



GAO

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United States General Accounting Office  
Washington, DC 20548

Resources, Community, and  
Economic Development Division

B-284381

March 9, 2000

The Honorable John R. Kasich  
Chairman, Committee on the Budget  
House of Representatives

Subject: Clean Coal Technology: Status of Projects and Sales  
of Demonstrated Technology

Dear Mr. Chairman:

The Congress established the Clean Coal Technology Demonstration Program in 1984 to demonstrate the feasibility of making the technology commercially viable. The Department of Energy (DOE) shares up to 50 percent of the costs of designing, constructing, and operating demonstration projects, and the project's participants provide the remainder. From 1985 through 1989, the Congress appropriated \$2.75 billion for the program, which is to remain available until spent. As of October 1999, the program had about \$784 million that was not spent: \$589 million to complete projects; \$66 million that DOE included in its 5-year projection for program administration through fiscal year 2004; and \$129 million in reserve. DOE believes that some of its funds will be needed for program administration after fiscal year 2004.

As agreed with your office, we determined (1) the status of 13 Clean Coal Technology projects that preliminary information indicated could have over \$1 million in unspent funds and (2) the extent to which DOE's participants in completed projects have sold demonstrated Clean Coal technologies to coal users, according to DOE's data. In December 1999, we briefed your staff on the results of our work. Enclosure I presents the information we provided at that briefing.

### **Status of the Thirteen Projects**

The 13 projects had a total of \$588.3 million in unspent funds. We found that these projects fell into two categories—those nearing completion and those that have been substantially delayed or will not be completed at all.

### Projects Nearing Completion

The five projects nearing completion—that is, they are within 2 years of their completion date—had \$58.9 million in unspent funds. Three of these projects are in their operation phase—the last phase before project completion—and one is in the construction phase. These four projects have \$52.2 million that was not spent. The fifth project had been withdrawn as an active project but had \$6.7 million that was not spent. DOE is in the process of negotiating a final closeout amount for this project.

### Projects that Are Substantially Delayed or Will Not Be Completed

Eight projects had serious delays or financial problems. Seven of these projects had \$529.4 million in unspent funds. The eighth project, whose participant is in bankruptcy, did not have any funds left. We had included this project in our analysis because preliminary data indicated that DOE might be asked for additional funding by the company that acquired the project assets at auction.

Six of the eight projects are ongoing but are behind their original schedules by 2 to 7 years, while two projects are bankrupt and will not be completed at all. We found two common reasons for the slippage in schedules and the inability to complete projects. First, six projects were moved from one location to another, and project participants changed. For example, one project was moved from Tallahassee, Florida, to York County, Pennsylvania, and then to Jacksonville, Florida, and has had three different participants; the project is now 7 years behind schedule. Projects have shifted location because nearby residents opposed the project, original participants decided they no longer needed additional energy capacity, or a participant had unforeseen financial difficulties.

Second, two projects will not be completed because the participants' assets were sold in bankruptcy proceedings. These two participants could not obtain funds to complete the projects. For example, one project was in operation when it experienced environmental problems, which the participant did not have the funds to correct. Finally, after DOE spent about \$58 million on the project, the project assets were auctioned for about \$3 million to a third party, who will not continue the project.

### **Sales of Demonstrated Clean Coal Technology**

One way DOE measures commercial acceptance is by collecting data on project participants' sales of the demonstrated technology. Under the program, DOE has completed 24 projects at a cost of about \$400 million. Of these 24 projects, 15 had sales of a demonstrated clean coal technology: 3 in domestic markets, 3 in international markets, and 9 in both domestic and international markets. For example, one participant sold a demonstrated gas suspension absorption system worth \$1.3 million to the U.S. Army for use in disposing of hazardous waste. These 15 projects cost DOE \$282 million.

The nine projects without sales cost DOE \$119 million. DOE provided several reasons for the lack of sales: the deregulation of the power generation and distribution industry; various amendments to the Clean Air Act, and the overall dynamics of the marketplace. DOE told us that “less tangible benefits need to be illustrated in order to have a complete understanding of the value gained from the investment.” For example, DOE pointed out that

- 18 separate awards for technological and environmental achievements have been bestowed on the projects by organizations in the field of energy and the environment, and
- demonstrated technologies serve as a foundation for meeting the stringent air quality requirements after the year 2000.

### **Agency Comments**

We provided a draft of this report to DOE for its review and comment. DOE stated that, overall, the program has succeeded in bringing new technologies to market for providing power and controlling harmful emissions. While we recognize the program may have had successes, the purpose of our review was to examine the funding status of the projects not yet completed. DOE also made a number of technical comments, which we incorporated as appropriate. DOE's detailed comments and our response are included in enclosure II.

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To determine the status of the Clean Coal Technology projects, we first identified the 50 projects that had received awards in the program. Second, we determined which projects were completed, which were ongoing, and which were withdrawn or terminated. Third, we identified and selected for review 11 projects that each had unspent funds of \$1 million or more. To these 11 projects, we added for review one project that had expended its funds but was being considered for over \$1 million in additional funds and one withdrawn project that, although no longer active, had over \$6 million in funds. For this total of 13 projects, we reviewed pertinent parts of the agreements between DOE and the projects' participants and DOE reports on the status of the projects. Additionally, we discussed the projects with the DOE officials responsible for overseeing the individual projects and the overall program.

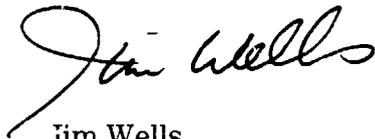
To identify the extent of commercial sales, we obtained DOE's information on the commercial sales for each completed project. We reviewed this information and discussed it with program officials. All funding data discussed in the enclosure are as of October 31, 1999. The status of the projects is as of December 1, 1999. The tables presented in enclosure I are our analysis of DOE's data.

We performed our review from November 1999 through February 2000 in accordance with generally accepted government auditing standards.

As agreed with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of this letter. At that time, we will send copies of this report to the Honorable Bill Richardson, the Secretary of Energy; Robert W. Gee, Assistant Secretary for Fossil Energy; and George Rudins, Deputy Assistant Secretary for Coal and Power Systems. We will also make copies available to others on request.

If you or your staff have any questions about this report, please contact me at (202) 512-3841. Key contributors to this report were Robert Antonio, Brad Hathaway, and Carrie Stevens.

Sincerely yours,

A handwritten signature in black ink, appearing to read "Jim Wells". The signature is fluid and cursive, with a large initial "J" and a long, sweeping underline.

Jim Wells  
Director, Energy, Resources  
and Science Issues

Enclosures - 2

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**GAO** Resources, Community, and  
Economic Development Division

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Clean Coal Technology Program

Briefing for the House Committee on the Budget

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# GAO Objectives

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- Determine the status of the 13 Clean Coal Technology projects that preliminary information indicated could have over \$1 million in unspent funds.
- Obtain information from DOE that shows the extent that DOE's participants have sold demonstrated Clean Coal technologies to coal users.

# GAO Thirteen Clean Coal Technology Projects

Common Name	DOE Project Name	Location
Mountaineer	Pressurized Fluidized Bed Combustion (PFBC) Utility Demonstration Project	New Haven, WV
Wabash River	Wabash River Coal Gasification Repowering Project	West Terre Haute, IN
LPMEOH	Commercial-Scale Demonstration of the Liquid-Phase Methanol (LPMEOH) Process	Kingsport, TN
Pinon Pine	Pinon Pine Integrated Gasification Combined Cycle (IGCC) Power Project	Reno, NV
Pulse Combustor	Pulse Combustor Design Qualification Test	Baltimore, MD
JEA	Jacksonville Electric Authority (JEA) Large-Scale Circulating Fluidized Bed (CFB) Combustion Demonstration Project	Jacksonville, FL
McIntosh 4A	McIntosh Unit 1A Pressurized Circulating Fluidized Bed (PCFB) Demonstration Project	Lakeland, FL
McIntosh 4B	McIntosh Unit 4B Topped Pressurized Circulating Fluidized Bed (PCFB) Demonstration Project	Lakeland, FL
Clean Coal Diesel	Clean Coal Diesel Demonstration Project	Fairbanks, AK
Kentucky Pioneer	Kentucky Pioneer Energy Integrated Gasification Combined Cycle (IGCC) Project	Trapp, KY
NOXSO	Commercial Demonstration of the NOXSO SO <sub>2</sub> /NO <sub>x</sub> Removal Flue Gas Cleanup System	No site
Self-Scrubbing Coal	Self-Scrubbing Coal: An Integrated Approach to Clean Air	Central City, PA
CPICOR	Clean Power from Integrated Coal/Ore Reduction	Vineyard, UT

# GAO Thirteen Clean Coal Technology Projects and Program Direction

Status	Projects	Unobligated	Obligated but not spent
		(millions)	
Nearing Completion	5	(\$0.8) <sup>a</sup>	\$58.9
Delayed	8	215.1	314.3
Subtotal	(13)	(\$214.3)	(\$373.2)
Projected reserve at end of fiscal year 2004	---	128.5	---
Projected program direction through fiscal year 2004	---	66.4	---
Total	13	\$409.2	\$373.2 <sup>b</sup>

<sup>a</sup> The amount represents a downward adjustment to one project that DOE funded in excess of its cost share.

<sup>b</sup> The table does not include \$1.4 million that has been obligated but not spent for four projects that each have less than a million dollars in unspent funds.

# GAO Projects Nearing Completion

Project	Unobligated	Obligated but not spent	Awarded	Stage
	(in millions)			
Mountaineer	(\$0.8)	\$6.7	1990	Withdrawn
Wabash River	0.0	3.5	1992	Operation
LPMEOH	0.0	38.0	1992	Operation
Pinon Pine	0.0	9.6	1992	Operation
Pulse Combustor	0.0	1.1	1992	Construction
Total	(\$0.8)	\$58.9		

# GAO Delayed Projects

Project	Awarded	Stage
JEA	1990	design and construction
McIntosh 4A	1991	design
McIntosh 4B	1994	design will begin when McIntosh A starts operating
Clean Coal Diesel	1994	on hold due to lack of participant funds
Kentucky Pioneer	1994	design
NOXSO	1991	awaiting conclusion of bankruptcy
Self-Scrubbing Coal	1992	awaiting conclusion of bankruptcy
CPICOR	1996	design

# GAO Status of Funds on Delayed Projects

Project	DOE Cost Share	Obligated	Unobligated	Obligated but not spent
(millions)				
JEA	\$74.7	\$74.7	\$0.0	\$73.1
Mcintosh 4A	93.3	93.3	0.0	86.9
McIntosh 4B	109.6	109.6	0.0	107.3
Clean Coal Diesel	23.8	23.8	0.0	14.3
Kentucky Pioneer	78.1	3.9	74.2	3.1
NOXSO	41.4	41.1	0.3	22.1
Self-Scrubbing Coal	38.0	38.0	0.0	0.0
CPICOR	149.5	8.8	140.6	7.5
Total	\$608.4	\$393.2	\$215.1	\$314.3

# GAO Original Versus Current Completion Dates on Delayed Projects

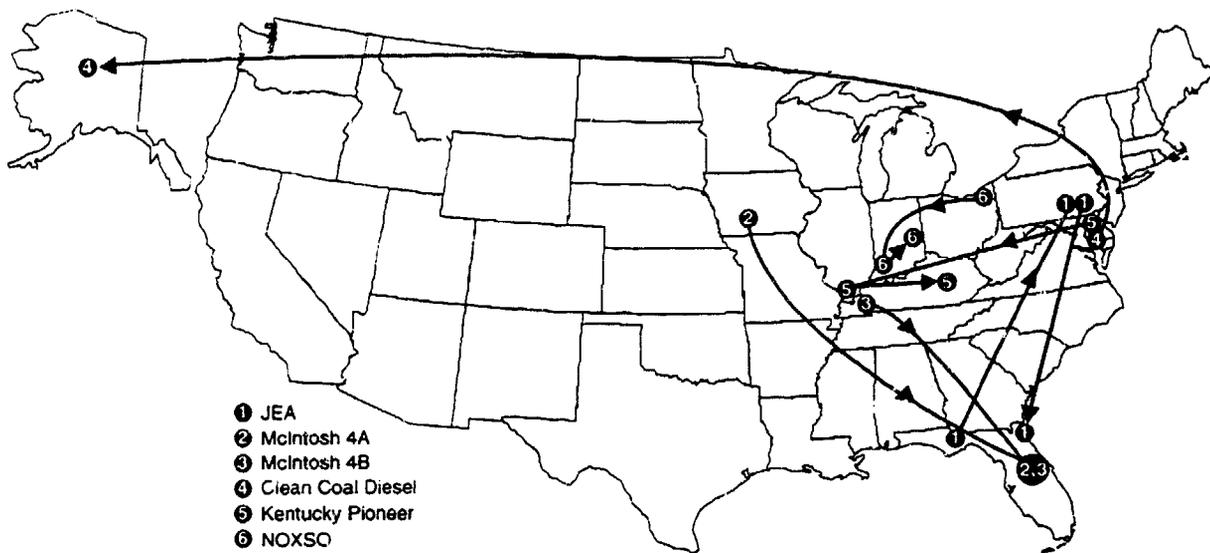
Project	Awarded	Original Completion	Current Completion	Completion Slippage
JEA	1990	1997	2004	7 years
McIntosh 4A	1991	1997	2004	7 years
McIntosh 4B	1994	2001	2006	5 years
Clean Coal Diesel	1994	2001	2004	3 years
Kentucky Pioneer	1994	2001	2004	3 years
NOXSO	1991	1997	will not be completed	
Self-Scrubbing Coal	1992	1995	will not be completed	
CPICOR	1996	2003	2005	2 years

# GAO Recurring Factors Contributing to Delays

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- Relocation of Projects
- Bankruptcies

# GAO Relocated Clean Coal Technology Projects



# GAO Length of Time at Sites for Delayed Projects That Were Relocated

Project	Project Sites			
	Prior Site(s)	Years at Prior Sites	Current Site	Years at Current Site
JEA	Tallahassee, FL; York, PA (two location in York)	7	Jacksonville, FL	2
McIntosh 4A	Des Moines, IA	6	Lakeland, FL	2
McIntosh 4B	Calvert City, KY	2	Lakeland, FL	3
Clean Coal Diesel	Easton, MD	2	Fairbanks, AK	3
Kentucky Pioneer	Baltimore, MD; Carbondale, ILL; (and period with no site)	5	Trapp, KY	0
NOXSO	Niles, Ohio; Newburgh, IN; Richmond, IN, (and periods with no site)	8	No site	1

# GAO Project Schedule: JEA

Project Milestones	Schedule	
	Original	Current
Project selected	1989	1989
Cooperative agreement awarded	1990	1990
Project is moved from Tallahassee, FL to York County, PA after first participant ends participation.	---	1992
Second Project site is replaced with a third site in York County, PA.	---	1993
Second participant terminates activities.	---	1996
Third participant is named with a fourth site.	---	1997
Design initiated	1990	1997
Design completed	1992	2000
Construction started	1992	1999
Construction completed	1995	2002
Operation started	1995	2002
Operation completed	1997	2004
Project completed	1997	2004

**Summary:** The completion date has slipped 7 years due to siting problems and changes in participants and the project is in the design/construction stage. DOE's cost is \$74.7 million with \$74.7 million obligated; \$73.1 million uncosted, and \$1.7 million spent over 9 years. According to DOE, the project was moved from Tallahassee because of protests from citizens. The project was moved from York County because of protests from citizens and the participant's decision not to continue.

# GAO Project Schedule: McIntosh 4A

Project Milestones	Schedule	
	Original	Current
Project selected	1989	1989
Cooperative agreement awarded	1991	1991
Design initiated	1991	1996
First participant and host site at Des Moines, Iowa end participation	---	1997
Cooperative agreement amended to add new participant and new site	---	1997
Design Completed	1993	2000
Construction started	1993	2000
Construction completed	1995	2002
Operation started	1995	2002
Operation completed	1997	2004
Project completed	1997	2004

Summary: DC&E's cost is \$93.3 million with \$93.3 million obligated, \$86.9 million uncOSTed, and \$6.3 million spent over 8 years. The project is in the design stage and the original completion date has slipped 7 years due to siting problems and a change in participants. The project was transferred to a second participant after the first participant merged with another company and determined that it did not need the additional power that would be generated.

# GAO Project Schedule: McIntosh 4B

Project Milestones	Schedule	
	Original	Current
Project selected	1993	1993
Cooperative agreement awarded	1994	1994
First participant and host site in Calvert City, Kentucky end participation	---	1996
Cooperative agreement amended to add a new participant and site.	---	1998
Design started	1994	2002
Design Completed	1997	2003
Construction started	1996	2003
Construction completed	1998	2004
Operation started	1998	2004
Operation completed	2001	2006
Project completed	2001	2006

**Summary:** DOE's cost is \$109.6 million with \$109.6 million obligated; \$107.3 million uncosted; and \$2.3 million spent over 5 years. The original completion date has slipped 5 years due to siting problems and changes in participants and design is not scheduled to begin until 2002 when McIntosh 4A begins operating. According to DOE, the project was transferred to a second participant and relocated when the first participant could not find a purchaser for the power the demonstration project would produce.

# GAO Project Schedule: Clean Coal Diesel

Project Milestones	Schedule	
	Original	Current
Project selected	1993	1993
Cooperative agreement awarded	1994	1994
Design started	1994	1994
Project is resited from Easton, Maryland to Fairbanks, Alaska	---	1996
Construction started	1995	1998
Design completed	1995	1999
Operation started	1997	2000
Construction completed	1998	2000
Operation completed	2001	2004
Project completed	2001	2004

**Summary:** The project is on hold until additional funding can be identified by the participant. DOE's cost is \$23.8 million with \$23.8 million obligated; \$14.3 million uncosted; and \$9.6 million spent over 6 years. According to DOE, the project moved from Easton, Maryland because of changes in the projected power demand by the electric service providers and consumers in that geographic area.

# GAO Project Schedule: Kentucky Pioneer

Project Milestones	Schedule	
	Original	Current
Project selected	1993	1993
Cooperative agreement awarded	1994	1994
First host site in Baltimore, MD ends participation	---	1995
Second site in Carbondale, Ill approved by DOE	---	1998
Second site ends participation and project transferred to new participant at third site in Trapp, Kentucky	---	1999
Design started	1994	1999
Design completed	1996	2001
Construction started	1996	2001
Construction completed	1999	2003
Operation started	1999	2003
Operation completed	2001	2004
Project completed	2001	2004

**Summary:** DOE's cost is \$78 million with \$3.9 million obligated; \$3.1 million uncosted; \$800,000 spent over 5 years; and \$74.1 million unobligated. The project is in the design stage and the original completion date has slipped 3 years due to siting problems and changes in participants. The project was relocated twice for economic reasons. In November 1999, the project was transferred to a new participant at a third site. It will process a blend of coal and municipal solid waste, instead of only coal as approved in the original project, to generate electric power.

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# GAO Projects with Participants in Bankruptcy

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Project	Bankruptcy		Cause
	Enter	Exit	
NOXSO	1997	assets sold	Could not obtain financing
Self-Scrubbing Coal	1997	assets sold	Could not obtain financing
CPICOR	1999	2000	Steel prices from foreign competitors

# GAO Project Schedule: NOXSO

Project Milestones	Schedule	
	Original	Current
Project selected	1989	1989
Cooperative agreement awarded	1991	1991
Design started	1991	1991
First site in Niles, Ohio ends participation.	---	1993
Cooperative agreement transferred to second participant.	---	1994
Second host site selected in Newburgh, Indiana.	---	1995
Second host site ends participation.	---	1997
Participant files for bankruptcy	---	1997
Third host site selected in Richmond, Indiana.	---	1998
Design completed	1993	assets sold and awaiting final bankruptcy proceedings
Construction started	1993	
Construction ended	1994	
Operation started	1994	
Operation ended	1997	
Project completed	1997	

**Summary:** The assets of the participant are being sold in bankruptcy proceedings. DOE's cost is \$41.4 million with \$41.1 million obligated, \$22.1 million uncosted; \$19 million spent over 9 years; and \$.3 million unobligated. An involuntary bankruptcy petition was filed against the participant by one of its team members and two other creditors. Additionally, the participant did not get the state of Indiana to guarantee revenue bonds for the participant's share of the project cost. As a result, the host company in Newburgh, Indiana withdrew from the project.

# GAO Project Schedule: Self-Scrubbing Coal

Project Milestones	Schedule	
	Original	Current
Project selected	1991	1991
Cooperative agreement awarded	1992	1992
Design started	1992	1992
Design completed	1994	1994
Construction started	1993	1993
Construction completed	1994	1995
Operation started	1994	1996
Project participant files for bankruptcy	- - -	1997
Project facility sold at auction	- - -	1998
Operation completed	1995	Awaiting final bankruptcy proceedings
Project completed	1995	

**Summary:** This project was in operation when the participant declared bankruptcy due to its inability to obtain financing to address the plant's technical and environmental problems. DOE's cost was \$33.0 million and all the funds have been obligated. However, DOE commented that \$2.1 million of its funds have since been deobligated. The plant was sold at auction for \$3 million because of the participant's bankruptcy.

# GAO Project Schedule: CPICOR

Project Milestones	Schedule	
	Original	Current
Project selected	1993	1993
Cooperative agreement awarded	1996	1996
Design started	1996	1996
Host site files for bankruptcy	---	1999
Design completed	1998	2000
Construction started	1998	2000
Construction completed	2000	2003
Operation completed	2003	2005
Project completed	2003	2005

**Summary:** The completion date has slipped 2 years and the project is in the design stage due to a change in technology and the host site's bankruptcy which was attributed to steel prices from foreign competitors. DOE believes the host site will complete its bankruptcy proceedings in early calendar year 2000. DOE's cost is \$149.5 million with \$8.8 million obligated; \$1.3 million spent over 3 years; \$7.5 million uncosted, and \$140.6 million unobligated.

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# GAO Sales of Clean Coal Technology

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Technology market	Number of projects	DOE Costs (millions)
Domestic and international sales	9	\$113.7
Domestic sales only	3	64.1
International sales only	3	103.8
No sales	9	118.8
Total	24	\$400.4

# GAO Projects with Domestic and International Sales

Project	Completed	DOE Cost (millions)
10-MWe Demonstration of Gas Suspension Absorption	1994	\$2.3
LIFAC Sorbent Injection Desulfurization Demonstration Project	1994	10.6
Evaluation of Gas Reburning and Low-NO <sub>x</sub> Burners on a Wall-Fired Boiler	1995	8.9
180-MWe Demonstration of Advanced Tangentially Fired Combustion Techniques for the Reduction of NO <sub>x</sub> Emissions from Coal-Fired Boilers	1992	4.4
Demonstration of Advanced Combustion Techniques for a Wall-Fired Boiler	1998	6.6
LIMB Demonstration Project Extension and Coolside Demonstration	1991	7.6
Nucla CFB Demonstration Project	1991	17.1
Development of the Coal Quality Expert	1995	10.9
ENCOAL Mild Coal Gasification Project	1997	45.3
Total		\$113.7

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# GAO Projects with Domestic Sales

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Project	Completed	DOE Cost (millions)
Full-Scale Demonstration of Low-NO <sub>x</sub> Cell Burner Retrofit	1993	\$5.4
Milliken Clean Coal Technology Demonstration Project	1998	45.0
Integrated Dry NO <sub>x</sub> /SO <sub>2</sub> Emissions Control System	1996	13.7
Total		\$64.1

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# GAO Projects with International Sales

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Project	Completed	DOE Cost (millions)
Demonstration of Innovative Applications of Technology for the CT-121 FGD Process	1994	\$21.1
SNOX Flue Gas Cleaning Demonstration Project	1994	15.7
Tidd PFBC Demonstration Project	1995	67.0
Total		\$103.8

# GAO Projects with No Sales

Project	Completed	DOE Cost (millions)
Confined Zone Dispersion Flue Gas Desulfurization Demonstration	1993	\$5.2
Advanced Flue Gas Desulfurization Demonstration Project	1995	63.9
Micronized Coal Reburning Demonstration for NO <sub>x</sub> Control	1999	2.7
Demonstration of Coal Reburning for Cyclone Boiler NO <sub>x</sub> Control	1992	6.3
Demonstration of Selective Catalytic Reduction Technology for the Control of NO <sub>x</sub> Emissions from High-Sulfur-Coal-Fired Boilers	1995	9.4
SO <sub>x</sub> -NO <sub>x</sub> -Rox Box Flue Gas Cleanup Demonstration Project	1993	6.1
Enhancing the Use of Coals by Gas Reburning and Sorbent Injection	1994	18.7
Advanced Cyclone Combustor with Internal Sulfur, Nitrogen, and Ash Control	1990	.5
Cement Kiln Flue Gas Recovery Scrubber	1993	6.0
Total		\$118.8

# Comments From the Department of Energy

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



Department of Energy  
Washington, DC 20585

FEB 28 2000

Mr. Brad Hathaway  
Resources, Community, and Economic  
Development Division  
U.S. General Accounting Office  
Washington, DC 20548

Dear Mr. Hathaway:

The following is in response to your request for comments on the proposed report, Clean Coal Technology: Status of Projects and Sales of Demonstrated Technology (GAO/RCED-00-86R Code 141386). We would like to make some general observations and then offer specific comments on the subject report.

As you stated in your report, the Clean Coal Technology Program (CCT) was initiated in 1984, however, the first competitive solicitation was not issued until 1986. There were a total of 5 competitive solicitations issued (with funding roughly equally divided) over a 7 year period. The last solicitation was issued in late 1992 and awards were made in 1993. The early solicitations were focused on emission control technology and resulted in a suite of technologies made available to the marketplace. This "technology base" resulted in both direct sales and the advancement of the overall state of the art in this area, which dramatically reduced compliance costs. The cumulative costs for controlling SO<sub>x</sub> emissions were reduced by approximately \$40 billion. Later solicitations were focused on highly efficient, very clean coal power plant technology. Rapidly changing market conditions, ever-stricter emission limits, competitive power trends, shorter investment horizons, and worldwide availability of natural gas at very low prices presented additional market pressures. Another very significant factor was the uncertainty associated with the pending deregulation of the power generation sector of the electric power market. These factors and others created project delays and sometimes forced location changes in the siting of these commercial demonstration projects, because not only did they have to demonstrate the technologies in question, they had to also be commercially competitive for the project to be sited.

The CCT program has been highly successful in bringing a broad suite of clean, efficient power technologies and control systems into the marketplace, which is the primary goal of the program and which will provide the primary benefits to the nation. Some are already broadly deployed. Low NO<sub>x</sub> burners are now installed on most of the coal power plants capable of using them (with accompanying cost savings to the U.S. taxpayers). Over \$8 billion in sales have been reported for AFB plants. Some CCT technologies are still in the early stages of market penetration. U.S. market opportunities for new coal plants have been pushed out in time; however the need and opportunity remains (EIA forecasts continuing demand for coal based power and shows new/replacement plants being built in the mid to long term time frame). There is also a huge immediate and continuing market for clean coal technology internationally.

With regard to specific comments on the report, we would like to offer the following:

- The draft report states “. . . (DOE) shares up to 50 percent of the costs of designing, constructing and operating demonstration projects, with the project participant providing the remainder.” This is a statement of fact, however the actual cost sharing has been DOE-34%; Industrial Participants-66%. This is a significant measure of the success of the CCT Program and the value industry attached to demonstrating the technologies.
- Under *Sales of Demonstrated Clean Coal Technology* on page 3 of the report, the Department would like to indicate that many of the 9 projects without sales to date still hold promise for deployment in the marketplace. The following is suggested:

The nine projects without sales to date cost DOE \$119 million and have project completion dates ranging from 1992 to 1999. Project participants are generally subject to repayment obligations for 20 years following the completion of the project. While some of these projects have generated interest in the marketplace, DOE provided several reasons for the lack of sales: the deregulation of the power generation and distribution industry; various amendments to the Clean Air Act; and the overall dynamics of the marketplace.

Now on p. 3.

See comment 1.

- On page 4, the report indicates that the status of the projects is as of December 1999. It is suggested that this date be as of December 1, 1999, as several projects had completed operation by the end of December that are not included in the 24 count of completed projects. It may also be useful to include the as-of-date on the briefing tables.

See comment 2.

- In the discussion on the presentation slide for the Kentucky Pioneer project, reference is made that the second time the project moved was for economic reasons and because the participant could not get the required environmental approvals. The second move was due to economics and market dynamics, not environmental issues.

See comment 3.

- The only example of a technology sale contained in the report was the sale of a gas suspension absorption system worth \$1.3 million to the U.S. Army for hazardous waste disposal. A more representative example that would not trivialize the return on the investment made in the CCT Program should be included. For example, a domestic manufacturer has secured contracts for low-NO<sub>x</sub> burners, representing 2,428 burners on 124 boilers representing over 31,000 MWe. The burners are valued at \$240 million. For completeness it is suggested that the attached Analysis of Commercial Use of Clean Coal Technologies for Completed Projects be attached to the Draft report to more completely represent the return on investment resulting from sales of technologies.
- The following represent some of the “less tangible benefits that need to be illustrated in order to have a complete understanding of the value gained from the investment” and should be included in the “Agency Comments.”

- Over 700 U.S. and international patents have been awarded to domestic technology suppliers of advanced electric power generation, environmental control, coal processing and industrial application technologies. These patents position U.S. industry to compete for an estimated \$480 billion export market over the next 30 years that will support more than 600,000 jobs in the U.S. power equipment industry.
- The database developed under the CCT Program's evaluation of NO<sub>x</sub> control on wall-fired and tangentially-fired boilers was used by the U.S. EPA in formulating NO<sub>x</sub> control provisions under the Clean Air Act Amendments of 1990.
- As a result of the CCT Program, nearly one-half of U.S. coal-fired generating capacity has installed low-NO<sub>x</sub> burners with sales to date exceeding \$1.5 billion.
- The advanced SO<sub>2</sub> scrubbers demonstrated under the CCT Program not only contribute to the solution of the acid rain issue in a cost-effective manner, but also produces valuable by-products such as gypsum. For example, in one year, the 528 MWe demonstration of an advanced flue-gas desulfurization unit eliminated 70,000 tons of SO<sub>2</sub> emissions and produced enough wallboard-grade by-product gypsum to construct nearly 25,000 homes.
- The CCT Program has and is currently demonstrating technologies that are redefining the state-of-the-technology in electric power generation. Technologies demonstrated under the CCT program such as atmospheric circulating fluidized-bed (ACFB), pressurized fluidized-bed combustion (PFBC), and integrated gasification combined-cycle (IGCC) are entering the domestic and international market place as illustrated below:
  - A recent review of data from ACFB and PFBC manufacturers showed that a total of 162 commercial ACFB and PFBC units, valued at \$9 billion are either in operation or soon-to-be-commissioned. This represents a commercial return of over \$9 for every \$1 of DOE demonstration dollars invested. These projects are distributed worldwide, 70 (3 GW) in Europe, 50 (2.4 GW) in Asia and 40 (2.2 GW) in North America. The ACFB and PFBC technologies present an opportunity to use low quality coal such as bituminous gob, anthracite culm, lignite and other run-of-mine materials. Biomass fuels are used as primary or secondary fuel in over one-third of these projects.
  - Since the first IGCC project in the CCT Program began operation in 1995, 82 gasification projects with a capacity of over 12.5 GW have been placed in service. These projects, distributed worldwide, have benefited from the technical, environmental and operational performance results emerging from the ongoing IGCC demonstrations.
- A number of the "delayed projects" represent a significant advancement in the state-of-the-technology in electric power generation and also provide the building blocks for the future. The significant attributes of the "delayed projects" are as follows:
  - JEA: The project moves ACFB to the largest sizes of utility boilers typically considered in capacity additions and replacements. The nominal 300 MWe JEA demonstration unit will be more than double the size of the Nucla demonstration unit (110 MWe). Environmental performance is estimated to be 98% reduction in SO<sub>2</sub> emissions, and over 90% reduction in NO<sub>x</sub>.

- McIntosh Unit 4A: The project is demonstrating an advanced PFBC and is addressing two major technological issues impeding post-2000 commercial deployment, namely: hot gas particulate clean-up and the use of non-ruggedized gas turbine in a pressurized fluidized-bed application.
- McIntosh Unit 4B: This project builds on the McIntosh Unit 4A project and involves the addition of a carbonizer island. This addition is estimated to increase efficiency by over 20%. In addition to the increased efficiency, the plant will (1) have a cost of electricity that is projected to be 20% lower than a conventional pulverized-coal-fired plant with flue gas desulfurization; (2) meet emission limits that are half those allowed by New Source Performance Standards; (3) operate economically on a wide range of coals; and (4) be amenable to shop fabrication.
- Kentucky Pioneer IGCC Demonstration Project: The project will demonstrate a high efficiency electric power generation system which has two unique attributes: (1) the integration of a molten carbonate fuel cell fueled by synthetic gas into an IGCC system; and (2) the use of municipal waste combined with coal as the fuel source. Both are significant advances in the state-of-technology for electric power generation.
- Clean Coal Diesel: The project's diesel engine has been delivered and operated on oil during September 1999. Final design of the low-rank coal-water fuel processing plant is complete but construction will be delayed until May 2001. The project will demonstrate the technology necessary to compete for the estimated 60,000 MWe U.S. diesel engine market. More importantly, the worldwide market is estimated to be 70 times that of the U.S. market where dispersed power generation is critical to the economy of developing countries.
- CPICOR™: The project will demonstrate the Hismelt® process for direct iron-making that avoids the need for coke production and thus eliminates emissions normally associated with coke ovens. Further, the project will prove the concept of co-production of electricity and iron-making. The market for the technology demonstrated under this project, for which the DOE contribution is 14%, is substantial. Of the existing 79 coke oven batteries, half are 30 years of age or older and are due for replacement or major rebuilds. There are about 60 U.S. blast furnaces, all of which have been operating for more than 10 years, with some originally installed up to 90 years ago. The Hismelt® process represents a viable option as a substitute for conventional iron-making technology.
- NOXSO, Self Scrubbing Coal™: Both projects have been withdrawn from the CCT Program.

To bring you up to date on the Custom Coals and NOXSO projects, both projects have now concluded and closeout activities are underway. Over \$20 million is expected to be returned from the NOXSO project and \$2 million from the Custom Coals project. Also, the Wabash River project concluded operation on January 1, 2000 and ownership of the demonstration facility transferred to Global Energy, Inc. The transfer of plant equipment to Global Energy also included transfer of the 20 year repayment obligation and resulted in repayment of \$550,000 to DOE.

Some additional comments focused on the Briefing Materials are provided on the following pages.

Yours truly,

A handwritten signature in black ink, appearing to be 'GR', with a long horizontal stroke extending to the left.

George Rudins  
Deputy Assistant Secretary  
for Coal and Power Systems

Enclosures

## **GAO's Comments**

1. We changed the report to include this information.
2. We removed this discussion of environmental issues from our presentation of the Kentucky Pioneer project.
3. We did not change the report. The purpose of our example was to explain what constitutes a sale, not to comment on the significance of the sale

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