CLEAN COAL TECHNOLOGY

DOE/FE-0553

Major Demonstration Programs: Program Update 2011

Includes demonstration projects performed under the Clean Coal Power Initiative (CCPI), FutureGen 2.0, and the Industrial Carbon Capture and Storage (ICCS) Programs

CARBON CAPTURE, UTILIZATION AND STORAGE CCUS

As of September 2011

November 2011

U.S. Department of Energy
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Updated information is available to the public from the National Energy Technology Laboratory's Clean Coal Technology Compendium, http://www.netl.doe.gov/technologies/coalpower/cctc/index.html

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Executive Summary

Introduction

The purpose of *Major Demonstration Programs: Program Update 2011* is to provide an updated status of the U.S. Department of Energy (DOE) commercial-scale projects performed under the Clean Coal Power Initiative (CCPI), FutureGen 2.0, and the Industrial Carbon Capture and Storage (ICCS) programs.

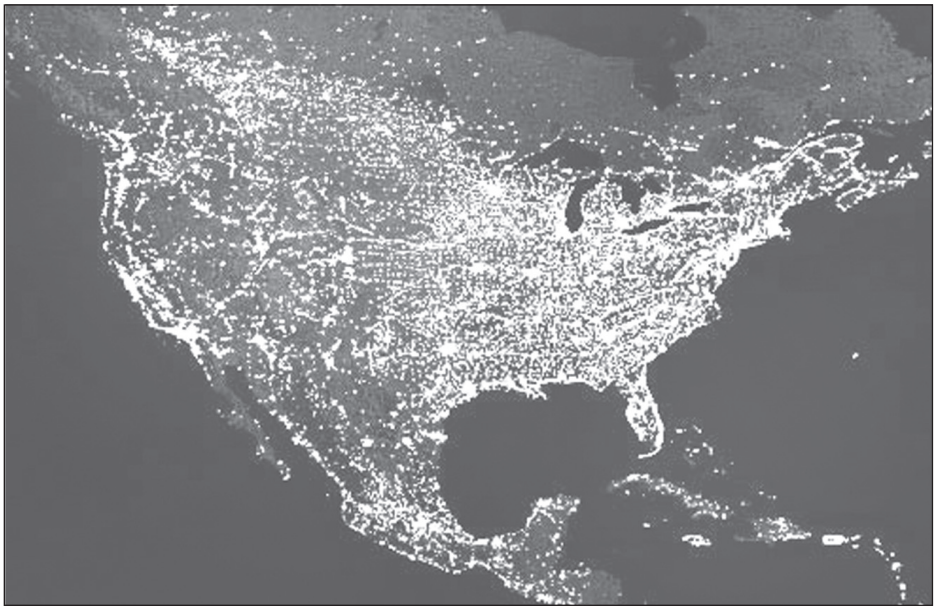
Program Update 2011 provides: (1) a discussion of the role of clean coal technology and carbon capture, utilization and storage (CCUS) demonstrations in improving the nation's energy security, electricity production and reliability, and environment; (2) a summary of the funding and costs of the demonstrations; and (3) an overview of the technologies being demonstrated, along with fact sheets for projects that are active or recently completed.

Program Update 2011 includes discussion on three recently completed, one discontinued, and 10 ongoing projects; including two new complimentary projects under FutureGen 2.0 and three new large-scale ICCS projects. While the ICCS projects due not utilize coal, the commercial-scale demonstration of CCUS technologies are of direct benefit to the fossil-fuel-based power generation and industrial market segments.

Role of Clean Coal and CCUS Demonstrations

Coal is the United States' most abundant fossil fuel and is recognized as a low-cost energy source that advances energy security and economic stability. Currently, coal-fired power plants generate close to half of the nation's electricity and represent a significant amount of baseload generating capacity. The sustained use of the nation's coal reserves relies on developing technological solutions that address environmental concerns while maintaining coal's economic advantage. These continually evolving and expanding technological solutions have been designated as clean coal technologies (CCTs).

For over 25 years, DOE has been cofunding large-scale demonstrations of emerging CCTs to hasten their adoption in the marketplace. Financial assistance was deemed necessary to reduce the risk associated with first-of-a-kind demonstrations. These demonstrations are part of an integrated CCT research, development, and demonstration (RD&D) program that contributes to the DOE's strategic theme of "Promoting America's energy security through reliable, clean and affordable energy."



Through the year 2035, the Energy Information Administration (EIA) forecasts electricity consumption will grow by approximately one percent per year. The ability of coal-fired generation to help meet this demand could be limited by concerns over climate change and the potential for future legislation to impose restrictions or penalties. While the CCT demonstrations performed to date have made significant gains in terms of environmental performance and efficiency, the greatest challenges may lie ahead from restrictions on carbon dioxide (CO_2) emissions. To address concerns over CO_2 emissions, CCUS technologies have become the exclusive focus of the CCPI program. As a result of funding provided under the American Recovery and Reinvestment Act of 2009 (ARRA), additional projects were awarded under the CCPI program along with projects under FutureGen 2.0 and the ICCS initiatives, all with exclusive focus on CCUS demonstrations.

For the foreseeable future, coal will continue to provide a significant amount of the nation's baseload generation capacity. If CCUS technologies are able to provide an economical solution to CO_2 emissions, the nation will continue to benefit from coal's competitive electric generation costs and security of its domestic availability.

Clean Coal and CCUS Demonstrations

Since 1985, DOE has shared with participants in the funding of commercial-scale demonstration projects through the Clean Coal Technology Demonstration Program (CCTDP), Power Plant Improvement Initiative (PPII), and the ongoing CCPI. While the specific technologies and focus of the programs continued to evolve over time, all three programs shared similar general provisions and administrative principles.

The CCTDP focused on:

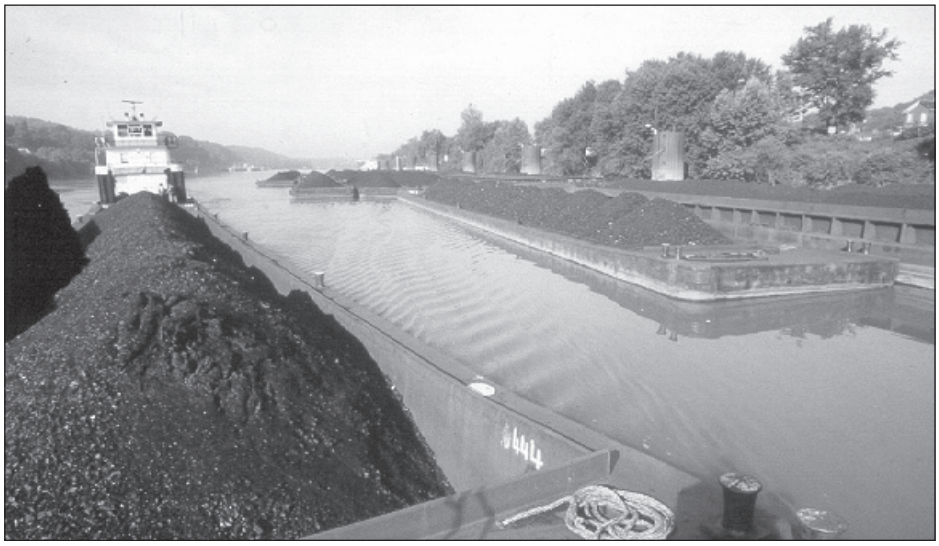
- Commercializing processes that reduced emissions of sulfur dioxide (SO_2) and nitrogen oxides (NO_x);
- Demonstrating more efficient and environmentally friendly alternatives to traditional pulverized coal boilers;
- Demonstrating coal preparation and conversion technologies leading to cleaner fuels; and
- Demonstrating improved industrial technologies for clean coal use.

With 33 successfully completed projects, the CCTDP yielded technologies that met or exceeded environmental regulatory requirements while providing the reliability and competitive costs necessary for success in the marketplace.

Following the power blackouts and brownouts experienced in 1999 and 2000, Congress directed establishment of the PPII 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, thereby leading to enhanced electric reliability. Of the five projects awarded, four were successfully completed.

The CCPI was initiated in 2002 to advance a broad spectrum of promising technologies that target today's most pressing environmental, economic, and energy security challenges. The first CCPI solicitation (CCPI-1) 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."

In February 2004, the second CCPI solicitation (CCPI-2) was issued seeking proposals to demonstrate advances in coal gasification systems, technologies that permit improved management of carbon emissions, and advancements



that reduce mercury and other power plant emissions.

In August 2008, the third CCPI solicitation was issued specifically focused on the capture and sequestration, or beneficial reuse, of CO_2 emissions from coal-based electricity production. Following the passage of ARRA, DOE announced the intent to re-open the third solicitation. In June 2009, DOE issued an amendment that provided for a second application due date. Thus far, CCPI has resulted in the successful completion of four projects and five ongoing projects.

In additional to the clean coal demonstrations performed under the CCTDP, PPII, and CCPI programs, commercial demonstrations are also being performed under the FutureGen 2.0 and ICCS initiatives. In August 2010, two projects were awarded in a complimentary effort under FutureGen 2.0 to demonstrate the oxy-combustion technology and to capture and sequester approximately 1.3 million tonnes of CO_2 per year. In June 2010, three large-scale projects were down-selected to receive full project funding from 12 previously selected applicants under the ICCS initiative. Combined, these three projects are expected to capture and sequester over 6 million tons per year of CO_2. The FutureGen 2.0 and ICCS projects are subject to similar administrative provisions as the CCTDP, PPII, and CCPI programs; however, these projects are not subject to the same cost sharing requirements or repayment provisions.

Exhibit ES-1
Projects by Market Sector

Project	Program	Participant	Status	Page
Emissions Control				
Mercury Specie and Multi-Pollutant Control	CCPI-2	NeuCo, Inc.	Completed	3-10
TOXECON Retrofit for Mercury and Multi-Pollutant Control on Three 90-MW Coal-Fired Boilers	CCPI-1	Wisconsin Electric Power Company	Completed	3-14
Advanced Power Systems				
Mesaba Energy Project – Unit 1	CCPI-2	MEP-I LLC	Design	3-20
Clean Coal Fuels				
Increasing Power Plant Efficiency – Lignite Fuel Enhancement	CCPI-1	Great River Energy	Completed	3-24
Carbon Capture, Utilization and Storage				
Mountaineer Commercial Scale Carbon Capture and Storage Project	CCPI-3	American Electric Power Service Corporation	Discontinued	3-30
W.A. Parish Post-Combustion CO_2 Capture and Sequestration	CCPI-3	NRG Energy, Inc.	Design	3-32
Demonstration of a Coal-Based Transport Gasifier	CCPI-2	Southern Company Services, Inc.	Construction	3-34
Commercial Demonstration of Advanced IGCC with Full Carbon Capture	CCPI-3	Hydrogen Energy California, LLC	Design	3-36
Texas Clean Energy Project	CCPI-3	Summit Texas Clean Energy LLC	Design	3-38
Oxy-Combustion Large Scale Test	FutureGen 2.0	Ameren Energy Resources Company	Definition	3-40
Pipeline and Regional CO_2 Storage Reservoir Project	FutureGen 2.0	FutureGen Alliance	Definition	3-42
CO_2 Capture from Biofuels Production and Sequestration into the Mt. Simon Sandstone	ICCS	Archer Daniels Midland Company	Construction	3-44
Demonstration of CO_2 Capture and Sequestration of Steam Methane Reforming Process Gas Used for Large-Scale Hydrogen Production	ICCS	Air Products and Chemicals, Inc.	Construction	3-46
Lake Charles CCS Project	ICCS	Leucadia Energy, LLC	Design	3-48

Clean Coal and CCUS Demonstration Funding

Funding for CCPI began in fiscal year 2002 and included unused funds from PPII. Funding through fiscal year 2005 was used for the first two CCPI solicitations. Funding from fiscal years 2006 through 2009 were used for the initial and re-opened third CCPI solicitation. The majority of funding was provided in 2009 with $800 million apportioned under ARRA. No additional appropriations were made in fiscal year 2010. Appropriations for fiscal year 2011 rescinded approximately $105 million.

In addition to the $800 million in funding for CCPI, ARRA funding was used for FutureGen 2.0 and the ICCS initiative. FutureGen 2.0 represents a more than a $1 billion government contribution towards the demonstration of the oxy-combustion technology and the development of a CO_2 pipeline and storage network. The ICCS initiative represents a $1.5 billion government contribution for a broad range of projects and R&D activities, including three large-scale projects that are valued at over $1 billion in total project costs with a government cost share contribution of $687 million.

Clean Coal and CCUS Projects

Program Update 2011 provides project fact sheets for the three recently completed, one discontinued, and 10 ongoing projects. The fact sheets are organized by the following market sectors: (1) emissions control; (2) advanced power systems; (3) clean coal fuels; and (4) carbon capture, utilization and storage. Exhibit ES-1 groups the projects by market sector and indicates the demonstration program, participant, status, and page number of the fact sheet for each project. The following provides highlights of the three recently completed projects.

Mercury Specie and Multi-Pollutant Control

The project demonstrated advanced sensors and neural network-based optimization and control technologies for enhanced mercury and multi-pollutant control on an 890-MW tangentially fired boiler at the NRG Limestone Plant in Jewett, Texas.

The deployed systems included fuel management, mercury specie control, soot blowing, and plant optimization. Despite a number of challenges, the project delivered significant benefits in plant performance. Some of the key findings included:

- With reliable mercury CEMS, the use of inductive methods can most likely support mercury optimization product development;
- Significant benefits are provided by an integrated platform upon which to bring the wide variety of data management and analytics approaches including advanced optimization technology;
- Advanced instrumentation must be reliable, robust and cost effective to have significant utility in a real production setting; and
- Regulation and market uncertainty are major obstacles to progress in developing the benefits of optimization opportunities.

While mercury emissions were not regulated during the project demonstration period, future regulations are expected and the most likely instrumentation scenario is one where stack-based mercury CEMS will be used to report against those regulations. The project analysis suggests that this kind of instrumentation supports some opportunity for reducing mercury emissions through the optimization of standard upstream processes, similar to NO_x, CO, and opacity. It is likely that optimization can play a role in helping to achieve the fastest possible path to effective utilization of those systems, while minimizing other impacts.

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

The TOXECON™ process injects powdered activated carbon (PAC) and sodium-based sorbents into a pulsed-jet baghouse installed down-stream of the plant's primary particulate matter (PM) control device. The project treated the flue gases of three 90 MW coal-fired units at Wisconsin Electric's Presque Isle Power Plant. The project was the first commercial-scale TOXECON™ demonstration using activated carbon injection for mercury removal.

In addition to successfully meeting objectives, the project addressed several other issues. Early in the testing phase, hopper fires occurred due to auto-ignition of the PAC/ash mixture. Extensive laboratory testing resulted in several recommendations for helping minimize the risk of overheating high carbon ash in hoppers. Optimization testing provided important data on reducing sorbent costs and maximizing the life of the bags in the baghouse. Additionally, the project was able to reduce the rate of carbon injection needed for achieving an average 90 percent mercury removal rate.

The demonstration provided long-term operational experience applicable to power plants that burn western subbituminous coal. Mercury in the flue gas produced by these units exists primarily in the elemental vapor form that is insoluble in water and, as such, will pass through most types of air pollution control devices. As a result of this project, the TOXECON™ process is in position to become a leading mercury control choice for western coals, especially for units that use a hot-side electrostatic precipitator (ESP).

Increasing Power Plant Efficiency – Lignite Fuel Enhancement

The project demonstrated Great River Energy's (GRE) fluidized-bed dryer technology (DryFining™) to obtain a 25 percent reduction in coal moisture content from North Dakota lignite that has approximately 40 percent as-received moisture content.

While the benefits of drying high moisture coals are widely recognized, most approaches involve considerable costs to supply the heat to dry the coal. The DryFining™ technology uses low-grade heat (that would otherwise not be put to beneficial use) to upgrade the low-rank coal feedstock to improve plant efficiency and performance. The high coal moisture content reduces efficiency by requiring application of heat generated during combustion to vaporize large amounts of water. High moisture content coals also place an energy penalty on auxiliary equipment and can also contribute to the corrosion of ductwork.

For tests performed with dried coal, the NO_x emission rate decreased by over 30 percent relative to the wet coal baseline while the SO_2 emission rate was approximately 54 percent lower. The lower NO_x emissions were largely attributable to lower primary air requirements (the amount of coal fed to the boilers is less with the dried coal). The lower SO_2 emissions primarily resulted from the removal of iron sulfide (pyrite) from the coal feedstock during the drying process, lower mass and volumetric flow rates of flue gas when operating on dried coal, and reduced fuel flow due to the improved heating value of the coal.

Testing with dried coal also reduced mercury emissions. Reduced mercury emissions resulted from some mercury being removed with impurities during in the drying process; the reduced fuel flow requirement using dried coal; and the combustion of dried coal tends to oxidize more of the mercury, improving capture by the flue gas desulfurization (FGD) system. Accounting for the reduction in flue gas flow rate, the mass emissions rate was reduced by 41 percent relative to the wet coal.

The DryFining™ upgrading process: improves plant economics; lowers plant heat loss; increases efficiency; and reduces plant emissions without the expense of additional control equipment. The project received the 2010 Coal-Fired Project of the Year award by the editors of *Power Engineering* magazine.

1. Role of Clean Coal Technology Demonstrations

Introduction

Coal is the nation's most abundant fossil fuel and is recognized as a low-cost energy source that advances energy security and economic stability. Currently, coal-fired power plants generate approximately 45 percent of the nation's electricity and represent a significant amount of baseload generating capacity. In addition to the generation of electricity, coal represents a stable domestic energy source that can be used to produce environmentally friendly fuels such as hydrogen, synthetic natural gas, and strategically important chemicals. The sustained use of the nation's coal reserves relies on developing technological solutions that address environmental concerns while maintaining coal's economic advantage. These continually evolving and expanding technological solutions have been designated as "clean coal technologies."

Federally sponsored research and development (R&D) for coal applications began in the 1970s. By the 1980s, many promising technologies had emerged. However, there was a realization that moving the technologies into the marketplace, where they could have an impact, required overcoming one major remaining hurdle—large-scale demonstration. Demonstration proves the competitive cost and performance of a clean coal technology (CCT) in a commercial setting in order to reduce risk to acceptable levels in the financial and technical arenas. To mitigate the risks at the demonstration stage, the U.S. Department of Energy (DOE) initiated the Clean Coal Technology Demonstration Program (CCTDP) in 1985. The CCTDP forged cost-sharing partnerships between DOE, non-federal public entities, and technology suppliers and users, which reduced the financial and technical risk facing participants to acceptable levels. CCTDP demonstrations were required to be at a scale and in an operational environment sufficient to determine their potential for satisfying technical, economic, and environmental needs.

The CCTDP comprised five competitive solicitations resulting in 33 successfully completed demonstration projects. In 2001, DOE implemented the Power Plant Improvement Initiative (PPII) in a single solicitation applying CCTDP principles for demonstrations addressing electric power reliability concerns.

In 2002, DOE launched the comprehensive Clean Coal Power Initiative (CCPI) to address 21st century energy issues through multiple solicitations. Thus far, DOE has conducted three solicitations resulting in four completed and five ongoing projects. In addition to the ongoing CCPI, DOE has initiated commercial-scale demonstration projects under the FutureGen 2.0 and Industrial Carbon Capture and Storage (ICCS) initiatives. The FutureGen 2.0 initiative represents the world's first commercial-scale, oxy-combustion power plant that will capture, purify, and sequester the CO_2 emissions from the flue gas. Under the ICCS initiative, three projects will demonstrate carbon capture, utilization and storage (CCUS) technologies applied to industrial applications.

Collectively, these commercial demonstrations, as part of an integrated CCT research, development, and demonstration (RD&D) program, contribute to the DOE strategic theme of "Promoting America's energy security through reliable, clean, and affordable energy."

Since the early beginnings of CCTDP, coal technologies have made significant gains in terms of environmental performance and efficiency; however, the greatest challenges may lie ahead with restrictions on carbon dioxide

(CO_2) emissions. To address concerns over greenhouse gas (GHG) emissions, CCUS technologies have become the primary focus of recent demonstration activities.

Through the year 2035, the Energy Information Administration (EIA) forecasts electricity consumption will grow by approximately one percent per year in EIA's *Annual Energy Outlook 2011 (AEO2011)* reference case. The reference case estimates that total electricity generation at coal-fired plants will increase by 25 percent by 2035, largely as a result of increased use of existing capacity; however, coal's contribution to electricity generation will decrease from 45 percent to 43 percent as a result of more rapid increases in generation from natural gas and renewables. Despite the forecasted growth from natural gas and renewables, coal continues to account for the largest share of electricity generation.

The EPA has proposed and is expected to enact several key regulations in the coming years that will have an impact on the existing and future deployment of coal-fired power plants. Because the rules have not been finalized, their impacts were not fully analyzed or included in the reference case. However, *AEO 2011* does include alternative cases that examine the sensitivity of the generation sector to various assumed requirements for future environmental regulations.

AEO 2011 forecasts few new coal-fired power plants beyond those already under construction or supported by incentives and the range of coal plant retirements varies considerably across the alternative cases. In the reference case, retirements are estimated at 9 gigawatts (3 percent of the coal fleet) and range to a high of 73 gigawatts (over 20 percent of the coal fleet) for the various alternative cases. The higher end of the plant retirement range was driven by rather aggressive assumptions that included: (1) enactment of restrictive environmental regulations; (2) investment decisions to install environmental equipment will require a short pay-back period (5 years); and (3) a forecast that natural gas prices remain low through 2035. In all alternative cases, coal continued to account for the largest share of electricity generation through 2035.

For the foreseeable future, coal will continue to provide a significant amount of the nation's baseload generation capacity. If CCUS technologies are able to provide an economical solution to CO_2 emissions, the nation will continue to benefit from coal's competitive electric generation costs and security of its domestic availability.

CCTDP

Begun in 1985, the CCTDP was an ambitious government-industry initiative to demonstrate inventive approaches to address environmental concerns and otherwise advance the utilization of the nation's abundant coal resources. The program's goal was to demonstrate the best, most innovative technology at a scale large enough so that industry could determine whether the new processes had commercial merit.

Projects proposed by industry were selected through a series of five competitions aimed at attracting promising technologies that had not been demonstrated at commercial scale. Projects selected included sulfur dioxide (SO_2) control systems; nitrogen oxides (NO_x) control technologies; fluidized-bed combustion; gasification; advanced coal processing technologies to produce clean fuels; and coal utilization for industrial applications. These technologies have allowed U.S. reliance on coal to continue, while cutting multiple pollutant emission levels by anywhere from 30–95 percent. More than 20 of the technologies tested in the original program have achieved commercial

success. The final CCTDP project ended in 2006.

Early on, the CCTDP responded to concerns over acid rain, which is formed by sulfur and nitrogen pollutants emitted by coal-burning power plants. In March 1987, President Reagan announced the endorsement of the recommendations of the *Special Envoys on Acid Rain*, calling for additional funding for industry/government demonstrations of innovative control technology.

The CCTDP introduced a number of innovative approaches and principles that advanced the effectiveness of government-industry partnerships, including:

- Strong and stable financial commitment for the life of a project, including full appropriation of the government's share of the costs;
- Multiple solicitations spread over a number of years enabling clean coal technologies 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;
- 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;
- A requirement for industry to commit to commercialize the technology;
- A requirement for repayment up to the government's cost-share; and
- A review of environmental impacts of a project according to National Environmental Policy Act (NEPA) requirements.

Nearly all of these approaches and principles employed for the CCTDP were carried over to the PPII and CCPI programs. A requirement for repayment was waived for CCPI Round 3.

PPII

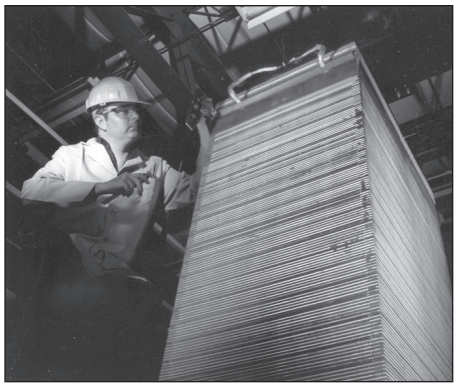
When U.S. consumers were confronted in 1999 and 2000 with blackouts and brownouts of electric power in major regions of the country, Congress responded by directing DOE to issue "a general request for proposals for the commercial-scale demonstration of technologies to assure the reliability of the nation's energy supply from existing and new electric generating facilities... ."

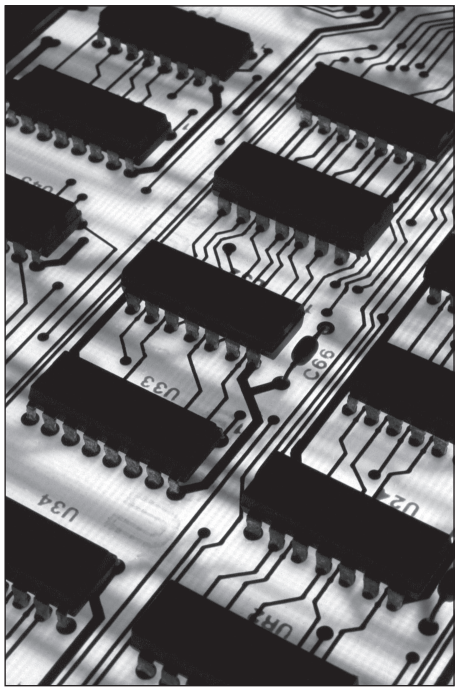
On February 6, 2001, DOE issued a solicitation for proposals under the program known as the PPII. By the deadline of April 19, 2001, 24 candidate projects had been submitted for government cost-shared financial assistance.

On September 28, 2001, DOE selected eight projects. Subsequently, three of the eight projects were withdrawn by their industrial sponsors, and a fourth project was discontinued. The four remaining projects were successfully completed.

CCPI

In the 21st century, additional environmental concerns have emerged: the potential health impacts of trace emissions of mercury, the effects of microscopic particles on people with respiratory problems, and the global climate-altering impact of GHGs. With coal likely to remain the predominant fuel for electric power generation for the foreseeable future, DOE remains committed to demonstrating the latest clean coal technologies that will continue to reduce the environmental impact of the lowest-cost domestic fuel resource.





The CCPI is closely linked with R&D activities that are focused on ultra-clean, fossil-fuel-based energy systems. In January 2004, the Clean Coal Technology Roadmap was developed cooperatively with the coal and power industry to address short- and long-term coal technology needs. Consistent with the Energy Policy Act of 2005, projects selected under the CCPI advance efficiency, environmental performance, and cost competitiveness well beyond that of technologies that are currently in commercial service.

Following the general principles of the original CCTDP, the CCPI was initiated in 2002 to advance a broad spectrum of promising technologies that target today's most pressing environmental, economic, and energy security challenges. The first CCPI solicitation (CCPI-1) 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."

Of the eight projects initially selected under CCPI-1, five awards were made. Two of the awarded projects ended prior to successful completion and the remaining three are complete. The completed projects demonstrated a relatively low-cost, advanced software-based application that was responsible for reduced emissions and improved plant efficiency; a coal drying system for improving the fuel efficiency of lignite coals; and a sorbent injection process to capture mercury and reduce other flue gas emissions.

In February 2004, the second CCPI solicitation (CCPI-2) was issued seeking proposals to demonstrate advances in coal gasification systems, technologies that permit improved management of carbon emissions, and advances that reduce mercury and other power plant emissions. In October 2004, DOE announced the selection of four projects from 13 proposals. Subsequently, one project withdrew during negotiations. Of the remaining three, one is complete, one is in construction, and one is in the design and permitting phase. The three awarded projects are valued at over $4 billion, with DOE commitments of $335.8 million. The two ongoing projects involve integrated gasification combined-cycle (IGCC) and the completed project addressed mercury and other power plant emissions.

On August 11, 2008, DOE issued the Funding Opportunity Announcement for the third solicitation (CCPI-3A). CCPI-3A specifically focused on the capture and sequestration, or beneficial reuse, of CO_2 emissions from coal-based electricity production (minimum 50 percent gross energy output as electricity). DOE established the following requirements for commercial-scale demonstration:

- Technologies must capture and sequester, or put to beneficial reuse, a minimum of 300,000 tons per year of CO_2 emissions;
- Technologies must attain 90 percent CO_2 capture efficiency in the flue gas being treated; and
- Technologies must show significant progress toward CO_2 capture and sequestration with less than 10 percent increase in electricity costs for gasification systems, and less than 35 percent for combustion and oxy-combustion systems.

Proposals were required by January 20, 2009 and the selection of two projects was announced on July 1, 2009. One project withdrew during negotiations and one project is in the design and permitting phase.

Following the passage of the American Recovery and Reinvestment Act of 2009 (ARRA), DOE announced the intent to re-open the third solicitation. On June 9, 2009, DOE issued an amendment that provided for a second application due date (CCPI-3B) of August 24, 2009, along with several programmatic and administrative revisions. Of particular note, revisions included a reduction in the carbon capture efficiency from 90 to 50 percent and a reduction in the minimum coal or coal refuse energy input requirement from 75 to 55 percent. Unlike prior CCPI solicitations, if funds became available as a result of unsuccessful negotiations, DOE may decide to select one or more additional projects under the CCPI-3B solicitation. The selection of three projects under CCPI-3B was announced on December 4, 2009. In February 2010, negotiations were initiated with a fourth project after one project withdrew prior to award. These three projects were awarded; however, one project withdrew after award, leaving two ongoing projects from CCPI-3B.

Projects awarded under CCPI-3A and -3B were funded, in whole or in part, from funds appropriated under ARRA. Approximately $800 million was provided under ARRA with the remainder provided through the annual congressional appropriations process. Projects receiving ARRA funding require special tracking and reporting requirements as specified under the ARRA legislation and related Office of Management and Budget (OMB) guidance.

FutureGen 2.0

Utilizing $1 billion in funding made available from ARRA and additional funding from annual appropriations, the FutureGen 2.0 effort was announced on August 5, 2010 to repower a 200 MW boiler with oxy-combustion technology and to capture and sequester approximately 1.3 million tonnes of CO_2 per year. In a two-part effort, the repowering will be performed by the Ameren Energy Resources Company and the CO_2 transport and sequestration by the FutureGen Alliance (FGA). The FGA is a non-profit membership organization formed to partner with DOE to demonstrate near-zero emissions coal technology.

The repowering effort represents the world's first commercial-scale, pulverized coal-fired, oxy-combustion power plant that will capture and compress CO_2 for transport. As a new or repowering technology, oxy-combustion can be applied to the large number of existing coal-fired power generation plants.

The transport and sequestration effort encompasses all aspects of the geologic site selection; the CO_2 monitoring, verification, and accounting (MVA) of the site; and the construction and operation of the transport pipeline from the power plant. In addition, the effort includes the establishment of a geologic sequestration research complex, craft labor training center, and a visitor center. These facilities will accommodate guests from around the world and promote the adoption of advanced clean coal technology.

As of September 30, 2011, Ameren has completed preliminary engineering studies required to finalize the project cost estimates necessary to obtain the commitments to proceed with the project. The FGA has announced the selection of Morgan County, IL as the preferred geologic sequestration site; obtained agreements for pore space acquisition for approximately 2,000 acres; and established a FutureGen Citizen's Board to serve as an additional communication channel to the community.

ICCS

With funding provided under ARRA, the ICCS addresses CO_2 emissions from the industrial sector that accounts for approximately one-quarter of total U.S. emissions. The ICCS program encompasses a broad range of projects and R&D activities including:

- Large-scale industrial projects;
- Innovative concepts for CO_2 use;
- Large-scale testing of advanced gasification technologies;
- Advanced turbo-machinery to lower emissions from industrial sources;
- Post-combustion CO_2 capture with increased efficiencies and decreased costs;
- Geologic storage site characterization;
- Simulation-based engineering user center; and
- Carbon capture and storage simulation initiative.

Only the large-scale industrial demonstrations under ICCS are included as part of *Program Update 2011*.

On June 8, 2009, DOE issued a Funding Opportunity Announcement for proposals to capture and sequester CO_2 emissions from industrial sources into underground formations. Proposals needed to make progress toward capture and sequestration of 75 percent of CO_2 from a stream comprising at least 10 percent CO_2 by volume and at a scale sufficient to evaluate full impact of the capture technology on plant operations, economics, and performance. The target was for one million tons per year of CO_2 emissions to be captured and sequestered.

On October 2, 2009, a total of 12 projects were selected for an initial project development phase of approximately seven months that was followed by another selection process to receive additional funding for design, construction, and operation. On June 10, 2010, three projects were selected to proceed under the ICCS program and include: capturing by-product CO_2 from ethanol production; vacuum swing adsorption (VSA) applied to hydrogen production; and the Rectisol® process applied at a methanol-producing gasification plant.

2. Funding and Costs

Introduction

Funding for the Clean Coal Technology Demonstration Program (CCTDP) and Power Plant Improvement Initiative (PPII) was provided through the annual appropriations bills for the Department of the Interior and Related Agencies. Current funding for the Clean Coal Power Initiative (CCPI) is provided under the Energy and Water Development Appropriations Act.

Congress appropriated a net amount of $1.74 billion for the CCTDP based on appropriations bills that began in fiscal year 1986. These funds were committed to demonstration projects selected through five competitive solicitations. The CCTDP has concluded with 33 successfully completed projects. The remaining $16.5 million in available funds, intended for use under the Clean Coal Power Initiative (CCPI), were rescinded in 2011.

A single PPII solicitation was conducted in 2001, with funding provided by appropriations for fiscal year (FY) 2001 that established a transfer of $95 million in funding previously appropriated for the CCTDP. The PPII has concluded with four successfully completed projects. Three projects withdrew during the negotiation phase prior to contract award. One project withdrew after award, but prior to successful completion.

Beginning in 2002, a net of nearly $1.7 billion has been appropriated for CCPI, including $800 million made available under the American Recover and Reinvestment Act (ARRA) of 2009. In addition, approximately $63 million in unused funds from PPII were authorized for use under CCPI. In FY2011, nearly $105 million of available funds were rescinded.

Exhibit 2-1 summarizes the funding by fiscal year for the PPII and CCPI programs. The amount of appropriated funds available for project awards is reduced by Program Support, the Small Business Innovation Research (SBIR) program, the Small Business Technology Transfer (STTR) program, and other adjustments. Program Support provides for a share of the DOE administrative expenses of the programs. The SBIR program implements the Small Business Innovation Development Act of 1982, and provides funding for small, innovative firms in selected research and development (R&D) areas. The STTR program implements the Small Business Technology Transfer Act of 1992, which provides funding for small business concerns performing cooperative R&D efforts. Other adjustments include across-the-board general and omnibus reductions imposed by Congress. Starting in FY09, the CCPI program was exempt from SBIR/STTR adjustments.

The Round 1 CCPI (CCPI-1) solicitation was conducted in 2002 based on funding provided by appropriations for fiscal year 2002 (FY02) and FY03. The Round 2 CCPI (CCPI-2) solicitation was conducted in 2004 with funding provided by appropriations for FY04

Exhibit 2-1
Funding for the CCPI and PPII Programs
(Dollars in Thousands)

	Fiscal Year											Total
	2001	2002	2003	2004	2005	2006	2007	2008[a]	2009[b]	2010	2011[c]	
PPII Projects	93,843										(53)	93,790
CCPI-1 Projects		144,565	143,626									288,191
CCPI-2 Projects				163,471	47,446							210,917
CCPI-3 Projects[d]						47,633	58,154	94,574	1,081,476		(104,876)	1,176,961
Program Support	948	1,500	1,490	1,701	493	495	604	694	6,304			14,228
SBIR & STTR		3,935	3,909	4,709	1,367	1,372	1,675	1,918				18,885
Other Adjustments[e]	209		975	2,119	694	500		789	394			5,680
Total	**95,000**	**150,000**	**150,000**	**172,000**	**50,000**	**50,000**	**60,433**	**97,975**	**1,088,174**	**0**	**(104,929)**	**1,808,653**

[a]Includes approximately $28 million in previously appropriated Fossil Energy Research and Development funding.

[b]Includes $285,488,260 in FY09 Appropriations and $795,988,000 in American Recovery and Reinvestment Act (ARRA) funding.

[c]Appropriations for fiscal year 2011 rescinded funds from PPII and CCPI.

[d] Projects awarded under CCPI-3A and -3B could be funded, in whole or in part, from funds appropriated under ARRA.

[e] General and Omnibus Reductions and Defense Contract Audit Agency (DCAA) charges.

and FY05, along with uncommitted funds from prior CCPI and PPII appropriations. The Round 3 CCPI (CCPI-3) solicitation was initiated in 2008 with applications due in January 2009 (CCPI-3A) and selections announced in July 2009. As a result of additional funding made available under ARRA, in June 2009 DOE announced an amendment to the CCPI-3 solicitation that provided for a second application due date of August 2009 (CCPI-3B). Projects selected under CCPI-3B were announced beginning in December 2009.

As of September 30, 2011, four CCPI projects were complete and five were ongoing. Six projects did not progress beyond the negotiation phase and three projects withdrew after award.

In addition to reopening the CCPI-3 solicitation to provide for additional proposals, ARRA funding made available in 2009 was used for FutureGen 2.0 and the Industrial Carbon Capture and Sequestration (ICCS) initiative. FutureGen 2.0 represents a more than $1 billion government contribution towards the demonstration of the oxy-combustion technology that facilitates the capture of carbon dioxide (CO_2) and the development of a CO_2 storage network for permanent sequestration.

The $1.5 billion government contribution to the ICCS program encompasses a broad range of projects and R&D activities, including three large-scale projects that were competitively selected from 12 initial projects based on a preliminary project definition and development period. Only the large-scale ICCS projects are discussed in *Program Update 2011* and are valued at over $1 billion, including a total government cost share contribution of $687 million.

CCTDP

Congress has appropriated a net amount of $1.74 billion for CCTDP project awards and program administration expenses. These funds were committed to demonstration projects selected through five competitive solicitations. The CCTDP has concluded with 33 successfully completed projects. The final active project withdrew prior to completion in March 2006 and submitted a Final Report of activities in March 2007. The successfully completed projects resulted in a combined investment by the federal government and the private sector of $3.25 billion. DOE contributed $1.3 billion toward these projects, representing approximately 40 percent of the total project costs. Project participants contributed the majority of the project costs, averaging 60 percent for the 33 successfully completed projects.

Appendix B provides a financial history of the CCTDP.

PPII

The PPII was established by appropriations made for FY01 (Public Law 106-291) through a transfer of $95 million in funding previously appropriated for the CCTDP. Funds were committed to demonstration projects from a single solicitation issued in February 2001. Eight projects were selected for negotiation in September 2001 among 24 applications.

The PPII has concluded with four successfully completed projects. Three projects withdrew during the nego-

Exhibit 2-2
PPII Project Costs and Financial Status as of September 30, 2011
(Dollars)

	Total Project Costs	DOE Share	DOE Obligated	DOE Cost
Achieving NSPS Emission Standards Through Integration of Low-NO_x Burners with an Optimization Plan for Boiler Combustion (project discontinued)	3,005,169	1,387,530	1,387,530	1,387,530
Big Bend Power Station Neural Network-Sootblower Optimization (project complete)	2,381,614	905,013	905,013	905,013
Commercial Demonstration of the Manufactured Aggregate Processing Technology Utilizing Spray Dryer Ash (project complete)	19,581,734	7,224,000	7,224,000	7,224,000
Demonstration of a Full-Scale Retrofit of the Advanced Hybrid Particulate Collector (Advanced Hybrid™) Technology (project complete)	13,353,288	6,490,585	6,490,585	6,490,585
Greenidge Multi-Pollutant Control Project (project complete)	32,742,976	14,341,423	14,341,423	14,341,423
Total PPII	**71,064,781**	**30,348,551**	**30,348,551**	**30,348,551**

tiation phase prior to contract award. One project withdrew after award, but prior to successful completion. No additional solicitations are planned, and unused funds were authorized for use under CCPI. In FY2010, $63 million of PPII funding were committed to a CCPI project.

The DOE funding commitments for the PPII projects totaled over $30 million. The total funding commitment for the projects was over $70 million. Participants have funded 57 percent of the total project costs. Exhibit 2-2 summarizes the project costs and financial status of the PPII projects. The financial status for the individual projects is provided under the "DOE Obligated" and "DOE Cost" columns in Exhibit 2-2. The amount shown under "DOE Obligated" indicates the amount DOE has funded toward the total DOE share of the project. The costs indicate the amount invoiced to DOE for payment.

CCPI

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. Thus far, three solicitations have been issued (CCPI-1, CCPI-2, and CCPI-3). Following submission of proposals for the initial CCPI-3 solicitation (CCPI-3A), the solicitation was re-opened with minor amendments for another round of proposals (CCPI-3B).

Funding provided by appropriations for FY02 and FY03 served as the basis for the CCPI-1 solicitation. The initial CCPI competition began in March 2002 when DOE issued a solicitation offering $330 million in federal matching funds for industry-proposed projects. In January 2003, DOE announced that eight projects, valued at more than $1.3 billion, would make up the first round of the CCPI. Subsequently, three projects were withdrawn. Of the remaining five projects, three are complete and two were discontinued in the design phase. As of September 30, 2011, the total cost of the five projects was estimated at about $121 million, with the DOE share being approximately $56 million.

Exhibit 2-3

CCPI-1 Project Costs and Financial Status as of September 30, 2011

(Dollars)

	Total Project Costs	DOE Share	DOE Obligated	DOE Cost
Advanced Multi-Product Coal Utilization By-Product Processing Plant (project discontinued)	1,245,305	617,366	617,366	617,366
Demonstration of Integrated Optimization Software at the Baldwin Energy Complex (project complete)	19,904,733	8,592,630	8,592,630	8,592,630
Increasing Power Plant Efficiency – Lignite Fuel Enhancement (project complete)	31,512,215	13,518,737	13,220,529	13,220,529
TOXECON Retrofit for Mercury and Multi-Pollutant Control on Three 90-MW Coal-Fired Boilers (project complete)	52,978,115	24,859,578	23,756,415	23,756,415
Western Greenbrier Co-Production Demonstration Project (project discontinued)	16,256,940	8,128,470	8,128,470	7,861,365
Total CCPI-1	**121,087,308**	**55,716,781**	**54,315,410**	**54,048,305**

Exhibit 2-4 CCPI-2 Project Costs and Financial Status as of September 30, 2011 (Dollars)				
	Total Project Costs	DOE Share	DOE Obligated	DOE Cost
Demonstration of a Coal-Based Transport Gasifier[a]	2,065,013,164	293,750,000	293,750,000	220,802,891
Mercury Specie and Multi-Pollutant Control (project complete)	15,560,811	6,079,479	6,079,479	6,079,479
Mesaba Energy Project – Unit 1	2,155,680,783	36,000,000	22,245,505	21,921,304
Total CCPI-2	**4,236,254,758**	**335,829,480**	**322,074,984**	**248,803,674**

[a]Includes funding associated with initial site in Orlando, Florida.

Exhibit 2-3 summarizes the project cost and financial status of the CCPI-1 projects.

Funding for CCPI-2 was provided by an appropriation of $172 million for FY04 and an appropriation of $50 million for FY05, along with uncommitted funds from prior CCPI and PPII appropriations. In February 2004, DOE issued the CCPI-2 solicitation offering approximately $280 million in federal funds. In October 2004, four projects were selected. Subsequently, one project withdrew prior to award, one is complete, and two are ongoing.

Exhibit 2-4 summarizes the project costs and financial status of the CCPI-2 projects.

In August 2008, DOE issued a Funding Opportunity Announcement (FOA) for the third solicitation (CCPI-3A) that focused exclusively on the capture and sequestration, or beneficial reuse, of CO_2 emissions from coal-fueled electricity production. Proposals were submitted in January 2009. In July 2009, DOE selected two projects for negotiation. Funds appropriated for FY06 through FY09 were available for CCPI-3A, along with uncommitted funds from previous solicitations and funds appropriated under ARRA. Of the two projects selected, one withdrew during negotiations and one is ongoing.

In May 2009, DOE issued a Notice of Intent to Issue an amendment for the third CCPI solicitation. On June 9, 2009, DOE issued an amendment that provided for a second application due date (CCPI-3B) of August 24, 2009. While the focus remained the same as under CCPI-3A, there were several programmatic and administrative revisions. Unlike prior CCPI solicitations, if funds became available as a result of unsuccessful negotiations, or in the event of withdrawals, DOE may decide to select one or more additional projects.

In December 2009, DOE announced the selection of three new projects under CCPI-3B. In February 2010, two projects were awarded and one withdrew from negotiations. A fourth project was selected and awarded in May 2010. Subsequently, one project withdrew after award, leaving two ongoing projects from CCPI-3B.

The four projects awarded under CCPI-3 were funded in part from ARRA appropriations. Of the nearly $1.4 billion of DOE funding awarded, approximately $800 million was provided under ARRA. Projects receiving ARRA funding require special tracking and reporting requirements as specified under the ARRA legislation. Exhibit 2-5 summarizes the project costs and financial status of the CCPI-3 projects.

Exhibit 2-5 CCPI-3 Project Costs and Financial Status as of September 30, 2011					
	Total Project Costs	DOE Share	ARRA Funding	DOE Obligated to Date	DOE Cost to Date
Commercial Demonstration of Advanced IGCC with Full Carbon Capture	4,008,132,814	408,000,000	275,000,000	408,000,000	54,502,690
Mountaineer Commercial Scale Carbon Capture and Storage Project (project discontinued[a])	668,000,000	334,000,000	146,493,376	334,000,000	12,590,213
Texas Clean Energy Project	1,726,628,229	450,000,000	211,097,445	450,000,000	42,965,162
W.A. Parish Post-Combustion CO_2 Capture and Sequestration	338,607,740	166,804,425	163,007,179	166,804,425	2,818,102
Total CCPI-3A	**6,741,368,783**	**1,358,804,425**	**795,598,000**	**1,358,804,425**	**112,876,167**

[a] Costs values for full project. Costs incurred through closeout of discontinued project will be significantly less.

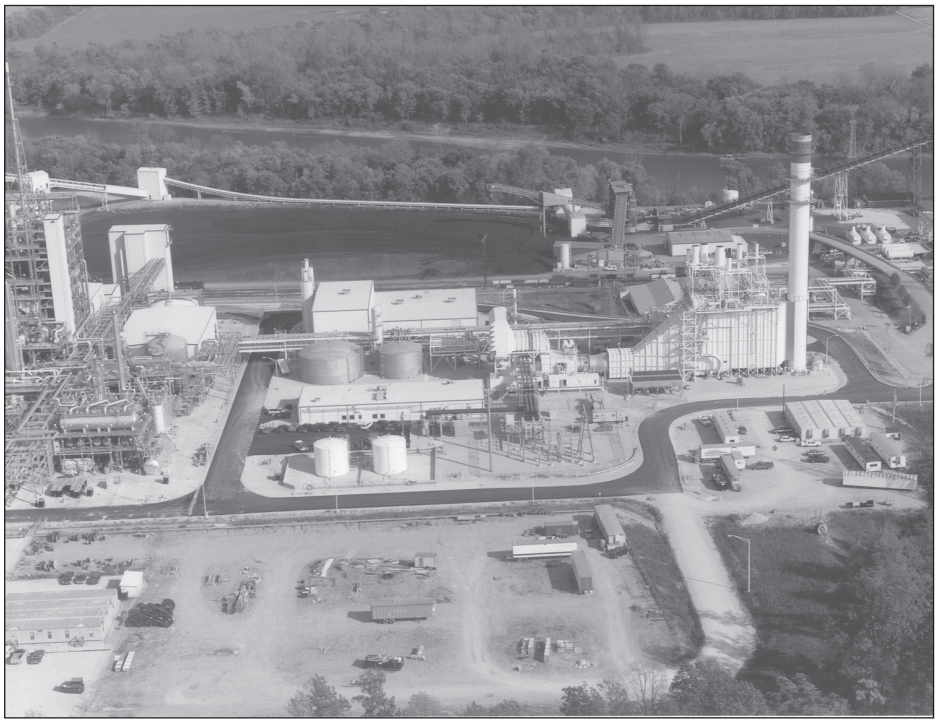
FutureGen 2.0

On August 5, 2010, DOE announced the awarding of $1 billion in ARRA funding to the FutureGen Alliance (FGA) and Ameren Energy Resources Company to build FutureGen 2.0, a clean coal repowering effort and carbon dioxide (CO_2) storage network. In a two-part effort with a total cost of nearly $1.3 billion, FutureGen 2.0 will demonstrate the oxy-combustion technology in a repowering application that will capture CO_2 for transport and permanent sequestration in geologic formations. In addition to the ARRA funding, the DOE share of the effort includes $53 million from annual appropriations and represents 81 percent of the overall total costs. Exhibit 2-6 summarizes the financial status of the FutureGen 2.0 program.

ICCS

With approximately $1.5 billion in funding provided under ARRA, the ICCS addresses CO_2 emissions from industrial sources. The ICCS program encompasses a broad range of projects and R&D activities; however, only the large-scale ICCS projects are represented in *Program Update 2011*.

On October 2, 2009, a total of 12 large-scale projects were initially selected under the ICCS solicitation and awarded nominal funding for a project definition period to further develop project specifics and prepare detailed proposals. On June 10, 2010, three projects were selected to proceed with demonstration activities. The total DOE share for the three projects is $687 million and accounts for between 60 and 68 percent of the individual project costs. The total costs for the three projects are over $1 billion. Exhibit 2-7 summarizes the project costs and financial status of the large-scale ICCS projects.



Wabash River Generating Station IGCC Facility.

Exhibit 2-6 FutureGen 2.0 Project Costs and Financial Status as of September 30, 2011					
	Total Project Costs	DOE Share	ARRA Funding	DOE Obligated to Date	DOE Cost to Date
Oxy-Combustion Large Scale Test	737,179,996	589,744,000	589,744,000	589,744,000	7,234,163
Pipeline and Regional CO_2 Storage Reservoir Project	552,535,075	458,604,112	404,985,000	458,604,112	11,683,082
Total FutureGen 2.0	**1,289,715,071**	**1,048,348,112**	**994,729,000**	**1,048,348,112**	**18,917,245**

Exhibit 2-7 Large-Scale ICCS Project Costs and Financial Status as of September 30, 2011				
	Total Project Costs	DOE Share (ARRA)	DOE Obligated to Date	DOE Cost to Date
CO_2 Capture from Biofuels Production and Sequestration into the Mt. Simon Sandstone	207,942,199	141,405,945	141,405,945	8,713,299
Demonstration of CO_2 Capture and Sequestration of Steam Methane Reforming Process Gas Used for Large-Scale Hydrogen Production	430,648,802	284,012,496	284,012,496	50,454,163
Lake Charles CCS Project	435,587,194	261,382,310	261,382,310	7,699,242
Total Large-Scale ICCS	**1,074,178,195**	**686,800,751**	**686,800,751**	**66,866,704**

General Provisions and Project Administration

Similar requirements and oversight apply to projects in CCTDP, PPII, and CCPI. A principal characteristic of the demonstration projects is the cooperative funding agreement between the participant and the federal government referred to as cost-sharing. This cost-sharing approach 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 demonstration projects, 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 participant is required throughout all phases of 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
- Investments in existing facilities, equipment, or previously expended R&D funds are not allowed for the purpose of cost-sharing.

Another principal characteristic of the demonstration projects is an agreement made by the participant for the federal government to recoup up to the full amount of the federal government's contribution. This approach enables taxpayers to benefit from commercially 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 duration of the repayment period was usually 20 years following the end of the project demonstration period. In accordance with congressional direction, funds obtained from repayment agreements will be retained by DOE for future activities.

While the specific repayment terms have varied between the solicitations, the repayment requirement was present from the first CCTDP solicitation through the second CCPI solicitation. The repayment provision was dropped for the CCPI-3A and -3B solicitations.

In terms of day-to-day oversight of the projects, the participant has responsibility for project management activities. 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 key project junctures. These junctures are used to divide most projects into several time and funding intervals known as budget periods. The number of budget periods is determined during the negotiation process for each project prior to contract award.

At the beginning of each budget period, DOE makes available the incremental amount of federal funds necessary 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. Through these activities, the federal government ensures the efficient use of public funds in the achievement of individual project and overall program objectives.

The FutureGen 2.0 and large-scale ICCS projects are subject to similar requirements and oversight as the previously described demonstrations programs; however, these projects are not subject to the same cost sharing requirements or repayment provisions. The ICCS projects require a minimum of 20 percent cost sharing as established by the Energy Policy Act of 2005. DOE approved an exemption to reduce the cost share below 20 percent for the FutureGen 2.0 project so as not to require cost sharing on the visitor and education facilities that are part of the CO_2 storage network effort.

3. Projects

Introduction

Project fact sheets are provided reflecting status as of September 30, 2011 on major demonstration projects encompassing the Clean Coal Power Initiative (CCPI), FutureGen 2.0, and the Industrial Carbon Capture and Sequestration (ICCS) programs.

The fact sheets are organized by the following technology areas: (1) emissions control; (2) advanced power systems; (3) clean coal fuels; and (4) carbon capture, utilization and storage (CCUS). Fact sheets under CCUS are further characterized as: (1) post-combustion capture; (2) pre-combustion capture; (3) oxy-combustion; and (4) industrial applications. All projects awarded under CCPI-3, FutureGen 2.0 and ICCS are found under the CCUS technology area.

Two-page fact sheets are presented for ongoing projects. In addition to providing an overview of the technology and accomplishments to date, the two-page fact sheets identify the project participants; team members; location; funding; objectives; benefits; and schedule.

Four-page fact sheets are provided for the three projects that have completed project activities. These fact sheets are expanded to include key findings and an overall project summary and include: the *Mercury Specie and Multi-Pollutant Control* project; the *TOXECON Retrofit for Mercury and Multi-Pollutant Control on Three 90-MW Coal-Fired Boilers* project; and the *Increasing Power Plant Efficiency – Lignite Fuel Enhancement* project.

Technology Overview

Following is an overview of major technology areas, underlying drivers, and associated challenges that have served as the focus of clean coal technologies.

Emissions Control

On February 21, 2011, the Environmental Protection Agency (EPA) proposed a rule that will reduce emissions of toxic air pollutants from new and existing boilers located at area source facilities. On the same day, the EPA issued a reconsideration notice for certain aspects of the standards on which the agency believed the public did not have a sufficient opportunity to provide comment. The rule established standards to address emissions of mercury, particulate matter (PM) (as a surrogate for non-mercury metals), and carbon monoxide (CO) (as a surrogate for organic air toxics). Existing sources are required to comply by March 2014.

Multiple industry groups petitioned the agency to delay the effective date of the major source boiler and commercial and industrial solid waste incinerator standards. In June 2011, the EPA set a schedule for issuing updated air toxics standards. To allow ample opportunity to provide additional input and information, the EPA intends to propose standards by the end of October 2011 and issue final standards by the end of April 2012.

On July 6, 2011, the EPA announced the Cross-State Air Pollution Rule (CSAPR) that would require 27 states to significantly improve air quality by reducing power plant emissions that contribute to ozone and/or fine particle pollution in other states. Resulting from a December 2008 court decision, the CSAPR would replace EPA's 2005 Clean Air Interstate Rule (CAIR).

Advanced NO_x Controls. Advanced nitrogen oxides (NO_x) controls address the need to comply with stringent emission requirements resulting from the following regulations/legislation: (1) the U.S. Environmental Protection Agency (EPA) Finding of Significant Contribution and Rulemaking for Certain States in the Ozone Transport Assessment Group Region for Purposes of

Advanced optimization software for enhanced emissions control was demonstrated at Dynegy Midwest Generation's Baldwin Energy Complex in Baldwin, Illinois.

Reducing Regional Transport of Ozone 1998 (commonly referred to as the NO_x SIP Call); (2) EPA's Standards of Performance for Electric Utility Steam Generating Units, et al., dated 2/27/06; and (3) EPA's Clean Air Visibility Rule (CAVR).

Advanced NO_x control 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), 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) usually are integrated with overfire air (air ports located above the combustion zone) to complete combustion in a cooler zone; and (4) can be used with neural network controls for optimum load-following performances. Reburning systems inject fuel into flue gas 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 relatively low post-boiler application temperatures, whereas SNCR simply involves ammonia/urea injection in the boiler where temperatures are high. Oxygen-enhanced combustion reduces available nitrogen and enables deeper staging through increased combustion efficiency.

While several projects that were recently completed address NO_x emissions as part of a multi-pollutant approach, DOE's NO_x emissions control research and development (R&D) activity ended in 2007.

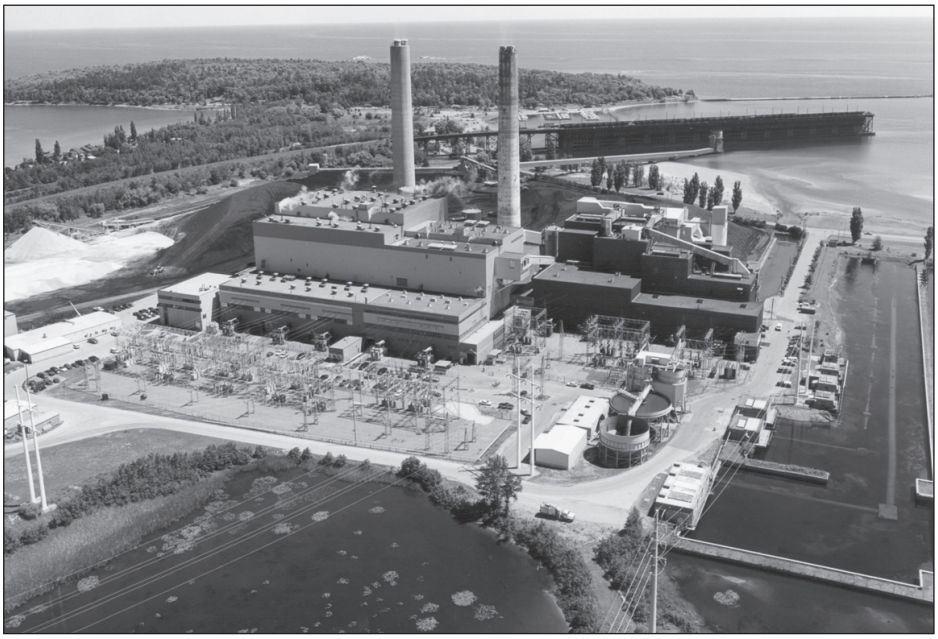
Mercury Controls. Mercury emissions from coal-based power generation represents roughly one-third of the U.S. mercury emissions. In February 2008, EPA's Clean Air Mercury Rule (CAMR) was vacated by the D.C. Circuit Court of Appeals, leaving no federal mandate to regulate mercury emissions. However, approximately half of the states have mercury regulations in place, some more stringent than under EPA's CAMR. In February 2011, EPA proposed a rule that would require mercury emissions to be reduced by 91 percent.

Mercury control technologies include:

- Sorbents and oxidizing agents to transform mercury into a solid to be removed along with fly ash in electrostatic precipitators (ESP) or fabric filter dust collectors (FFDCs), also referred to as "baghouses;"
- Oxidizing agents in conjunction with wet flue gas desulfurization (FGD) scrubbers to capture mercury in sulfate by-products; and
- Real-time measurement of mercury species and total mercury, for process control and validation.

Solid sorbents adsorb the mercury and then are removed in either an ESP or 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. Mercury instrumentation and controls measure both elemental and oxidized mercury species entering the control device, and the total mercury entering the stack.

While DOE has ended R&D activities for mercury control to focus on carbon dioxide (CO_2) control technologies, a number of recently completed CCPI projects provide commercial demonstrations of mercury control technologies.



TOXECON™, a multi-pollutant control technology providing high mercury capture efficiency was demonstrated at Wisconsin Electric's Presque Isle Power Plant in Marquette, Michigan.

Particulate Matter Controls. EPA regulations require control of particulate matter (PM), including PM equal to or less than 2.5 microns in size ($PM_{2.5}$). The objective of the PM control program is to develop technology for coal-based sources that will result in substantial reductions in primary PM, its secondary precursors [sulfur dioxide (SO_2) and NO_x], and problematic acid gases that can cause localized plume opacity and visibility impairment. Control technologies include:

- ESP/FFDC hybrids to leverage the best features of both NO_x and SO_2 removal;
- Flue gas preconditioning to enhance ESP performance;
- Concentration of PM 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 PM for capture on collection plates. FFDCs use fabric filter bags that receive and collect PM on the outside surface, and then are pulsed internally with jets of air to disengage the collected particulate. Preconditioning agents either lower resistivity or induce agglomeration of incoming PM. Alkaline injection converts SO_2 and SO_3 acid precursors into readily captured sulfate particulates, and neutralizes other acid gases such as hydrochloric and hydrofluoric acids. SO_3 analyzers measure input and output levels for control and validation.

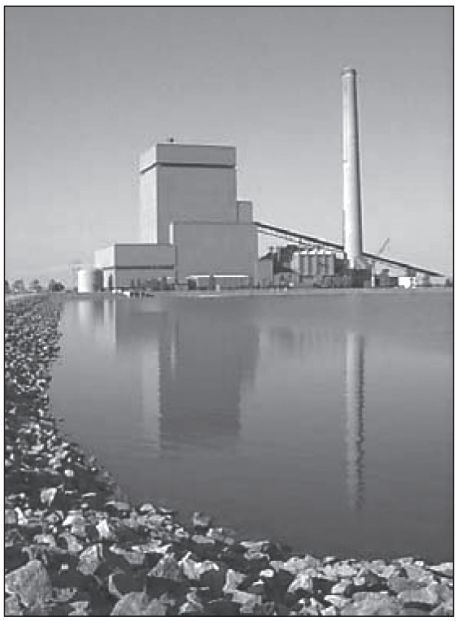
DOE has ended R&D activities for controlling PM. However, several projects have provided commercial demonstrations that address PM emissions in terms of both removal efficiency and cost savings compared to conventional technologies.

Advanced Power Systems

Advanced power system technologies include integrated gasification combined-cycle (IGCC) systems, circulating fluidized-bed (CFB) systems, and advanced combustion techniques that use oxygen in lieu of air (oxy-combustion) or chemical means (chemical looping) to achieve the equivalent of combustion.

The IGCC, oxy-combustion, and chemical looping technologies are considered "carbon capture ready" and as such, are also technology options under the Carbon Capture, Utilization and Storage market sector. For the purposes of *Program Update 2011*, the Advanced Power Systems market sector includes one project utilizing IGCC technology that does not include CCUS as part of the DOE cost-shared demonstration. Three additional IGCC projects that include CCUS as part of the DOE demonstration are presented under the Carbon Capture, Utilization and Storage market sector. The technology overview for IGCC, oxy-combustion, and chemical looping technologies are presented under the Carbon Capture, Utilization and Storage market sector.

Circulating fluidized-bed (CFB) combustion systems can 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. CFBs use jets of air to support combustion, effectively mix feedstocks with 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 that drives 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.



An advanced hybrid particulate collector was demonstrated at Otter Tail Power Company's Big Stone Power Plant in Big Stone City, South Dakota.

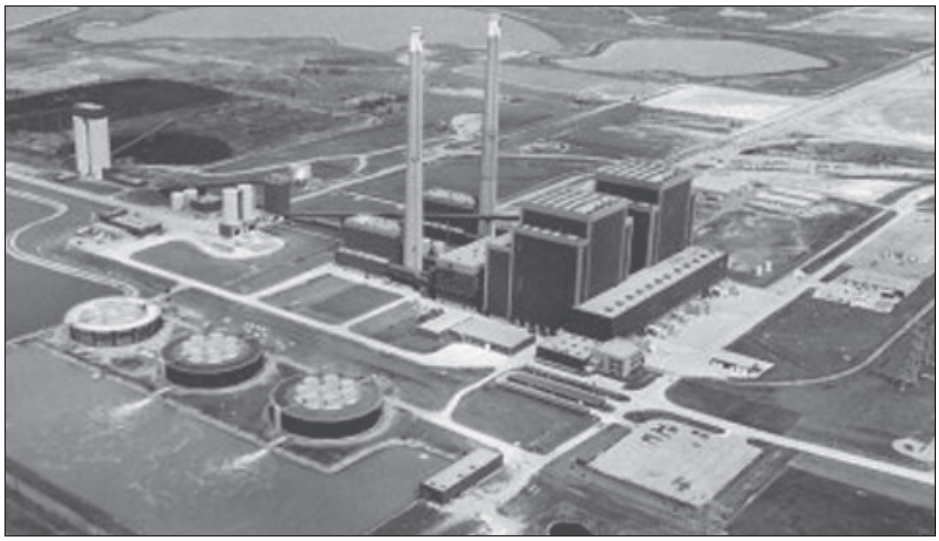
The challenge is to move today's coal-based advanced power systems from roughly 40 percent efficiency to between 45 and 50 percent.

Clean Coal Fuels

Upgrading. Upgrading coal quality enhances power plant efficiency and reduces emissions per kW of electricity produced. Upgrading technologies include coal drying and ash removal methods to significantly increase coal energy density.

The challenge in coal drying and ash removal is to realize a net energy benefit in using the upgraded product; and for processes that export the product, a significant challenge resides in maintaining stability (preventing spontaneous combustion) of the product after removing in-situ water.

Conversion. Conversion of coal to clean liquid fuels, chemicals, or hydrogen includes coal liquefaction, which involves converting coal gasification-derived synthesis gas into zero-sulfur, aromatic-free transportation fuels using the Fischer-Tropsch process;



Lignite fuel upgrading was demonstrated at Great River Energy's Coal Creek Station in Underwood, North Dakota.

Conversion of spray dryer ash to lightweight aggregate for construction materials was demonstrated at the Birchwood Power Facility in King George, Virginia.

and hydrogen-from-coal processing techniques, which currently are under development.

The challenge is to reduce process costs so that products are competitive with transportation fuels in the world market and reduce the CO_2 emissions to a level equal to or less than petroleum refining.

Carbon Capture, Utilization and Storage

The carbon capture, utilization and storage (CCUS) technologies address climate change and are the exclusive focus of CCPI Round 3, FutureGen 2.0, and large-scale ICCS projects. In April 2007, the United States Supreme Court ruled that the EPA had the authority to regulate CO_2 and other greenhouse gases under the existing Clean Air Act. In December 2010, the EPA entered into a settlement agreement to issue rules that will address greenhouse gas emissions from fossil fuel-fired power plants. The rules would establish new source performance standards (NSPS) for new and modified electric generating units and emission guidelines for existing units.

CCUS technologies include:

Post-Combustion Capture. Technologies that remove CO_2 from flue gas generally utilize some form of solvent scrubbing that includes solvent regeneration and reuse. Typically, flue gas passes through an alkaline solvent and becomes bound to the solvent. The CO_2-laden solvent flows from the absorber vessel to a separation unit (stripper). The rich solution is heated to reverse the absorption process, releasing a concentrated CO_2 stream that can then be compressed for pipeline transport. The solvent is circulated back to the absorber for reuse.

Pre-Combustion Capture. Pre-combustion capture is mainly applicable to IGCC or other gasifier applications and refers to removal of the CO_2 from the synthesis gas (syngas) prior to its

combustion or conversion to other chemicals or products. Gasifiers are used 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 cause chemical reactions, producing syngas—primarily hydrogen and carbon monoxide. The syngas is passed through one or more water-gas shift reactors to convert the carbon monoxide and steam to CO_2 and hydrogen. The CO_2 can be readily captured from the syngas prior to the combustion of hydrogen in a turbine for electricity generation. 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 byproduct.

Oxy-Combustion. The oxy-combustion technology uses nearly pure oxygen instead of air for combustion to produce a flue gas that is primarily CO_2. Since nitrogen composes approximately 75 percent of air, the volume of flue gas generated using oxy-combustion is only a quarter of that generated using air. This increases the concentration of the contaminants in the flue gas, reduces the mass flow for heat transfer, and can significantly increases the flame temperature. To address these issues, a portion of the flue gas is recycled to approximate traditional air-fired conditions and the recycle gas can be treated to reduce corrosive constituents reentering the boiler. The constituents in the flue gas exiting the boiler can be controlled with traditional systems.

Chemical Looping. Chemical looping is a relatively new, indirect combustion process that converts fuel to energy producing a concentrated stream of CO_2 ready for sequestration, no NO_x emissions, and no costs or energy penalties for gas separation. Chemical looping typically employs a dual fluidized bed system where a solid oxygen carrier is employed as a bed material providing the oxygen for combustion in the fuel reactor. The oxygen carrier is reduced by the fuel that is converted to mainly CO_2 and H_2O. After condensing the water vapor, a stream of almost pure CO_2 is obtained. The reduced carrier is then transferred to the second bed (air reactor) and re-oxidized before being reintroduced back to the fuel reactor completing the loop. While chemical looping offers great potential as a cost-competitive sequestration technology, additional research and development is needed before large-scale demonstrations are pursued.

While not representing a unique type of CCUS technology, CCUS applications in industrial settings are presented in a separate category under the Carbon Capture, Utilization and Storage market area. CCUS technologies represented under industrial applications include projects demonstrating: capturing by-product CO_2 from ethanol production; vacuum swing adsorption (VSA) applied to hydrogen production; and the Rectisol® process applied at a methanol-producing gasification plant.

Project Fact Sheets

An index to project fact sheets by market sector is provided in Exhibit 3-1. An index by program (CCPI, FutureGen 2.0, and ICCS) is provided in Exhibit 3-2. Within these categories, projects are listed alphabetically by project name. Exhibit 3-3 is a map showing the location of the projects. Exhibit 3-4 presents the project schedules by market sector.

General project information is provided in sidebars and headers surrounding the more detailed project information in each fact sheet. On the first page above each schematic, specific technical thrusts within the four market sectors are indicated by a filled-in box (appears as a black box). At the top of the second page of each fact sheet, the project duration and period of operation are indicated in months. The project duration is the time from project award to the operation completed date. The schedule is shown based on the functional phases of the project. The phases are represented in a non-overlapping manner above a time line that encompasses the full duration of the project. The month and year are provided for the beginning and ending date of each phase. A status arrow indicates the progress to date.

Most 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 denoted by a shaded area. For projects that have successfully completed the operation phase, the term *Demonstration Operations Complete* is shown directly below the project title. Projects that have been discontinued are also noted as such below the project title.

Other Information Sources

Other sources of information complement this document, allowing interested parties to follow programs and projects as they unfold. The home page of the DOE Office of Fossil Energy Web site is at *http://www.fossil.energy.gov*. The National Energy Technology Laboratory (NETL) implements the clean coal technology programs, and provides another source of program and project information at *http://www.netl.doe.gov*, including a comprehensive repository for the latest published information known as the *CCT Compendium* at *http://www.netl.doe.gov/technologies/coalpower/cctc/index.html*. The latest versions of the individual project fact sheets can be viewed by following the appropriate program link from the web address above, selecting a particular project, and clicking on the "Project Brief" link.

The *Fossil Energy Today* online newsletter offers readers a quarterly look at clean coal technologies, related issues, and upcoming events. Current and past editions of the newsletter can be found at *http://www.fe.doe.gov/news/energytoday.html*.

As projects unfold, NETL publishes *Topical Report* documents at critical junctures, highlighting particular technological advantages, project plans, and expected outcomes. Upon project completion, *Project Performance Summary* documents are published, providing synopses of the projects and highlighting operational, environmental, and economic performance. NETL also publishes a DOE assessment of each completed project.

Exhibit 3-1

Project Fact Sheets by Market Sector

Project	Program	Participant	Status	Page
Emissions Control				
Mercury Specie and Multi-Pollutant Control	CCPI-2	NeuCo, Inc.	Completed	3-10
TOXECON Retrofit for Mercury and Multi-Pollutant Control on Three 90-MW Coal-Fired Boilers	CCPI-1	Wisconsin Electric Power Company	Completed	3-14
Advanced Power Systems				
Mesaba Energy Project – Unit 1	CCPI-2	MEP-I LLC	Design	3-20
Clean Coal Fuels				
Increasing Power Plant Efficiency – Lignite Fuel Enhancement	CCPI-1	Great River Energy	Completed	3-24
Carbon Capture, Utilization and Storage				
Post-Combustion Capture				
Mountaineer Commercial Scale Carbon Capture and Storage Project	CCPI-3	American Electric Power Service Corporation	Discontinued	3-30
W.A. Parish Post-Combustion CO_2 Capture and Sequestration	CCPI-3	NRG Energy, Inc.	Design	3-32
Pre-Combustion Capture				
Demonstration of a Coal-Based Transport Gasifier	CCPI-2	Southern Company Services, Inc.	Construction	3-34
Commercial Demonstration of Advanced IGCC with Full Carbon Capture	CCPI-3	Hydrogen Energy California, LLC	Design	3-36
Texas Clean Energy Project	CCPI-3	Summit Texas Clean Energy LLC	Design	3-38
Oxy-Combustion				
Oxy-Combustion Large Scale Test	FutureGen 2.0	Ameren Energy Resources Company	Definition	3-40
Pipeline and Regional CO_2 Storage Reservoir Project	FutureGen 2.0	FutureGen Alliance	Definition	3-42
Industrial Applications				
CO_2 Capture from Biofuels Production and Sequestration into the Mt. Simon Sandstone	ICCS	Archer Daniels Midland Company	Construction	3-44
Demonstration of CO_2 Capture and Sequestration of Steam Methane Reforming Process Gas Used for Large-Scale Hydrogen Production	ICCS	Air Products and Chemicals, Inc.	Construction	3-46
Lake Charles CCS Project	ICCS	Leucadia Energy, LLC	Design	3-48

Exhibit 3-2
Project Fact Sheets by Program

Project	Participant	Status	Page
CCPI-1			
Increasing Power Plant Efficiency – Lignite Fuel Enhancement	Great River Energy	Completed	3-24
TOXECON Retrofit for Mercury and Multi-Pollutant Control on Three 90-MW Coal-Fired Boilers	Wisconsin Electric Power Company	Completed	3-14
CCPI-2			
Demonstration of a Coal-Based Transport Gasifier	Southern Company Services, Inc.	Construction	3-34
Mercury Specie and Multi-Pollutant Control	NeuCo, Inc.	Completed	3-10
Mesaba Energy Project – Unit 1	MEP-I LLC	Design	3-20
CCPI-3			
Commercial Demonstration of Advanced IGCC with Full Carbon Capture	Hydrogen Energy California, LLC	Design	3-26
Mountaineer Commercial Scale Carbon Capture and Storage Project	American Electric Power Service Corporation	Discontinued	3-30
Texas Clean Energy Project	Summit Texas Clean Energy LLC	Design	3-38
W.A. Parish Post-Combustion CO_2 Capture and Sequestration	NRG Energy, Inc.	Design	3-32
FutureGen 2.0			
Oxy-Combustion Large Scale Test	Ameren Energy Resources Company	Definition	3-40
Pipeline and Regional CO_2 Storage Reservoir Project	FutureGen Alliance	Definition	3-42
ICCS			
CO_2 Capture from Biofuels Production and Sequestration into the Mt. Simon Sandstone	Archer Daniels Midland Company	Construction	3-44
Demonstration of CO_2 Capture and Sequestration of Steam Methane Reforming Process Gas Used for Large-Scale Hydrogen Production	Air Products and Chemicals, Inc.	Construction	3-46
Lake Charles CCS Project	Leucadia Energy, LLC	Design	3-48

Exhibit 3-3
Geographic Locations of Projects

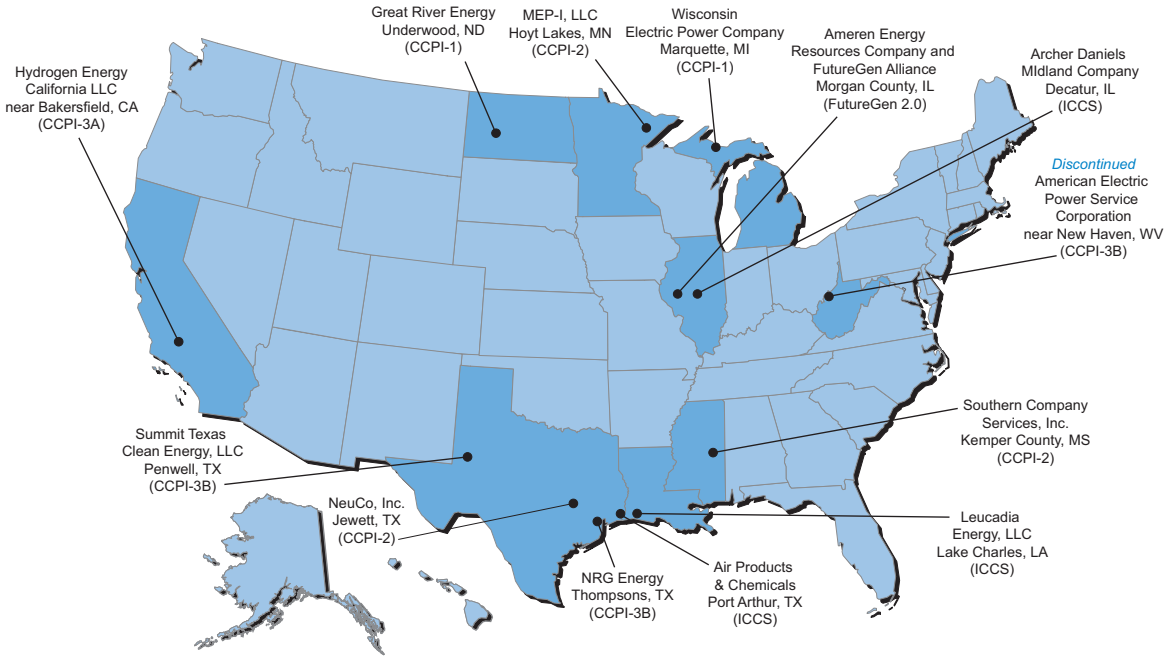
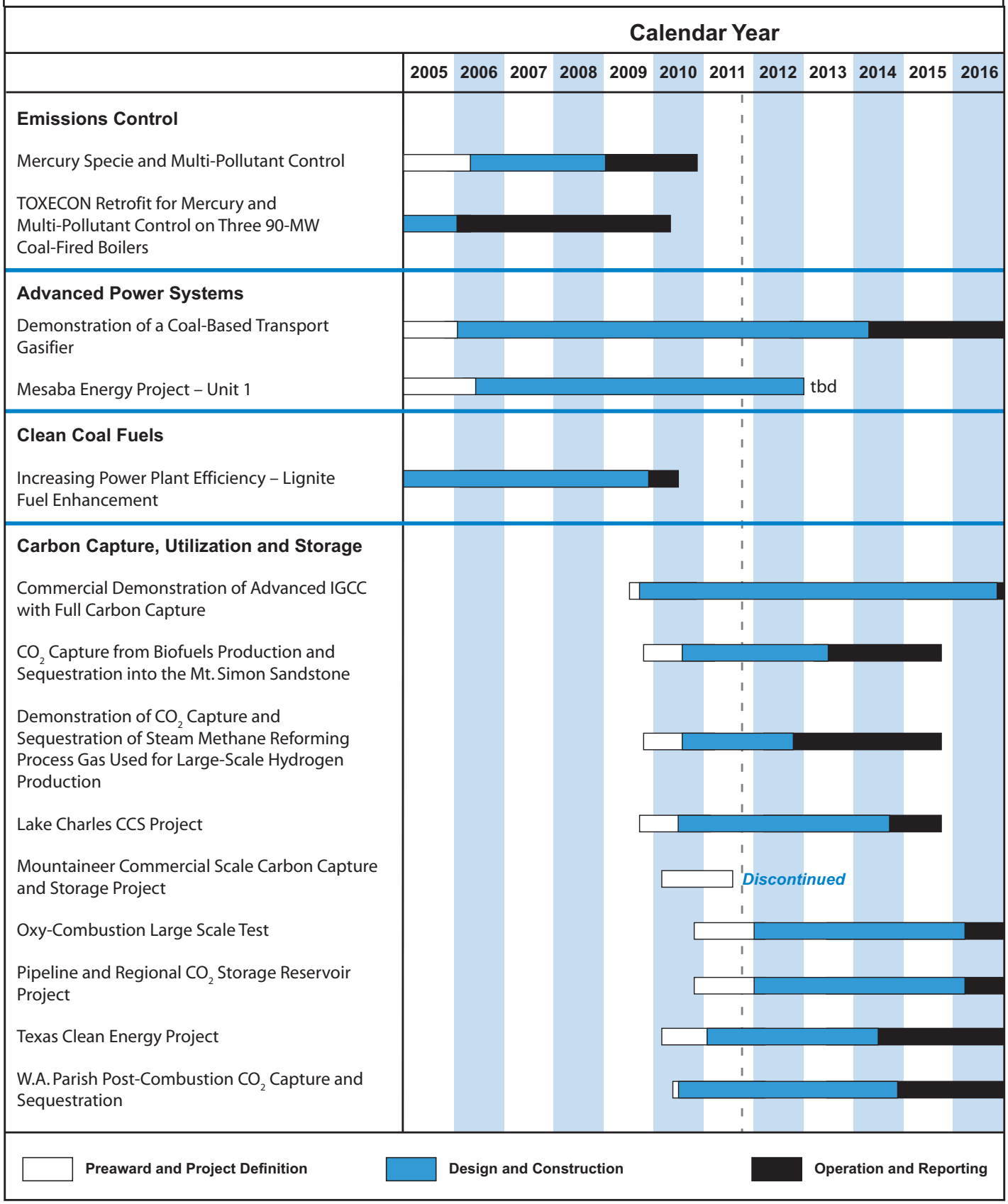


Exhibit 3-4
Project Schedules by Market Sector



Emissions Controls

Mercury Specie and Multi-Pollutant Control

Demonstration Operations Complete

CCPI-2

Emissions Control

Mercury	■	NO_x	■
SO_2	■	$PM_{2.5}$	□

Participant
NeuCo, Inc. (acquired original participant, Pegasus Technologies)

Additional Team Members
NRG Texas, LLC—collaborator and host

Location
Jewett, Limestone County, TX (NRG Limestone Plant)

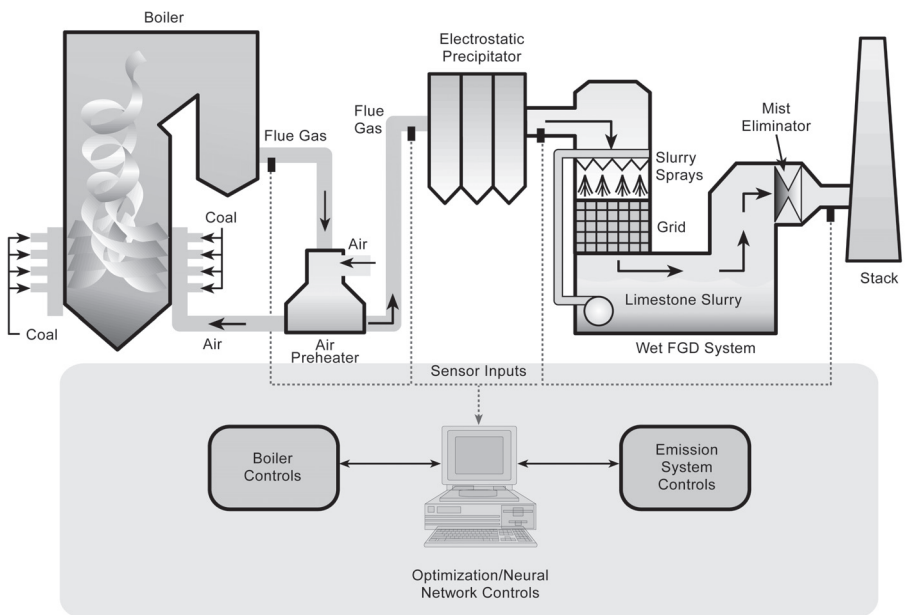
Technology
Advanced sensors and neural network-based optimization and control system for enhanced mercury and multi-pollutant control

Project Capacity/Production
890 MW (gross); 14,500 tons of coal/day input

Coal
Texas lignite and Powder River Basin (PRB) subbituminous

Project Funding

Total	$15,560,811	100%
DOE	6,079,479	39
Participant	9,481,332	61



Objectives

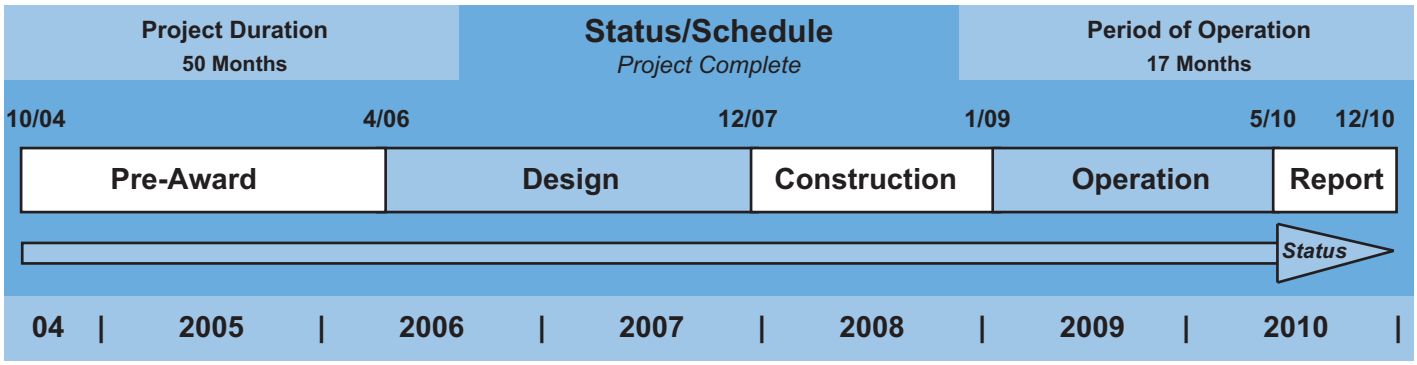
To demonstrate that state-of-the-art sensors and neural network-based optimization and controls can measure mercury species (elemental and oxidized mercury); control mercury emissions with existing flue gas desulfurization (FGD) and electrostatic precipitator (ESP) systems; and reduce pollutant emissions in general without major capital expenditure.

Technology/Project Description

The project demonstrated non-intrusive, advanced sensors and neural network-based optimization and control technologies for enhanced mercury and multi-pollutant control on an 890-MW tangentially fired boiler at the NRG Limestone Plant in Jewett, Texas. The plant is equipped with both a cold-side ESP rated at 99.8 percent particulate removal efficiency, and a wet limestone FGD system rated at 90–95 percent sulfur dioxide (SO_2) removal efficiency. The wet FGD system is capable of high mercury capture efficiency if the mercury is in an oxidized state rather than elemental state. The plant burns a blend of Texas lignite and PRB subbituminous coal, which are known to emit relatively high levels of elemental mercury under routine combustion conditions. NeuCo applied sensors to evaluate the mercury species at key locations, developed optimization software that sought the best plant conditions to promote mercury oxidation and minimize emissions in general, and used neural networks to effect the optimization conditions.

Benefits

The technology affords plant operators the means to: assess how plant operating parameters affect mercury species determination; translate the data into plant-wide optimization software that provides the lowest possible pollutant emissions; and effect optimization through neural networks. The technology allows operators to maximize emissions control with existing pollutant control systems. This capability maximizes emission reduction with minimal capital expenditure. The



technology has broad application to the existing fleet of coal-fired boilers and minimal impacts on the quality of salable by-products.

Status/Accomplishments

The Categorical Exclusion (CX) for the project was signed in March 2005. The cooperative agreement was signed in April 2006.

The project was conducted in three phases: installation of advanced sensors; installation and integration of optimizers; and validation and demonstration of all control systems and software. The first phase consisted of installing advanced sensors, designing the optimization application, and establishing the plant's baseline operating metrics. The second phase began in December 2007 and consisted of configuring the optimizers for maximum emissions removal, increasing unit performance, and development of a virtual on-line mercury analyzer. Optimizers were installed for combustion, sootblowing, unit performance, and equipment reliability. New optimizers were developed for the fuel, FGD, and ESP systems. The various products were operated in closed-loop with a focus on mercury and multi-pollutant performance. The third phase began in January 2009 and continued to operate the optimizers in an on-line mode with a focus on product tuning and interactions.

Results Summary

The project involved the application of a suite of advanced instrumentation and integrated optimization systems to improve unit operations across a variety of performance objectives, including mercury removal. Specifically, the Mercury Specie Control System was comprised of a boiler optimization system, in-furnace laser sensors that provided real-time information indicating species compositions and temperatures directly within the combustion zone, and continuous emission monitors (CEMS) at key post-combustion locations.

The boiler optimization system used neural networks, model predictive control, and other technologies to extract knowledge about the combustion process and determine the optimal balance of fuel and air mixing in the furnace. The system was used to adjust dampers, burner tilts, pulverizer settings, over-fire air and other controllable parameters to their optimal levels for a given set of conditions, objectives and constraints.

The boiler optimization model intended to utilize in-furnace mercury data; however, the laser sensors were subject to intermittent signal problems due to high ash content and slagging issues. Several sensor upgrades were made by the vendor to address these issues; however, a series of network technology issues prevented integration of the new, more consistent data into the real-time optimization during the demonstration period. While the improved sensors were not able to play a strong role in the boiler optimization or analysis for this project, their

The project demonstrated a new multivariable process controller utilizing direct search optimization designed to facilitate test efficiency through direct learning combined with statistical tools.

Over thirty manipulated variables were used to optimize NO_x while the neural network was monitoring and learning the effects of these variables on mercury.

The final phase of the project began in January 2009 and involved an operational demonstration of plant-wide optimization.

Contacts

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expectation of future utility is very high and their value has been demonstrated at other sites.

Additional difficulties were encountered with the post-combustion mercury CEMS. The Mercury CEMS were installed at the ESP inlet, FGD inlet, and FGD outlet and proved to be challenging to maintain. The instruments used were not sufficiently hardened for the harsh conditions and frequent repairs were required to obtain reliable data. Despite good faith efforts on the part of the vendor, the amount of mercury data taken from around the ESP and FGD was smaller than expected. Furthermore, analysis showed that even when data was coming in it was not always of usable value, presenting inconsistent or infeasible results that could not be reconciled with other indications. Calibration drift and hardware failure were the most frequent culprits. Relatively late in the project and on the plant's initiative, an additional mercury monitor was added in the stack that ultimately provided the majority of useful data. Utilizing the data from the stack monitor, mercury was added as a direct optimization objective in the form of a "down" objective for the neural optimizer.

Mercury data collection using the stack-based CEMS was discontinued on December 31, 2009. The decision to stop was based largely on a change in the regulatory context for mercury emissions. It was also decided to decommission the other mercury CEMS instruments due to the high cost of maintenance.

Analysis of mercury removal across post-combustion equipment found that the total amount of mercury removed across the ESP is essentially zero (to within measurement error). However, significant mercury oxidation occurs across the ESP. The ratio of elemental mercury to total mercury decreased from 35 to 25 percent. It was also shown that the FGD removes most of the oxidized mercury; thus, oxidation of mercury across the ESP is important to the total mercury removal rate of the FGD. It was also shown that there is a slight increase in elemental mercury across the FGD (commonly referred to as re-emission). The results also support the importance of upstream changes to combustion on the total mercury reduction from the inlet of the ESP to stack, suggesting that primarily combustion processes can have a large effect on removal rates.

Despite the instrumentation issues and other challenges, the project delivered significant benefits for plant performance and reduced emissions. NO_x production was reduced by 16 percent while carbon monoxide (CO) was reduced by 24 percent. Losses efficiency showed an improvement of 0.5 percent with a heat rate improvement of between 0.52 and 1.2 percent. Over the course of the project, the fuel blend was transitioned from a 70/30 lignite/PRB blend to a ratio closer to 50/50. This transition was significantly aided with the optimization systems through improved control over combustion and heat transfer processes. With respect to mercury emissions, total stack mercury emissions were reduced by 22 percent, primarily as a result of changes in the fuel blend with additional reductions attributable to optimization.

Project Summary

The project applied a suite of advanced instrumentation and integrated optimization systems at NRG's tangentially-fired Limestone Power Plant.

Of the systems evaluated, several were abandoned due to equipment difficulties or overriding operational priorities. These systems included: the Advanced ESP Optimization System, the Advanced FGD Optimization System, and a High Fidelity Control Room Simulator.

The Advanced ESP Optimization System was abandoned following equipment and vendor support issues with the carbon-in-ash (CIA) virtual online analyzer, identification that negligible mercury was removed in the ESP, and determination that the ESP already had an adequate power optimization system to control opacity from the stack. The value of developing an Advanced FGD Optimization System was undermined by the low cost of SO_2 credits and the operator's priority to minimize costs by reducing FGD operation. The Control Room Simulator was abandoned after it was determined that there was limited value from the simulated setting that enhanced the operators' understanding of how the optimizers functioned.

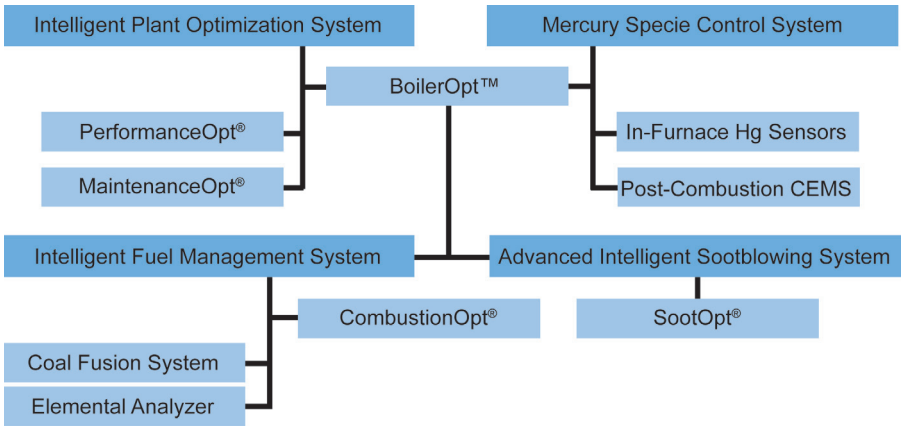
The deployed systems included fuel management, mercury specie control, soot blowing, and plant optimization. The components and interactions of the various systems are shown in Exhibit 3-5.

The Intelligent Fuel Management System was composed of the Combustion Optimization System (Combustion-Opt®), Ready Engineering's Coal Fusion System, and Sabia's elemental analyzer. The Coal Fusion System controls the coal transport hardware that blends lignite coal with PRB coal. Changes to the blend impact the amount of Hg and NO_x in the flue gas due to the inherent characteristics of the two coal types. The coal analyzer required routine calibration and was used to determine and adjust the Btu content of the blend allowing operator to adjust the blend to account for variations in coal quality.

The Mercury Specie Control System included the boiler area optimization

Exhibit 3-5

Overview of Advanced Instrumentation and Integrated Optimization Systems



system (BoilerOpt™), in-furnace laser sensors that provided real-time information indicating species compositions and temperatures directly within the combustion zone, and CEMS at the ESP inlets, an FGD inlet and outlet, and the stack.

The Advanced Intelligent Soot Blowing (ISB) System was composed of the SootOpt® intelligent soot blowing software. This module was previously demonstrated; however, certain advances were made. SootOpt® models the effect of soot blowing activity on heat transfer throughout the furnace and backpass and dynamically determines the optimal boiler cleaning actions to improve availability, heat rate and emissions performance.

The Intelligent Plant Optimization system ensures that all of the other optimization systems are working together effectively and consists of BoilerOpt™, which ties together the optimization of the combustion and heat transfer processes, as well as PerformanceOpt® and MaintenanceOpt®, which measure unit performance and provide early detection of operating and equipment problems. Specifically, BoilerOpt™ consists of the integration of the combustion and soot blowing optimization systems (CombustionOpt® and SootOpt®). PerformanceOpt® is a real-time proactive performance management system. It continuously monitors thermal performance, alerts users to unit efficiency and capacity degradation and provides the contextual data to efficiently diagnose unit-wide performance issues. MaintenanceOpt® employs adaptive neural network models that monitor plant data in real-time, constantly searching for anomalies that point to equipment health problems.

The project encountered a number of challenges including:

- Maintenance of consistent mercury level readings from the mercury CEMS;
- Changing regulatory and market conditions resulting in varying operator priorities;
- Installation and maintenance of wide array of instrumentation from multiple vendors;
- Remote management of network systems and evolving security requirements; and
- Achieving high rates of optimization technology utilization.

Despite these challenges, the project delivered significant benefits on plant performance. Some of the key findings included:

- With reliable mercury CEMS, the use of inductive methods can most likely support mercury optimization product development;
- Significant benefits are provided by an integrated platform upon which to bring the wide variety of data management and analytics approaches including advanced optimization technology;
- Advanced instrumentation must be reliable, robust and cost effective to have significant utility in a real production setting; and
- Regulation and market uncertainty are major obstacles to progress in developing the benefits of optimization opportunities.

While mercury emissions were not regulated during the project demonstration period, future regulations are expected and the most likely instrumentation scenario is one where stack-based mercury CEMS will be used to report against those regulations. The project analysis suggests that this kind of instrumentation supports some opportunity for reducing mercury emissions through the optimization of standard upstream processes, similar to NO_x, CO and opacity. It is likely that optimization can play a role in helping to achieve the fastest possible path to effective utilization of those systems, while minimizing other impacts.

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

CCPI-1

Emissions Control

Mercury	■	NO_x	■
SO_2	■	$PM_{2.5}$	■

Demonstration Operations Complete

Participant
Wisconsin Electric Power Company (We Energies)

Additional Team Members
ADA-ES—management support/ design input

Cummins & Barnard—A/E services/ construction management

Wheelabrator Air Pollution Control, Inc.—baghouse design and installation

Electric Power Research Institute (EPRI)—technology supplier

Location
Marquette, Marquette County, MI (Wisconsin Electric's Presque Isle Power Plant Units 7, 8, and 9)

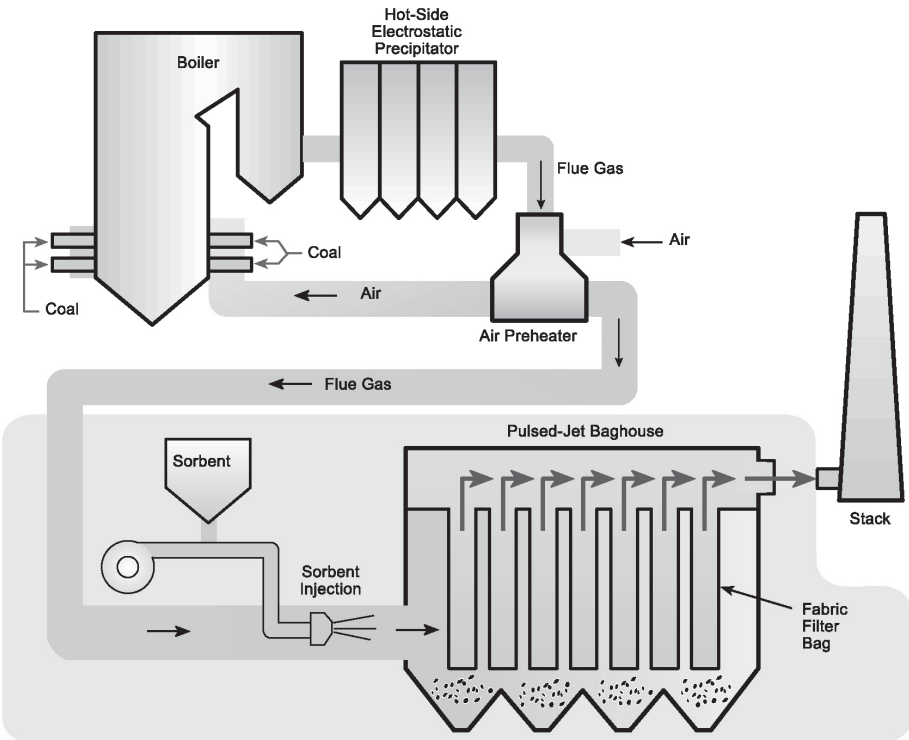
Technology
TOXECON™ sorbent injection process

Capacity
270 MW

Coal
Powder River Basin subbituminous

Project Funding

Total	$52,978,115	100%
DOE	24,859,578	47
Participant	28,118,537	53

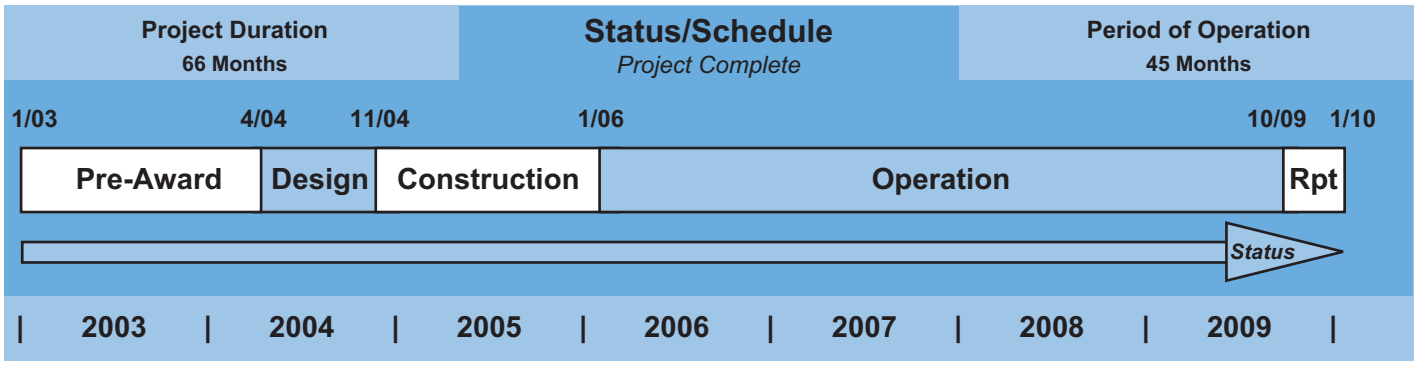


Objectives

To demonstrate the performance of the TOXECON™ technology to obtain 90 percent removal of mercury through injection of powdered activated carbon (PAC) downstream of an existing hot-side electrostatic precipitator (HESP) that is then captured in a new baghouse. To evaluate trona injection (a naturally occurring sodium bicarbonate mineral) to reduce nitrogen oxides (NO_x) an additional 30 percent and sulfur dioxide (SO_2) emissions an additional 70 percent in the new baghouse. Additional objectives included: reduced particulate matter (PM) emissions, recovery of mercury from the spent sorbent, and demonstration of a reliable mercury continuous emission monitoring system (CEMS).

Technology/Project Description

The TOXECON™ process, developed and patented by EPRI, injects PAC and sodium-based sorbents into a pulsed-jet baghouse installed down-stream of the plant's primary PM control device. The existing PM collectors at the project site were HESPs that removed the bulk of the PM. The TOXECON™ equipment was located downstream of the air preheater to operate at relatively cool temperatures conducive to mercury and other pollutant absorption. Injected into the ductwork upstream of the baghouse, the sorbents mixed with and absorbed pollutants in the flue gas. Continuing in-flight pollutant absorption was significantly enhanced by fixed-bed absorption as pollutants passed through a sorbent filter cake that formed on the fabric filter bags in the baghouse. The captured sorbent was processed to recover up to 90 percent of the mercury. The fly ash collected in the HESPs continued to be marketable and two methods for using the high-carbon flyash from the TOXECON™ baghouse in structural concrete were developed and tested.



Benefits

The TOXECON™ process achieves high mercury capture efficiency, reduces overall PM emissions, and retains the sales value of fly ash collected in the primary PM collection device. Installed downstream of an existing PM collector, the process only has to be applied to the small portion of remaining fly ash and can be used for additional SO_2 and NO_x control. The process offers a significant benefit for western subbituminous coals as mercury in flue gas exists primarily in the elemental vapor form and will pass through most types of other air pollution control devices. For units equipped with a HESP, TOXECON™ appears to be the prime control option when high levels of control are required. The process can also be applied to power plants that are equipped with cold-side electrostatic precipitators.

Status/Accomplishments

The TOXECON™ retrofit project demonstrated long-term reliability by continuously operating the powdered activated carbon (PAC) injection system over a 44-month test period, achieving greater than 90 percent mercury removal on average. During a two-week test using a sodium-based sorbent (hydrated sodium bicarbonate carbonate), SO_2 emissions were reduced by 70 percent, although no coincident removal of NO_x was achieved. The baghouse also provided enhanced particulate control, particularly during startup of the boilers. Mercury CEMs were developed and tested in collaboration with Thermo Fisher Scientific, resulting in a reliable CEM that could be used in the power plant environment and that could measure mercury concentrations as low as 0.1 µg/m3. Sorbents were injected downstream of the primary particulate collection device, allowing for continued sale and beneficial use of captured fly ash. Two methods for recovering mercury using thermal desorption on the TOXECON™ PAC/ash mixture were successfully demonstrated and two methods for using the TOXECON™ PAC/ash mixture in structural concrete also were successfully developed and tested.

The project demonstrated a significant reduction in mercury and particulate emissions and established design criteria for the retrofit control technology. Cost improvements resulted in a levelized cost for 90 percent mercury removal calculated at $77,031 per pound of mercury removed with a capital cost of $63,189 per pound of mercury removed. Mercury removal at the Presque Isle Power Plant averages approximately 97 pounds per year.

NEPA was satisfied with a Finding of No Significant Impact (FONSI) in September 2003.

The Superior Watershed Partnership in Marquette, Michigan presented its 2006 Corporate Conservation Award to We Energies in recognition of the project's significant mercury reduction accomplishments.

Ash from the TOXECON™ process was evaluated for use in conductive concrete applications.

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Results Summary

We Energies and the project team designed, installed, evaluated, and operated an integrated emissions control system for mercury and particulate matter that treated the flue gases of three 90 MW subbituminous coal-fired units. The project was the first commercial full-scale TOXECON™ demonstration using activated carbon injection (ACI) for mercury removal. The project was selected in 2003 and awarded in April 2004. Construction was initiated in November 2004 and activated carbon injection began in late January 2006.

The TOXECON™ system was integrated through modification of the flue gas ductwork from each of the three units into a single duct that leads to the new baghouse. A single duct exits the baghouse and is then split into three individual ducts, each with a new booster fan. The ducts exiting the booster fans are then recombined into a single duct back to the existing stack, where the combined duct is again separated into three branches that supply the three existing individual unit stack flues. The TOXECON™ system also includes the PAC storage silo and injection system, and a new ash storage silo and ash unloading system for the PAC/ash collected in the baghouse.

In addition to the baghouse and PAC injection equipment, the project addressed balance-of-plant design considerations. These included booster fans, compressed air system, ash handling system, ductwork, electrical, and instrumentation and controls. The project also sought to develop and demonstrate an advancing a monitoring system that would reliably measure mercury in flue gas from coal-fired power plants. Design considerations also included reporting and monitoring needs pertaining to mercury.

The specific project objectives were to demonstrate the operation of the TOXECON™ multipollutant control system and achieve the following:

- Ninety percent mercury removal from flue gas through ACI: This objective was met during 30 of the 34 months of long-term testing. One of the months that did not meet the criteria was due to alternative PAC testing, which bypassed the main PAC injection equipment. The other three months did not meet the criteria due to operational issues with the outlet CEM.
- Evaluation of the potential for 70 percent SO_2 control and trim control of NO_x from flue gas through sodium-based or other novel sorbent injection: 1) The goal of 70 percent SO_2 removal was achieved during short-term tests when injecting trona (trisodium hydrogendicarbonate dihydrate) at an average normalized stoichiometric ratio (NSR) of 1.02. The highest removal was 74.1 percent with PAC injection at 3.8 lb/MMacf. 2) There was very little reduction in NO_x during the test period. In addition, the effect of a side reaction, where NO is oxidized to produce NO_2, was observed on one test day when PAC injection was turned off. This indicates that there was some conversion of NO to NO_2. The NO_2 level from the conversion was high enough to be visible and cause an increase in opacity of almost 3 percent. On days with simultaneous injection of PAC and sodium sorbents, the opacity increased by a maximum of 0.75 percent with no visible plume. 3) Injection of trona for SO_2 control resulted in a decrease in mercury removal using activated carbon. This effect was seen whenever trona was injected. When trona injection was discontinued, mercury removal slowly recovered over a ten-hour period to the pre-test level of >90 percent. On the last two days of testing, PAC injection was increased to attempt to regain the >90 percent removal rate. Test conditions and schedule did not allow sufficient time to achieve this target rate while injecting trona. An estimate of the required PAC is three times the pre-trona test rate.
- Reduced PM emission through collection by the TOXECON™ baghouse: The main long-term co-benefit of the TOXECON™ process was the reduction in PM emissions. With full-load conditions and all three units directed to the baghouse, the inlet particulate flow was 117 lb/hr and outlet flow was 17 lb/hr, which was an 85 percent reduction. The inlet PM consisted of small ash particles that exited the main hot-side ESPs.
- Recovery of 90 percent of the mercury captured in the sorbent: Two thermal desorption methods were successful in removing mercury from the TOXECON™ PAC/ash material. 1) The first method utilized the "air slide" technology patented by We Energies and licensed by United E & E. Sorbent and/or fly ash with affixed mercury compounds is exposed to heated flowing air until the sorbent reaches a temperature of at least 700 °F (372 °C). 2) The second technology used microwave energy to selectively heat the PAC particles, thereby saving on energy costs. 3) In addition, ADA-ES developed a new approach to using PAC-containing ash for structural concrete. This method utilized the combination of a specific batch design developed by ADA-ES with a foam-based air entraining agent (AEA) developed by Miracon™ Technologies, Inc.

and modified specifically for this application. This combined technology was tested on concrete mixtures with ash containing <1 percent to as much as 30 percent loss of ignition (LOI) from PAC. A successful field demonstration using 30 percent LOI ash to make a large concrete pad at the Presque Isle plant was completed in June 2009. Leaching tests on concrete samples showed a reduction in leached mercury and chromium from the high-PAC samples, although all samples were well below the EPA Toxicity Characteristic Leaching Procedure (TCLP) reporting criteria. All samples showed that only a very small amount of bromide was leachable.

- Utilization of fly ash collected in the existing ESP: Throughout the project, the ash from the existing ESPs was not affected by the TOXECON™ process, resulting in 100 percent beneficial utilization.
- Demonstration of a reliable, accurate mercury CEM suitable for use in the power plant environment: At the beginning of the project, several mercury analyzers were commercially available for ambient and laboratory mercury measurements but they were not designed to operate in a power plant environment in an automated fashion to produce reliable and accurate data continuously over long periods. In December 2005, two newly developed commercial Thermo Mercury Freedom™ CEMs were installed at the inlet and outlet of the baghouse. These systems were monitored remotely and provided mercury removal data for the demonstration project.
- Successful system integration and optimization of TOXECON™ operation for mercury and multi-pollutant control: The TOXECON™ baghouse and associated equipment was successfully integrated into plant operations. The equipment and operation of the system were upgraded and optimized during the project.

In addition to successfully meeting objectives, the project addressed several other issues. Early in the testing phase, hopper fires occurred due to auto-ignition of the PAC/ash mixture. Extensive laboratory testing to understand the mechanism and operational changes at the plant resulted in several recommendations for helping minimize the risk of overheating high carbon ash in hoppers. The development of operational guidelines has proven useful to other utilities using the TOXECON™ configuration. Optimization testing also provided important data on reducing sorbent costs and maximizing the life of the bags in the baghouse.

Additionally, the project was able to reduce the rate of carbon injection needed for achieving an average 90 percent mercury removal rate. Numerous test runs pointed out the importance of various factors that impacted mercury removal efficiency, including the temperature of the flue gas, the amount of time PAC remained on the bags, the amount of PAC on the bags, and the amount of carbon in the fly ash. The observations led to a revised control scheme for cleaning the baghouse that reduced operating costs while not impacting emissions or maintenance costs.

Project Summary

The demonstration of the TOXECON™ process provided long-term operational experience directly applicable to power plants that burn western subbituminous coal. With its proven ability to reduce mercury emissions, the process offers a significant benefit to operators of subbituminous-fueled units in that mercury in flue gas produced by these units exists primarily in the elemental vapor form that is insoluble in water and, as such, will pass through most types of air pollution control devices. As a result of this project, the TOXECON™ process is in position to become a leading mercury control choice for western coals, especially for units that use a hot-side ESP.

The demonstration confirmed that TOXECON™ is a viable option for obtaining high, consistent mercury removal. The technology can be applied to either new plants or retrofit applications. Capital and installation costs for this project were relatively high. The cost of capital equipment and installation for the TOXECON™ and balance-of-plant systems was $34.6 million, including the engineering effort. The cost of the additions and modifications after construction was $413,500. This installation was a retrofit application that represents higher costs than would be required for a new plant application. However, new plant applications of the TOXECON™ technology are unlikely as hot-side ESP installations on units burning PRB coal are no longer being considered.

Advanced Power Systems

Mesaba Energy Project—Unit 1

CCPI-2

Advanced Power Systems

IGCC	■	CFB	□
Hybrid	□	Adv Comb	□

Participant
MEP-I LLC (Excelsior Energy, Inc.)

Additional Team Members
ConocoPhillips—gasification technology licensor

Fluor—feasibility engineering

Granherne—owner's engineer

SEH—environmental/site assessment

URS—environmental/site assessment

TBD—engineering, procurement, and construction (EPC)

Location
Taconite, Itasca County, MN

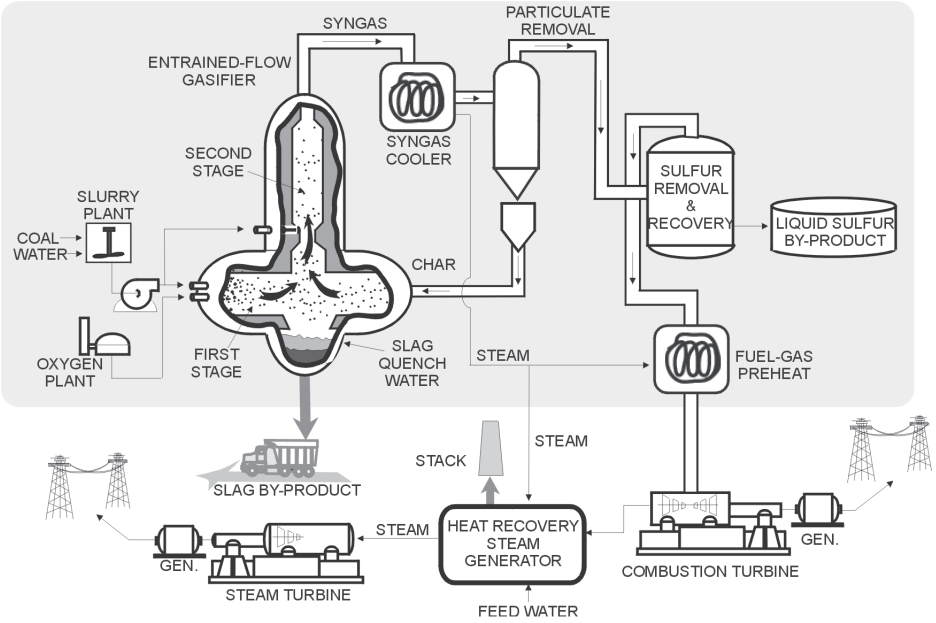
Technology
Advanced ConocoPhillips E-Gas™ technology applied in a multiple-train integrated gasification combined-cycle (IGCC)

Capacity
Up to 606 MWe (net); 4,731 tons of coal/day input

Coal
PRB subbituminous (preferred)
Illinois Basin #6 bituminous

Project Funding

Total	$2,155,680,783	100%
DOE	36,000,000	1.7
Participant	2,119,680,783	98.3



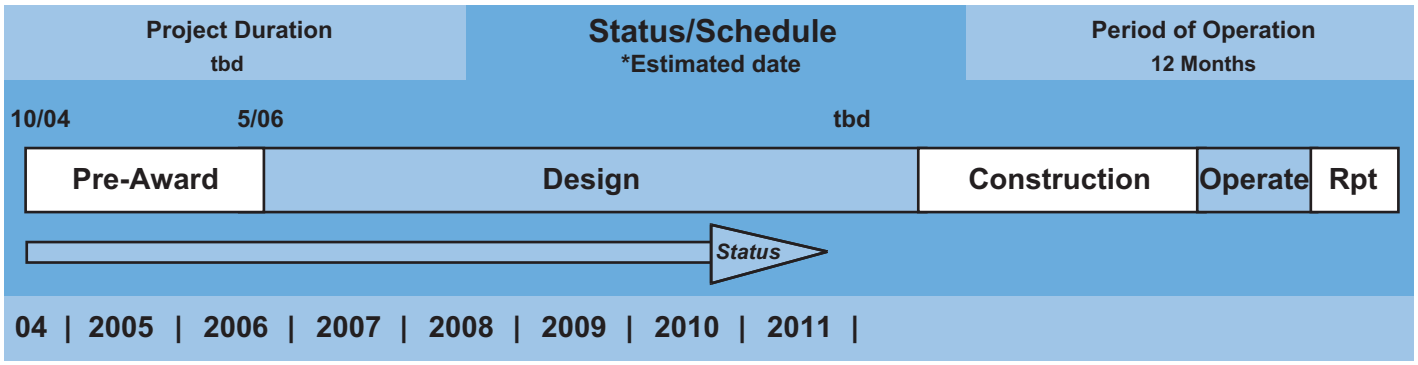
Objectives

To demonstrate the ConocoPhillips E-Gas™ technology at twice the generating capacity of the *Wabash River Coal Gasification Repowering Project* performed under the Clean Coal Technology Demonstration Program (CCTDP). To achieve a 90 percent or better operational availability from an advanced full-slurry quench (FSQ) multiple-train gasifier system with a first-of-a-kind (U.S.) integrated air separations unit. To demonstrate carbon dioxide (CO_2) emissions 15–20 percent lower than the 2006 average for U.S. coal-based power plants and emission levels for criteria pollutants and mercury equal to or below those of the lowest emission rates for utility-scale, coal-based generation.

Technology/Project Description

The project will demonstrate the next-generation ConocoPhillips E-Gas™ technology in up to a 606-MWe (net) IGCC application. The ConocoPhillips E-Gas™ gasifier features an oxygen-blown, continuous-slagging, two-stage entrained-flow process. Coal is slurried, combined with 95 percent pure oxygen from an air separation unit, and injected into a first stage gasifier, which operates at 2,600 °F and 535 pounds per square inch gage (psig) pressure. In the first stage, the coal slurry undergoes a partial oxidation reaction at temperatures high enough to bring the coal's ash above its melting point. The fluid ash falls through a tap hole at the bottom of the first stage into a water quench, forming an inert vitreous slag. The synthesis gas (syngas) formed in the first stage flows to a second stage where additional coal slurry is injected. The coal undergoes pyrolysis in an endothermic reaction with the hot gas, enhancing the syngas heating value and improving efficiency.

The syngas (with entrained particulate matter) exiting the gasifier system is cooled in the syngas cooler, converting a significant portion of the heat from the gasifier to high pressure steam for use in power generation. The syngas is then directed to the particulate matter removal system consisting of a hot gas cyclone followed by



a particulate matter filter. Sulfur (a marketable by-product) is removed through a carbonyl sulfide (COS) hydrolysis unit converting sulfur compounds to hydrogen sulfide (H_2S), which is then removed downstream in an acid gas removal (AGR) system. A trim sulfur removal system consisting of a zinc oxide bed followed by selective catalytic reduction (SCR) removes any residual sulfur. Fixed beds of activated carbon complete the syngas cleanup by removal of residual mercury. The heat recovery steam generator (HRSG) produces steam for power generation from the combustion turbine exhaust.

Benefits

ConocoPhillips E-Gas™ technology established its potential for providing clean energy at competitive costs in the successful demonstration under the CCTDP at the Wabash River Generating Station. The Mesaba project will incorporate cost and performance improvements from more than a decade of experience with the predecessor design, including: (1) gasifier scale-up; (2) increased system pressure; (3) increased slurry percentage to the second-stage gasifier; and (4) enhanced by-product and contaminant removal systems.

Status/Accomplishments

The notice of availability of the Final Environmental Impact Statement (EIS) was published in the Federal Register in November 2009. On March 4, 2010, the Minnesota Public Utilities Commission (MPUC) approved a Large Electric Power Generating Plant Site Permit and corresponding High Voltage Transmission Line Route and Pipeline Route Permits for the West Range site in Taconite, Minnesota.

Excelsior is currently in the process of updating pre-construction environmental permit applications for re-submission. The Section 404 (wetlands permit) application was submitted on March 31, 2011 and the Water Appropriations application was submitted on August 18, 2011.

Excelsior is exploring the potential for a statewide market for the power produced by the Mesaba Project.

The project will demonstrate the commercial viability of a large, multiple-gasifier system with CO_2 emissions 15 to 20 percent lower than the 2006 average for U.S. generation with similar feedstocks.

The ConocoPhillips E-Gas™ gasifier features an oxygen-blown, continuous-slagging, two-stage entrained-flow process that can produce a concentrated CO_2 stream that would be amenable to capture for geologic storage or beneficial reuse such as enhanced oil recovery.

Excelsior intends to adopt zero-liquid discharge and thereby eliminate any discharge to the environment of process water and cooling tower blow-down water from the proposed plant.

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Clean Coal Fuels

Increasing Power Plant Efficiency – Lignite Fuel Enhancement

CCPI-1

Clean Coal Fuels
Upgrading ■
Conversion □

Demonstration Operations Complete

Participant
Great River Energy (GRE)

Additional Team Members
Electric Power Research Institute—collaborator

Lehigh University—collaborator

Barr Engineering—lignite handling

Falkirk Mining Company—lignite coal supplier

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

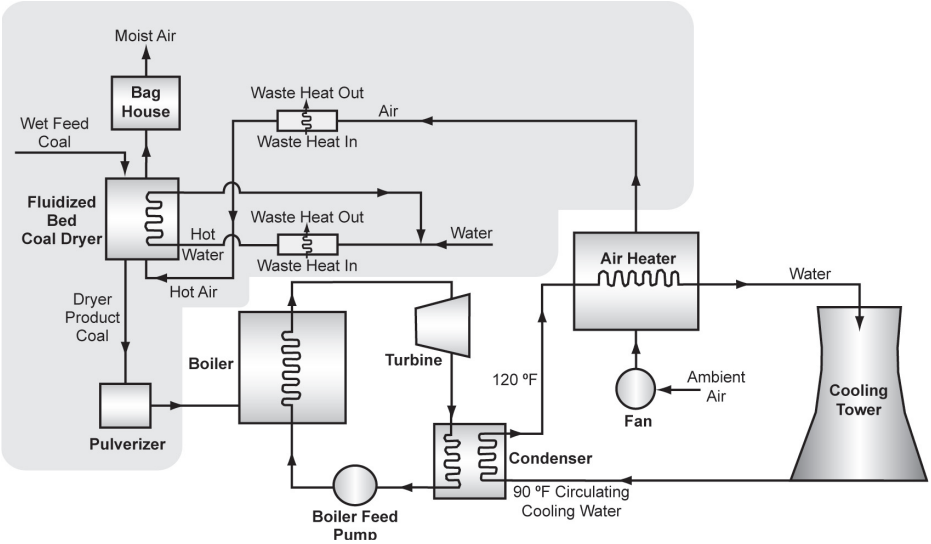
Technology
DryFining™ drier system for high-moisture coals

Project Capacity/Production
546 MW

Coal
Lignite

Project Funding

Total	$31,512,215	100%
DOE	13,518,737	43
Participant	17,993,478	57



Objectives

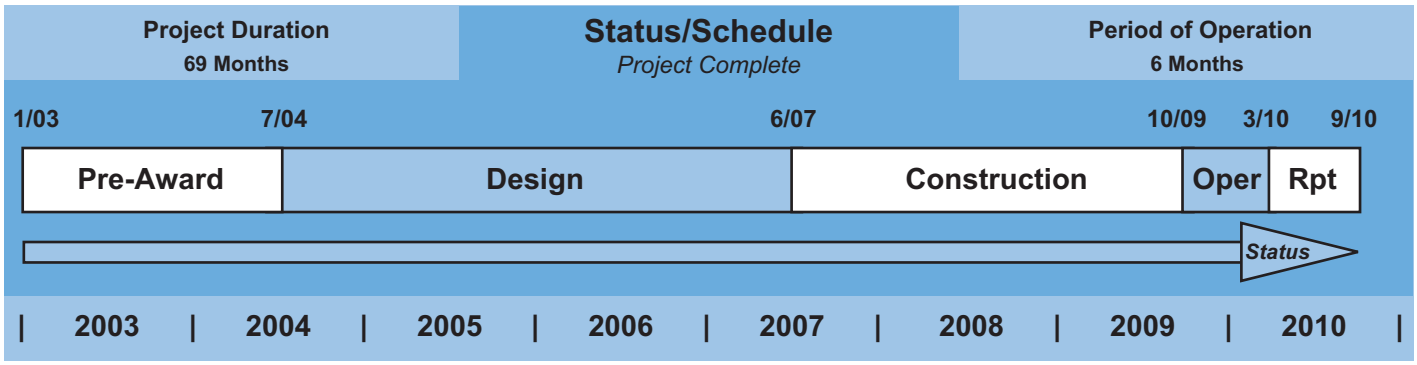
Demonstrate a 25 percent reduction in lignite moisture content (from about 40 to 30 percent moisture in this application) using plant waste heat to dry the coal. Assess benefits of plant operation on dried coal to quantify reduced emissions, higher efficiency, and improved plant operations.

Technology/Project Description

The project demonstrated GRE's fluidized-bed dryer technology (DryFining™) for low-rank coals at GRE's Coal Creek Station using North Dakota lignite that has approximately 40 percent moisture content. Initially, GRE constructed and operated a prototype dryer module capable of producing 75 tons/hr of dried coal for testing on one of the two 546-MW tangentially-fired boiler units in use at the station. Following validation of the prototype dryer, the project terms called for the installation of four commercial size dryers (135 tons/hr) to cover the full requirements of one of the two units at the station (Unit 2). However, because of the successful results of the prototype dryer, GRE management decided to install commercial dryers on both units at no additional expense to the project (only Unit 2 was part of the scope of the project). GRE installed a total of eight commercial size dryers to cover the full requirements of both units, including associated conveying systems and particulate control systems.

The DryFining™ technology employs a fluidized bed dryer with the bed volume divided into several compartments to segregate the heavier non-fluidizable material and to dry the coal to a desired outlet moisture level through a combination of heat from the fluidizing air and an in-bed heat exchanger. Coal fines from the fluidized bed are collected in a baghouse.

The DryFining™ system uses plant cooling water and flue gas (normally waste heat) as the primary heat sources for drying the lignite fuel. Water drawn from the cooling tower captures heat from the steam condenser in the boiler circuit, raising the temperature to about 120 °F. The heated water is routed to an air heater before returning to the plant cooling water circuit. Ambient air is heated in an air



heater to serve as the fluidizing media in the fluidized-bed dryer and to provide part of the heat for drying the coal. For the prototype dryer, a two-stage fluidized bed was used to enhance heat transfer. For the commercial design, dryers were constructed with three stages to facilitate density segregation of the coal feed and removal of the segregated material through multiple scrubbing boxes and air locks.

Benefits

The DryFining™ technology uses low-grade heat (that would otherwise not be put to beneficial use) to upgrade the low-rank coal feedstock to improve plant efficiency and performance. The high moisture content in low-rank coals significantly increases plant heat rates and reduces efficiency by requiring application of heat generated during combustion to vaporize large amounts of water in coal. This heat of vaporization represents a heat loss because it does not contribute to power generation. High moisture content coals also place an energy penalty on fans that move the vaporized water and the pulverizers that size the coal prior to combustion. The high moisture content can also contribute to the corrosion of ductwork. The DryFining™ upgrading process: improves plant economics; lowers plant heat loss; increases efficiency; and reduces plant emissions without the expense of additional control equipment. Any power plant utilizing high-moisture coals may benefit from the demonstration technology.

Results Summary

A single 75 tons/hr prototype dryer operated over a range of operating conditions from February 2006 to the summer of 2009. While in service, the dried coal from the prototype represented approximately 14 percent of the total coal flow rate supplied to the boiler. The measured changes in operating and performance parameters obtained from the blend of partially dried and wet coals fed to the full unit were extended to estimate the operation on a 100 percent dried coal feed.

Formal testing consisted of a series of consecutive, day-long performance tests with the prototype dryer in operation followed with it off (wet coal). Prototype performance was also monitored during regular dryer operation. Results indicated that applying the DryFining™ technology to 100 percent of the coal feed to the boiler unit would reduce the coal moisture 8.5 percentage points and the higher heating value (HHV) of the coal would increase by approximately 800 Btu/lb. The coal flow rate would be reduced by 14 percent and the flue gas flow rate would be reduced by nearly 4 percent. Performance of the prototype confirmed the capability of a large-scale dryer to reduce fuel moisture to the target level and that the density segregation effects observed during pilot testing translated to the prototype.

The project received the 2010 Coal-Fired Project of the Year award by the editors of *Power Engineering* magazine.

"*DryFining™ turned out to be the most economical solution for achieving long-term environmental compliance. Rather than increasing our O&M budget to achieve environmental improvements, we estimate more than $30 million per year in expense reductions in fuel, auxiliary power and consumables.*" John Weeda, Plant Manager at Coal Creek Station

By the conclusion of the demonstration project, GRE had signed 63 confidentiality agreements. These include parties in Canada, Australia, China, India, Indonesia, and Europe.

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In preparation of the installation of a full complement of commercial dryers, a series of tests were conducted in September 2009 to establish a baseline using non-dried coal. Following the commissioning of commercial dryers on both 546 MWe units in December 2009, four tests with a single commercial dryer were conducted in January 2010 to evaluate the functional performance of the commercial design. Coal throughput ranged from 132 to 134 tons/hr for the 135 tons/hr design rating. As expected, total moisture decreased as heat input to the dryer was increased. At 85 percent heat input to the dryer, the moisture content in the product stream was 30.2 percent, which compares favorably to the target value of 29.5 percent at full heat input. Samples were taken from the feed segregation and product streams and analyzed for HHV and composition. The results of the functional tests also confirmed that the commercial dryers performed as well as the prototype with respect to removal of pollutant precursors.

In March and April 2010, a second test series was performed utilizing all four commercial dryers for a unit operating at full load, steady-state conditions to determine the effect of reduced coal moisture content on unit performance, emissions, and operation. During the test, one unit was in outage; therefore, the test unit was carrying the entire station load and providing auxiliary steam extractions from the turbine cycle. This introduced uncertainty in calculating the turbine cycle and effect of dried coal on unit performance and the heat rate evaluation was not performed. GRE planned to conduct additional tests to confirm the performance during normal operation.

For tests performed with dried coal with all four commercial dryers feeding the unit, the NO_x emission rate decreased by 31.8 percent relative to the wet coal baseline while the SO_2 emission rate was approximately 54 percent lower relative to the wet coal. The lower NO_x emissions are largely attributable to lower primary air requirements (the amount of coal fed to the boilers is less with the dried coal requiring less primary air) as well as to adjustments to the burner tilt angles. The lower SO_2 emissions primarily result from the removal of iron sulfide (pyrite) in the first dryer stage, lower mass and volumetric flow rates of flue gas when operating on dried coal, and reduced fuel flow due to the improved heating value of the coal.

Full unit testing with dried coal also reduced mercury emissions. Some mercury is removed with the segregation stream produced in the drying process. The amount of mercury entering the boiler is also reduced due to the reduced fuel flow requirement using dried coal. Further, the combustion of dried coal tends to oxidize more of the mercury, improving capture by the flue gas desulfurization (FGD) system. Testing with dried coal reduced mercury concentration at the boiler outlet by approximately 20 percent. Accounting for the reduction in flue gas flow rate, the mass emissions rate was reduced by 41 percent relative to the wet coal.

Project Summary

During the 1990s, GRE began investigating alternative approaches to dealing with future emission regulations. To avoid efficiency losses from new environmental control equipment, GRE pursued a fuel enhancement strategy of reducing the high moisture content of the lignite fuel by thermal drying. Initial projections indicated that a decrease in the lignite moisture would have a significant improvement on unit performance. Based on laboratory testing, a fluidized bed dryer was selected as the best technology to reduce moisture content due to its high heat and mass transfer coefficients and compact size. An approach was developed that employed waste heat sources available in the plant for thermal drying of the raw lignite coal feed.

The overall technology development consisted of a feasibility stage that involved evaluation of a 2 tons/hr fluidized bed at the plant site. The pilot dryer confirmed the ability to dry lignite as predicted and the inherent characteristic of bed fluidization naturally segregated material by density allowing the removal of the heavier components, most notably pyrite and rock material. This segregation of sulfur-bearing minerals provided the opportunity to remove a significant proportion of sulfur from the fuel stream prior to combustion.

The CCPI project involved the design, construction, and operation of a 75 tons/hr prototype fluidized bed dryer to be followed by the deployment of four commercial dryers (135 tons/hr each) to supply the entire fuel need for Unit 2. The prototype dryer utilized a two-stage design (the bed volume is divided in two parts) were the first stage captures the heavier non-fluidizable material, pre-heats and pre-dries the coal, and provides uniform flow of the fluidizable coal to the second stage. In the second stage, the coal is heated and dried to a desired outlet moisture level by heat supplied by the fluidizing air and an in-bed heat exchanger. Coal dried to the desired moisture content is discharged from the dryer as a product stream. Coal fines, elutriated from the dryer, are collected in a baghouse.

The prototype operated over a range of operating conditions from February 2006 to the summer of 2009 and confirmed the capability of a full-scale dryer to reduce fuel moisture to the

target level and that the density segregation effects observed during pilot testing translated to the larger prototype.

The successful performance of the prototype resulted in a decision by GRE to install commercial-scale drying systems on both Units 1 and 2 at the project site (the CCPI project involved only the installation on one unit, not both). Benefits included the prospects of large offsets in capital expenditures for additions to the flue gas desulfurization systems, improved mercury control, and reduced NO_x emissions.

For the commercial design, the dryers were constructed with three stages (the bed volume is divided in three parts) to facilitate density segregation and removal of segregated material through multiple scrubbing boxes and air locks. Another improvement in the commercial design was the processing of the segregation stream by air jigs (pulsed fluidized beds) to further concentrate sulfur and mercury and maximize the useful fuel content. Processing of the segregation stream reduced the inlet heating value lost to segregation from approximately 10 percent to less than 0.5 percent. During testing periods, the cleaned segregation stream was returned to the product stream. The processing of the segregation stream was developed by GRE outside the scope of the CCPI project. In the future, GRE intends to treat the segregated stream in the prototype dryer for use as a beneficiated fuel at GRE's combined heat and power plant in Spiritwood, North Dakota.

Wet lignite was fired during a series of tests conducted in September 2009 to establish a baseline using non-dried coal. The full complement of commercial dryers was commissioned on both 546 MWe units in December 2009. To gain preliminary operation and performance information on the commercial design, tests with one coal dryer were conducted in January 2010. In March and April 2010, a second test series was performed at Coal Creek Unit 1 utilizing all four commercial dryers while the unit operated at full load, steady-state conditions to determine the effect of reduced coal moisture content on unit performance, emissions, and operation. GRE planned to conduct additional tests; however, these tests were beyond the scope of the CCPI project.

The ability of the DryFining™ system to reduce the moisture of the coal by the target amount of 8.5 percent was consistently demonstrated with the prototype dryer, during operation with the single commercial dryer, and with all four commercial dryers in operation on Unit 1. The use of the DryFining™ technology resulted in a HHV improvement from 6290 Btu/lb to 7043 Btu/lb. The full load operation on Unit 1 also demonstrated that emissions were significantly reduced. NO_x and SO_2 emissions were reduced by 32 and 54 percent, respectively. NO_x emissions were reduced primarily by improved boiler performance enabled by the improved fuel quality. Reduced SO_2 emissions were due to a substantial amount of sulfur being removed in the first dryer stage. Mercury emissions were reduced by 41 percent due to some removal in the first dryer stage and by the increased oxidation of mercury that allows for greater removal in the FGD system.

The project demonstrated the ability of the technology to reduce the moisture content of the lignite (approximately one-fourth of the as-received moisture) providing increased heating value of the coal along with commensurate reductions in heat rate and emissions of criteria pollutants. Auxiliary power was virtually unchanged from the wet baseline operation as reductions in fan and mill power offset the DryFining™ system requirements. An additional benefit of the lower heat rate is lower CO_2 emissions. *Power Engineering* magazine recognized the DryFining™ demonstration as the 2010 Best Coal-Fired Project of the Year. This prestigious award honors excellence in design, construction, and engineering of power generation facilities worldwide.

Cost information other than the DOE share and overall project cost is considered proprietary by GRE.

While the benefits of drying high-moisture coals are widely recognized, most approaches involve considerable costs to supply the heat to dry the coal. DryFining™ offers a significant advantage by using low-grade waste heat that is normally not recovered. While all power plants utilizing high-moisture coals will benefit from reduced moisture content, not all coals will segregate as readily as the demonstration coal and the emission reduction benefit can vary based on coal and plant characteristics. Further, application of the DryFining™ technology requires site-specific engineering and customization for successful implementation. To facilitate these requirements, GRE entered into a commercialization agreement with WorleyParsons, as the exclusive licensor and process integrator of the DryFining™ technology. WorleyParsons is an experienced engineering, procurement and construction management organization with offices throughout the world. WorleyParsons has received interest from all parts of the world including North America, Southeast Asia, and Australia where low rank coals are predominant.

Carbon Capture, Utilization and Storage

Mountaineer Commercial Scale Carbon Capture and Storage (CCS) Project

Project Discontinued

Participant

American Electric Power Service Corporation (AEP)

Additional Team Members

Appalachian Power Company (APCo)—host utility

Alstom Power Inc.—carbon dioxide (CO_2) capture equipment

Battelle Memorial Institute—CO_2 monitoring, verification, and accounting (MVA)

Worley Parsons—balance of plant design

Location

New Haven, Mason County, WV

Technology

Alstom's Chilled Ammonia Process (CAP) for post combustion capture of CO_2

Plant Capacity/Production

Capture and sequester nearly 1.5 million metric tons per year of CO_2 from 235 MWe slipstream

Coal

tbd

Project Funding

Total	$668,000,000	100%
DOE Share	334,000,000	50
Participant	334,000,000	50

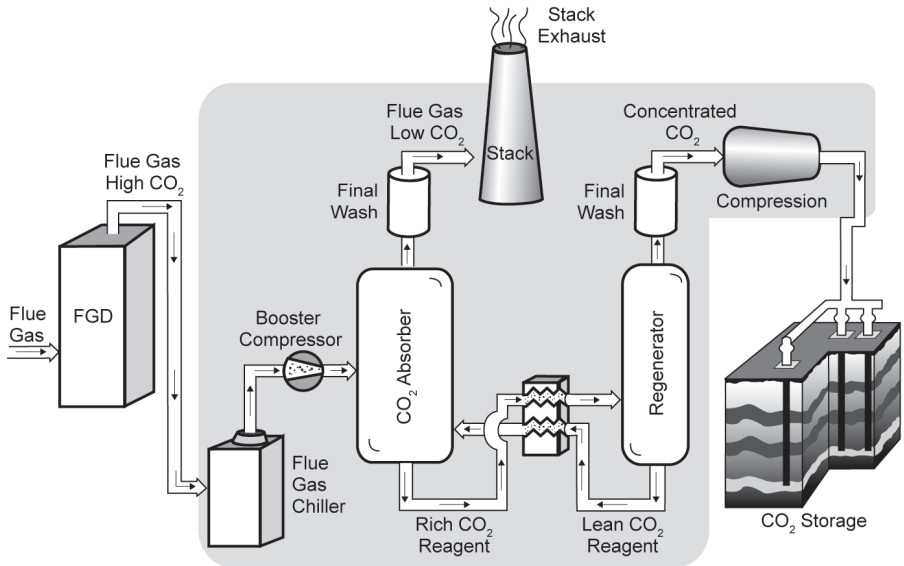
While part of the Carbon Capture, Utilization and Storage (CCUS) market sector, this project intended to geologically sequester CO_2 in saline formations.

CCPI-3

Carbon Capture, Utilization and Storage

Oxy Comb ☐ **Pre-Comb** ☐

ICCS ☐ **Post-Comb** ■



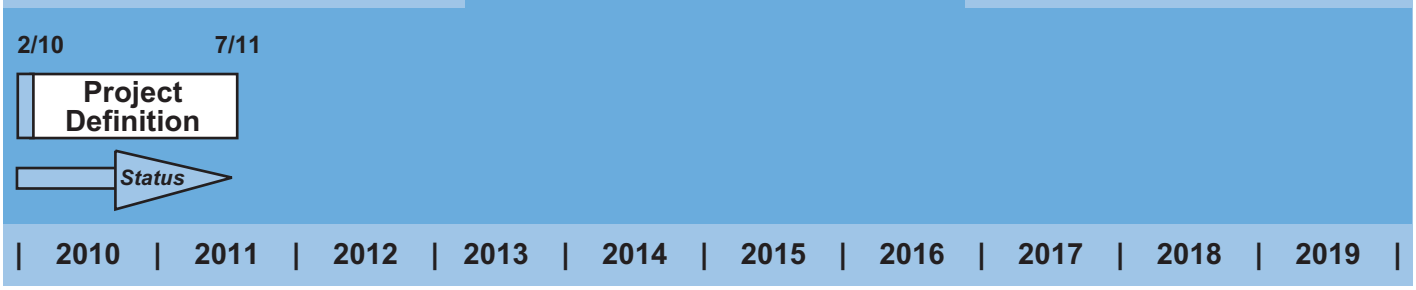
Project Objective

To design, construct, and operate a scaled-up CCS system using Alstom's CAP to capture at least 90 percent of the CO_2 from a 235 MWe flue gas slip stream and demonstrate progress toward less than a 35 percent increase in the cost of electricity (COE). The captured CO_2 will be treated, compressed, and transported by pipeline to nearby injections sites for geologic sequestration in deep saline reservoirs.

Technology/Project Description

The project utilizes Alstom's CAP to achieve 90 percent CO_2 capture efficiency and geologic storage equipment to sequester nearly 1.5 million metric tons per year of CO_2 in deep saline reservoirs at a depth of more than 6,500 feet. Booster fans supply a 235 MWe flue gas slip stream from the flue gas desulfurization (FGD) absorber to Alstom's CAP inlet where the flue gas is chilled in a two-stage cooling process and water created by the cooling process is sent to a water treatment system. The chilled flue gas is pumped to the CO_2 absorber vessel where the CO_2 in the flue gas is introduced to a reagent to form ammonium bicarbonate. With most of the CO_2 removed, the flue gas is returned to the existing stack for discharge. The ammonium bicarbonate solution is sent under pressure to a regenerator where the solution is heated using a low-pressure reboiler to reverse the reaction and release a high-purity stream of CO_2. The reagent is returned to the CO_2 absorber for reuse and the captured CO_2 is compressed to approximately 2,500 psi to a liquid-like state that is piped to the geologic storage equipment. The injection sites are subject to MVA practices.

Project Duration	Status/Schedule	Period of Operation
17 Months	*Project Discontinued*	N/A



Benefits

The CAP system has the potential to reduce overall costs compared to existing conventional CO_2 post combustion capture systems. Economic advantages include lower energy consumption, the use of a regenerable reagent with low reagent make-up, and an ammonium sulfate byproduct with potential commercial value. In addition, the CAP technology produces a high-purity CO_2 product stream at elevated pressure, resulting in reduced CO_2 compression costs. With inlet flue gas conditions that are tolerant of acid gases at levels consistent with outlet conditions of modern FGD systems, the post-combustion system is applicable to much of the coal-based power generation capacity in the United States and throughout the world.

Status/Accomplishments

The cooperative agreement was awarded on January 29, 2010. The front end engineering and design (FEED) has been completed incorporating the knowledge and lessons learned from the Mountaineer Product Validation Facility, yielding a +/-25 percent cost estimate. The PVF began injecting CO_2 underground in October 2009 at an annual rate of more than 100,000 tons per year. A characterization well was completed and evaluated that indicated strong potential for storage of the project's CO_2.

At AEP's request and based on DOE evaluation, DOE and AEP have agreed to a partial termination of the project effectively ending project development activities at the end of project definition on September 30, 2011. AEP was unable to meet their financial obligations via rate recovery citing uncertain U.S. climate policy and continued weak economy. All project definition activities will be completed including a final comprehensive report, a comprehensive +/-25 percent cost estimate, and public design document. This represents the most comprehensive design information developed to date at the demonstration scale for CCS using Alstom's CAP and deep saline formation storage in the world.

Federal funding includes funds provided under the American Recovery and Reinvestment Act of 2009 (Recovery Act).

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W.A. Parish Post-Combustion CO_2 Capture and Sequestration Project

CCPI-3

Carbon Capture, Utilization and Storage

Oxy Comb	☐	Pre-Comb	☐
ICCS	☐	Post-Comb	■

Participant
NRG Energy, Inc.

Additional Team Members
Fluor Enterprises—carbon dioxide (CO_2) separation system

Sargent & Lundy—system integration

University of Texas Bureau of Economic Geology—CO_2 monitoring, verification, and accounting (MVA)

Location
Thompsons, Fort Bend County, TX

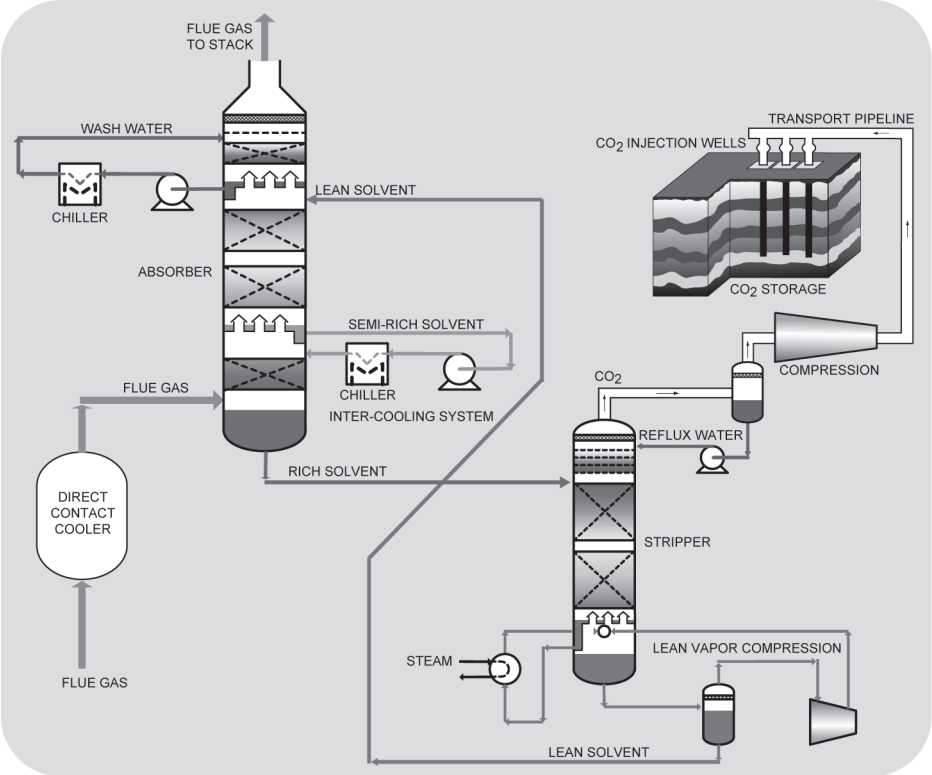
Technology
Fluor's advanced Econamine FG Plus^{SM} CO_2 capture process

Plant Capacity/Production
From a 60 MW_e flue gas stream, capture and sequester 400,000 tons per year of CO_2

Coal
Coal

Project Funding

Total	$338,607,740	100%
DOE Share	166,804,425	49.3
Participant	171,803,315	50.7



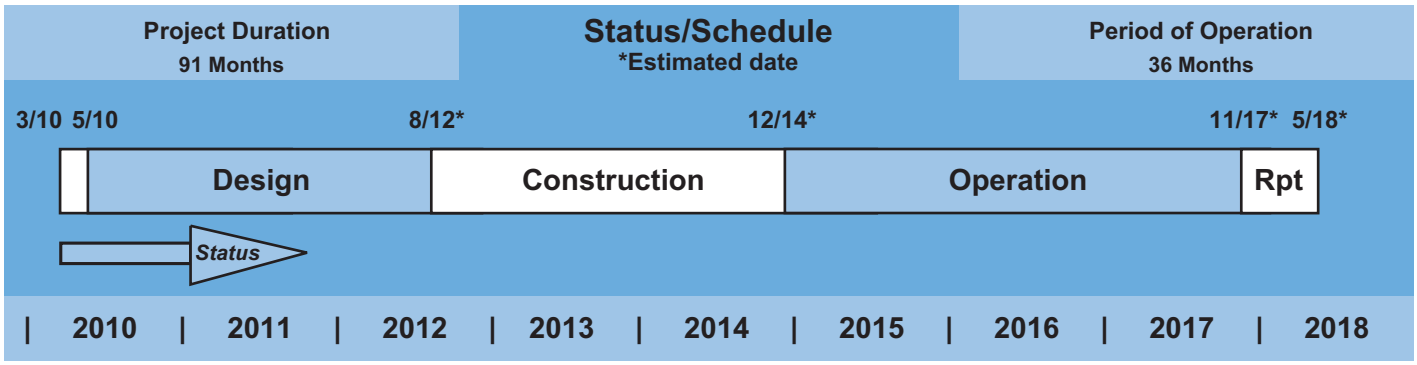
Objectives

To design, construct, and operate a 60 MW_e carbon capture demonstration facility utilizing Fluor's advanced Econamine FG Plus^{SM} carbon capture process. The project will demonstrate 90 percent removal of CO_2 from treated flue gas resulting in 400,000 tons per year of pipeline quality CO_2 that will be used for enhanced oil recovery (EOR) in regional oil fields.

Technology/Project Description

In a retrofit application, the project uses Fluor's advanced Econamine FG Plus^{SM} carbon capture process to capture 90 percent of the CO_2 from a 60 MW_e flue gas stream. Fluor's capture technology demonstrates advances in the monoethanoloamine (MEA) solvent, absorber inter-cooling, and lean solution vapor compression technologies. In addition to the baseline solvent, the project will test two additional advanced solvents.

The CO_2 capture equipment is located downstream of the conventional flue gas cleanup systems. The project employs a direct contact cooler (DCC) for gas cooling and flue gas conditioning to remove residual quantities of SO_x and other pollutants prior to the absorber. Lowering the inlet temperature of the flue gas increases the efficiency of the CO_2 capture process and removal of impurities reduces the operating cost. In the absorber, the flue gas is heated as it travels upward through the column due to the heat of reaction from the absorption of CO_2 in the MEA solvent. Near the top of the column, temperatures are reduced by the lean solvent entering the absorber. Higher operating temperatures improve reaction kinetics but reduce the solvent's carrying capacity. The inter-cooling system is used to maintain an optimum temperature profile for CO_2 capture by the solvent.



The CO_2 rich solvent is sent from the absorber to the stripper for separation. A lean vapor flash configuration is used in which the hot lean solvent from the stripper is flashed at low-pressure in a flash drum. The resulting flashed vapor consists mostly of steam with small amounts of CO_2 and solvent. The flashed vapor is compressed in a thermo-compressor and returned to the bottom of the stripper where it flows upward through the column while stripping CO_2 from the rich solvent. The captured CO_2 is compressed for pipeline transport.

Benefits

The project demonstrates that post-combustion carbon capture for existing plants can be done economically, especially when the plant has the opportunity to sequester CO_2 in nearby oilfields. The flue gas pre-treatment steps and absorption solvent also remove most of the residual quantities of SO_x, particulates, and other trace constituents from the flue gas. This project will demonstrate use of a natural gas-fired combustion turbine to supply steam required for solvent regeneration. This avoids use of steam supplied by the steam turbine, which would significantly compromise operation of the entire unit for a full scale system.

Status/Accomplishments

The cooperative Agreement was awarded on May 7, 2010. Front-end engineering design (FEED) activities were initiated in July 2010. Work on the Environmental Information Volume (EIV) was initiated in September 2010. National Environmental Policy Act (NEPA) requirements will be addressed with an Environmental Impact Statement (EIS). NRG submitted its air permit application in September 2011; approval of the application is expected to take one year.

NRG has shown interest in a project scale-up and has initiated work on the front end engineering design (FEED) for a 240 MWe system. A 240 MWe system would produce 1.4 million metric tons of CO_2 per year assuming an 80 percent capacity factor.

Federal funding includes funds provided under the American Recovery and Reinvestment Act of 2009 (Recovery Act).

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Demonstration of a Coal-Based Transport Gasifier

CCPI-2

Carbon Capture, Utilization and Storage

Oxy Comb	☐	Pre-Comb	■
ICCS	☐	Post-Comb	☐

Participant
Southern Company Services, Inc.

Additional Team Members
Mississippi Power Company (MPC) —host utility

Kellogg Brown and Root, LLC (KBR)—technology supplier

Location
Kemper County, MS

Technology
KBR air-blown transport gasifier fueled by low-rank coal in an integrated gasification combined-cycle (IGCC) application

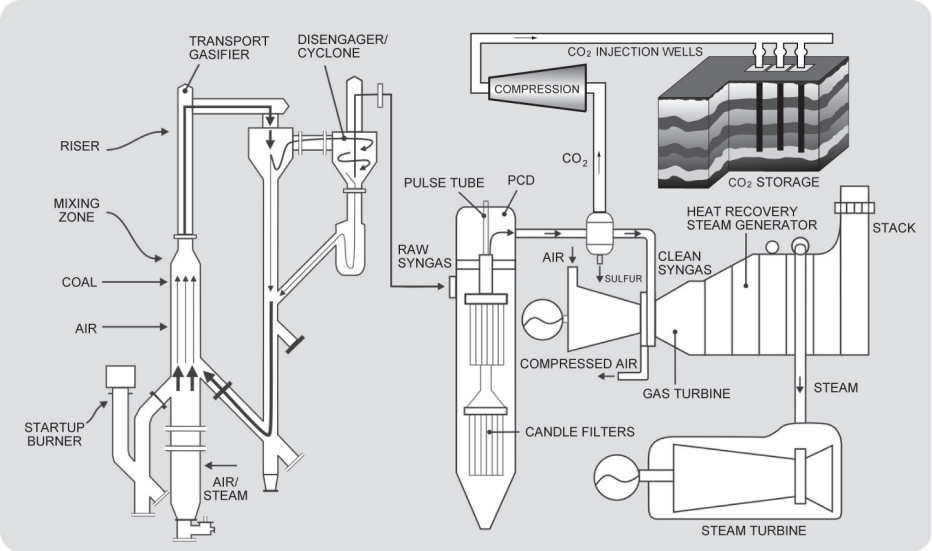
Capacity
582 MW peak (net) of electricity and sequestration of nearly 3 million tons per year of carbon dioxide (CO_2) in an enhanced oil recovery (EOR) application

Coal
Mississippi lignite

Project Funding*

Total	$2,014,812,860	100%
DOE Share	270,231,360	13
Participant	1,744,581,500	87

*Does not include funding associated with initial site in Orlando, Florida.



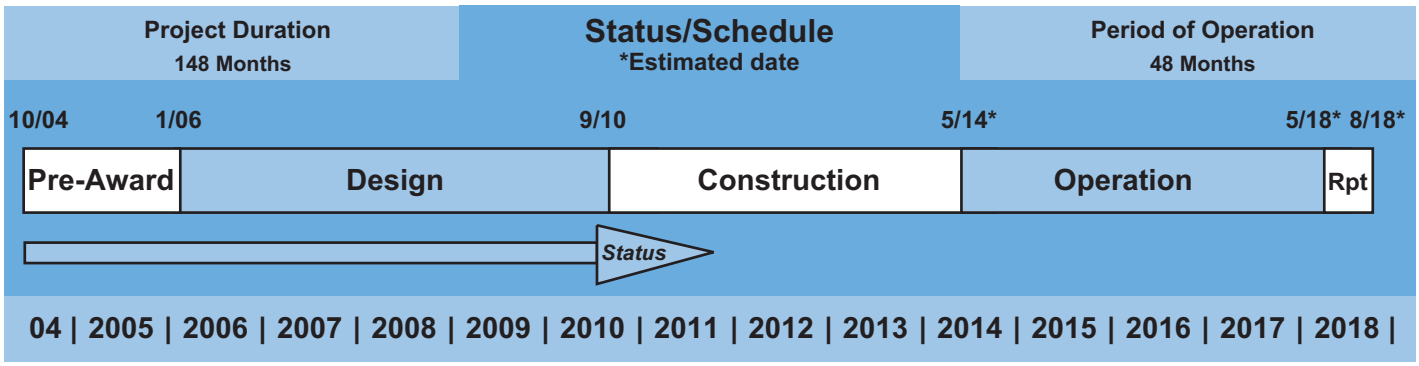
Objectives

To design, construct, and operate a greenfield commercial scale air-blown Transport Gasifier and integrate it with a combined cycle island and capture approximately 65 percent of the CO_2 for geologic sequestration in an EOR application.

Technology/Project Description

The project will demonstrate air-blown coal gasification and syngas cleanup systems, which will be integrated with a standard combined-cycle power generating unit to form an IGCC power plant. The overall IGCC facilities can be divided into two major systems or components: lignite coal gasification and combined-cycle power generation. The gasification component will consist of two lignite coal gasifiers utilizing Transport Integrated Gasification (TRIG™) technology, syngas cleanup systems, a cooling tower, and other supporting infrastructure. The combined-cycle component's main equipment will include two gas combustion turbines; two heat recovery steam generators; a single steam turbine; a separate cooling tower; and associated support facilities.

The TRIG™ technology centers around the Transport Gasifier, a pressurized, circulating fluidized bed unit, derived from fluidized catalytic cracking units used in petroleum refining. Employing state-of-the-art emission controls, the facility will produce marketable byproducts of ammonia, sulfuric acid, and CO_2. Over 65 percent of the CO_2 will be captured and used for EOR making the Kemper County facility's emissions comparable to a natural gas-fired combined cycle power plant.



Benefits

The transport gasifier operates at considerably higher circulation rates, velocities, and riser densities than does a conventional circulating fluidized-bed, resulting in higher throughput, better mixing, and higher mass and heat transfer rates. The recycling of solids increases the effective residence time and increases carbon conversion. This process technology makes possible the cost effective production of syngas from low-rank, high-moisture, and high-ash coals, whereas most other gasification technologies cannot. Such coals make up half the proven reserves in both the United States and the world. The transport gasifier can also be operated on oxygen, which affords the option to produce chemicals.

Status/Accomplishments

The cooperative agreement was awarded on January 30, 2006 for a single-train (285 MW net) demonstration unit to be built in Orlando, Florida. As initial construction was under way, the activities at Orlando were canceled over concerns for carbon emissions. Carbon capture, utilization and storage (CCUS) was not viewed as economical for the Orlando site. In December 2008, DOE modified the cooperative agreement which granted approval to relocate the demonstration to Kemper County, Mississippi using a dual train configuration with carbon capture.

The National Environmental Policy Act (NEPA) requirement for the Mississippi site was met with an Environmental Impact Statement (EIS) and issuance of a Record of Decision (ROD) in August 2010. An offical groundbreaking ceremony was held on December 16, 2010. The project is currently in the detailed engineering and construction phase with all major equipment under order. Construction activities on underground utilities and major foundations are underway with over 600 on site construction personnel.

The project will demonstrate an advanced syngas cleanup system that includes sulfur removal and recovery; high-temperature, high-pressure (HTHP) particulate filtration; ammonia recovery; and mercury removal.

The transport gasifier has a fuel-flexible design projected to have higher efficiency and lower capital and operating costs compared to oxygen-blown entrained-flow gasifiers.

The plant will design, build, and operate a CO_2 capture and compression system to capture and geologically sequester nearly three million tons per year of CO_2 in an EOR application.

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Commercial Demonstration of Advanced IGCC with Full Carbon Capture

CCPI-3

Carbon Capture, Utilization and Storage

Oxy Comb ☐ **Pre-Comb** ■

ICCS ☐ **Post-Comb** ☐

Participant

Hydrogen Energy California, LLC (HECA)

Additional Team Members

Mitsubishi Heavy Industries (MHI)—integrated gasification combined-cycle (IGCC) supplier

Occidental of Elk Hills—carbon dioxide (CO_2) off take for enhanced oil recovery (EOR)

Fluor Enterprises—front end engineering and design (FEED)

Location

Near Bakersfield, Kern County, CA

Technology

MHI gasification technology and power block; Rectisol® process for acid gas recovery

Plant Capacity/Production

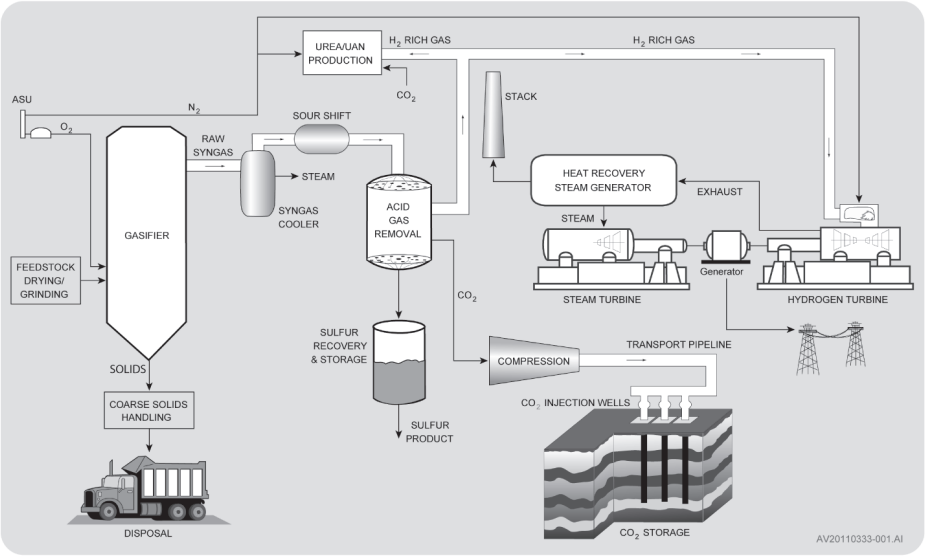
400 MW (gross), approximately 280 MW (net) of electricity, approximately 1 million tons per year of fertilizer, and sequestration of 2.5 million tons per year of CO_2 in an EOR application

Fuel

75% western bituminous coal/25% petroleum coke fuel blend

Project Funding

Total	$4,008,132,814	100%
DOE Share	408,000,000	10
Participant	3,600,132,814	90



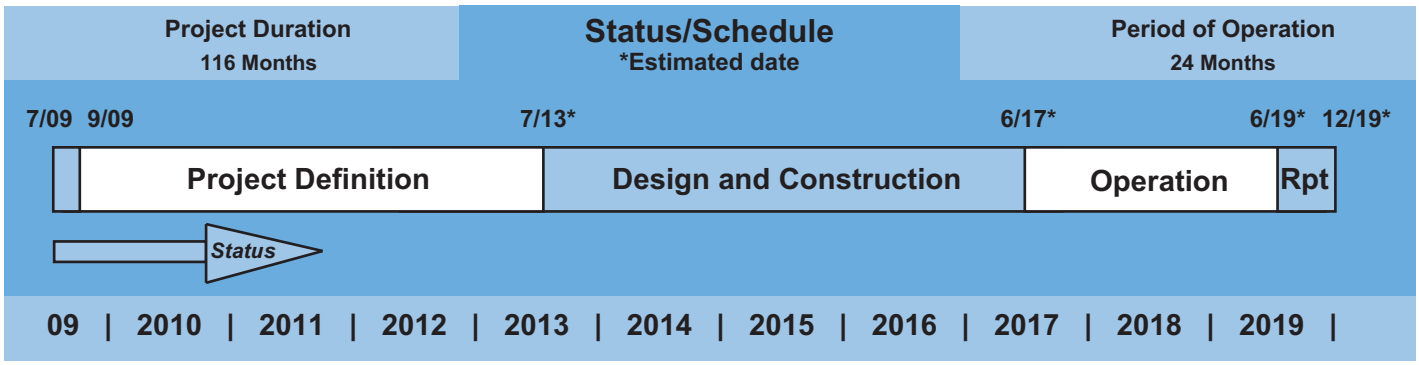
Objectives

To design, build and operate a greenfield, commercial scale, fully integrated advanced Integrated Gasification Combined Cycle (IGCC) power plant and fertilizer production facility with carbon capture in Kern County, California. The project is designed to achieve at least 90 percent CO_2 capture efficiency while storing approximately 2.5 million tons per year in an EOR application.

Technology/Project Description

The project will employ IGCC technology to nominally generate 400 MW (gross) and approximately 280 MW (net) of electricity and produce approximately 1 million tons per year of fertilizer using a 75 percent coal and 25 percent petroleum coke fuel blend. The fertilizer could be a combination of urea ammonium nitrate (UAN), urea, or other fertilizer equivalent, with the proportion dependant on market and commercial conditions. The off-take agreements contemplated by HECA will enable geologic storage of CO_2 at a rate of approximately 2.5 million tons per year. The captured CO_2 will be transported via pipeline to the Elk Hills oil field approximately 4 miles away from the power plant. The design of these integrated facilities allows operating protocols that optimize: (1) the efficiencies of the physical plants while allowing steady state operation of the gasification unit; (2) the use of hydrogen to match product output volumes with demand under the terms of the urea/UAN and power off-take contracts; and (3) the use of the project's capital investment.

The project will utilize the Rectisol® process to achieve the intended CO_2 capture efficiency. Water quality and availability issues are addressed by utilizing local brackish groundwater treated on-site to meet all industrial water requirements. The brackish groundwater will be supplied from the Buena Vista Water Storage District (BVWSD), which is a local water district with some groundwater sources not suitable for agricultural use. The project will also incorporate a Zero Liquid Discharge (ZLD) system. All project wastewater including wastewater generated from the IGCC, raw water treatment, and cooling tower blowdown will



be directed to ZLD system(s) with the recovered water recycled for reuse in the process. This further reduces the water demands of the project.

Benefits

The project should have the lowest power plant emissions of any commercial solid fuel plant built or under construction and significantly exceed the emission targets for 2020 established under the Energy Policy Act of 2005. In addition, the project will be well below the California requirements that baseload plants emit greenhouse gases less than that of a combined cycle natural gas plant. The CO_2 captured by the project will enable sequestration at a rate of over two and a half million tons of CO_2 per year and increase domestic oil production.

The use of local, non-potable brackish groundwater for all process and cooling needs will maintain area freshwater aquifers for agricultural use. All project wastewater will be directed to the 100 percent ZLD system, with the recovered water recycled for reuse in the process.

Status/Accomplishments

The cooperative Agreement was awarded on September 29, 2009. Following preliminary design activities and economic evaluation, SCS Energy acquired the project from its initial owners. SCS Energy intends to advance a polygeneration facility that produces fertilizer; power; carbon dioxide; and sulfur. The agreement for SCS Energy to take over ownership of the HECA project was finalized effective September 2, 2011.

Federal funding includes funds provided under the American Recovery and Reinvestment Act of 2009 (Recovery Act).

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Texas Clean Energy Project

CCPI-3

Carbon Capture, Utilization and Storage

Oxy Comb ☐ **Pre-Comb** ■

ICCS ☐ **Post-Comb** ☐

Participant

Summit Texas Clean Energy LLC

Additional Team Members

Siemens AG—gasifier and combined cycle power block

Selas Fluid Products Corporation (Linde)—chemical block, including air separation unit (ASU), gas cleanup, carbon dioxide (CO_2) capture, ammonia and urea block

Fluor Enterprises—front end engineering design (FEED), block integration, and balance of plant

Central Basin Pipeline System—CO_2 delivery for enhanced oil recovery (EOR)

University of Texas Bureau of Economic Geology—CO_2 monitoring, verification, and accounting (MVA)

Location

Penwell, Ector County, TX

Technology

Siemens' gasification and power generation technology and Linde Rectisol® process for acid gas recovery

Plant Capacity/Production

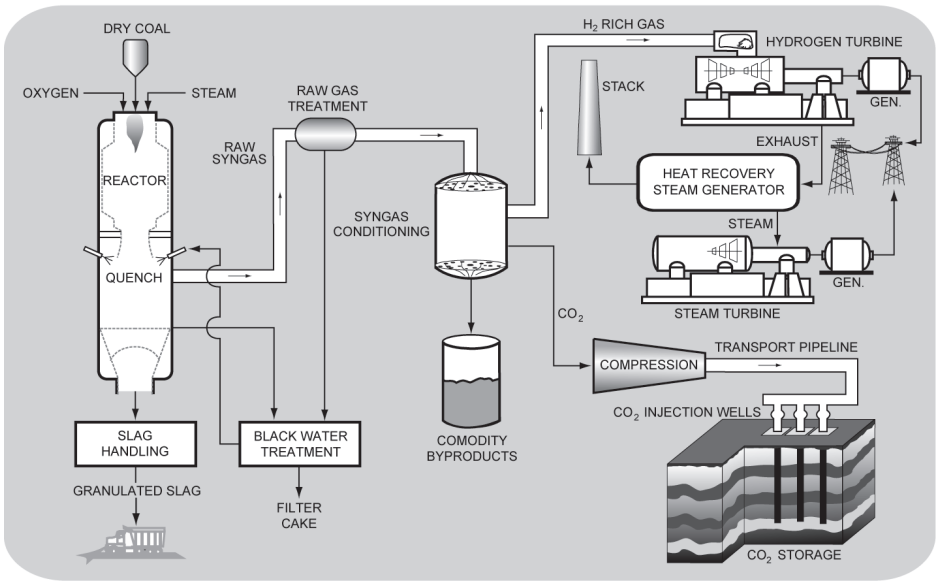
400 MW (gross), with about 200 MW of electricity to the grid; sequester or put to beneficial reuse about 3 million tons per year of CO_2 for urea production and EOR

Coal

Powder River Basin sub-bituminous

Project Funding

Total	$1,726,628,229	100%
DOE Share	450,000,000	26
Participant	1,276,628,229	74



Objectives

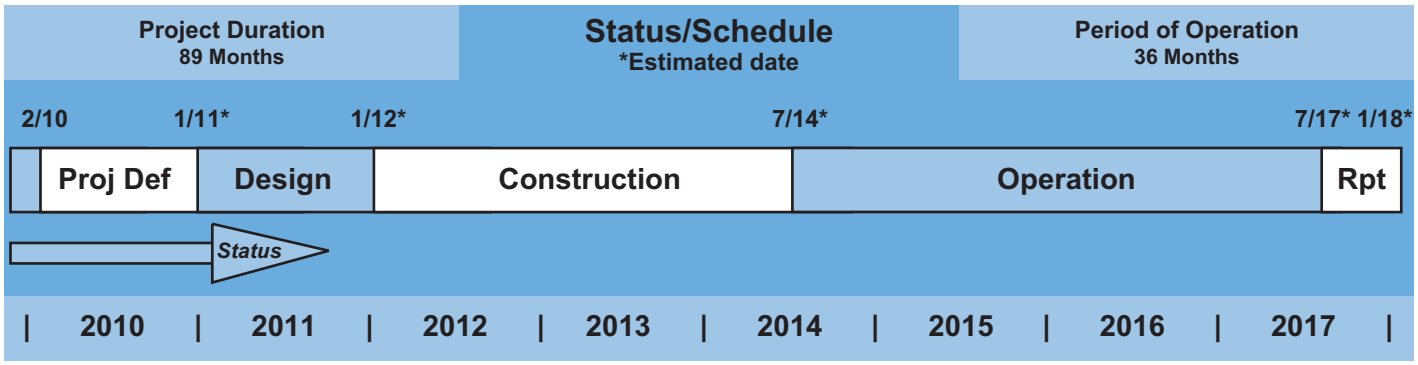
To demonstrate the full integration of CO_2 capture and geologic sequestration with a first-of-a-kind, commercial, coal-based poly-generation plant that produces electric power and chemicals. To capture or put to beneficial reuse about 90 percent of the CO_2 from the synthesis gas (syngas), or about 3 million tons per year, for use in urea production and EOR subject to MVA.

Technology/Project Description

The 400 MW (gross) project uses low-sulfur coal as feedstock for conversion into syngas, consisting of about 90 percent pure hydrogen (H_2), using Siemens gasifier technology. After chemical conversion and processing, capture and removal of CO_2 is performed using the Linde Rectisol® technology. Syngas is used in the power island to produce about 200 MW of electricity available to the utility grid. Another 70 MW is used to produce commercial urea and CO_2. This leave about 130 MW consumed by site conditions and ancillary plant loads. Other salable by-products of the gasification and syngas cleanup processes include argon, sulfuric acid (H_2SO_4) and slag.

The project employs a two-gasifier configuration using Siemens entrained-flow SFG-500 gasifiers, with one high-H_2 capable gas turbine and one steam turbine. Coal is pulverized and transferred to the gasifiers, along with limited amounts of nearly pure oxygen (O_2) gas, where it is converted into raw syngas. This configuration produces excess syngas used to make urea for fertilizer. Gasification is a thermo-chemical process that converts coal, or other carbon-based materials, into raw syngas composed primarily of H_2, carbon monoxide (CO) and CO_2. The conversion occurs in a reduced O_2 environment and at temperatures up to 3,000°F.

The raw syngas is cooled and cleaned of particulate matter (PM) and then flows through a water-gas shift reactor. There steam is injected over a catalyst bed, initiating a reaction where CO is converted to CO_2 and steam is converted to additional H_2. This provides a syngas stream concentrated in both CO_2 and H_2.



The syngas then passes through a mercury (Hg) removal system using sulfur-impregnated activated carbon beds, and then a Linde Rectisol® acid gas removal (AGR) system. Rectisol® AGR uses concentrated methanol (greater than 99 percent by weight) as a solvent in a re-circulating wash column to physically dissolve and remove hydrogen sulfide (H_2S), carbonyl sulfide (COS), and CO_2. The H_2S and COS is removed in the lower section of the wash column and the CO_2 is removed in the upper section. The sulfur-containing gases are sent to the H_2SO_4 plant. The clean H_2-rich syngas exiting the system is used to produce both electricity and urea. The captured CO_2 is also split, where about 1,600 tons per day is sent to urea synthesis while about 8,000 tons per day is dried, compressed to about 2,200 psig, and delivered to a nearby regional CO_2 pipeline for use in EOR.

Benefits

The project will provide scientific and technical information verifying the commercial efficacy and viability of pre-combustion CO_2 capture and geologic storage as applied to the world's first commercial-scale, integrated, coal-based very-low emissions electric power and chemicals poly-generation facility. The project is a capstone demonstration representing decades of DOE sponsored research and development in coal gasification; environmental technologies for the oxides of nitrogen (NO_x) and sulfur (SO_x), PM and Hg; high-H_2 gas turbines; and, CO_2 capture and geologic storage. The project will have NO_x, SO_x and PM emissions far below the lowest-yet limits permitted in Texas for a fossil-fuel plant. The plant will achieve 99 percent sulfur removal, greater than 95 percent Hg removal from syngas, and will have CO_2 emissions (lbs per MWhr) only 20-30 percent of a comparable natural gas combined cycle (NGCC) plant without CO_2 capture.

Status/Accomplishments

The Cooperative Agreement was awarded on January 29, 2010. The Texas Commission on Environmental Quality (TCEQ) issued the air permit in December 2010. Front-end engineering design (FEED) was completed in June 2011. The National Environmental Policy Act (NEPA) Final Environmental Impact Statement (EIS) was released to the public in July 2011 and the Record of Decision (ROD) was issued on September 26, 2011.

Federal funding includes funds provided under the American Recovery and Reinvestment Act of 2009 (Recovery Act).

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Oxy-Combustion Large Scale Test

FutureGen 2.0

Carbon Capture, Utilization and Storage

Oxy Comb ■ Pre-Comb □
ICCS □ Post-Comb □

Participant
Ameren Energy Resources Company

Additional Team Members
Babcock & Wilcox Power Generation Group (B&W)—technology supplier

Air Liquide Process & Construction Company—air separation unit

AL Engineering & Construction Cryogenics—compression and purification unit

URS—balance of plant

Location
Meredosia, Morgan County, IL

Technology
Utility scale oxy-combustion power generation with CO_2 purification

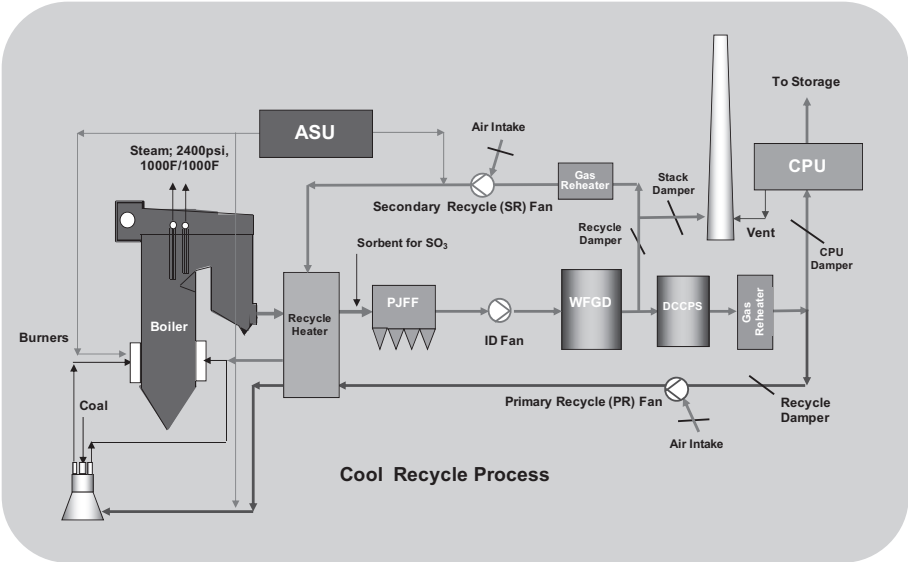
Plant Capacity/Production
139 MW (net) electric power and capture approximately 1.3 million metric tonnes per year of CO_2

Coal
Illinois basin bituminous

Project Funding

Total	$737,179,996	100%
DOE Share	589,744,000	80
Participant	147,435,996	20

While part of the Carbon Capture, Utilization and Storage (CCUS) market sector, this project will geologically sequester CO_2 in saline sandstone formations.



Objectives

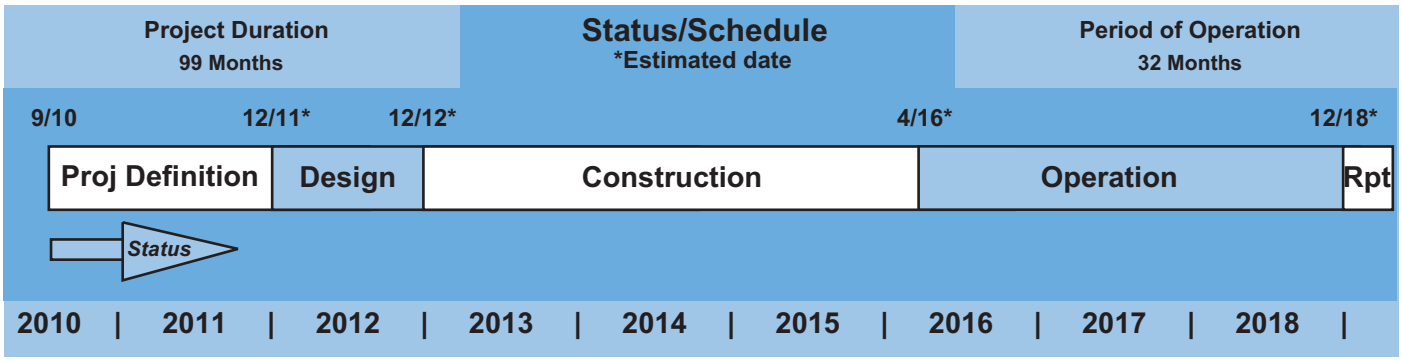
To demonstrate at full scale, an integrated oxy-combustion power generation facility with carbon capture, purification, and compression that will treat 100 percent of the flue gas and remove 90 percent or more of the CO_2 resulting in the capture of approximately 1.3 million metric tonnes per year from the plant.

Technology/Project Description

As the power generation portion of a two-part FutureGen 2.0 effort, the project will repower an existing oil-fired boiler as the world's first commercial-scale, pulverized coal-fired, oxy-combustion power plant that will capture and compress CO_2 for transport. The *Pipeline and Regional CO_2 Storage Reservoir Project* will perform the transport and monitoring, verification, and accounting (MVA) aspects of the overall FutureGen 2.0 effort.

The oxy combustion technology uses nearly pure oxygen instead of air for combustion to produce a flue gas that is primarily CO_2. Since nitrogen composes approximately 75 percent of air, the volume of flue gas generated using oxy combustion is only a quarter of that generated using air. This increases the concentration of the contaminants in the flue gas, reduces the mass flow for heat transfer, and can significantly increases the flame temperature. To address these issues, a portion of the flue gas is recycled to approximate traditional air-fired conditions and the recycle gas can be treated to reduce corrosive constituents reentering the boiler. The constituents in the flue gas exiting the boiler can be controlled with traditional systems.

The project will filter the flue gas leaving the boiler to remove particulates and treat in a wet scrubber to remove acid gases before being recycled to the boiler. The process will also utilize a dry sorbent injection system, flue gas cooler, and polishing scrubber. The project will treat 100 percent of the flue gas using an innovative CO_2 purification process and deliver the compressed stream to a terminal point for transfer to the *Pipeline and Regional CO_2 Storage Reservoir Project*.



Benefits

The project represents the first commercial-scale oxy-combustion power generation plant and will demonstrate the full integration of an innovative air separation unit and a CO_2 compression and purification unit. Because oxy-combustion results in a high concentration of CO_2 in flue gas, a separate post combustion capture process is not necessary to achieve up to 90 percent concentration levels. Since the high concentration of nitrogen in air is replaced with near pure oxygen for combustion, NO_x emissions produced in the boiler are reduced by 60 to 70 percent. Further, oxy-combustion increases the oxidized-to-elemental mercury ratio resulting in enhanced mercury capture in the particulate and acid gas removal systems. The project will capture of approximately 1.3 million tonnes per year of pipeline quality CO_2 from the plant.

The capital and operating costs for the air separation unit (ASU) represent the majority of the penalty for CO_2 capture with oxy-combustion and future advances in oxygen production hold promise to reduce capital costs and power consumption. As a repowering technology, oxy-combustion can be applied to the large number of existing coal-fired power generation plants.

Status/Accomplishments

A conditional Cooperative Agreement was awarded September 28, 2010. Specifics of a preliminary design phase to complete the design basis and prepare a project cost estimate were established in December 2010. Ameren has completed the preliminary design as well as the capital and operating cost estimates for the oxy-combustion project and is preparing an application to DOE to proceed with the project.

All federal funding provided under the American Recovery and Reinvestment Act of 2009 (Recovery Act).

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Pipeline and Regional CO_2 Storage Reservoir Project

FutureGen 2.0

Carbon Capture, Utilization and Storage

Oxy Comb ■ Pre-Comb □

ICCS □ Post-Comb □

Participant
FutureGen Alliance (FGA)

Additional Team Members
Battelle Memorial Institute—storage site selection support and design

Location
Morgan County, IL

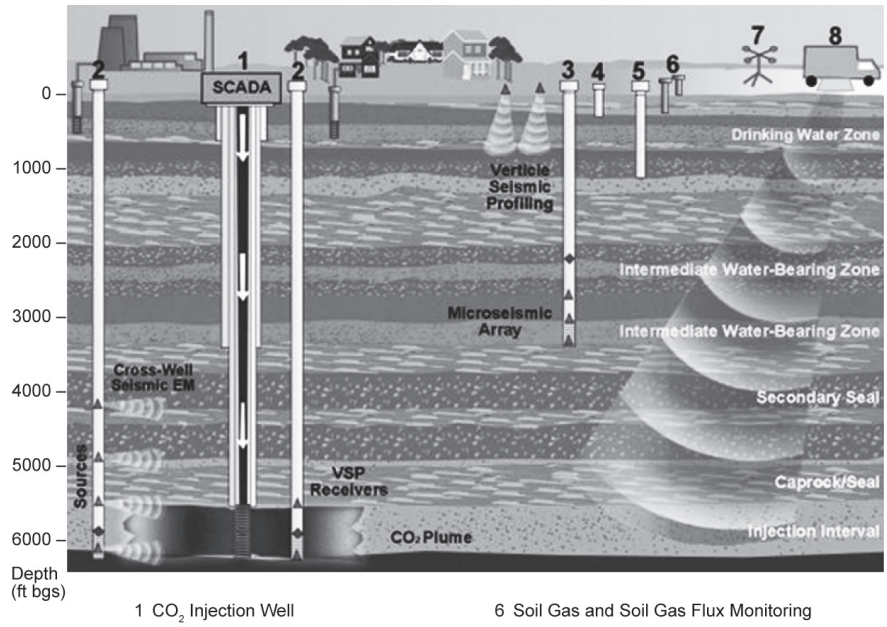
Technology
Geologic CO_2 sequestration in saline formations

Plant Capacity/Production
Transport and sequester approximately 1.3 million metric tonnes per year of CO_2

Project Funding

Total	$552,535,075	100%
DOE Share	458,604,112	83
Participant	93,930,963	17

While part of the Carbon Capture, Utilization and Storage (CCUS) market sector, this project will geologically sequester CO_2 in saline sandstone formations.



1 CO_2 Injection Well
2 Deep Monitoring Wells
3 Intermediate Monitoring Wells
4 Shallow Monitoring Well
5 Contingency Monitoring Well
6 Soil Gas and Soil Gas Flux Monitoring
7 Eddy Covariance
8 3D Surface Seismic
◆ Pressure and Temperature Monitoring
▲ Seismic Array

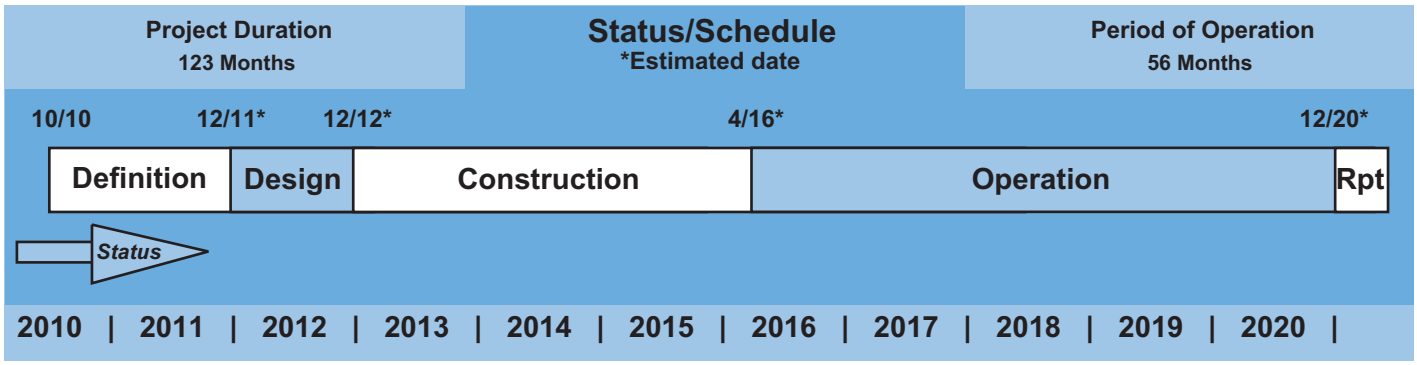
Objectives

To demonstrate the development of a geologic storage facility for CO_2 sequestration for the *Oxy-Combustion Large Scale Test project*, including: the selection of a suitable sequestration site; the development of the subsurface sequestration field; the development of any necessary CO_2 transport infrastructure (e.g., pipeline); establishment of standardized technologies and protocols for CO_2 monitoring, verification, and accounting (MVA); and the design and construction of associated research, training, and education facilities.

Technology/Project Description

As the CO_2 sequestration portion of a two-part FutureGen 2.0 effort, the project will encompass all aspects of the selection, implementation, and MVA of a geologic storage facility and transport pipeline for sequestration of CO_2 resulting from the *Oxy-Combustion Large Scale Test* project. The oxy-combustion repowering planned under the parallel FutureGen 2.0 effort will serve as the source of approximately 1.3 million metric tonnes per year of pipeline quality CO_2.

The FGA established and conducted an open and competitive storage site selection process based on criteria including: the ability to meet or exceed minimum technical requirements including storage volume; environmental impact; overall costs; and expectation to meet the aggressive schedule for the project. The site will include the establishment of a geologic sequestration research complex, training center, and a visitor center. Following site selection, the project will design and implement a CO_2 pipeline system, including pumping and/or compression systems, access infrastructure, and an MVA plan for continued monitoring of the sequestered CO_2 after project completion by a responsible party for a period of time sufficient to verify the permanence of the sequestration.



Benefits

The project will verify effectiveness, safety, and permanence of CO_2 sequestration in saline sandstone formations and contribute standardized technologies and protocols for CO_2 MVA. The FGA will study the appropriateness of the site to serve as a regional CO_2 storage hub that could accept CO_2 from a variety of sources for safe storage. The project's visitor, research and training facilities will accommodate guests from around the world and promote the adoption of advanced clean coal technology.

Status/Accomplishments

On October 25, 2010, the FGA released the request for proposals for communities that would like to host the CO_2 storage site. On February 28, 2011, FGA announces the selection of Morgan County, IL as the preferred site. In March 2011, FGA obtained binding agreements for pore space acquisition for approximately 2,000 acres over the predicted Morgan County injection site plume area.

The FGA established a FutureGen Citizen's Board to provide an additional communication channel to the community and provide a forum to provide routine input to the project. Public scoping meetings were held in early June 2011 as required to prepare the draft Environmental Impact Statement (EIS). FGA completed a CO_2 pipeline feasibility study and initiated site activities for a characterization well located in Morgan County, IL.

Approximately $405 million of federal funding was provided under the American Recovery and Reinvestment Act of 2009 (Recovery Act).

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CO_2 Capture from Biofuels Production and Sequestration into the Mt. Simon Sandstone

Large-Scale ICCS

Carbon Capture, Utilization and Storage

Oxy Comb ☐ Pre-Comb ☐
ICCS ■ Post-Comb ☐

Participant

Archer Daniels Midland Company (ADM)

Additional Team Members

Schlumberger Carbon Services—site characterization, carbon dioxide (CO_2) injection well, and deep CO_2 monitoring, verification, and accounting (MVA)

Illinois State Geological Survey—site characterization, shallow CO_2 MVA, and outreach

Richland Community College—CCS training and an associate degree program in sequestration technology

Location

Decatur, Macon County, IL

Technology

ADM produces high purity CO_2 (>99%) as a by-product from the processing of corn to fuel-grade ethanol at its existing biofuels plant. The CO_2 is compressed using reciprocating compressors and dehydrated using a tri-ethylene glycol (TEG) system prior to sequestration.

Plant Capacity/Production

Approximately one million tons per year of CO_2

Industry

Biofuel ethanol production

Project Funding

Total	$207,942,199	100%
DOE Share	141,405,945	68
Participant	66,536,254	32

While part of the Carbon Capture, Utilization and Storage (CCUS) market sector, this project will geologically sequester CO_2 in saline sandstone formations.

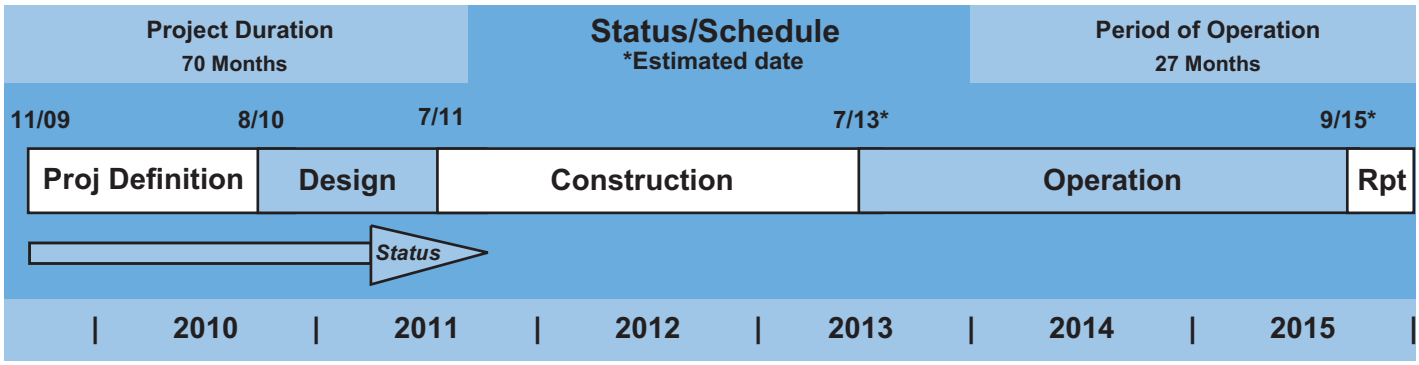
Objectives

To demonstrate an integrated system of CO_2 capture in an industrial setting and geologic sequestration in a deep saline sandstone formation.

Technology/Project Description

The project includes the design, construction, and demonstration of a CO_2 compression and dehydration facility as a precursor to CO_2 storage and subsequent MVA of the stored CO_2. The CO_2 used in this project is produced by ADM as a by-product in the production of fuel grade ethanol. ADM will capture approximately one million tons of CO_2 per year using dehydration and compression. The compressed CO_2 will be sequestered in the adjacent Mount Simon Sandstone formation (saline reservoir). Research data indicate that the Mt. Simon Sandstone formation contains favorable characteristics to safely store CO_2 at great depths. At its lowest depth, around 7,000 feet, the sandstone formation has high porosity and can readily store CO_2. Researchers estimate that the sandstone formation can potentially store billions of tons of CO_2.

To support the requirements of the compression equipment, the project includes the design and construction of a 100 MW substation and associated electrical infrastructure. Integral to the project will be the formation of an educational and training facility, the National Sequestration Education Center (NSEC), slated to be housed at nearby Richland Community College in Decatur, Illinois. The center will offer training, laboratory facilities, and associate degrees in sequestration technology.



Benefits

The project addresses climate change concerns and plans to sequester approximately 2,500 metric tons of CO_2 per day in the saline Mt. Simon Sandstone formation at depths of approximately 7,000 feet – making it the largest saline sequestration project in the United States. Because all of the captured CO_2 is produced from biologic fermentation, a significant feature of the project is its "negative carbon footprint," meaning that the sequestration results in a net reduction of atmospheric CO_2. This project helps gather crucial scientific and engineering data for large-scale saline sequestration in advance of carbon capture requirements. This project also demonstrates the cost advantages and economic viability of carbon storage technologies at ethanol production facilities.

Status/Accomplishments

This project has completed front-end engineering design (FEED), environmental assessment (EA) and associated finding of no significant impact (FONSI), and most of the detailed design for the compression, dehydration, and injection facilities. Construction of compressor building, motor control center, and gas-insulated switchgear building and foundation work for the compressors are in progress. Long-lead equipment such as compressors and blowers were ordered. The construction of the NSEC building is also underway.

All federal funding provided under the American Recovery and Reinvestment Act of 2009 (Recovery Act).

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Demonstration of CO_2 Capture and Sequestration of Steam Methane Reforming Process Gas Used for Large-Scale Hydrogen Production

Large-Scale ICCS

Carbon Capture, Utilization and Storage

Oxy Comb	☐	Pre-Comb	☐
ICCS	■	Post-Comb	☐

Participant
Air Products and Chemicals, Inc.

Additional Team Members
Denbury Resources, Inc.—CO_2 monitoring, verification, and accounting (MVA)

Location
Port Arthur, Jefferson County, TX

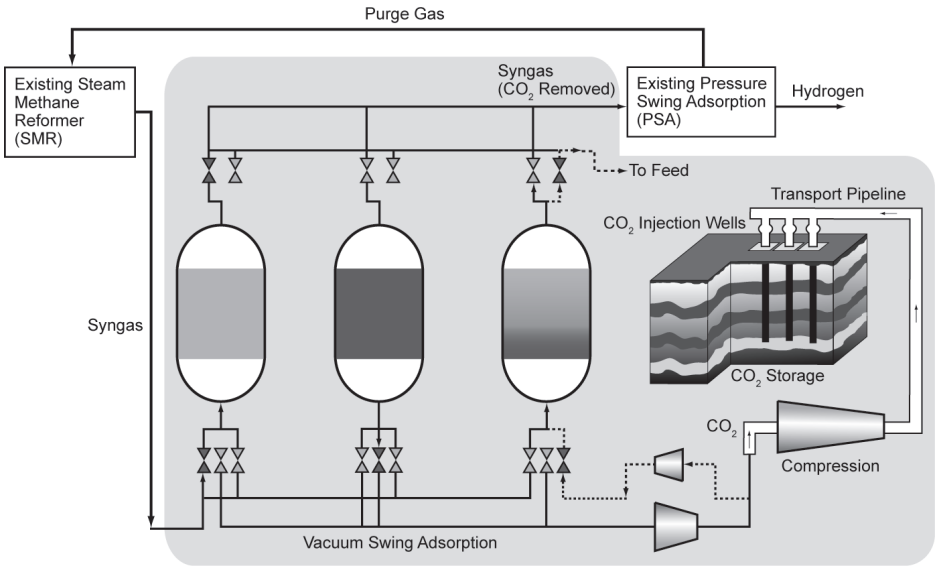
Technology
Vacuum swing adsorption (VSA) system to capture CO_2 from hydrogen production for enhanced oil recovery (EOR)

Plant Capacity/Production
Approximately 1 million metric tons per year of CO_2

Industry
Steam methane reformer (SMR) for hydrogen production

Project Funding

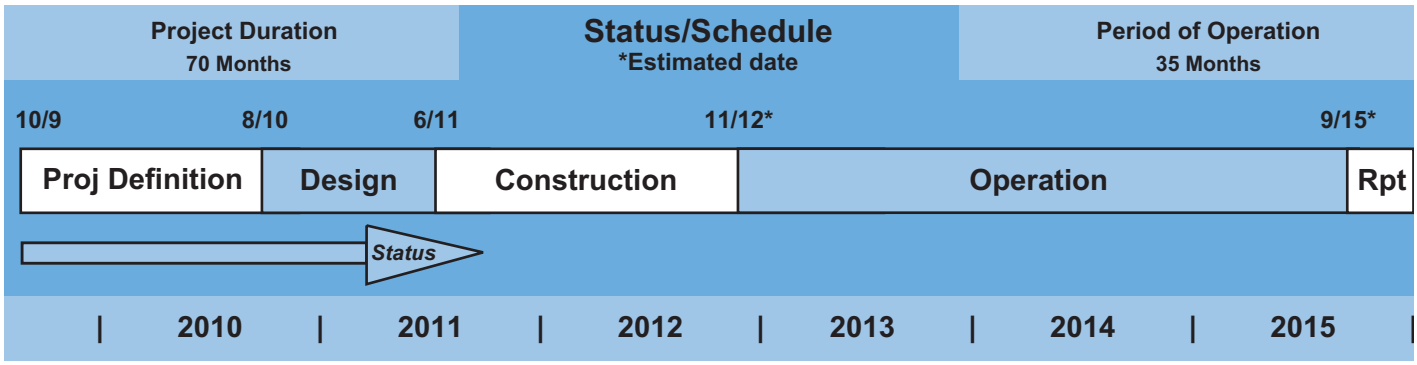
Total	$430,648,802	100%
DOE Share	284,012,496	66
Participant	146,636,306	34



Objectives
To design, construct, and operate a carbon capture and storage (CCS) system from two steam methane reformer (SMR) process gas streams and deliver the carbon dioxide (CO_2) to a nearby oil field for sequestration in an EOR application.

Technology/Project Description
The project demonstrates a retrofit application of a VSA system to concentrate CO_2 from two SMR process gas streams and transport the captured CO_2 via pipeline for injection into the West Hastings oil field in eastern Texas for sequestration and improved oil production. The VSA process uses adsorbents to selectively remove one or more components, in this case CO_2, from the feed stream at high pressure. The process then ultimately swings to a vacuum to regenerate the adsorbent material. The process removes more than 90 percent of the CO_2 from the feed stream with greater than 98 percent purity for delivery to the pipeline, with negligible impact on the efficiency of hydrogen production.

Benefits
Approximately 1 million metric tons per year will be delivered for sequestration and EOR, which will lead to an estimated annual increase in oil production of 1.6 to 3.1 million barrels.



Status/Accomplishments

The project was selected in June 2010 to proceed under the large-scale Industrial Carbon Capture and Storage (ICCS) program. The award was signed on September 28, 2010.

The draft Environmental Assessment (EA) was made available for public comment on May 18, 2011. The public comment period ended on June 17, 2011. A Finding of No Significant Impact (FONSI) was issued to Air Products on July 8, 2011. The Texas Commission on Environmental Quality (TCEQ) issued Air Products a Permit by Rule on May 20, 2011. A Standard Permit was issued on May 27, 2011, completing the air permit process. DOE granted approval to proceed with the construction and commissioning phase of the project on June 1, 2011.

All federal funding provided under the American Recovery and Reinvestment Act of 2009 (Recovery Act).

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Lake Charles CCS Project

Large-Scale ICCS

Carbon Capture, Utilization and Storage

Oxy Comb ☐ Pre-Comb ☐

ICCS ■ Post-Comb ☐

Participant

Leucadia Energy, LLC

Additional Team Members

KBR—design engineering for Rectisol®/carbon dioxide (CO_2) compression systems

Denbury Onshore, LLC—CO_2 transport and injection

University of Texas—CO_2 monitoring, verification, and accounting (MVA)

Location

Lake Charles, Calcasieu Parish, LA

Technology

Gasification of petroleum coke to produce methanol. CO_2 captured via Rectisol® for use in enhanced oil recovery (EOR).

Plant Capacity/Production

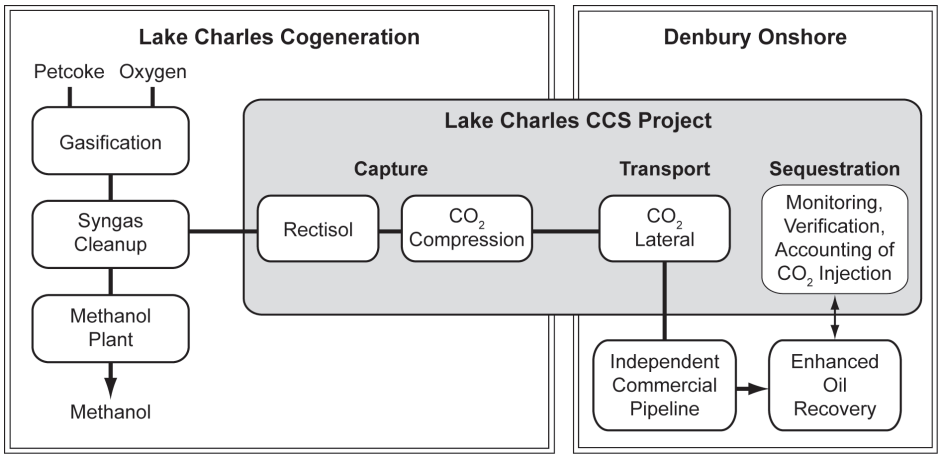
Approximately 4.5 million metric tons per year of CO_2

Industry

Gasification for methanol production

Project Funding

Total	$435,587,194	100%
DOE Share	261,382,310	60
Participant	174,204,884	40



Objectives

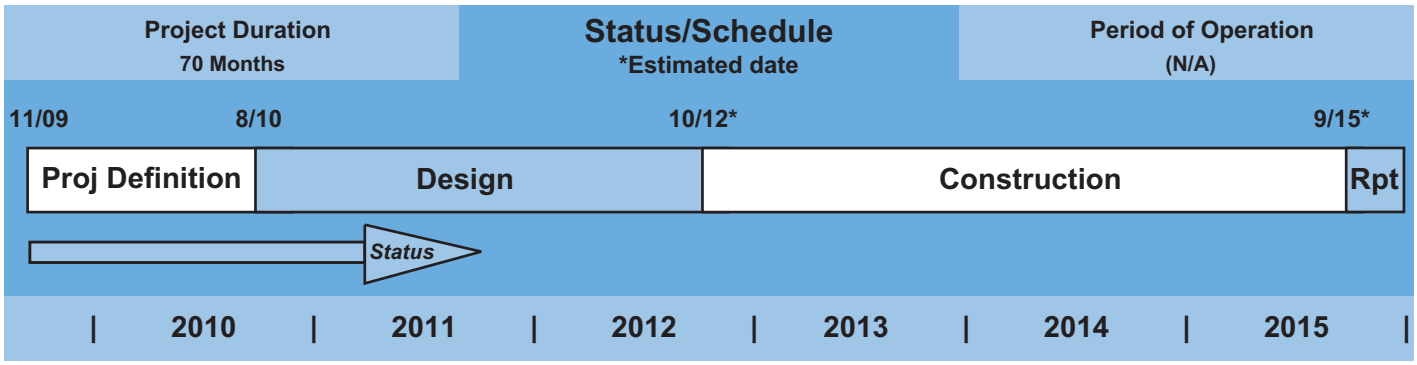
To design, construct, and operate a large-scale carbon capture and storage (CCS) system from a methanol-producing petcoke gasification plant and transport the captured CO_2 for EOR in the U.S. Gulf Coast Region.

Technology/Project Description

The project will employ the Rectisol® process to perform the separation of CO_2 from a petroleum-coke-to-chemicals (methanol and other by-products) gasification plant being developed by Lake Charles Cogeneration, LLC (a Leucadia Energy, LLC affiliate). The Rectisol® process operates selectively to recover the CO_2 as a separate stream that will be purified to remove contaminants and compressed to a pressure suitable for commercial pipeline transport to oil fields in Texas for EOR. The project will also implement a comprehensive MVA program to confirm the long-term sequestration of produced CO_2.

Benefits

The project represents a large-scale capture and beneficial reuse of CO_2 from an industrial source. EOR operation is estimated to result in oil production of approximately 6 million barrels per year. By using CO_2 from the gasification plant, less CO_2 will be used from naturally occurring sources. In addition, the infrastructure developed by the project could potentially enable other CO_2 sources in the Lake Charles area to commercially dispose of CO_2 in the Gulf Coast EOR operations.



Status/Accomplishments

The project was selected in June 2010 to proceed under the large-scale Industrial Carbon Capture and Storage (ICCS) program. The Public Scoping Meetings for the preparation of an Environmental Impact Statement (EIS) were held on May 16 and 17, 2011 in Pearland, TX and Lake Charles, LA. Design activities of the Rectisol® system are ongoing. Activities needed to initiate construction of the gasification plant include finalizing off-take agreements and achieving financial close.

All federal funding provided under the American Recovery and Reinvestment Act of 2009 (Recovery Act).

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Appendix A. Historical Perspective, Legislative History, and Public Laws

CCTDP Historical Perspective

A number of key events prompted the 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 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 examined 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 Round 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 being 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 (FY) 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. On April 4, 1987, the President asked 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.

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, recissions, and transfers to other Fossil Energy activities. 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.

Recissions and transfers 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).
- $95 million was transferred to the Power Plant Improvement Initiative by Public Law 106-291.
- $33.7 million was transferred to Fossil Energy Research and Development by Public Law 107-63.
- $10,000 was rescinded by Public Law 107-206 (Admin and Travel Rescission).
- $88 million was rescinded by Public Law 108-108.
- $20 million was rescinded by Public Law 109-103.
- $166 million was transferred to Fossil Energy Research and Development by Public Law 110-161.
- $149 million was transferred to the Clean Coal Power Initiative (CCPI) by Public Law 111-8.
- $16.5 million was rescinded by Public Law 112-10.

In addition to rescissions and transfers, the annual appropriations bills have deferred the availability of various amounts of previously appropriated funds until the start of subsequent fiscal years. These deferrals only involved funding not needed in the current fiscal year and therefore, did not impact ongoing projects. In 2009, Public Law 111-8 transferred the full amount of previously deferred CCTDP funding ($149 million) to the CCPI. With no active projects remaining in the CCTDP Program, these funds were no longer needed. This transfer left less than $17 million in unobligated funding in CCTDP accounts. Public Law 110-161 granted authorization to utilize remaining unobligated CCTDP funds for the CCPI. In 2011, the remaining $16.5 million was rescinded by Public Law 112-10.

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 (Funding Only)

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.
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 & 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 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.	Two solicitations (CCTDP-IV and CCTDP-V) to be issued, one each appropriation, to demonstrate technologies capable of replacing, retrofitting, or repowering existing facilities, 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.

Exhibit A-1 (continued)
CCTDP Legislative History (Funding Only)

Public Law	Date Enacted	CCTDP Round	Program Funding	Implementation Provisions
101-164	11/21/89	CCTDP-IV & 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 & CCTDP-V	Obligation of funds previously appropriated for CCTDP-IV and was deferred until 9/1/91.	
101-512	11/5/90	CCTDP-IV & 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 (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.

Exhibit A-1 (continued)
CCTDP Legislative History (Funding Only)

Public Law	Date Enacted	CCTDP Round	Program Funding	Implementation Provisions
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.	
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 FY97, $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 funds made available for obligation in prior years, $40,000,000 was deferred and $33,700,000 was transferred to Fossil Energy Research and Development.	
108-7	2/20/03		Of funds made available for obligation in prior years, $87,000,000 was deferred.	
108-108	11/10/03		Of funds made available for obligation in prior years, $97,000,000 was deferred and $88,000,000 rescinded.	
108-447	12/8/04		Of funds made available for obligation in prior years, $257,000,000 was deferred.	
109-103	11/19/05		Of funds made available for obligation in prior years, $257,000,000 was deferred and $20,000,000 rescinded.	
110-5	2/15/07		Of funds made available for obligation in prior years, $257,000,000 was deferred.	
110-161	12/26/07		Of funds made available for obligation in prior years, $149,000,000 was deferred and $166,000,000 was transferred to Fossil Energy Research and Development.	
111-8	3/11/09		Of funds made available for obligation in prior years, $149,000,000 was transferred to the Clean Coal Power Initiative.	
112 -10	4/15/11		Of the unobligated balances from prior year appropriations available for `Department of Energy, Energy Programs, Clean Coal Technology', $16,500,000 is rescinded.	

[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 FY2001 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 included 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 in excess of the needs of the PPII procurement be made available for the Clean Coal Power Initiative (CCPI). In 2011, the remaining $52,569 was rescinded by Public Law 112-10.

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.

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, and mercury, new technologies are needed to provide consistent, reliable, low-cost energy while meeting these standards. Electricity demand is expected to grow at a significant pace for the foreseeable future. Driven by the rise in the digital economy, higher quality electricity is in greater demand than ever before. Digital-based technologies are playing an ever-increasing role in the development of new power plant technologies. Neu

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.	
112 -10	4/15/11	As part of a $140 million rescission under Fossil Energy Research and Development', $52,569 of remaining PPII funding was rescinded.	

ral 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.

By spreading out multiple solicitations, CCPI will be able to emphasize the most pressing environmental issues of the day, such as climate change, and the latest technologies that are ready for commercial-scale demonstration.

CCPI Legislative History

The legislation authorizing CCPI is found in Public Law 107-63, Department of Interior and Related Agencies Appropriations Act for FY02. 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 (RD&D) 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 RD&D 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. Again in 2003 under Public Law 108-108, Congress made an additional $172,000,000 available for CCPI. In 2004, Congress appropriated another $50,000,000 for CCPI in Public Law 108-447.

In 2005, Congress appropriated $50,000,000 for CCPI in Public Law 109-103 for use in a third solicitation. In 2007, Public Laws 110-5 and 110-161 made available a total of $130.4 million for the third solicitation. In 2009, Public Law 111-8 added $288.2 million and the American Recovery and Reinvestment Act (ARRA) added an additional $800 million. The ARRA funding could be used for new or modified applications under the third solicitation. The requirement for a repayment provision was dropped for the third solicitation.

In 2011, as part of a $140 million rescission under Fossil Energy Research and Development, $104,876,186 of remaining unobligated CCPI funding was rescinded.

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 use 107-63. 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.

Exhibit A-3 (continued)
CCPI Legislative History

Public Law	Date Enacted	Program Funding	Implementation Provisions
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.	Comparable to prior years.
108-108	11/10/03	Made an additional $172,000,000 available for CCPI.	Comparable to prior years.
108-447	12/8/04	Made an additional $50,000,000 available for CCPI.	Comparable to prior years.
109-58	8/8/05	(Contained no funding provisions).	Section 401—Report to Congress – The Secretary shall submit to Congress the report required by this subsection not later than March 31, 2007. The report shall include, with respect to subsection (a), a plan containing (1) a detailed assessment of whether the aggregate funding levels provided under subsection (a) are the appropriate funding levels for that program; (2) a detailed description of how proposals will be solicited and evaluated, including a list of all activities expected to be undertaken; (3) a detailed list of technical milestones for each coal and related technology that will be pursued; and (4) a detailed description of how the program will avoid problems enumerated in Government Accountability Office reports on the Clean Coal Technology Program, including problems that have resulted in unspent funds and projects that failed either financially or scientifically. Section 402—Project Criteria – Section provided detailed requirements to be eligible to receive assistance under CCPI, including specifics regarding efficiency, environmental performance, cost competitiveness, and that at least 70 percent of the funds are used only to fund projects on coal-based gasification technologies. Section 403—Report to Congress – Not later than 1 year after the date of enactment of this Act, and once every 2 years thereafter through 2014, the Secretary, in consultation with other appropriate Federal agencies, shall submit to Congress a report describing—(1) the technical milestones set forth in section 402 and how those milestones ensure progress toward meeting the requirements of subsections (b)(1)(B) and (b)(2) of section 402; and (2) the status of projects funded under this subtitle.
109-103	11/19/05	Made an additional $50,000,000 available for CCPI.	Comparable to prior years.
110-5	2/15/07	Made an additional $60,433,000 available for CCPI.	Comparable to prior years.
110-161	12/26/07	Made an additional $70,000,000 available for CCPI.	Comparable to prior years.
111-5	2/17/09	Made $3,400,000,000 available to Fossil Energy under the American Recovery and Reinvestment Act of 2009. $800,000,000 was made available for CCPI.	Senate conference language recommended a second closing date under CCPI-3 for new or modified applications and consideration of applications that utilize petroleum coke for some or all of the project's fuel input.
111-8	3/11/09	Made an additional $288,174,000 available for CCPI.	Specified a two-year time limit from time of project selection to award that may be extended at the Secretary's discretion for matters outside the control of the applicant, or if the Secretary determines that extension of the time limit is in the public interest.
112 -10	4/15/11	Remaining unobligated balance ($104,876,186) was rescinded as part of a $140,000,000 rescission of prior year Fossil Energy Research and Development funding.	

FutureGen 2.0 and Industrial Carbon Capture and Storage

Funding for FutureGen 2.0 and the large-scale Industrial Carbon Capture and Storage projects was provided under ARRA in 2009. No additional funding is anticipated. Funding for the initial FutureGen effort began in 2004 under appropriations for Fossil Energy Research and Development. Approximately $53 million remaining from these prior appropriations will be used toward the FutureGen 2.0 effort.

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.

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 FY86 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 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 percent 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 FY89 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 the 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 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 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 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 unobli-

gated 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 FY03 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.

Public Law 108-108

Public Law 108-108, 117 Stat. 1241 (2003)

Clean Coal Technology (Deferral and Recision)

Of the funds made available under this heading for obligation in prior years, $97,000,000 shall not be available until October 1, 2004, and $88,000,000 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.

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), $681,163,000, 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; of which not to exceed $536,000 may be utilized for travel and travel-related expenses incurred by the headquarters staff of the Office of Fossil Energy; and of which $172,000,000 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 42 U.S.C. 5903d: *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.

Conference Report (H.R. Conf. Rep. No. 108-330, 108th Cong., 1st Sess. [2003])

Clean Coal Technology (Deferral and Recision)

The conference agreement defers $97,000,000 in clean coal technology funds as proposed by the Senate instead of a deferral of $86,000,000 as proposed by the House. The conference agreement also rescinds $88,000,000 in clean coal technology funds. These funds have been added to the base budget for the fossil energy research and development account where all continuing research programs and associated administrative expenses should be funded. Clean coal technology funds are limited to completing active projects under that program. Once those projects are completed, a separate clean coal technology account will no longer be required.

The managers have not included bill language authorizing the use of clean coal technology funds for the FutureGen program as proposed by the Senate. Funding is included in the fossil energy research and development account for FutureGen. The managers agree that clean coal technology funds should not be transferred to fund ongoing programs in fossil energy research and development. Rather, a rescission of excess clean coal funds should be proposed and, to the extent new and expanded research program funds are required, including funds for FutureGen, they should be budgeted directly in the fossil energy research and development account.

Fossil Energy Research and Development

The conference agreement includes $681,163,000 for fossil energy research and development, instead of $609,290,000 as proposed by the House and $593,514,000 as proposed by the Senate. The conference agreement includes funds for several ongoing programs that were previously funded under the clean coal technology account, funding to begin the FutureGen program, and funding increases for programs that provide critical underpinning for, and are critical for the success of, FutureGen. The increase in funding above the Senate proposed level is offset fully by the rescission of $88 million in clean coal technology funding. The numerical changes described below are to the House recommended level.

The conference agreement includes increases of $42,000,000 for the clean coal power initiative and $9,000,000 to initiate the FutureGen program. The funds provided for the FutureGen program are contingent on the receipt of a complete program plan that clearly and fully delineates by project and by year the funding for each element of, and milestone associated with, the FutureGen program. This plan should be closely coordinated with industry cooperators and submitted to the House and Senate Committees on Appropriations no later than December 31, 2003. The managers understand the need for a lower cost share for the initial research and planning stages of the FutureGen program, but any demonstration component must include at least a 50 percent industry cost share.

Public Law 108-447

Public Law 108-447, 118 Stat. 2809 (2004)

Clean Coal Technology (Deferral)

Of the funds made available under this heading for obligation in prior years, $257,000,000 shall not be available until October 1, 2005: *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), $579,911,000, 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: *Provided*, That of the amounts provided, $18,000,000 is to continue a multi-year project coordinated with the private sector for FutureGen, without regard to the terms and conditions applicable to clean coal technology projects: *Provided further*, That the initial planning and research stages of the FutureGen project shall include a matching requirement from non-Federal sources of at least 20 percent of the costs: *Provided further*, That any demonstration component of such project shall require a matching requirement from non-Federal sources of at least 50 percent of the costs of the component: *Provided further*, That of the amounts provided, $50,000,000 is 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 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 42 U.S.C. 5903d: *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 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 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.

Conference Report (H.R. Conf. Rep. No. 108-792, 108th Cong. 2nd Sess. [2004])

Clean Coal Technology (Deferral)

The conference agreement defers the availability of $257,000,000 in clean coal technology funds until October 1, 2005, as proposed by the Senate instead of a deferral of $237,000,000 as proposed by the House. The FutureGen program is not funded in this account, as proposed by the House, but is funded in the fossil energy research and development account.

The managers expect the Department to include a table on the FutureGen program, as outlined in the House Report 108-542, in future budget requests for fossil energy research and development account. The managers make no assumptions on the future use of deferred clean coal technology funds.

Fossil Energy Research and Development

The conference agreement provides $579,911,000 for fossil energy research and development instead of $601,875,000 as proposed by the House and $542,529,000 as proposed by the Senate. The changes described below are to the House recommended funding level.

FutureGen—There is an increase of $18,000,000 for the FutureGen power plant initiative.

Clean Coal Power Initiative—There is a decrease of $55,000,000 for the clean coal power initiative.

The managers note that funding will need to be increased substantially in FY06 if the program is to remain on a schedule consistent with the President's clean coal initiative.

Public Law 109-103

Public Law 109-103, 119 Stat. 2247 (2005)

Clean Coal Technology (Deferral and Rescission)

Of the funds made available under this heading for obligation in prior years, $257,000,000 shall not be available until October 1, 2006: *Provided*, That funds made available in previous appropriations Acts shall be made available for any ongoing project regardless of the separate request for proposal under which the project was selected: *Provided further*, That $20,000,000 of uncommitted balances is rescinded.

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, the hire of passenger motor vehicles, the hire, maintenance, and operation of aircraft, the purchase, repair, and cleaning of uniforms, the reimbursement to the General Services Administration for security guard services, 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), $597,994,000, to remain available until expended, of which $18,000,000 is to continue a multi-year project coordinated with the private sector for FutureGen, without regard to the terms and conditions applicable to clean coal technological projects: *Provided*, That the initial planning and research stages of the FutureGen project shall include a matching requirement from non-Federal sources of at least 20 percent of the costs: *Provided further*, That any demonstration component of such project shall require a matching requirement from non-Federal sources of at least 50 percent of the costs of the component: *Provided further*, That of the amounts provided, $50,000,000 is 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 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 42 U.S.C. 5903d as well as those 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: *Provided further*, That for fiscal year 2006 salaries for Federal employees performing research and development activities at the National Energy Technology Laboratory can continue to be funded from program accounts: *Provided further*, That the Secretary of Energy is authorized to accept fees and contributions from public and private sources, to be deposited in a contributed funds account, and prosecute projects using such fees and contributions in cooperation with other Federal, State, or private agencies or concerns: *Provided further*, That revenues and other moneys received by or for the account of the Department of Energy or otherwise generated by sale of products in connection with projects of the Department appropriated under the Fossil Energy Research and Development account may be retained by the Secretary of Energy, to be available until expended, and used only for plant construction, operation, costs, and payments to cost-sharing entities as provided in appropriate cost-sharing contracts or agreements.

Public Law 110-5

Public Law 110-5, 121 Stat. 8 (2007)

The final continuing resolution for fiscal year 2007 did not contain language specific to the Clean Coal Technology Demonstration Program or the Clean Coal Power Initiative. For the Clean Coal Technology Demonstration Program, the availability of $257,000,000 was deferred until October 1, 2007. For the Clean Coal Power Initiative, $60,433,000 was made available.

House Report 109-474 (2006)

Clean Coal Technology (Rescission)

The Committee recommends the rescission of $257,000,000 in clean coal technology funding. These balances are no longer needed to complete active projects in this program. For several years the Administration has proposed, and Congress has to some extent obliged, the deferral of these balances to the out-years, for the appearance of retaining them for FutureGen activities. The practice of 'deferring balances' or 'transferring balances' is purely a budgetary optical illusion. Congress appropriates FutureGen activities on an annual basis. There are no budgetary savings by utilizing prior year clean coal technology balances. The Committee will continue to evaluate budget requests for FutureGen activities on an annual basis, and appropriate directly, without the budget scoring gimmickry of clean coal technology prior year balances.

Fossil Energy Research and Development

Clean coal power initiative—This program researches, develops, and demonstrates commercial readiness to implement advanced clean coal-based technologies that enhance electricity reliability, increase generation capacity,

and reduce emissions. The Committee recommends $36,400,000 for the clean coal power initiative (CCPI), an increase of $31,443,000 over the budget request. This funding will support the third round of demonstration projects, incorporating the latest advances in clean coal technologies. The Committee believes it is important to keep momentum in this program towards the accumulation of balances for future rounds of CCPI awards. The Committee does not accept the Department's argument that this next solicitation is not needed because the technologies demonstrated will be too late for incorporation in FutureGen. The Committee views FutureGen as a major step in the development of coal fired power plants, but not the end of new technology in this area.

Senate Report 109-274 (2006)

Clean Coal Technology (Including Deferral and Rescission)

The Committee recommends the deferral of $203,000,000 in clean coal technology funding until fiscal year 2008. The Committee recommends that the Department rescind $50,000,000 of prior year balances from excess contingency estimates in demonstration projects.

Fossil Energy Research and Development

Clean Coal Power Initiative—The Committee recommends $70,000,000. The Committee is frustrated by the remarkably low level of funding provided to this initiative which demonstrates advanced coal technologies including carbon capture, mercury control and other co-production opportunities. The budget only provided $4,957,000. The Committee is aware that not all of the previously awarded projects have been successfully developed for a variety of reasons, and available balances will not be used. The Department has identified one project that will not be able to spend the remaining balances of $50,000,000. The Committee directs the Department to rescind the available balances and apply that funding to the Clean Coal Power Initiatives for a future competitive award. In addition, the Committee provides an additional $20,000,000.

Combined with existing balances of $70,000,000 provided in the current year, the Department will have $140,000,000 to commit to the next CCPI solicitation.

Public Law 110-161

Public Law 110-161, 121 Stat. 1844 (2007)

Clean Coal Technology (Deferral and Transfer)

Of the funds made available under this heading for obligation in prior years, $149,000,000 shall not be available until October 1, 2008: *Provided*, That funds made available in previous appropriations Acts shall be made available for any ongoing project regardless of the separate request for proposal under which the project was selected: *Provided further*, That $166,000,000 of uncommitted balances are transferred to Fossil Energy Research and Development to be used until expended.

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 the hire of passenger motor vehicles, the hire, maintenance, and operation of aircraft, the purchase, repair, and cleaning of uniforms, the reimbursement to the General Services Administration for security guard services, 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), $750,000,000, to remain available until expended, of which $166,000,000 shall be derived by transfer from 'Clean Coal Technology': *Provided further*, That funds appropriated for prior solicitations under the Clean Coal Technology Program, Power Plant Improvement Initiative, and Clean Coal Power Initiative, but not required by the Department to meet its obligations on projects selected under such solicitations, may be utilized for the Clean Coal Power Initiative Round III solicitation under this Act in accordance with the requirements of this Act rather than the Acts under which the funds were appropriated: *Provided further*, That no project may be selected for which full funding is not available to provide for the total project: *Provided further*, That financial assistance for costs in excess of those estimated as of the date of award of original Clean Coal Power Initiative financial assistance may not be provided in excess of the proportion of costs borne by the Government in the original agreement and shall be limited to 25 percent of the original financial assistance: *Provided further*, That at least 50 percent cost-sharing shall be required in each budget period of a project: *Provided further*, That in accordance with section 988(e) of Public Law 109-58, repayment of the DOE contribution to a project shall not be a condition of making an award under this solicitation: *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 in this Act and future Acts, 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 Fossil Energy account: *Provided further*, That in this Act and future Acts, the salaries for Federal employees

performing research and development activities at the National Energy Technology Laboratory can continue to be funded from any appropriate DOE program accounts: *Provided further*, That revenues and other moneys received by or for the account of the Department of Energy or otherwise generated by sale of products in connection with projects of the Department appropriated under the Fossil Energy Research and Development account may be retained by the Secretary of Energy, to be available until expended, and used only for plant construction, operation, costs, and payments to cost-sharing entities as provided in appropriate cost-sharing contracts or agreements.

Public Law 111-5

Public Law 111-5, 123 Stat. 115 (2009)

American Recovery and Reinvestment Act of 2009

Fossil Energy Research and Development

For an additional amount for 'Fossil Energy Research and Development', $3,400,000,000.

House Report 111-016 (2009)

Fossil Energy Research and Development

For an additional amount for 'Fossil Energy Research and Development', $3,400,000,000.

Senate Report 111-003 (2009)

Fossil Energy Research and Development

The Committee provides an additional $4,600,000,000, to remain available for projects awarded by September 30, 2010. Of the amounts appropriated, $2,000,000,000 is available for one or more near-zero emissions powerplant(s) designed to capture and sequester a high percentage of carbon dioxide.

Of the amounts appropriated, $1,000,000,000 is available, in addition to amounts appropriated in the fiscal year 2009 spending bill and such other amounts available from prior appropriations, for selections under the Department's Clean Coal Power Initiative Round III Funding Opportunity Announcement. The Department is encouraged to establish a second closing date on or after April 1, 2009 for the receipt of new or modified applications. Notwithstanding the mandatory eligibility requirements of the Funding Opportunity Announcement, the Committee finds that projects using petroleum coke as a fuel may directly lead to improvements in technology applicable to coal-based systems and is consistent with program objectives. Therefore, language is included in the bill directing the Department to consider applications that utilize petroleum coke for some or all of the project's fuel input.

Of the amounts appropriated, $1,520,000,000 is available for a competitive solicitation pursuant to section 703 of Public Law 110-140 for projects that demonstrate carbon capture from industrial sources. Such projects may include plant efficiency improvements for integration with carbon capture technology. Preferences will be given to projects that capture and sequester at least 75 percent of the carbon dioxide that would otherwise be emitted to the atmosphere or put such carbon dioxide to beneficial reuse that provides an equivalent net reduction of carbon emissions to the atmosphere.

Of the amounts appropriated, $50,000,000 is available for a competitive solicitation pursuant to section 702(c)(3)(B) of Public Law 110-140 to conduct site characterization for a minimum of 10 candidate geologic sequestration formations. The Secretary may provide awards to project recipients previously provided funding for large-scale testing by the Department of Energy. Preference should be given to qualifying projects which include a private-public partnership with State Geological Surveys, and have storage sites near high point sources of carbon dioxide emissions.

$20,000,000 is available to carry out the geologic sequestration training and research grant program authorized in section 705(b) of Public Law 110-140, and $10,000,000 is available for program direction funding. The Committee recognizes the broad sequestration experience resident in the Office of Fossil Energy.

Public Law 111-8

Public Law 111-8, 123 Stat. 524 (2009)

Clean Coal Technology (Transfer)

Of the funds made available under this heading for obligation in prior years, $149,000,000 of uncommitted balances are transferred to Fossil Energy Research and Development to be used until expended: *Provided*, That funds made available in previous appropriations Acts shall be made 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), $876,320,000, to remain available until expended, of which $149,000,000 shall be derived by transfer from 'Clean

Coal Technology': *Provided*, That of the amounts provided, $288,174,000 is available for the Clean Coal Power Initiative Round III solicitation, pursuant to title IV of the Public Law 109-58: *Provided further*, That funds appropriated for prior solicitations under the Clean Coal Technology Program, Power Plant Improvement Initiative, Clean Coal Power Initiative, and FutureGen, but not required by the Department to meet its obligations on projects selected under such solicitations, may be utilized for the Clean Coal Power Initiative Round III solicitation under this Act in accordance with the requirements of this Act rather than the Acts under which the funds were appropriated: *Provided further*, That no Clean Coal Power Initiative project may be selected for which full funding is not available to provide for the total project: *Provided further*, That if a Clean Coal Power Initiative project selected after enactment of this legislation for negotiation under this or any other Act in any fiscal year, is not awarded within 2 years from the date the application was selected, negotiations shall cease and the Federal funds committed to the application shall be retained by the Department for future coal-related research, development and demonstration projects, except that the time limit may be extended at the Secretary's discretion for matters outside the control of the applicant, or if the Secretary determines that extension of the time limit is in the public interest: *Provided further*, That the Secretary may not delegate this responsibility for applications greater than $10,000,000: *Provided further*, That financial assistance for costs in excess of those estimated as of the date of award of original Clean Coal Power Initiative financial assistance may not be provided in excess of the proportion of costs borne by the Government in the original agreement and shall be limited to 25 percent of the original financial assistance: *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 42 U.S.C. 5903d as well as those contained under the heading 'Clean Coal Technology' in prior appropriations: *Provided further*, That any technology selected under these programs shall be considered a Clean Coal Technology, and any project selected under these programs 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 funds available for the Clean Coal Power Initiative Round III Funding Opportunity Announcement may be used to support any technology that meets the requirements of the Round III Announcement relating to carbon capture and storage or other beneficial uses of CO_2, without regard to the 70 and 30 percent funding allocations specified in section 402(b)(1)(A) and 402(b)(2)(A) of Public Law 109-58: *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, of the amount appropriated in this paragraph, $43,864,150 shall be used for projects specified in the table that appears under the heading 'Congressionally Directed Fossil Energy Projects' in the text and table under this heading in the explanatory statement described in section 4 (in the matter preceding division A of this consolidated Act).

Public Law 111 -85

Public Law 111 -85, 123 Stat. 2845 (2009)

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), $672,383,000, to remain available until expended: Provided, That for all programs funded under Fossil Energy appropriations in this Act or any other Act, the Secretary may vest fee title or other property interests acquired under projects in any entity, including the United States: Provided further, That, of the amount appropriated in this paragraph, $36,850,000 shall be used for projects specified in the table that appears under the heading ``Congressionally Directed Fossil Energy Projects'' in the joint explanatory statement accompanying the conference report on this Act.

Public Law 112 -10

Public Law 112 -10 (2011)

Sec. 1461. Of the unobligated balances from prior year appropriations available for `Department of Energy, Energy Programs, Fossil Energy Research and Development', $140,000,000 is rescinded.

Sec. 1463. Of the unobligated balances from prior year appropriations available for `Department of Energy, Energy Programs, Clean Coal Technology', $16,500,000 is rescinded.

Appendix B. CCTDP Financial History

Appendix B provides historical funding and cost information on the CCTDP. Over a series of five solicitations, the CCTDP produced 33 successfully completed projects. The final active project withdrew prior to completion in March 2006. Exhibit B-1 summarizes the costs associated with the 33 successfully completed projects.

Exhibit B-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 for CCTDP management.

Exhibit B-3, on the following page, depicts the apportionment of appropriated funds to DOE. Funds can be transferred among subprogram budgets to meet project and program needs.

Exhibit B-1
CCTDP Project Costs and Cost-Sharing for Successfully Completed Projects
(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	23	239,640	604,723	28	72
CCTDP-II	318,577	9	139,195	179,382	44	56
CCTDP-III	1,138,741	30	483,665	655,076	42	58
CCTDP-IV	950,429	25	437,876	512,553	46	54
CCTDP-V	0	0	0	0	0	0
Total[a]	3,252,110	100	1,300,376	1,951,734	40	60
Application Category						
Advanced Electric Power Generation	1,978,492	61	812,912	1,165,580	41	59
Environmental Control Devices	620,110	19	252,832	367,278	41	59
Coal Processing for Clean Fuels	431,810	13	192,029	239,781	44	56
Industrial Applications	221,698	7	42,603	179,095	19	81
Total[a]	3,252,110	100	1,300,376	1,951,734	40	60

[a] Totals may not add up to the total figure shown due to rounding.
[b] DOE share does not include $156,833,000 obligated for withdrawn projects and audit expenses.

Exhibit B-2
Relationship Between Appropriations and Subprogram Budgets
(Dollars in Thousands)

Appropriation Enacted	Subprogram	Adjusted Appropriations	SBIR & STTR Budgets[a]	Program Direction Budget	Projects Budget
P.L. 99-190	CCTDP-I	380,600	4,902	144,767	230,931
P.L. 100-202	CCTDP-II	473,776	6,781	32,512	434,483
P.L. 100-446	CCTDP-III	304,298	6,906	22,548	274,844
P.L. 101-121[b]	CCTDP-IV	331,990	7,065	24,990	299,935
P.L. 101-121[b]	CCTDP-V	247,437	5,427	25,000	217,007
Total		1,738,098	31,081	249,817	1,457,200

[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, 108-7, 108-108, 108-447, 109-103, 110-5, 110-161, 111-8, 111-85, and 112-10.

Exhibit B-3

Annual CCTDP Funding by Appropriations and Subprogram Budgets

(Dollars in Thousands)

Fiscal Year	1986–01	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total[d]
Adjusted Appropriations[a]												
P.L. 99-190	380,600											380,600
P.L. 100-202	458,776	15,000										473,776
P.L. 100-446	574,998	(33,700)		(185,000)	97,000							304,298
P.L. 101-121[b]	265,000	26,990	(47,000)	87,000								331,990
P.L. 101-121[b]	449,934				(257,000)	(20,000)		(58,000)			(16,500)	247,437
Total	2,129,308	8,290	(47,000)	(98,000)	(160,000)	(20,000)	0	(58,000)	0	0	(16,500)	1,738,098
Subprogram Budgets												
CCTDP-I Projects	259,931	(14,000)	(15,000)									230,931
CCTDP-II Projects	419,483	15,000										434,483
CCTDP-III Projects	545,544	(33,700)		(185,000)	97,000							274,844
CCTDP-IV Projects	232,935	27,000	40,000									299,935
CCTDP-V Projects	419,507		(87,000)	87,000	(257,000)	(20,000)		(58,000)			(16,500)	217,007
Projects Subtotal	1,877,400	(5,700)	(62,000)	(98,000)	(160,000)	(20,000)	0	(58,000)	0	0	(16,500)	1,457,200
Program Direction	220,827	13,990	15,000									249,817
Fossil Energy Subtotal	2,098,227	8,290	(47,000)	(98,000)	(160,000)	(20,000)	0	(58,000)	0	0	(16,500)	1,707,017
SBIR & STTR[c]	31,081											31,081
Total[d]	2,129,308	8,290	(47,000)	(98,000)	(160,000)	(20,000)	0	(58,000)	0	0	(16,500)	1,738,098

[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, 108-7, 108-108, 108-447, 109-103, 110-5, 110-161, 111-8, 111-85, and 112-10.

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

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

Exhibit B-4
Financial Status of the CCTDP
(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	257,048	257,048	257,048
CCTDP-II	434,483	434,483	165,335	165,335	165,335
CCTDP-III	274,844	274,844	506,012	506,012	506,012
CCTDP-IV	299,935	299,935	476,770	476,770	476,770
CCTDP-V	217,007	217,007	52,035	52,035	52,035
Projects Subtotal	1,457,200	1,457,200	1,457,200	1,457,200	1,457,200
SBIR & STTR[a]	31,081	31,081	31,081	31,081	31,081
Program Direction	249,817	249,817	249,817	249,817	249,082
Total	1,738,098	1,738,098	1,738,098	1,738,098	1,737,363

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

[b] Totals may not appear to add up to the total figure shown due to rounding.

Exhibit B-4 shows the financial status of the CCTDP by subprogram. SBIR and STTR funds are included in this exhibit to account for all funding.

Exhibit B-5 indicates the apportionment sequence as modified by Public Law 112-10. These values represent the amount of budget authority made available for the CCTDP. In FY2011, all remaining unobligated funds were rescinded.

Exhibit B-5
Apportionment Sequence
(Dollars in Thousands)

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	37,055	2,259,650
1996	150,000	2,409,650
1997	(2,121)	2,407,529
1998	(101,000)	2,306,529
1999	(40,163)	2,266,366
2000	(146,038)	2,120,328
2001	8,980	2,129,308
2002	8,290	2,137,598
2003	(47,000)	2,090,598
2004	(98,000)	1,992,598
2005	(160,000)	1,832,598
2006	(20,000)	1,812,598
2007	0	1,812,598
2008	(58,000)	1,754,598
2009	0	1,754,598
2010	0	1,754,598
2011	(16,500)	1,738,098

Appendix C. NEPA Actions and Status for Active Projects

Introduction

Projects are required to comply with the procedural requirements of the National Environmental Policy Act (NEPA) of 1969 and associated regulations promulgated by the Council on Environmental Quality (CEQ) at 40 Code of Federal Regulations (CFR) Parts 1500-1508, and by the U.S. Department of Energy (DOE) at 10 CFR Part 1021.

In carrying out NEPA, DOE examines the environmental aspects of each proposed demonstration project in the evaluation phase of the selection process. Each proposed project is rated against environmental evaluation criteria, which are heavily weighted in the scoring process.

Upon selection, project participants are required to prepare and submit additional environmental information. The 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. The three documents that serve as possible outcomes of the NEPA process are outlined below.

Categorical Exclusions

"Subpart D—Typical Classes of Actions" of the DOE NEPA regulations provides for categorical exclusions (CX) as a class of actions that DOE has determined do not individually or cumulatively have a significant effect on the human environment.

Environmental Assessments

Environmental Assessments (EA) have the following three functions:

1. To provide sufficient evidence and analysis for determining whether a proposed action requires preparation of an Environmental Impact Statement (EIS) or a Finding of No Significant Impact (FONSI);
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.

The content of an EA is determined on a case-by-case basis and depends 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. CEQ regulations describe the FONSI as a document that briefly presents the reasons why an action will not have 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.

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 whether 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.

NEPA Actions and Status

Exhibit C-1 provides the NEPA action taken and the status of that action for each of the active demonstration projects. The projects are presented by program and are listed alphabetically within each program.

Exhibit C-1

NEPA Action and Status

Project	NEPA Action	Status
CCPI-1		
Increasing Power Plant Efficiency – Lignite Fuel Enhancement	EA	FONSI issued 1/6/04
TOXECON™ Retrofit for Mercury and Multi-Pollutant Control on Three 90-MW Coal-Fired Boilers	EA	FONSI issued 9/19/03
CCPI-2		
Demonstration of a Coal-Based Transport Gasifier	EIS	ROD issued 8/19/10
Mercury Specie and Multi-Pollutant Control	CX	Completed 3/28/05
Mesaba Energy Project – Unit 1	EIS	In process
CCPI-3		
Commercial Demonstration of Advanced IGCC with Full Carbon Capture	EIS	In process
Mountaineer Commercial Scale Carbon Capture and Storage Project	EIS	In process
Texas Clean Energy Project	EIS	ROD issued 9/26/11
W.A. Parish Post-Combustion CO_2 Capture and Sequestration	EIS	In process
FutureGen 2.0		
Oxy-Combustion Large Scale Test	EIS	In process
Pipeline and Regional CO_2 Storage Reservoir Project	EIS	In process
ICCS		
CO_2 Capture from Biofuels Production and Sequestration into the Mt. Simon Sandstone	EA	FONSI issued 5/3/11
Demonstration of CO_2 Capture and Sequestration of Steam Methane Reforming Process Gas Used for Large-Scale Hydrogen Production	EA	FONSI issued 7/8/11
Lake Charles CCS Project	EIS	In process

Appendix D. 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
ACFB	atmospheric circulating fluidized-bed
ACFM	actual cubic feet per minute
ACI	activated carbon injection
ADM	Archer Daniels Midland Company
A/E	architect/engineering
AEA	air entraining agent
AFBC	atmospheric fluidized-bed combustion
AGR	acid gas removal
AHPC	Advanced Hybrid Particulate Collector
AI	artificial intelligence
APCo	Appalachian Power Company
APH	air preheater
API	application programming interface
ARRA	American Recovery and Reinvestment Act of 2009
ASTM	American Society of Testing Materials
ASU	air separation unit
atm	atmosphere(s)
avg.	average
B&W	The Babcock & Wilcox Company
BOP	balance of plant
BSA	by-product storage area
Btu(s)	British thermal unit(s)
Btu/kWh	British thermal units per kilowatt-hour
BVWSD	Buena Vista water storage district
CAAA	Clean Air Act Amendments of 1990
CAER	Center for Applied Energy Research
CAIR	Clean Air Interstate Rule
CAMR	Clean Air Mercury Rule
CAP	chilled ammonia process
CAVR	Clean Air Visibility Rule
CCPI	Clean Coal Power Initiative
CCPI-1	First CCPI solicitation
CCPI-2	Second CCPI solicitation
CCPI-3	Third CCPI solicitation
CCS	carbon capture and storage
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
CD-ROM	compact disk-read only memory
CDS	circulating dry scrubber
CEM	continuous emissions monitor
CEMS	continuous emission monitoring system
CEQ	Council on Environmental Quality
CFB	circulating fluidized-bed
CFBDS	circulating fluidized-bed dry scrubber
CFR	Code of Federal Regulations
CO	carbon monoxide
CO_2	carbon dioxide
COE	cost of electricity
COS	carbonyl sulfide
CSAPR	Cross-State Air Pollution Rule
CSC	convective syngas cooler
CUB	coal utilization by-product(s)
CX	Categorical Exclusion
DCAA	Defense Contract Audit Agency
DCC	direct contact cooler
DCS	digital control system
DEP	Department of Environmental Protection
DOE	U.S. Department of Energy
DOE/HQ	U.S. Department of Energy Headquarters
DSE	dust stabilization enhancement
EA	Environmental Assessment
EIA	U.S. Energy Information Administration
EIS	Environmental Impact Statement
EIV	Environmental Information Volume
EOR	enhanced oil recovery
EPA	U.S. Environmental Protection Agency
EPAct	Energy Policy Act
EPC	engineering, procurement & construction
EPRI	Electric Power Research Institute
ESP	electrostatic precipitator
FBC	fluidized-bed combustion

FCC	fluidized catalytic cracking
FD	forced draft
FE	Office of Fossil Energy
FEED	front-end engineering design
FFDC	fabric filter dust collector
FGA	FutureGen Alliance
FGD	flue gas desulfurization
FOA	Funding Opportunity Announcement
FONSI	finding of no significant impact
FSQ	full-slurry quench
ft, ft^2, ft^3	foot (feet), square feet, cubic feet
FT	Fischer-Tropsch
FY	fiscal year
gal	gallon(s)
gal/ft^3	gallons per cubic foot
GHG	greenhouse gases
gob	coal waste used as a fuel
gpm	gallons per minute
gr	grains
GRE	Great River Energy
GUI	graphical user interface
GW	gigawatt(s)
GWe	gigawatt(s)-electric
H_2	molecular hydrogen
H_2S	hydrogen sulfide
H_2SO_4	sulfuric acid
HAPs	hazardous air pollutants
HCl	hydrogen chloride
HECA	Hydrogen Energy California, LLC
HESP	hot-side electrostatic precipitator
HF	hydrofluoric acid
Hg	mercury
HHV	higher heating value
hr.	hour(s)
HRSG	heat recovery steam generator
HTHP	high-temperature, high-pressure
ICCS	Industrial Carbon Capture and Storage
ID	induced draft
IGCC	integrated gasification combined-cycle
in, in^2, in^3	inch(es), square inch(es), cubic inch(es)
IOU	investor-owned utility
KBR	Kellogg Brown and Root, LLC
kV	kilovolt
kW	kilowatt(s)
kWh	kilowatt-hour(s)
lb	pound
LHV	lower heating value
LLC	limited liability company
LNB	low-NO_x burner
LOI	loss on ignition
LP	low pressure
LPA	Large Particle Ash
MEA	monoethanoloamine
MHI	Mitsubishi Heavy Industries
MHz	megahertz
mills/kWh	mills per kilowatt-hour
min	minute(s)
mo	month(s)
MOU	Memorandum of Understanding
MPC	Mississippi Power Company
MPUC	Minnesota Public Utilities Commission
MVA	monitoring, verification, and accounting
MW	megawatt(s)
MWe	megawatt(s)-electric
MWt	megawatt(s)-thermal
N_2	molecular nitrogen
N/A	not applicable
NAAQS	National Ambient Air Quality Standards
$NaHCO_3$	sodium bicarbonate
$NaNO_3$	sodium nitrate
NaOH	sodium hydroxide
Na_2CO_3	sodium carbonate
Na_2SO_4	sodium sulfate
NEPA	National Environmental Policy Act
NETL	National Energy Technology Laboratory
NH_3	ammonia
NH_4HCO_3	ammonium bicarbonate
NH_4NO_3	ammonium nitrate
$(NH_4)_2SO_4$	ammonium sulfate
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NSEC	National Sequestration Education Center
NSPS	New Source Performance Standards
NSR	normalized stoichiometric ratio
O_2	molecular oxygen
O_3	ozone
O&M	operation and maintenance
OMB	Office of Management and Budget
PAC	powdered activated carbon
PC	pulverized coal
PCD	particulate collection device
PM	particulate matter
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
PON	Program Opportunity Notice
PPA	power purchase agreement
PPII	Power Plant Improvement Initiative
PRB	Powder River Basin
ppm	parts per million (mass)
ppmv	parts per million by volume
PSC	Public Service Commission

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
Pty	Proprietary
Pub.L.	Public Law
PVF	Mountaineer Product Validation Facility
R&D	research and development
RD&D	research, development, and demonstration
RFP	request for proposals
ROD	Record of Decision
RRI	Rich Reagent Injection
S	sulfur
SBIR	Small Business Innovation Research
scf	standard cubic feet
scfm	standard cubic feet per minute
SCR	selective catalytic reduction
SCS	Southern Company Services, Inc.
SDA	spray dryer ash
SIP	State Implementation Plan
SMR	steam methane reformer
SNCR	selective noncatalytic reduction
SO_2	sulfur dioxide
SO_3	sulfur trioxide
STTR	Small Business Technology Transfer Programs
syngas	synthetic gas
TBD	to be determined
TCEQ	Texas Commission on Environmental Quality
TCLP	Toxicity Characteristic Leaching Procedure
TEG	tri-ethylene glycol
TRI	Toxics Release Inventory
TRIG™	Transport integrated gasification
UAN	urea ammonium nitrate
U.S.	United States
VIP	value improving practices
VOA	virtual online analyzer
VSA	vacuum swing adsorption
yr.	year(s)
ZLD	zero liquid discharge

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

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