Major Points of Written Testimony of John A. Fees, Chief Executive Officer, The Babcock & Wilcox Companies Before the Subcommittee on Energy and Air Quality Committee on Energy and Commerce U.S. House of Representatives

- Society will be best served if an array of competitive technologies is available to meet the climate challenge. The promise of marketplace competition will stimulate investment in technology development. Therefore, while considering carbon management legislation, Congress should reject provisions in bills that would explicitly or implicitly provide preferential advantage or disadvantage to any potentially viable technology. The regulatory system must be based on a "level playing field".

- Many ways will emerge to capture the CO2 that would be otherwise be emitted from coal power plants. The three major approaches with the potential to be commercially available in the near to mid term may be categorized as oxygen combustion, post-combustion scrubbing using sorbents such as amines and other chemicals, and pre-combustion (IGCC). Of these, studies by B&W and others lead us to believe that oxycombustion shows great promise in terms of cost effectiveness and nearness to commercialization.

- We continue to make significant technical progress in oxycombustion. We are on track to deploy the first commercial scale near zero emissions coal power plant with carbon capture and storage in North America using oxycombustion technology.

- It will be necessary to have clear policies regarding legal ownership of and liability for the injected CO2, and concise communications to overcome local concerns with large annual injections at storage sites.

- We anticipate that the first wave of commercial carbon capture plants will begin operation around 2012. Through lessons learned at these plants and with additional innovations/modifications, improvements in efficiency and cost will be attained with subsequent installations.

- Deployment of coal combustion units with higher steam (working fluid) conditions, such as those in modern supercritical steam plants, will result in higher efficiency. Increasing the efficiency reduces the intensity of CO2 emissions, as less coal fuel is required to generate a unit of electric power. Efficiency increases also cause proportionately lower generation of traditional pollutants. Very low levels of pollutant emissions can be attained with modern environmental control facilities.

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Chairman Boucher, Mr. Hastert and Members of the Subcommittee:

My name is John Fees and I am the Chief Executive Officer of The Babcock & Wilcox Companies.

It is my privilege to present this testimony on the combustion-based technology alternatives available today, and on the near horizon, that are designed to capture carbon dioxide emissions from electric power plants.

The Babcock & Wilcox Company has a rich legacy of providing reliable engineered technology solutions for efficient, base load electric generation throughout the U.S., North America and across the globe. We have sustained our business by developing and commercializing realistic solutions. Over many decades, we have successfully met the challenges of power generation and

provided the technologies and equipment to resolve the associated environmental control issues. We provide commercially viable solutions to meet emissions control requirements of regulated pollutants. We will provide practical technologies to resolve the challenges of greenhouse gas emissions as well. B&W is a premier, comprehensive provider of clean energy.

The Babcock & Wilcox Company was formed in 1867. The first utility power plant in the United States had a boiler designed and supplied by B&W. B&W is the world's expert on steam which is still the most economic medium to generate electricity worldwide. B&W has literally written the book on "Steam." "Steam, Its Generation and Use" a text book produced by The Babcock & Wilcox Company, is the longest continuously published engineering textbook of its kind in the world, first published in 1875 and last updated in 2005.

Our manufacturing capabilities have also powered national security since the start of the last century. Teddy Roosevelt's Great White Fleet was primarily powered by B&W boilers. At the end of World War II, at the surrender of Japan, 395 of the 400 U.S. Navy ships in Tokyo Bay were powered by B&W boilers. In the 1950s, B&W became a major U.S. manufacturer and supplier of components for the U.S. Navy's fleet of nuclear powered ships and submarines.

Beyond defense, nuclear power is a route to carbon-free electricity generation for civilian purposes. We are the only US manufacturer of the heavy nuclear components that will be required for the emerging civilian nuclear power plant build-up. As such we anticipate playing a critical role in the coming nuclear renaissance to provide clean, safe nuclear power. I could easily write a substantial amount on nuclear power and its potential to help reduce carbon emissions, but the principal focus of this paper is coal fired generation and carbon capture.

Coal-fired and nuclear power plants provide the vast majority of the reliable and lowest cost electricity generation in this Country. Coal-fired and nuclear power plants combined comprise 41 percent of the Nation's electric generation capacity. Due to their cost effectiveness these plants generate 69 percent of all the electricity in the Country. These technologies are the foundation of our economic competitiveness, energy security, and increasing standard of living.

B&W's position as a premier developer and manufacturer of coal technologies and facilities is widely recognized. Thirty-eight percent of US coal-fired boilers have been designed and manufactured by B&W. B&W supplies around one-third of all environmental control technologies and equipment to the US coal power marketplace. We have been selected to provide many of the emission control technology solutions used by electric power generators to meet the strictest requirements under the Clean Air Act, the Clean Air Interstate Rule (CAIR) rule

and various stringent air permitting requirements in the states. B&W has also been awarded a number of the new, highly efficient supercritical coal fired power plant projects, including the first high efficiency Ultra Supercritical Power plant in the US in four decades.

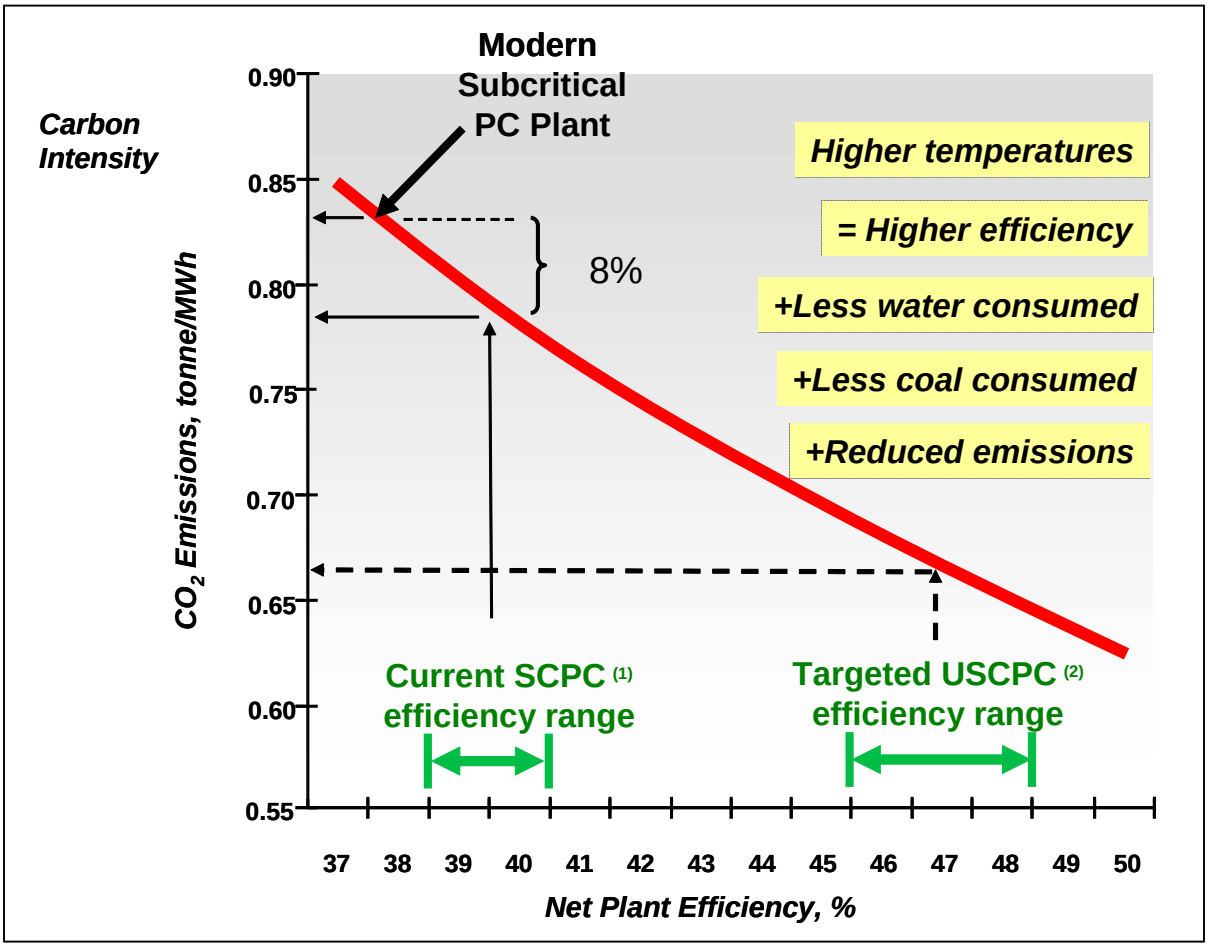
Advanced Coal Power Technologies

Efficiencies

Efficiency at a power plant is measured by the ratio of the electricity generated compared to the energy in the fuel used. Increasing steam temperatures and pressures provides more energy to the steam turbine, enabling higher efficiency and allowing the same amount of electricity to be generated by burning less coal. This results in less production of CO_2 and pollutants derived by coal combustion, and reduced fuel costs.

Many existing US coal-fired plants operate with relatively low steam temperatures and pressures (subcritical steam conditions). These old plants are generally used during high electricity demand periods because of the low generation efficiency, typically in the 30-35 percent range. When steam conditions exceed the combination of both 760F and 3200psi, the steam (or working fluid) is said to reach supercritical conditions. Efficiencies of these plants exceed 37 percent. Replacement of a relatively common 37 percent efficient

subcritical unit with a 40 percent supercritical unit of same generating capacity would reduce CO_2 emissions by about 8 percent. Supercritical plants with efficiencies around 40 percent are already commercially available and being increasingly deployed. R&D projects with advanced materials and manufacturing methods are underway to permit increases of working fluid temperatures to 1200F, and then to around 1400F. When this happens efficiencies will rise above 43 percent toward 48 percent.



It is important to note when evaluating coal plant performance, that efficiency numbers, taken at face value, can be misleading. The US convention for calculating efficiency, called “higher heating value (HHV),” is different from that used in Europe, “lower heating value (LHV).” One of the factors responsible for the difference is the way moisture in coal is treated in the efficiency calculation. There are other factors that enter into the calculation as well. The result is that, for virtually identical plant performance (coal fuel in vs. power out), the US efficiency (HHV basis) would be reported as being 2 to 4 percent lower than European efficiency (LHV basis).

Pollutants

The emissions from pulverized coal-fired power plants have been reduced tremendously over the past three decades, with this achievement due in part to market based regulatory structures pulling technology forward for deployment. Great strides have been made in SO_2 and NOx reduction through scrubbing and selective catalytic reduction technologies. Fabric filters and improvements in electrostatic precipitators have reduced particulate emissions and more recently, technologies such as wet electrostatic precipitators and sorbent injection are capable of further reductions including fine particulates (PM2.5).

With technologies available to address regulated pollutants and major programs to retrofit the existing fleet in progress, public and industry attention turned to mercury. As a result, commercially available mercury control, for both eastern

and western coals are being deployed. Now, concerns about climate change have intensified leading to the pressing need for the development of ways to address carbon dioxide emissions.

Carbon Dioxide Capture

There are several promising technologies to address capture of CO_2 from the use of fossil fuels and all are dependent upon development of a safe means of permanent storage. Assuming storage technologies can be commercialized and enabled, the challenge for coal combustion processes becomes one of extracting the CO_2 from the combustion process. A modern power plant using sub-bituminous coal will produce about 1,800 lbs of CO_2 per MWh. In an uncontrolled state, the CO2 is diluted in the exhaust gas to about 15 percent of its volume; this creates a challenge to produce a concentrated CO_2 stream for storage.

Three approaches are presently seen as plausible carbon capture techniques: 1) Oxy Coal Combustion for new and existing plants that burn coal, 2) amine scrubbing for new or existing plants that burn coal, and 3) pre-combustion processes utilized by IGCC. Oxygen combustion produces a concentrated CO_2 in the combustion process by supplying pure oxygen instead of air for combustion eliminating nitrogen which dilutes the CO_2 concentration. Pre-combustion and amine scrubbing process extract the CO_2 from the gas stream using a regenerable solvent such as monoethanolamine (MEA). Some current

studies now show oxygen combustion as the least costly while other studies lean toward pre-combustion or advanced amines, indicating that technology development is underway and competition is strong. None of the technologies has been demonstrated at significant size in an integrated full-scale system for electricity generation.

Oxy-Coal Combustion

Only the Oxy Coal Combustion process is based upon equipment and systems that are already commercially available at the required scale. However, there are integration requirements, operating parameters and final designs that require verification at larger scale. Oxygen combustion and the major operational processes have been demonstrated at pilot scale and a new 300 MW commercial plant using this technology is being developed by B&W for the SaskPower Corporation to be located at Estevan, Saskatchewan.

In spite of the additional cost to concentrate a CO_2 stream for storage, recent studies show oxygen combustion to be competitive with the other capture technologies. Since this technology utilizes conventional equipment, it is likely to have a considerably lower deployment and operational risk, and has potential for retrofit to the existing fleet of conventional plants.

Additionally, recent studies by the U.S. Department of Energy indicate oxygen combustion will be the lowest cost solution for coal and that the incremental cost

increases of electricity using oxy combustion is less than the increase associated with amine CO_2 scrubbing.

Oxygen combustion provides a means of replacing the nitrogen in air with CO_2 gas exiting the combustion chamber. By recirculating a portion of the combustion stream the oxy coal combustion plant effectively replaces the nitrogen in a conventional system with CO2 thereby inherently creating a concentrated CO_2 stream for permanent storage. The net effect is that the system looks and acts like a conventional power plant with which power plant operators are comfortable, but which is capable of near zero emissions given carbon storage. Additionally, by excluding air conveyed nitrogen from the combustion chamber there is a sharp reduction in nitrogen oxide emissions from this technology, which is likely to obviate the need for selective catalytic reduction facilities.

Although the properties of the flue gas differ from those with air firing due to the lack of nitrogen, it has been found that with the proper recycle ratio, an existing boiler can be converted to oxy coal combustion without changing heat transfer surfaces and only experiencing a small impact on fuel efficiency in the boiler island. For new units, optimized arrangements are being studied that offer some reduction in equipment size and improved performance.

The first generation of full-scale units is intended to require minimal change to the conventional power plant as reasonable to permit retrofit application and minimize risk. Advanced air separation technologies and optimization of the product gas specification and the cleanup/compression process are also expected to improve both performance and cost.

Radical Innovations

We see Oxy Coal technology as one of the potential carbon management solutions for the relatively near future. B&W is developing a portfolio of potential solutions, including some that are radically different from any that are currently approaching readiness for full scale testing. One of these approaches involves destruction of carbon dioxide, using naturally occurring enzymes to catalyze the reaction. While clearly still at the research stage, this approach may bear the potential for greatly reducing the costs for carbon dioxide reduction in the longer term.

Closing Comments

The first wave of near-zero emission coal plants will start operations around 2012. As industry learns from these early commercial deployments, we will make adjustments to improve efficiency and competitiveness. Technology development, economic and market incentives can accelerate the timeframe for implementing widespread carbon capture deployments on a commercial scale. This will only be successful if legislation does not favor one technology over another.

We are confident that our Oxy Coal Combustion technology can provide the most cost-effective solution for some power plants, while other technologies are better suited for others.

We are encouraged by indications that a consensus is building toward a market-based system for carbon management. A market-based system should encourage an efficient allocation of resources for reductions of carbon emissions both at new plants and, where tenable, at some existing plants. It is important to recognize that to significantly reduce our nation's CO2 emissions, capture of CO2 will have to occur at existing fossil-fired plants.

We ask that the legislation support the acceleration of resolving and expanding Research and Development associated with carbon storage. In addition there is a need for clear policies regarding legal ownership of and liability for the injected CO2, and concise communications to overcome local concerns with large annual injections at storage sites. We believe that unless the regulatory and technical obstacles to the long-term storage of carbon dioxide from electric power plants are resolved, these will become the limiting factors in reducing carbon emissions.

Thank you for the privilege to testify before the Subcommittee on these critically important matters.