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**TESTIMONY BEFORE THE U.S.-CHINA ECONOMIC AND SECURITY  
REVIEW COMMISSION: “U.S.-CHINA CLEAN ENERGY COOPERATION:  
STATUS, CHALLENGES AND OPPORTUNITIES”**

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Thank you for the opportunity to provide information to the US-China Commission today. My name is Jerry Fletcher and I am a professor at West Virginia University specializing in natural resource, energy and environmental economics. I also direct the US-China Energy Center at WVU and serve as the US Director for the Advanced Coal Technology Consortium of the US-China Clean Energy Research Center (CERC). The CERC is the implementation of a joint protocol agreement between the US and China that was signed by President Obama in 2009 and initiated in 2010 as part of the overall bilateral cooperation on clean energy innovation.

I am pleased to have the opportunity to provide information about programs at West Virginia University that relate to collaborations between the United States and the People’s Republic of China in the energy area. I will first describe activities in which West Virginia University has been involved over the past several years including support for Annex II - Clean Fuels (Transportation & Chemicals) to the Protocol for Cooperation in the Field of Fossil Energy Technology Development and Utilization between the US and China signed in 2000. The opportunity to work with universities and businesses in China led to other cooperative activities and, ultimately, to the creation of the US-China Energy Center at WVU. I will then provide an overview of activities under the US-China Clean Energy Research Center (CERC), a program announced in November 2009 by President Obama and then President HU Jintao. President Obama and China’s President XI Jinping have indicated continuing support for future activities under the CERC. It is my opinion that the US and China collaborations are of the upmost importance as we consider the growing demand for energy worldwide and the implications of increased fossil energy usage on the levels of carbon dioxide in the atmosphere.

**Background**

The initial impetus for WVU’s current role in US-China energy collaborations with USDOE came from meetings in 2002 with ZHANG Yuzhuo, then President of the China Shenhua Coal to Liquid and Chemical Co., Ltd. and now the President of the Shenhua

Group, the world's largest coal company. Throughout the rest of my remarks, I will use Shenhua to indicate cooperation with the overall Shenhua Group or specific subsidiaries.

Dr. ZHANG was tasked with developing the first coal conversion plant to use direct coal liquefaction (DCL) technologies in the post-World War II era. Germany successfully used DCL technologies to produce liquid fuels from coal when access to petroleum resources was restricted during the war. Like Germany, China was searching for alternatives to imported oil that could be derived from domestic resources. Qingyun SUN, now the Associate Director of the US-China Energy Center at WVU, was asked to help locate potential technology partners that could assist in the development of the DCL plant. I was first introduced to Dr. ZHANG in July of 2002. During our initial discussions, he also expressed interest in developing a better understanding of the economic and environmental impacts of such a plant.

## **Annex II to the Fossil Energy Protocol**

As further background, the US - China Protocol for Cooperation in the Field of Fossil Energy Technology Development and Utilization in the US Department of Energy is composed of a number of annexes on specific topics including Annex II – Clean Fuels (Transportation & Chemicals). Although Annex II had not yet been implemented in 2002 since appropriate joint activities and participants for this aspect of the protocol had not been identified, China's interest in the direct liquefaction technology lined up well with prior work in the US and provided an avenue for mutual cooperation. Joint work related to the development of the DCL plant became the basis for the initial agreements under Annex II that included a focus on the assessment of the economic and environmental impacts of the DCL plant. The US Department of Energy has provided financial assistance for WVU's support of Annex II activities since 2003.

I should also note that the direct conversion of coal to fuels and chemicals produces a relatively highly concentrated carbon dioxide stream as one of the byproducts of the overall process. In 2007, our cooperation with Shenhua under Annex II expanded to include a prefeasibility study of options for capturing and storing a portion of the carbon dioxide produced by the direct coal liquefaction plant in deep geological formations. This work resulted in one of the first successful demonstrations of carbon capture and storage (CCS) in China.

WVU has also been engaged with China on other studies of carbon storage and utilization options designed to reduce releases of carbon into the atmosphere. These activities have included technical exchanges between the two countries and hosting visitors from China interested in developing collaborations and better understanding.

Annex II support activities include a series of workshops that alternate between the US and China. The latest workshop organized by WVU was a technical workshop held in Birmingham, Alabama in April 2013 that attracted industrial and research participants from both the US and China. There were 143 participants registered – 62 from China and 81 from the US – representing 25 Chinese and 34 American companies as well as universities and government agencies from both countries. Additional support for the

workshop was provided through corporate sponsorship by Southern Company and Peabody Energy. The next round of these workshops will be hosted by China and held in Taiyuan in September 2014 with support from the USDOE, the China National Energy Administration and Chinese business sponsorships. WVU has also organized and managed a USDOE technical exchange program under the Annex II umbrella designed to increase communication and understanding among energy professionals from the two countries. The first round of technical exchanges occurred in 2013 with a second round planned for 2014.

### **US-China Energy Center at West Virginia University**

The US-China Energy Center (USCEC) was initially conceived as an umbrella to house the energy related activities between the US and China located at West Virginia University. The USCEC activities at WVU have also been supported by the West Virginia Development Office, a state activity designed to help develop relationships between businesses in the US and China. For example, Petitto Mine Equipment Co. of Morgantown, WV developed an agreement with the Datong Coal Group to develop and provide advanced mining equipment for use in China. Facilitating communications and relationship development between the US and China continues to be a primary focus of activities of the USCEC. For additional information, see <http://uscec.wvu.edu/> - a site maintained in both English and Chinese.

### **US-China Clean Energy Research Center (CERC) – Initial Implementation**

The US-China Clean Energy Research Center represents an innovative approach to supporting cooperation between the US and China in areas dominated by technology. The protocol establishing the CERC takes a direct approach to addressing not only technology, but the intellectual property issues that play such an important role in today's industrial society. See <http://www.us-china-cerc.org/pdfs/protocol.pdf> for a copy of the protocol including Annex I – Intellectual Property) Additional background on the CERC including participants and progress, can be found on the primary CERC web site. Please see <http://www.us-china-cerc.org> for further information.

As initially conceived and implemented, the CERC includes programs in three major areas: building energy efficiency, clean vehicles and clean coal including carbon capture and storage. The US participants in the three areas were selected through an open competition based on proposals submitted in answer to a funding opportunity announcement (FOA) issued in March of 2009 by the USDOE. Proposals were due in May, 2010, with projects to begin October 1, 2010.

WVU is the lead institution of the US Advanced Coal Technology Consortium, a group selected to provide the US participation in the coal area. Other members include academic participants (University of Wyoming, University of Kentucky, Indiana Geological Survey at the University of Indiana, Washington University in St. Louis), National Laboratories (Lawrence Livermore National Laboratory, Los Alamos National Laboratory, National Energy Technology Laboratory), non-governmental organizations (World Resources Institute, US-China Clean Energy Forum) and private sector partners

(Duke Energy, LP Amina, Babcock and Wilcox). As planned, the project was initiated October 1, 2010.

The China coal consortium is led by Prof. ZHENG Chuguang of the Huazhong University of Science and Technology (Wuhan), the lead institution for the China consortium. Other participants are the China Huaneng Group Clean Energy Research Institute (Beijing), China Huaneng Group Power International, Inc. (Beijing), China Power Engineering Consulting Group Corporation (CPECC) (Beijing), China Power Investment Corporation (Beijing), ENN (XinAo Group) (Langfang), Harbin Institute of Technology (Harbin), Institute for Rock & Soil Mechanics, Chinese Academy of Science (Wuhan), Northwest University (Xi'an), Research Center for Energy & Power, Chinese Academy of Sciences (Beijing and Lianyungang, Jiangsu), Shaanxi Yanchang Petroleum Group Co., Ltd. (Xi'an), Shanghai JiaoTong University (Shanghai), Shenhua Group (Beijing), Tsinghua University (Beijing), and Zhejiang University (Hangzhou). While both the Ministry of Science and Technology (MOST) and the National Energy Administration (NEA) in China are listed as responsible government agencies, in practice most of the communications have been through MOST. In my opinion, more commitment from NEA would enhance the ability of the larger state-owned enterprises in China to fully engage in the CERC.

The first meetings between the US and China research teams under the CERC took place in Beijing, October 26-30, 2010. As the two research teams in the area of clean coal including carbon capture and storage had not communicated previously and had no prior knowledge of the specific goals and objectives of the other side, there were significant and wide ranging discussions in a number of areas. These discussions covered the broad areas of technical interest of highest priority to both the American and Chinese research teams. The teams agreed to use the Advanced Coal Technology Consortia (ACTC) to refer collectively to the US and China research teams. One of the overarching issues of immediate concern was how to implement the requirements written into the protocol – namely how to deal with the intellectual property issues and how to develop the technology management plans required by the protocol, in conjunction with the overall research plan.

The CERC protocol as established and approved by the two governments thus fundamentally required that the communication gaps between the US and China participants related to intellectual property and technology management plans be overcome and appropriate communication channels developed prior to initializing joint, collaborative research. Approval of the research plans and the technology management plans by both governments was needed prior to initiating research. This applied to all participants in the CERC. Thus, under the leadership of the US-China Clean Energy Forum, one of the US ACTC members, discussions related to intellectual property became one of the primary activities of the first year of the CERC.

Joint work plans for each area were completed and approved by both governments on January 18, 2011, as part of a signing ceremony held in Washington, DC. The discussions on IP and the development of technology management plans took longer. The first joint workshop on IP was held in conjunction with the ceremony to approve the work plans. A

second workshop for ACTC participants was held in Wuhan, China, in May of 2011. The technology management plan for the ACTC was finally approved by the directors of the US and China ACTC at a signing ceremony held at West Virginia University on August 19, 2011 ( [http://www.us-china-cerc.org/pdfs/CERC-ACTC\\_TMP\\_19\\_Aug\\_2011.pdf](http://www.us-china-cerc.org/pdfs/CERC-ACTC_TMP_19_Aug_2011.pdf) ). Final government approval was obtained as part of a joint meeting in Beijing on September 23, 2011. ( [http://www.us-china-cerc.org/pdfs/US/CERC-ACTC\\_TMP\\_Endorsement\\_English\\_23\\_Sep\\_2011.pdf](http://www.us-china-cerc.org/pdfs/US/CERC-ACTC_TMP_Endorsement_English_23_Sep_2011.pdf) )

Thus the first year of the CERC was devoted to developing communication links, identifying and planning longer term research efforts of joint interest and technology management plans that reflected appropriate intellectual property provisions. While this was a time consuming process, the breakthroughs in intellectual property discussions and understanding are significant for this and other US-China cooperative activities.

### **US-China Clean Energy Research Center (CERC) – Progress and Potential**

Advancements in intellectual property management have continued. While the initial impetus was due to the requirements of the protocol, there is a clear understanding that this is an area where additional advancement is in the mutual interest of both countries. Joint workshops were held in Haikou, China March 5-6, 2012 and in Stanford, CA February 26-27, 2013. ( [http://www.us-china-cerc.org/Intellectual\\_Property.html](http://www.us-china-cerc.org/Intellectual_Property.html) )

The cooperative research efforts within the ACTC have also continued. Joint workshops on the separate research areas have alternated between the US and China. Annual project meetings have provided the opportunity to both review research progress and plan future work. The latest was held in Jackson, Wyoming October 2-4, 2013. The next is planned for Hangzhou, China September 18-20, 2014.

The federal commitment to the US ACTC is \$2.5 million per year. This has been matched by resources provided by the universities and private sector partners. Through the first three years of the project, about 36% of the cost share has been provided by our industrial partners and the balance by the universities. While we believe that the China contribution has matched that of the US, the actual mechanisms for support in China are unclear. There are no financial issues between the two US and Chinese organizations; all US funds are US specific and the funding for the Chinese participation are provided in and used by China. We do know that our Chinese counterparts have had the resources necessary to fully engage in the activities of the ACTC.

The research effort is divided into seven themes to match the research interests and efforts of both the US and China. These can be loosely categorized into three general areas: carbon capture, utilization and storage; power generation; and coal conversion. While both countries are engaged in all aspects of the research, it has been clear from the beginning that the US perceived the carbon management issues to be of the highest interest while China was most interested in the increasing efficiency and technical advances in power generation and coal utilization.

In terms of the overall impacts of the program, there seem to be few, if any, concerns related to national security or economic damage. The experiences acquired to date indicate that the overall economic impact will be positive – strengthening trade and the related economic factors while increasing overall energy efficiency. Both countries will benefit from initiatives such as the CERC. In the longer term, it would be difficult to assess which country gains the most – the US and China are in very different points on the development scale and must assess the benefits from their own perspective.

### **Summary**

In summary, I would like to close with a personal thought. I believe that it is important to keep certain facts in mind in understanding relations between the US and China. With roughly four times the population and an economy half the size of the US, China is at a very different place on the overall economic development scale. Per capita income is about 1/8 that of the US and 2/3 that of the world average. From an environmental perspective, the issues we see in China today are reminiscent of those in the US when the USEPA was founded. Air and water quality problems abound. As we engage China on long-term carbon management issues, it is important to remember that China is facing a broad array of environmental issues of immediate importance. Including issues with immediate impact in China will no doubt encourage cooperation on the longer term issues of worldwide importance.