

FOSSIL ENERGY R&D FOR A COMPETITIVE POWER INDUSTRY¹

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Thank you. I am pleased to be here today to discuss a vision for the Morgantown Energy Technology Center's (METC's) advanced power generation program. I will cover four topics:

- The status of the electric industry as it deregulates, particularly those aspects of deregulation that impact advanced power generation technologies;
- A snapshot of the environmental trends that influence the program;
- How we're structuring our research, development, and demonstration (RD&D) program in response to these trends; and
- The status of METC's merger with our sister center, the Pittsburgh Energy Technology Center.

Starting with deregulation, in April of this year, the Federal Energy Regulatory Commission issued the final version of Order Number 888. This Order requires electric utilities to open their transmission lines to competitors on a nondiscriminatory basis. Order 888 will effectively deregulate electric power generation in the U.S. In a deregulated world, electric utilities can sell electricity to any customer--whether that customer is inside or outside their traditional service area.

I do not have to be a visionary to predict the impact of deregulation on the electric industry. We know what happened when the Government deregulated the natural gas,

telephone, trucking, and airline industries. Cutthroat price competition is the most visible sign of deregulation--and it has started. Some utilities are selling their excess electricity on the wholesale market for 2 cents/kWhr. This is the incremental price to produce the electricity, with virtually no capital recovery in the price.

Deregulated utilities will aggressively market their products. Utilities in Argentina carried this to the extreme recently. There, the electric industry is further down the deregulation path. Argentina had a month-long electricity "price war." In an attempt to attract new customers, utilities were giving away their electricity free. In the U.S., when deregulation is extended to retail customers, expect to see more advertisements for electricity--the equivalent of Sprint, MCI, and AT&T ads--but for electric products. These products will be anything we, the customers, want and are willing to pay for, be that total energy supply (electric, gas, steam), energy management services, coupled energy/telecommunications services, or tree-pruning services by the utilities' line crew.

To reduce cost, electric companies are cutting staff and are merging. Some are friendly mergers; some hostile. They are also getting more out of their existing equipment by shipping more electrons through existing transmission systems and generating more kWhr of electricity in existing plants. To achieve higher utilization rates, equipment has to be available to dispatch. This makes reliability and ease of maintenance important parameters for the electric industry.

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To increase demand during off-peak times of the day, many utilities are exploring time-of-day pricing. Cheaper electricity at midnight may encourage us to stay up to midnight to do our laundry--thereby filling a valley in the daily demand profile. This greater use of existing plants means there is much more excess capacity than anyone thought!

Reducing fuel cost is another cost reduction strategy. Deregulation is the death knoll for pass-through-fuel-costs. Without pass-through-fuel-cost, efficiency becomes an important parameter in the cost of electricity equation. Utilities are looking for low-cost upgrades for their existing plants to improve efficiency. The industry is negotiating lower-cost fuel supply contracts. They are also exploring the use of low-cost opportunity fuels such as orimulsion and petroleum coke.

The electric industry will cut societal benefit programs way back in a competitive market. These programs range from wind farms, to demand side management, to helping the poor pay their electric bills. In the past, the industry paid for these programs through a hidden subsidy in the rate structure. In a competitive market, there will be no more hidden subsidies.

The outlook for natural gas in a deregulated environment is less clear. Electronic bulletin boards and open access will let utilities transmit low-cost coal or nuclear power over long distances. This suggests a downward trending in gas use. However, gas prices are projected to stay low for at least the next 2 decades. The Department of Energy's Energy Information Agency (DOE/EIA) projects that wellhead gas prices will rise a modest 1.5 percent per year between now and the year 2015.

Low gas prices coupled with low prices for gas turbine equipment means that the total cost of electricity from new, state-of-the-art combined cycles is very low, in the range of 2.5 to 3.0 cents per kWhr. Clearly, in the near term, natural gas will be the fuel of choice for new capacity additions. New gas-fired combined cycles can also be used in the near term for economic replacements. These are replacement and/or repowering of nuclear or old coal plants that have high operating and maintenance (O&M) costs.

RD&D will suffer in a deregulated, competitive industry, particularly long-range R&D. For the utility industry, RD&D is a back burner issue. Issues like deregulation and mergers are more important. Utilities are spending their limited RD&D funds to reduce O&M costs or to improve reliability. There is little incentive to invest in advanced power generation technologies. The technology will still produce electrons, and customers cannot distinguish one electron from another.

Utilities also have little incentive to invest in collaborative RD&D projects, particularly if the project helps their competitors. The Electric Power Research Institute and the Gas Research Institute are seeing this dynamic play out in real time as they lose their supporting members.

Utilities also have limited incentive to cost share in Government RD&D projects. This is a difficult trend for the Government to deal with. Congress is demanding that we shift our RD&D projects toward longer-term research. Yet they are defining success as increased levels of industry cost sharing.

A major remaining uncertainty is how fast deregulation will occur. It could occur quickly, over a 2- to 3-year period, or it

could drag out for a decade or more. Further, each state Public Utility commission could establish their own version of deregulation and their own timetable for it. These uncertainties coupled with the low domestic demand growth mean that the industry is reluctant to invest in new plants in the U.S. With excess capacity available at 2 cents per kWhr (at least in some parts of the country), it is difficult to find sites where new units make economic sense. And with deregulation, the electric industry does not have captive customers to foot the bill for imprudent investments.

Switching from deregulation to the environment, the U.S. public is clearly committed to the goal of clean water, blue skies, and a healthy environment for our children and our children's children. For the electric industry, the uncertainty in the environmental arena is what is reality and what is fear-mongering. The Integrated Gasification Combined Cycle (IGCC) and Pressurized Fluidized-Bed Combustion (PFBC) technologies that are the subjects of this conference will meet the Phase I and Phase II requirements of the Clean Air Act amendments for SO_x and NO_x emissions. I see three remaining environmental uncertainties for these advanced power generation technologies.

The first uncertainty relates to both air toxics and fine particulate matter--particles less than 10 microns or less than 2.5 microns. We need, and we plan to obtain, quality data from our Clean Coal Technology (CCT) demonstration projects to learn the real emission levels and if we need mitigation strategies. However, we are confident that emissions will be not higher than those from conventional coal-fired power plants; we have good reason for believing the emissions will be much lower. Whatever the outcome of the measurements, the air toxic and fine

particulate issue is common to other coal-fired technologies.

The second environmental issue is the Not in My Backyard (NIMBY) syndrome. NIMBY can apply to the siting of both new transmission and new generation facilities. This syndrome manifests itself in concerns over electromagnetic fields which makes it nearly impossible to obtain new right-of-ways for high-voltage transmission systems.

A partial answer to the transmission system dilemma may be distributed power generation technologies--fuel cells, small gas turbines, and gas-fired reciprocating engines. These can be installed close to the end-user of the electricity. Thus, no new transmission system is needed but an adequate gas supply pipeline is required.

The last environmental issue is global warming. There are strong opinions on both sides of this debate. On one end of the spectrum, a few months ago, an editorial in Wall Street Journal suggested that publicity on global warming was a political strategy "to keep the populace alarmed and hence clamorous to be led to safety by menacing it with an endless series of hobgoblins, all of them imaginary." At the other end of the spectrum, the banking and insurance industry are becoming vocal on the topic. They want to limit fossil fuel that they feel is causing global warming, which is triggering giant storms, which are costing them billions of dollars.

Given these environmental trends and deregulation in the electric industry, how is DOE structuring its coal power systems RD&D program? The first issue we need to address is, should the Government fund an RD&D program at all? Is it corporate welfare? Why should the Government support

electric sector R&D when it does not fund R&D in other industries?

I believe the Government's unique role in assuring that regulatory requirements do not choke our economy. We, the Federal Government, originate most of these requirements, and, therefore, we should help industry in developing cost-effective technologies to meet these requirements. Electric power generation has a major impact on the economy. We spend nearly \$200 billion per year for electricity in the U.S. The ripple effect to the industrial, commercial, and residential sectors is several times that amount.

The issue then becomes--why do R&D on power generation technologies when our demand growth rate will continue to be low for the next 20 years? DOE/EIA projects a growth rate of 1.4 percent per year. The reality is despite the low demand growth rate, the U.S. is applying this growth rate to a large and aging fleet of power plants. Thus, there are lots of opportunities to build new plants to meet both new capacity and retirement needs. DOE/EIA projects more than 230 gigawatts (GW) of new capacity will be needed between 1996 and 2015 to meet these needs. While much of this will be peaking capacity, we will need 27 GW of new coal capacity. We will need the new coal base-load capacity primarily after 2005 to replace nuclear plants that are being retired at the end of their 40-year licensing period. Thus, in the next 20 years, the domestic investment in new plants will be more than \$100 billion. If nuclear plants are retired early, then the new capacity needs will shoot up dramatically. Some believe this will happen because of nuclear's high O&M costs.

The offshore need for new plants is many times larger than our domestic needs. I am

sure the next speaker will enlighten us on this topic. The large offshore demand will provide U.S. jobs through the export of generation equipment (particularly high power density equipment such as gas turbines and fuel cells) and engineering and project development services.

The debate continues. Some advocate abandoning fossil-based power generation. But fossil energy currently provides 68 percent of our electricity. DOE/EIA projects this will grow to 79 percent by 2015. The growth is primarily due to increased use of natural gas and coal. The fact is we cannot say no to coal and to gas-fired power generation and still keep electric prices low and the economy healthy. We believe it is vital that cleaner, less expensive advanced technology for producing electricity be available. The goal of our R&D program is to produce these technologies--technologies that are responsive to the need of the deregulated electric industry and to environmental drivers.

Thus, our R&D program responds to eight issues that I want to cover:

1. Repowering. Advanced technologies like IGCC and PFBC are ideal technologies to repower existing permitted sites. These sites are irreplaceable assets. Repowering means using the existing steam turbine-generator and any other usable equipment at an existing site, including coal-handling equipment. You do not need to obtain new transmission right-of-ways with repowering. It is relatively free of NIMBYism since it generally reduces net emissions from the existing site. The market opportunities for repowering are large. More than 280 GW of existing fossil/steam

capacity will be >40 years old by 2015, with about one-half of that capacity the 65 to 250 MW range of interest for repowering.

2. Use of opportunity fuels--petroleum coke and other low-cost fuels. We are starting to address the use of opportunity fuels in the program. Low-cost, opportunity fuels may offer the best approach to move advanced technologies along the path toward commercialization.
3. Capital cost reduction. The program is emphasizing reducing capital cost of our technologies--without compromising either efficiency or reliability. For example, tight integration of the gasifiers and the turbine can improve efficiency but devastate cost and/or reliability. Advanced technologies must be much cheaper, more reliable, and more efficient than conventional technologies to offset any perceived increased technical risk.
4. Right-sized technologies. The program is committed to targeting the "right-sized" technologies for the deregulated market. New power plants will need to be small enough to reduce capital exposure, large enough to capture the benefits of economy of scale. Thus, new units are likely to be 100- to 400-megawatt (MW) size range. This is a much more modest size than the 800- and 1000-MW units that utilities built in the 1970's.
5. Global warming. We are convinced we need to take the global warming challenge head-on. Thus, we set a long-term goal of zero emissions--including CO₂ emissions--from our advanced technologies. In the nearer term, we intend to push on improving efficiency as an approach to reducing CO₂ emission. Fuel/cell turbine systems on natural gas will have efficiencies of more than 70 percent--nearly twice that of today's average fossil steam plant. On coal, these systems will be more than 60 percent efficient. In the longer term, at a minimum, we will develop better estimates of the real cost of zero emission systems, including CO₂ mitigation strategies such as tree planting.
6. R&D partnerships. We will work to develop more R&D partnerships with industry and with other parts of DOE. These partnerships may be outside our traditional menu of power generation technologies. We are exploring the formation of joint research programs with DOE/Energy efficiency and DOE/Energy Research to leverage funding.
7. Grand challenges. We intend to seek out some grand challenges and explore how we can integrate them into our R&D program, at least on a small scale. In the late 1970's and early 1980's, the Government sponsored two massive systems studies to develop conceptual designs for a whole boatload of advanced power generation concepts. For students of history, these were the ECAS and the DAFFS studies. We have dropped the losing technologies from the program: magneto hydrodynamics, air-cooled PFBC, and metal vapor Rankine topping cycles. The winners, as you will hear today, are in the demonstration stage in the CCT program. There are not many new fossil energy technologies in the pipeline.

The grand challenge is to envision what power generation technology the U.S. will be using 100 or 200 years from now--and then do the enabling research to bring them into existence. It could be the fossil equivalent of cold fusion coupled with room temperature superconductivity. We believe that an appropriate role for the Government is to lead the charge with "paradigm shifters" that could remake the electric industry. This is fertile for the university community to contribute to understanding--what could be. We must focus on forging the future, not preserving the past.

8. Working smarter. The reality is that Government funding for R&D is being reduced. We need to work smarter to structure programs that offer taxpayers the best value for their investment in the context of lower budgets. Part of working smarter is merging METC and PETC--my last topic.

Discussions on a METC and PETC merger have been underway since 1993. It takes a long time to make things happen in the Government! At last year's Contractor's meeting we thought the merger would happen soon. My hope is that it is really happen now! After several on-again/off-again over the past few weeks, I believe the merger is back on track and will be completed this fiscal year. The language in the report accompanying the Senate subcommittee markup of the Fiscal Year 1997 Appropriation bill conditionally approved the merger--subject to several conditions--none of which appear to be showstoppers. The merger will be a complete integration of METC and PETC. The consolidated center

will have one Director and a joint management team operating both sites as if they were co-located. With modern communications systems, we believe this is eminently doable. We will lose the "lead center" designation for R&D programs. Thus, personnel at either center can carry out R&D programs.

I see two primary benefits of the merger for you, our customers. First, it will reduce our overhead costs, leaving more funds available for the R&D program. Second, joint planning and budgeting will enable us to make better strategic decisions on the direction of the program.

In conclusion, we cannot ignore the role that low-cost electrical power plays in keeping the U.S. economy globally competitive. Advanced power systems will help keep electric costs low while still meeting our environmental imperatives. The combination of improved environmental performance and lower cost is critical if U.S. companies are to compete and win in the domestic and burgeoning global markets. We need your leadership in making sure that we are working on the right technologies, addressing the right R&D issues, and providing you the information you need to do your job--be that university researcher, equipment developer, or utility participant.

The "new DOE" is more than open to your opinions; we will assertively seek it and we commit to reflect it in our actions. Unless our customers succeed, we have no reason for being.

Thank you for your attention and hopefully your comments and questions during this conference.