U.S.-China
Energy Security Cooperation Dialogue

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REPORT

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Introduction and Summary

The Atlantic Council of the United States and the China Institutes of Contemporary International Relations organized the first "U.S.-China Energy Security Cooperation Dialogue," held in Beijing on 31 October-1 November 2006. Conference participants included foreign policy analysts and energy experts from the U.S. and Chinese governments, international organizations, non-governmental organizations, and universities in both the United States and China. The agenda covered a broad spectrum of energy and energy-related geopolitical issues, including long-range forecasts for energy supply and demand, energy sources ranging from oil and gas to coal, nuclear and renewables.

The Chinese and American participants held similar understandings on the overall energy situation in the world. The energy market can be analyzed from both the production and the use side. The participants discussed issues surrounding the production of oil, gas, coal, nuclear and renewable energy. They held generally similar views, consonant with the analyses of the International Energy Agency, as to the likely growth of energy requirements over the next 25 years, and they discussed both transportation and electrical requirements as key usage issues.

There was agreement that the current course of growing energy demand and consumption, especially of fossil fuels, raises important issues of resource availability, price volatility, and environmental consequences. There was recognition that nations, including the United States and China, are increasingly interdependent economically and thus have a growing stake in the energy security of other nations as well as in their own access to energy. Meeting the growth of energy demand, moderating prices and protecting the international flow of energy are thus global and not just national problems. There was general recognition of the importance of working on key issues, including a substantial increase in energy efficiency and energy conservation, a long-term reduction in carbon dioxide emissions, development of alternative energy sources, and efforts to ensure global energy security. Participants agreed that there should not be a zero-sum global competition for energy among nations. Rather, sufficient and secure energy supplies at reasonable prices are necessary for the prosperity and security of all countries and this security and prosperity cannot be insured for individual nations in isolation from the rest of the world economy.

Participants identified important similarities and differences in the energy situation of China and the United States. Both countries are petroleum producers and also importers. Both countries are currently looking to balance their reliance on international oil markets by increasing domestically-produced fuel sources. Both countries have huge, multi-century reserves of coal and will likely rely on coal as a major – and in the case of China, the primary – source of energy for the foreseeable future. But the Chinese participants pointed out that China cannot replicate the energy patterns of the United States in its own economic development, and that China currently faces issues of energy efficiency and pollution from

energy sources in a much more intense fashion than does the United States. China and the United States do, however, face a similar problem of developing and using technology if they are to reduce CO_2 emissions significantly in the future. Similarly, both countries will benefit from maintaining national strategic petroleum reserves (SPRs) to protect against supply disruptions and oil price spikes, although only the United States participates in the IEA system at this time.

Participants from each side discussed the value of efficiencies and conservation. The meeting thus examined the prospects for bringing on line technologies to reduce energy intensity and promote conservation, improved fuel efficiency for automobiles, greater use of renewable energy sources from wind power to biofuels, expansion of the use of nuclear energy, and the development and use of clean coal technology.

Although the U.S. and Chinese delegations share a broad perspective on energy and understand that they must work together to ensure energy security for both nations, the two sides recognized that their countries did not have similar decision-making processes and economic structures regarding energy and environment issues – differences which must be considered in seeking to understand the perspective of the other side and to forge policy prescriptions for unilateral and cooperative actions by the United States and China to meet the energy security challenge.

Chinese delegates presented an overview of how energy policy in China is developed within the State Energy Office and the Energy Leading Group through a process of research, analysis and consultation among various government ministries and energy researchers both in the government and in partially state-owned firms. The product of these studies and discussions is injected into the policy process through the development of China's Five Year Plans, the most recent being the 11th, which covers the years 2006-2011. Energy and its relationship to China's economic and development objectives are brought together through this process to set a broad set of goals and priorities for China's central, provincial and local officials. For the United States, participants discussed the role of the executive branch in developing a national energy strategy, and the role of Congress in the process, describing the passage of energy-related laws, regulations, and taxes, and their implementation, as well as the role of the states. This process in the United States creates what one U.S. participant described as a montage of various laws regulations and policies rather than a single, unified strategy.

The participants recognized that the two countries have different approaches to markets and market actors in the energy arena. The major energy companies in China are state-owned or controlled while in the United States they are private and the U.S. government exercises influence over the energy sector primarily through regulations, tax policies and other indirect incentives and disincentives, set by both the Congress and the Executive branch. There are also multiple layers of local, state and national government as well as many governmental agencies, the courts as well as private business and NGOs involved in the policy making

process. Despite the result of the involvement of these numerous and varied actors, implementation of regulations, tax laws and other measures is relatively reliable and consistent in the United States. In China, on the other hand, while the policy making process is more centralized and the government has more direct control over the energy sector, in practice, the central government has far more difficulty ensuring that its policies are implemented than is the case in the United States.

The United States and China disagree on how to evaluate undertaking energy investments in at least some third countries. One important disagreement is seen in U.S.-Chinese disputes over the Sudan where Chinese companies have a large investment. The Chinese government so far has been reluctant to respond to U.S. government urging to be more aggressive in using the leverage created by those investments to influence the behavior of the Sudanese government, especially in the Darfur region of the country where the U.N. has determined that government has been involved in large-scale genocide.

The participants concluded by recognizing that the discussion has given them a good basis for further cooperation and that a second conference should be held at which specific strategies could be discussed.

Geopolitical Challenges

The energy market, as noted above, divides among oil, natural gas, coal, nuclear and renewables. In the international arena, oil and natural gas are the key market. While, accordingly, there are important geopolitical issues, it is important to note that seventy percent of China's primary energy consumption is provided by domestic coal sources for which there are no issues of competition, supply stability, terrorism, or disruption of sea lanes. The same is true for nuclear and renewables. For these types of energy ,the issues are similar for China and the United States, including how to upgrade power generation plants with clean coal, and particularly carbon sequestration, technologies; how can coal be used in an environmentally friendly way for transportation fuel; how to ensure the safety and cost-effectiveness of nuclear power as well as to resolve the issues of waste disposal; and how to enhance the development of renewables and improvements in energy efficiency and conservation. These need not be issues of geopolitical competition but rather of economics, technologies and potential cooperation.

In the international arena, there was some common analysis. The participants agreed on the generally dominant position of the United States, arising from a combination of its impact on the markets, the role of its companies, and its protection of international energy assets and transportation. The increasingly important role of national energy companies (particularly for oil and gas) was noted. Some Chinese participants noted that since the current supply and demand relationship for energy benefits energy producers, specific actors such as Russia, Iran and Venezuela have begun to exert a greater influence on global political

and security relations. Russia and Venezuela were cited as examples of major energy producers that have re-nationalized their oil assets and have used these energy assets in pursuit of foreign policy objectives. While the Chinese saw this trend as having a negative impact on their own energy security, it was also seen as an increasing challenge to U.S. dominance in global energy and political affairs and a new and growing challenge for ensuring global as well as national energy security.

Participants noted that China and the United States have increasingly coincidental and overlapping energy security interests in supply and price stability, reliability and sustainability. U.S. protection of sea lanes of communication (SLOCs) has benefited all countries who export or import oil, including China. However, the more immediate threat in the oil market is not a cutoff of the SLOCs, but rather short-term disruption or a sharp increase in price. Oil markets are now global so a price spike anywhere is a price spike everywhere.

One insurance for China, the United States and other countries against price spikes is the use of strategic petroleum reserves (SPRs). China benefited when OECD countries released oil from SPRs in response to the disruption resulting from the devastation of Hurricane Katrina, leading to a decrease in oil price. U.S. participants encouraged greater discussion and transparency in China regarding the expansion of its strategic petroleum reserves and the role these reserves can play in short-term stabilization efforts, especially if leveraged through international coordination. Although SPRs were identified as a key tool and an important area for bilateral cooperation, some Chinese participants questioned whether geopolitical or domestic political calculations drove the United States in the fall of 2006, to propose filling its SPR at a time of high prices. This was seen by some in China as putting additional pressure on international supplies and prices.

Enhancing cooperation requires reducing mutual suspicions and will help reduce mistrust. But at this point there continues to be mistrust in China as well as the United States about the strategic intentions of the other side. One Chinese participant noted that since China does not control the SLOCs for its imported oil, 80 percent of which is transported through the Straits of Malacca, many Chinese think that the United States will try to prevent China from getting resources. He said he disagreed with this view, but that China also did not want to want to rely on U.S. protection of the sea lanes, including from terrorism. He also pointed out that the dispute over the purchase of Unocal by CNOOC affected the perceptions in China of the United States and reflected the mistrust between the two countries.

Global Oil Markets

There is mistrust between China and the United States in the global oil market. One participant attributed this largely to divergent energy investment strategies. A key part of China's strategy is its focus on national oil companies (NOCs), equity oil supplies, bilateral deals, and physical control as key aspects of energy security. The Chinese NOCs have

significant government diplomatic, trade and economic support, including low cost of government investment financing. Chinese strategy reflects a sense of China's vulnerability, a lack of confidence in global energy markets to deliver reliable supplies at reasonable prices, U.S. strategic power, and the competitive weakness of Chinese NOCs playing catch-up with the international oil companies (IOCs).

The United States is also concerned about its access to resources. The U.S. strategy, however, is to leave energy access primarily to markets. Private oil companies invest in equity supplies to be commercially competitive and profitable, and the strength and competitiveness of companies are key to U.S. energy security. There is no direct government support or coordination, although there is indirect U.S. energy diplomacy. The key goal of the U.S. government is to contribute to increasing global oil supplies rather than to bring oil back to the United States, including through diversifying transport routes. Oil moves to the U.S. market on the basis of flexible, long-term contracts negotiated on competitive terms with prices regularly adjusted to global market prices, just like the majority of global oil trade.

Divergent Chinese and U.S. strategies are adding to mistrust over energy and complicate efforts to advance Sino-American energy security cooperation. Some in the United States see China's focus on physical equity control as mercantilist, taking oil off the market. A different view is that such oil just becomes part of the supply fulfilling overall worldwide demand. Chinese participants generally saw U.S. concerns about mercantilism as hypocrisy and an attempt to deny access to energy supplies to weaken China. According to Chinese participants, China's NOCs are doing much the same things as U.S. IOCs are doing – everyone is looking for low-cost resources. In their view, this is not a direct strategic challenge to U.S. interests.

Representatives from Chinese NOCs with investments in Sudan and other areas noted that a very small percentage of the oil they produce overseas is transported back to China. In the case of Sinopec, it has been less than 1 percent over the years. They pointed out that it would be very costly to transport the oil back to China so it is traded on the international market. One Chinese expert commented that heavy overseas investment of Chinese oil companies has led to an increase in the total amount of oil on the international market. Investment that produces more oil is a contribution to the market, so Chinese investment in prospecting and exploration helps secure long-term supplies for the United States as well. Like other oil companies, Chinese companies are seeking a profit, so prospecting and investment is important for their bottom line. Chinese companies, he noted, have lower labor costs, so they can make money in places IOCs would not find investment profitable. He saw 'going global' by Chinese companies as a good supplement for the international oil market. He also noted, however, that the international investment market is worsening, for example, in Latin America where the oil industry is being nationalized and thus provides few and fewer opportunities for NOCs and IOCs.

U.S. participants noted that Chinese policymakers need to understand that equity oil does not provide energy security. Energy security requires stable global oil markets, diversified and secure transport lines. Supply disruptions are global and do not respect equity ownership. Strong, competitive, diversified, and globally integrated NOCs should support global as well as national energy security. The United States and China have a common stake in the stability of the global oil market – this is not a zero-sum competition.

Key Technological Responses

Given the magnitude of the challenges posed by growing energy requirements, China, the United States, and the rest of the world share an urgent need to focus resources on developing new technological solutions to energy problems -- solutions that must be both economically and environmentally sustainable. Environmental sustainability requires us to concentrate on climate change issues related to greenhouse gases, as well as the ongoing requirement to reduce pollutants adversely affecting the world's air, water and agricultural resources. It also requires an immediate focus on technologies that improve energy efficiency and support conservation.

While there is much debate over the long-term availability of resources and the pace of technological innovation, the magnitude of the growing gap between the developing world's need for energy and emerging limitations on conventional oil suggests there exists an urgent need to accelerate the pace of research and development and commercialization of a variety of energy sources. Long-term energy security will only be available to China and the United States if both countries work together (often with others) to assure our nations of the availability, accessibility and affordability of reliable environmentally sustainable energy.

During the discussion, technological responses to the above challenges were focused in four key areas:

- Coal
- Transportation Fuels
- Nuclear Power
- Renewable Energy Sources.

Coal

Both China and the United States are and will remain heavily dependent upon coal for many decades. In China, coal accounts for over 50 percent of total final energy demand and provides over 75 percent of electricity.[1] Coal-fired power plants will remain the major source of electricity even with the addition of numerous, huge hydropower plants and the rapid

1 World Energy Outlook 2004, International Energy Agency, page 483, OECD, Paris, France.

increase in nuclear plants. In the United States, coal is primarily used to produce over fifty percent of the electricity. The two countries emphasize different approaches to address environmental issues and energy demand associated with reliance on coal. To a great extent, these differences in approach reflect the two countries' different levels of economic and technological development.

In the United States, the electric power industry already achieved a substantial reduction in the traditional pollutants of SO_2, NO_x, and particulate matter. However, mercury emission regulations have only recently been legislated, and there are currently no restrictions on CO_2 emissions. Today, power plants rely on pulverized coal and improve efficiencies by incorporating supercritical and ultra-supercritical designs, as well as new turbine designs.

In order to address the challenges presented by the need for even tighter emission controls; major reductions in CO_2 releases; greater power plant efficiencies; and new clean fuel sources, the U.S. government has established a $2 billion Clean Coal Power initiative.[2] This initiative incorporates a large number of projects designed to develop several new clean coal technologies, most notably, an integrated gasification-combined cycle (IGCC) plant and the FutureGen project that incorporates a number of technologies to obtain a zero-emission plant that produces hydrogen as well as electricity. At this stage, the IGCC design is closest to commercialization. The initiative also focuses on proving Carbon Capture and Storage Technology viable, an essential process in U.S. and international efforts to reduce CO_2 emissions.[3]

Until recently, U.S. energy producers preferred to invest in natural gas-fired power plants over coal and nuclear. However, the last few years have seen price increases for natural gas, as well as for oil, and most utilities now look to coal and nuclear for increased capacity despite higher capital costs. Electric utilities also focus on ways to reduce the need for capacity additions by improving demand efficiencies and encouraging conservation.

China does not consider coal technology the principal driver to increasing energy security despite China's abundant coal resources. China's population of 1.3 billion is so large that energy efficiency measures and conservation are now considered the most critical to ensuring the sustainability of China's economic growth. From this perspective, improving the efficiency of electricity production and consumption is critical, and the government has set a goal of reducing the country's overall energy/GDP ratio by 20 percent by the year 2010. According to U.S. and Chinese participants, meetings this target is proving to be very difficult, and the government already acknowledges that the initial targets were not met. The Chinese hope that as 2010 draws nearer, the effects of adopting higher efficiency technologies and measures will become more visible.

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2 www.USA.Gov/U.S. Department of Energy/DOE Office of Fossil Energy/Clean Coal &Natural Gas Power Systems

3 These demonstration projects which test and showcase the technical and commercial viability of new technologies will be a critical step in U.S. efforts to improve its energy security while meeting environmental objectives through the development of new clean coal technology, including carbon capture and sequestration.

China is well aware of most technologies that would be required to improve the efficiency of the coal industry and coal-fired power plants. It also recognizes the technologies needed to increase consumption efficiencies. The major challenge lies in making the structural changes required to stimulate the replacement of obsolete plants, provide industries access to the financing required to modernize, and encourage the population to adopt more sustainable consumption patterns.

Capital cost concerns have caused new coal technology to penetrate slowly. However, with the rapid expansion of coal powered electricity capacity, many utilities are planning on increasing plant efficiencies by installing ultra-supercritical steam-cycle units (USSC). While substantial progress has been made in the reduction of SO_2, NO_x and particulates from the newer larger plants, controls are much weaker on most of the smaller (less than 100 MW) plants. China recognizes that climate change issues will ultimately have to be addressed, but like the United States, China has not imposed CO_2 restrictions.[4]

Transportation Fuels

Today, both China and the United States are dependent upon traditional petroleum products to meet over 90 percent of their rising demand for transportation fuels. In both countries, energy security concerns related to geopolitics and global supply security issues have largely been focused on the petroleum industry. There is general concurrence that global joint endeavors will be required to reduce the insecurity associated with the world's petroleum markets. Within each country there are multiple efforts to examine the vulnerability to petroleum markets and to assess the economics and longer-term viability of changing the mix of transportation fuels.

In China, government policymakers understand that transportation fuel consumption cannot follow the U.S. experience without causing severe pressures on world petroleum markets. Utilizing life-cycle methodology and ISO standards to analyze 130 routes to produce transportation fuels, some have concluded that the long-term solution lies in relying on electricity from nuclear, hydro, and renewables and transportation fuels primarily from hydrogen.

China's abundant coal resources would provide the same option if the U.S. FutureGen project were proven commercially viable. In the meantime, China has revealed an ambitious national coal-to-liquids strategy with planned sites and products. The Shenghua coal-to-liquids plant will be on line in 2008. In order to reduce the adverse environmental impact of emissions from such a plant, it must be equipped with carbon capture and storage technology, thereby raising costs. There is a strong desire to develop indigenous lower-cost technologies in order to avoid an excessively rapid escalation in fuel prices.

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4 Activities to develop carbon capture and storage technology are being closely monitored. In addition, the government follows the U.S. clean coal initiative and is participating in the U.S. FutureGen project, which would provide a step change in the ability to control emissions and would also produce hydrogen.

China does not view bio-fuels as an energy-efficient solution. The production of bio-fuels is seen as more polluting than the direct consumption of petroleum products. Moreover, with a shortage of arable land and water, it is not feasible for China to use food crops to meet energy needs. However, there is an interest in developing ethanol from cellulose materials. Corn-based ethanol provides only a slight gain in energy supplies and competes with resources for human food and animal feedstock grains. But cellulosic ethanol could provide a seven-to-eightfold gain in energy supplies; will be either carbon-neutral or provide a carbon sink; and can be produced on land unsuitable for agricultural food stocks. There is also a focus on bio-fuels for diesel from crops and from algae. In addition, advanced clean diesel vehicles are being developed with improved efficiencies.

In the next few decades, China will increase its efforts to shift the modal mix by building mass transit systems to reduce the population's perceived need for road transportation.[5] Also, China will continue to tighten fuel economy standards that are already above those in the United States. In addition, there is interest in fuel cells and in hybrid technologies, although few have been deployed to date.

In the United States, the debate on the magnitude and type of transportation fuels to be employed increased dramatically in the last few years. Until the recent escalation in oil prices, transportation fuels were a relative bargain in the United States, providing little incentive to increase efficiencies or to develop new sources of fuel. However, with a growing concern over the economy's exposure to oil import costs and the increasing regional insecurity of supply sources, there is a growing desire to reduce the country's increasing dependence on overseas oil. Additionally, the world's tightening oil supply-demand balance and the rapidly diminishing expandability of conventional oil production exacerbate these concerns. The recent increase in oil prices has led to a dramatic acceleration of research and development projects to access unconventional supplies and expand fuel source options for motorists.[6] In the near term, there is a need to produce solutions compatible with existing infrastructure. These include a shift to electric hybrids, electric "plug–in" hybrid vehicles, and heavier use of bio-fuels.

Concomitant pressures are building to increase CAFE standards more significantly than the most recent administration proposal. Experts recognize this requires changes in regulatory management while also creating a need for financial incentives for car manufacturers.

Taken together, the above activities could significantly reduce U.S. oil demand over the next decade and, in the longer-term, could shrink that demand dramatically. The reductions in U.S. transportation fuels demand would provide China and other developing countries more

5 Already the ratio of cars to population in Japan and Europe is considerably lower than in the United States.

6 Projects to improve the economics and environmental viability of oil shale are being pursued, although commercial production may not occur until after 2020. Coal liquefaction is also being pursued, but may need to be coupled with carbon capture and sequestration. Other longer-term activities designed to meet at least a portion of transportation requirements, are the previously discussed FutureGen project to produce hydrogen for fuel cells or direct combustion.

time to make adjustments in their transportation infrastructure, vehicle fleets and fuel requirements.

Nuclear Power

Over time, nuclear power has the potential to become a major source of electricity in both China and the United States. This will not occur, however, without overcoming a number of serious obstacles, including waste disposal, safety, and nonproliferation.

Public perception of nuclear plant safety has delayed progress in the United States and elsewhere for the last few decades. Participants discussed how there have been safety advances since the Chernobyl (1986) and Three Mile Island (1979) incidents. and that the public's exposure to radiation from the world's 440 existing plants in 32 countries remains negligible thanks to design changes and decommissioning some obsolete plants.[7] More recently, Generation III plant designs incorporate passive safety features that prevent facilities overheating and provide for automatic shut-down without active human intervention.[8] While these plants prove highly competitive and dramatically improve safety and operational concerns, the level and characteristics of waste continue to raise disposal and potential proliferation issues.

The Generation IV International Forum (GIF) now addresses the challenges waste disposal and nuclear weapons proliferation present. The United States, Argentina, Brazil, Canada, France, Japan, South Korea, South Africa, the United Kingdom and the European Union chartered the Forum in 2001. China and Russia joined in 2006. The GIF selected six advanced reactor technologies to greatly enhance the sustainability, economics, safety, reliability and proliferation-resistance of nuclear power.[9] The forum will deploy projects between 2010 and 2030.[10] High-temperature gas-cooled reactors are also being developed to provide a step change in safety, economics and proliferation resistance.

In the United States, the 2005 energy bill gave nuclear power developers financial incentives, industry standardized designs and regulators simplified the licensing process. The United States also supports the IAEA in the GIF initiative. As necessary as these measures are, they are still small compared to the magnitude of developments needed if the U.S. is to expand advanced nuclear power's potential to provide electricity. The United States also still needs to implement a long-term nuclear waste disposal strategy.

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7 The IAEA is still working on improving conditions in some of the Generation II water-cooled reactors in Eastern Europe and Russia. "Safety of Nuclear Power Reactors," Nuclear Issues Briefing Paper 14, January 2007, Australian Uranium Association, Melbourne, Australia

8 Generation III designs were first introduced in 1996 and have been steadily improved. Today, plants using advanced standardized Generation III designs strive to lower capital costs, improve longevity and operational reliability, increase fuel efficiency, and lower the output of waste.

9 Generation IV Nuclear Reactors, UIC Briefing Paper #77, July 2006, Uranium Information Centre Ltd, Melbourne, Australia

10 These reactors have the advantage of greater load flexibility, inherent safety with automatic shut down and relatively low construction and operating costs. Major projects include South Africa's Pebble Bed Modular Reactor, supported by Eskom and Westinghouse, Chinergy's Pebble Bed Reactor (HTR-10) developed at Tsinghua University, and a Gas Turbine-Modular Helium Reactor designed by General Atomics in partnership with Russia's Minatom.

Despite plans in China to have 40 GW of nuclear capacity installed by 2020, nuclear power will still represent only a small portion of total capacity. China believes that newer technologies are needed to reduce the amount and toxicity of waste streams and to minimize the disposal and proliferation potential. As in the United States, China has yet to establish a firm nuclear waste disposal strategy. There is also a limited pool of personnel technically capable of operating nuclear plants. If there is to be a massive increase in nuclear power, new safety standards need to be established based on what is possible with advanced Generation III designs. The absence of technology vendors like GE and Westinghouse limits China's pace of development, as does the limited number of utilities with nuclear experience. Given the inability to expand nuclear power faster over the near term, electrical utilities in both China and the United States have turned to other fuel sources, especially coal, as economically viable alternatives.

Renewable Energy Sources

The potential role of renewable energy sources has received much attention despite its relatively minor role in meeting today's energy demand. The IEA estimates that non-commercial consumption of biomass for heating and cooking in developing countries represented half of the world's demand for renewables in 2002 (seven percent of total world energy consumption). Commercial use of biomass accounted for another four percent of total energy demand. Mini-hydropower plants (10-30 MW) represented another two percent, and one percent was provided by solar, geothermal, wind, tide and wave energy.[11]

The low level of demand for renewables to date reflects their relatively high costs, which limits their application to niche markets. However, recent increases in costs for petroleum and natural gas encouraged further developments that reduce costs for a number of renewable applications and are spurring additional research and development activities.

In China, biomass gasification technologies have also been successful in providing cooking and heating fuel in rural areas. Similarly, solar power for cooking, water heating, and passive heating proved beneficial in rural locations.[12] These technologies are well understood and require little additional development.

The major technological developments for renewables currently focus on electricity generation. Here again, some of the technologies, such as mini-hydro and geothermal, are well understood although materials and equipment design refinements remain ongoing. Similarly, the co-firing of biomass in coal power plants is cost effective when biomass is readily available and is less than 10 percent of fuel input.

Solar photovoltaic technologies include both off-grid and on-grid applications. Economic efficiency is steadily improving, but solar power is still only attractive for niche applications

11 Ibid. World Energy Outlook 2004, page 226

12 The potential for bio-fuels, in particular for cellulosic ethanol, has been addressed in the transportation section.

and remote off-grid sites. Future cost decreases will result from research and development of materials, process and conversion design, and economies of scale. Eventually, solar technologies may prove competitive with conventional peak load power plants.

On the other hand, concentrating solar power (CSP) technology is beginning to show promise. With changes to regulatory frameworks, several plants are being developed in the United States and Spain, and projects are being tendered in Algeria and Egypt. These plants have a unique capacity for being integrated into conventional thermal plants.[13] China has identified large areas in the Northwest and Qinghai-Tibet plateau where such facilities might be attractive with some financial incentives.[14]

The economics of wind power have steadily improved with an increase in turbine size and economies of scale. The largest favorably located facilities can produce electricity for between $0.03 and $0.04 per kWh. However, the variable nature of wind power and the need for some form of storage make it most appropriately used in conjunction with other more conventional power sources. Onshore facilities are currently more cost effective than offshore facilities, although the economics of the latter have improved especially in shallow waters. While electricity production costs are competitive today in many locations, penetration of winder power into the market can only occur with further reductions in costs associated with grid integration and storage are needed to expand its market penetration. In addition, the public's adverse reaction to the siting of wind farms has become an issue in some locations.

In China, experts estimate the potential for wind power at 253 GW for onshore and 750 GW for offshore based on mapping wind velocities throughout the country.[15] Onshore wind power is being commercialized in China today, though it is a small proportion of the world's total installed capacity of 47 GW in 2004. Currently, wind-generated electricity costs are over double that of conventional coal-fired plants in China.[16]

China shows interest in developing ocean energy resources and has plans to construct several 300MW plants by 2010 based on tidal power. In the United States, efforts have been mainly associated with the IEA's Ocean Energy Systems Implementing Agreement that is developing programs to be operational in 2007. Technologies being addressed through research, development and demonstration projects include wave, tidal (marine currents and barrage), and thermal energy conversion.

While the long-term potential of some renewables for producing electricity is considerable, over the next fifteen years they are not expected to contribute more than one percent to China's electricity production.[17] Nevertheless, it is important for both China and the United

13 Ibid. World Energy Outlook 2004, page 226

14 Ibid. China's Energy Outlook 2004, page 82

15 Ibid. China's Energy Outlook 2004, page 83

16 Many of these coal plants have limited pollution controls and do not have any controls over mercury or GHG emissions.)

17 Ibid. China's Energy Outlook 2004, page 82

States to maintain and increase development efforts needed to eventually commercialize some of these. Selecting optimal technologies is risky as the commercial success at commercializing of even some of the most promising renewable technologies remains uncertain. The cost of electricity from renewables may eventually become more competitive as climate change concerns increase costs for both conventional thermal power plants with carbon capture and storage; and Generation IV nuclear technology that better addresses safety, waste disposal and proliferation concerns.

U.S.-China National Energy Strategic Outlook

China's national energy strategy has been a work in progress for the last half century with the most recent iteration embodied in the 11th Five Year Plan, 2006-2011. The policy in that plan was adopted after several rounds of research that included the Energy Research Institute, the National Development and Reform Commission, the Chinese Academy of Engineering, and the Central Party School.[18]

According to Chinese participants, China's energy strategy through 2020 is now more in line with the international consensus that stresses energy security, efficiency and conservation and environmental protection. China's strategy is also based on specific Chinese conditions, particularly the key role of coal and of the ongoing rural-urban migration of over 400 million Chinese. More broadly, China cannot follow the path of energy consumption of the United States. The United States consumes 30 tons of oil per person annually while China consumes only about 200 pounds per person.

Chinese participants also noted that if China followed U.S. per capita consumption, all the current global oil production would still not be enough for China's supply needs alone. So China needs to reduce its consumption and change consumption patterns. China has to develop an energy efficient society or it (and the world) will not be able to sustain economic development.

Chinese participants also noted that at the 2006 St. Petersburg G-8 meeting, President Hu Jintao outlined a comprehensive new strategy and proposed a new concept of energy security.[19] He said that the basic content of China's energy strategy involved greater efficiency, a focus on the environment and international cooperation on energy issues. He called for cooperation with both producers and consumers. He noted that every country has the right to utilize its energy resources, but that most cannot provide for energy security without international cooperation. Thus Hu argued, and conference participants agreed, China needs a new energy security concept based on international cooperation and diversification.

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18 The Central Part School also commissioned a study on China's energy and sustainable development strategy that was published in 2005.

19 http://www.fmprc.gov.cn/eng/wjdt/zyjh/t264261.htm

Chinese research institutes have invested significant effort in research on how to achieve the goal of sustainable development and an environmentally friendly, energy efficient society. China for the first time plans to have an energy law, which is currently under development, drawing on recommendations from the public as well as from scientists and lawyers. Additionally, there are discussions and studies regarding changing China's pricing structure for electricity and transportation fuels in order to further incentivize reduction in consumption and create greater market mechanisms for managing supply and demand issues.

An American participant noted U.S. energy strategy and policy is influenced by many more agencies and interest groups than Chinese strategy and policy. In addition to the federal government, policy is influenced or set by Congress, courts and legal precedents, state governments, private individuals in the energy sector, private citizens associated with environmental groups, and others interest groups. The give-and-take among all these groups slows down changes to energy policy but also makes them more transparent. As a result, U.S. energy policy is a montage rather than a strategy. There have been two energy laws in recent years and 17 amendments from Congress that affect energy. This creates a patchwork effort at meeting U.S. energy security goals.

One key aspect of U.S. energy strategy is the U.S. SPR. It is managed by the Department of Energy (DOE) and is centrally directed by the Administration while Congress manages the program through its funding. The SPR is strategically important and both countries could benefit from extensive dialogue, including on how SPRs are managed and the technologies involved. Another key aspect of government energy policy is research and development. The United States now spends about $4 billion per year on energy efficiency and conservation. The results have been significant to date and will so continue. The U.S. is willing to use those efforts for a dialogue with China to understand what positive steps can be learned for each other.

Potential Cooperative Steps to Enhance Energy Security

The energy strategies of China and the United States have global consequences, so the approaches of both countries should be bilateral, regional and global. The United States and China have common interests in all these areas and need to generate common approaches. They need to actively involve leaders and develop an information strategy to help both nations understand what the situation is and the strategy for the way forward. Some areas for possible cooperation suggested by the U.S. side include:

- We need a "Partnership for Energy Security" that goes beyond words. To be effective, we need to talk about the obstacles on both sides at all levels. We need to recognize the real problems we face and go beyond simple agreement on strategies. For example, the United States knows CO_2 emissions are a serious and urgent problem, but also that there

are significant obstacles to developing new energy policies. In China, there is a serious obstacle in local execution and enforcement of the central government's national policies. We need to talk about these issues and recommend how to address them.

- We need to introduce resources into the problem. Fortunately, there is significant and successful American research and development projects related to energy and environmental issues. Since much of this is governmental, it allows for easier cooperation - private companies are often reluctant to compromise their commercial interests by sharing technology. So we need to expand government-to-government cooperation, including joint research and development.

- We need to ask ourselves if we are going in the right direction. We discussed different possible energy scenarios. If one wants to get to a different place than the present destination, a change in current actions and strategies must occur. One issue that should be discussed is the reliance on coal and what we can do to mitigate its negative consequences. What can be done to significantly reduce the release of pollutants in China and CO_2 emissions in both countries.

- Both countries can do more to improve energy efficiency and share technologies and techniques.

- We need to create a somewhat more elastic oil market. It is now so inelastic that small changes drastically affect price. SPR creates some policy options for governments to respond to market shocks caused by short-term inelasticity. However, the primary U.S. objective in maintaining an SPR is to meet supply shortfalls caused by major national emergencies.

- We must expand nuclear power while resolving waste, nonproliferation and safety issues.

- China needs to further electrify, and that is an area for discussion and cooperation.

- We need to find new ways to finance smaller projects. China could create a Fannie Mae equivalent that could buy small energy loans, consolidate them, and resell them.

- The United States could help China develop financing structures for gas and pipeline costs, both the long range and the last mile.

Chinese participants suggested the most important issue in addressing U.S.-China cooperation on energy is to develop mutual trust. A Chinese expert suggested "four shifts":

1. We have to shift our relationship from one of competitors to one of cooperators. Security issues have to be solved on the basis of cooperation. We are not cooperating for cooperation's sake but for common security.

2. We should shift from a strategic to a technical dialogue. The government has rounds of strategic dialogue, but we need cooperation among businesses, for example.

3. We should shift from theoretical discussion to concrete action if we want to be successful. The United States has advantages in technology and energy efficiency. China has a lot to learn from the United States, including in nuclear power technology. The United States should be more open in technical cooperation, as Europe is in its cooperation with China.

4. We also need to cooperate on environmental pollution. We have to solve the problem of providing clean coal technology as well as new technologies.

Another Chinese participant suggested that U.S.-China cooperation focus on preventing major fluctuations in oil prices. China does not so much want a low oil price as stability in the oil market so that it is predictable. China and the United States should create a mechanism together to stabilize the oil market, which will benefit OPEC as well as the United States. The weapon the United States and China have is SPRs, he noted.

Next Steps in the Energy Security Dialogue

The U.S. side proposed moving forward not only on technical issues, but also on issues of process, bureaucracy and politics. The two sides should develop recommendations for each other, for themselves, for joint cooperation, and for regional and global action. The two sides could write a joint, consensus report or write two reports (without attribution) to make available to the respective publics and governments. Then they could have another session to come up with particular proposals on how to proceed. The problem is to focus on what is *not* being done – getting to a more strategic view, getting to senior leaders, and getting to joint activities with broader affects. U.S.-China cooperation is of critical importance not only to China and the United States but to the world.

The Chinese side agreed with the U.S. side on ideas for how to continue the joint cooperation. One point of particular importance mentioned by the U.S. side is that it focuses on sustainable development while China focuses on expansion and sustainable development. Economic expansion places demand on expanding energy consumption. China and the United States have both much in common and real differences. They should address the reasons for obstacles in cooperation and strike a balance between commonalities and differences. They can have joint research on topics of common interest. There is a need to develop mutual trust not only between governments but also between think tanks and the public. There is a need to develop private-public cooperation.

Appendix: Conference Agenda and Participants

THE ATLANTIC COUNCIL
OF THE UNITED STATES

CICIR
中国现代国际关系研究院
CHINA INSTITUTES OF CONTEMPORARY INTERNATIONAL RELATIONS

清華大學
Tsinghua University

Building Strategic Understanding and Cooperation on Energy Security between the United States and China*

October 31-November 1, 2006

Tuesday, October 31

Morning Chair: CICIR Vice President Tao Jian

0845-0900 Opening Remarks by President Cui Liru, US Representative, and Ford Foundation Representative

0900-1100 Session I: Building an Understanding of Energy Outlook: *Overview of Future Energy Supply and Demand*

Each presentation includes: assumptions on energy reserves/production, pricing, pace of technological innovation, pace of environmental regulation, pace of energy conservation measures and energy trade flows.

- ***IEA Presentation and Discussion:*** The Global Picture, Overview and Assumptions (40 minutes) (Lawrence Eagles)
- ***EIA Presentation and Discussion:*** U.S. Energy Picture, Overview and Assumptions (40 minutes) (Linda Doman)
- ***Chinese Presentations and Discussion:*** China's Energy Picture, Overview and Assumptions (40 minutes) (Xu Xiaojie)

1100-1230 Session II: Energy Security Vs. Sustainable Development

Sustainability of current economic development and energy models

- Challenges to global resources stemming from projected economic growth through 2020, including competition for resources
- Impact of soaring oil prices
- Impact of environmental factors and concerns, including global climate change (priority of addressing environmental issues)

Chinese Presentation: (20 minutes) (Han Wenke)
U.S. Presentation: (20 minutes) (John Lyman)
Comments and Discussion (50 minutes)

1230-1330 Lunch

Afternoon Chair: General Richard L. Lawson

1330-1500 Session III: Geopolitical Challenges

Geography, geopolitics and political instability factors affecting energy resources

- Supply security
- Competition over resources
- Transportation security issues
- Regional instability, conflicts and terrorism
- International cooperation, including IEA

Chinese Presentations: (20 minutes) (Zhao Hongtu and Feng Yujun)
U.S. Presentation: (20 minutes) (Robert Manning and Franklin Kramer)
Discussion: (50 minutes)

1500- 1700 Session IV: Energy Markets and New Resources

– Investment requirements
  - The role of public (including international aid and governmental) vs. private investment
  - Reliance on market vs. equity oil, long-term bilateral contracts
  - Role of national energy companies (NOCs) compared with multinationals and challenges for new players

– Pricing mechanisms and controls –global and domestic markets

Chinese Presentations: (30 minutes) (Wang Nengquan and Wang Zhen)
U.S. Presentation: (30 minutes) (Mikkal Herberg)
Discussion: (60 minutes)

Wednesday, November 1

Morning Chair: Professor S. T. Hsieh

0900-1200 Session V: Key Technological Responses

- Nuclear, capital cost, safety, waste and reprocessing issues and availability of uranium supplies

  Chinese Presentation: (15 minutes) (Wu Zonxin)
  U.S. Presentation: (15 minutes) (Barry Worthington)
  Discussion: (30 minutes)

- Improving coal technology, increasing efficiencies, environmental impacts, CO_2 sequestration, and growing impact of international coal trade

  Chinese Presentations: (15 minutes) (Yu Cong and Wang Yanjia)
  U.S. Presentation: (15 minutes) (Daniel Driscoll.)
  Discussion: (30 minutes)

- Future transportation fuels requirements and new fuel options

  Chinese Presentation: (15 minutes) (Zhang Aling)
  U.S. Presentation: (15 minutes) (John Baltrus)
  Discussion: (30 minutes)

1200-1300 Lunch

Afternoon Chair: CICIR President Cui Liru

1300-1430 Session VI: US-China National Energy Strategy Outlook

Each side gives an explanation of its own national energy strategy with particular reference to the China factor or the US factor in their strategy

Chinese Presentation: (20 minutes) (Xu Dingming)

US Presentation: (20 minutes) (Richard Lawson)

Discussion: (50 minutes)

1430-1600 Session VII: Potential Cooperative Steps to Enhance Energy Security

A) – Opening comments on ideas for cooperation based on previous sessions

US presentation (10 minutes) (Franklin Kramer)

Chinese presentation (10 minutes) (Jiang Yuechun)

B) – Group discussion on any of the following, or additional topics arising from dialogue

- Exploration and production
- Transportation – security of pipelines, tankers, etc.
- Technology development and sharing
- New transportation fuels
- Clean coal technology and CO_2 sequestration
- Alternative energy sources
- Nuclear power waste and reprocessing
- Conservation measures
- Efficiency measures
- International cooperation (data sharing, emergency energy stockpiles, standards and specifications, etc.)

(C) – Next Steps in Energy Security Dialogue

- Process to be followed in each country
- Specific discussion topics for next meeting
- Concluding comments (Tao Jian; Franklin Kramer and General Lawson)

U.S. Participants

Franklin D. Kramer, Chairman, Asia & Global Security Committee, Atlantic Council; former Assistant Secretary of Defense for International Security. *Co-chair of delegation.*
General Richard Lawson, Vice Chairman, Atlantic Council; Chairman, Program on Energy and Environment, Atlantic Council. *Co-chair of delegation.*
Jonathan Adams, Assistant Director, Asia Programs, Atlantic Council
John Baltrus, Research Group Leader, Defense Fuels Chemistry & Surface Division, NETL-DOE
Linda Doman, Energy Analyst Energy Information Administration, Department of Energy
Daniel Driscoll, Senior Project Manager, Gasification and Combustion Division, NETL-DOE
Lawrence Eagles, Head of Oil Industry and Markets Division, International Energy Agency
Banning Garrett, Director, Asia Programs, Atlantic Council
Robert Gee, President, Gee Strategies Group LLC; former Assistant Secretary of Energy for Policy and International Affairs
Mikkal Herberg, Director, Asian Energy Security and Globalization programs, National Bureau of Asian Research
S.T. Hsieh, Professor, Tulane University
Eliane Lomax, Associate Director, Program on Energy and Environment, Atlantic Council
John R. Lyman, Director, Program on Energy and Environment, Atlantic Council; former Vice President, Amoco Corporation
Robert Manning, Policy Planning, U.S. Department of State
Barry Worthington, Executive Director, United States Energy Association

Chinese Participants

From CICIR:
Cui Liru, President
Tao Jian, Vice President
Chen Fengying, Director, Institute of World Economic Studies
Fu Mengzi, Director, Institute of American Studies
Du Yanjun, Director, Department of International Exchanges
Lin Limin, Director, Center for Strategic Studies and Editor in Chief, *Xiandai Guoji Guan Xi* (
Zhao Hongtu, Deputy Director, Institute of World Economic Studies
Feng Yujun, Deputy Director, Institute of Russian Studies
Liu Bo, Deputy Director, Department of International Exchanges
Zhang Hao, Editor, *Xiandai Guoji Guan Xi* (the CICIR Journal in Chinese)
Liang Jianwu, Director of Economic Security Studies, Institute of World Economic Studies
Yuan Chunqiang, Asst Professor, Institute of World Economic Studies
Wang Miao, Asst Professor, Institute of World Economic Studies
Li Xuefei, Institute of American Studies

From Other Chinese Institutions:

Feng Fei, Director, Industrial Economy Studies, Development Research Center, State Council

Han Wenke, Director, Institute of Energy Studies, National Development and Reform Commission

He Xianjie, Consultant, Consultation and Research Center, Ministry of Land and Resources

Jiang Yuechun, Director of Economic Studies, China Institute of International Studies

Wang Nengquan, Chief Economist, International Petroleum Company, Sinochem International Corporation

Wang Yanjia, Director, Sino-US Center on Energy and Environmental Technology, Tsinghua University

Wang Zhen, Dean of Business School, China Petroleum University

Wu Zonxin, Dean, Institute of Energy, Environment and Economy, Tsingshua University

Xu Dingming, Deputy Director, National Energy Office

Xu Xiaojie, Director, Institute of Investment Environment Studies, China Petroleum & Chemical Corporation

Xu Yongfa, President, Research Institute of Economic and Technology, China National Petroleum Corporation*

Yu Cong, Director, Center for Energy Efficiency, National Development and Reform Commission

Zhang Aling, Deputy Dean, Institute of Energy, Environment and Economy, Tsingshua University

Zhang Kang, Deputy Director, Advisory Council, Institute of Exploration and Development, China National Petroleum Corporation

Zhang Yan, Deputy Director, Economic Cooperation Office, Department of Policy and Planning, Ministry of Foreign Affairs