



CLEAN COAL TODAY

U.S. Clean Coal Technology Demonstration Program

Office of Fossil Energy, U.S. Department of Energy

Introducing the Global CCT Opportunity

Opening the International Orientation Session of the Fourth Annual Clean Coal Technology Conference, the first gathering at this four-day event, were Barbara N. McKee, Director, Office of International Program Coordination, and Dr. Lowell Miller, Associate Deputy Assistant Secretary for Clean Coal.



Dr. Lowell Miller, Associate Deputy Assistant Secretary for Clean Coal

Since world economies and environments are interconnected, McKee observed, it is crucial for continued quality of life that coal be used cleanly, efficiently, and economically throughout the world. "Clean coal technologies allow us to do this. The global opportunities for clean coal technologies are significant, and working together, we can accelerate market deployment," she said.

McKee explained that potential new clean coal technology applications in China, the Pacific Rim, and South Asia are more than double those in the rest of the world. Investors already

are active in these regions. Significant retrofit opportunities also exist throughout the world. At the same time, many changes are occurring in global electric power sectors, providing both excitement and challenges for the power sector worldwide. McKee believes that we are in the midst of major changes challenging old theories and thinking. A new spirit of invention has been unleashed worldwide, as governments, industry, and investors work together to reform the global energy and power sectors. Some of these reforms will influence the global deployment of clean coal technologies.

In closing, McKee said, "We must protect and nurture this earth so that its responses, and its resources to us, will be here for future generations. We live in challenging times.... But out of these challenges emerge new opportunities for us. I have full confidence in the resilience and creativity of the human spirit to overcome these hurdles. Working together with commitment, courage, mutual respect, and friendship, we can do wonders for the good of the earth and for the people on it."

See "Opportunity" on page 2. . .

O'Leary Heralds Wabash Startup

In November, the Clean Coal Technology (CCT) Program passed a major milestone with dedication of the 262-MW Wabash River Coal Gasification Repowering Project in Indiana, the first operating repowering project in the CCT Program. The project repowers a 1953-vintage steam generator at PSI's Wabash River Generating Station, and is a joint venture of Destec Energy, Inc., and PSI Energy, Inc.

Secretary of Energy Hazel O'Leary, who spoke at the ceremony, hailed the project as "the forerunner of a new era of environmentally superior clean coal technologies." IGCC technology has potentially wide application for repowering aging boilers, particularly in the east and midwest.

The Destec process removes 98 percent of the sulfur in coal, reducing

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Miller then addressed the importance of CCTs in the global market. He explained that the two major focuses of political and economic agendas globally are the growth in energy demand, and the growth of environmental concerns. Clean coal technologies can bridge the need for more energy and the need for more environmental controls.

Miller explained that the DOE Clean Coal Technology Demonstration Program began with a relatively narrow acid rain focus, but now addresses other environmental concerns including global warming, emission caps, air toxics, and solid waste.

To emerging economies, electric power is the preferred source of energy to increase social stature, to move from a developing nation into a developed nation, and to achieve the social and economic benefits that developed nations now experience. Miller stated that most investment in the energy sector will be to meet this increase in power demand. And, if past trends continue, the most likely source of energy globally is coal.

Miller also noted that since 1971 there has been a steady increase in average annual coal production; world coal use is projected to grow between 2000 and 2075.

While the most significant projects in the Clean Coal Program have been for advanced power genera-

tion, Miller pointed out that there are equally important technologies, particularly in the global market, which provide the ability to progressively increase control of environmental problems. These options range from flue gas desulfurization (FGD) to the advanced, capital-intensive new technologies such as integrated gasification combined-cycle (IGCC), and pressurized fluidized-bed combustion (PFBC).

CCTs provide the opportunity to remove emissions of SO₂ and NO_x, and they can be used individually or in combination. The repowering technologies represent some of the advanced new technologies that require major modification of a power plant or construction of a completely new facility. Miller concludes that we have the options necessary to solve almost any kind of cleanup problem facing a utility that seeks to utilize coal as an energy source.

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emissions to a fraction of the Clean Air Act Amendments of 1990 requirements due to take effect in 2000. Over ninety percent of NO_x is removed — well within Federal air quality standards. Sulfur by-products will be converted into an ingredient of fertilizer, while the coal ash can be marketed as aggregate for road construction. Indiana high-sulfur coal will be used, helping to preserve local jobs and aiding the regional economy.

DOE is providing approximately \$219 million, half of the total project cost, and will conduct a three-year test program to collect performance data. Look for details in the next issue of *Clean Coal Today!*

CCT



Dr. Miller with delegates from Russia and The Netherlands.



Richard Lynch (DOE-HQ) listens to ideas from the Slovakian delegation.



Delegates from India discuss clean coal issues.



The United Kingdom delegation shares some thoughts.

A Message from the Editor

This issue of *Clean Coal Today* is designed to give our readers highlights of the Fourth Annual Clean Coal Technology Conference — The Global Opportunity — held in Denver, Colorado, September 5-8. The conference offered a chance for U.S. participants and visitors from over a dozen foreign countries to get to know each other, discuss issues of importance, visit two local projects (Arapahoe and Cherokee Stations) funded under the DOE Clean Coal Program, and enjoy Western style food and entertainment.

The prediction that coal will be the important baseload fuel of the future was repeated throughout the sessions. The challenge is to continue development momentum for clean coal technologies so that they will be ready when needed, both domestically and internationally. Some of the conference themes were: clean coal technologies can address growing worldwide environmental concerns; new, non-revenue incentives are possible; CCTs are flexible enough to meet needs in developing countries where maximum environmental control is unfeasible; and finally, the domestic front for CCTs is as important as the international market.

Attendees were fortunate to have a panel of Polish energy experts, who described Poland's efforts to privatize the energy sector. The last day represented a new focus for the CCT conference, as panel members described non-DOE international clean coal projects, emphasizing additional plans and opportunities.

Bud Annan, Special Assistant to the Secretary of Energy, gave keynote luncheon remarks on the larger context of Secretarial trade missions, while Ben Yamagata, Executive Director of the Clean Coal Technology Coalition, spoke about overcoming barriers to the international CCT market, and the need to invigorate the domestic CCT market.



Bud Annan, Special Assistant to the Secretary of Energy

Proceedings of the non-technical sessions are being compiled and will be mailed to conference attendees. Others will be able to order proceedings from Kim Yavorsky at: Pittsburgh Energy Technology Center, Bldg. 920 Wallace Road, Pittsburgh, PA 15236, or phone (412) 892-6244.

In other CCT news, the Program passed a major milestone with dedication of the Wabash River Coal Gasification Plant (see page 1). The NOXSOSO₂/NO_x Removal Flue Gas Cleanup System also is going forward, having received the final \$36.4 million in DOE cost sharing that will allow it to complete construction, followed by two years of test operations. In September, the Metropolitan Edison Company and York County Energy Partners (YCEP) announced their joint decision to restructure the power purchase agreement for YCEP's cogeneration project and build a natural gas-fired plant at the site near York, Pennsylvania. Finally, in October, the commercial-scale demonstration of the Liquid-Phase Methanol project broke ground. CCT



Czech Republic and Hungarian delegates participate in International Orientation session.



CCT Commercialization Challenges

“Our challenge today is to continue the transition from clean coal technology demonstrations to commercialization,” Assistant Secretary for Fossil Energy Patricia Fry Godley noted as she opened the plenary session of the Fourth Annual Clean Coal Technology Conference in Denver, Colorado. Godley moderated a panel discussion on the global opportunities and the diverse challenges for clean coal technologies.

Nearly 300 participants, including 34 representatives from more than a dozen countries, attended the September 5-8 meeting jointly sponsored by the U.S. Department of Energy, the Center for Energy and Economic Development, and the National Mining Association.

“Our challenge is to continue to capitalize on the investments made to date — to look to new mechanisms that can accelerate the deployment of these new technologies mechanisms that go beyond traditional government subsidies,” Godley told the conference group.

She noted that earlier this year, the Tidd fluidized-bed plant generated its 11,000th hour of operational data, wrapping up a successful four-year demonstration run. Godley expects clean coal technology sales, now at \$10 billion worldwide, to grow as the result of the CCT program. She added, “All of these are measurable results — but they only represent a small fraction of the potential opportunities. Our challenge today is...to make clean coal technology the conventional, state-of-the-art technology of the 21st century.”

Jerry J. Oliver, Vice President and Manager of Technology for Bechtel Corporation, indicated the need for a collaborative effort so that the user community could provide input to basic R&D. Government assistance, he added, is still needed to move promising technologies from research to reality.

David Crikelair, Vice President, Texaco, Inc., cautioned DOE and other agencies to “...stay focused on the ultimate objective — securing a project that means more U.S. jobs, American leadership in technology, and a return on the money the stakeholders have invested....”

Addressing clean coal technologies and coal’s role in an expanding world economy, General Richard Lawson, President of National Mining Association, said, “This century has shown Americans to be good at some things and poor at others....We are good at bringing about conditions for lasting peace and balance, and we are good at advancing technology,” he said. “We are

sometimes not as good at introducing the advanced technology.”

However, he concluded that, “We have come too far to quit short of commercial deployment of our clean coal technology advancements.”

The Deputy Executive Director of the International Energy Agency, John Ferriter, spelled out just why General Lawson’s statement is so vital in 1995. He depicted an expanding market where developing countries are requiring more energy that could, in part, be supplied by clean coal. Ferriter referenced the IEA 1995 edition of the World Energy Outlook, published earlier in the summer, to identify several major elements emerging for energy policy makers to contend with in the medium and long-term:

- Energy-derived CO₂ emissions could grow by almost 50 percent by 2010.
- World oil consumption is expected to increase by about 40 percent by 2010, with most of the increase in consumption taking place in non-OECD (Organization for Economic and Cooperative Development) countries.
- Natural gas will account for 22-24 percent of total energy demand by 2010.
- Coal will continue to account for about 30 percent of total energy demand.
- The share of nuclear energy will decline, as hydroelectric generation increases modestly.
- Non-OECD countries are taking over as the major users of energy — now accounting for about 50



Patricia Fry Godley, Assistant Secretary for Fossil Energy

percent of the world's total energy consumption, and that share will inevitably increase.

- Power generation accounted for 56 percent of demand for coal in 1992 and by 2010 this share is expected to be 58 percent.

Ferriter emphasized that energy policy makers need to recognize the major contribution that will come from coal:

- Coal is one of the world's most important and abundant fossil fuels. The wide distribution of

reserves around the world enhances energy diversity, and thus increases energy security.

- Coal is low-cost compared with oil or gas. Many countries have economically viable domestic resources of coal to support sustainable economic development.

However, there are many opportunities for improving the efficiency with which coal is used and for mitigating the pollution and emissions that its production and use can cause. Ferriter explained that industrialized countries have to act first to reduce

carbon emissions, since their carbon emissions are greater than those of the developing world.

Ferriter concluded, "It will be private decisions which will determine if and where coal provides the fuel for the next generation of power stations. It is instructive, then, to look at the attitudes expressed by the coal producers, equipment manufacturers and utilities, to see which technologies are likely to be taken out of the laboratories and into commercial service." CCT

International CCT Deployment Needs Strong U.S. Support

Ben Yamagata, Executive Director for the Clean Coal Technology Coalition, was one of the luncheon speakers at the Fourth Annual Clean Coal Technology Conference. He centered his speech on the marketability of CCTs, emphasizing the following points:

- The current environment in the United States is not likely to foster domestic markets any time soon;
- Although tremendous opportunities exist for deployment of CCTs internationally, U.S. firms and the U.S. government will have to be very creative to overcome existing barriers to the international marketplace; and
- Government support of the Clean Coal Program must be reinvigorated while fostering continued support for R&D and deployment of CCTs here in the United States, or we will suffer potentially crippling consequences.



Ben Yamagata, Executive Director for the Clean Coal Technology Coalition

Yamagata continued that, although the benefits associated with CCTs are well documented, these technologies "have not and will not escape the challenge that confronts the commercialization of any new technology. . . .

The path to the marketplace is ultimately predicated upon demand, cost-competitiveness, proven reliability, and commercially acceptable degrees of risk." Furthermore, "demand for a product exists once the risk and costs are reduced; yet this risk and costs cannot be reduced until adequate demand is present... this co-dependency cannot be broken."

He views the following as the three basic barriers to CCT commercialization domestically.

- A regulated, risk-averse electric utility industry in rapid and dynamic change moving toward open competition, without benefit of a regulated return on investment, may have little interest in CCTs;
- Suppliers with gloomy market forecasts, unable to assume great risks or absorb the costs of development and early, first-of-a-kind use, cannot provide an acceptable or attractive price with appropriate guarantees to potential customers to create demand; and

See "International" on page 6. . .

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- Most importantly, citizen activists doggedly seek to prevent the use of coal under any circumstances.

The current government approach of giving up on CCTs, Yamagata calls "unwise, and perhaps even a foolish waste of taxpayers' investment given the billions of private and public dollars already invested in CCT development." He noted that Federally sponsored R&D has, in the past, led to innovation and economic growth. The private sector cannot pick up the slack and remain competitive.

Yamagata continued that the international market "is where it is at" for coal-based technologies today. However, he sees it as "an interim market," and emphasized that the domestic market ultimately ought to be the principal focus for CCTs. "These technologies, and the clean coal program were, and are, intended to primarily benefit the U.S. coal industry, U.S. equipment suppliers, and U.S. consumers and taxpayers."

The most significant barrier to international implementation of CCTs is adequate financing, which at present can only be provided by multilateral and bi-lateral development banks and export promotion agencies.

Additionally, Yamagata believes that developing countries, in their efforts to obtain basic infrastructure, "cannot afford to be environmentalists.... Once all citizens have the ability to turn lights on and off, then a country will consider more efficient light bulbs." Conventional technologies are also favored over new technologies to avoid higher costs and risks associated with "first-of-a-kind" technologies.

Despite these barriers, "the international market is too large to ignore," concluded Yamagata, offering five action areas that could overcome these obstacles.

1. Re-think our concept of foreign aid by promoting international sustainable development that rewards the host country and the U.S. with returns on investments. He cites EXIM and OPIC, which provide partial substitution of direct foreign assistance, whereby the U.S. saves Federal tax dollars, and gains the benefits of exportation and long-term private investment in developing nations.
2. Search for and support low-cost activities that offer high returns, and continue to facilitate government-to-government interactions to promote opportunities for U.S. industry throughout the international market.
3. Review opportunities that exist in current programs, such as the Global Environment Facility, to which the U.S. substantially contributes.

4. Think creatively to provide incentives for international projects, through such innovations as aggressively examining tax and regulatory incentives. For example, U.S. companies could receive tax breaks for building CCTs abroad, if the project retains American services and parts, and the domestic project does not increase emissions.
5. Develop incentives through global climate change and innovative programs, such as Joint Implementation. Consider offering incentives to U.S.-based developers through emissions credits and off-sets.

In conclusion, Yamagata stated, "We must think and act creatively and we must put our money with our words. The Administration has voiced the benefits of technology development, yet backed away from this commitment by cutting program dollars.... We must break this trend. We also must continue to work hard and work together." CCT



Informal exchanges enliven the Conference Exhibition area.

Polish Energy Experts Discuss Privatization

A desire to push forward to full privatization was a theme emphasized by the Polish energy experts on the panel on "Transitions in the International Power Sector." The five visiting officials from the utility, environment, and government sectors were in the United States under the auspices of the Utility Partnership Program administered by the U.S. Energy Association and funded by the U.S. Agency for International Development.

Zbigniew Bicki, President of the Polish Power Grid Company and Chair of CENTREL, indicated that Poland is learning from the deregulation experiences of the United States. "The American Government's Utility Partnership Program offers us an extraordinary opportunity to follow the [extensive] changes in the U.S. electricity sector. We are learn-

ing from the results so far and we are working together with American experts on particular solutions which could be adopted in Polish circumstances."

Coal, both "hard" (the Polish term for bituminous) and "brown" (lignite), is virtually the only fuel used to generate power in Poland. Coal is also widely used in small industrial boilers, district heating, or home furnaces. Before 1990 there were virtually no enforced pollution controls.

Jan Popczyk, former President of the Polish Power Grid Company and former Chair of CENTREL, summarized the challenging steps toward privatization. "...the main problem of transformation in Poland [is] to become part of the international community, striving to learn and use global development rules, instruments, and agreements to achieve long-run effectiveness in the supply of electricity." Basically, Popczyk said that this requires decentralization; promotion of competition; deregulation of monopolies; treatment of electricity as a commodity; allowance for access to global capital markets; and consideration of integrated resource planning, supply side management, demand side management, and environmental protection.

Progress thus far toward privatization includes the establishment of joint stock companies throughout the Polish energy sector. Stock, which is owned by the government, eventually will be sold. In addition, utilities now compete with each other to sell power to the transmission company — the Polish Power Grid Company. Competition is based on economic efficiency and is spurred on by a surplus capacity environment and the threat of job loss. The transmission company, in turn, sells power to a growing number of distributing companies who eventually will set their own prices.



Polish energy experts participate in a panel discussion (L-R: Nowicki, Blaszczyk, Popczyk, Bicki, Luczkiewicz).

Roman Luczkiewicz, Advisor to the Minister of Industry and Trade, described a favorable trend toward decentralized decisionmaking. "Representatives of foreign investors are often surprised to learn that the directors of energy units are fully competent to conclude long-term agreements on a large scale, without waiting for any acceptance or decision of a ministry or other central administration authorities."

The impending connection of the CENTREL system (Poland and neighboring countries) to the European power grid (the UCPTE) is seen as major progress for Poland. A trial synchronous operation is to take place in 1996. Ac-

ording to Bicki, "This is sure to be the first serious step forward toward Poland's economic integration with the countries of the European Union."

As privatization moves forward, Poland is taking steps toward environmental improvement. Professor Maciej Nowicki, President of EcoFund, discussed pollution taxes imposed during the past five years, and how his organization has transferred these funds to environmentally worthy energy projects. In 1991, a State Ecological Policy was adopted, and stricter controls will go into effect in 1998. Further, the largest power plant in Poland, the 4,320-MW Belchatow Plant, has been equipped with flue gas desulfurization, and three more such retrofits are planned. The Turow power plant and two combined heat-power plants in Warsaw have been equipped with fluidized-bed combustors.

See "Polish Experts" on page 8. . .



Sharon Marchant (PETC) greets Octavian Pavnotescu of Romania.

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Luczkiewicz cited goals for the mid term as reducing 1980-level emissions of SO₂ by 30 percent, and NO_x by 10 percent. A longer term goal is to meet the restrictions imposed by international obligations. Bernard Blaszczyk, Vice Minister for Air Protection at the Ministry of Natural Resources and Forestry, stressed the priorities of developing an economic variety of smokeless coal for the domestic sector, and using more efficient small boilers.

As for foreign investment, Luczkiewicz said that a total of \$50 billion may be needed by 2010 to modernize the energy sector. He indicated that western companies are currently negotiating for joint ventures to modernize power plants and combined heat and power plants, or to install desulfurization equipment. Bicki, however, pointed out uncertainties over some modernization efforts, citing the withdrawal of prospective investors in the CHP Power Plant Krakow, due to insufficient privatization guarantees. He fears that this may have "dulled the appetites of foreign investors." CCT

Improving the "Enabling Environment" for CCTs

Improving the "enabling environment" in a host country is an important key to successful energy ventures in foreign countries, agreed panelists at the "International Business" session. Dolores Kern, Assistant Vice President, National Mining Association, moderated the panel and opened with remarks tracing the posture of U.S. banks toward international lending over the past decade. Between 1990 and 1994, she cited renewed interest in international lending at a "measured approach."

Some enabling environments are deficient in terms of legal safeguards. "A body of well tested law that recognizes personal property rights" is vital according to Chase Manhattan Bank's Vice President, Anthony Biddle, who spoke on international commercialization mechanisms. This theme also was addressed by DOE's Assistant General Counsel, Paul Gottlieb, who spoke on the subject of international intellectual property. Gottlieb differentiated between intellectual property rights in countries that protect such rights (chiefly the U.S., Canada, and Western Europe) and rights in countries still attempting to develop such protection (China, Eastern Europe, and the Newly Independent States). In these countries, "Enforcement of these laws is not yet reliable," he added. Businesses must "weigh the costs, the risk that rights will not be protected, and the long-term potential of new markets."

Other barriers to an enabling environment are economic. Thomas E. Rappold, an Assistant Vice President at Norfolk Southern Corp., pointed out that a country may not select the cheapest fuel to produce power because it is more interested in saving jobs. This approach might also include using indigenous coal supplies. "Decisions are not always made on a strictly economic basis," Rappold observed. Still other problems may be regulatory or legislative — the absence of strong environmental requirements that would otherwise give an impetus to environmentally superior technologies.



Karl Jechouteck of the World Bank

The World Bank's Karl Jechouteck, Chief of the Power Development, Efficiency and Household Fuels Division, spoke of the Bank's Clean Coal Initiative — working with technology developers and investors to find mechanisms to reduce costs, manage risks, and finance (or facilitate private sector financing) projects that are economically and environmentally sound. He observed that, while the market may be in developing countries, "There is not very much on the ground in terms of what we broadly term clean coal technologies."

Jechouteck presented the Bank's "laundry list" for improving a country's enabling environment, which includes: deregulating coal pricing and allocation systems; unbundling coal mining, rail transport, and power system government monopolies; eliminating cross subsidies between mines and between users; and opening up the various sectors to private investors.

What can a project sponsor do in the presence of shortcomings in the enabling environment? Biddle stressed

the need for foreign exchange parity protection, and made a "strong plug" for using a local partner. "Look for people who have extraordinarily commercial transit and extraordinarily political transit because you will desperately need these things to compete with the already embedded interests there," he recommended. If laws insufficiently protect personal property, he added, you may need a "...bigger stick, and that's where folks like the World Bank, and government agencies step in because local

entities have obvious compelling reasons to cooperate with them regardless of local law or any lack thereof."

Both Biddle and Rappold stressed the importance of demonstrating a technology first in the United States. According to Biddle, "Your number one market is the U.S.A. You cannot take a new technology overseas if it's unproven. It's got to be working somewhere and people overseas want to see it working in the United States." CCT

Power Generation Competition Threatens Clean Coal

Clean coal technologies will require non-revenue government incentives if they are to survive the next five to seven year transition as electric power generation moves into a more competitive and not yet clearly defined market, according to panelists speaking on the third day of the Fourth Annual Clean Coal Technology Conference. This was a key point panelists repeated in the session, "Transition to Competition in the Electric Power Generation Industry and Its Impact on CCT Markets."

"The transition toward competition is already having a dramatic impact on the electric generation market," said James Markowsky, Executive Vice President of Engineering and Construction for American Electric Power, and the panel moderator. "This move will also have a dramatic impact on the market for CCTs, and could prevent us from ever realizing the potential benefits they offer."

Agreeing with Markowsky, Joseph P. Kearney, President and CEO of U.S. Generating Co., argued for the importance of clean coal R&D in the transition period. He said that DOE must rank programs according to priority for funding, and industry should agree on which technologies have the most potential, and communicate this information to DOE. Kearney concluded that, "Generators — as they become better defined — should commit



Joseph P. Kearney, President and CEO of U.S. Generating Co.

to assisting the suppliers and manufacturers in CCT efforts. However, the present lack of a clearly defined generation community now is the best rationale for Federal R&D funding for CCT. The transition to a more defined generation community could take the five to seven years that it will take the market to evolve. In that time, we could lose CCT."

Bruce Driver, Special Counsel to the Land and Water Fund of the Rockies, described utilities in the present transition period as unwilling to commit for the long term, even in areas where demand might justify it, and as engaged in unbalanced resource planning. Driver said that this attitude "...acts to the disadvantage of resources like renewables and clean coal technologies that happen to be relatively cost intensive but have no or relatively low expected fuel costs over the long run."

Dr. Bil Tucker, a Commissioner with the Wyoming Public Service Commission, noted that we can learn from the Federal Energy Regulatory Commissions' efforts to foster competition and emphasize local conditions and realities instead of a "one-size-fits-all" approach.

See "Power Generation" on page 10. . .



**Dr. Bill Tucker, Commissioner,
Wyoming Public Service Commission**

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Panelists called for newly designed incentive programs to head off the potential loss of technologies developed under the U.S. Department of Energy's Clean Coal Technology Program, but still not mature enough for use without significant initial financial risks.

The Clean Coal Technology Coalition, Markowsky said, looked at revenue-neutral incentives and identified permitting reforms, export and tax incentives, and an education program on advantages of CCTs.

According to Markowsky, "A combination of structured tax incentives has the potential of bringing the life cycle cost of initial CCT plants to the same level as the life cycle cost of a natural gas combined cycle (NGCC) plant, even at the current price differential between natural gas and coal."

He argued, "Even with tax incentives, a CCT plant will bring more tax dollars to the Federal treasury over its lifetime than an NGCC plant, because of the more capital-intensive nature of a CCT plant compared to the NGCC plant."

Greg Vincent, Vice President of Fuel Supply and Engineering for Tennessee Valley Authority, spoke of issues that pose challenges to CCTs, from the perspective of a public power utility. In particular, Vincent discussed disaggregation of the electricity supply market, which he described as the separation of generation from transmission and distribution, which will make electricity look like a real "commodity."

Vincent contends that, as a commodity, "electricity will have to be priced competitively." Under these conditions, Vincent predicts that externalities will no longer be economic factors, and investors will favor projects where environmental compliance is tied to a market-based system, such as trading of SO₂ allowances.

Vincent also stated that it is difficult for generators to invest in CCTs "any time in the foreseeable future in the anticipation of some future regulation that will make low emission valuable," because guaranteed recovery through ratemaking is a thing of the past. However, he said that technologies offering fuel flexibility and some revenue enhancement through co-products and by-products may have some advantage, and will be able to overcome a high investment or fixed cost.

Derek Cheetham, Section Manager for England's West Burton Power Station, characterized the increased competition created in a privatized United Kingdom electric power industry, and drew comparisons with a U.S. industry just now entering a similar phase.

Supply, he said, remains secure, wholesale prices have come down, and customers are exerting more choice. But, Cheetham cautioned, there have been losers. Shutdown of

uneconomic and redundant plants have eliminated thousands of jobs. The British Coal industry has lost its guaranteed utility customers.

Availability of North Sea natural gas and the popularity of combined-cycle gas turbines have contributed to coal's decline. Cheetham explained, "Since 1990 some 5,400 MW of new combined cycle gas turbines have entered the system, and as nuclear output and the contribution from the interconnectors with Scotland and France have grown, so excess capacity has emerged on the system making older, coal-fired and oil-fired plants redundant and uneconomic." Cheetham concluded: "Accordingly, the existing generating companies have reduced existing fossil-fueled capacity substantially by closing or mothballing old coal-fired and not-so-old, oil-fired plants. National Power has withdrawn 9 GW from service since privatization." CCT



Conference literature and information was distributed.

Clean Coal Today
Published quarterly by
The Office of Clean Coal Technology
U.S. Department of Energy
Washington, D.C. 20585

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Domestic Regulatory Challenges

Competitive trends, monetized externality values, energy choices available to utilities, and emissions regulations were among the topics addressed in the session, "Domestic Challenges," moderated by John Scheibel, Business Unit Manager for Gas and New Coal Generation at Electric Power Research Institute (EPRI).

Edward Brady, Assistant General Counsel for American Electric Power Service Corporation, and John Hanger, a Commissioner with the Pennsylvania Public Utility Commission, offered a utility and regulatory perspective on changes brought about by the Energy Policy Act of 1992 (EPACT), and whether these changes should be characterized as "evolutionary" or "revolutionary." Both speakers wished for a controlled, evolutionary process of change, but thought that some of the Act's impacts were drastic enough to be labelled revolutionary. Brady identified the revolutionary changes (some of which were under way before EPACT) as: competitive contracting for wholesale power; restructuring for retail competition; integrated resource planning and demand side management; and comparability and transmission access. Competition in the wholesale market is under way. Legislatures in 13 states are considering proposals for retail restructuring, but none have yet passed.

Both Brady and Hanger were concerned about the issue of state jurisdiction over the retail sector. While EPACT gives states the right to structure the retail market, Hanger pointed out that FERC, in its April 1995 mega-Notice Of Proposed Rulemaking, proposes to take some of this authority onto itself. States must act now, he said, in favor of customer choice.

Competition also has its downside. Hanger cautioned that the reliability we enjoy today will not continue automatically in the restructured era, and that utilities will need to cooperate with each other to provide a stable environment. Other problems relate to equity, such as concern about stranded investment that places a utility at a disadvantage from the outset, and the possibility that low-income customers might have to do without electricity.

Heidi Heitkamp, Attorney General of North Dakota, also praised the reliability of our current system, but said it needs to



Edward J. Brady, American Electric Power Service Corp.



Heidi Heitkamp, Attorney General of North Dakota

be "fine tuned." She stressed the importance of educating the public on utility restructuring, since this restructuring will not succeed without a political base.

Environmental externalities were debated by two panel speakers: Fred Palmer, General Manager and CEO of the Western Fuels Association, and DOE's Tom Grahame, a Senior Policy Analyst in the Office of Coal Technology. Both agreed that the current trend seems to be against the use of monetized externality values at the state level.

Palmer, an opponent of externality calculations, is worried about their entry through the back door through such features as wire taxes or renewable set-asides.

Grahame predicted that externality calculations will survive because of their inseparability from cost/benefit analysis, which is increasingly in demand. Externality calculations previously were not based on an estimate of damage. Recent studies by Oak Ridge National Laboratory and the State of New York offer improvements in the form of a "damage function method," which puts a net economic value on environmental impacts.

Ron McMahan, President of Resource Data International, Inc., and Marshall Pendergrass, an Assistant General Manager at Tri-State Generation and Transmission Association, addressed the issue of energy choices. McMahan brought out that even renewables have adverse environmental impacts. Technological and logistical problems prevent renewables from supplying reliable electricity to power grids. Use of renewables (excluding hydro) could increase to 4 percent of U.S. electricity generation by 2010, but with



Clean Coal Conference provides a global marketplace of ideas

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competition this could decrease to 1 percent. Aggressive subsidies would only bring this share up to 11 percent. McMahan predicted that coal will supply more than half of all electricity generation in 2010.

Pendergrass, whose company owns and operates the successful Nucla CFB clean coal project, predicts that fluidized-bed generation will be the coal combustion choice of the future. He contends that Federal and State funding may be needed to move some of the new clean coal technologies into the marketplace. Also, present low natural gas prices pose a challenge for coal.

William Harnett, Deputy Director of Air Quality Strategies and Standards at the U.S. Environmental Protection Agency, cited important upcoming air issues affecting utilities. These include the necessity for regional strategies to reduce NO_x; the possibility that new ozone standards could increase the need for national NO_x reductions; tightening of fine particulate standards could bring a need for additional sulfur and nitrogen controls, because fine particles may be generated by the oxidation of sulfur and nitrogen; and the fact that utility air toxics emissions as a group may be significant. CCT

Expanding the International Market

The final day of the conference provided affirmation that CCTs have a definite place in the global energy environment. During the first three days of presentations, attendees heard reviews of the current status of clean coal technologies, descriptions of barriers to commercialization domestically and internationally, explanations of how the changing utility organization and structure may affect these technologies, and recommendations of support required both here and abroad to ensure the continuing future of CCTs. One common warning for all developing areas — do not assume that if a country wants a project it already has adequate infrastructure. Attendees also were told that changing environmental requirements, such as those in India, are likely to enhance the position of CCTs.

Information was provided on the following international projects, which are explained in more detail in the Conference Proceedings.

1. The Custom Coals coal slurry pipeline — the 15-million ton/year Yu-Wei Pipeline Project — is expected to begin construction in 1997 and is anticipated to help meet the quickly expanding energy needs in China. Sheldon Wool, Custom Coals Chairman, explained that coal will be brought from the eastern ShangXi Province to Shandong Province. In Qingdao, coal will proceed to a dewatering and briquetting plant en route to the Weifang Power Station (and other coastal power plants and the spot market). China sees this pipeline as a vast improvement over rail transport.
2. China's Trigen Project, using the Institute of Gas Technology (IGT) U-Gas process, was approved in 1991 to provide town gas (U-Gas) for the city of Shanghai, as well as 200,000 tons/year of methanol. According to Bernard Lee of IGT, the U-Gas reactor is flexible, can use up to 40 percent ash coal, and uses air or oxygen as the oxidizing agent, under low or high pressures. The gasifiers are processing coal from the ShangXi Province. The second phase of this project calls for a 70-MW IGCC power generation unit. IGT has licensed the technology to a partner in China.
3. Six commercial coal gasification projects, originally used for chemical and ammonia fertilizer, and more recently for power generation, have been established in China over the past 15 years through Texaco. Robert Horton, of Texaco's Alternate Energy Department, credits success to simplicity of design, maintenance, and operation, and flexibility of feedstock. Following operation of the first six gasifiers, eight more are in various stages of design and construction, with start-up expected soon for two units. Nine new projects were awarded this year alone, and should be ready for commercial operation from 1988 to 2004.
4. There are over 142,000 MWe planned for India's power market by the year 2005, and since demand is growing faster than supply, it is predicted that new supplies will be lower in quality and higher in price. Any new energy projects located in India will have to contend with the need for mine expansion, more coal washing plants, and an overburdened rail system.

Meher Saran, of Ahlstrom Pyropower, said that India can use its existing low quality coal resources in circulating fluidized-bed power plants, which she considered the most appropriate technology for India.

5. In Indonesia, TEK-KOL is pursuing two projects that build on experience gained at the Powder River Basin liquid-from-coal project in Wyoming, which is considered a “showcase” project for foreign investors. The projects, now in design stage, are located in East Kalimantan and South Sumatra. According to Dennis Coolidge of TEK-KOL, opportunities exist for advanced CCTs throughout Indonesia, if economic factors fall into place. The primary barrier will be lack of infrastructure.
6. The U.S./Ukraine Power Plant Upgrade Project is being conducted by DOE’s Pittsburgh Energy Technology Center, with participation of DOE, USAID, Ukraine Ministry of Power and Electrification, Ukraine Academy of Sciences, and the World Bank. The project will define the most effective option to upgrade the anthracite-burning Lugansk power plant, to enable the World Bank and others to provide up to \$200 million in loans to conduct the modernization.

In addition to these projects, other panelists observed what could be done to promote CCT projects internationally.

Joseph Yancik, Director, Energy Division, U.S. Department of Commerce, drew on his experiences over the past 10 years as an advocate for U.S. energy projects abroad. He is optimistic about CCT deployment

because the U.S. already is a leader in developing energy projects; lending institutions often give preference to environmentally superior projects; and U.S. embassies are increasingly willing to act as advocates.

Gurgen Olkhovsky, General Director, All-Russia Thermal Engineering Institute, talked about clean coal efforts under way in Russia, and indicated that the most urgent problem in his country is life extension and eventual replacement of fossil fuel power stations, with the goal of increasing their efficiency and reducing environmental impacts. He concluded that the most fruitful way of transferring the clean coal technologies is by jointly producing equipment and employing Russian personnel to solve possible technical problems. This may require revising U.S. technical specifications to comply with Russian standards, materials, and manufacturing technologies.

Craig O’Connor, Environmental Liaison Officer for the Export-Import Bank of the U.S., described the Bank’s role in helping U.S. exporters, in line with its mission through creation of American jobs. He described Ex-Im as proactive in environmental export development, and cited recent financing arrangements for CFB boilers at Poland’s Turow Power Station.

Kenneth Langer, Director of International Energy Projects at Coleman Research Corporation, stressed the need for public/private cooperation to develop innovative financing strategies for clean coal projects. He suggested a program for clean coal similar to the World Bank’s Global Environmental Facility program. It



**Joseph Yancik, U.S.
Department of Commerce**

would be funded by venture capital and would buy down the incremental costs of CCTs.

Robert Joyce, President of Ahlstrom Development Corporation, which has 45 percent of the CFB market globally, emphasized that CFB is *not* a developing technology, and is “absolutely financeable.”

Since global energy users want to increase output and efficiency, as well as improve environmental performance, CFBs are a good choice. He warned that if this technology is not actively promoted, “it won’t be long before something else will come along and replace it.”

P.J. Adam, chairman and CEO of Black & Veatch, which is developing power plants in seven developing countries, opposed selling advanced clean coal technologies to developing countries who would be better served by first developing clean drinking water and sewage disposal systems. He stressed the importance of designing a project with waste minimization in mind, and employing cheaper environmental controls with a high payback.

William Meagher, Executive Director of Partners in Economic Reform, stressed that U.S. companies must take advantage of all opportunities to “tilt the table” in their favor, such as exploring the different financial opportunities and arming themselves with maximum background and technical information on the host country. Companies also must utilize the technical expertise of host countries, some of which have a highly trained work force.

[CCT]

List of Technical Papers Delivered at the Fourth Annual Clean Coal Technology Conference

"Wabash River Project Moves Into Commercial Operation." *Woodruff, M.R.*, Destec Energy, Inc.

"Status Update — Polk Power Station IGCC." *Pless, D.E.*, TECO Power Services Corporation.

"The Piñon Pine IGCC Project: Advanced Coal-Fired Power Generation Systems." *Motter, J.W.*, Sierra Pacific Power Company.

"Coal-Diesel Combined-Cycle Demonstration Update." *Benedek, K.R., Benson, C.E., and Wilson, R.P., Arthur D. Little, Inc.; Parkinson, J.W.; CQ Inc.; and Rao, A.K.*, Cooper-Bessemer Reciprocating.

"Healy Clean Coal Project: Fabrication and Construction Status." *Ubhayakar, S.K.*, TRW Space & Technology Division.

"An Update on Liquid Phase Methanol (LPMEOH™) Technology and the Kingsport Demonstration Project." *Schaub, E.S., Stein, V.E., Heydorn, E.C., and Osterstock, E.R.*, Air Products and Chemicals, Inc.

"500-MW Demonstration of Advanced Wall-Fired Combustion Techniques for the Reduction of Nitrogen Oxide Emissions from Coal-Fired Boilers." *Sorge, J.N.*, Southern Company Services, Inc.; *Menzies, B.*, Radian Corporation; *Smouse, S.M.*, U.S. DOE/Pittsburgh Energy Technology Center; and *Stallings, J.W.*, Electric Power Research Institute.

"Demonstration of Gas Reburning-Sorbent Injection Technology for NO_x/SO_x Emission Control." *Sommer, T.*, Energy and Environmental Research Corporation.

"Demonstration of Gas Reburning-Low NO_x Burner Technology for Cost Effective NO_x Emission Control." *Folsom, B. and Payne, R.*, Energy and Environmental Research Corporation, Irvine, California; *Sommer, T. and Engelhardt, D.*, Energy and Environmental Research Corporation, Orrville, Ohio; and *Ritz, H.*, U.S. DOE/Pittsburgh Energy Technology Center.

"Demonstration of Selective Catalytic Reduction (SCR) Technology for the Control of Nitrogen Oxides (NO_x) Emissions from High Sulfur Coal-Fired Utility Boilers at Plant Crist SCR EST Facility." *Hinton, W.S., and Maxwell, J.D.*, Southern Company Services, Inc.; and *Baldwin, A.L.*, U.S. DOE/Pittsburgh Energy Technology Center.

"Status of the SNOX Technology and Demonstration." *Borio, R.*, ABB Environmental Systems.

"Rosebud Syncoal Partnership Syncoal® Demonstration Technology Development Update." *Sheldon, R.W.*, Rosebud SynCoal Partnership; and *Kornosky, R.M., O'Dowd, W.J., and Renk, III, J.B.*, U.S. DOE/Pittsburgh Energy Technology Center.

"SO_x-NO_x-Rox Box™ Technology Review and Global Commercial Opportunities." *Martinelli, R.*, Babcock & Wilcox, Environmental Equipment Division; *Doyle, J.B.*, Babcock & Wilcox, Power Generation Group; and *Redinger, K.E.*, Babcock & Wilcox, R&D Division.

"CQE: Integrating Fuel Decisions." *Harrison, C.D. and Kehoe, D.B.*, CQ Inc.; *O'Connor, D.C.*, Electric Power Research Institute; and *Stallard, G.S.*, Black & Veatch.

"Tri-State's NUCLA CFB Demonstrates Benefits of Clean Coal Technology Program." *Bush, S.A. and Pendergrass, M.L.*, Tri-State Generation and Transmission Assn., Inc.; and *Friedman, M.A.*, Combustion Systems Inc.

"Environmental Design Considerations for the York County Energy Partners Circulating Fluid Bed Boiler." *Diamond, B.W.*, Air Products and Chemicals, Inc.

"TIDD Pressurized Fluidized Bed Combustion Demonstration Plant Assessment." *Marrocco, M.*, American Electric Power Service Corporation.

"Commercialization of the Liquids from Coal Process." *Frederick, J.P.*, ENCOAL Corporation; and *van Hoften, S.A.*, SGI International.

"Blast Furnace Granular Coal Injection." *Walter, L.L. and Bouman, R.W.*; Bethlehem Steel Corporation, Bethlehem, PA; and *Hill, D.G.*, Bethlehem Steel Corporation, Burns Harbor, IN.

"CPICOR™." *Wintrell, R.*, Geneva Steel; Air Products and Chemicals, Inc.; Centerior Energy Corporation.

"Demonstration of the Air Cooled Slagging Combustor on a 500-KW Coal Fired Power Plant." *Zauderer, B., Frain, R., Peng, K., and Borck, B.*, Coal Tech Corporation.

"Bailey Station AFGD Demonstration Program." *Manavi, G.B. and Lewnard, J.J.*, Pure Air; *Styf, D.A.*, Northern Indiana Public Service Company (NIPSCO); and *Sarkus, T.A.*, U.S. DOE/Pittsburgh Energy Technology Center.

"The Clean Coal Technology Program 10-MWe Demonstration of Gas Suspension Absorption for Flue Gas Desulfurization." *Hsu, F.E. and Bhagat, B.R.*, AirPol Incorporated; *Marchant, S.K. and Pukanic, G.W.*, U.S. DOE/Pittsburgh Energy Technology Center; and *Norwood, V.M. and Burnett, T.A.*, Tennessee Valley Authority.

"Chiyoda Thoroughbred 121 Phase II Demonstration Results." *Pearl, I.G.*, Radian Corporation.

"Performance of the Integrated Dry NO_x/SO₂ Emissions Control System." *Hunt, T.*, Public Service Com-

pany of Colorado; *Muzio, L.J. and Smith, R.*, Fossil Energy Research Corporation; *Jones, D.*, NOELL, Incorporated; *Mali, E.*, Babcock & Wilcox; and *Stallings, J.*, Electric Power Research Corporation.

"Milliken Station Demonstration Project FGD Retrofit Update — 1995." *Baron, III, E.S.*, and *Gauffilet, G.*, New York State Electric & Gas Corporation; and *Jackson, C.E.*, Gilbert/Commonwealth.

"Self Scrubbing Coal - A Progress Update." *Harrison, K.E.*, Custom Coals Corporation.

"The NOXSO Clean Coal Project." *Black, J.B.*, *Woods, M.C.*, *Friedrich, J.J.*, *Leonard, C.A.*, and *Browning, J.P.*, NOXSO Corporation.

Public Service Co. of Colorado hosted well-attended site tours at Arapahoe and Cherokee Stations.



Site visitors are issued hard hats for protection on the plant tour.



A tour guide explains the process.



Terry Hunt, representative of Public Service Co. of Colorado, led a tour of Arapahoe Station.

Recent CCT Publications

April 1995	Topical Report 4	Clean Coal Technology SO ₂ Removal Using Gas Suspension Absorption Technology, AirPol Topical Report
July 1995	DOE/MC/27362-4089	Blast Furnace Granular Coal Injection Project Annual Report for 1994
March 1995	DOE/MC/27362-4073	Blast Furnace Granular Coal Injection System Demonstration Project — Public Design Report
April 1995	DOE/FE-0330	Clean Coal Technology Demonstration Program, Annual Program Update Report
July 1995	DOE/FE-0339	Clean Coal Technology Demonstration Program: Project Fact Sheets
March 1995	DOE/MC/27339-4064	ENCOAL Mild Coal Gasification Project Annual Report for 1994
December 1994	DOE/MC/27339-4065	ENCOAL Mild Coal Gasification Project Public Design and Construction Report
March 1995	DOE/MC/27339-4088	The ENCOAL Project: Initial Commercial Shipment and Utilization of Both Solid and Liquid Products, Topical
July 1995	DOE/FE-0291 (revised)	The Investment Pays Off
January 1995	DOE/MC/29309-4054	Piñon Pine Power Project Annual report for 1994
December 1994	DOE/MC/29309-4056	Piñon Pine Power Project Public Design Report Public Design Report
May 1995	DOE/MC/27363-5012	IGCC Demonstration Project, Annual Report for 1994 (Tampa Electric)
April 1995	DOE/MC/24132-5037	Tidd PFBC Demonstration Project, First Three Years of Operation, Topical Report (2 Volumes)

Upcoming Events

Date	Event	Contact
March 18-21, 1996	21st International Technical Conference on Coal Utilization & Fuel Systems Clearwater, Florida	Barbara Sakkestad Phone 202-296-1133
March 20-22, 1996	5th International Symposium on Biological Processing of Fossil Fuels, Madrid, Spain	Joe Strakey Phone 412-892-6124