TESTIMONY OF SARAH M. FORBES

SENIOR ASSOCIATE, CLIMATE AND ENERGY PROGRAM
WORLD RESOURCES INSTITUTE

HEARING BEFORE THE US-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION "US-CHINA CLEAN ENERGY COOPERATION: STATUS, CHALLENGES, AND OPPORTUNITIES"

April 25, 2014

Thank you for the opportunity to contribute to the deliberations of this commission. My name is Sarah Forbes, and I am a Senior Associate in the Climate and Energy Program at the World Resources Institute (WRI). WRI is a non-profit, non-partisan think tank that focuses on the intersection of the environment and socio-economic development. We go beyond research to put ideas into action, working globally with governments, business, and civil society to build transformative solutions that protect the earth and improve people's lives. We operate globally because today's problems know no boundaries. We provide innovative paths to a sustainable planet through work that is accurate, fair and independent.

I am delighted to speak with you today about clean energy cooperation between the United States and China. I would like to open my testimony with a quote from the April 2013 Joint US-China statement on Climate Change:

> *"[F]orceful, nationally appropriate action by the United States and China – including large scale cooperative action – is more critical than ever. Such action is crucial both to contain climate change and to set the kind of powerful example that can inspire the world"*

In my testimony I will describe the context for US-China collaboration on clean energy, outline the need for policies that encourage innovation throughout the value chain, describe how collaboration with China can advance US energy goals, and, perhaps most importantly, give recommendations for how US-China collaboration on clean energy could be improved so that we can inspire the world and speed the transition towards a clean energy future. My testimony will discuss not only clean energy collaboration, but will also touch on the issues you raised in inviting me around the state of cooperation on shale gas.

I will expand on the following five recommendations throughout my testimony. Future US-China collaboration on clean energy and shale gas should include:

1. Creation of collaborative networks that include supporting innovators' needs and building capacity in the workforce;

2. Continued high-level strategic engagement between the US federal government and China's central government on clean energy collaboration;
3. Substantive work on developing and implementing environmental regulations for air, water, and climate impacts;
4. Private sector engagement and investment, personnel training, and more transparency; and
5. Facilitation of opportunities for joint R&D.

Context for Clean Energy Cooperation between the US and China

Many parallels exist in the US and Chinese energy profiles. Both are continent-sized countries with geographically dispersed energy resources and with energy demand centers (cities) that are often far from energy supplies. Both countries currently rely heavily on fossil fuels to power their economies, primarily drawing on coal, natural gas, and imported oil (the US and China have similar levels of crude import dependence). Both countries seek to increase energy independence by diversifying the energy mix and ramping up domestic energy production, particularly unconventional fossil fuels such as shale gas as well as renewable energy technologies.

Collaboration on clean energy – energy efficiency, renewable energy and carbon capture and storage (CCS) – and shale gas falls into these broad categories:

- Business-to-Business
- Government-to-Government
- Researcher-to-Researcher

The following provides a brief overview of the scope of existing collaboration on clean energy and shale gas, with the shale gas discussion adapted from a paper I recently drafted for the Brookings Institution[1].

Business-to-Business (B2B)

The following are examples of key B2B collaborations[2]:

- Duke Energy and Huaneng have been cooperating on clean energy technology since 2009. The two companies have been sharing information, especially on carbon capture, utilization and storage (CCUS). In 2012, the original agreement was expanded to examine the feasibility of brining carbon capture and storage technology that had been pilot tested in China to US power plants.
- GE and State Grid Corp have formally agreed to cooperate to jointly develop standards for smart grids in China. GE has formed an equally-owned joint venture

[1] http://www.brookings.edu/~/media/Events/2014/2/06%20china%20clean%20energy/USChina%20Moving%20Toward%20Responsible%20Shale%20Gas%20Development_SForbes.pdf

[2] These examples are excerpted from WRI China FAQS factsheet "US-China Collaboration: Can they "inspire the world"? (http://www.chinafaqs.org/library/chinafaqs-us-china-collaboration-can-they-inspire-world)

in China to offer leasing services to the energy industry and an equally-owned joint venture to market and manufacture grid monitoring and diagnostic products.

- A consortium of US and Chinese companies including Boeing, Honeywell, PetroChina, and Air China has been collaborating to develop biofuels for passenger jets. In 2011, this effort led to a successful Chinese test flight of a Boeing 747 using a 50% blend of traditional jet fuel and the new biofuel. This collaboration benefits from being a part of the US-China Energy Cooperation Program.

In terms of shale gas, Chinese companies currently possess the ability to drill wells horizontally and have some experience with hydraulic fracturing but are in the nascent stages of acquiring experience and applying these techniques to shale gas extraction. Operators and service providers in the United States currently have substantial experience with drilling and fracking shales, having mastered these techniques effectively to maximize output. Given this level of technical and experiential asymmetry, China has made it possible for US entities to strike up partnerships with Chinese companies, primarily the National Oil Companies (NOCs). But China has prohibited foreign companies from fully entering the onshore energy production sector on their own, forcing them to form partnerships with Chinese entities. As a result, several foreign companies have already begun participating in shale gas development in China, through joint ventures (JVs) such as PetroChina-Shell and China National Offshore Oil Company-British Petroleum (CNOOC-BP).[3] Leading US service providers like Schlumberger, Baker Hughes, and Halliburton also have well-established offices and/or research institutes in Beijing and provide services to Chinese companies, including the NOCs and other smaller new entrants.

China has also invested in shale gas development in the United States, with NOCs establishing JVs with US companies. These generally take the form of acquiring stakes in company assets—investments in specific shale gas plays—and not as investments in the US companies themselves. It is a model that the global oil and gas industry has long used to sustain growth and hedge against financial risk. The rationale for these Chinese investments varies. In some cases, Chinese petroleum engineers are able to spend time onsite learning about shale gas development first hand. However, limits on "access to technology" remain an oft-cited constraint on China's future shale gas developments. What is meant by "access to technology" may be best described as "know how." That is, the technology for horizontal drilling or fracking may not be the key barrier for China *per se*—instead, it is the lack of experience in applying these tools to different geological formations to maximize the flow of the gas.

[3] Forbes, Sarah, 2012. "China's Prospects for Shale Gas and Implications for the United States" Congressional Testimony. http://pdf.wri.org/testimony/forbes_testimony_china_shale_gas_2012-01-26.pdf

Government-to-Government (G2G)

In 2009, the following key forums for G2G collaboration on clean energy were established:

- The Clean Energy Research Center, or CERC (electric vehicles, building efficiency, and advanced coal technology), is a unique bilateral platform to allow both countries' researchers to work closely on the same tasks and is operated as a public-private partnership on both sides.
- US-China Energy Cooperation Program is a government-led collaboration that includes private-sector partners on both sides, supporting projects in the areas of smart grid, green buildings, combined heat and power and renewable energy.
- US-China Renewable Energy Partnership includes road mapping renewable energy deployments in each country, an annual US-China renewable energy forum and sharing best practices.
- US-China Electric Vehicles Initiative supports joint standards development and demonstrations in a dozen cities.
- US-China Energy Efficiency Action Plan supports officials in both countries to develop codes and rating systems and benchmark industrial energy efficiency as well as a training program for inspectors and an annual US-China Energy Efficiency forum.

In 2013, the Climate Change Working Group (CCWG) for the Strategic and Economic dialogue completed a report that took stock of the existing collaboration. The CCWG was established in April 2013 to deepen and extend existing collaboration that spurs large-scale cooperative efforts. The report resulted in a July 2013 commitment to new action initiatives for collaboration on five issues, which will draw on the relevant agencies in each country:

1. Emissions reductions from heavy-duty and other vehicles
2. Smart grid
3. Carbon capture utilization and storage
4. Collecting and managing GHG emissions data
5. Energy efficiency in buildings and industry

With respect to shale gas specifically, in 2009, President Obama and then-President Hu Jintao announced the launch of the US-China Shale Gas Resource Initiative, with the goal of sharing information about shale gas exploration and technology to reduce greenhouse gas emissions, promote energy security, and create commercial opportunities. Activities conducted under the initiative include forums, workshops, and a Chinese delegation's visit to a US shale gas development operation. The governments' collaboration includes the following activities, led by key agencies:

- The US Geological Survey and the Department of Energy (DoE) have worked with Chinese counterparts to develop estimates for China's shale gas resource. Although the collaboration resulted in sharing information on methodology, Chinese geological data is considered a state secret and cannot be shared with foreigners.

- DoE manages the US-China oil and gas industry forum, which sponsors an annual meeting designed to bring industry players together to share information via technical presentations.[4] In September 2012, the forum sponsored a meeting focused on shale gas. DoE also has relevant work underway that focuses on issues under Annex III of the bilateral Fossil Energy Protocol.[5]
- In April 2013, the US Trade and Development Administration partnered with the National Energy Administration on a training program. The program included four short courses led by the Gas Technologies Institute and targeted attendees from the Chinese government and industry.[6]

Researcher-to-Researcher (R2R)

Regardless of the G2G or B2B framework for collaboration, the effectiveness of collaboration on clean energy technology development ultimately depends on the relationships established between researchers. G2G frameworks like the CERC are designed to foster such R2R relationships, however the depth and extent of collaboration ultimately depends on a collection of individual relationships among researchers who share the same interests and vision.

It is increasing common for effective G2G, B2B and R2R collaborations to result in bilateral public/private partnerships:

- CERC participants from Yanchang Petroleum, University of Wyoming, and the China Academy of Sciences are partnering on a CCUS/Enhanced Oil Recovery project in Shaanxi province.
- CERC participants from Huaneng Energy, Lawrence Livermore National Laboratory, and Duke Energy have conducted carbon capture cost modeling on Duke's Gibson Power Plant and Huaneng's Shidonku plant.

Future Environmental Challenges Require Innovation

Transforming the global energy picture requires innovation. Such innovation will not happen without investment from the public and private sector, commitment from governments and industry, support from local communities, and out-of-the box ideas that push the envelope of what seems possible. All of these must be sustained over time.

R&D spending alone is not effective in deploying new energy technologies, and the innovations created in U.S. national laboratories and universities often do not get manufactured or deployed into the marketplace. For instance, a recent WRI report comparing clean energy industries across major countries highlighted that the United States had the highest public investments in wind energy R&D. Yet, it was the only wind

[4] http://www.uschinaogf.org/
[5] http://www.fossil.energy.gov/international/International_Partners/China.html
[6] http://www.rpsea.org/attachments/calendarevents/452/US-China%20Shale%20Gas%20Resource%20Characterization%20and%20Assessment%20Workshop-%20US%20V%204_3_2013)USE.pdf

energy market among the five countries analyzed that maintained a long-term trade deficit in wind equipment, importing more than it exports, due largely to the uncertainty surrounding the longevity of policies that support deployment of wind energy technologies.[7]

WRI's work on innovation concluded the following:[8]

"Innovation is a powerful, cumulative process but it does not happen automatically in a highly regulated sector like electricity. It is critical that policymakers support innovators by building a robust, dynamic innovation ecosystem. This goes beyond investing in public research and development and creating markets through subsidies. It also includes building collaborative networks, creating stable regulatory environments, providing infrastructure, supporting innovators' needs for finance, and building capacity in the workforce."

International collaboration, and US-China collaboration specifically, is one way to create collaborative networks and build global capacity among researchers and ultimately in the workforce. In the area of CCUS, bi- and multi-lateral mechanisms for collaboration, such as the US-China Clean Energy Research Center's Advanced Coal Technology Consortium and the Carbon Sequestration Leadership Forum, have already been established. These efforts together create a globally integrated collaborative network. However, US-China collaboration stands out among international efforts on CCUS because of the sustained nature of the collaboration and the level of commitment among the businesses and researchers engaged.

US Benefits from US-China Clean Energy Cooperation

There was a time when US-China collaboration on clean energy was geared primarily towards "capacity building" or "technology transfer." That view of the world is increasingly outdated. China is a global leader in clean energy investment and in clean energy technology development and the benefits from US-China collaboration on clean energy can and will be realized by both countries. China is now a center of global clean energy collaboration, working with Australia, Canada, and European Union on a range of clean technologies.

U.S. businesses, universities and think tanks are already leveraging the benefits of international collaboration to advance clean energy technology and reduce the environmental impacts associated with continued fossil fuel use.

In a world where companies and products are globally integrated, the benefits of US-China cooperation on clean energy technology innovation extends beyond either the US or China. A visit to an industrial facility anywhere the world might reveal parts and

[7] http://www.wri.org/publication/delivering-on-the-clean-energy-economy
[8] http://pdf.wri.org/factsheets/factsheet_power_of_innovation.pdf and http://www.wri.org/publication/two-degrees-of-innovation

technologies purchased from dozens of countries. By leveraging and combining the collective ingenuity of engineers and scientists in both the US and China, we can help unlock a clean energy revolution by developing smarter approaches to producing and using energy. These new developments can and will be used globally.

An intangible benefit of cooperation is the benefit of the cooperation itself. And the benefits of this cooperation are not merely bilateral. The frameworks under which cooperation occurs provide opportunities for businesses, government agencies, and academics within each country to engage in discussions and work jointly in ways would not be possible otherwise. Such cross-fertilization directly benefits the US entities involved in the collaboration.

Before I turn to my recommendations, I would like to end my testimony with a concrete example of how collaboration under Clean Energy Research Center-Advanced Coal Technology Consortium and the US-China Energy Cooperation Partnerships has resulted in deployment of new coal technology and created manufacturing jobs in the United States.[9]

LP Amina, a North Carolina-based company, developed and patented a new coal classifier to sort pulverized coal. The classifier was easy to add to existing plants and such a retrofit would lead to a reduction in coal consumption and emissions. The classifier prevents larger coal particles from entering the boiler, reducing nitrogen oxide emissions by up to approximately 15 percent and with slight efficiency improvements. Despite the benefits, customers in the United States would not buy the new classifier because it had not yet been demonstrated. After engagement in joint R&D and workshops convened by the CERC-ACTC, LP Amina installed one of its new classifiers at the Fengtai Power Station in the Anhui Province in eastern China. After the successful demonstration in China, LP Amina is now marketing this technology to global companies, including plants in the United States. The technology was developed here in the United States, demonstrated in China, and is now being deployed globally. And the innovation is creating American manufacturing jobs. Each classifier keeps 10-20 manufacturing workers busy for a month and manufacturers in Michigan, Ohio, and West Virginia have already been put to work building them.

Recommendations for Improving US-China Cooperation on Clean Energy

Note: the final three recommendations are an adapted and expanded version of the recommendations made for US-China collaboration on shale gas in "The United States and China: Moving towards Responsible Shale Gas Development"[10].

---

[9]WRI published a more comprehensive version of this story as a ChinaFAQs factsheet; see http://www.chinafaqs.org/files/chinainfo/China%20FAQs_Road_Testing_Tech_v1_6.pdf.

[10] http://www.brookings.edu/~/media/events/2014/2/06%20china%20clean%20energy/uschina%20moving%20toward%20responsible%20shale%20gas%20development_sforbes.pdf

1. *Creation of collaborative networks that include supporting innovators' needs and building capacity in the workforce.*

   While deployment of clean energy technologies depends on national regulatory changes and infrastructure investments, innovation also can be accelerated by collaborative networks. US-China collaboration that fosters true innovation and is sustained over time can play an important role in clean energy innovation. Such collaboration should extend beyond R&D and also build capacity in the workforce. The framework for such sustained, capacity-building collaboration is already in place through the US-China Clean Energy Research Centers, the Energy Cooperation Partnership Program and the US-China Renewable Energy Partnership—however, the budgets for these efforts are continually at risk of inadequate resources as they are subject to annual Congressional appropriations. In addition to ensuring collaborative efforts are adequately funded, Congress can also play a role in tracking the progress of various collaborative efforts through a periodic assessment or report to congress. Such a report could include recommendations for improving and reshaping existing collaborations.

2. *Continued high-level strategic engagement between the US federal government and China's central government on clean energy collaboration.*

   High-level communication and engagement is very important. China's top-down innovation system requires government leadership and guidance. An institutional collaborative mechanism between China and the US could be beneficial. Such a platform should integrate current platforms and promote information sharing-among complimentary efforts. For example, although some of the same businesses and researchers are engaged in the shale gas initiatives led by different governmental agencies, there does not seem to be a formal integration or assessment of efforts. Ideally such an integration would look across clean energy cooperation, including energy efficiency, renewable energy, CCUS and shale gas. The Climate Change Working Group (CCWG) is designed explicitly to bring the relevant agencies and ministries together in such a manner. However, its scope is currently limited to collaboration on the five issue areas described. Congress could request a report that analyzes the gaps and progress in current collaboration and evaluates whether the CCWG could effectively serve a coordinating function among clean energy cooperation between the two countries.

3. *Substantive work on developing and implementing environmental regulations for air, water, and climate impacts.*

   Too often collaboration focuses only on technology and not on the important interaction between technology and policy, including addressing the environmental impacts of technology deployment. Comprehensive, life cycle environmental concerns regarding clean energy development must be addressed as part of future collaboration. This collaboration should involve both technical and policy aspects of clean energy deployment. One way to accomplish this would be for the US and China

to initiate a platform for multi-agency/ministry dialogue between the countries that is focused specifically on environmental policies needed for clean energy deployment in China and the US. Such a platform could be led by two agencies, or perhaps occur under the auspices of the CCWG, but would include all relevant agencies/ministries in the discussions and would focus on policies and regulations rather than technologies and demonstrations. Congress could encourage such collaboration through supporting international collaboration efforts undertaken by Environmental Protection Agency.

4. *Private sector engagement and investment, personnel training, and more transparency.*

   Business-to-business collaboration will continue to be important, but there are barriers that must be addressed for it to be effective. They include inadequate involvement of companies on both sides, and sensitivities surrounding information protection and technology sharing.

   To remedy these issues, the two governments could initiate a joint industry forum focused on the interests and needs of companies that cross-cuts clean energy issues. A new workforce training program could provide opportunities for young professionals from both countries to have an extended stay in the respective country. This would help to cultivate a group of engineers and scientists, ready to support clean energy development anywhere in the world. Leaders in both governments should jointly discuss the barriers to cooperation including intellectual property and data availability. Such an effort could begin by Congress requesting a special report on US-China business-to-business collaboration that includes input from industry, government, and academic stakeholders engaged in cooperative efforts and assessing the opportunities and barriers for private sector engagement in collaboration.

5. *Facilitation of opportunities for joint R&D.*

   While existing technical collaboration is important, it should evolve into deeper efforts that include exchanges of researchers and dialogues aimed at solving the unique challenges of various clean energy approaches. Both governments should create platforms for cooperation and fund researchers in academia and industry to partner bilaterally and co-develop novel clean energy solutions.

   Taking this recommendation seriously means prioritizing extended exchange programs over short workshops and meetings as part of existing and new collaborative efforts. It also means expanding beyond the questions around technology and including joint research on the economic and policy aspects of clean development. A collaborative clean energy demonstration program, modeled on existing international collaborations such as the CERC, could be one way to effectively encourage joint green technology development and demonstration.