted to Congress an interim version of its technical assessment of toxic air pollutant emissions from power plants, *Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units, Interim Final Report.* EPA plans to continue evaluating the potential exposures and potential public health concerns from mercury emissions from utilities. In addition, the agency was to evaluate information on various potential control technologies for mercury. If EPA were to decide that HAPs pose a risk, then the agency was to propose air toxic emissions controls by November 15, 1998, and make them final two years later.

Following up on the October 1996 report to Congress, a report was released by EPA focusing on mercury emissions. The December 1997 report, *Mercury Study Report to Congress*, estimates that U.S. industrial sources were responsible for releasing 158 tons of mercury into the atmosphere in 1994 and 1995. The EPA estimates that 87 percent of those emissions originate from combustion sources such as waste and fossil fuel facilities, 10 percent from manufacturing facilities, 2 percent from area sources, and 1 percent from other sources. The EPA also identified four specific categories that account for about 80 percent of the total anthropogenic sources: coal-fired power plants, 33 percent; municipal waste incinerators, 18 percent; commercial and industrial boilers, 18 percent; and medical waste incinerators, 10 percent. More recently, the National Academy of Sciences released a report in June 2000 reinforcing the importance, especially for women in their childbearing years, of heeding consumption advisories on noncommercial fish to avoid methylmercury.

The results of the HAPs program have significantly mitigated concerns about HAP emissions from coal-fired generation and focused attention on but a few flue gas constituents.

Appendix D. Project Contacts

Project Contacts

Listed below are contacts for obtaining further information about specific active Clean Coal Technology Demonstration Program (CCTDP), Power Plant Improvement Initiative (PPII), and Clean Coal Power Initiative (CCPI) demonstration projects. Listed are the name, title, phone number, fax number, mailing address, and e-mail address, if available, for the project participant contact person. In those instances where the project participant consists of more than one company, a partnership, or joint venture, the mailing address listed is that of the contact person. In addition, the names, phone numbers, and e-mail addresses for contact persons at DOE Headquarters and the National Energy Technology Laboratory (NETL) are provided.

CCTDP

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PPII

Development of Hybrid FLGR/SNCR Advanced NO_x Control

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Achieving NSPS Emission Standards Through Integration of Low-NO_x Burners with an Optimization Plan for Boiler Combustion

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Demonstration of a Full-Scale Retrofit of the Advanced Hybrid Particulate Collector

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CCPI

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Appendix E. Acronyms, Abbreviations, and Symbols

¢	cent
°C	degrees Celsius
°F	degrees Fahrenheit
$	dollars (U.S.)
$/kW	dollars per kilowatt
$/ton	dollars per ton
%	percent
®	registered trademark
™	trademark
ABB CE	ABB Combustion Engineering, Inc.
ABB ES	ABB Environmental Systems
ACCP	advanced coal conversion process
ACFB	atmospheric circulating fluidized-bed
ADL	Arthur D. Little, Inc.
A/E	architect/engineering
AEO2002	*Annual Energy Outlook 2002*
AER2001	*Annual Energy Review 2001*
AFBC	atmospheric fluidized-bed combustion
AFGD	advanced flue gas desulfurization
AIDEA	Alaska Industrial Development and Export Authority
AOFA	advanced overfire air
APEC	Asia Pacific Economic Cooperation
APF	advanced particulate filter
ARIL	Advanced Retractable Injection Lances
ASFE	Assistant Secretary for Fossil Energy
ASME	American Society of Mechanical Engineers
Ass'n.	Association
ATCF	after tax cash flows
atm	atmosphere(s)
avg.	average
B&W	The Babcock & Wilcox Company
BFGCI	blast furnace granular-coal injection
BG	British Gas
Btu	British thermal unit(s)
Btu/kWh	British thermal units per kilowatt-hour
BOD	biological oxygen demand
CAAA	Clean Air Act Amendments of 1990
$CaCO_3$	calcium carbonate (calcitic limestone)
CAG	Coal Advisory Group
Ca/N	calcium-to-nitrogen
CaO	calcium oxide (lime)
$Ca(OH)_2$	calcium hydroxide (calcitic hydrated lime)
$Ca(OH)_2$•MgO	dolomitic hydrated lime
CAPI	Clean Air Power Initiative
Ca/S	calcium-to-sulfur
$CaSO_3$	calcium sulfite
$CaSO_4$	calcium sulfate
CCOFA	close-coupled overfire air
CCT	clean coal technology
CCTDP	Clean Coal Technology Demonstration Program
CCTDP-I	First CCTDP solicitation
CCTDP-II	Second CCTDP solicitation
CCTDP-III	Third CCTDP solicitation
CCTDP-IV	Fourth CCTDP solicitation
CCTDP-V	Fifth CCTDP solicitation
CCPI	Clean Coal Power Initiative
CCPI-I	First CCPI solicitation
CCPI-II	Second CCPI solicitation
CCRI	China Coal Research Institute
CDL®	Coal-Derived Liquid®
CD-ROM	Compact disk-read only memory
CEED	Center for Energy and Economic Development
CEM	continuous emissions monitor
CenPEEP	Center for Power Efficiency and Environmental Protection
CEQ	Council on Environmental Quality
CFB	circulating fluidized-bed
CFD	Computational Fluid Dynamics
C/H	carbon-to-hydrogen
CHP	combined heat and power
CKD	cement kiln dust
CO	carbon monoxide
CO_2	carbon dioxide
COP	Conference of Parties
CQE™	Coal Quality Expert™
CQIM™	Coal Quality Impact Model™
CSC	convective syngas cooler
CSI	Clear Skies Initiative
CT-121	Chiyoda Thoroughbred-121
CTI	Climate Technology Initiative

CUB	coal utilization by-product(s)
CURC	Coal Utilization Research Council
CX	categorical exclusion
CZD	confined zone dispersion
dB	decibels
DER	discrete emissions reduction
DME	dimethyl ether
DOE	U.S. Department of Energy
DOE/HQ	U.S. Department of Energy Headquarters
DRI	direct reduction of iron
DSE	dust stabilization enhancement
DSI	dry sorbent injection
EA	environmental assessment
EE	Eastern Europe
EE/FSU	Eastern Europe/Former Soviet Union
EEI	Edison Electric Institute
EER	Energy and Environmental Research Corporation
EERC	Energy and Environmental Research Center, University of North Dakota
EETC	Energy and Environmental Technology Center
EFCC	externally fired combined-cycle
EIA	U.S. Energy Information Administration
EIS	environmental impact statement
EIV	Environmental Information Volume
EMP	environmental monitoring plan
EPA	U.S. Environmental Protection Agency
EPAct	Energy Policy Act of 1992
EPCRA	Emergency Planning and Community Right-To-Know Act
EPDC	Japan's Electric Power Development Company
EPRI	Electric Power Research Institute
ESP	electrostatic precipitator
EU	European Union
EWG	exempt wholesale generator
ext.	extension
FBC	fluidized-bed combustion
FCCC	Framework Convention on Climate Change
FE	Office of Fossil Energy
FeO	iron oxide
Fe_2S	pyritic sulfur
FERC	Federal Energy Regulatory Commission
FETC	Federal Energy Technology Center (now NETL)
FGD	flue gas desulfurization
FLGR	flue gas recirculation
FLGR/SNCR	flue gas recirculation/selective noncatalytic reduction
FONSI	finding of no significant impact
FRP	fiberglass-reinforced plastic
FSU	Former Soviet Union
ft, ft^2, ft^3	foot (feet), square feet, cubic feet
FY	fiscal year
gal	gallon(s)
gal/ft^3	gallons per cubic foot
GB	gigabyte(s)
GDP	gross domestic product
GE	General Electric
GEP	Greenhouse Gas Pollution Prevention
GHG	greenhouse gases
GNOCIS	Generic NO_x Control Intelligent System
GPC	Gilberton Power Company
gpm	gallons per minute
gr	grains
GR	gas reburning
GRI	Gas Research Institute
GR-LNB	gas reburning and low-NO_x burner
GR-SI	gas reburning and sorbent injection
GSA	gas suspension absorption
GVEA	Golden Valley Electric Association
GW	gigawatt(s)
GWe	gigawatt(s)-electric
H	elemental hydrogen
H_2	molecular hydrogen
H_2S	hydrogen sulfide
H_2SO_4	sulfuric acid
HAPs	hazardous air pollutants
HCl	hydrogen chloride
HF	hydrogen fluoride
Hg	mercury
HGPFS	hot gas particulate filter system
HHV	higher heating value
hr.	hour(s)
HRSG	heat recovery steam generator
ICCR	International Committee on Coal Research
ICR	information collection request
ID	Induced Draft
IEA	International Energy Agency
IEAT	Industrial Estates Authority of Thailand
IEO2003	*International Energy Outlook 2003*
IGCC	integrated gasification combined-cycle
IGFC	integrated gasification fuel cell
in, in^2, in^3	inch(es), square inch(es), cubic inch(es)
JBR	Jet Bubbling Reactor®

KCl	potassium chloride
K_2SO_4	potassium sulfate
kW	kilowatt(s)
kWh	kilowatt-hour(s)
LAC	Latin America and the Caribbean
lb	pound(s)
L/G	liquid-to-gas
LHV	lower heating value
LIMB	limestone injection multistage burner
LNB	low-NO_x burner
LNCB®	low-NO_x cell burner
LNCFS	Low-NO_x Concentric-Firing System
LNG	liquefied natural gas
LOI	loss-on-ignition
LPMEOH™	Liquid phase methanol
LRCWF	low-rank coal-water-fuel
LSDE	Laboratorium Sumderdaya Energi
LSFO	limestone forced oxidation
MACT	maximum achievable control technology
MASB	multi-annular swirl burner
MB	megabyte(s)
MCFC	molten carbonate fuel cell
MCR	Maximum Continuous Rating
MDEA	methyldiethanolamine
$MgCO_3$	magnesium carbonate
MgO	magnesium oxide
MHz	megahertz
mills/kWh	mills per kilowatt hour
min	minute(s)
mo	month(s)
MOST	Ministry of Science and Technology
MPF	multiphase flow
MSW	municipal solid waste
MTBE	methy tertiary butyl ether
MTCI	Manufacturing and Technology Conversion International
MTF	memorandum (memoranda)-to-file
MW	megawatt(s)
MWe	megawatt(s)-electric
MWt	megawatt(s)-thermal
N	elemental nitrogen
N_2	molecular nitrogen
n.d.	not dated
N/A	not applicable
NAAQS	National Ambient Air Quality Standards
Na/Ca	sodium-to-calcium
Na_2/S	sodium-to-sulfur
$NaHCO_3$	sodium bicarbonate
NaOH	sodium hydroxide
Na_2CO_3	sodium carbonate
NARSTO	North American Research Strategy for Tropospheric Ozone
NEDO	New Energy Development Organization
NEP	National Energy Policy
NEPA	National Environmental Policy Act
NETL	National Energy Technology Laboratory (formerly FETC)
NGCC	natural gas combined cycle
NH_3	ammonia
Nm^3	normal cubic meter
NMA	National Mining Association
NO_2	nitrogen dioxide
NOPR	Notice of Proposed Rulemaking
NO_x	nitrogen oxides
NRC	National Research Council
NSPS	New Source Performance Standards
NSR	New Source Review
NSR	normalized stoichiometric ratio
NTHM	net tons of hot metal
NTIS	National Technical Information Service
NTPC	National Thermal Power Corporation
NYSEG	New York State Electric & Gas Corporation
O	elemental oxygen
O_2	molecular oxygen
O_3	ozone
O&M	operation and maintenance
OC&PS	Office of Coal & Power Systems
OECD	Organisation for Economic Co-operation and Development
OSTI	Office of Scientific and Technical Information
OTAG	Ozone Transport Assessment Group
OTC	Ozone Transport Commission
PASS	Pilot Air Stabilization System
PC	personal computer
PCAST	Presidential Committee of Advisors on Science and Technology
PCFB	pressurized circulating fluidized-bed
PDF®	Process-Derived Fuel®
PEIA	programmatic environmental impact assessment
PEIS	programmatic environmental impact statement
PEOA™	Plant Emission Optimization Advisor™
PENELEC	Pennsylvania Electric Company
PEP	progress evaluation plan
PFBC	pressurized fluidized-bed combustion
PJBH	pulse jet baghouse

PM	particulate matter
PM_{10}	particulate matter less than 10 microns in diameter
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
PON	program opportunity notice
PPA	Pollution Prevention Act
PPII	Power Plant Improvement Initiative
PRB	Powder River Basin
ppm	parts per million (mass)
ppmv	parts per million by volume
PRC	People's Republic of China
PSCC	Public Service Company of Colorado
PSD	Prevention of Significant Deterioration
PSDF	Power Systems Development Facility
psi	pound(s) per square inch
psia	pound(s) per square inch absolute
psig	pound(s) per square inch gauge
PUHCA	Public Utility Holding Company Act of 1935
PURPA	Public Utility Regulatory Policies Act of 1978
QF	qualifying facility
RAM	random access memory
R&D	research and development
RD&D	research, development, and demonstration
RDF	refuse derived fuel
REA	Rural Electrification Administration
ROD	Record of Decision
ROM	run-of-mine
RP&L	Richmond Power & Light
rpm	revolutions per minute
RUS	Rural Utility Service
S	sulfur
SAP	sulfuric acid plant
SBIR	Small Business Innovation Research
SCADA	supervisory control and data acquisition
scf	standard cubic feet
scfm	standard cubic feet per minute
SCR	selective catalytic reduction
SCS	Southern Company Services, Inc.
SDA	spray dryer absorber
SER	Schuylkill Energy Resources
SFC	Synthetic Fuels Corporation
S-H-U	Saarberg-Hölter-Umwelttechnik
SI	sorbent injection
SIP	State Implementation Plan
SM	service mark
SNCR	selective noncatalytic reduction
SNRB™	SO_x-NO_x-Rox Box™
SO_2	sulfur dioxide
SO_3	sulfur trioxide
SOFA	separated overfire air
SOFC	solid oxide fuel cell
SOW	statement of work
SPG	Shangdong Power Group
SPPC	Sierra Pacific Power Company
std ft^3	standard cubic feet
STTR	Small Business Technology Transfer Program
SVGA	super video graphics adapter
SVOC	semi-volatile organic compounds
TAG™	Technical Assessment Guide™
TCLP	toxicity characteristics leaching procedure
TRI	Toxics Release Inventory
TVA	Tennessee Valley Authority
UAF	University of Alaska, Fairbanks
UARG	Utility Air Regulatory Group
UBC	unburned carbon
UBCL	unburned carbon losses
U.K.	United Kingdom
UNDEERC	University of North Dakota's Energy and Environmental Research Center
UNESCO	United Nations Educational, Scientific and Cultural Organization
URL	Uniform Resource Locator
U.S.	United States
USAID	U.S. Agency for International Development
VFB	vibrating fluidized bed
V·I	voltage current product
VOC	volatile organic compound
w.c.	water column
WDNR	Wisconsin Department of Natural Resources
WES	wastewater evaporation system
w.g.	water gage
WLFO	wet limestone, forced oxidation
WMPI	Waste Management Processors, Inc.
WPFF	Working Party on Fossil Fuels
wt.	weight
yr.	year(s)
ZPEG	Zhejiang Provincial Energy Group

State Abbreviations

AK	Alaska
AL	Alabama
AR	Arkansas
AZ	Arizona

CA	California
CO	Colorado
CT	Connecticut
DC	District of Columbia
DE	Delaware
FL	Florida
GA	Georgia
HI	Hawaii
IA	Iowa
ID	Idaho
IL	Illinois
IN	Indiana
KS	Kansas
KY	Kentucky
LA	Louisiana
MA	Massachusetts
MD	Maryland
ME	Maine
MI	Michigan
MN	Minnesota
MO	Missouri
MS	Mississippi
MT	Montana
NC	North Carolina
ND	North Dakota
NE	Nebraska
NH	New Hampshire
NJ	New Jersey
NM	New Mexico
NV	Nevada
NY	New York
OH	Ohio
OK	Oklahoma
OR	Oregon
PA	Pennsylvania
PR	Puerto Rico
RI	Rhode Island
SC	South Carolina
SD	South Dakota
TN	Tennessee
TX	Texas
UT	Utah
VA	Virginia
VI	Virgin Islands
VT	Vermont
WA	Washington
WI	Wisconsin
WV	West Virginia
WY	Wyoming

Other

Some companies have adopted an acronym as their corporate names. The following corporate names reflect the former name of the company.

BG/L	British Gas Lurgi
JEA	Jacksonville Electric Authority
KRW	Kellogg Rust Westinghouse

Index of Projects and Participants

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