Hearing on U.S.-China Clean Energy Cooperation:
Status, Challenges, and Opportunities

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Members of the Commission: good morning, and thank you for the invitation to participate in this hearing to discuss U.S.-China Clean Energy Cooperation. I am currently a professor at Georgetown University, and have been working on the issue of U.S.-China clean energy cooperation for several years in a variety of roles. My own academic research focuses on the evolving nature of U.S.-China relations on energy and climate, including models of and obstacles to clean energy cooperation and to clean energy technology transfer, as well as China's domestic energy and climate policy strategy. Currently I am the Principal Investigator on a multi-year National Science Foundation supported research project, **"**International Partnerships and Technological Leapfrogging in China's Clean Energy Sector," in which I'm conducting an international review of bilateral clean energy cooperation initiatives with China.

Previously I served as the Research Director of the Asia Society's Initiative for U.S.-China Cooperation on Energy and Climate, and led the drafting of a "Roadmap for U.S.-China Cooperation on Energy and Climate Change" in 2008 that aimed to inform the incoming Administration's clean energy cooperation priorities with China. From 2008-2010 I served on a panel of the U.S. National Academies to review "U.S.-China Cooperation on Electricity from Renewable Sources" along with the Chinese Academies of Sciences and Engineering. I have also been directly involved in many U.S.-China clean energy cooperation projects myself, including as a researcher at Lawrence Berkeley National Laboratory's China Energy Group, as an international advisor to the Energy Foundation's China Sustainable Energy Program, and as a visiting scholar at Tsinghua University.

As the largest energy consuming nation and largest greenhouse gas emitter in the world, China plays an increasingly important role in the geopolitics of energy as well as climate

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[1] This testimony draws from Lewis, Joanna I. (2013), "Engaging China on Clean Energy Cooperation," Chapter 7 in *Green Innovation in China: China's Wind Power Industry and the Global Transition to a Low-Carbon Economy.* New York: Columbia University Press; and Lewis, Joanna I. (2014), "Managing intellectual property rights in cross-border clean energy collaboration: The case of the U.S.–China Clean Energy Research Center." *Energy Policy* 69: 546–554.

change mitigation. A longtime proponent of multilateralism, China has been increasing its engagement and its seniority in various multilateral forums, including the United Nations. It has, however, been viewed by many industrialized nations as an obstructionist player in the ongoing international negotiations under the United Nations Framework Convention on Climate Change. China, for many reasons, plays a very different role in the multilateral context from the role it plays in a bilateral one.

In these negotiations, China time and again has served the role of spokesperson for the developing world, defending its right to emit in the name of economic development. In a direct bilateral discussion with a leading industrialized nation like the United States, however, China wants to be seen as an equal, and as the global superpower that it has become. For this reason direct bilateral discussions can lead to more effective platforms for cooperation on topics that become politicized in a larger negotiation.

Bilateral cooperation allows for the identification of clear technical areas of mutual interest between the countries involved. For example, while China and the United States frequently disagree over core issues in the UN climate negotiations, the technical challenges behind their mitigation options are distinctly similar. Both countries have abundant domestic coal resources that provide energy security benefits but are a significant source of emissions. While both China and the United States also have excellent renewable resources, including wind and solar, the best resources and locations for renewable power development tend to be located far from population centers and electricity demand and therefore will require expanded and modernized transmission infrastructures. Both countries have realized the potential energy efficiency gains they can achieve but still lag behind Europe, Japan, and others in developing a more efficient energy system.

China and the United States have a somewhat unique positioning in the international community on energy and climate change issues, as the two largest economies, the two largest energy consumers, and the two largest greenhouse gas emitters on the planet. Owing to the similarities in energy systems shared by the two countries, there are many areas where both the United States and China could benefit from cooperation on climate change and clean-energy development.

The United States and China have a long history of bilateral clean energy cooperation, both through official governmental channels and between universities and nongovernmental organizations. For this testimony I am focusing specifically on official bilateral cooperation activities facilitated by the governments of the Untied States and China.

The U.S.–China Agreement on Cooperation in Science and Technology (S&T Agreement) was signed in 1979, soon after the normalization of diplomatic relations between the two countries. This agreement established a framework for many of the subsequent agreements on energy-related cooperation between the United States and China signed over the next thirty years. Many of the agreements signed during the 1970s and 1980s focused on promoting collaboration and understanding in basic research related to many core energy technologies of this period, including the 1970 Agreement on High Energy Physics, the 1983 Protocol on Nuclear Physics and Magnetic Fusion, and the 1985 Protocol on Cooperation in the Field of Fossil Energy Research and Development.

Cooperation on basic research topics continued during the 1990s, but a new set of cooperation agreements were signed focusing more on energy policy discussions. These included policy discussions on fossil and nuclear energy, energy efficiency, and renewable energy. In 1995 U.S. Secretary of Energy Hazel O'Leary signed several bilateral agreements with China on high-level energy policy consultations, nuclear energy, renewable energy, energy efficiency, coal-bed methane, and climate research. That year the initial Protocol for Cooperation in the Fields of Energy Efficiency and Renewable Energy Technology Development and Utilization was signed; it was subsequently amended with new programs of cooperation (through annexes to the agreement) in the years following.

The agreements signed from 2000 to 2010 built upon the agreements of the previous two decades, which allowed for a further broadening of the energy topics being discussed bilaterally, as well as further linkages to other bilateral discussions taking place between the United States and China on economic and security issues. In 2006 the U.S.–China Strategic Economic Dialogue (SED) was founded by Vice Premier Wu Yi and U.S. Treasury Secretary Henry Paulson. The biannual, cabinet-level dialogue involved several agencies, including the U.S. Department of Energy and Environmental Protection Agency, and China National Development Reform Commission and Ministry of Science and Technology, and included a specific track for energy and environment discussion. In 2008 the fourth SED led to the establishment of the U.S.–China Ten-Year Framework for Cooperation on Energy and Environment. The Framework involves multiple U.S. and Chinese government agencies that work on environment and energy. It initially established five joint task forces on the five functional areas of the framework: (1) clean, efficient, and secure electricity production and transmission; (2) clean water; (3) clean air; (4) clean and efficient transportation; and (5) conservation of forest and wetland ecosystems. These five areas were further elaborated in seven specific action plans for implementation and were later expanded on in the July 2009 Memorandum of Understanding to Enhance Cooperation on Climate Change, Energy, and Environment, and meetings and negotiations under this agreement continue today.

Over the past 5 years, clean energy has emerged as a leading topic of cooperation between China and the United States. In November 2009, the United States and China signed 7 new agreements on clean energy cooperation, covering energy efficiency, renewable energy, electric vehicles, advanced coal technologies, and shale gas. These agreements also launched the U.S. China Energy Cooperation Program (ECP), which helps U.S. companies engage in China's clean energy sector, and the U.S.-China Clean Energy Research Center (CERC), which facilitates joint research and development on clean energy technology by teams of scientists and engineers from both countries. While these agreements were by no means the first agreements with China to focus on clean energy, the launch of a comprehensive package of clean energy agreements at the Presidential level signified a new model, as well as an elevated status bilaterally, for U.S.-China Clean Energy Cooperation.

Five years later, this cooperation has not waned, but rather is being strengthened. In 2013, the Obama Administration worked with the incoming Xi Administration to sign several new agreements building on the package of bilateral cooperation signed back in 2009. Key

among these agreements were the establishment of a high level Climate Change Working Group, which included five new initiatives: (1) Emission Reductions from Heavy Duty and Other Vehicles, (2) Smart Grids, (3) Carbon Capture Utilization and Storage, (4) Collecting and Managing Greenhouse Gas Emissions Data, and (5) Energy Efficiency in Buildings and Industry.

The signing of such agreements is often an accomplishment in itself. For example, many issues on which the United States now has official bilateral agreements with China long eluded U.S. policymakers, including agreements that addressed somewhat sensitive topics like measuring greenhouse gas emissions data, or that targeted challenging technical and political topics like carbon capture and sequestration. However, now that many of these agreements have been underway for several years, we can begin to assess what is working well, and what could be improved.

Much is working well. For example, the U.S.-China Renewable Energy Partnership has hosted multiple industry forums in China and the United States to facilitate new collaborations. The U.S. Department of Energy reports that a recent achievement of the partnership is the signing of a MOU between the U.S. company BrightSource Energy and several Chinese entities to deploy BrightSource's concentrating solar thermal power (CSP) technology in Qinghai province. This project, valued at $350 million, is structured such that key components would be manufactured in the United States, including some which may contain sensitive intellectual property, and the technology would be demonstrated in China, serving as China's first commercial-scale deployment of CSP technology.

Another agreement, The U.S.-China Energy Efficiency Action Plan has helped facilitate multiple research and commercial collaborations between U.S. and Chinese partners, as well as policy development in China. For example, with assistance from the U.S. Department of Energy, China enacted its first-ever energy code for rural residential buildings in May 2013. DOE estimates this could save up to 50 percent of the energy used in residences that house 700 million people, in a footprint equal to the entire U.S. residential building sector.

One bilateral initiative in particular that has moved beyond negotiated text and into the realm of real cooperation is the U.S.-China Clean Energy Research Center (CERC). The goals of the CERC are to spur innovation of clean energy technologies, diversify energy supply sources, improve energy efficiency, accelerate the transition to a low-carbon economy, and help to avoid the worst consequences of climate change. The focus on innovation through joint R&D and particularly the emphasis on the creation of intellectual property makes the CERC is unique from previous U.S.-China clean energy cooperation agreements. Approximately 1100 researchers in the U.S. and China are supported by the work of the CERC, and each of the partner organizations are either contributing funds or directly performing research.

The CERC is governed by a steering committee that includes ministerial- or secretary-level oversight from the relevant government agencies. From the United States, the lead agency is the Department of Energy (DOE). In contrast, China has 3 different government ministries all playing a leadership role in the CERC, including the Ministry of Science and

Technology (MOST), the National Energy Administration (NEA), and the Ministry of Housing and Urban and Rural Development (MOHURD).

The CERC has three technology areas that were targeted for initial cooperation activities: advanced coal technologies, efficient building technologies and clean vehicle technologies. The CERC currently consists of 88 individual projects within these three tracks, and almost all of these projects are joint collaborations between U.S. and Chinese researchers. The types of projects that are included in the CERC are varied along the technology research, development, demonstration and deployment (RDD&D) continuum, ranging from basic science research to technology demonstration. In addition, several projects focus on policy analysis to support the technologies being developed.

In order to address intellectual property concerns related to the CERC's R&D activities head-on, each CERC consortia has agreed upon and signed a contract that details the IP rules for participation called a Technology Management Plan (TMP). The TMP was established after months of negotiations between U.S. and Chinese lawyers and the respective government agencies involved. All participants involved in the CERC's activities are subject to the provisions of the TMP, and any new participants that join the CERC consortia must agree to its terms.

The TMP was specifically designed to clarify the joint ownership of IP resulting from joint research activities, and invented jointly by signatories to the CERC protocol from both the U.S. and China. If project IP is invented by signatories from one territory only, then the TMP requires that participants agree to negotiate in good faith terms of a nonexclusive license to the participants from the other territory. There are also provisions in the TMP that encourage the sharing of data and information related to the project work with the public, except when there is a need to preserve confidentiality. If any disputes over IP arise in the context of CERC activities, there are provisions in the TMP for how they are to be resolved.

CERC participants with IP-related disputes are first supposed to try to work out a mutually agreeable resolution. If such a resolution cannot be reached, then an arbitral tribunal in accordance with the applicable rules of international law as set by the United Nations Commission on International Trade Law (UNCITRAL) is to be utilized. The inclusion of such a provision for dispute resolution is rare among collaborative research efforts, which typically leave any disputes to the individual laws of the relevant countries to resolve.

The CERC begins to shed some light on the question of how IP can be better managed to promote cross-national technology cooperation in the clean energy sector. While the CERC is still in its early stages, my own analysis of the CERC's IP framework highlights some of the unique characteristics of the model for collaborative clean energy research that it has established, as well as a range of expectations about what the CERC can and will achieve. Many CERC participants reported that they had initially joined the initiative because they believed the IP framework could be beneficial to their continued work in China, although they did not expect that the TMP would solve all of their IP challenges. Several private companies involved in the CERC mentioned tangible results from their participation,

including new business ventures, and new IP. By mid-2013, all of the CERC consortia had reported inventions and IP that originated from CERC R&D initiatives.

Almost all of the U.S. commercial participants across the three consortia mentioned that one of the biggest advantages of participating in the CERC was to gain leverage for technology demonstration projects. Many have invested their own money in the collaborations taking place under the CERC far in excess of government support because government involvement provided leverage for project approvals, and many CERC collaborations were perceived to have current or future commercial value.

While it is too early to comprehensively assess the efforts of the CERC, it is increasingly evident that the CERC provides a model for collaborative clean energy research, development and demonstration (RD&D) that is unique in the history of U.S.-China collaborations in this area. Spanning the public and private sectors and involving top researchers from universities and national laboratories in both countries, the CERC has also been credited with propelling numerous other clean energy collaborations, including some with commercial value. The scale of the CERC is extremely impressive, and it is clearly building important clean energy-focused research partnerships between China and the United States.

The CERC experience provides some useful insight about improvements that are still needed in order to effectively navigate IP concerns specific to U.S.–China collaborations. There is still clearly a need to better alleviate the concerns of the participants related to IP protections, as well as to better educate researchers about how to use legal tools like the TMP to better facilitate collaborative research endeavors. Rather than attempt to navigate complicated IP issues, researchers not trained in IP law are more likely to avoid IP negotiations, even at the expense of potentially valuable cross- border collaborations, unless they are confident that they have institutional support. As the first U.S.–China program targeting clean energy R&D, the CERC may ultimately play an important role in building trust among the consortia participants, which could lead to even more constructive collaborations in the future.

U.S.-China clean energy bilateral initiatives provide important channels for technical cooperation and information. Without sustained support, and continued attention to IP concerns, it will be even harder for China and the United States to make progress towards developing true cross-national collaborations which ultimately could produce considerable global benefits, particularly in the clean energy field. Just because we have a record number of bilateral agreements on the books, does not mean we can reduce our focus on the relationship. The significance of the U.S.-China clean energy relationship merits a sizable and sustained level of effort.