CHAPTER 3

CHINA'S ENERGY AND ENVIRONMENTAL POLICIES AND ACTIVITIES

SECTION 1: CHINA'S ENERGY POLICY, DEMAND, AND SUPPLY

"The Commission shall investigate and report on—

"ENERGY—The effect of the large and growing economy of the People's Republic of China on world energy supplies and the role the United States can play (including joint research and development efforts and technological assistance), in influencing the energy policy of the People's Republic of China."

Energy Policymaking in China

China's rapid economic development and its rising energy demand are interrelated; energy fuels the country's production, and domestic consumption drives its need for energy. Given energy's intrinsic link to economic development, the Chinese government has highlighted this issue as a priority of government policy, and until recently has kept the majority of the energy market under government control. While the success of China's economic reforms occurred as a result of the decentralization of government control over the market, the decentralization of energy policymaking to local officials has not produced a comparably positive outcome. Instead, it has resulted in a fragmented energy policy that lacks both the coordination and the capacity for consistent implementation of national policies.[1]

China has no Ministry of Energy at present. In June 2006, the World Bank and the Development Research Center of the State Council recommended the establishment of an energy ministry to coordinate energy policy at the cabinet level, but China has not acted on this recommendation.[2] Currently, the Energy Bureau of the National Development and Reform Council (NDRC) holds primary responsibility for energy policy coordination within the Chinese government. The Energy Bureau must approve significant energy-related projects such as the construction of power plants, and its internal departments have control over pricing of fuels and electricity as well as regulating industrial energy use.[3] In addition to the NDRC, the Energy Leading Group and the State Energy Office, created in 2005 by the State Council led by Premier Wen Jiabao, play significant roles in China's energy policymaking. The Energy Leading Group issues "guiding principles" about the direction of en-

ergy policy. The State Energy Office, led by Ma Kai, minister of NDRC, reports directly to the State Council, but has little political power and an unclear mandate.[4] It is said to focus mainly on energy-related academic matters.[5]

This central government structure and the decentralization of policy implementation to local levels have created an unclear distribution of responsibilities. They have created a system that is easily influenced by local concerns for economic development. Local governments often prioritize these concerns over energy efficiency policies and environmental controls that—if implemented—could slow the pace of growth. Moreover, the flight of policymakers to the private sector has led to a loss of policymaking expertise, and an increase in the relative influence of China's energy companies. As Dr. Erica Downs of the Brookings Institution writes in her paper, "The Brookings Foreign Policy Studies Energy Security Series: China," " ... the Chinese government relies on the energy companies for manpower and for their knowledge and experience."[6] The Energy Bureau of NDRC and the State Energy Office lack the capacity and expertise to gather the statistical information needed to construct and implement effective energy policies, and this situation gives energy companies unwarranted influence over energy sector data and policy.

According to Dr. Downs, "The country's fractured energy bureaucracy has impeded formulation of a long-term national energy strategy accepted by all stakeholders." The lack of a clear bureaucratic infrastructure over energy policy, the lack of clear, detailed information, and the fear of disrupting the economy with a rapid policy change have to date prevented improvements in the development, coordination, and implementation of energy policy in China.[7] Instead, Chinese energy policy has been created with "... a reactive management style, which approaches energy challenges by 'treating the head when the head hurts, treating the foot when the foot hurts.'"[8]

The ad hoc reforms China has instituted in the energy sector have been at least in part a response to the pressure created by market reforms in other economic areas. As Mr. David Helvey, Country Director for China, Taiwan, and Mongolia at the U.S. Department of Defense, stated in testimony before the Commission, these pressures have created tension between the "dynamic elements of China's increasingly market-based economy" and "the Chinese Communist Party's desire to retain its monopoly on political power and control [of] its strategic industries and sectors of the economy including energy."[9] Moreover, as incomes rise and a middle class develops, the Chinese people are beginning to apply pressure on the government to improve the environment and reduce industrial pollution, thus creating another energy-related concern for the government to consider.[10]

The central government has tried to balance these competing tensions by combining socialist and market-based principles in its energy policies. Mr. Saad Rahim, Manager of the Country Strategies Group at PFC Energy, described this approach as attempting "to capture most of the efficiency gains that come from reliance upon markets, while preserving much of the political stability made possible by an authoritarian state."[11] He argued that the govern-

ment's approach to energy is a microcosm of China's larger development strategy, in which continued, rapid economic growth is perceived as necessary for maintaining the credibility of the Chinese Communist Party leadership and for preserving social stability. In his testimony he stated, "Chinese officials realize that it is in their own best interests to limit future energy demand, and thus are amenable to pragmatic solutions as long as they do not perceive a direct economic threat from adopting them." [12]

Preserving an adequate supply of energy for China's rising demand—at a price that will not impose a significant burden on producers—is a vital prescription for maintaining an environment conducive to economic growth. For this reason, China defines "energy security" operationally as ensuring it has access to a stable supply of energy by controlling sources of production and the supply chain. As this relates to oil, consumption of which is rapidly growing in China, the government appears to distrust the international market to deliver reliable supplies because it fears China may at some point be denied access to the oil it needs, so it prefers long-term supply contracts for access to supplies in nations abroad with which China has developed bilateral political relationships. If a disruption to global supply occurs, other nations are concerned that Chinese companies will ship equity oil back to China and not add it to the global oil supply.

Given its perception of the global oil market, China has encouraged a "going out" strategy for its national oil companies whereby they seek equity oil assets in order to own the sources of production abroad. However, Assistant Secretary of Energy for Policy and International Affairs Karen Harbert testified that China will not be able to own enough of these resources to meet either its current or its future oil demand,[13] implying that China, at least in part, will have to rely on the global market in order to fulfill its petroleum needs.

Faced with questions on the secure and reliable supply of energy as well as growing negative consequences of air and water pollution, China is beginning to adopt a strategy that diversifies fuel supplies and pursues clean energy alternatives. China's 11th Five-Year Plan highlights energy as a priority policy area for development, with a focus on conservation and energy efficiency to stem demand. The plan contains only two quantitative targets: the first is for GDP growth, and the second is for increased energy efficiency.[14] China announced that it plans by 2010 to reduce energy consumption per unit of GDP by 20 percent.[15] Even though it has succeeded in slowing the trajectory of its energy consumption growth, it has fallen short of the annual reduction targets necessary to meet its 2010 goal. China's National Bureau of Statistics reported that in 2006 China missed its announced target of a four percent reduction, and instead reduced consumption per unit of GDP by only 1.33 percent.[16] However, the government has made several public statements about its continued commitment to reduce consumption. Additionally, China aims to increase the proportion of its energy needs met by renewable energy to 16 percent by 2020.

In June 2007, China announced a policy for addressing global climate change, in line with its obligations under the U.N. Frame-

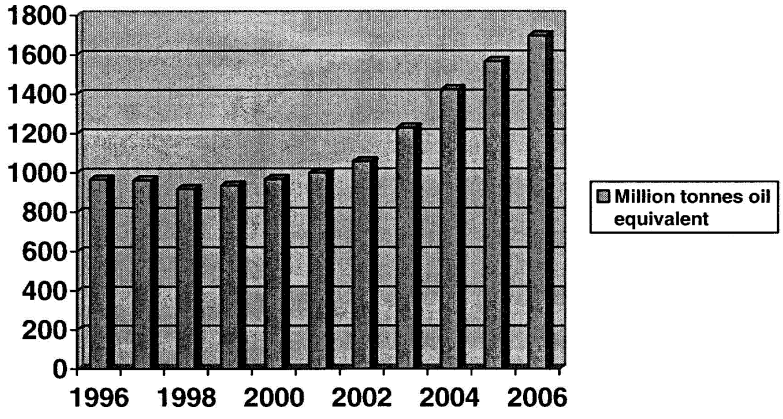
work on Climate Change. This plan acknowledges the problem of global climate change and China's contributions to the rising levels of greenhouse gases. The report highlights domestic policies that China will follow to address climate change, such as supporting research and development of energy technology, raising public awareness about energy conservation, increasing forest coverage, and addressing water shortages through more effective allocation of water resources.[17] China does not accept the imposition of emissions caps on developing countries (a category in which it places itself for this purpose), arguing that such caps may restrict economic development. Nor will it accept the standards imposed on industrialized nations such as the United States. This plan nonetheless represents an attempt to participate in the international discussion on climate change and to ensure that China has a role in crafting the global response.

In addition, China is in the process of drafting an energy law to provide a legal framework for the development of energy policymaking and enforcement of related regulations.[18] The draft of the law is expected to be completed by the end of 2007.[19] While the effect of these two new initiatives is yet to be determined, these goals and policies reflect a change in rhetoric and suggest that China recognizes the need to mitigate unbridled energy demand growth and environmental pollution due to energy consumption trends.

Trends in China's Energy Demand

From China's initial implementation of economic reforms in the 1980s until today, its energy demand growth has averaged 3.9 percent per year, while its GDP grew an average of 9.8 percent per year.[20] However, in the past five years energy demand has grown at 13 percent per year, more than three percentage points above the average GDP growth.[21]

Figure 3.1 China's Primary Energy Consumption 1996–2006



Source: BP Statistical Review of World Energy, June 2007.

Mr. Trevor Houser, Visiting Fellow at the Colin Powell Center for Policy Studies at the City College of New York, and a Director of China Strategic Advisory LLC, explained that the growth in energy consumption has occurred due to provincial economic policies that focus on development of heavy industries such as steel and cement. These industries, which support China's urban development and exports abroad, are more energy intensive than light manufacturing industries. Given the decentralization of economic policy, the central government has little control over the economic practices of the provinces that are driving this industry growth, and heavy industries receive protection from provincial leadership because of their profitability.[22]

As a result, industrial energy demand now equals 70 percent of China's total energy demand. The iron and steel industries alone account for 16 percent of that demand.[23] Incentives such as low environmental compliance standards, inexpensive land prices, and access to capital support the continued pursuit of these profitable heavy industries.[24] Consequently, industrial energy demand is expected to grow at a rate of 4.1 percent per year,[25] complicating Beijing's goals for energy efficiency and conservation.

While heavy industry growth is considered China's current energy challenge, the country's future energy challenge is consumption-led growth.[26] Rapid urbanization and rising urban incomes will lead to increased energy demand for residential and commercial and also for urban transportation needs. In the coming years, transportation-related energy demand is expected to grow more rapidly than any other area of energy use.[27] Dr. Lee Schipper, Director of Research for the EMBARQ program at the World Resources Institute,[28] argues that unsustainable development of China's transportation systems and an increase of vehicle ownership will be responsible for this increased demand.[29] A lack of urban planning has resulted in the unrestricted sprawl of many urban areas, and this pattern of development increases the population's reliance on cars to move around the cities. China's vehicle ownership is projected to increase from 25 million in 2007 to 140 million in 2020.[30] This increase will have significant consequences for urban use of space, energy consumption, and urban air quality.

Trends in China's Energy Consumption and Supply

Energy Consumption Trends

If current trends continue, both China's energy consumption and its share of global energy consumption will increase further in the future. In 2004, China consumed 40 percent less energy than the United States, but the U.S. Department of Energy predicts that by 2030 it will consume 11 percent more energy than the United States. Coal is expected to supply 65 percent of China's energy needs in 2030; oil will supply 22 percent; natural gas will supply 6 percent; renewable energy sources will supply 5 percent; and nuclear energy will supply 2 percent.[31]

A key obstacle to addressing consumption trends is China's poor energy efficiency relative to other countries. As Deputy Assistant Secretary of Energy for International Energy Cooperation David Pumphrey testified, "According to the National Development and

Reform Commission (NDRC), the level of energy efficiency in China is about 10 percentage points below that of more advanced countries."[32] In practical terms, this means that for every U.S. dollar's worth of GDP, "Chinese producers consume 4.3 times more energy than their counterparts in the U.S., 7.7 times more than Germany or France, and 11.5 times more than Japan."[33]

Another obstacle to reducing its energy consumption is a lack of publicly-available data, particularly at provincial or local levels. In his testimony, Mr. Rahim noted that "[m]easuring energy use—like measuring economic activity—in an emerging economy such as China is always a challenge. In China, in particular, energy use can be politically sensitive—especially as relates to reporting between different level governments."

Coal

Coal currently provides two-thirds of China's energy supply. China is both the world's largest consumer and the world's largest producer of coal. China's consumption of coal amounts to nearly one-third of all coal consumed worldwide,[34] and it has the world's third largest proven reserves of coal, totaling 114.5 billion tons, or 13 percent of global coal reserves.[35] Last year, China's coal production equaled 2.33 billion tons, and the National Development and Reform Commission announced that annual coal production will be capped at 2.6 billion tons by 2010.[36] China has approximately 30,000 coal mines, 80 percent of which are small mines.[37]

While China sets the price of its domestically-mined coal at a level comparable to the international price, that price nonetheless is lower than the prices of other fuels in China, and coal remains the cheapest source of energy for most areas.[38] This is the primary reason that its share in China's energy consumption picture is not predicted to decline absent government intervention or the deployment of strong market incentives to reduce its use.

Coal is primarily used for electricity generation, industrial power supply, and chemical feedstocks. Nearly 80 percent of China's electricity needs are generated by coal-fired power plants, and—paralleling China's economic growth—its electricity generation capacity has grown more than 11 percent each year since 2003, even as it has experienced power shortages. The Massachusetts Institute of Technology (MIT) study on *The Future of Coal* notes, "At this rate, China is adding the equivalent of nearly the entire UK power grid each year."[39] Another comparison provided in testimony by Mr. Houser is that China's addition last year of 100 gigawatts of new coal-fired capacity was more than the installed base of Africa.[40]

Coal-based power will account for at least 400 gigawatts of the 600 gigawatts of new capacity that China will build between now and 2020.[41] The International Energy Agency (IEA) reports that every week China installs a new coal-fired power plant.[42] China plans to build 562 new coal-fired power stations by 2012.[43] China's current construction of coal-burning plants and its plans for constructing others strongly suggest that the proportion of energy China derives from coal will not diminish significantly in the future absent substantial policy changes. According to the U.S. Department of Energy, China's coal consumption for electric power is pro-

jected to grow at an average of 3.5 percent per year between 2004 and 2030.[44]

Although China has a plentiful coal supply—sufficient to meet its needs and also to export coal to other nations—various transportation impediments have resulted in China importing considerable amounts of coal. Transportation costs make domestically-mined coal prohibitively expensive in some areas of China, such as Guangdong province, and in these areas it is cheaper to import coal or natural gas. In January 2007, tight rail capacity and transportation bottlenecks caused the government to conclude that it was much cheaper to import coal to coastal provinces than to transport coal to those areas by rail from the inland coal-producing provinces. Although this is not expected to be a permanent situation, it has caused China to become a net importer of coal, with imports coming primarily from Indonesia and Australia.[45] These imports, however, will not significantly change China's coal consumption or dependence.

Oil

Oil provides approximately 20 percent of China's energy supply. In 1993, China became a net oil importer, and in just fourteen years has grown to become the second largest oil consumer after the United States. In 2006, China's oil demand grew to 7.4 million barrels per day, of which it imports 3.6 million barrels per day.[46] The International Energy Agency estimates that by 2030 China's oil consumption will increase to 15 million barrels per day, equivalent to 13 percent of projected world oil demand.[47] Even with China's consumption at that level, the United States is projected to remain the largest consumer of oil—consuming 26.9 million barrels of oil in 2030.[48]

While China's rapidly escalating consumption of oil has forced it to increase its oil imports in the past several years, the country is, in fact, the fourth largest petroleum producing country outside the Middle East and produces more than 50 percent of the oil it consumes. In 2006, the U.S. Energy Information Administration estimated that China produced 3.8 million barrels per day.[49] China recently discovered an oilfield in Bohai Bay in northeastern China, and China National Petroleum Corporation (CNPC) announced that the field holds about 7.35 billion barrels.[50]

Although this discovery does not significantly affect China's energy security, it indicates that domestic exploration and production can assist in securing the amount of oil China needs. Despite this discovery, however, China's domestic production capacity has peaked or is declining, thereby suggesting that China's reliance on oil imports will grow in the future. China's two largest suppliers of oil imports are Angola and Saudi Arabia, supplying an average of 525,000 barrels per day and 465,000 barrels per day, respectively.[51] China's joint venture holdings in Sudan produce approximately 350,000 barrels per day, although only 140,000 barrels per day of this equity oil are under the control of the China National Petroleum Company.[52] While China is dependent on Middle Eastern oil, China also seeks imports from Africa, Central Asia, Latin America, and North America. China's oil imports are predicted to

increase from approximately 3 million barrels per day in 2005 to between 6 million and 11 million barrels per day by 2020.[53] By 2030, China is expected to rely on oil imports for 69 percent of its oil supply.[54]

Consistent with China's definition of energy security—which supports ownership of resources "in the ground"—China's equity oil production has been increasing in recent years. Chinese oil companies have equity contracts and operations in more than 30 countries.[55] The Chinese government and its state-owned oil companies do not officially publish figures about how much equity oil is derived from overseas investments and whether it is transported to China.[56] However, Mr. Houser estimated in his testimony that last year China's three largest national oil companies produced 690,000 barrels of equity oil per day,[57] compared to approximately 370,000 barrels of equity oil per day in 2004.[58] Mr. Houser also testified, based on Customs statistics, that approximately 250,000 barrels of oil produced abroad by China's oil companies are transported to China for use there, and the remaining quantity is sold into the global market.[59] For example, a Eurasia Group report commissioned in 2006 by the Commission noted that while China has investments in Syrian oil production, available customs data on oil imports by China do not show any imports in recent years from Syria. The deduction from this observation of the report is that the oil produced by Chinese joint ventures in Syria is being sold and used elsewhere rather than being transported to and consumed in China.[60]

In pursuit of equity production, China's national oil companies are aggressively entering the global oil market and working in countries where international oil companies have not invested due to conflict, political instability, or human rights concerns. Most national oil companies do not rely on capital from the government to fund equity investments, and Mr. Rahim noted that the "going out" strategy of foreign exploration and production is not viewed by China's oil companies as a guarantor of energy security, but rather is seen as an opportunity to gain experience in the global market and make a profit.[61] Several witnesses testified to the Commission that it appears China's state-owned oil companies made equity investment decisions for commercial and profitability reasons, but it is unclear to what degree these investments also are motivated by government policies. It *is* known that China's national oil companies are not subject to many of the government-imposed conditions, limitations, and mandates inposed on multinational oil companies by Western governments.[62] (See Chapter 3, Section 3 for further discussion of equity oil investments.)

China National Petroleum Corporation (CNPC) is China's largest upstream oil company with equity production of 329,810 barrels per day in 2004.[63] The nations in which Chinese equity production is greatest are Sudan and Kazakhstan.[64] Equity production in Sudan equals about 140,000 barrels per day, in oil fields partially controlled by CNPC.[65] CNPC also owns assets in Kazakhstan that produced approximately 200,000 barrels per day in 2007.[66] It is expected that oil imports from Kazakhstan will increase to 400,000 barrels per day in the next few years, as China continues to invest in oil production there.[67] Additionally, in June 2007, CNPC pur-

chased the rights to explore and develop a Canadian oil sands field, which is estimated to hold two million barrels.[68]

While Chinese companies are actively seeking foreign oil assets, the majority of China's oil imports originate from the "spot market"—the international open market. Not surprisingly, China's domestic oil pricing system is dependent on world crude oil prices. The government, however, controls downstream prices of gasoline and other refined products, and their artificially controlled prices foster consumption and increased energy demand. The controlled prices also can reduce production and transportation costs for manufactured goods—which lowers the price of exports and effectively subsidizes them.

Given the artificial ceilings placed on downstream petroleum products, refiners are caught in a major non-market economic squeeze. Messrs. Houser and Daniel Rosen of China Strategic Advisory LLC write, "As the price China paid for its imported crude doubled between 2004 and 2006, refiners . . . lost money with each barrel processed. In 2006 the refining industry as a whole lost over $5 billion."[69] Since 2003, China has increased prices for refined oil products 12 times, but in January 2007 lowered the prices of gasoline and kerosene to correspond with fluctuations in international oil prices.[70]

Also in January 2007, China opened the wholesale oil market to foreign-owned oil companies, and issued regulations on the distribution, storage, and sale of retail products.[71] While certain restrictions apply to such investment, this change represents a positive step toward improving China's energy infrastructure, as private foreign companies will seek to invest in the development of China's oil retail market and distribution infrastructure.

Natural Gas

Natural gas historically has not been an important energy source for China, comprising only about three percent of its energy supply. China has limited domestic natural gas reserves and limited domestic production offshore and in inland provinces.[72] Therefore, in the future China will rely on imports to meet more than 40 percent of its natural gas demand.[73] China already imports natural gas from Australia into Guangdong province.[74] Additional terminals are being constructed in Fujian province and in Shanghai. Shanghai began constructing a terminal in January 2007 for receiving liquefied natural gas, and it is expected to begin operations in 2009. The terminal will be supplied through a 25-year contract with Petronas, a Malaysian oil company.[75]

In June 2007, China began regulating imports of natural gas in order to reduce domestic competition among its oil companies. According to the Ministry of Commerce, the competition between CNPC, China Petroleum and Chemical Corporation (Sinopec), and China National Offshore Oil Corporation (CNOOC) in purchasing natural gas on the international market enabled exporters to raise prices for Chinese imports. The effect of the new regulations in "[b]ringing gas imports under unified control will be conducive to increasing the influence of major Chinese buyers on the market."[76] This move reflects China's distrust of international oil markets,

and demonstrates its willingness to interfere with the operation of its national oil companies in order to protect China's larger interests.

The NDRC Energy Bureau controls natural gas prices in the Chinese market, but these prices may vary by province.[77] Beijing has lowered natural gas prices specifically for power generation in an attempt to encourage the use of gas instead of coal, but power producers have not dramatically increased their use of natural gas.[78] Barriers to expanded natural gas use include a limited distribution infrastructure, high investment costs for building that infrastructure, and a price structure that still leaves the price of coal lower than the price of gas.[79] Indeed, Mr. Rahim testified that natural gas is the most underexploited source of energy in China.[80]

As long as coal remains a cheaper source of fuel, consumers will be inclined to choose it rather than more expensive natural gas.[81] Nonetheless, growing costs for coal transportation, the environmental costs of coal burning that increasingly are being recognized and protested in China, and improvements in the infrastructure for natural gas distribution facilitate the emergence of natural gas as a competitor. The U.S. Energy Information Administration estimates that China's natural gas consumption will increase by an average of 6.8 percent each year between 2003 and 2030, to comprise six percent of China's energy supply.[82] Although this will not alter China's energy fuel mix significantly, it will provide more options for provinces, especially coastal provinces, to improve their energy security and their air quality simultaneously.

Nuclear

As China struggles to lower high levels of emissions from coal-fired power plants, nuclear energy has emerged as an important option for diversifying China's energy supply, moving it away from dependence on coal. Nuclear energy provides only about one percent of China's current energy supply, but by 2020, China's nuclear capacity is expected to expand five times from the current 8,000 megawatts to 40,000 megawatts.[83] The majority of this expansion will occur in coastal provinces where coal transportation costs are highest. Although nuclear power still will constitute a small share of China's total generated power—approximately three to four percent,[84] this reflects a shift in the government's energy supply strategy. This strategy calls for increasing nuclear energy output, but this will not appreciably alter the current percentage of China's total consumption attributable to nuclear power.

The China National Nuclear Corporation and China Guangdong Nuclear Power Holding Company operate China's existing nuclear reactors. In May 2007, the State Nuclear Power Technology Company was created by the State Council and four state-owned enterprises to lead efforts to sign contracts to construct third-generation nuclear power facilities. China's nuclear power companies will benefit from the transfer of technology that will improve China's current second-generation nuclear energy capabilities. The State Council financed 60 percent, or 2.4 billion renminbi, of the registered capital of the company.[85]

The Administration and the U.S. nuclear power industry have been actively working in concert to help jumpstart China's nuclear energy expansion. Secretary of Energy Samuel Bodman and NDRC Minister Ma signed a Memorandum of Understanding concerning nuclear energy cooperation that restates U.S. approval to export third-generation nuclear technology to China.[86] GE-Westinghouse Electric Company and China's State Nuclear Power Technology Corporation signed an agreement in March 2007 to build four third-generation pressurized water reactors—two in Sanmen, Zhejiang Province, and two in Haiyang, Shandong Province—with Westinghouse's AP1000 technology. Westinghouse outbid France's Areva and Russia's Atomstroiexport in a negotiation that began in 2004. Both parties agreed that a formal contract would be signed before the end of May 2007. In mid-May, three Chinese nuclear power companies signed a Memorandum of Understanding with Westinghouse and the Shaw Group, again stating their intention to develop a contract for this sale,[87] and the final contract was signed in July 2007.[88]

This project will introduce the first AP1000 reactors to be built in China and is estimated to be worth $5.3 billion.[89] According to Deputy Assistant Secretary Pumphrey, "The AP1000 Westinghouse design adopts passive safety features and simplified design for enhanced safety and cost effective construction."[90] The U.S. Nuclear Regulatory Commission certified this technology complies with nonproliferation safeguards for use and sale abroad.[91] Nonetheless, given concerns about China's proliferation history, questions remain about the possible impacts of these sales.

China's interest in nuclear power is extending in a number of directions. According to *Xinhua* news agency, "The Chinese government ... expected the new company [State Nuclear Power Technology Company] to develop self-owned, third-generation nuclear power technologies using technologies imported from Westinghouse, to build a fifth plant."[92] China has joined the Generation IV Forum, a multilateral research initiative to develop a fourth-generation nuclear technology with higher safeguards.[93]

Renewable Energy

In recent years, China has expanded its use of renewable energy as part of its diversification strategy. China is now the eighth largest wind power producer in the world.[94] China's wind power generation capacity increased 165 percent last year to equal 1,330 megawatts.[95] China's planned wind power target is 20,000 megawatts by 2020.[96] Currently wind power is mainly concentrated in Xinjiang, Inner Mongolia, and Guangdong. During the April 2007 visit of a Commission delegation to China, the delegation visited a General Electric wind turbine factory located in Shenyang. According to GE representatives, demand for wind turbines is increasing in China as the government seeks to diversify its energy resources. GE faces competition from local manufacturers, primarily because the local firms are able to source their components domestically. The more components that American firms must import, the more expensive the assembly of turbines becomes. For

this reason, firms are being forced to localize the supply of their parts in order to remain competitive in the Chinese market.

China also has ambitious plans for expanding its solar power capacity. Beijing aims to install three megawatts of solar power for the 2008 Olympics. By 2010, China plans to consume 300 megawatts of solar energy, even though last year China's solar power consumption was less than 10 megawatts. China has patented solar water-heater technology that lessens its reliance on imported solar technology. However, China does rely on imports of polycrystalline silicon, or polysilicon, that is required for solar cell production. China's solar power efforts face a significant economic hurdle because traditional energy sources usually are less expensive and the majority of people in China do not have large amounts of disposable income. Primarily as a result of this situation, China currently exports 90 percent of its solar cell production.[97]

Additionally, China is the largest consumer of hydroelectric power in the world, and with new projects coming online, this capacity is expected to expand. China currently has 86,000 dams, 22,000 of which are considered large dams.[98] Hydroelectric power provided approximately 16 percent of China's electricity needs in 2005.[99] In numerical terms, China plans to expand capacity from 120 gigawatts to 300 gigawatts by 2020. As Mr. Houser testified, this would require China to construct a new Three Gorges-sized dam every year for the next 13 years to meet this target[100]—a seemingly unattainable goal, the achievement of which also would have significant impacts on China's water supply and environment.

Dr. Elizabeth Economy, C.V. Starr Fellow at the Council on Foreign Relations, stated in written testimony for the Commission that although hydropower has the significant virtue of not contributing airborne pollutants or carbon dioxide, it is a very mixed blessing. The dams and reservoirs required to produce hydropower have caused declines in biodiversity, soil erosion, water pollution, loss of cultural sites, and the necessity to resettle entire towns and villages.[101]

The government has taken steps to encourage the use of renewable energy, expand U.S.-China cooperation in this field, and support the introduction of renewable energy technologies in the market. In 2005, the National People's Congress passed the Law on Renewable Sources that went into effect in 2006. This law is intended to expand use of renewable energy in order to meet the goals set by the 11th Five-Year Plan. Among the new law's provisions is a requirement that "power grid operators ... purchase 'in full amounts' resources from registered renewable energy producers."[102] These operators must purchase renewable energy—such as solar power, wind power, or hydropower—at prices controlled by the government. The law also provides financial incentives such as tax breaks for renewable energy projects.[103]

Despite these efforts, barriers to the use of renewable energy still exist. Wind turbines and solar panels require a significant investment, and state-controlled prices for electricity reduce the incentive to make the investments needed to diversify power production. In addition, many American firms, including some with whose representatives the Commission delegation met during its trip to China in 2007, are concerned about the theft of intellectual prop-

erty, given the high research and development costs for new technology.[104] Foreign manufacturers face competition from local companies that do not face the same transportation costs for components. This situation requires companies to localize supply chains in China in order to be price competitive, which supports the overall development of the renewable energy industry but also significantly raises the risk of intellectual property rights violations as well as the risk that the enterprises established by foreign firms will never recover their initial investments, much less produce profits.

Conclusions

- The lack of policy coordination and implementation between the central government and local or provincial levels of government is hindering China from achieving greater gains in energy efficiency, promoting greater use of alternative fuels, and mitigating the environmental consequences that result from China's dependence on coal. If this structure is not reformed, the Chinese government will not have, for the foreseeable future, the administrative tools necessary to reform China's domestic energy consumption patterns, and also will be limited in its ability to address global energy problems proactively.
- As incomes rise in China and the economy becomes more consumption-oriented, effective conservation programs will be essential if energy demand growth is to be limited. China will have to pay close attention to mitigating the effects of energy-intensive and heavily polluting consumer items such as automobiles and air conditioners, which will require government regulation or market-based incentives that influence consumer choices on such items. Changing consumer demand also will affect the composition of China's fuel needs, likely increasing China's use of oil and natural gas, which will increase global demand for both.
- China is pursuing an energy diversification strategy that seeks to find cleaner alternatives to coal. However, as long as the environmental costs of burning coal are not built into coal's price, the degree of diversification into natural gas, nuclear power, and renewable energy sources will have little impact on the complexion of the fuel supply, and China will continue to rely on coal as its primary energy source and increase its reliance on oil. This has long-term negative environmental and strategic consequences for the United States, but also raises opportunities for U.S.-China collaboration on clean coal technologies.