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Written Testimony
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before the

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Subcommittee On Energy, Natural Resources, and Infrastructure
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Chairman Bingaman, Senator Thomas, and Members of the Subcommittee: It is a privilege to testify before you today on the importance of maintaining coal as a vital source of energy for the production of electricity in our Nation and the importance of continuing Federal support for coal. As history has clearly shown, Federal funding of research and development and Federal tax incentives are catalysts to stimulate the development of innovative and cost-effective technologies that can address our country's energy and environmental concerns, such as the control of emissions from coal-fired power plants.

For the past 30 years, the scientists and engineers at ADA Environmental Solutions (ADA-ES) have built an international reputation for developing and commercializing highly efficient emissions measurement and control technologies for the power industry. Starting in 2000, we began to focus our efforts on research, development, and demonstration of technology for reducing mercury emissions. Today, we are the market leader in providing commercial equipment to capture up to 90% of mercury generated by the combustion of coal. These experiences demonstrate the importance of the right Federal involvement as this Subcommittee and firms such as ADA-ES begin to grapple with other challenges to our energy supply.

Our Testimony Today

Today we would like to give you our perspective of clean coal by discussing the following points:

1) Coal is critical to our future because it is reliable (base load capacity), inexpensive, abundant, and local.
2) The industry has demonstrated the ability to meet environmental challenges involving NO_x, SO_2, particulates and mercury.
3) Federal incentives, such as tax credits, have been effective in advancing technology to ensure realistic options exist and that the costs of these options are manageable.
4) Success for new technologies depends on a careful balance between:
    - Incentives for technological developments;
    - Sufficient time for risk mitigation; and
    - Regulation or tax-based market drivers (often referred to as "sticks" or "carrots").
5) CO_2 control seems to be the next concern for our nation's coal industry and the critical points are:
    - The scale is massive;
    - The timeframe is probably long -- 10 to 20 years;
    - Sufficient investment is critical;
    - Success is likely; and
    - Investment and incentives need to be designed to ensure that multiple technological paths are followed and that costs and risks are reduced.

Coal Is Critical To Our Future

As an environmental technology company, ADA-ES believes that the continued use of coal is critical for sustainable and reliable power generation in the U.S.

America leads the way in environmentally beneficial technologies. As a result of tightened regulations, we continue to improve technology so that the air we breathe and the water we drink are cleaner. We reap these related health benefits because our nation's strong economy allows us to allocate significant resources to these efforts. Much as our country demands higher air and water quality standards, we also need power generation that is inexpensive, reliable, and secure. Coal meets these needs. Today, more than 1,100 coal-fired boilers produce more than 50% of our nation's electricity. Figure 1 illustrates the strong correlation between the use of coal and the ability to provide inexpensive electricity.

Electricity is a much more valuable commodity than it has ever been. Coal plants have increased operational capacity from 59% in 1990 to between 80% and 85% in 2006. The U.S. is expected to need 50% more electrical capacity by 2030. To meet this need, the reliability of coal-fired power plants must continue to improve.

Economic development requires enormous investments in all aspects of energy infrastructure and significant increases in power generation. This is the motivation that drives us to optimize our current investment. We really have no other choice, as it would take decades to replace our current infrastructure.

Any expansion of power supplies must recognize that no single energy source can meet this need -- it requires a portfolio of solutions, including efficiency gains, more renewables, new nuclear power capacity and new coal-based generation. As renewables, such as solar and wind power, become a greater portion of our energy mix, it becomes more important to maintain a source of reliable power that can operate continuously in all weather conditions.

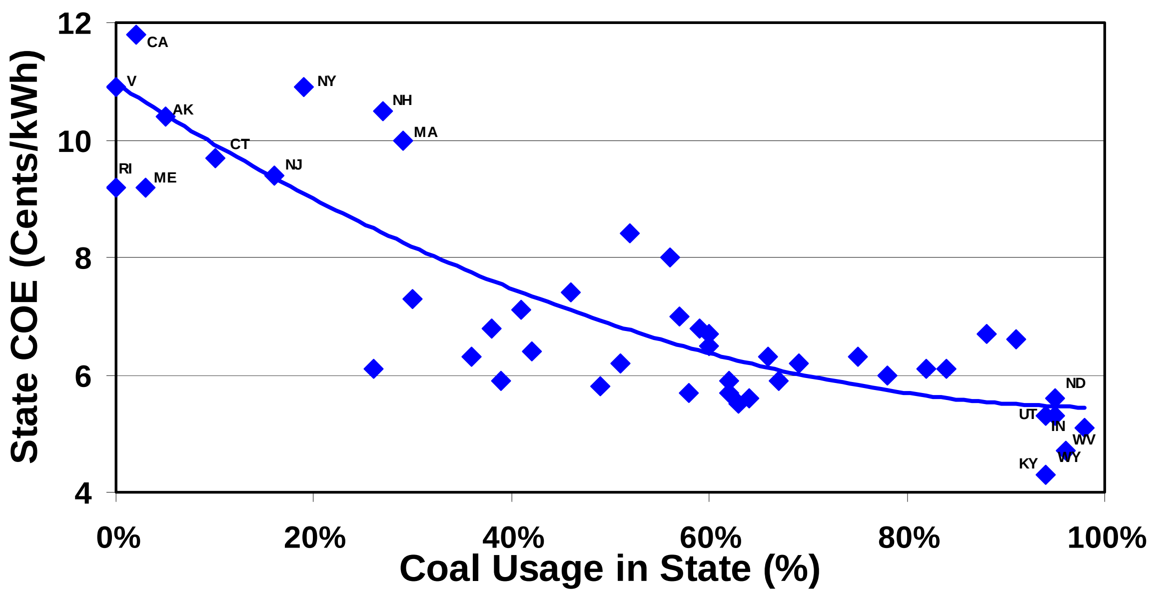

Figure 1. Cost of Electricity in a State as a Function of the Percentage of Electricity Produced from Coal.

Coal can also play an important role in national security by reducing our dependence on foreign energy sources. The United States has the largest coal reserve in the world, and have more coal than any nation has of any single energy resource. At current consumption rates, these coal reserves could supply our nation with 250 years of fuel. This is far greater than our reserves of natural gas and oil combined.

For these reasons, coal remains an essential part of the U.S. generation mix as a secure, plentiful, and relatively inexpensive fuel source. However, we as a nation must determine how to continuously improve emissions. Our goal needs to be "clean coal".

Clean Coal Background

The emissions control industry has made huge advancements in technology to improve emissions from coal-fired power plants. Collaboration among research organizations, universities, and power generation partners has enabled emissions of criteria pollutants sulfur dioxide (SO_2), nitrogen oxides (NO_x), and particulates from the existing fleet of coal fueled power plants to be lower today than they were in 1970, even as power produced from coal plants has increased by 173% (See Figure 2).

Reductions in NOx, SO_2, and particulate emissions were driven by a balance between technology development incentives and emissions regulations. As an example, in the early 1970's, flue gas desulfurization equipment, commonly referred to as "scrubbers," were new and suffered from poor reliability and performance. Over time, as experience was gained and equipment modified, efficiencies rose from about 70% SO_2 removal to 95% to 98% today, with similar improvements in reliability. The emissions of criteria pollutions shown in Figure 2 will continue to decrease each year as emission control equipment is installed on more plants as a result of new regulations such as the Clean Air Interstate Rule.

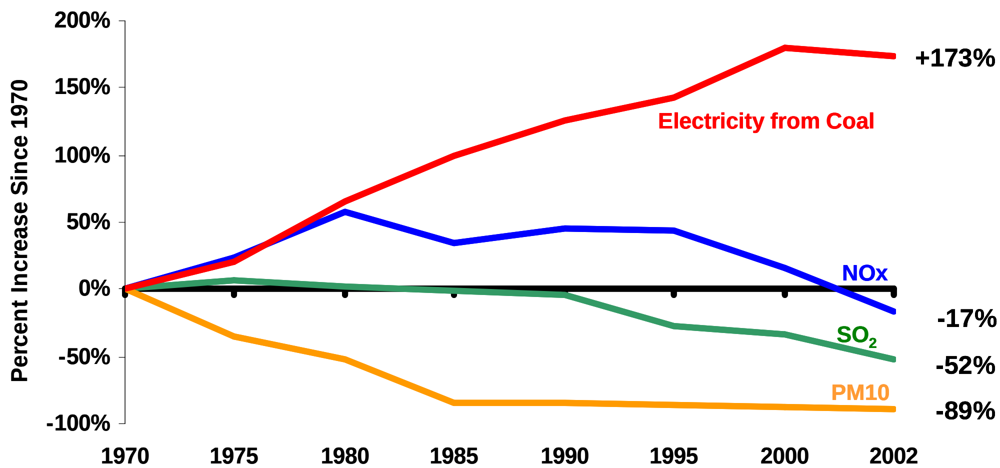

Figure 2. NO_x, SO_2, and particulate emissions from coal-fired power plants continue to decrease even as we increase production significantly.

Challenges in Developing New Emission Control Technology for the Power Industry

To understand how to make coal cleaner, it is helpful to appreciate how emissions control technology has developed for this industry. Since the first Clean Air Act of 1970, the power industry has gone through several rounds of implementing emissions control technology for NO_x, SO_2, and particulates. In each case, there were very similar experiences as new technology was applied in an industry where reliability and compliance are mandatory. We learned the following important lessons:

- Be prepared for unexpected reactions between flue gas constituents and chemical reagents used to control the pollutants;

- Do not underestimate the differences in coal and plant operating conditions to cause wide variations in emissions;

- Try to plan for significant O&M problems that might not show up until after long-term operation; and

- Look for secondary effects on other components of the power plants.

In each case, new-technology challenges had a significant impact on the reliability of power generation. The plants were forced to operate at reduced loads and suffered many unplanned shutdowns for maintenance and repair. Over time, technologies were improved to an acceptable level of cost and reliability. This is the true measure of acceptance, although significant risks may remain depending on how widespread the technology was applied during the early adopter phase. For example, Hot-Side Electrostatic Precipitators (for particulate control) have cost the industry over a billion dollars. After initial successes, the technology was quickly applied to 150 power plants only to have a fatal flaw subsequently discovered.

One of the challenges with implementing new emissions control technology is that the scale is massive. For example, emissions control equipment for a 500 MW plant treats two million cubic feet of flue gas every minute. Scrubbers may be as large as the power plant to which they are attached. Imagine the complications involved when we need to add new emissions control technology without taking the plant off-line.

We have learned that the best way to bring new technologies to an existing coal-fired power plant is to proceed through a carefully chartered course:

1. Laboratory testing: Provides a cost effective means to determine general feasibility and test a variety of parameters.
2. Pilot-scale: Test under actual flue gas conditions but at a reduced scale.
3. Full-scale field tests: Scale up the size of the equipment and perform tests under optimum operating conditions to define capabilities and limits of the technology.
4. Full-scale field tests at multiple sites: Each new site represents new operating conditions and new challenges.

5. Long-term demonstrations at several sites: Some problems will not show up until the first year or so of operation.
6. Widespread implementation: Problems will still be found at new sites, but most of the fatal flaws will have already been discovered and resolved.

We know from experience that trying to accelerate technology development by skipping these steps can result in large-scale operating problems and untimely and expensive plant outages. We also know that it takes ten to twenty years to successfully implement a major technology in this industry and implementation presents significant risks to the developer and user at each stage. In addition to the technology risk, there is significant financial risk to the developer. This is especially true when there is no regulation to guarantee a market will exist for a technology to control an emission that has not been previously regulated. There is often a "chicken and egg" dilemma in which there is no regulation to incentivize the development of a new technology and therefore there is no technology on which to base a regulation. Such was the case in the recent past, when the power industry was faced with reducing mercury emissions for the first time as discussed below.

ADA-ES Experience in Developing and Implementing Mercury Control Technology

It is instructive to present a case study on how Federal initiatives effectively provided incentives and risk mitigation that allowed industry to successfully develop cost-effective mercury control technologies for coal-fired power plants.

Methylmercury, which builds up in certain fish, is a neurotoxin that leads to developmental problems in fetuses of pregnant women. Mercury contained in coal represented the largest man-made source of mercury. In December 2000, the Environmental Protection Agency announced that it was beginning to consider regulating mercury emissions from the nation's coal-fired power plants.

In anticipation of future regulations, the Federal government and industry funded research to characterize the emission and control of mercury compounds from the combustion of coal. Some estimates showed that 90% mercury reduction for utilities would be expensive for the industry because of the large volumes of gas to be treated, the relatively low mercury concentrations, and the difficulty of capturing certain species of mercury in its vapor phase.

With potential regulations rapidly approaching, it was important to concentrate efforts on the most mature retrofit control technologies. Injection of dry sorbents such as powdered activated carbon (PAC) into the flue gas and further collection of the sorbent by ESPs and fabric filters represented potentially the most cost-effective control technology for power plants.

The Department of Energy (DOE) realized the criticality of demonstrating and optimizing scale-up of sorbent injection technology to provide performance data for regulations. The DOE National Energy Technology Laboratory cost-shared these demonstrations, with additional funding from several power companies, the Electric Power Research Institute, and private ADA-ES funding.

The DOE-supported field tests resulted in great advances in technologies to capture mercury emissions and decreased costs. A 2005 report by the DOE Energy Information Administration concluded that because technology for 90% mercury control from Western (Powder River Basin) coals was not available, an overall 90% mercury control rule could cost $358 billion. However, use of these new technologies later demonstrated that the 90% reduction for PRB coal could be achieved for less than $1 billion per year. This saving represents a huge return on the investment made by the Federal government in supporting early development and demonstration of mercury control technology.

This success has allowed a dozen states to take mercury control into their own hands and implement stringent regulations on power plants in their respective states. This action has created the first real commercial market for the new mercury control technology.

Refined Coal Tax Credit (Section 45)

Tax incentives also play a vital role in achieving even further emission reductions. The 2004 American Jobs Creation Act included a production tax credit designed to incentivize clean coal at the front end – changing the way the coal burns - for older plants with limited resources or space to add back-end emission control. The tax credit was written with clear emissions reduction goals: 20% NO_x reduction and either 20% mercury or SO_2 reduction. An additional market value test, requiring that the product result in a 50% increase in market value over the feedstock coal still needs clarification (e.g., a baseline determination), but the credit is significant in that it represents a strong goal-oriented, rather than specific technology-driven, tax incentive.

ADA-ES responded to the incentive of the tax credit and assembled a team to apply mercury control expertise to invest in technology development for a refined coal product that will allow older cyclone boilers to reduce mercury emissions by 90% -- enough to meet stringent state regulations -- simply by burning refined coal. Clarification on the market value test will allow us to move to full-scale demonstrations to optimize and deploy our refined coal technology, and realize the goals Congress intended by the legislation.

Clean Coal: Carbon Challenges

Carbon, in the form of carbon dioxide (CO_2), is a greenhouse gas that contributes to climate changes. Our goal is to reduce CO_2 from both new and existing coal-fired power plants. This presents a number of challenges for technology development. It is not our purpose to detail the technologies being advanced to address these issues - there will be a comprehensive report issued by the National Coal Council this summer that will provide in-depth background on the various approaches. Instead, we would like to briefly note three key areas for technology development.

1) First, increased efficiency. The most effective way to quickly decrease carbon emissions is to increase efficiency of power production on new and existing boilers. Today we have more than 1,100 coal-fired boilers in the U.S. with an average age of 45 years. When many of these plants were built during the 1950’s and 1960’s, we did not care much about efficiency because coal was readily available, and inexpensive.

Figure 3 shows that we produce 25% less CO_2 as boiler efficiency increases from 35% to 50%. That is 25% less carbon that we have to separate and sequester. In May 2001, the National Coal Council produced a report that identified technologies that could increase the amount of electricity from the existing fleet of coal plants by 40,000 MW in a three-year period. Those recommendations remain viable today. To increase the amount of electricity generated by the existing fleet by 40,000 MW without the need to build a single new plant of any fuel type represents a tremendous greenhouse gas mitigation opportunity for this country.

However, although increased efficiencies result in lower CO_2/MW-hr, it also requires higher investment per mega watt-hour. At present, there is no incentive to absorb these increased costs for reducing carbon dioxide emissions.

2) Carbon separation. Nitrogen comprises 78% of the flue gas from a coal-fired power plant. We have to separate the carbon from the nitrogen. Known technologies to do so include oxygen-fired combustion and amine (MEA) scrubbing for pulverized coal (PC) boilers, or chemical separation for integrated gasification combined cycle (IGCC) systems. The challenges now relate to scale and cost with this technology.

3) Carbon storage and sequestration. Once the carbon is separated, we must store, or sequester, it. Known technologies to do so include injection for enhanced oil recovery (representing only a small percent of CO_2), deep well injection, and deep ocean injection. The biggest challenges are the unknown long-term effects, which will determine long-term ownership and legal liabilities. Transportation of CO_2 from plants to storage sites will require large and expensive infrastructure development.

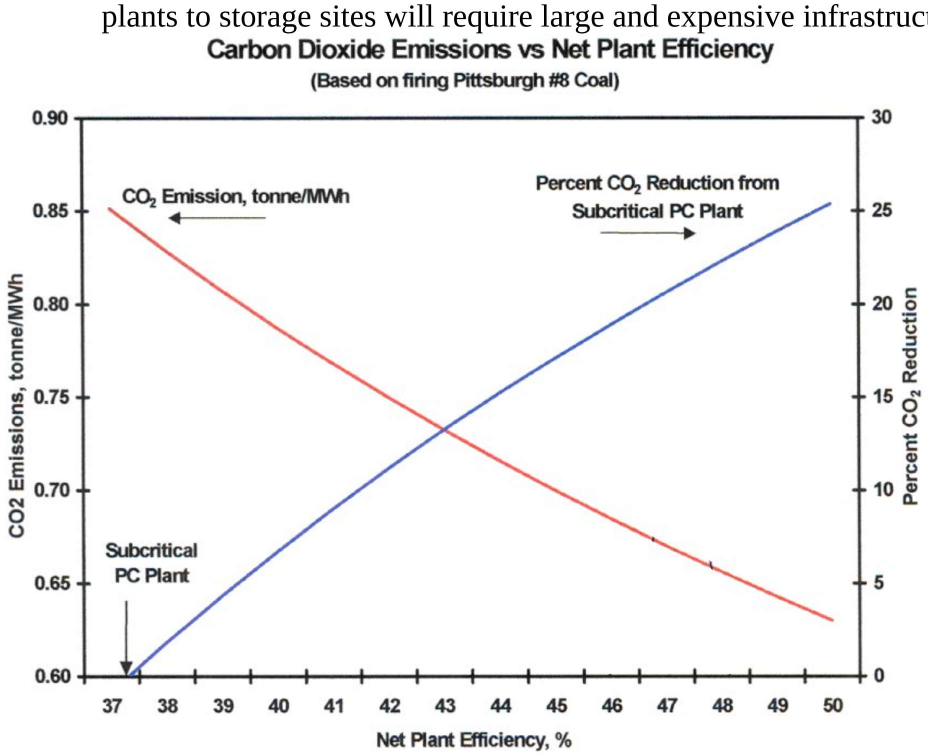

Figure 3. CO_2 emissions as a function of Net Plant Efficiency.

The Size of the CO_2 Problem

Carbon dioxide emissions from coal-fired power plants are bigger than anything our industry has experienced in the past. The average 500MW plant produces 900,000 lbs of CO_2 per hour, and for a typical PC boiler, this CO_2 is highly diluted in the flue gas. Compare this amount of CO_2 to about 0.01 lbs of mercury per hour for the same plant. The scale for carbon capture and storage technology is daunting and the costs will be high.

Technology maturation for carbon capture and storage will take time and the technologies are in their infancy. However, based on advances to date, they should become available and less costly, within the next 20 years or sooner. Carbon capture and storage technologies can be expedited, but they cannot be willed into existence overnight by changes in policy. CO_2 emissions from the U.S. are only a fraction of the world's carbon emissions. Technology developed in the U.S. can be transferred to countries like China and India that will allow the U.S. to leverage its investment in technology development.

New Coal-Fired Generation

Utilities are designing new coal-fired power plants to incorporate carbon separation and capture technologies as they become available. New coal plants will include both supercritical and ultra-supercritical PC boilers, as well as IGCC systems. They will incorporate the same carbon separation and storage technologies described above.

The Role of Carrots and Sticks in Encouraging Investment in Technology:

Not Choosing a Winning Technology

Coal-fired electricity is cleaner today as a result of a balance between "carrots" (e.g., government-funded technology development or tax incentives) and "sticks" (e.g., government regulation or restrictions). It is ineffective to impose the stick until technologies are ready, or nearly ready. Carrots, of course, will help speed up this process. In promulgating carrots and sticks, it is also important that the government defines a goal (e.g., reduced carbon emissions), but does not choose winning technologies. This notion is supported by most recent collaborative studies on reduced carbon emissions. For example, the 2007 MIT Interdisciplinary study, "The Future of Coal," suggests that the government must not select specific technologies, but rather should incentivize technology development towards a common goal.

Timing is Critical: If we impose clean coal restrictions (e.g., in the form of carbon taxes or emission limits) before separation and storage technologies are available, electricity costs will spiral, unraveling our economy and our ability to afford new technologies. However, history has demonstrated that if we first incentivize technology development, provide for risk reduction, and carefully time restrictions, the market will develop and provide winning technologies.

Summary

Clean coal is an important and viable part of our energy future. To move coal into a carbon-constrained world, we need to:

- Preserve base load electricity-generating capacity with reliable, inexpensive sources.
- Balance base-load capacity with renewable sources.
- Carefully balance timing between the carrots (e.g., tax credits and technology development funding) and the sticks (e.g., regulations).
- Incentivize the achievement of goals, not specific technologies (i.e., we should reward any carbon reduction, not just the known technologies to do so).
- Encourage more technology development (R&D tax credits, demonstration tax credits, etc., and coordination with DOE R&D funding).

We need to invest now in tax incentives and support for technology development. We do not know enough, yet, to decide which technology will be most cost-effective for each particular facility. Following multiple paths will increase the likelihood of sufficient successful options for application in the future, and will not preclude out-of-the-box technologies that have not yet been envisioned.

We believe that, based upon our past accomplishments, given sufficient resources and incentives, we can make clean coal a reality.

Thank you for your attention to this important National matter. We look forward to working with the Subcommittee and the Congress in meeting the challenges ahead. We would be happy to provide any additional information, analysis, etc., that you or your staff require.