China's Energy Security and the Climate Change Conundrum

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China is an energy superpower. It is the world's second largest consumer of energy after the United States and already accounts for about 14 percent of total greenhouse gas emissions (GHGs)—the second largest emitter in the world. As the world's workshop and the most populous nation, China's appetite for energy today will pale in comparison to its estimated need in the future. To fulfill its declaration of building a *Xiaokang Shehui* ("well-off society"), China aims to quadruple its gross domestic product by 2020. This means that the equivalent of three more economies the size of present China will be added in less than two decades. Judging from recent figures, China's GDP is growing consistently toward that goal. Chinese researchers project that energy needs will more than double during that period, presenting a formidable energy and environmental challenge not only for China but for the whole world. How China supplies its growing energy needs will have an enormous effect on global energy security and climate change in the coming decades.

During the past three years, China has accounted for one-third of global economic growth, twice as much as the United States. To fuel its breakneck economic growth (at around 9 percent per year) and the ever-increasing demands of its emerging middle class, China is voraciously demanding energy, a demand that is beginning to spiral out of control. China is gobbling up coal, electricity, oil, and other raw materials. In 2003 alone, China consumed more than 40 percent of the world's cement output, and was responsible for one-third of the world's growth in oil consumption and a staggering 90 percent in steel demand.

China's transportation sector is also developing rapidly. Although in the last few years it was responsible for only 9 percent of China's energy-related carbon emissions, this figure is likely to grow dramatically. In the early 1980s, China had only a small number of private cars. This sector is growing spectacularly fast because rising incomes make cars more affordable to the growing middle class. By 2002, China had 10 million private cars, a number which may mushroom to as many as 150 million by 2015—18 million more than were driven in the United States in 1999. In 2003 alone, there was an increase of more than 80 percent of the number of cars sold over the previous year. This was due in no small part to the government's policy of growing its auto sector, which China sees as "an engine of economic growth" (no pun intended). Another part of the transportation sector, the airline industry, is often overlooked as a major energy consumer. China, which has the largest number of scheduled passengers in Asia, is expecting a 200 percent increase between 1999 and 2014.

The energy consequences of China's explosive growth will be a massive increase in demand for all forms of energy. China's energy consumption already rose by 14 percent in 2003. To put this into perspective, China is adding the energy consumption equivalent of one middle-sized country every two years. By 2015, transportation fuel consumption is expected to quadruple. Last year, China overtook Japan as the world's second-largest oil consumer. Chinese oil demand is expected to grow by an average of 5.3 percent per year through 2025, largely for automobile consumption. Thus, China, which according to recent International Energy Agency estimates consumes more than 6 million barrels each day, will continue to be "the driver" of world oil demand.

The world's most populous country, China is also spending billions of dollars on electric power generating projects. About 70 percent of the new power plants in the world are being built in China, adding new capacity at a frantic rate to the existing 385 gigawatts (GW). In 2003, the central government approved more than forty power stations, thereby adding 30 GW in new capacity. Another 37 GW of new power is expected to be added in 2004. Yet, despite these gargantuan efforts, China is still struggling to keep the lights on. Last year, nearly two-thirds of the provinces and autonomous regions of China experienced varying degrees of blackouts. In 2004, with the exception of remote Xinjiang province, Hainan Island, and three provinces in the Northeast, China suffered chronic blackouts and electricity rationing during the first half of the year. Tens of thousands of factories in the eastern provinces were forced to cancel production because of power cuts; shortages are expected to plague industry into the foreseeable future. Concerned by this growing shortage, foreign investors are considering building their own generation and are seeking preferential treatment in electricity supply from local governments.

Demand is likely to outpace supply for a while; the 2004 gap is between 20 GW to 30 GW and will widen over time. Although China's leaders are taking steps to cool down the economy, to avoid repeating the boom and bust events of a

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decade ago and to achieve a "soft landing," the expected increase in energy demand will continue even with a more sustainable but respectable 6 percent to 7 percent GDP growth.

How and where will China get the energy to meet the demand of such phenomenal growth? China, endowed with rich resources of coal, has the dubious distinction of being both the world's largest producer and consumer. Historically, coal has supplied more than 70 percent of China's energy needs, although coal's share of domestic energy consumption has reportedly declined from 76 percent in 1990 to 66 percent in 2000. In the late 1990s, the government began shutting down small, inefficient coal mines both for environmental and safety reasons and for economic reasons—oversupply threatened large state-owned mines. Even so, overall coal consumption in absolute terms is expected to continue to rise (it grew by 15 percent in 2003) and dominate the energy mix well into the future.

Much of China's total coal supply is relatively low quality. But its proven reserves, 114,500 million tons at the end of 2003 (the third largest in the world), are believed to be sufficient to satisfy current demand for several hundred years. These abundant coal resources, however, are located primarily in the north, central, and southwest parts of the country; transforming those resources into energy and transporting them to the centers of demand in the southern and eastern coastal provinces is problematic. Moreover, drastic domestic air pollution from coal combustion and international environmental concerns over coal use make China's long-term reliance on this resource simply unsustainable. Thus, China has established a goal in its Tenth Five-Year Plan (2001–2005) of reducing coal's dominance by increasing the share of cleaner-burning, more efficient fuels: natural gas, oil, nuclear power, hydropower, and renewable energy.

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Natural gas has not been a major fuel in China. Proven reserves were listed as 53.3 trillion cubic feet (Tcf) at the beginning of 2004, approximately 1 percent of the world total. Most of these reserves are located in the southwest, central, north, and off-shore regions. They remain largely undeveloped as a result of lack of investment, infrastructure, and technology. Natural gas currently accounts for only about 3 percent of total energy consumption in China. However, with China seeking to realize the environmental benefits of using natural gas (as opposed to dirtier forms of fossil fuels like coal), consumption is expected to more than double by 2010. Thus, in the late 1990s China embarked upon a major expansion of its gas infrastructure, eager to find significant new discoveries. Considerable investment will be needed to develop these resources, build transport and distribution infrastructure, and create natural gas markets. Gas production is expected to grow most rapidly in the northern region and offshore. Completion of the 4,200 kilometer West-to-East gas pipeline project from Xinjiang Province in far western China to Shanghai is by 2007. An East China Sea natural gas development project, which began in 2000, is expected to produce 10 billion cubic meters per year by 2010. China is also actively pursuing imports via pipeline and liquefied natural gas (LNG).

China's proven oil reserves as of the end of 2003 were 23.7 billion barrels (bb), just 2.1 percent of the world total. Some experts suspect that production has peaked in 90 percent of China's domestic fields and is now in decline or will reach a plateau in the next decade. China became a net oil importer in 1993 and, like the United States, has become more dependent on foreign oil. With imports expected to continue to grow for decades, China is diversifying its sources by investing both in exploration in the Middle East and Africa as well as in building pipelines from Central Asia and Russia.

While nuclear power has not played a major role in the past, China plans to significantly expand this sector in the coming decades. Total installed capacity increased from 2.1 GW at the beginning of 2002 to 8.7 GW in 2004. China hopes to generate 32 GW to 50 GW by 2020. These ambitious plans face significant financial and technical barriers, but even if the proposed plants were to come on line, nuclear power would only supply about 4 percent of China's 2020 electricity needs.

As to renewable energy, China has the most abundant hydropower resources in the world. However, most of this potential is located in the southwest, over 900 miles away from load centers of coastal China, in rivers heavily laden with silt. Although only 79 GW of installed capacity has been developed, China's most ambitious hydropower project, the Three Gorges Dam, is expected to provide 18 GW of capacity when fully operational in 2009. This project has been controversial because the 372-mile long reservoir will block the third longest river in the world (the Yangtze), displace more than 1 million people, flood m ore than 240,000 acres of productive crop land, and submerge more than 1,000 archeological sites. There is growing sensitivity to opposition from local and international groups over significant environmental impacts from larger projects, as evidenced by Premier Wen Jia Bao's recent suspension of the massive Nu River Dam project. As a result, although China plans to aggressively pursue hydropower projects, the expected trend is toward mostly medium and small plants (<300 MW). Despite new hydro additions, China's energy resources will be inadequate to satisfy its 1.3 billion population, growing 10.4 million per year, and its rapidly expanding economy. According to the Energy Foundation, just the expected increase in new air conditioners over the next five years will absorb the entire

electricity output of the massive Three Gorges Dam.

China is rich in other renewable resources such as wind, solar, geothermal, small hydropower, and biomass. Except for small hydroelectric projects, renewables have played only a minor role in total energy supply and have been used primarily in remote regions. The government, however, recently initiated efforts to promote renewables development, announcing the goal of generating 10 percent of China's electricity needs from renewable sources by 2020 (mostly from small-scale hydro projects). The largest increases, other than small-scale hydro, are expected to come from wind power. Such enthusiasm is also reflected in China's promotion of the 2008 "Green Olympics" where some facilities will be powered by wind, solar, and geothermal energy. It remains to be seen whether China can actually meet the 10 percent renewables goal.

China's Impact on Global Energy Security and Climate Change

So what is the significance of China's current and future energy mix and how will it affect the rest of the world in the coming decades? China is shaping the world's energy and geopolitical landscape. The widening gap between China's limited domestic fossil fuel energy supply and its huge and rapidly growing energy demand is a fundamental threat to global energy security and climate change. Coal will remain the largest fuel source in the overall energy mix, while oil will continue to be of critical importance to China's energy security. However, if China continues its "business as usual" trajectory, satisfying China's soaring demand may destabilize global energy markets and create irreversible climate impacts. Thus, China's policy direction in the development of cleaner sources of energy such as natural gas, hydro, and renewables will play a significant role in determining the sustainability of future energy supply.

Traditionally, China's energy policy has been largely based on the Maoist principle of self-reliance, "*zili gensheng*." The oil city of Daqing, once the national symbol of self-reliance, proudly supplied much of China's domestic needs. Energy was, therefore, not a significant security concern. In fact, China was a net oil exporter little more than a decade ago. But since 1993, as production at the ageing Daqing field began to decline, China became a net importer and is now the world's third largest. Some experts worry that by 2020, China's need for crude oil imports may equal Saudi Arabia's total current output.

In light of domestic production constraints, China worries about its vulnerability to price volatility in international markets and supply disruptions. At present, China imports about one-third of its oil requirements and expects to import one-half by 2010. Of this, around 60 percent comes from the politically unstable Middle East (mostly Iran, Saudi Arabia, and Syria) and is expected to increase to around 80 percent by 2010. These imports traverse the Malacca Strait, a supply route notorious for piracy. Recognizing these security concerns and the need to diversify its sources, China has been negotiating with Russia and Kazakhstan to build oil pipelines. Although one proposal, a pipeline from Angarsk in Russia to Daqing may not materialize, another pipeline from Central Asia to China, which had made little headway because of cost concerns, is back on track. In May 2004, China and Kazakhstan signed an agreement for the construction of a 1,000-kilometer section that will bring both sides closer to completion of a 3,000-kilometer oil pipeline. Chinese President Hu Jintao also recently visited three energy-exporting African nations—Egypt, Gabon, and Algeria—to secure oil sources and build energy relationships for the future. In addition, China is reportedly constructing a seventy-five-day-capacity strategic petroleum reserve, with completion expected by 2010.

China is also stepping up its use of cleaner natural gas. A Chinese-led consortium is building a gas pipeline from the remote northwestern Xinjiang region to Shanghai, the country's commercial capital. There is also a preliminary agreement with Iran to buy US$29 billion worth of LNG over twenty-five years in one of the biggest deals of its kind. China's first LNG terminal, due for completion in 2005, is currently under construction in the southern province of Guangdong, and a second terminal will come on line in 2007 in neighboring Fujian. According to a Chinese industry official, China may build up to nine LNG terminals in the next few years.

The security dimensions of China's demand for energy imports affects both China and the rest of the world. Although some experts are optimistic that the growing demand in China will be easily offset by increased supply from Central Asia and Russia, uncertainty about political environments and the uncertainty of when those resources may peak make evaluating the likelihood of these potential energy sources complicated. The rising demand from fast-growing China may shift the political and economic dependence of many Middle Eastern oil producers from the West to East Asia. China has already joined the European Union, Russia, and the United States in taking a significant interest in the Middle East to ensure a reliable and stable flow of oil. In addition, China may also start flexing its military muscles in the South China Sea over the oil and gas reserves off its coast and those of neighboring countries. The shift in centers of global demand may make national economies more vulnerable to supply disruptions and price shocks, and may increase the risk of resource conflicts and competition between countries, such as China and the United States. This year's price spikes at our gas pumps are partly a result of China's increased thirst for oil.

China's impact on global climate change is equal to if not greater than its impact on global energy security. After the United States, China is the second largest emitter of GHGs, about 14 percent of world total. World carbon dioxide (CO_2) emissions are estimated to have risen 4 percent in 2003, with one-half of the growth from China. Therefore, we cannot even begin to solve the problem of climate change without addressing China's GHG emissions. Although China's emissions intensity (GHG emissions per unit of GDP) has been falling, its absolute emissions contin-

ue their upward trajectory; depending on its growth path, China's GHG emissions may exceed the industrialized world's within the next twenty-five years.

CO_2 accounts for about 90 percent of total GHG emissions in China, with the bulk of emissions coming from the large state-owned industrial and power sectors. Coal is the primary source of GHGs in China, contributing up to 75 percent of CO_2 emissions. As coal is the most abundant and the least expensive domestic fuel resource in the country, it will continue to play a pre-eminent role in the energy mix and hence China's industrial development. Given China's stated goal of quadrupling its economy by 2020, this poses an enormous threat to the global climate. As the world increasingly sees China as the environmental keystone in the climate change conundrum, there will be growing international pressure on China to reduce GHG emissions.

As China gradually moves away from a planned economy, curbing its "carb" appetite will become a great challenge because it cannot afford to slow growth significantly to reduce energy demand. China's most urgent and overarching priorities are social and economic development and the elimination of poverty. The march toward a "well off society" is already in progress and China has little choice but to maintain rapid economic growth to provide for its burgeoning population. In other words, unless it can shift to a low-carbon development path, China will continue to rely heavily on coal and other fossil fuels.

The relationship between energy consumption and GHG emissions can vary significantly depending on whether or not China adopts aggressive policies to optimize power generation, improve energy efficiency and increase the use of renewables today. According to some experts, with appropriate policies, China could cut 1 billion tons of coal by 2020 by growing its fossil energy use at a far slower pace than economic growth. Carbon emissions could drop over 40 percent such that, by 2020, its per capita carbon emissions will be less than 1 ton, about 33 percent of OECD countries' and 93 percent of the world's average.

China acknowledges that its long-term energy security and climate change challenges could be serious impediments to its necessary objective of quadrupling GDP by 2020. There is an urgent need to go beyond short-term measures. China must not only increase regional energy cooperation in cross-border power and gas projects but, most importantly, it must significantly invest in clean energy technology, the development of renewable energy sources, and in energy-efficiency markets to achieve national self-reliance and a sustainable energy future.

The Great Leap Forward to a Low-Carbon Path

China's attempt to leapfrog to a low-carbon path raises great challenges but also brings new development opportunities. Driven primarily by concerns for energy security and fuel cost savings, and secondarily by a desire to reduce GHGs, China has launched a great leap forward to a more sustainable energy future. China is a party to the United Nations Framework Convention on Climate Change, and in 2002 ratified the Kyoto Protocol, committing itself to a low-carbon path. Consistent with these international commitments, China has aggressively adopted policies and implemented programs to encourage foreign direct investment to improve energy efficiency and promote renewable and clean energy technologies. One of the most significant policies is derived from the Kyoto Protocol's Clean Development Mechanism (CDM), which allows developed countries (Annex I Party) to invest in cost-effective projects aimed at reducing or sequestrating GHG emissions in developing countries (non-Annex I Party). The resulting certified emission reductions (CERs) can then be used by the developed countries to help meet their own emission reduction targets, thus reducing their cost of compliance. Developing countries, at the same time, benefit from increased technology investment flows to advance sustainable development goals.

China, with approximately 45 percent of the total CDM potential, has been building institutional capacity to promote CDM development. As early as 1990, the government established the interministerial National Climate Change Coordinating Committee (NCCCC) as the body responsible for policies and measures to address climate change. Now the national policy leader on CDM, NCCCC consists of fifteen member organizations, with the National Development and Reform Commission (NDRC) as dhair, and the Ministry of Foreign Affairs, Ministry of Science and Technology, and the State Environmental Protection Administration as vice chairs. NCCCC also decides on the appointment of members to the National CDM Board, which reviews CDM projects and makes recommendations to NCCCC on operation and management of CDM. NDRC, established in 2003 to replace the State Development Planning Commission, is the designated national authority (DNA) for CDM responsible for processing and approving project applications pursuant to the CDM Board's decision. Successful launching of CDM in China hinges on several key factors, particularly the attractiveness of the investment and the transparency of the process. For instance, foreign investment will be limited by restrictions contained in the new rules, such as requiring that project applicants be either Chinese or Chinese majority-owned. The new rules for CDM management in China were released in June 2004 and a handbook on CDM implementation is expected shortly. (The new rules will be posted at http://cdm.cchina.gov.cn/.)

The government's priority goal is to promote technology transfer especially in renewable energy and energy efficiency. The following types of CDM projects are now under consideration in China: methane recovery from landfill gas, coal mine methane, fuel switching, energy efficiency (e.g., cogeneration), renewable energy (e.g., wind, solar PV, and biomass); and forest carbon sequestration. Several projects currently under development include a wind farm in Inner Mongolia, the Xiaogushuan hydropower plant, and HFC decomposition projects with the World Bank. Thus far, the most active participants in CDM efforts have been Japan,

the Netherlands, other EU countries, and the World Bank. Because the United States has not ratified the Kyoto Protocol, a U.S. company probably cannot undertake a CDM project under the Protocol's Marrakech Accords. However, it is unclear whether there are other means of participating in projects through subsidiaries or joint ventures with a company registered in a country that has ratified.

In addition to using CDM, China is undertaking a number of other initiatives. At the time of writing, a draft renewable promotion law had been submitted to the National Peoples' Congress for consideration. Modeled on Germany's renewable energy law, it reportedly will cover subsidies for green energy, guarantee purchase contracts, and above-market prices.

China is also actively encouraging the development of clean coal technologies such as circulated/pressurized fluidized bed combustion, integrated gasification combined cycle, and liquefaction technologies. This is because coal, in addition to releasing nearly twice as much CO_2 per unit of energy as natural gas, is responsible for China being the world's largest emitter of sulfur dioxide (SO_2), a pollutant which contributes to a sizable share of air pollution and acid-precipitation both within China and neighboring countries, causing severe damage to human health and natural ecosystems.

On the energy conservation and efficiency front, China achieved substantial improvement over the past two decades in reducing energy intensity. Recent legal efforts have focused on the development of energy efficiency standards and labeling, including appliance and building codes standards. Nonetheless, China still has one of the most wasteful energy and industrial sectors in the world. This is particularly worrisome, given the accelerated investment in energy-intensive sectors such as automobiles, aluminum, cement, and steel.

China has adopted various laws but with varying degrees of success. For example, its 1997 Energy Conservation Law has yet to be effectively implemented because of slow progress in developing implementing regulations and sporadic enforcement. Building Design Energy Efficiency Standards were promulgated as early as 1986 but compliance has been slow. Given that the booming construction sector already consumes 23 percent of the nation's total energy, it is critical for China to bring about energy savings through effective implementation and enforcement of advanced building energy codes. The Ministry of Construction is apparently in the process of developing implementation measures for both commercial and residential buildings.

China's focus on energy production is changing as it recognizes that conservation and efficiency are the fastest and the most economic method of reducing energy use and GHG emissions. Over the last decade, some Chinese provinces and cities have utilized Demand-Side Management (DSM), the most significant of which has been the reduction of peak capacity demand through pricing. Progress has been slow and uneven partly due to the governments' unwillingness to impose higher electricity prices because of the fear of rising unemployment and dampening industrial output. However, prospects appear to be more promising as reflected in the State Council's recent decision to emphasize the need for sustained political commitment at all levels of government to promote DSM. Local authorities have raised tariffs at peak time and ordered factories to schedule more night and weekend shifts to ease the growing shortage.

On the transportation side, the prominence of the auto sector in future GHG emissions cannot be ignored. One way to significantly reduce these is through fuel-efficiency. Unlike other pollutants, CO_2 emissions cannot be lowered by the use of catalytic converters; thus, China's fuel efficiency standards in the transportation sector receive much attention. While China's vehicle emission standards are ten years behind current European standards, concerns about rising oil demand together with limited disposable income have encouraged a greater willingness on the part of the government to consider better fuel efficiency for cars and trucks. China recently announced it would adopt a weight-based fuel efficiency standard. If enacted, these standards will be much more stringent on light trucks and sports utility vehicles than the current U.S. CAFE standards. In addition to increasing fuel efficiency standards, many cities have begun using alternative fuel-powered vehicles which run on liquefied petroleum gas and compressed natural gas through the Clean Vehicle Action Program. China also recognizes the need to aggressively develop modern transit systems and promote smart land use planning.

While energy occupies center stage in China's development of a low-carbon economy, forestry carbon and sink projects will also have a significant role. Forest protection is now the largest ecological investment program in the country. Historically, China's forests have continuously shrunk due to ever-increasing population and agricultural encroachments. This already difficult situation was further exacerbated during Mao's Great Leap Forward, which actually proved to be an enormous leap backward for the forestry sector. In more recent times, however, with the drying of the Yellow River in 1997 and the subsequent Yangtze floods, China implemented two significant programs: Natural Forest Protection and Sloping Land Conversion. Both programs have contributed substantial progress with logging bans, harvest reductions and resource protection, although there also has been some economic dislocation. Over 1 million hectares of sloped cropland has been reforested thus far; additional reforestation will occur over time with the expected implementation of sink projects by the private sector under the CDM and through the State Forest Administration's newly established Climate Change Office. The Italian government is developing a pilot project, and organizations like The Nature Conservancy are actively engaged in capacity-building workshops and the development of forestry protocols.

Opportunities for U.S. Involvement

China is now the largest recipient of foreign direct investment in the world. With proper legal and economic incentives, it also has the largest potential market for

renewable and clean energy technology as well as carbon mitigation projects. The Chinese government and private enterprise should join with foreign investors to aggressively develop incentives and market-based mechanisms to promote renewable energy, energy efficiency, and clean technology projects. These may include DSM and Integrated Resource Planning (DSM/IRP), energy service companies, life cycle cost analysis, consumer education, market pricing mechanisms and the internalization of external cost.

There are, however, significant institutional and statutory challenges impeding access by foreign companies to the clean energy technology market. Despite China's obvious need for energy-efficient and clean energy technologies, foreign firms continue to face significant obstacles, such as high tariffs; low rate of return; lack of hard currency; inadequate protection of intellectual property; and a nontransparent, fragmented regulatory bureaucracy. Most importantly, China lacks well-developed financial mechanisms critical to reducing risk and generating investment funds. Financing constraints are probably the most significant impediments to sales by foreign firms to clean energy markets.

While it still may take some time, changes are inevitable. With China's accession to the WTO in December 2001, and China's policy and institutional changes now moving inexorably toward market orientation, China will have to even the playing field—reducing discriminatory practices and enhancing transparency of the country's legal regime. It remains to be seen how rapidly and completely the government can put in place measures to ensure compliance with its WTO commitments. Incentives or market-based approaches have been slow to permeate in China, largely due to the Chinese regulators' lack of experience in and understanding of how to use incentive- and market-based mechanisms as policy tools. Financial authorities also have had little experience with green projects and are skeptical about creative financing. This is, however, changing as China makes the transition from a centrally planned to a socialist market economy. As the role of state enterprises and the authority of the central government steadily declines, the antiquated command mechanisms are also disappearing along with the "iron rice bowl" (guaranteed benefits conferred by state-owned enterprises). The system of imposing quotas and forced shut-downs may have been more palatable to achieve energy savings in the past but that is simply not workable as China moves toward decentralization and liberalization (albeit with Chinese characteristics).

To develop effective incentives and market-based mechanisms, the central government must formulate a comprehensive national energy strategy and implement it consistently at both national and provincial levels. With the introduction of Deng Xiaoping's market reforms, the central government passed a great deal of power to provincial and local government without establishing clear rules and procedures to govern this decentralization. This has led to a fragmented policy decision-making process and has blurred the division of responsibility. While the reforms have encouraged the rapid growth of the private sector and competition, a new institutional and legal framework has not developed at the same pace to support these reforms.

There is an urgent need to develop a transparent energy law and regulatory framework. Although China has over the years formulated a series of laws and regulations to establish and regulate the market system, as China's energy industry undergoes significant restructuring, some laws are no longer applicable while others need to be revised to avoid conflicts and overlapping jurisdictions among various departments. Laws must be improved and, and in some cases created, in the area of property rights, contractual protection, guarantees, competition, bankruptcy, rulemaking, public participation, conflict of interest, separation of power, and respect for an independent judiciary. In addition, market-based mechanisms must be instituted in conjunction with mandatory environmental laws and regulations, aggressive compliance standards, and vigorous enforcement. China also needs to bolster domestic capabilities to enforce compliance with these regulations; currently there is a lack of both funding and highly skilled manpower to carry out their functions.

It is important for the United States to help China make this significant transition, not only because of the commercial opportunities but because it is in our national interest to help China avoid excessive reliance on foreign oil and slow its growth in GHGs. Recognizing this unique opportunity for China to leapfrog to clean and efficient energy technologies and systems, U.S.-based companies and nongovernmental organizations are already helping China chart a new course. However, while U.S. entities in many cases offer superior technology and capacity-building capability, they are unable to compete with their European and Japanese counterparts, as the latter have not only their government's support, but the added advantage of tied aid programs and soft loans.

Unlike the governments of the EU and Japan, the U.S. government has not played a prominent role in encouraging energy efficiency, renewable energy, and clean energy projects in China. Although there are currently at least twenty U.S. government agencies involved in some type of environmental or energy collaboration with their Chinese counterparts, their work is funded completely by their own agency budgets rather than by formal development assistance. This is because congressional restrictions and limited budgets prevent agencies like USAID from operating environmental assistance and governance programs in China. Also, for political reasons, U.S. government agencies have been scrupulously avoiding actions and programs relating to climate change and the Kyoto Protocol.

High-level officials in the U.S. administration and Congress need to devote significantly more resources to fully support U.S. entities' energy efforts in China, and to promote statutory and regulatory law reform, transactional and financial expertise, technical assistance, and educational and research exchanges. China's ability to achieve a more sustainable energy future, thus ensuring a stable future for ourselves, hinges on our foresight to effectively engage today.