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CHINA ENVIRONMENT FORUM BRIEF

COOPERATIVE COMPETITORS:

Potential of U.S.-China Clean Energy Cooperation

By Peter V. Marsters and Jennifer L. Turner

U.S. and Chinese bilateral cooperation was reinvigorated in 2009 with nine clean energy agreements signed by Presidents Obama and Hu. Expanding clean energy cooperation between the world's two largest energy consumers will be essential in lowering the costs to transition the world into a low-carbon growth model. Making this shift will demand collaboration of the government, NGO, research and business sectors to promote clean energy policies and technologies—a cooperative process that currently faces some crucial market and policy obstacles. Promising areas for the two countries to promote low-carbon development and jobs include: scaled renewables, power grid modernization, carbon capture and sequestration, and shale gas exploration. Furthermore, as both countries face growing confrontations between energy development and water resources, a new and untapped issue for bilateral cooperation will be to create policies and governance mechanisms to encourage energy technologies that are both low carbon and water efficient.

Crouching Suspicions, Hidden Potential

To tame China's explosive hunger for energy and stem severe air pollution problems, over the past six years the Chinese leadership has pushed aggressive targets, policies, and investments focused on renewable energy and energy efficiency. These progressive energy policies and priorities to decarbonize the economy have attracted considerable international investment into China, giving rise to pilot projects and joint business ventures in nearly every type of energy technology—renewables, cleaner coal, biofuels, and shale gas. China also has become the world's largest laboratory for testing relatively untried, but promising clean energy technologies, such as commercial-scale carbon capture and sequestration projects and algae biofuels.

In the United States, China's "green revolution" has sparked a broad range of reactions, ranging from calls for proactive clean energy legislation and sustained investments into green technologies to complaints that China's excessive subsidies for clean energy manufacturing provide Chinese companies with an unfair competitive advantage. Along these lines, in October 2010, the United Steelworkers Union brought a complaint to the World Trade Organization against Chinese wind turbine makers that choose domestic wind tower components over imports. In a surprising reaction to this complaint, in June 2011, the Chinese government agreed to get rid of all domestic content requirements for its wind turbine manufacturers,[1] a policy that in effect opened up new potential to expand bilateral wind power cooperation.

U.S. policymakers have long been critical of China's protectionism, more recently targeting Chinese investments in the clean energy sphere with rhetoric over China stealing green jobs being notably high before the 2010 mid-term elections. While the American Recovery and Investment Act did promote short-term spending in the clean energy sphere, U.S. policymakers have not succeeded in passing energy and climate legislation or creating sustained clean energy policies to develop domestic markets.

U.S. and Chinese bilateral energy cooperation was bolstered in 2009, when Presidents Obama and Hu signed a total of nine new clean energy agreements. Expanding the clean energy cooperation between the world's two largest energy consumers will be essential in transitioning the world onto a more low-carbon growth path. This transition will demand collaboration of government, nongovernmental organizations (NGOs), and businesses to promote clean energy policies and technologies. Cooperative initiatives could increase the capacity and reduce the cost of new energy technologies, which over the long term will produce economic, energy, and environmental security benefits on both sides of the Pacific. In this brief, we focus on five specific areas of potential cooperation—scaled renewable development, 'soft' technology and management,

shale gas, and carbon capture and sequestration, as well as the intersection of water and energy issues.

Collaboration To Drive Job Growth

The economic benefits from U.S. energy cooperation with China potentially offer a win-win situation for certain clean energy sectors—both in terms of absolute GDP growth and direct job creation in the two countries. Global demand for clean technology is growing rapidly, offering significant investment opportunities in a potentially lucrative, multi-trillion dollar market. China's strong manufacturing sector, ability to complete projects at scale, and comprehensive policies mandating low-carbon development have created promising investment potential in this market. The country is expected to spend $3.1 trillion to meet its electricity demand in the next 20 years, which will require massive infrastructure developments and open up markets for U.S. companies to expand their operations and create jobs. For U.S.-based firms, participation in China's large, rapidly expanding market will allow for significant clean energy experimentation at scale, as well as lessons that can be brought back to strengthen U.S. markets.

> *"…some suggest the race for jobs is a zero-sum game, saying clean energy technology development in China would be detrimental to the U.S. market. Accelerated development of energy technologies…could create hundreds of thousands of new jobs in the United States and China."*
>
> – U.S. Secretary of Commerce Gary Locke
>
> Woodrow Wilson Center Meeting, October 6, 2010

Although the United States is lagging behind China in terms of clean energy policies and investments, Chinese clean energy industries have attempted to invest in the United States. However, such investment is not always welcome as was evidenced by harsh opposition to the use of stimulus funds to support a China-U.S. joint wind farm project in Texas in 2009. Criticism that Chinese investments only create jobs in China is shortsighted. Some research estimates that over 70 percent of clean energy jobs are established where the energy infrastructure is built, not where the equipment is manufactured.[3] The Obama-Hu 2009 clean energy agreements have opened up opportunities for fruitful areas of bilateral clean energy cooperation that could enable the United States to take advantage of a growing global market. Some U.S. state governments and universities—often in partnership with U.S. environmental NGOs—have notably been reaching out to Chinese counterparts on clean energy cooperation, with an eye on opening up joint investment and promoting job growth. (See Box 1 on page 3).

Five Areas of Potential Cooperation

Scaled Renewables

Over the past decade, China's aggressive targets and investments for wind and solar energy have created a massive and expanding global industry. As a result, U.S. solar and wind companies have flocked to China, particularly as newer policies and the 12th Five-Year Plan targets are encouraging the expansion of domestic renewable markets. (See Box 2 about the energy and water targets in the plan). China's rapid deployment of renewables has helped bring down the price of wind and solar, a long-standing obstacle to extensive adoption in the United States. Renewable energy expert Joanna Lewis from Georgetown University argues that "China is making these technologies more accessible and affordable, which is crucial for shifting the world to a low-carbon economy."[4]

China currently produces around 40 percent[5] of the world's solar photovoltaic (PV) panels, and its domestic wind power industry is booming. Because China is the first country to produce large gigawatt-sized wind and solar projects, they will likely face many transmission and integration challenges associated with such large penetration rates of renewables. Therefore, besides job creation, cooperation on large-scale renewable energy developments in China could yield significant benefits to the United States in terms of knowledge of both grid management and complications that come with such large wind and solar development.

Revolutionizing "Soft Technology" for Power Sector Reforms

High-level forums and on-the-ground projects on clean energy between the United States and China have focused heavily on low-carbon technologies. However, simply building wind turbines, PV arrays, carbon

BOX 1

Opportunities for Subnational Collaboration

By Joyce Wenfang Wang

The new buzzword in China is "low carbon." In August 2011, the central government announced a national low-carbon plan to cap China's energy use.[1] China is launching cap-and-trade pilots in at least six provinces over the next two years, with plans to begin a nationwide program in 2015. In 2010, the Chinese government selected five provinces and eight cities as low-carbon pilot sites.[2] Whether China will reach the nation's proposed 40 to 45 percent carbon intensity reduction goal[3] by 2020 will depend on how effective the implementation of these and other new low-carbon initiatives will be at the local level.

Low-carbon policies in key provinces and cities are essential for China's goal to curb energy demand, which is expected to grow by an average of 4.24 percent annually for the next five years.[4] Increasing subnational cooperation between the United States and China offers many mutual benefits as the two countries seek a balance between growth and sustainability.

Many international NGOs are working with Chinese cities and provinces in designing policies and projects to lower their carbon footprint. WWF-China has partnered with Baoding and Shanghai on low-carbon initiatives focusing on energy efficiency in the industrial, construction and transportation sectors. The Natural Resources Defense Council brokered a partnership between California and Jiangsu Province to implement demand-side management policies and projects to push energy efficiency throughout the industrial and building sectors. This subnational partnership was one of the models for the national Demand-Side Management regulations passed in China in the spring of 2011.

The renewed bilateral energy talks and forums have helped to spark a new wave of subnational cooperation on energy and environmental issues between American states and Chinese provinces. In May 2010, the U.S.-Strategic and Economic Dialogue pledged to promote more EcoPartnership Programs with businesses, governments, and NGOs at the subnational level. These new initiatives include: development of eco-friendly ports in Dalian and Washington State; joint demonstration of advanced clean air and water technology between Kansas and Jiangsu Province; as well as corporate-local government alliances with Duke Energy and ENN, which are carrying out residential building efficiency demonstration projects and conducting trials for innovative deployment of smart meters in both Langfang and Charlotte. The first NGO EcoPartnership was formed in the spring of 2011 between the U.S.-based Center for Climate Strategies and their Chinese partner the Global Environmental Institute. These NGO partners have begun creating a program promoting U.S.-China subnational action and cooperation on energy, climate, and economic issues.

The recently established Office of Special Representative for Global Intergovernmental Affairs at the U.S. State Department has been particularly active in promoting subnational partnerships with China. In June 2011, it launched the new "U.S.-China Governors Forum," which aims to create a platform to encourage peer-to-peer learning on key economic, environmental, and trade issues.

Despite years of policy gridlock around energy and climate legislation at the federal level, many American states have created policies and incentives to stimulate low-carbon energy development. There are many mutually beneficial investment and development opportunities for states and cities in the U.S. and their Chinese counterparts that can be achieved through cooperation and sharing of policy, regulatory, and technical expertise.

BOX 2

Energy and Water Goals of China's 12th Five-Year Plan (2011-2015)

By Joyce Wenfang Wang and Jake Reznick

Energy Conservation and Management

- Reduce energy intensity—the energy consumption per unit of GDP—by 16 percent by 2015.
- Cut carbon emissions per unit of GDP by 17 percent by 2015 (40 to 45 percent by 2020).
- Total investment in the power sector under the 12th Five-Year Plan is expected to reach 5.3 trillion Yuan ($803 billion); State Grid's investment on smart grid will exceed 17 billion Yuan ($2.66 billion) over the next five years.

Non-Fossil Fuel Development

- Increase the share of non-fossil fuels in the primary energy mix to 11.4 percent by 2015
- Double natural gas in the energy mix to 8 percent by 2015.
- Increase installed nuclear power capacity five times to 43 GW by 2015, doubling the number of nuclear power plants in operation to 25.
- Increase hydropower capacity by 50 percent (to 300 GW) by 2015. To help reach this goal, large hydropower stations will be built along major rivers such as the Jinsha, Yalong and Dadu, which together will produce an installed capacity of 120 GW.

Pollution Control

- Invest at least 3 trillion Yuan ($469 billion) into environmental protection over the next five years.
- Reduce sulphur dioxide and chemical oxygen demand by 8 percent; decrease nitrogen oxides and ammonium nitrate by 10 percent, the latter of which comes mainly from China's dominant coal sector. The plan also focuses on cutting heavy-metal pollution from industry.
- Decrease the number of coal enterprises from the current 11,000 to 4,000, with 8-10 coal companies expected to account for about two-thirds of total coal production by 2015.

Water Management

- Reduce water intensity – the water consumption per unit of value-added industrial output – by 30 percent.
- China's annual water use is expected to reach 620 billion cubic meters by 2015—up from 599 billion cubic meters in 2010.
- Reduce chemical oxygen demand, a measure of water pollution, by 8 percent and ammonium nitrate, a common fertilizer for agriculture, by 8 to 10 percent compared to 2010 levels.
- Double the investments in water management and infrastructure construction in the next 10 years.
- Introduce a new tax on land sales; 10 percent of the proceeds—an estimated 60-80 billion Yuan ($9.34 billion-$12.52 billion) per year—will be used to strengthen water management in rural areas.

Endnotes for Box 1

1. In late summer of 2011, the Chinese government settled on a total energy cap of 4.1 billion tons of coal equivalent by 2015, which is 25 percent higher than the amount of coal consumed in 2010 in China.
2. The five provinces are: Guangdong, Liaoning, Hubei, Shanxi, and Yunnan and eight cities include: Tianjin, Chongqing, Shenzhen, Xiamen, Hangzhou, Nanchang, Guiyang, and Baoding.
3. This target is based on 2005 emissions.
4. These regulations require that utilities spend a portion of their revenues in developing large-scale energy-saving programs in factories, businesses and homes across China.

capture facilities, and nuclear reactors is not enough. Without pricing and pollution control policies to curb electricity demand growth, the benefits of even a massive build-out of low-carbon technologies will be limited. In the absence of a regulatory system that fosters transparent and cost-reflective energy pricing, rising costs may doom new technologies before they can make it onto the grid. Moreover, opportunities for developing new forms of energy, such as expanding natural gas generation, may be missed.

Despite the obvious importance of dialogue between the United States and China on electricity issues, the understanding both countries have of each other's electricity sectors is surprisingly inadequate. Promising new initiatives on technical cooperation in clean energy are likely to have limited success until the similarities and differences in engineering, economic, and political challenges facing each country's electricity sectors are better appreciated. With improved understanding, there is a large untapped potential for joint research and problem solving.

Thus, one of the most promising areas of U.S.-China clean energy collaboration is power grid development, which could enable each country to deliver electricity more efficiently and enable users to conserve more energy. China is spending considerable resources to build new high-power transmission lines, while the United States is facing challenges to replace much of its antiquated power grid infrastructure. Federal Electricity Regulatory Commission Chairman Wellinghoff has argued that China's technical revolution in transmission, large-scale renewables, and smart grid could offer cost savings and other valuable lessons for the United States.[6]

Coal Gasification and Carbon Capture and Sequestration

Although clean energy targets and investments in China are substantial, greenhouse gas emissions will continue to rise so long as the country continues to rely on conventional coal-based generation to fuel economic growth. Chinese coal consumption more than doubled between 2000 and 2010 and is predicted to continue to grow at steady rates over the next two decades. As the United States is the second largest coal consumer after China, bilateral cooperation in the coal sector is paramount to reduce absolute carbon emissions. Decarbonizing coal-fired power plants will reduce harmful emissions, and may also create new jobs. If there eventually is a price on carbon, decarbonizing the power sector, specifically coal, potentially has significant economic and environmental benefits for both countries.

With their respective comparative advantages, China and the United States are in an excellent position to help facilitate the development and implementation of more efficient coal-fired power plants that are carbon capture and sequestration (CCS) ready. In arguing for more U.S.-China cooperation in this area, Jim Rogers, CEO of Duke Energy, has explained:

> *The toughest part of the energy business is the actual scaling.… With the Chinese power sector growing at 30 percent a year, they are currently tackling the issues that come with [such large-scale] development, maintenance, and operation. This knowledge is extremely valuable and can be taken back to the United States.*[7]

One innovative agreement that could accelerate bilateral cleaner coal cooperation was made in November 2009 by Presidents Barack Obama and Hu Jintao to establish the Clean Energy Research Center (CERC), which aims to facilitate joint research, development, and commercialization of clean energy technologies between the United States and China. The advanced coal technology consortium is one of the three areas of CERC programs (building energy efficiency and clean vehicles are the others).[8] West Virginia University and Huazhong University of Science and Technology are leading teams of experts from public and private institutions to investigate technology and practices for clean coal utilization and carbon capture, utilization, and storage.[9]

Besides CERC, bilateral cooperation on coal also is growing due to efforts by NGOs such as the Clean Air Task Force and the U.S.-China Energy Cooperation

Program, which are bringing U.S. and Chinese companies together for cleaner coal joint research and projects.[10] The following examples illustrate the potential of the business cooperation on cleaner coal:

- GreenGen, the world's first CCS-ready coal-fired power plant in Tianjin, is a project led by China Huaneng Group that also involves a consortium of Chinese and U.S. companies, including Peabody Energy and Duke Energy.[11]
- EmberClear—the exclusive North American licensee of an advanced coal gasification technology developed by China's Thermal Power Research Institute—is building an integrated gasification coal combustion/CCS-ready coal fired power plant in Good Springs, Pennsylvania. The project promises job growth in a region with high unemployment.[12]
- Collaboration between Duke Energy and ENN—China's largest private energy company and leader in alternative energy investment—has led to technology exchanges on CCS-relevant systems like coal gasification, as well as joint investment in solar technology.[13]
- American Electric Power and State Grid, China's largest electricity distributer, are pursuing a partnership to develop highly efficient high-voltage transmission lines and "smart grid" systems.[14]
- Caterpillar is working with China United Coalbed Methane Co., Ltd. on a U.S. Trade and Development Agency-funded project to promote the utilization of advanced coal mine methane technology for power generation.[15]
- The U.S. company Calera is preparing to sign a MOU with North United Power/Huaneng and Peabody Energy for a project in Inner Mongolia that will produce cement materials from CO_2.[16]

四 Shale Gas and Natural Gas Cooperation

Shale gas has the potential to become a major component of the future energy mix in the United States, China, and a number of European countries. While the total greenhouse gas lifecycle emissions of shale gas are debated, carbon emissions from combustion per unit of energy using shale gas are much lower than those of coal and oil. Because the United States and China are similarly rich in shale gas resources, this fuel source could significantly lower carbon emissions and increase energy security in both countries.[17]

However, there are concerns regarding the effect of shale gas development on water quality and quantity. For example, the amount of water required for drilling and fracturing a horizontal shale gas well—ranging from 2 million to over 4 million gallons per well—can have a significant effect on ecosystems and create community opposition, as has been the case in a number of shale plays in the United States. Additionally, the injection of multiple chemicals[18] during the hydraulic fracturing process, as well as leaks, spills, overflows, and other releases during the extraction process, can contaminate both surface and ground water sources.

The 2009 U.S.-China Shale Gas Initiative aimed at enhancing technology exchange and business-to-business partnerships has already catalyzed collaboration. For example, in early 2011, the China National Offshore Oil Corporation bought a one-third interest in Chesapeake Energy Corporation's natural gas plays in 800,000 leased acres in northwest Colorado and southeast Wyoming. As part of its participation in CERC, Lawrence Livermore National Laboratory signed an agreement with the Clean Energy Research Institute (formed by China's Huaneng Power) to conduct joint research and development of clean energy technologies, such as shale gas, CCS, and enhanced oil recovery.

Such bilateral technological research collaboration promises to help China avert some of the challenges the development of shale gas industry has faced in the United States. However, this collaboration should also be expanded to include subnational partnerships between American states and Chinese provinces that focus not only on joint investment opportunities, but also on joint exploration into technologies, regulations and policies to both protect water and limit additional greenhouse gas emissions.

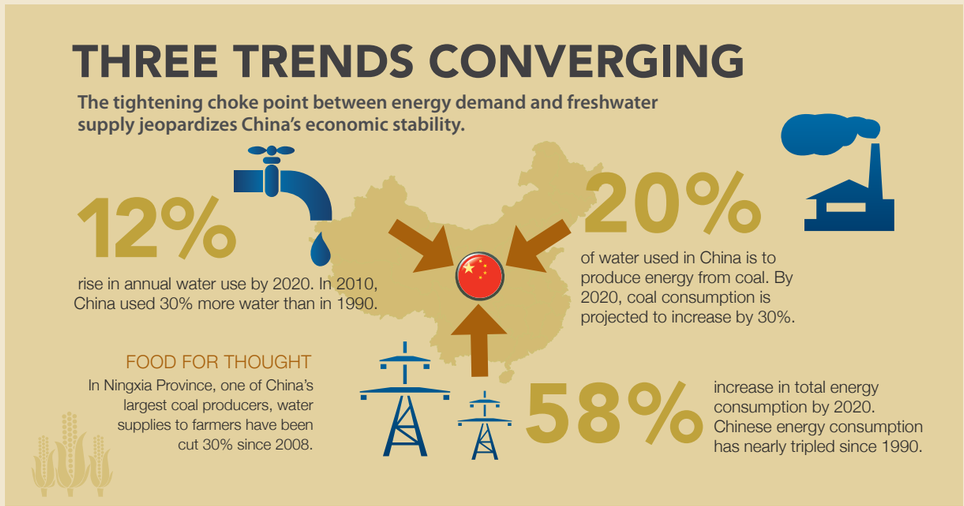
五 Water and Energy

In contrast to the success of aggressive and comprehensive low-carbon policies and investments to improve energy efficiency, efforts in China to promote water conservation have long been hindered by clashing bureaucracies, unclear water rights and notoriously low water fees. Although there has been progress in the Chinese government's recent efforts to protect vulnerable water resources through progressive water trading pilot schemes, rapid development of water-efficient renewable energy technologies, increases in water prices, and ambitious urban water treatment and recycling programs, much more needs to be done. Without comprehensive reform of water governance to effectively protect water resources, reductions in freshwater supplies and quality will jeopardize China's economic stability. This is especially true when it comes to demands on water from the energy sector.

Today, about 20 percent of China's water is used to produce energy from coal.[19] The nation's coal reserves are enormous, but most lie beneath the deserts in China's northern and western provinces, Inner Mongolia, Xinjiang, Shanxi, Shaanxi, and Ningxia, where annual rainfall is measured in mere millimeters. The crucial challenge for China is where the country will find enough water, perhaps 20 billion cubic meters a year over the next decade, to develop its expanding coal energy sector.

Data from Chinese research institutes and government agencies suggests there may not be enough water to both build the modern cities and manufacturing centers in the northern and western provinces and tap the regions' enormous coal reserves to fuel the growth. From 2000 to 2009, China's Ministry of Water Resources found that China's total water reserves have fallen 1.5 percent annually, resulting in a total 350 billion cubic meters of water lost during the decade. That is roughly as much water as the Yangtze River pushes past Shanghai in eight months. Chinese analysts in academia and the government expect that China will increase its annual water consumption by 71 billion cubic meters by 2020 from the current 599 billion. Over the next ten years, roughly two-thirds of this increase in demand will come from the coal sector.[20] (See graphic below for more information on the tightening choke point between energy demand and the freshwater supply in China).

Significant water-energy confrontations are also occurring in the United States. Water-demanding solar thermal development in the arid Southwest, the massive expansion of oil refineries in the dry Midwestern states to process Canadian oil sands, and water intensive shale gas hydraulic fracturing across the country are all putting major strains on U.S. fresh water resources.[21] As both countries develop new energy infrastructures, creating energy policies to encourage low-carbon and water efficient technologies[22] will be essential to avoid potential water and energy supply crises.



Tapping Potential of Clean Energy Cooperation

Low-carbon economies will dominate in a carbon constrained world. Economic growth, job creation, energy security, and pollution reduction can all advance and benefit from U.S.-China clean energy policy and technology cooperation. At a China Environment Forum meeting in December 2010, Joanna Lewis suggested that U.S. and Chinese cooperation in clean energy "could build in strategic trust that would carry over into these other areas where we need to cooperate."[23] Given the size of the U.S. and Chinese energy markets, any substantial progress made by the two countries in deploying renewables, CCS, smart grids, and lowering the water footprint of energy development will advance technological understanding and reduce the cost of clean energy. Cooperation on clean energy will directly support low-carbon development in both the United States and China and make such technologies more affordable for the world.

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8 See CERC homepage for details on the three consortia: http://www.us-china-cerc.org/index.html.

9 Some of the key partners in the Clean Coal Program include: universities of Wyoming, Kentucky, Zhejiang, and Tsinghua; Lawrence Livermore National Laboratory, Los Alamos National Laboratory; U.S. companies such as: AEP, Alstom, Babcock and Wilcox, Duke, GE, LP Amina and Chinese companies such as: ENN, CNOOC, Huaneng Group and Shenhua Group.

10 See Clean Air Task Force, a Boston-based NGO, has been brokering U.S.-China cleaner coal partnerships for the past three years: www.catf.us/coal/where/asia/. The U.S.-China Energy Cooperation Program, is an NGO that leverages business resources in both the U.S. and China to: (1) promote commercially viable project development in clean energy and energy efficiency and (2) support the sustainable development of the energy sectors in both countries.

11 Duke Energy is notably involved in building a CCS-ready power plant in Indiana, so this company is gaining significant experience in both countries on deploying this technology at a commercial scale.

12 "Decarbonizing King Coal: Growing U.S.-China Clean Technology Cooperation." CEF Meeting, Washington, DC. May 12, 2010. Future Fuels, the original North American licensee of the Thermal Power Research Institute (TPRI) technology, was acquired by EmberClear in 2010. Meanwhile, TPRI has been replaced by the Huaneng Clean Energy Technology Research Institute as the licensor of the technology.

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20 Keith Schneider. (2011). "Choke Point: China—Confronting Water Scarcity and Energy Demand in the World's Largest Country." Choke Point: China.

21 See Circle of Blue's Choke Point: US research and reporting on the water-energy confrontation in the United States: http://www.circleofblue.org/waternews/featured-water-stories/choke-point-us/.

22 Only solar photovoltaic and wind avoid significant water penalties for energy production. Solar thermal, shale gas, coal liquefaction and carbon capture and storage facilities and new coal and thermal power development in both countries, depending on region, will confront significant water supply issues.

23 "Here Comes the Sun (and the Wind, Water, and Biogas)"