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**CHINA'S ENERGY EQUATION:  
A STRATEGIC OPPORTUNITY**

**BY**

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## ABSTRACT

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China's astounding economic growth of the past two decades has placed enormous strains on available energy supplies. Continued economic growth, which is the key to China's future, is constrained by a skewed energy equation in which domestic and foreign energy supplies are far removed from China's burgeoning population. The energy barriers are a combination of economic, natural, and political factors that afford the U.S. a unique opportunity to initiate bilateral relations with the People's Republic of China. Engagement with China via an energy scheme sidesteps the issue of Taiwanese independence and will not negatively impact bilateral relations with our allies in the region who are even more dependent on the same supply of energy imports. The key is to initiate cooperation in areas in which there is common ground void of ideological conflict, which will provide mutual benefit to both the U.S. and China, and will not negatively impact security arrangements with our allies in the region. The purpose of this paper is to focus on China's energy equation and examine energy-related opportunities the U.S. could exploit to initiate bilateral cooperation with China.



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## **CHINA'S ENERGY EQUATION: A STRATEGIC OPPORTUNITY**

The astounding economic growth of the past two decades appears to have put China on the verge of becoming an economic power on the world stage. This remarkable progress, however, has outpaced China's ability to provide its citizenry with an inexpensive and abundant supply of energy. China now stands at a crossroads. Continued economic growth, which is the key to China's future, is now constrained by a skewed equation in which domestic and foreign supplies are far removed from the galloping demand of China's population centers.

The energy equation is not merely a hurdle to be overcome by the Chinese people. It has implications that affect U.S. interests on a global scale and in East Asia. These interests are not purely economic, but are linked directly to U.S. security and the security of our allies in the region. Only through engagement can the U.S. hope to influence an outcome favorable to U.S. interests. Inaction incurs great risks. To date, U.S. efforts to engage China have, for the most part, been in a multilateral forum. But the historical lack of a cooperative security framework in the region and China's overwhelming preference for bilateral efforts limits the effectiveness of a multilateral engagement policy.

The severity of China's energy equation offers a unique opportunity for the U.S. to engage China bilaterally without disrupting relations with our allies in the region, who are even more dependent on the same supply of energy imports. Additionally, engagement from the energy avenue sidesteps the issue of Taiwanese independence, which has long been a roadblock to forward movement in Sino-U.S. relations.

Because of our profound ideological differences and perceptions, engagement with China through energy related initiatives must start on small scale. The key is to initiate cooperation in areas in which there is common ground void of ideological conflict, which will provide mutual benefit to both the U.S. and China, and will not negatively impact security arrangements with our allies in the region. The purpose of this paper is to focus on China's energy equation and determine specific energy-related areas that meet these requirements.

### **THE STRATEGIC IMPLICATIONS OF CHINA'S ENERGY DEMAND**

There is little doubt that China's economic future and security are closely linked with the availability of an abundant and inexpensive supply of energy. China's economy, which experienced double-digit growth from 1990 to 1995, has continued to keep pace with the rate of the booming US economy in the late 1990's even in the face of the Asian economic crisis.<sup>1</sup> This explosive growth, coupled with a transition to a consumer economy has seriously affected China's energy balance. China, a long time exporter of oil to its East Asian neighbors, became a

net importer in 1993.<sup>2</sup> According to the Ministry of Electric Power, 20 percent of China's present demand for electrical power cannot be met, and an estimated 100 million Chinese, living in the rural areas, have no electricity.<sup>3</sup> Despite the current energy shortfalls, demand is projected to accelerate, fueled by further economic and population growth. By the year 2020, China's oil imports will increase by 43 percent over that of 2000.<sup>4</sup> Consumption of natural gas and coal, which fuel the vast majority of the country's electrical power plants, will increase by 631% and 110% respectively.<sup>5</sup> This sharply deteriorating energy equation, which is rooted in the deep desire for a higher standard of living by the average Chinese citizen, has enormous strategic consequences from an domestic, regional, and global perspective.

### DOMESTIC IMPERATIVES

Domestic considerations, rather than regional or global concerns drive the communist Chinese government's energy plans and policy. The ideological basis for the Communist Party's hold on national power has subsided. Legitimacy is now largely a function of the party's ability to sustain economic growth and continue to improve the average living standard. Up to the present, the communist government has been largely successful in this arena, but the party faces staggering challenges in sustaining the progress of the past. With its 1.2 billion people – five times the population of the United States and ten times that of Japan – China has a huge latent demand for energy that will become manifest as its economy develops further.<sup>6</sup> The problem is further exacerbated by China's population growth. If the population continues to grow at one percent-its estimated growth for 1998-China's population would increase by 12 million people per year. This is the equivalent of adding the population of Illinois, including Chicago, to the United States each year.<sup>7</sup>

The strain on China's energy supply is not based only on the size of its population. China in 2000 consumed very little energy when measured on a per capita basis. Chinese per capita energy consumption is only 54 percent of the world per capita average, an average that is already lowered by the 2 billion people of the world who do not have access to electricity or other modern forms of energy.<sup>8</sup> Stated another way, per capita consumption of energy in China is one-twentieth of that in Japan and one-thirtieth of that in the United States. As China reaches the stage at which its population will want to enjoy the lifestyle and standard of living already attained by other industrializing countries in the region, such as Japan, Taiwan, and South Korea, the demand for energy will increase exponentially. With few exceptions, the current energy grid will not support the use of major appliances nor is it reliable enough to support information systems required for the emergence of China's service industry. To approach the

living standards that currently exist in South Korea, China will need to build an energy infrastructure capable of delivering twice the current consumption of the United States.<sup>9</sup>

## REGIONAL IMPLICATIONS

The regional energy perspective is dominated by a fierce competition for energy from common suppliers. In contrast with other geographic areas of the world that have a much more favorable combination of indigenous energy resources and diversity of import alternatives, the rapidly industrializing countries of East Asia are unusually poor in indigenous energy sources and commensurately dependent on long-distance imports of oil and natural gas.

China and other East Asian nations are keenly aware of their dependence on external energy supplies and are driven toward the completion of an industrialization process that is crucially intertwined with energy use. The result is that all of the region's major players place energy security high on their lists of foreign policy concerns. These countries are in an inherent situation of energy competition on a regional basis, and this situation can only be expected to intensify should a sudden scarcity of world energy supplies occur. During 2000-2020, China, South Korea, and India are expected to increase very substantially their respective shares of Asian oil imports. By 2020, China's share of Asian oil imports might equal the share that Japan has today.<sup>10</sup>

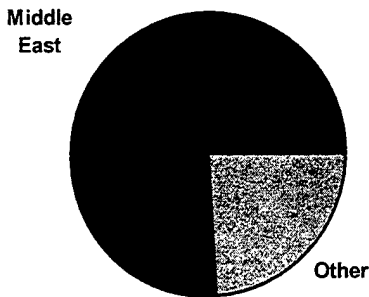
Competition for energy resources, therefore, carries a potential for escalation into armed conflict in future years. The most obvious example of this interlinkage concerns the competing territorial claims of the Southeast Asian countries in the South China Sea, where the potential for oil discovery is believed to be high. China has asserted a historical claim to sovereignty over almost the entire South China Sea, a claim that has already led to both diplomatic and actual skirmishes over the Paracel and Spratly Islands. Moreover, these disputes could disrupt oil tanker traffic transit from the Persian Gulf, which supplies 75 percent of Asian oil demand.<sup>11</sup>

## GLOBAL IMPLICATIONS

By the year 2010, world energy demand is expected to grow approximately 40 percent above current levels. Nearly half of the expected increase will come from fast developing economies of the Asia-Pacific region. China alone is expected to account for 20 to 25 percent of the total world increase in demand.<sup>12</sup> The largest looming issue, however, will be the extent of China's dependence on Middle East oil in the long term. Figure 1 shows the supply of Middle East oil to China and the region in 1998. The figures show that only 32 percent of China's oil imports originate in the Middle East. This is in stark contrast to the rest of the region, which depends on oil from the Middle East for more than three-quarters of its oil supply. This picture

could be radically altered depending on the fuel that China chooses for the government-sponsored, "people's car."

Sources of Asian Oil Imports



Sources of China Oil Imports

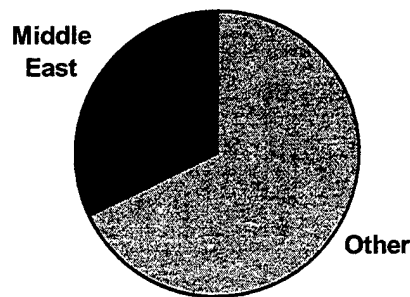


FIGURE 1: DEPENDENCE ON ASIA AND CHINA ON MIDDLE EAST OIL, 1998

If a gas-powered engine is chosen, it is clear that China risks becoming overly dependent on Middle East oil to fuel the economy. With so much at stake, the Chinese government will have little leverage in the relationship with the oil-rich countries in the Arabian Gulf, which could result in a strengthening of military cooperation and increased military sales from China to Persian Gulf states such as Iran and Iraq. This appears to be the case in the 16 February 2001 U.S. air strike on Iraqi radar sites.<sup>13</sup> According to Pentagon officials, Chinese technical experts were building a fiber-optic communications to link Iraqi air-defense radars and provide better coordination. The Chinese government denied the allegations most likely because providing military assistance to the Iraqis is a clear violation of UN sanctions against Iraq.<sup>14</sup> It is probable that oil was the main motivator in China assisting the Iraqis. This incident is a clear indicator that increasing dependence on Middle East oil will complicate China's non-proliferation commitments and widen the gap between Chinese and American global interests.

In order to avoid this outcome, China is actively engaged in diversifying their oil-supply sources and reducing considerably the share of oil in their energy mix and to increase the roles of other energy sources. The most cost-effective alternate energy sources, however, require China to deal directly with Russia or with Former Soviet Union states in Central Asia. In November of 2000, the Asian Pacific Economic Council (APEC) created the framework to support the Natural Gas Initiative, which will connect the rich natural gas resources of Russian

far east with population centers in China, Japan, and South Korea.<sup>15</sup> If these initiatives become a reality, the proposed exports of crude oil and natural gas from Russia to China could be expected to lead to closer political relationships between these two countries, with unpredictable consequences for their relations with the United States.<sup>16</sup>

A second, yet equally important global implication of China's energy situation in the long term is the environmental impact of China's energy emissions. Currently, China is second only to the U.S. in the production of greenhouse gases<sup>17</sup> but is expected to become the largest emitter as early as 2015.<sup>18</sup> Although complex and not fully understood, climate change due to production of greenhouse gases is clearly an issue of international importance. The growing international concern over global warming has resulted in the UN Framework Convention on Climate Change (FCCC), which was signed by 150 nations in 1992.<sup>19</sup> The FCCC was a non-binding agreement, signed by both the United State and China to limit emissions of greenhouse gases. Although the FCCC was widely accepted, it highlighted the dichotomy between industrialized nations and developing countries, which is often referred to as the North-South conflict.

In industrialized countries, the issue of energy production and consumption on global and regional environments has begun to displace issues of energy security and price stability. On the other hand, developing countries, which include China, can ill afford the cost of reducing fossil fuel emissions concurrent with transitioning to a market driven consumer economy. Developing countries further argue that the industrialized countries previously accomplished industrialization has caused the climate change and should therefore demonstrate a good faith effort to reduce their own emissions before asking developing countries to do so. The Kyoto Protocol of 1997 was an attempt to reconcile the differences between the nations of the North and the South. This document attempted to commit industrialized countries to fund research with the goal of achieving a technological breakthrough that would either permit continued fossil-fuel consumption and economic growth without damage to the environment, or provide cost-competitive energy alternatives to fossil fuel. Because the Kyoto Protocol did not place commitments on developing-country emissions reduction, the Clinton Administration refused to submit the protocol to the Congress for ratification.<sup>20</sup> This would appear to place the U.S. and China at the center of the North-South environmental conflict, but China's more immediate environmental concerns may provide a common ground for Sino-U.S. cooperation.

## ENERGY AND THE ENVIRONMENT

Coal, the most environmentally damaging of the fossil fuels, is the dominant source of energy in China. The country relies on coal for 75 percent of its consumption and has sufficient quantities to fuel its current demand for more than a hundred years.<sup>21</sup> Coal is the staple fuel for primitive stoves used for cooking and heating in the vast majority of homes throughout the country. Additionally, most power plants that supply the energy grid are mostly coal-fired plants that are old, inefficient, and without modern cleaning equipment.<sup>22</sup> As a result of this combination, much of China's urban citizenry suffers from particulate pollution indoors and outdoors that is visible and irritating to the eyes, throat, and lungs. A study of five major urban areas in China found that airborne particulate levels are two to five times the maximum deemed acceptable by the World Health Organization.<sup>23</sup> In the comprehensive World Bank-lead study of air and water pollution in China, it was estimated that annually 400,000 premature deaths occur due to poor air quality and costs the Chinese economy \$54 billion, or 8 percent of GDP, in health effects.<sup>24</sup> China's version of the Environmental Protection Agency estimates that sulfur and acid deposition, which are byproducts from coal combustion, erase 2 percent of GDP by reducing crop productivity and damaging exposed infrastructure.<sup>25</sup> Simply put, it is no longer in China's economic interest to ignore the effects of pollution.

### ENVIRONMENTAL ASSISTANCE: THE FIRST STRATEGIC OPPORTUNITY

The Chinese Communist Party (CCP) regime has become acutely aware of the impact of fossil fuel emissions on the economy and the general population. This is evident in the Chinese government's effort to develop alternative energy sources such as clean burning natural gas, nuclear power, and hydroelectric power. Full development of the first two will require cooperation with foreign governments in addition to capital and technology available only in industrialized nations. The CCP's commitment to minimizing the environmental effects, driven by domestic concerns, coupled with international concern over China's contribution to global warming, are compelling reasons for the CCP to be receptive to cooperative ventures with the U.S., either bilaterally or multilaterally, to develop alternative energy sources.

In addition to providing a common ground for cooperative efforts, joint environmental efforts can provide lucrative business opportunities for U.S. environmental companies. According to the Peoples Republic of China's State Council's Ninth Five-Year Plan, the CCP plans to expend a total of \$54 billion on pollution control.<sup>26</sup> In the short term, the most promising environment-related energy business opportunities are those that focus on technology that reduces pollution from coal combustion, particularly desulfurization technology.

These include industries that produce high efficiency sulfur scrubbers, efficient boiler technology, and dust control equipment that have long since matured in the U.S. domestic market.<sup>27</sup> Another smaller yet promising business sector is the environmental monitoring and analytical equipment/analytical services sector. Entry into this market has precedence as a major proportion of multilateral and bilateral technical assistance funds support this type of work and invariably contain a budget for purchase of foreign equipment.<sup>28</sup> This offers immediate opportunities since many of the legal and cultural barriers that have discouraged foreign investment in China in the past have already been successfully navigated.

Achieving success in the Chinese environmental market will require American businesses to seek out areas where there is a determination to achieve international solutions and standards. These companies must also devise strategies that do not demand immediate returns but aim at long-term rewards.<sup>29</sup> Both conditions are highly dependent on U.S. commitment to long-term engagement with the CCP. Additionally, the U.S. government will need to initiate measures, such as tax incentives, to encourage investment in the Chinese environmental sector.

The environmental industry, while the most promising in the near term, reflects only a small percentage of the potential opportunities available to American businesses in China's energy sector. The power-generating sector is potentially more lucrative, is on a much larger scale, will take a great deal more capital, and offers the greatest returns in terms of U.S.-China cooperation. This opportunity can only be fully appreciated in the context of the geopolitical landscape of the Northeast and Central Asia's energy equation.

## **GEOPOLITICAL FACTORS AFFECTING CHINA'S ENERGY EQUATION**

Within Asia's vast land there are extensive fossil fuel resources. However, the uneven distribution of oil and gas resources within the region is at the core of every barrier in tapping these supplies for use in China's domestic market. Most are far from major population centers and economic growth. Transportation systems on Asia's mainland are insufficient to provide a cost competitive alternative to coal and will require an alternative distribution system that will rely on interstate cooperation. Onshore, the largest gas and oil reserves are found in the Central Asian states and Russian Far East Asia. Promising offshore energy resources abound in the East China Sea and the South China Sea. Although abundant, the region's diversity in politics, stages of economic development, and location of major energy resources make development of these resources a complex international, financial, and industrial issue.

## THE PROBLEM WITH PIPELINES

The U.S. Department of Energy reports estimates of 10-17 billion barrels of proven oil reserves and 53-83 trillion cubic feet of natural gas in Kazakhstan and 98-155 trillion cubic feet of natural gas in Turkmenistan.<sup>30</sup> Sakhalin Island, which sits on the rim of the Sea of Okhotsk, has estimated natural gas reserves of up to 223 trillion cubic feet.<sup>31</sup> In each case, supply to China will require the construction of a cross border pipeline from Russian or from states that are heavily influenced by the Russian Federation. The dependency of the gas and oil-rich Central Asian states on Russia is a legacy of the Cold War. The energy infrastructure, which was created under the Soviet regime, is designed to carry gas and oil into Russia where it is then distributed to the energy starved FSU states in Eastern Europe<sup>32</sup>. The energy flow, therefore, is controlled by Russia and is used as leverage in relations with both the energy suppliers in Central Asia and the energy consumers in Eastern Europe. A pipeline bypassing Russian territory is a direct threat to Russia's energy monopoly and represents the most significant political hurdle to pipelines that supply natural gas to China from Central Asia.

A second impediment is the instability of the Russian government and the fledgling governments in Central Asia. According to findings of the Asia Pacific Economic Council (APEC) Working Group,<sup>33</sup> public finance cannot fully meet the enormous capital requirements to build a natural gas infrastructure, and will require mobilization of the private sector. In China's case, a weak internal financial system makes it necessary for the required capital to be supplied from foreign sources.<sup>34</sup> Foreign investment, which is typically offered to exploit energy resources as rich as those found in Central Asia and the Russian Far East, has not been forthcoming. Studies by APEC show that foreign investment will not appear in earnest until the "establishment of stable, transparent, independently administered, predictable and non-discriminatory legal, fiscal, regulatory and trade regimes that will consider the interests of all the participants."<sup>35</sup> The Asian Development Bank estimates that the "independent administration" mentioned in the APEC statement will cost 70 billion dollars,<sup>36</sup> nearly as much as China is spending for construction of the Three Rivers Gorges Project. Given the high startup cost and the region's historical lack of successful multilateral cooperation, and the lack of post Cold War governmental stability, it is unlikely that these preconditions will exist in the near term.

## TREASURE ISLANDS?

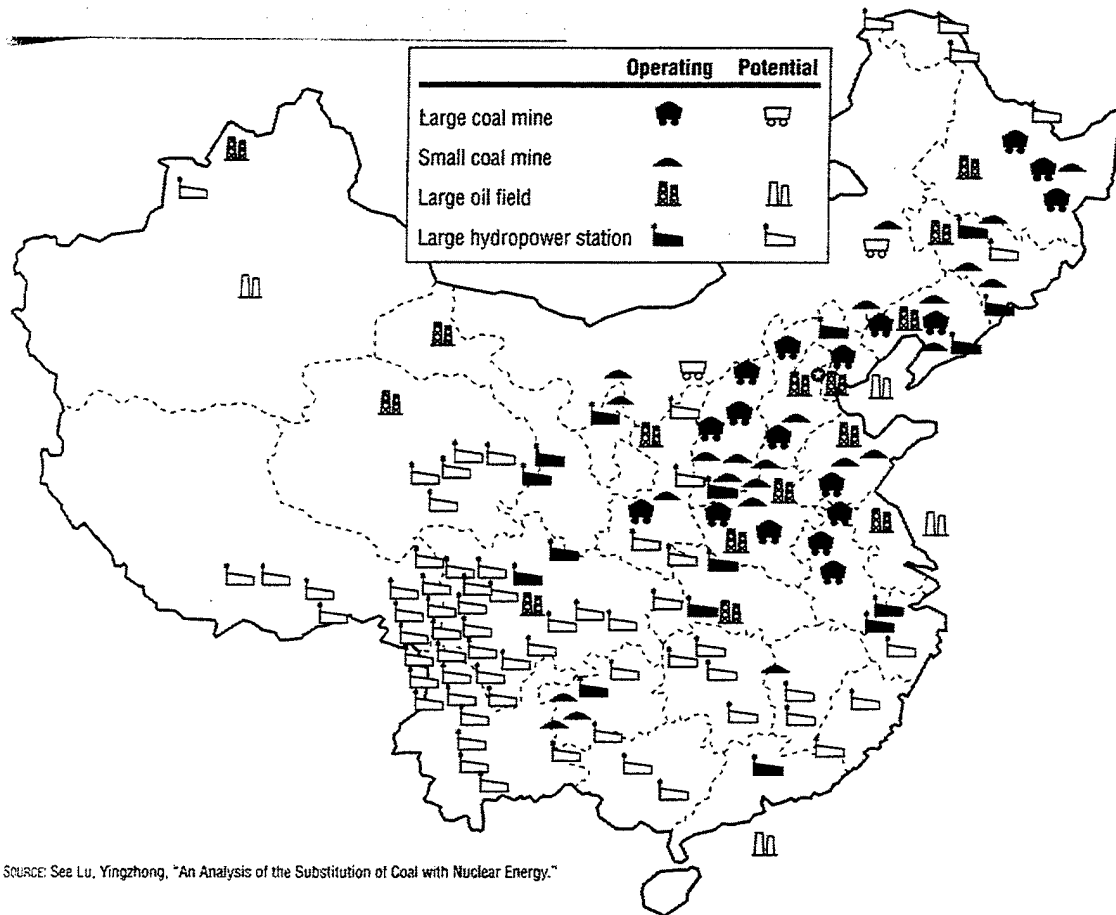
Offshore, the political obstacles are equally challenging. Exploitation of potentially rich reserves in the East China Sea and the South China Sea are constrained by overlapping claims of island chains with neighboring states. The most contentious dispute is over the Spratly

Islands, which are claimed in whole or part by China and five other nations. The Spratly Islands are situated in the southern part of the South China Sea and are comprised of 230 shoals, reefs, and small, uninhabited islets that encompass nearly 150,000 square miles.<sup>37</sup> Ownership of the Islands would improve China's energy outlook in two ways. It would more than double offshore areas available for energy development and would influence the sea lines of communication to the Middle East oil wells.<sup>38</sup> The complexity of the conflicting claims, however, rule out an environment conducive to energy exploration and development in the foreseeable future.

The situation is similar in the East China Sea. In the southern reaches, the Senkaku Islands, which consists of eight uninhabited islets and rocks without vegetation, is the center of a three-way dispute between China, Taiwan, and Japan. Possession of the island would confer title to 15,000 square miles, which encompasses three potential major oil bearing sub-basins with an estimated potential of 10-100 billion barrels of oil.<sup>39</sup> Japan is hesitant to resolve the issue in fear of disrupting a strong economic relationship with Taiwan. Both have agreed to the Deng Xiaoping Plan,<sup>40</sup> which leaves the dispute to future generations for resolution. In other words, exploration of the area will not proceed until the larger issue of Taiwanese independence is resolved. At the northern part of the East China Sea, China must compete between conflicting loyalties on the Korean Peninsula. In the past, China recognized North Korea as the only legitimate Korean government, and therefore disputed the outer boundaries of all South Korean claims.<sup>41</sup> More recently, improved relations between China and the ROK has shown some promise, but offshore boundary settlements will probably be linked to a resolution of the nuclear weapons issues on the Korean Peninsula.<sup>42</sup>

## **CHINA'S DOMESTIC ENERGY OPTIONS**

The majority of domestic energy sources is also far removed from China's population centers, and suffers from the limitations of a poor quality transmission network, insufficient exploration, and an inadequate transportation system. The net affect of these limitations will require China to look outward for capital and technology.<sup>43</sup> Figure 2 shows the distribution of all domestic energy sources with the exception of nuclear power.



SOURCE: See Lu, Yingzhong, "An Analysis of the Substitution of Coal with Nuclear Energy."

FIGURE 2 ENERGY PRODUCTION BASES IN CHINA

## COAL

Although coal is available in abundant quantities, the geographic mismatch between coal production and consumption centers requires the transport of hundreds of millions of tons of coal each year. Nearly 40 percent of China's railway capacity is dedicated to the transport of coal, which significantly constrains the use of railway systems for other economic activity.<sup>44</sup> The best coal, which has a high heat content and low sulfur content, is mined primarily in the northern provinces of Shanxi, Heilong, and Shandong. Coal from the southern regions is far less suitable because of a high sulfur content and contains more than 25 percent ash, which are the main culprits in the environmental cost of coal emissions.<sup>45</sup> In addition to limited rail capacity, exploitation of the northern reserves is exacerbated by the rugged terrain.

China plans to overcome the transportation limitation by building new power plants close to the coal mines. Electricity could then be transported via high voltage power lines to regional

demand centers. Because of the transmission line losses, however, demand centers in the eastern and southeastern areas will not benefit from these new facilities.<sup>46</sup>

## OIL

Oil and gas reserves sufficient to ease China's energy crunch are located predominantly in remote northern and northwest areas of the nation, roughly 1500-2000 miles from the coastal areas where economic growth and demand is the highest. Development of oil and gas resources is compounded by the high cost of exploration and development in the harsh environmental conditions and challenging geological formations typically encountered in the remote areas.

China's developed oil fields in the east and the near shore areas have matured.<sup>47</sup> Offshore exploration efforts to date, which have been funded largely by European and American oil companies, have not produced significant discoveries. Contract disagreements with the Chinese government and periodic fluctuations in world oil prices have slowed the pace and scope of development.<sup>48</sup> Cumulatively, these problems have caused China's domestic oil production to stagnate. Production levels have been nearly constant since 1995, during which oil supply met only 17 percent of indigenous demand.<sup>49</sup> By 1998, demand had increased by nearly 30 percent, nearly all of which was satisfied through increased oil imports from the Middle East<sup>50</sup>.

## NATURAL GAS, THE SECOND STRATEGIC OPPORTUNITY.

Although tapping domestic natural gas faces the same distribution problems as oil, the Chinese government is intent on increasing the percentage of natural gas in the energy mix. Natural gas offers the best combination of low emissions and high potential for substitution for oil in the industrial sector, and is ideal for the China's energy balance and environmental concerns. Unlike coal or oil, natural gas combustion produces virtually no sulfur dioxide and particulate emissions<sup>51</sup>. This combination has proved irresistible to the Chinese government who is now moving forward with several ambitious initiatives to bring natural gas from the remote northwest and beyond to the heavily populated southeast coast.

Construction is already underway for a trans-China gas pipeline that will run from Xinjiang province in western China to Shanghai on the east coast.<sup>52</sup> The 12 billion-dollar pipeline, which represents investment by the Chinese government second only to the Three Gorges Project, has a dual role. It can serve as an extension of an 1800-mile pipeline proposed by China that will extend from western Kazakhstan to Xinjiang,<sup>53</sup> or it can serve as a conduit for large undeveloped gas deposits in Xinjiang's Tarim Basin. According to the China Natural Gas and

Petroleum Corporation, there are nearly 30 trillion cubic feet of natural gas deposits in Xinjiang's Tarim Basin,<sup>54</sup> but extraction of the gas reserves is extremely difficult. Seismic exploration is aggravated by sand dunes thirty to forty feet high, rivaling those of Saudi Arabia. Tarim's wells are the deepest in the world-on average twice the depth of those in Saudi Arabia. The geological formations are very old, resulting in faults that fragment deposits into small, hard to find pockets. All this makes Tarim exorbitantly expensive to drill.<sup>55</sup>

Political barriers will most likely defeat China's effort in making a Kazakhstan/Xinjiang pipeline a reality in the near term. Until then, China will be eager to exploit Tarim's natural gas resources. New technology can lower the cost of finding and using natural gas. Three dimensional seismic imaging and horizontal drilling technologies,<sup>56</sup> which are widely used by U.S. energy firms, can significantly improve the chances of finding and developing profitable gas fields in Tarim's challenging environment. If exploitation is successful with the aid of U.S. technology and capital this will make a considerable contribution to the satisfying China's domestic demand. This situation is the second energy related strategic opportunity for the U.S. to engage China through U.S. companies.

#### HYDROELECTRIC POWER

China has the most abundant hydropower resources in the world with an estimated exploitable capacity of 379GW,<sup>57</sup> nearly twice the country's total electrical power generating capacity. As is the case with other domestic energy sources, China's hydropower resources are not uniformly distributed. Seventy percent of exploitable resources are in the southwest and 10 percent are in the northwest.<sup>58</sup> Therefore, long distance transmission lines become a limiting factor.

Three Gorges Project, which has been highly touted by the Chinese government, has in fact only frustrated efforts to tap the full potential of hydropower. The roots of the project are political rather than scientific. Mao was intensely interested in mammoth projects and had written a well-known poem on the "Three Gorges Dam" which eventually evolved into a political mandate.<sup>59</sup> Because of the political pressure, the project was begun prematurely, without consideration of cost effective alternatives and without adequate planning. The end result has been enormous cost overruns, and construction on more favorable sites with 5.6 times the capacity of the Three Gorges project, has been postponed because of lack of funds.<sup>60</sup>

#### RENEWABLE ENERGY SOURCES

Renewable energy sources, such as wind, solar, and geothermal are attractive because of the low environmental impact and the relatively low cost of construction. But because of the

low-energy density of these sources, their usefulness is limited to specific uses and location. For example, 60 square kilometers of solar cells or windmills would be needed to generate the output of a single relatively small power plant. Good sites for renewables, such as thermal, can be found in the remote areas of Tibet and Yunnan, where coal and oil reserves are lacking.<sup>61</sup>

Although the use of solar energy in residential building has been highly publicized in the Chinese press, the Chinese government is well aware of the limitations and has devoted only a paltry \$150 million dollars towards the project.<sup>62</sup> Large-scale expansion of renewable energy resources will not occur until there are significant advances in the technology.<sup>63</sup>

### NUCLEAR POWER; THE THIRD STRATEGIC OPPORTUNITY

Nuclear power has several significant advantages of over other energy sources in China's current energy situation. First and foremost, nuclear power circumvents the problems of long distance transmission and is not dependent on China's substandard transpiration system. Nuclear power plants can be built next to population centers and do not require a natural resource to be transported in large quantities for power generation. Secondly, nuclear power offers the Chinese government self-reliance, as operations are independent of cross border pipelines, on oil wells in contested offshore areas, or on imports from the Middle East. Finally, nuclear power plants do not emit harmful gases in the power generation process.

The stigma of radioactive waste and the "China Syndrome" effect that most Americans associate with nuclear power does not apply in China.

"The attitude of many Chinese environmentalist is somewhat different from that of their Western colleagues. Every kind of energy has its environmental impact. If one has to choose one evil over another, the more annoying one (in this case, coal) will be condemned. The Chinese public also prefers nuclear heat and electricity to suffering in a freezing house in the winter and frequent blackouts. As a result, the prevailing global anti-nuclear atmosphere is rather weak."<sup>64</sup>

Thus, many of the political hurdles to constructing nuclear power plants in the U.S. are generally not encountered in China.

Currently, nuclear power represents only one percent of China's total power generation capacity, but China has an ambitious plan to boost this share to four percent by 2010. Currently, three nuclear power plants are in operation and eight more have been ordered. All but one of these plants have been the result of joint ventures with France, Canada, and Russia.<sup>65</sup> But the capacity of these plants is well below that needed to reach established goals in nuclear power generation. Meeting goals will require an additional nuclear capacity of 2,400

megawatts a year. This is equivalent to ordering a new nuclear plant (with two reactors) every year.<sup>66</sup> This shortfall is the third strategic energy-related opportunity.

#### ADVANCING U.S. INTERESTS THROUGH COOPERATIVE NUCLEAR COMMERCE

Nuclear cooperation with China can significantly advance U.S. interests in several ways. Increasing nuclear power in the energy mix will aid in minimizing the environmental impact of China's current energy trajectory. Greenhouse gas from fossil fuel emissions that contribute to global warming can be reduced.

Reactor safety of the Chinese nuclear power can be enhanced through the association with the U.S. nuclear industry. The newest technology from the United States is clearly safe and is based on infrastructure with the most operating experience in the world. The U.S. industry has developed a standardized, advanced light-water reactor that has been designed to be safe, more reliable, and more cost competitive than any other existing technology. The most effective method to enhance safety is to use "families" of standardized reactor designs. Standardization facilitates effective and efficient engineering, procurement, training, operations, and maintenance, and quality assurance programs. It also facilitates the establishment of an effective regulatory regime for regulating a rapidly growing nuclear program. If China were to standardize its program using the U.S. designed light water reactor, nuclear safety worldwide would be enhanced.<sup>67</sup>

The economic benefits of cooperation could be considerable. For example, the two new French plants at Ling Ho are worth \$2.7 billion to Framatome, and the Canadian order (2 plants) is valued at \$3 billion. If the U.S. nuclear industry were contracted to build plants at a rate necessary to fill China's nuclear generating shortfall, it is estimated that such a market could produce more than \$1.6 billion per year in U.S. exports to China. Additionally, more than 25,400 U.S. technical jobs would be created and sustained by those exports.<sup>68</sup>

The most crucial U.S. interest is national security. Engagement through cooperative nuclear commerce can serve as a basis to encourage or persuade the Chinese government to adhere to non-proliferation regimes, which is necessary to halt the spread of weapons of mass destruction. Cooperation with China could afford a continuing dialog and may provide opportunities to put in place a strong infrastructure and controls to create the culture necessary for a solid nuclear non-proliferation scheme.<sup>69</sup> At a glance, this may appear to exacerbate the non-proliferation efforts. It should be noted, however, that China already has a nuclear industry and will get advanced nuclear technology with or without U.S. assistance.

## ENGAGING U.S. COMMERCIAL FIRMS

In summary, there are three energy-related opportunities the United States could exploit to initiate bilateral cooperation with China. In each case, the United States, through commercial U.S. firms provides capital and technology to the Chinese on their most pressing energy issues. The energy opportunities are a listed below.

- Environmental Engineering. The Chinese government needs capital and technology to combat the high economic cost of fossil fuel emissions.
- Capital and Technology for exploration and development of the Tarim Basin. The Chinese government is building a costly 1800-mile pipeline from Tarim to Shanghai. The Chinese government needs the seismic imaging and horizontal drilling technology resident in U.S. energy firms to fully realize the potential of the Tarim Basin.
- Construction of Nuclear Power Plants. Nuclear Power plants can be built next to population centers circumventing the need for long distance transmission associated with other domestic energy resources. Additionally, the quality and safety of U.S. nuclear technology is attractive to the Chinese government.

U.S. commercial firms will participate only if a Washington's energy engagement strategy is aimed at leveling the playing field for the U.S. companies that decide to enter the Chinese energy market. The goal should be to lift barriers to foreign investment and to minimize financial risk incurred through local (Chinese) competition in the long run. The U.S. should provide tax incentives to participating U.S. firms to offset the long lead-time expected to make a profit in China's energy market.

With the backing of the United States government, U.S. energy industry sectors should realize a return on investment in the longer term that is commensurate with their domestic enterprises. The American economy will benefit directly through the creation of highly technical jobs, which on average, produce salaries 13 percent higher than non-exporting jobs in the United States.<sup>70</sup> Indirectly, domestic energy costs can be reduced because of the economies of scale that will be provided by the large Chinese energy industry. Conversely, if the United States is sidelined from the Chinese energy market, the principal economic effects will be felt in two places: the United States, through loss of jobs and revenues, and abroad, as U.S. competitors gain the same jobs and revenue.

## **CONCLUSION**

If exploited, these opportunities will not erase China's energy shortfall but will provide a common ground to establish broader energy cooperation. On a broader scale, energy-related dialog with the Chinese government can have a profound impact on U.S. global interests and on our allies in East Asia. The risks of inaction are high. Over reliance on Middle East oil imports may cause China to depart from non-proliferation schemes, which directly conflicts with U.S. interests in southern and southwest Asia. If left unchecked, the severity of China's skewed energy equation could threaten internal stability.

Engagement with China via an energy scheme is unique in that it is void of ideological conflict and sidesteps the issue of Taiwanese independence, which has crippled U.S.-China bilateral relations for the last 50 years. Additionally, energy initiatives will not likely have a negative impact on bilateral relations with our allies in the region because they are dependent on the same energy imports as China. Given the domestic imperatives, China should be receptive to any bilateral cooperation that offers a long-term solution to domestic energy constraints. The stakes are high, but engagement with China via energy related issues have a high probability of success with relatively low risk.

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