United States General Accounting Office

GAO

Report to the Chairman, Subcommittee on Energy and Power, Committee on Energy and Commerce, House of Representatives

March 1989

FOSSIL FUELS

Commercializing Clean Coal Technologies

GAO/RCED-89-80

GAO **United States**
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-230504

March 29, 1989

The Honorable Philip R. Sharp
Chairman, Subcommittee on Energy and Power
Committee on Energy and Commerce
House of Representatives

Dear Mr. Chairman:

You asked us to assist your Subcommittee by reviewing the Department of Energy's implementation of the Clean Coal Technology (CCT) program. As part of our work in response to your request, we presented our views on the CCT program in testimony before your Subcommittee on June 22, 1988 (GAO/T-RCED-88-47). As agreed with your office, this report assesses the CCT program's progress and problems and the effect that potential acid rain control legislation could have on the program.

As arranged with your office, we plan to distribute copies of this report to interested parties and make copies available to others upon request 30 days after the date of this letter.

This work was performed under the direction of Keith O. Fultz, Director, Energy Issues. Other major contributors to this report are listed in appendix V.

Sincerely yours,

J. Dexter Peach
Assistant Comptroller General

their share of project costs. Negotiations were also delayed because of (1) sponsors' reluctance to agree to repay the federal share of project costs should the technology become commercialized and (2) sponsors' and other project participants' reluctance to release proprietary data to DOE. Further, DOE's headquarters review and approval process to ensure negotiation consistency added time to the agreement formalization process. Although DOE made changes for round two of the program, federal repayment requirements and proprietary data rights could continue to cause delays in completing agreements with project sponsors.

Seven of the nine funded round-one projects are not progressing as planned because of equipment failure, delays in obtaining equipment, project financing problems, and delays in obtaining permits. DOE said it is too early to tell whether the slippage will affect the timing of the commercial availability of the clean coal technologies.

The CCT program can play an important role in reducing emissions from fossil fuel-fired power plants. The new administration has indicated its commitment to full funding of the program. Enactment of legislation that prescribes stringent deadlines and/or reduced levels of emissions to control acid rain could affect the program's potential effectiveness by diverting investment from emerging clean coal technologies into available conventional technologies. On the other hand, enactment of legislation that allows for development of emerging technologies while also requiring some near-term emissions reductions through conventional technologies, could encourage commercialization of more efficient, cleaner, emerging technologies.

Principal Findings

Negotiating Agreements

DOE expected to finalize cooperative agreements for round-one projects within 9 months after the projects were selected. However, only two of the nine initially selected projects were brought under agreements within that time frame. Agreements for five projects were signed about 2 to 9 months later than planned, and sponsors withdrew two projects.

The withdrawn projects were replaced with four others from an alternate list in October 1987, but only two of the replacement projects had been brought under agreements as of December 31, 1988. Further, in December 1988, DOE terminated negotiations with the sponsor of one

costs will increase until later phases of the projects or until restructuring proposals have been reviewed.

Acid Rain and the CCT Program

The 101st Congress will likely deliberate the need to enact acid rain control legislation requiring reductions in sulfur dioxide and nitrogen oxide emissions levels from coal-fired power plants within prescribed time frames. The new administration has indicated that it will request full funding for the CCT program and introduce legislation to reduce emissions that cause acid rain. The Environmental Protection Agency (EPA) plans to draft the legislation to revise the Clean Air Act. It is, therefore, important that DOE work closely with EPA in drafting the legislation.

The CCT program's full benefits could be unrealized if the Congress enacts legislation with compliance dates that take effect before clean coal technologies are commercially available, or if the target levels for emissions reductions are more stringent than the technologies can attain. The Congress, however, could establish compliance deadlines and emissions reduction levels that allow for significant near-term emissions reductions using conventional technologies or processes, but are not so stringent as to deter the development and use of emerging technologies.

Recommendation

The Congress continues to debate whether acid rain-causing emissions can be reduced in the near term without impeding the development and commercialization of clean coal technologies. Included in this debate will be the proposed legislation the new administration plans to submit to the Congress to revise the Clean Air Act. Accordingly, we recommend that the Secretary of Energy work closely with the Administrator of the Environmental Protection Agency to ensure that the proposed legislation that is submitted for congressional consideration appropriately links compliance dates for reducing emissions with the expected commercial availability of emerging clean coal technologies.

Agency Comments

GAO obtained and incorporated the views of responsible DOE officials on the factual information presented. However, as requested by the Chairman's office, GAO did not obtain official agency comments on a draft of this report.

Table

Abbreviations

CCT	Clean Coal Technology Program
DOE	Department of Energy
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
GAO	General Accounting Office

period from 1988 to 1992. The administration also announced that future clean coal technology demonstration projects would be selected, where possible, to reduce acid rain-causing emissions.

The Congress has appropriated $1.55 billion for the CCT program ($400 million for round one and $575 million each for rounds two and three). DOE has proposed an additional $1.2 billion in program funds for rounds four and five.

In February 1986, as the first phase, or round one, of the program, DOE solicited cost-shared proposals for the construction and operation of projects that would demonstrate the feasibility and commercial application of a broad slate of emerging clean coal technologies. In July 1986, after evaluating 51 proposals, DOE selected 9 projects for funding and a list of several others to serve as replacement projects in the event that cooperative agreements could not be negotiated with project sponsors.

As of December 31, 1988, DOE had funded nine round-one projects (including two replacements) and was in the process of formalizing cooperative financial assistance agreements with sponsors of four other replacement projects. The funded projects were to receive about $271 million in federal assistance and about $590 million in nonfederal financing. (App. I lists the funded round-one projects, their sponsors, and their estimated costs. App. II lists the unfunded replacement projects and their sponsors, but the estimated costs cannot be determined until the cooperative agreements are completed.)

The overall objective of round two of the program is to provide financial assistance to demonstration projects that can reduce pollutants commonly associated with the formation of acid rain, which is consistent with the recommendations of the envoys' report.

In September 1988 DOE selected 16 round-two projects from 55 proposals and began the process of formalizing cooperative financial assistance agreements with the projects' sponsors. DOE expects to complete those agreements by October 1989 and to begin the round-three project solicitation process by May 1989. (App. III lists the 16 round-two projects and their sponsors.)

Acid Rain Control and the CCT Program

The Congress has been debating the need, and proper time, to mandate controls to reduce acid rain-causing emissions associated with fossil fuel combustion. About 20 acid rain control bills were introduced, but not

agreements for projects selected for funding, we reviewed DOE's procurement and financial assistance regulations and project files. We also discussed the process with members of DOE's negotiating teams for the projects, and with several of the project sponsors, including two sponsors who withdrew their proposals when they encountered problems in finalizing agreements with DOE. To obtain information on the background and status of the projects, we reviewed the project files and interviewed DOE's project managers.

To obtain the views of other parties with an interest in the CCT program and to understand the effects of coal combustion technologies, we discussed relevant issues with officials of industry groups, such as the Electric Power Research Institute (EPRI) and the Industrial Gas Cleaning Institute; environmental groups, such as the Natural Resources Defense Council and Greenpeace; and governmental entities, such as the Environmental Protection Agency (EPA) and representatives of the government of Canada.

Our audit work was performed during the period from November 1987 through December 1988. We discussed the factual information in this report with DOE officials responsible for the CCT program. On the basis of these discussions, we made clarifications in the report, where appropriate. However, as the Chairman's office requested, we did not obtain official agency comments on a draft of this report. Our work was performed in accordance with generally accepted government auditing standards.

During the fact-finding phase, DOE requested and obtained additional information from the project sponsors to enable it to better understand and evaluate technical data, project timetables, proposed costs, third-party financing and business arrangements, and other issues concerning the projects. DOE also obtained and evaluated the sponsors' rationales for any deviations from DOE's proposed agreement. Once the centers were satisfied with the information provided, the results of the fact-finding process were presented to DOE headquarters. The centers then prepared a negotiation plan and entered into the negotiation phase.

The negotiation phase of the agreement formalization process consisted of four steps. First, the negotiation plan was finalized and approved by DOE headquarters. The plan contained DOE's and the sponsor's positions regarding various issues to be resolved. For example, most project sponsors wanted to limit public and government access to the physical plant site for safety or proprietary reasons, whereas DOE insisted on government access to the property. The second step consisted of the actual negotiations on issues identified in the negotiation plan. The third step involved the preparation of a negotiation summary that addressed any deviations from the negotiation plan and reflected agreed-upon resolutions to the deviations. During the final step in the process, DOE developed and submitted a comprehensive pre-award report to the Congress for a 30-day review period, after which DOE signed the cooperative agreement for funding the project.

For round-one projects, the fact-finding phase took about 4 to 14 months to complete for the nine originally selected projects and 6.5 and 8.1 months to complete for two of the four initially selected replacement projects. One of the replacement projects was still in the fact-finding phase as of December 31, 1988. DOE terminated negotiations with the sponsor of the other replacement project in December 1988, after the sponsor had spent more than a year in attempting to obtain necessary industrial participation and financial support from other participants in the proposed project.

The entire agreement formalization process took from about 8 to 18 months to complete for seven of the originally selected projects (two projects withdrew during the negotiation phase) and about 12 to 13 months to complete for the two replacement projects.

smaller-scale projects previously handled this way, it was not unusual to require this information. However, in the CCT program, the comparatively large amount of money involved in some projects, coupled with the requirement for proof of financing for the entire project cost, caused problems. In addition, the Pittsburgh center's Program Director stated that the drop in oil prices during the agreement formalization period may have made some of the technologies less attractive to potential investors or project participants.

Recoupment Provision

For round one, DOE established the policy that the government should recoup its investment in clean coal projects within 20 years after commercialization of project technology. Recoupment was to come primarily from (1) net revenues generated from project operations and (2) revenues accruing from the commercial sale, lease, manufacture, licensing, or use of the demonstrated technology.

The recoupment requirements were not very well received by project sponsors. The issue also received considerable negative reaction in public comments submitted in response to the draft solicitation notice. DOE and sponsor deliberations on recoupment requirements delayed formalization of one cooperative agreement and were a factor in another sponsor's withdrawal of a proposed project. According to the project selection committee chairman, although sponsors were aware of the recoupment requirements before they submitted proposals, project sponsors generally did not want to be legally bound to repay the government if the demonstrated technology was eventually commercialized. Many sponsors, therefore, attempted to negotiate elimination of this requirement from the cooperative agreements before signing them. However, sponsors of the nine projects for which cooperative agreements have been signed ultimately agreed to the recoupment requirements.

Because of sponsors' general reluctance to agree with the recoupment requirements, it may be difficult for DOE to make the recoupment requirements more satisfactory to them. If that is the case, delays in the cooperative agreement formalization process attributable to sponsor dissatisfaction with these requirements may continue to occur.

Proprietary Information

According to DOE, the issue of access to proprietary information caused delays in formalizing agreements. To enable it to evaluate and monitor project performance, DOE required access to technical data that some technology owners considered to be proprietary information they were

Round-Two Changes Could Help Reduce Delays

Round two of the CCT program is intended to provide financial assistance to demonstration projects that can reduce pollutants commonly associated with the formation of acid rain. In an effort to minimize the problems and reduce the delays in formalizing cooperative agreements, DOE has initiated several programmatic and procedural changes for round-two projects. They include (1) establishing mutually agreeable schedules and milestones for formalizing the agreements, (2) allowing project sponsors to phase the timing of financial commitments for the projects, (3) allowing sponsors to be reimbursed for some pre-award costs during the agreement formalization process, (4) revising the bases for recouping federal funds, and (5) streamlining DOE's headquarters coordination procedures. Further, DOE does not plan to select alternative projects, as was done in round one, to replace any of the 16 round-two projects that may be withdrawn.

Although the changes should be beneficial for the program, it is too early to judge their effectiveness. However, on the basis of the sponsors' and other project participants' general dissatisfaction with federal funding repayment requirements and government access to proprietary technical information, these issues may continue to affect the timely completion of the cooperative agreement formalization process.

In addition, although DOE obtains data on the emissions reduction capability of each demonstration project, because of the sensitive and proprietary nature of the information, DOE excludes it from the comprehensive pre-award report that it provides the Congress for review before signing a cooperative agreement. However, this information is available to the Congress upon request if needed to review the estimated emissions reduction capability of the individual projects selected for funding.

Round-Two Projects

The objective of round one of the CCT program was to demonstrate the feasibility and commercial application of a broad slate of clean coal technologies using different types of coal in various types of applications. The objective of round two is to emphasize emerging clean coal technologies that can significantly reduce sulfur dioxide and nitrogen oxide emissions that contribute to acid rain. However, the general CCT program objective of improving the economics of using coal and converting it into fuels that could substitute for oil and natural gas still applies in round two.

resolve the problems and to reaffirm in writing the sponsor's commitment to the project by explaining why the agreement formalization process should be continued. The written record, along with the sponsor's performance, will then form the basis for DOE's assessment of whether to continue agreement formalization efforts with the sponsor.

Financial Arrangements

DOE required sponsors of round-one and round-two projects to submit with their proposals a detailed financing plan covering all phases (design and permitting, construction and startup, and operation) of their projects. However, according to DOE officials, in evaluating and selecting round-two projects, DOE placed somewhat greater importance and emphasis on project financing plans than it did in round one.

In addition, as a condition for signing a cooperative agreement, DOE has required round-two sponsors to provide evidence of a firm financing commitment only for the project's preliminary design phase. Firm financing commitments for the construction and operation phases are not required until after the cooperative agreement is signed, but they must be in place before DOE will authorize the sponsor to proceed beyond the preliminary design phase. As previously mentioned, sponsors of round-one projects were required to have firm financing commitments for all phases of their project before DOE would sign an agreement.

DOE believes that the revised requirement should help to reduce the delays that were experienced in round one. Sponsors, in approaching potential investors, should be able to obtain financing commitments for the construction and operation phases of their project more easily by using the cooperative agreement as evidence of government cost-sharing.

Expanded Cost-Sharing Arrangements

Public Law 100-202 expanded the CCT program's cost-sharing arrangements to allow sponsors of round-two projects to be reimbursed for costs incurred in acquiring or preparing certain material requested by DOE during the cooperative agreement formalization process. After the cooperative agreement is signed, these pre-award costs will be reimbursed in the same ratio as the cost share for the total project.

Under the new authority, sponsors can now be reimbursed for a portion of the costs associated with acquiring and submitting project-specific environmental data needed to satisfy the requirements of the National Environmental Policy Act. They can also be reimbursed for a portion of

Headquarters Coordination Procedures

For round-two projects (and the round-one replacement projects), DOE assigned headquarters staff to the centers' negotiation teams to coordinate the headquarters review and approval of each step of the negotiation phase of the agreement formalization process and serve as contact points for the headquarters offices. DOE expects this procedural modification to help reduce the time required for the headquarters review and approval process and thereby expedite the process of signing cooperative agreements by compressing the time required to complete the steps in the process.

Proprietary Information

On the basis of our discussions with DOE officials, we believe that technical data access issues will continue to pose problems and delay the cooperative agreement formalization process. DOE officials said that although they are very sensitive to the need for safeguarding sponsors' proprietary technical and other data, both during the agreement formalization process and after agreements are signed, some sponsors and other project participants are concerned that this information could be publicly released.

The selection committee chairman told us that, as a matter of DOE policy, sensitive, project-specific data are not publicly released but can be provided to congressional committee chairmen on an as-requested basis. He noted that this policy was adopted to prevent the "chilling effect" that public disclosures could have on prospective project sponsors. Further, DOE advised project sponsors to identify the parts of their submissions that should be treated as confidential information. However, in spite of DOE assurances and safeguards, on the basis of comments from prospective project participants and our discussions with DOE officials, it appears that sponsors' and other project participants' concerns about the potential public disclosure of proprietary data could persist.

No Replacement Projects

In evaluating round-one project proposals, DOE ranked all the proposals in descending order of selection preference. The replacement projects were ranked lower, for one reason or another, than the projects they replaced.

According to DOE officials, there is no requirement to expend all the available round-two funds on round-two projects if the selected projects are subsequently withdrawn or dropped. Therefore, DOE will not select alternative replacement projects, as was done in round one. Instead, DOE

Status of Round-One Funded Projects

According to DOE's Pittsburgh and Morgantown Energy Technology Centers' Program Directors and project managers, the seven original round-one projects are not progressing according to their originally scheduled estimated completion dates. As of December 31, 1988, four projects were expected to slip 3 to 13 months; the other three were behind schedule, but revised completion dates had not been established. The reasons for the slippages vary but generally involved equipment failure, delays in obtaining equipment, project financing problems, and delays in obtaining required permits. In addition, because of these and other problems, such as unanticipated cost increases, sponsors requested DOE to approve a restructuring or modification of four projects. As of December 31, 1988, these requests were under consideration. DOE said it is too early to tell whether the slippages will affect the timing of the commercial availability of the technologies.

Cost overruns have also occurred in some phases of some of the projects as a result of the slippages, but the projects' overall cost estimates have not been revised because funds have been reallocated from use in later phases of the projects to offset the overruns that occurred in the early phases. DOE said that it could not determine whether some of the projects' overall costs will increase until later phases of the projects or until restructuring proposals have been reviewed. In two cases where project costs will likely increase, DOE has the option of deciding whether to share project cost overruns with the project sponsors. However, in other cases, the agreed-upon DOE project cost share is fixed by the terms of the cooperative agreement.

Project Phases

Each project consists of three phases: (1) design and permitting, (2) construction and startup, and (3) operation (demonstration) and, if necessary, dismantlement. During the first phase, the preliminary and detailed project designs are completed and the necessary environmental and construction permits and licenses to build and operate the project are obtained. During the second phase, the site is prepared, equipment is obtained, the project is constructed, and its operational system is tested. Projects sometimes have an overlap between the first two phases to avoid delays in obtaining or testing project equipment. During the demonstration phase, the project is operated and operational data are collected, analyzed, and reported. The project may or may not be dismantled at the completion of the demonstration, depending upon the sponsor's project plans or the success of the demonstration.

behind schedule because of delays in obtaining the required permits, and one project has been delayed for other reasons.

Advanced Cyclone Combustor

This project, with an estimated initial cost of $786,000, is sponsored by the Coal Tech Corporation and was in the demonstration phase. The cyclone combustor uses multistage burning to control nitrogen oxide emissions. Sulfur is removed by two separate sorbent mechanisms inside the combustor, or by injecting a sorbent into the boiler. (A sorbent is an agent to chemically react with and neutralize sulfur dioxide during coal burning.)

The project's estimated completion date has slipped about 3 months (to June 1989) because of equipment operating problems in the boiler. About 320 hours of testing using about 100 tons of coal had been completed. However, according to the Pittsburgh center's Program Director, because of the operating problems that have been encountered, the sponsor will not be able to complete the project in accordance with the scope of work cited in the cooperative agreement. Therefore, the sponsor proposed a modification to the original project that will likely increase project costs by about $200,000 and extend the demonstration completion date by about 3 to 6 months beyond June 1989. According to the terms of the cooperative agreement, DOE, at its discretion, can fund cost overruns up to a maximum of about $100,000 for this project.

Underground Coal Gasification

This project, with an estimated initial cost of $70.1 million, is sponsored by Energy International, Incorporated, and was in the design and permitting phase. Underground coal gasification is the process by which coal is burned underground to decompose and gasify additional coal to produce fuel and other products.

The project's original April 15, 1988, design completion date slipped three times—from July 1 to August 31, 1988, to February 1989. The Morgantown center's Deputy Program Director said that these extensions were needed because of contingencies in the approved plan for financing project construction. Project financing was contingent on the Congress extending a nonconventional fuels production investment tax credit, which was signed into law in November 1988. A decision on extending the project's estimated completion date or increasing the estimated cost had not been made. DOE's and the sponsor's tentative figures indicated that the project's cost would increase from $70.1 million to

Tidd Pressurized Fluidized Bed Combustor

This project, with an estimated cost of $167.5 million, is sponsored by the American Electric Power Service Corporation and was concurrently in the design and construction phases. A fluidized bed combustor consists of pulverized coal with air flowing through it, at about 3 feet per second, to maintain the coal in a turbulent, suspended state. Sulfur dioxide is reduced by adding a sorbent to the bed. Pressurizing the bed permits exhaust gases to be used to drive a gas turbine, and nitrogen oxides are reduced by operating the bed at lower temperatures than conventional boilers.

The project's completion date has slipped because the sponsor, after signing the cooperative agreement, waited for DOE to sign the agreement before finalizing an order with an equipment vendor. The sponsor therefore lost its position in the vendor's production schedule, which will delay delivery and installation of the equipment by about 7 months. This delay has increased the project's estimated cost by $2.5 million (from $167.5 million to $170 million). In addition, the sponsor projects a 6-percent cost overrun due to inflation and the fact that cost estimates become firmer as the detailed design work nears completion. However, under the agreement, DOE's contribution to the project is fixed at $60.2 million.

Advanced Coal Gasification Combined Cycle Power Generation Plant

This project, with an estimated cost of $243.8 million, is sponsored by the M. W. Kellogg Company and was in the design and permitting phase. The project was designed to convert 551 tons of coal per day into a gasified fuel. In the gasification process, crushed coal, limestone, air, and steam are fed into a gasifier, which converts the mixture to a gas. Sulfur is removed by the limestone sorbent and by adding a zinc ferrite sorbent to the gases.

Completion of the project's design phase slipped from July 1988 to September 1988 and was extended again to January 1989. According to the Morgantown center's Deputy Program Director, the slippage occurred because the sponsor was unable to formalize an agreement, as planned, with an electric company to purchase power generated by the plant that the sponsor planned to build. Before the project could proceed into the next phase, the sponsor needed an agreement with someone to buy the power.

In November 1988, the sponsor, citing better economic and market advantages, requested DOE approval to redesign and move the project from the proposed location in Pennsylvania to an existing site in New

Circulating Fluidized Bed Combustor

This replacement project, with an estimated cost of $54.1 million, is sponsored by Colorado-UTE Electric Association, Incorporated. It was an operating plant that was ready for the demonstration phase at the time that the cooperative agreement was signed. The project will use fluidized bed technology in a boiler that circulates the bed materials.

DOE completed negotiations with the project sponsor on April 27, 1988, and submitted the required pre-award report to the Congress on August 4, 1988. Although all parties were in agreement in April, it took time for the sponsor to revise its agreements with project participants. The cooperative agreement was signed in October 1988.

According to DOE, when the project was not initially selected in July 1986, the sponsor proceeded with the project anyway. As a result, the sponsor was in a better position to formalize an agreement with DOE than were other replacement project sponsors.

Advanced Slagging Combustor

This replacement project, with an estimated cost of $49 million, is sponsored by TRW, Incorporated, and was in the design and permitting phase. The project will burn coal hot enough to melt the coal ash (the unburned mineral matter in coal) into a molten slag. The slag will be removed before the hot gases enter the boiler and thus improve boiler efficiency by reducing build-up on closely-spaced boiler tubes. The process will also use a sorbent to reduce sulfur dioxide emissions.

DOE signed the cooperative agreement for this project in November 1988 and expects the project to meet its originally scheduled completion date of September 1991.

become commercially available between 1992 and 2000; most of the technologies will be potentially available in the mid-1990s. Again, that time frame is consistent with the compliance dates contained in some of the legislative proposals the 100th Congress was considering. EPRI, however, pointed out that because most utilities are traditionally conservative and risk-aversive, several demonstrations of each technology, as well as regulatory, financial, and other factors, will be involved in the overall process of commercializing these new technologies. Thus, it believes the dates for their ultimate commercialization are uncertain.

Clean Coal Technology and Acid Rain Control Legislation

We identified about 20 acid rain control bills that were introduced in the 100th Congress. Most would have amended the Clean Air Act by requiring reductions in sulfur dioxide and nitrogen oxide emissions associated with fossil fuel combustion. The bills contained varying compliance dates, target levels for emissions reductions, or other provisions to control emissions that cause acid rain.

Legislation Could Affect the CCT Program

The enactment of legislation that prescribes new deadlines and/or emissions targets for controlling acid rain could, according to some industry and government officials we contacted, affect the potential effectiveness of DOE's CCT program. First, the projected demonstration completion dates for round-one projects range from mid-1989 to early 1996. However, the emissions reduction compliance dates of some of the 100th Congress' acid rain control bills were as soon as the early 1990s. Therefore, some of the clean coal technology projects may not be successfully demonstrated by some of the proposed emissions reduction dates. If this situation occurs, industry would be compelled to comply by using available control technology or processes and likely to forgo investment in emerging technology for existing plants.

Second, according to DOE and some industry officials, if emissions reduction target levels are more stringent than emerging technologies can attain, utilities are also likely to choose conventional options over emerging technologies. Conventional options include methods such as coal switching (from high-sulfur coals to low-sulfur coals), using chemical and mechanical processes to clean coal before burning it, or using scrubbers, which desulfurize coal combustion emissions.

According to some experts we contacted, coal switching could result in adverse socioeconomic impacts because the coal industry would have to shift from high- to low-sulfur coal production. Some observers believe

Proponents of this approach contended that costly decisions about the use of emerging technologies can be deferred until the success of these technologies is more certain. At the same time, small environmental benefits can be achieved earlier and continue to accrue incrementally. Critics, on the other hand, contended that the phased-in approach does not address the urgency with which the acid rain problem should be addressed. They further contended that there is significant potential for large-scale negative socioeconomic impacts on the high-sulfur coal mining industry because coal switching would probably be a primary means by which the smaller, near-term emissions reductions would be achieved.

A somewhat different strategy included in H.R. 4331 would have extended compliance deadlines for utilities that choose to use an emerging technology to meet their emissions reduction target. This bill would have authorized states to extend for up to 2 years the date by which utilities using emerging clean coal technologies must meet emissions reduction requirements. Under this approach, those utilities choosing to use existing technologies would have to start reducing emissions early. This provision was intended to satisfy the concerns of those who favor immediate acid rain controls. At the same time, it could also allow DOE to achieve its goal of clean coal technology commercialization by providing other utilities an incentive to use the technologies.

According to some industry and government officials we contacted, without some form of legislation it is unlikely that pollution control equipment will be installed on existing power plants or that new plants will be built to operate more cleanly than current standards require using emerging clean coal technologies. For example, an official at the Natural Resources Defense Council told us that, in view of the substantial cost involved, it is unlikely that utilities will voluntarily commit the required resources to upgrade or build new clean-burning power plants unless they are compelled to do so by the enactment of acid rain control legislation. Also, DOE's Deputy Assistant Secretary for Coal Technology noted, in testimony in June 1988, that utilities, because of their aversion to risk, are unlikely to invest in even promising clean coal technologies until reliability and performance are assured and, in the case of retrofit technologies, legislation requires that emissions be reduced.

The 101st Congress will likely deliberate the need to enact acid rain control legislation requiring reductions in sulfur dioxide and nitrogen oxide emissions levels from coal-fired power plants within prescribed time frames. On February 9, 1989, President Bush stated in a speech before

Unfunded Round-One Replacement Projects and Sponsors

Project[a]	Sponsor
Gasification combined cycle with hot gas cleanup	Foster Wheeler Power Systems Corp.
Advanced coal cleaning process[b]	Combustion Engineering, Inc.
Micronized coal combustion with limestone sorbent[b]	United Coal Co.
Advanced coal cleaning process[b]	Western Energy Co.

[a]Estimated project costs will not be available until cooperative agreements have been completed.

[b]In December 1988, DOE terminated negotiations with the Minnesota Department of Natural Resources (sponsor of a proposed ironmaking project) and began negotiations with the sponsors of these three new replacement projects.

Acid Rain Control Bills Introduced in 100th Congress

Number	Sponsor	Reduction Requirement		Emphasis (if other than reduction requirement)
		Sulfur Dioxide (SO2)	Nitrogen Oxides (NOx)	
HR 1664	Solomon	10 mil tons below 1980 levels over eastern U.S. in 2 phases—half by early 1991 and remainder by 1996	Not required but can be substituted for SO2 reduction on 2:1 ratio	
HR 1679	Cheney	10 mil tons below 1980 levels over eastern U.S. in 2 phases—half by early 1993 and remainder by end of 1997	Not required	
HR 2133	Walgren	N/A	N/A	Prohibits sources in one state from interfering with another state's attainment of air quality
HR 2355	Scheuer	N/A	N/A	Authorizes research on acid rain
HR 2399	de la Garza	N/A	N/A	Establishes 10-year program to document threat from acid rain
HR 2423	Torres	N/A	N/A	Requires new stationary sources of air pollution located in attainment areas to periodically reduce emissions
HR 2497	Gregg	N/A	N/A	Amends the Internal Revenue code to impose excise tax on SO2 and NOx emissions
HR 2498	Gregg	N/A	N/A	Similar to HR 2497 but also authorizes an acid rain control program and requires studies of effectiveness of tax in reducing pollution
HR 2666	Sikorski	10 mil tons below 1980 levels nationwide in 2 phases—half by 1993 and the balance by 1997	4 mil tons by 1997	
HR 3632	Kemp	10 mil tons in 2 phases—1994 and 1999	3 mil tons by 1999	
HR 4331	Cooper	10 mil tons below 1980 levels nationwide phased in by 2003	3 mil tons below 1980 levels nationwide phased in by 2003	
S 95	Kerry	12 mil tons below 1980 levels over contiguous states in 2 phases—seven/twelfths by 1992 and the balance by 1995	3 mil tons by 1995 over contiguous states	
S 300	Stafford	No specific reduction required but strategy would result in 12-million-ton reduction below 1980 levels nationwide during the early mid-1990s	No specific reduction required but strategy would result in some NOx reductions by 1995	
S 316	Proxmire	10 mil tons over U.S. in 2 phases—1993 and 1997	3 mil tons over eastern U.S. states by 1997	
S 321	Mitchell	12 mil tons below 1980 levels by 1996 over 50 states	4 mil tons below 1980 levels by 1996 over 50 states	
S 796	Durenberger	N/A	N/A	Requires EPA to establish new SO2 and NOx standards

(continued)

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Number	Sponsor	Reduction Requirement		Emphasis (if other than reduction requirement)
		Sulfur Dioxide (SO2)	Nitrogen Oxides (NOx)	
S 911	Durenberger	N/A	N/A	Implements recommendations of Special Envoys to authorize a program deploying clean coal technologies
S 1123	Durenberger	12 mil tons nationwide below 1980 levels in 2 phases—by 1994 and 1997	4 mil tons nationwide below 1980 levels in 2 phases—by 1994 and 1997	
S 1894	Mitchell	12 mil tons nationwide below 1980 levels in 3 phases—5 mil by 1993, 5 mil by 1998, and 2 mil by 2000	4 mil tons nationwide by 1996	

Round-Two Clean Coal Technology Demonstration Projects and Sponsors

Project[a]	Sponsor
Pressurized fluidized-bed combustor	American Electric Power Service Corp.
Coal gasification combined cycle	Combustion Engineering, Inc.
Advanced flue gas desulfurization	Pure Air
Circulating fluidized-bed combustor	Southwestern Public Service Co.
Post-combustion dry sorbent injection technology	Combustion Engineering, Inc.
Flue gas desulfurization	Southern Co. Services, Inc.
Catalytic removal of sulfur dioxide and nitrogen oxides from flue gas	Combustion Engineering, Inc., and Snamprogetti, USA, Inc.
Coke oven gas desulfurization	Bethlehem Steel Corp.
Advanced tangentially-fired combustion techniques to reduce nitrogen oxides	Southern Co. Services, Inc.
Low nitrogen oxide/sulfur dioxide burner retrofit for utility cyclone boilers	TransAlta Resources Investment Corp.
Advanced wall-fired combustion techniques to reduce nitrogen oxides	Southern Co. Services, Inc.
Nitrogen oxide control retrofit	The Babcock and Wilcox Co.
Sorbent injection, selective catalytic reduction	The Babcock and Wilcox Co.
Scrubbing system to reduce sulfur dioxide emissions	Passamaquoddy Tribe
Selective catalytic reduction to control nitrogen oxides	Southern Co. Services, Inc.
Otisca fuel coal-water slurry	Otisca Industries, LTD.

[a]Estimated project costs will not be available until cooperative agreements have been completed. According to DOE, the projects will receive a total of about $537 million in federal funds to be added to more than $800 million in proposed private sector funding.

Funded Round-One Clean Coal Technology Demonstration Projects, Sponsors, and Estimated Costs

Dollars in millions

Project	Sponsor	Project costs[a] DOE	Sponsor
Advanced cyclone combustor	Coal Tech Corp.	$0.4	$0.4
Pressurized fluidized-bed combustor	American Electric Power Service Corp.	60.2	107.3
Limestone injection multistage burner	The Babcock and Wilcox Co.	7.6	11.8
Gas reburning and sorbent injection	Energy and Environment Research Corp.	15.0	15.0
Prototype commercial coal/oil co-processing plant	Ohio Ontario Clean Fuels, Inc.	45.0	180.7
Underground coal gasification	Energy International, Inc.	11.8	58.3
Advanced coal gasification combined cycle power generation plant	The M. W. Kellogg Co.	87.5	156.3
Pyropower circulating fluidized-bed combustor[b]	Colorado-UTE Electric Association, Inc.	19.9	34.2
Advanced slagging combustor[b]	TRW, Inc.	23.5	25.5
Total		**$270.9**	**$589.5**

[a]Estimated costs when cooperative agreements were completed.

[b]Replacement project.

the Congress that he would request the full funding for the CCT program and would introduce legislation for a new, more effective Clean Air Act, which will include a plan to reduce by a specific time the emissions that cause acid rain. EPA plans to draft the proposed legislation to revise the Clean Air Act. It is, therefore, important that DOE work closely with EPA in drafting the legislation.

Conclusions

Enactment of acid rain control legislation could affect the future use of emerging clean coal technologies. If legislative compliance deadlines take effect before funded technologies are commercially available, or if emission-reduction target levels are more stringent than the emerging technologies can attain, utilities would likely comply with the new emission requirements by using existing control methods. Consequently, the CCT program's potential benefits could be unrealized for a large portion of the power plants that now use coal-fired boilers.

To accommodate the concerns of both environmentalists and clean coal technology proponents, the Congress could establish compliance deadlines and emissions reduction levels that allow for significant near-term reductions in emissions using conventional technologies, but are not so stringent as to deter the development and use of clean coal technologies aimed at the same goal.

Recommendation

The Congress continues to debate whether acid rain-causing emissions can be reduced in the near term without impeding the development and commercialization of clean coal technologies. Included in this debate will be the proposed legislation the new administration plans to submit to the Congress to revise the Clean Air Act. Accordingly, we recommend that the Secretary of Energy work closely with the Administrator of the Environmental Protection Agency to ensure that the proposed legislation that is submitted for congressional consideration appropriately links compliance dates for emissions reductions with the expected commercial availability of emerging clean coal technologies.

that the loss of mining jobs and related work in high-sulfur coal mining areas could create economic hardships for affected workers.

According to DOE and industry officials, although conventional technologies have played a large role in dramatically reducing sulfur dioxide emissions in the past decade, further control of sulfur dioxide from existing plants with available technologies is limited and problematic. To illustrate, an EPRI official said that because of power plant design specifications, some plants that are designed to burn high-sulfur coals could not be operated on low-sulfur coal without major, costly structural modifications. And according to DOE data, existing coal cleaning processes have limited effectiveness in terms of the level of future emissions reductions that can be achieved. Also, while conventional scrubbers can achieve comparatively high sulfur dioxide emissions reductions levels—over 90 percent in some applications—they do not remove nitrogen oxide emissions.

Linking Acid Rain Control Legislation and Clean Coal Technologies

The shift in the focus of the CCT program to emissions reductions ties into the objectives of controlling acid rain. In view of the new administration's commitment to provide full funding for the CCT program, it may be advantageous to link acid rain control legislation with the commercial availability of clean coal technologies if maximum benefits are to be realized from the program. This could be accomplished, while also providing for near-term emissions reductions using conventional means, if emissions reduction levels, time frames, and reduction approaches are established in such a way as to allow significant near-term emissions reductions using conventional technologies or processes, but are not so stringent as to deter the use of clean coal technologies aimed at the same goal. As discussed below, a few of the bills introduced in the 100th Congress provided for time frames and emissions reduction levels consistent with the anticipated commercial availability of clean coal technologies. (Key provisions of acid rain control legislation proposed in the 100th Congress are presented in app. IV.)

One suggested strategy is a phased-in approach whereby states or utilities would reduce their emissions in stages. An example of this approach was reflected in H.R. 2666, which would have required an estimated 10-million-ton reduction in sulfur dioxide in two phases—the first phase by 1993 and the second by 1997. Nitrogen oxide reductions from stationary sources would have had to be reduced by 2 million tons by 1997; mobile sources would have been required to achieve another 2-million-ton reduction.

Acid Rain Control Legislation Should Be Linked to Clean Coal Technologies

To develop additional electrical generating capacity for expected demand increases, utilities will need to decide whether to build new plants or upgrade existing ones. Because emissions from coal-fired plants contribute to acid rain, utilities' decisions will be largely influenced by the technological options available and acid rain control requirements the Congress may eventually enact. DOE and the Congress, therefore, need to foster development of cost-effective ways to burn coal more cleanly, both to control acid rain and to improve our energy security by reducing dependence on imported oil and gas.

The 100th Congress had been debating whether mandates for reducing acid rain-causing emissions can be imposed without impeding the development and commercialization of emerging clean coal technologies. Key issues in the debate center on the need, proper time, and optimal method to mandate emissions reductions. Enactment of legislation that prescribes new deadlines and/or emissions reduction levels to control acid rain could affect the potential effectiveness of DOE's CCT program by diverting investment from emerging technologies into available conventional technologies. On the other hand, enactment of legislation that allows for development of emerging technologies while also requiring some near-term emissions reductions could encourage commercialization of technologies that, if adequately demonstrated, are more efficient and cleaner. Because the central theme of the CCT program has shifted to achieving reductions in emissions, it would be beneficial, if possible, to specifically link acid rain control legislation with the CCT program.

Commercial Availability of Emerging Clean Coal Technologies

The issue of when emerging clean coal technologies will be commercially available is a key element in the debate over acid rain control legislation. DOE officials at the energy technology centers that are monitoring round-one projects estimated that the first commercial application for six of the seven originally selected round-one technologies for which agreements have been signed will occur from 1992 to 1995, and the seventh by the year 2000. These dates are consistent with the compliance dates for emissions reductions in some acid rain control bills introduced in the 100th Congress. They cautioned, however, that these estimates are best-case scenarios that do not appear to leave much room for such things as regulatory or financing problems that may occur. And others have cautioned that these estimates do not take into account the conservative nature of most utilities in deciding on major capital expenditures.

According to the Electric Power Research Institute, technologies similar to those being demonstrated under round one of the CCT program will

York and to add a New York utility project participant. The sponsor estimated that the total project costs would decrease by about 25 percent (to about $190 million) because a plant was already available at the new site and there would be no need to build one. According to a center official, however, the DOE project cost share would remain at $87 million. The center official said that if the sponsor's request is approved, the project's completion date would probably be delayed, but revised project cost and completion estimates had not been determined.

Prototype Commercial Coal/Oil Co-Processing Plant

This project, with an estimated cost of $225.7 million, is sponsored by Ohio Ontario Clean Fuels, Incorporated, and was in the design and permitting phase. The project will use two technologies to simultaneously liquefy coal and upgrade heavy residual oils to produce liquid fuels that are low in sulfur, nitrogen, and trace metals and high in heating value. In this process, crushed coal, petroleum residue, and recycled oil will be mixed, pressurized, and heated. Hydrogen will be added to this mixture to break it into simpler chemical compounds, such as hydrogen sulfide and ammonia.

As of December 31, 1988, only preliminary design work had been done on the project. According to the Pittsburgh center's Program Director, the project is behind schedule because of the sponsor's slow start and regulatory and economic problems. Because the sponsor was having difficulty obtaining the necessary environmental permits for the project site, it did not want to do extensive design work for that site and then, if environmental permits could not be obtained, have to do the same work at another site. In addition, the estimated costs of distributing the produced fuel, which are critical to the project's economics, have tripled.

The sponsor was pursuing alternative sites for the demonstration project. However, DOE put the project on hold pending its review of a restructuring proposal submitted by the sponsor. The sponsor wanted to change the marketing strategy to target the end product to utility-based fuels rather than refinery products. DOE has slipped the completion date of this project from December 1994 to January 1996 (about 13 months) and expects to slip it further because of the restructuring request. According to a DOE center official, if a suitable alternative site cannot be identified or the required permits obtained for the current project site, this project may not proceed.

about $113 million, but DOE's share under the current agreement is fixed at $11.8 million.

Limestone Injection Multistage Burner

This project, with an estimated cost of $19.4 million, is sponsored by the Babcock and Wilcox Company and was concurrently in the design and construction phases. The project will use sorbent injection in multiple stages to control sulfur dioxide. Low nitrogen oxide burners will be used to control nitrogen oxide.

The project resulted from an agreement between DOE and the project sponsor to use the facilities at an existing EPA-funded project in Ohio to demonstrate a variation of the process used at that project to control sulfur dioxide and nitrogen oxides emissions by injecting sorbents into a boiler. The EPA-funded project used only one type of coal and sorbent combination, while the DOE-funded project will use combinations of different types of coals and sorbents. However, the DOE-funded project could not begin until the testing was completed for the existing project. DOE has slipped the completion date of its project by 3 months because testing the EPA-funded project took longer than anticipated.

Gas Reburning and Sorbent Injection

This project, with an estimated initial cost of $30 million, is sponsored by the Energy and Environmental Research Corporation and was in the design and permitting phase. The project will use a two-part process to control emissions—sorbent injection to control sulfur dioxide emissions and gas reburning to control nitrogen oxide emissions. In the reburning stage, natural gas will be injected to produce an oxygen-deficient condition that converts some of the nitrogen oxide to nitrogen.

The project's design was to have been completed by October 1, 1988. In July 1988, the sponsor requested a 6-month extension to satisfy environmental permitting requirements. However, as of December 31, 1988, the sponsor had deferred further design work and was restructuring the project to reduce costs. The sponsor's engineering analysis had projected a 30-percent increase in total project costs based on the original project plans. Under the terms of the cooperative agreement, DOE, at its discretion, can fund cost overruns up to a maximum of about $3.75 million for this project. The balance of cost overruns would have to be funded by the project sponsor. According to the Pittsburgh center's Program Director, the project's estimated completion date of December 1991 will be extended, but as of December 31, 1988, the revised date had not been determined.

Project managers at DOE's Pittsburgh and Morgantown Energy Technology Centers monitor the progress of funded projects through the various project phases. They stay abreast of whether projects are meeting milestones and experiencing any problems.

As of December 31, 1988, the status of the nine round-one funded projects was as follows. Five projects (four original and one replacement) were in the design and permitting phase, two projects were concurrently in design and construction phases, and two projects (one original and one replacement) were in the demonstration phase. Sponsors of three projects anticipate dismantling their projects after the demonstrations are completed.

Project Status

Table 4.1 compares the originally scheduled and revised completion dates for the nine round-one funded projects as of December 31, 1988. Four of the seven initially selected projects had slipped their completion dates by at least 3 to 13 months, and the other three were behind schedule, but DOE had not established revised completion dates. The two recently funded replacement projects were just getting started and were still on schedule.

Table 4.1: Comparison of the Originally Scheduled and Revised Completion Dates for Round-One Projects

	Scheduled completion date at time of agreement	Projected completion date as of December 31, 1988
Advanced cyclone combustor	March 1989	June 1989[a]
Underground coal gasification	March 1991	Unknown
Limestone injection multistage burner	December 1990	March 1991
Gas reburning and sorbent injection	December 1991	Unknown
Tidd pressurized fluidized bed combustor	March 1993	October 1993
Advanced coal gasification combined cycle power generation plant	October 1993	Unknown
Prototype commercial coal/oil co-processing plant	December 1994	January 1996[a]
Circulating fluidized bed combustor[b]	August 1990	August 1990
Advanced slagging combustor[b]	September 1991	September 1991

[a]DOE indicated that this date would likely slip further.

[b]Replacement project.

According to DOE officials, two projects are behind schedule because of equipment failures or delays in obtaining equipment, two projects have been delayed because of project financing problems, two projects are

plans to carry over any uncommitted or unexpended round-two funds for subsequent solicitations under the CCT program.

Project Environmental Information

As part of its overall strategy for complying with the National Environmental Policy Act, DOE developed an environmental impact analysis in September 1988. The analysis described generic clean coal technologies that are representative of the technologies to be funded under round two of the CCT program. The report contains generic environmental information describing the maximum potential change in principal air emissions, water effluents, and solid wastes that might be produced regionally and nationally in the year 2010 if technologies similar to the round-two clean coal technology demonstration projects are commercialized. However, DOE does not plan to provide the Congress with information on the emissions reduction capabilities of the specific projects to be demonstrated under the CCT program.

The chairman of DOE's project selection committee told us that project-specific emissions reduction data would not be included in the pre-award report that DOE is required to submit to the Congress because DOE is concerned that release of such information, in addition to the information that will be included in the pre-award report on how the particular technology is expected to work, could result in disclosure of sensitive or proprietary information. In addition, DOE is concerned that sponsor-provided information on how effectively the project is expected to reduce emissions could be challenged by companies that submitted proposals that were not selected for federal funding. The selection committee chairman said that project-specific emissions reduction data were available and, in accordance with DOE policy, could be obtained by cognizant chairmen of congressional committees and subcommittees on an as-needed basis.

the costs incurred in preparing certain material requested by DOE for negotiating the cooperative agreement.

DOE officials believe that project sponsors are more likely to provide better and more complete required data during the cooperative agreement formalization process if they are reimbursed for the cost of acquiring and submitting the data. In this regard, we noted that public comments on proposed changes for round two of the CCT program indicated that the reluctance of project sponsors to incur the cost of providing additional information to DOE may have been a contributing factor to delays experienced in formalizing some of the round-one cooperative agreements.

Recoupment Provisions

In responding to unfavorable comments from electric utilities and round-one project sponsors, in round two DOE eliminated the requirement that net revenues from project operations be used as a basis for recouping federal funds. Instead, DOE established a requirement that equipment sales revenues associated with the demonstrated technology should be used as a basis for calculating recoupment. Our review of public comments disclosed that this change has also met with resistance, primarily from equipment vendors who are not project sponsors and do not want to disclose equipment sales data for the purpose of calculating recoupment payments if the technologies are commercialized.

For round-two projects, recoupment of federal funds, adjusted for inflation, will be based on

- 2 percent of gross sales of equipment that is manufactured as the result of commercialization of the demonstration technology and
- 3 percent of the royalties from licensing the technology to third-party end-users.

According to DOE officials, recoupment requirements are not expected to be as much of a problem in round two as they were in round one. However, on the basis of public comments, it appears that sponsors' and other participants' concerns about the recoupment requirements could persist.

In September 1988, DOE selected 16 projects from 55 proposals submitted for round-two funding. DOE expects to sign the cooperative agreements with the project sponsors by October 1989. These projects, if successfully negotiated, will receive about $537 million in federal funds to be added to about $800 million in proposed nonfederal funding. According to DOE, most of the projects will demonstrate technologies that can reduce sulfur dioxide and nitrogen oxide emissions at coal-burning power plants.

Changes

DOE made several programmatic and procedural changes as a result of lessons learned from its round-one program and a statutory change concerning cost reimbursement.

Agreement Formalization Schedules

DOE plans to establish an agreement formalization schedule with round-two project sponsors that includes mutually agreeable, specific milestones for determining progress and for completing the fact-finding and negotiating phases of the agreement formalization process. DOE also plans to establish deadlines for signing the cooperative agreements and for sponsors to provide additional information that DOE may request. In round one, these types of milestones were established for three of the four replacement projects, but not for the originally selected projects. However, it is not clear that the agreement formalization process for the replacement projects was enhanced as a result of establishing the milestones. Also, target dates for signing the cooperative agreements for the originally selected projects were not mutually agreed to by DOE and the project sponsors.

DOE believes that by establishing mutually agreeable milestones at the beginning of the process, DOE and the round-two project sponsors can avoid the protracted negotiations that characterized round-one agreement formalizations. DOE officials said that DOE has reinforced the importance of establishing and following the negotiation schedule by emphasizing to the selected round-two project sponsors that noncompliance with the agreed-upon negotiation schedule and milestone dates can be cause for terminating negotiations.

According to DOE officials, if an important milestone is not met, DOE will try to ascertain whether the sponsor has reasonably done all that could be expected by asking the sponsor to document the problems causing the delay. The sponsor will be asked to comment on any actions taken to

reluctant to release. Project participants were able to withhold from the public technical data developed prior to signing the agreement. However, according to patent counsels at DOE headquarters and Oak Ridge Operations Office, the participants were concerned that technical data resulting from the project after the agreements were signed would be subject to public disclosure.

According to a DOE patent counsel who assisted in the negotiations, resolving proprietary data rights issues was important to formalizing all five of the cooperative agreements he helped to negotiate. In addition, a DOE official noted that in the case of one withdrawn project, the inability of the parties to resolve proprietary data rights was a major cause for delays before the sponsor finally withdrew its proposal. The sponsor's chief negotiator for the project cited the principal contractor's refusal to provide DOE with technical data as a primary reason for withdrawing the proposal.

Headquarters Coordination, Review, and Approval

Unlike other energy research and development programs in which the centers have total negotiation authority, for round one of the CCT program, DOE headquarters retained authority to coordinate, review, and approve each step of the negotiation phase of the agreement formalization process. DOE officials told us that this arrangement was adopted because of the program's size and the competition surrounding potential replacement projects, and to ensure that a consistent approach was used in negotiating the cooperative agreements. DOE officials said that this approach added time to the formalization process.

Formalizing Agreements for Replacement Projects

As previously mentioned, DOE took 12 to 13 months to formalize cooperative agreements for two of the replacement projects, primarily because the project sponsors encountered difficulties in firming up project financing. According to the Morgantown center's Deputy Program Director, the sponsors of two other replacement projects also had difficulties in firming up commitments for project financing. One of these replacement projects was still in the fact-finding phase as of December 31, 1988, and the other was dropped by DOE in December 1988 because the sponsor could not obtain adequate financial backing from other participants.

Agreement Formalization Problems

Federal financial assistance could not begin for the selected projects until cooperative agreements had been signed. As a result of the problems and delays in formalizing the agreements for seven of the originally selected projects, financial assistance for five projects did not begin as early as it otherwise could have, and sponsors withdrew two projects because they could not satisfactorily resolve negotiation issues with DOE. The delay in starting the projects, and the delay and problems encountered after the projects were funded (discussed in ch. 4), have extended the anticipated completion dates for most of the projects.

Agreement formalization problems and delays were experienced because sponsors had difficulty in finalizing financial and other business arrangements. In addition, recoupment requirements of the agreements, which established the basis for repaying federal funds expended on the projects if the demonstration technology was eventually commercialized, were not very well received by sponsors, who generally disliked the repayment terms. Sponsors and other project participants were also concerned that proprietary data concerning the projects would be subject to public disclosure. Further, DOE's headquarters coordination, review, and approval arrangements added time to the formalization process.

Financial and Other Business Arrangements

Sponsors' difficulties in finalizing financial and other business arrangements caused the major delays in signing agreements and were the primary reason that sponsors of two of the originally selected projects withdrew. The sponsors, as part of their proposals, provided DOE with plans showing how their projects would be financed and conducted. DOE required the financial and business arrangement plans to ensure that the projects represented carefully considered and supported industry proposals. These plans usually contained letters of interest from organizations expressing their desire to participate in the project by providing funding or other assistance, such as providing coal or a project site. After the projects were selected, however, DOE, as a condition to signing a cooperative agreement, required the sponsors to obtain firm financial or other business commitments from third parties covering the project's entire cost. These commitments were to be evidenced by documents, such as letters of commitment, contracts, or partnership or other agreements.

The sponsors generally had difficulty in demonstrating to DOE that they had the necessary financing and/or other third-party arrangements to conduct the project. The centers' Program Directors told us that, for

Difficulties in Formalizing Cooperative Agreements

DOE experienced difficulties in completing cooperative agreements with round-one project sponsors because (1) sponsors had difficulties in completing financial and other business arrangements, (2) it took time to resolve sponsors' dissatisfaction with the requirement that the federal share of project costs be repaid if the technology is commercialized, and (3) sponsors and other project participants were reluctant to agree to provide DOE with proprietary data. DOE's headquarters oversight to ensure negotiation consistency also added time to the agreement formalization process. As a result, cooperative agreements for seven of the nine initially selected projects were not signed by DOE's April 1987 target date, and two of the unsigned projects were withdrawn by the sponsors in October 1987. Agreements for two projects were signed within the 9-month time frame anticipated, and agreements for the other five projects were signed between June 25, 1987, and January 22, 1988.

The two withdrawn projects were replaced with four others from an alternate list of eligible projects in October 1987. However, DOE has also had problems formalizing agreements for the replacement projects, primarily because of sponsors' difficulties in obtaining project financing. Only two of the replacement projects had been brought under cooperative agreements as of December 31, 1988. One agreement was signed in October 1988, the other in November 1988.

In December 1988, DOE terminated negotiations with the sponsor of one of the two unsigned replacement projects because it did not appear that agreement formalization problems could be resolved. DOE also announced that, in an effort to commit all of the funds appropriated for round one, it would begin negotiations with the sponsors of three additional replacement projects that it selected for funding.

The Cooperative Agreement Formalization Process

The cooperative agreement formalization process for projects selected for financial assistance consisted of two major phases—fact finding and negotiations. For round one of the program, DOE headquarters delegated the authority for formalizing agreements with project sponsors to its Pittsburgh and Morgantown Energy Technology Centers. However, because of the magnitude of the program, the ongoing competition among sponsors on the alternate list of replacement projects, and the need to ensure negotiation consistency with all project sponsors, DOE headquarters retained authority for coordinating, reviewing, and approving each step in the negotiation phase of the process.

enacted, in the 100th Congress. Similar bills likely will be introduced in the 101st Congress. A key issue is whether near-term efforts to control acid rain-causing emissions will impede the development and commercialization of clean coal technologies. Chapter 5 discusses the need to coordinate acid rain control legislation that may be enacted with the CCT program.

Objectives, Scope, and Methodology

Concerned about the effectiveness and implementation of the CCT program, in May 1987, the Chairman, Subcommittee on Energy and Power, House Committee on Energy and Commerce, requested that we review DOE's implementation of the first phase of the program. We briefed the Chairman's office on the results of our review on February 18, 1988. During that briefing, we were also asked to testify and later report on the following issues:[1]

- DOE's process of negotiating cooperative agreements with project sponsors.
- Changes DOE made for round-two projects.
- The status of funded projects.
- The interrelationship between acid rain control proposals and the potential commercialization of clean coal technologies.

In conducting this review, we interviewed DOE headquarters officials involved with the CCT program and the project selection and approval process. We also obtained and analyzed relevant reports, documents, records, and other information at DOE headquarters. We reviewed documentation on the solicitations for project proposals, public comments on the proposed solicitations, DOE and project sponsor information on the selected projects, and DOE's procedures for evaluating and selecting project proposals and formalizing cooperative agreements with project sponsors.

We also performed work at DOE's Morgantown and Pittsburgh Energy Technology Centers. These centers, which were involved in the cooperative agreement formalization process, monitor the funded projects. We reviewed the management controls used by the centers to monitor the status of funded projects. In addition, to obtain an understanding of DOE's process and the problems encountered in formalizing cooperative

[1]We testified before the Subcommittee on June 22, 1988 (GAO/T-RCED-88-47).

Introduction

The Clean Coal Technology Program

In 1984, under Public Law 98-473, the Congress set aside $750 million in the Energy Security Reserve Fund to establish the Department of Energy's (DOE) Clean Coal Technology (CCT) program. The Congress directed DOE to select cost-shared (industry- and government-financed) projects to demonstrate clean coal technologies. Clean coal technologies include a variety of processes by which sulfur dioxide, nitrogen oxides, and other potentially harmful emissions are reduced when coal or coal products are burned for energy production. The demonstration projects were to use coal as an energy source in a more environmentally responsive, economic, and efficient manner than existing commercial coal-fueled applications.

The CCT program is conducted under the broad statutory authority of the Energy Reorganization Act of 1974 and the Federal Nonnuclear Energy Research and Development Act of 1974. Since the program's inception, the Senate and House Appropriations Committees have provided supplementary guidance through various appropriations actions. The program is designed to encourage the commercialization of emerging clean coal technologies by providing federal funding of up to 50 percent of a demonstration project's cost; industry and other nonfederal sources provide the balance of project financing.

In December 1985, the Congress made $400 million from the Energy Security Reserve Fund available for the first phase, or round one, of the CCT program. The legislative history of round-one appropriations contains several guidelines to assist DOE in establishing criteria for selecting demonstration projects, including a concern that the demonstrated technologies be capable of commercialization in the 1990s.

In January 1986, special U.S. and Canadian envoys issued a joint report (referred to as "the envoys' report") that contained several recommendations aimed at reducing the environmental problems associated with U.S., Canadian, and transboundary acid rain. Sulfur dioxide and nitrogen oxide emissions associated with coal combustion contribute to the formation of acid rain. The envoys' report recommended that the U.S. government implement a 5-year, $5 billion commercial demonstration program in which the federal government would provide up to half, or about $2.5 billion, of the funding to advance technologies that would be needed for any future acid rain control program.

On March 18, 1987, the administration announced and later requested for the CCT program the full amount of federal funding recommended by the envoys' report. The funding was to be provided over the 5-year

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unfunded replacement project and selected three more replacement projects for funding.

The delays in completing the round-one project agreements were primarily attributable to the time it took to resolve sponsors' problems with project financing and other business arrangements, including proprietary data rights. Also, although sponsors knew all along of the requirement to repay DOE's investment in the projects should the technologies be commercialized, many attempted to negotiate elimination of this requirement before signing the agreements. Further, DOE's headquarters review to ensure that a consistent approach was used in negotiating agreements added some time to the process, according to DOE officials.

Round-Two Changes

DOE has made several changes for round two of the program to reduce the time required to formalize cooperative agreements with project sponsors. The changes included establishing mutually agreeable milestones for completing the various phases of the agreement formalization process; placing more emphasis on project financing arrangements, but requiring firm financial commitment only for the preliminary design phase; allowing sponsors to be reimbursed for some pre-award costs; revising federal repayment requirements to base repayment on revenues from sales of equipment associated with the technology rather than on net revenues from project operations; and streamlining DOE's headquarters review. However, sponsors' dissatisfaction with the revised repayment requirements and DOE's access to proprietary information could continue to extend the time it takes to formalize agreements.

Status of Projects

As of December 31, 1988, DOE had extended the estimated completion dates for four round-one projects from 3 to 13 months beyond the dates established when the cooperative agreements were signed. DOE indicated that the completion dates for three other round-one projects would also slip, but had not established revised dates. The projects are behind schedule because of equipment failure, delays in obtaining equipment, project financing problems, and delays in obtaining permits.

Also, because of unanticipated problems, sponsors of four projects requested DOE to approve a restructuring or modification of their projects. As of December 31, 1988, these requests were under consideration. Cost overruns also occurred in some phases of some projects, but DOE said that it could not determine whether some of the projects' total

Executive Summary

Purpose

Coal, an abundant domestic energy source, provides 25 percent of the nation's energy needs, but its use contributes to various types of pollution, including acid rain. The Department of Energy (DOE) has a Clean Coal Technology (CCT) program whose goal is to expand the use of coal in an environmentally safe manner by contributing to the cost of projects demonstrating the commercial applications of emerging clean coal technologies. Concerned about the implementation of the CCT program, the Chairman, Subcommittee on Energy and Power, House Committee on Energy and Commerce, requested GAO to report on (1) DOE's process of negotiating cooperative agreements with project sponsors, (2) changes DOE has made to the program, (3) the status of funded projects, and (4) the interrelationship between acid rain control proposals and the potential commercialization of clean coal technologies.

Background

Under the CCT program, DOE funds up to 50 percent of the cost of financing projects that demonstrate commercial applications of emerging clean coal technologies. DOE has conducted two solicitations for demonstration project proposals and is planning a third solicitation by May 1989. The Congress has appropriated $400 million for the first solicitation, or round one of the program, $575 million for round two, and $575 million for round three, for a total of $1.55 billion.

For the round-one solicitation, DOE received 51 proposals from project sponsors. As of December 31, 1988, DOE had funded nine projects and was in the process of negotiating cooperative financial assistance agreements with sponsors of four projects. In September 1988, DOE selected 16 round-two projects from 55 proposals submitted and began the process of negotiating cooperative agreements with the project sponsors.

The Congress has debated the need to reduce acid rain-causing emissions associated with fossil fuel combustion. The 100th Congress considered but did not enact about 20 acid rain control bills. On February 9, 1989, President Bush told the Congress that he plans to propose legislation for a new, more effective Clean Air Act, which will include a plan to reduce, by a specific date, the emissions that cause acid rain.

Results in Brief

DOE experienced difficulties in negotiating cooperative agreements with round-one project sponsors, which delayed completing agreements for five projects and resulted in the termination of negotiations for three projects. One of the main problems was that project sponsors had difficulty in completing financial and other business arrangements to fund