

China's Quest for Energy



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China's Quest for Energy¹

Executive Summary

China's rapid industrial growth in the past three decades—averaging nearly 12% per year—has fueled a surging demand for energy. Indeed, in 2009, China edged out the United States to become the world's largest energy consumer and in the late 1990s China shifted from being a net energy exporter to a net importer. China's demand for energy continues to grow and is expected to account for a quarter of global energy consumption by 2035. Consequently, the quest for energy supplies has taken on strategic importance. Evidence shows that China has led an intensive search for all available energy supplies, ranging from coal to hydroelectric power, both at home and abroad.

China's energy mix is heavily reliant on fossil fuels, much more than the rest of the world. Fossil fuels accounted for more than 92% of China's energy consumption in 2009. Coal is the primary fossil fuel used, followed by oil and an insignificant amount of natural gas. In contrast, coal accounts for the lowest share of the fossil-fuel base in the United States and the rest of the world. Coal has become China's dominant energy source because it is readily available and inexpensive.

China consumes nearly half of global supplies of coal and only 10% of oil. Natural gas and nuclear energy each accounted for less than 3% of the global supplies, while renewable—nearly all of which is hydropower—were around 9%.

China's global share of all of these fuels is expected to increase even more in the years ahead. The Energy

Information Administration's (EIA) Annual Energy Outlook is typical of many projections. By 2035, EIA expects that China will account for 54% of world coal demand, 15% of oil demand, 6% of natural gas demand, 13% of nuclear demand, and 18% of renewable demand (the lion's share of which is from hydropower).²

On the renewable energy front, China also leads the world in its use of hydroelectric power, consuming nearly one-fifth of global production, and it has caught up with the United States on the wind energy capacity. However, consumption of ethanol, solar and geothermal energy sources is virtually nil.

Surging energy demand has attracted resources to the highly profitable energy and power industry in China. In 2009, China invested more than \$286 billion in fossil-fuel-based energy industries and \$34.6 billion in clean energy. Reflecting China's heavy reliance on coal, more than half the workers in the energy and power industry—9 million people in 15,472 enterprises in 2007—are employed in coal mining and dressing.

Since there is virtually no market demand at home, Chinese solar manufacturers focus almost solely on

1 The author would like to acknowledge the invaluable comments and analytic contributions of Mark Schmidt, Principal at ndp|consulting and the research assistance of Ross Cohen. This research received support from the U.S. Chamber of Commerce. The analysis and views expressed here are solely those of the author.

2 International Energy Outlook 2010, EIA.

exports and are fierce competitors in global markets, capturing approximately 60% of global production of solar panel products. Indeed, anti-dumping cases have been filed by European countries against China over its official subsidies for domestic manufacturers. In response to the booming market at home and abroad, the number of Chinese wind turbine manufacturers increased from 6 to 90 in the last five years. Wind producers became the world's largest producers to export their large-scale wind power equipment products to India, the United States, the United Kingdom, and Thailand.

China's quest for more supplies of energy to sustain its economic growth also is reflected in the wide range of strategic investments it is making abroad in multiple industries. The country is taking steps to strengthen its energy security directly through its outward foreign direct investment (OFDI) in energy projects and indirectly in related infrastructure projects overseas. In 2010, nearly two-thirds of China's \$57 billion in OFDI was made in 37 energy and power projects in 19 countries. In addition to direct investments in energy projects, Chinese oil companies are also engaged in service contracts and strategic alliances with international energy companies. Chinese national banks also provide crucial foreign assistance and long-term loans for energy projects as well as non-energy-related infrastructure.

Projections from the U.S. Energy Information Administration (EIA), International Energy Agency, and others show that global energy demand will depend heavily on a fossil-fuel base for the foreseeable future. Recognizing this, China is engaged in a race to produce energy for domestic use and to manufacture energy-related products for export. Therefore, the race is focused primarily on fossil fuels—particularly coal and increasingly oil—both at home and abroad.

Renewables are still a small part of China's energy sources, accounting for less than 8% of its energy consumption (mostly from hydroelectric power) and approximately 15% of total global energy consumption.

China is engaged in a race to produce energy for domestic use and to manufacture energy-related products for export. This race is not focused solely on renewables but in all energy sources, both at home and abroad. Renewables

remain a small part of energy sources, accounting for approximately 15% of total global energy consumption but not even 8% in China. Global energy demand still depends heavily on a fossil-fuel base. More so, China relies heavily on coal and is not on a path to diverge from this path in foreseeable future.³

China Is the World's Largest Energy Consumer

As the world's fastest growing economy for more than three decades—and given its heavy emphasis on industrial development—China has increased its energy consumption exponentially, and its share of global energy consumption in many instances exceeds that of the U.S.

Since 1980, the Chinese economy has grown at an average annual rate of 10%, more than three times faster than the U.S. and world averages (Figure 1). Like every other country, China has experienced swings in the business cycle over the past 30 years, but it never posted a year of negative growth over that time. Indeed, in 2009, while most of the world was suffering through a deep economic recession and experiencing negative growth, China's economy grew at an enviably brisk 9.1%.

Figure 1. Annual GDP Growth of China, the U.S., and the World, 1980–2009⁴

(in percent)

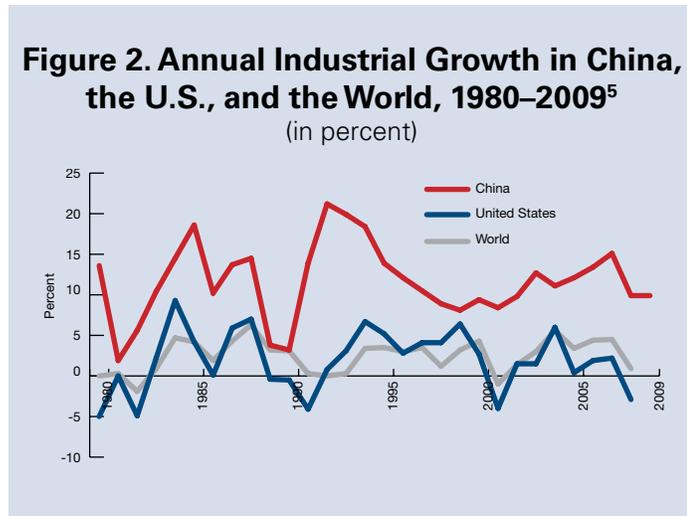


Although China's economy is second in the world in size, it is still only one-third the size of the U.S. economy,

³ International Energy Outlook 2010, EIA.

⁴ Databank, World Bank.

accounting for just 8.6% of world output in 2009. China's economic growth is driven largely by its energy-intensive industrial sectors, which include manufacturing, mining, construction, and utilities. During 1980–2009, the industrial sector as a whole grew by an average rate of 11.6% a year, much higher than the world average (Figure 2 and Table 1).

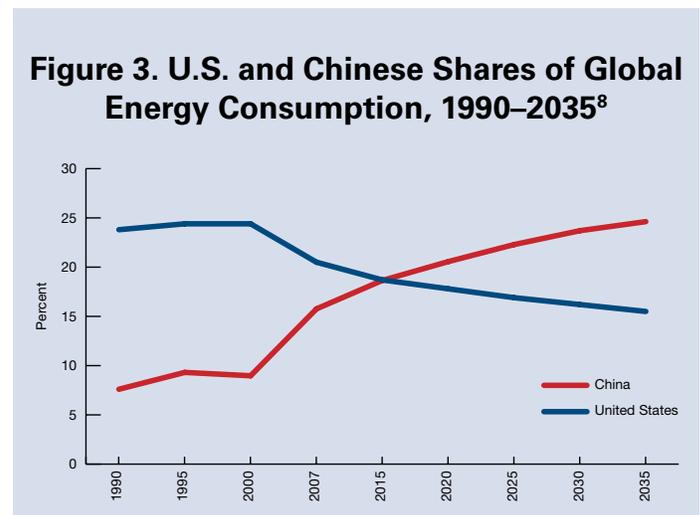


China only recently moved from being a low-income country to a lower-middle-income country with still-untapped economic potential. In 2009, GDP per capita was \$3,744 in China, compared with \$45,989 in the U.S. (Table 2).⁶ While its middle class has grown tremendously, hundreds of millions of people remain in poverty, and many areas lack basic access to modern energy services. China continues to move rapidly to provide access to electric power to undergird economic growth in regions relatively untouched by the recent wave of growth.

Because personal consumption accounts for a relatively small portion of GDP (less than 35%), China's growth is based on exports of manufactured goods, more so than in other countries with higher personal consumption rates. In 2009, Chinese exports and imports totaled nearly \$2.5 trillion and accounted for nearly half of China's GDP. The comparable, figure for the United States is about 25%.

In addition to being the world's two largest economies, the United States and China also are the world's two largest

energy users. It has only been in the past year or so that the U.S. and China have traded roles as the world's largest energy consumers, with China now occupying the top spot. The U.S. share of global energy consumption has dropped from about 25% in 1990 to 20% in 2009, reflecting mostly growing energy consumption in others parts of the world rather than falling U.S. demand. Over the same period, China's share of global consumption rose from less than 8% in 1990 to about 20% in 2009, and it is expected to capture an even greater share in future years. According to U.S. Energy Information Administration projections (EIA),⁷ by 2035 China's portion of global energy consumption is expected to rise to about 25% while that of the U.S. is expected to dip to 15% (Figure 3).



Rapid Growth Has Fueled a Sharp Rise in Energy Use

Although the Chinese economy is only one-third the size of the U.S. economy, its energy demand exceeds U.S. demand. This is because China uses considerably more energy to produce a unit of GDP than the U.S. does (Figure 4). Over time, changes in energy intensity reflect generally two things: (1) how efficiently energy is used in the economy (for example, in manufacturing processes) and (2) structural shifts in the economy either away from or toward energy intensive activities (for example, away from manufacturing and toward service industries).

5 Industry corresponds to ISIC divisions 10-45 and includes manufacturing (ISIC divisions 15-37); Databank, World Bank.

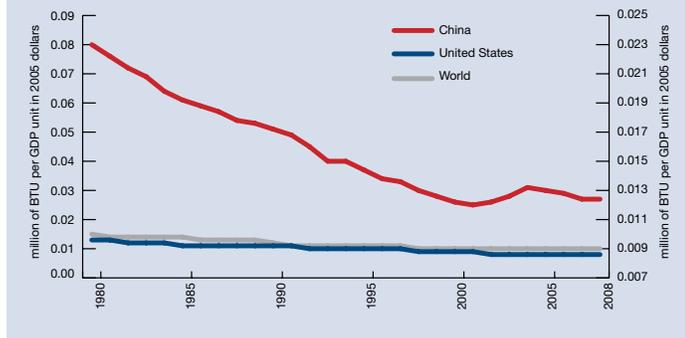
6 Databank, World Bank.

7 International Energy Statistics, EIA.

8 International Energy Statistics, EIA.

From 1980 to 2008, China's energy intensity improved by a respectable 66%—largely because of a more energy efficiency industry—as its GDP improved by a remarkable 1,300% to 1,400%. Despite this improvement, in 2008, China's energy intensity was still 3.6 and 2.7 times higher than the comparable figures for the United States and the world, respectively. As long as China's rate of economic growth exceeds its rate of intensity improvement, its energy consumption will continue to grow.

Figure 4. Energy Intensity in China, the U.S., and the World, 1980–2008⁹
(Millions of BTU per Chained 2005\$)



China's rapid economic growth and comparatively high level of energy intensity mean it has a huge and growing energy appetite that is altering the dynamics of international energy markets. Over the decade ending in 2009, China's global share of primary energy consumption almost doubled, growing from 10% in 2000 to nearly 20% in 2009.¹⁰ For many years, energy demand in China has grown at far higher rates than in developed countries, and since about 2002, it has increased exponentially. So rapid has been the increase that from about half the level of U.S. demand in 2002, Chinese demand surpasses the U.S. demand just seven years later (Figure 5 and Table 3).

Figure 5. Primary Energy Consumption, 1965–2009¹¹



To meet this high and growing level of domestic energy demand, China has turned almost exclusively to fossil fuels. China's energy mix is much more heavily reliant on fossil fuels than the rest of the world's, and in 2009, they accounted for more than 92% of China's energy consumption. Most of the rest is from hydropower and nuclear power, with other renewables such as wind and solar contributing very little.

Coal: Coal is the primary fossil fuel used (about 70%), followed by oil (18%) and an insignificant amount of natural gas (about 4%).

Once a net energy exporter, China has combined rapid economic growth over the past three decades with the high energy intensity of its industrial economy, leaving it increasingly reliant on imported fossil-based energy. Primary energy imports have been rising since 1998, accounting for an average 5% of total primary energy use, and are expected to continue rising in the future. Still, China's level of energy dependency is lower than that of the United States. Net U.S. primary energy imports have totaled nearly 28.4% of total primary energy use in the last decade, compared with 13.2% in the early 1980s (Figure 6).¹²

9 EIA, International Energy Statistics

10 Primary energy in this calculation comprises coal, oil, natural gas, petroleum, nuclear, and hydropower and excludes wind, geothermal, and solar power generation.

11 BP Statistical Review of World Energy, June 2010.

12 BP Statistical Review of World Energy, June 2010.

**Figure 6. China and the U.S.:
Primary Energy Imports, 1980–2008¹³**

(Percent of Primary Energy Consumption)



Coal has become China's dominant energy source because it is readily available and inexpensive. In 2009, China ranked as the world's largest coal consumer, accounting for some 47% of global coal consumption (Table 4).

EIA forecasts that China's coal use will continue to grow rapidly (2.6% a year), though it will probably account for a smaller slice of China's energy mix in 2035 (about 62%). Even as coal use shrinks relative to other fuels in China's economy, the country's share of international coal consumption is forecast to grow to more than 50% by 2035.¹⁴

Coal is an important fuel for China's industrial development. The great majority of China's coal consumption is electric power production, and it is building coal-fired power plants at a tremendous rate, estimated to be about one new plant every two weeks or so. This has put tremendous pressure on China's coal reserves, which are among the world's largest. Recent estimates place China's recoverable reserves third, behind those in the United States and Russia and ahead of those in Australia and India.

To satisfy surging demand, domestic Chinese coal production between 2000 and 2009 rose 136% (Table 5). The demand for coal, however, eventually exceeded China's capability to mine and transport sufficient quantities domestically, and within the past two years,

China has moved from a net exporter to a net importer of coal.

Oil: China consumed about 10% of global oil supplies in 2009, while the U.S. share was nearly 22%. However, while growth in U.S. oil consumption is expected to flatten out and its share of global oil demand to decline over the next 25 years, China's domestic oil demand will continue to grow strongly, and by 2035, its global share could climb to 15%.¹⁵

China is a net importer of oil. Its recoverable oil reserves represent less than 2% of the world total. Since 2000, its domestic production has jumped 17%. Even with this increase, however, China's oil production in 2009 accounted for only about 5% of world output. Moreover, while domestic production grew 17%, domestic demand grew at a much faster rate of 74%. As will be explained later in this report, China is thinking and acting strategically through its national oil companies to ensure stable supplies of oil to meet its growing demand.

Natural Gas: Natural gas plays a small role in China's energy mix. Recent reserve estimates suggest that China's natural gas resources are quite small, less than 2% of recoverable reserves globally, so it has not played a significant part. Since 2000, production has tripled, but it still amounted to only 3% or so of world output.

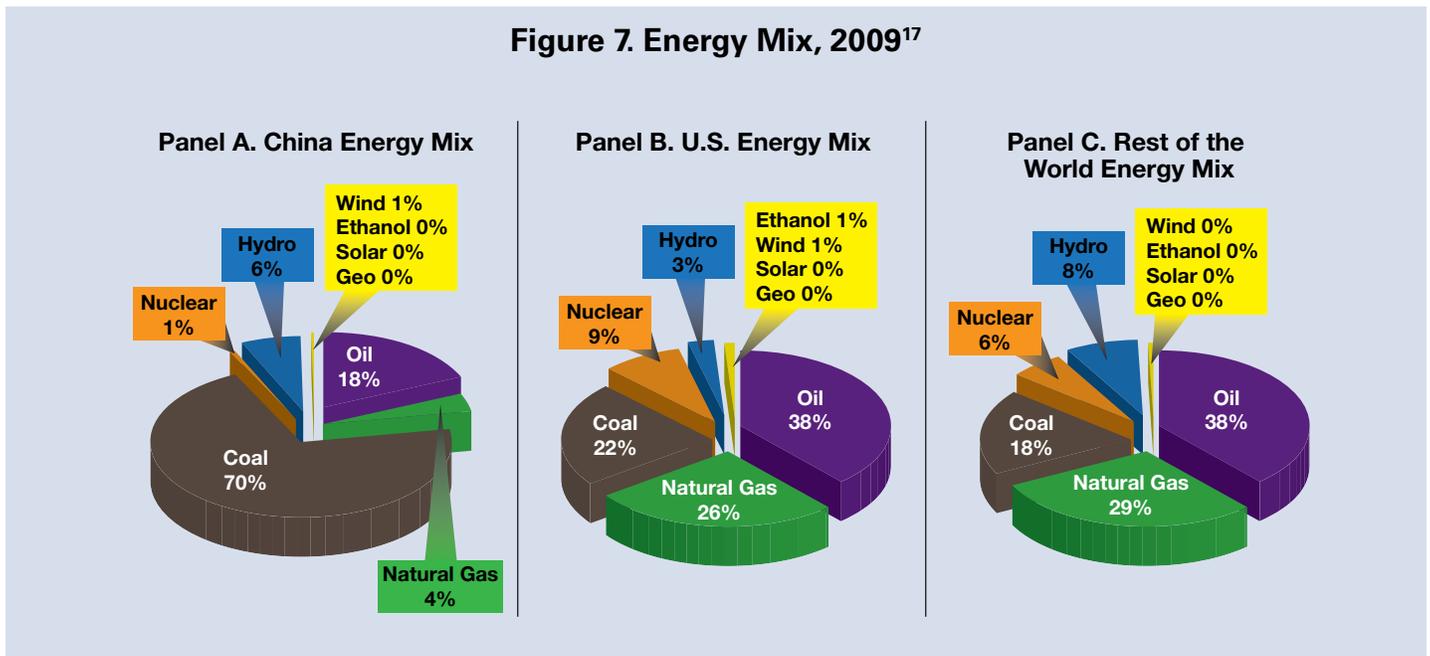
This could all begin to change. Technological advances in hydraulic fracturing and horizontal drilling have allowed producers to tap into shale gas formations once thought to be too expensive. This has opened up new areas to natural gas exploration and production. EIA's recent report on world shale gas resources suggests that Chinese reserves of gas could increase from a current estimate of about 107 trillion cubic feet to 1,382 trillion cubic feet, nearly 13 times the current estimate¹⁶ and about 10% of the world total. This is a huge potential resource that, if tapped, could lead to a shale gas revolution in China similar to what is occurring in the United States, which could change the energy picture in China in far-reaching but unpredictable ways.

13 International Energy Statistics, EIA.

14 International Energy Outlook 2010, EIA.

15 International Energy Outlook 2010, EIA.

16 World Shale Gas Resource: An Initial Assessment, EIA.

Figure 7. Energy Mix, 2009¹⁷

Chinese officials say production of gas locked in shale rock could start before the end of 2015, and China reportedly has drilled more than 10 wells and signed cooperation agreements with foreign companies to develop its shale gas resources.

Nuclear: While not now a large producer and consumer of nuclear power, China is poised to become one. It has 13 nuclear plants in operation, and these fill just under 1% of domestic demand. More than 25 nuclear power reactors are in various stages of construction and will add considerably to China's nuclear generating capacity. By 2020, the country is expected to increase its nuclear capacity to more than 10 times its current capacity.¹⁸ EIA forecasts that nuclear power consumption will increase at an annual rate of more than 8% through 2035. Even then, however, it will only account for about 3% of domestic demand.¹⁹

Renewables: China's consumption of renewable energy is increasing rapidly, but except for hydropower, it is—and is expected to remain—a relatively small share of domestic energy consumption. China is a large hydropower producer. In 2009, hydroelectric power accounted for

more than 6% of China's total energy consumption, and 19% of the global total.

Non-hydro renewables such as wind, ethanol, solar, and geothermal accounted for much smaller shares (Figure 7, Panel A). As to wind power, China's use of it exceeds that of other countries and has caught up with the United States, the world's largest wind power user, but up to a third of its wind capacity is unconnected to its grid. In China (like the United States), the really large wind resources tend to be located at a distance from load centers. China is expanding and upgrading its grid to accommodate more renewable, but this is likely to take many years.

Other renewable energy sources in China are quite small. Although China is one of the top 10 consumers of ethanol and solar energy, its shares of global consumption in 2009 were less than 3% for ethanol and its share of global capacity was a little more than 1% for solar. China's geothermal capacity is virtually nil (Table 6)

China's clean energy production has increased notably over the past 10 years. From 2000 to 2009, hydroelectric consumption grew more than 176%. Wind and solar renewable energy sources have seen their capacity rise sharply since 2000.

¹⁷ BP Statistical Review of World Energy, June 2010.

¹⁸ Nuclear Power in China, Updated on March 2011, World Nuclear Association.

¹⁹ International Energy Outlook 2010, EIA.

Despite these large increases, renewables still account for only a small portion of China's energy mix and remain insignificant relative to world production levels (Table 7). Although the country has recently increased its investments in renewable energy projects, China's share of renewable energy in total energy consumption is about half that of the United States and the rest of the world (Figure 7, Panels B and C). Most of the future growth in renewables is likely to come from hydropower, a plentiful resource in China.

The country also is working to improve its energy efficiency, which has become something of a political issue. In March 2011, Wen Jiabao, China's premier pledged to reduce the country's energy intensity 16% by 2015. After struggling with higher-than-expected energy consumption in 2009, China announced that it had reduced energy per unit of GDP in 2010 by 19% below the 2005 level. Unfortunately, the reduction was not the result of added energy efficiency. Rather, the reduction was the result of aggressive but unsustainable policies to cut power to factories, homes, and public buildings and to shut down some inefficient factories in the second half of 2010. Several local governments, including Anping County in Hebei Province, cut electricity for 22 hours over every three-day period.

Energy and Power Industry Is the Biggest Employer and Most Profitable in China

China's energy and power industry is booming. According to Chinese industrial data, the industry employed nearly 9 million workers in 15,472 enterprises in 2007 (Table 8).²⁰ More than half of workers in the energy and power industry are working in 7,066 coal enterprises. The energy and power industry also tends to employ a large number of workers per enterprise (577 workers per coal enterprise versus 220 in all other industries).

High sales and high profits are attracting resources to energy and power industry. Sales and gross profits of China's energy and power industry in 2007 were higher than all other Chinese industries, with a gross profit margin of 11.1%, compared with 5.5% for all other industries. On average, sales per enterprise in 2007 were \$31 million and profits per enterprise were \$3.5 million (Table 9).

With high domestic savings and investments, China can afford to invest in energy and power industry, which is more capital-intensive than other high-employment industries. The nearly \$1.3 billion²¹ in energy and power industry assets far exceeded those of any other Chinese industry in 2007 and averaged \$273 million per enterprise. The debt ratio of China's fossil-fuel companies was also lower than all other industries in 2007, averaging 56%. In contrast, other high-employment industries have much lower assets per enterprise and higher debt ratios (Table 10).

Alternative Energy: China a Producer and Exporter

In the energy sector, its export trade is focused not on raw materials, but on manufactured goods, such as wind and solar technologies. Nearly all of China's fossil resources are consumed domestically, and it is a net energy importer. China has become a major producer of solar panels and wind turbines, but its domestic sales are small, and the equipment is predominantly for export. Chinese solar companies have stepped up their output substantially in the past several years, and China's photovoltaic industry (solar energy) has become less dependent on foreign raw materials and equipment.²² Domestic companies have developed and produced their own polysilicon, an input for solar panels, and other solar equipment. Since solar energy consumption remains negligible in domestic markets, the industry is heavily dependent on overseas sales. China's photovoltaic products account for an estimated 40% of the global market,²³ and its photovoltaic companies' growing world market share has triggered anti-dumping complaints by European countries and investigations of China's official subsidies for domestic manufacturers.

Chinese wind turbine producers have also geared up to expand their global market share. China has already become one of the world's largest producers; it had just six wind turbine manufacturers in 2004 but nearly 90 in 2009. Domestic manufacturers now account for about 70% of

20 2007 is the latest cross-industry dataset.

21 Based on an exchange rate of 1 yuan = 0.1518 U.S. dollars.

22 Photovoltaic power generation uses solar panels composed of a number of cells containing a photovoltaic material, such as monocrystalline silicon and polycrystalline silicon.

23 Statement of Zhao Yumen, vice chairman of the Chinese Renewable Energy Society (CRES) at the fourth China New Energy International Forum in Beijing on January 20, 2010, Interfax China Business News.

China's domestic market demand and are beginning to export their large-scale products. The largest Chinese wind turbine manufacturers—such as Sinovel, Goldwind, XEMC, Shanghai Electric Group, and Mingyang—are developing larger turbines to compete in the global market for large-scale wind power equipment. In 2009, Sinovel, Sewind, and Goldwind exported 20 large-capacity complete wind turbine sets to India, the United States, the United Kingdom, and Thailand. Although Chinese wind turbine exports are rising, a major concern is the quality of the product.²⁴

China is a strategic producer and consumer of rare-earth metals, a group of 17 elements that are used in high-tech and clean energy applications. China exported 39,813 metric tons of these materials in 2010. It controls more than 90% of the current global supply and sets limits on its exports. The materials are used in windmills, hybrid automobiles, and critical components in sensitive military applications like missile guidance systems. Concerned with China's growing control over rare-earth supplies and its plans for a stockpile, Japan, South Korea, and the United Kingdom are also considering building strategic stockpiles. And in the United States, some lawmakers are discussing legislation to require the government to build a strategic reserve.²⁵

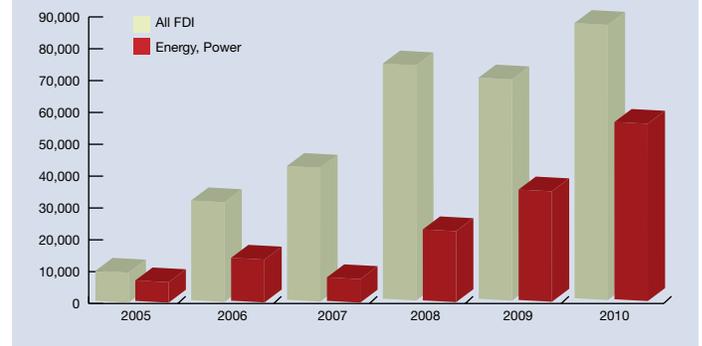
Outward Foreign Direct Investment Is Concentrated in Energy

As noted earlier, China's concern about energy security has pushed it to ensure adequate and secure supplies through its OFDI and other measures. Starting from virtually no OFDI in 1980, China has rapidly become an important source of OFDI since the adoption of the "go global" policy in the past 10 years. While global OFDI flows declined by half from its peak in 2007 due to the global financial crisis, China's nearly doubled from its 2007 level.²⁶

Even more impressive, China OFDI grew more than nine times between 2005 and 2010, from \$9.6 billion in

13 projects to \$88.2 billion in 81 projects (Figure 8 and Table 11).²⁷ During 2005–10, OFDI totaled \$318.9 billion, invested in 283 projects in 82 countries. The two largest destinations for all categories of Chinese OFDI are Australia (\$34 billion in 31 projects) and the United States (\$28 billion in 32 projects).

Figure 8. Chinese Foreign Direct Investment, 2005–10²⁸



Although rising exponentially, China's OFDI stock accounts for less than 10% of global FDI, which is far below the country's share of world trade and GDP. With massive foreign-exchange reserves of more than \$2.5 trillion, current account surplus, and no credit crunch, China is therefore expected to continue to invest in large projects overseas.

China needs to secure natural resources to fuel rapid economic growth. Consequently, China's aggressive domestic investment in energy and power has boosted its OFDI in energy and power projects. Chinese OFDI in the energy and power sector increased by 772% from \$6.5 billion in 2005 to \$56.7 billion in 2010. During the period between 2005 and 2010, accumulated OFDI in the energy and power sector amounted to \$152.2 billion in 109 projects in 42 countries and accounted for nearly 48% of total FDI in 2010 (Table 11).

24 China Wind Power Outlook 2010, Chinese Renewable Energy Industry Association, Global Wind Energy Council, October 2010.

25 Aredy, James T., 2010, "China Moves to Strengthen Grip Over Supply of Rare-Earth Metals," *The Wall Street Journal*.

26 UNCTAD, 2011, "Global and Regional FDI Trends in 2010," UNCTAD Global Investment Trends Monitor.

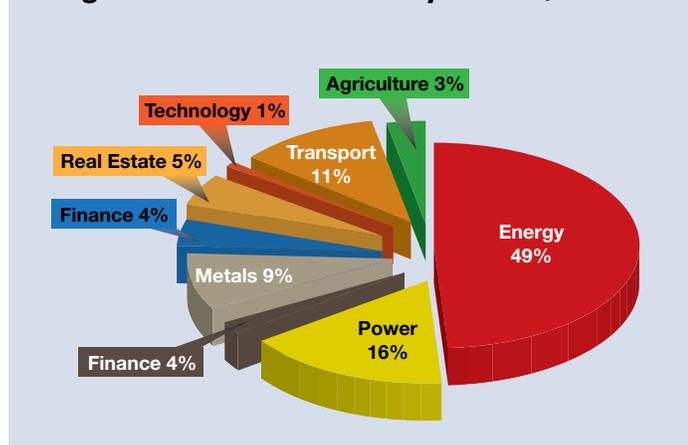
27 Four industries in 2005 are energy (\$6.6 billion), metals (\$2.2 billion), industry (\$500 million), and transportation (\$350 million); 9 industries in 2010 are energy (\$43.1 billion), power (\$13.8 billion), transportation (\$10.1 billion), metals (\$8.4 billion), real estate (\$9.6 billion), finance (\$3.2 billion), agriculture (\$2.5 billion), industry (\$1.9 billion), and technology (\$1.1 billion).

28 Scissors, Derek, 2011, "China Global Investment Tracker: 2011," *The Heritage Foundation*.

China's OFDI of \$152.8 billion in energy and power projects in 42 countries during 2005–10 was concentrated in 10 countries. Chinese OFDI in energy and power projects totaled \$57.1 billion in the top five countries (Iran, Nigeria, Brazil, Kazakhstan, and Australia) and \$91.2 billion in the top 10. The United States ranked 10th as a destination for Chinese OFDI (Table 12).

In 2010, Chinese OFDI totaled \$88.2 billion in 39 countries (Figure 9), dominated by energy and power investments. Total Chinese OFDI in energy and power projects was \$56.8 billion in 37 projects, accounting for 64.4% of total Chinese OFDI in 2010. China also has large OFDI in the transportation industry, accounting for \$10.1 billion in 11 projects in 2010. Several of these transport projects are also energy-related, such as PT Bukit Asam Coal Transportation in Indonesia and an investment rail project in Sri Lanka by China National Machinery Import and Export.

Figure 9. Chinese OFDI by Sector, 2010²⁹



Seven of China's 10 largest FDI projects in 2010 were in the fossil-fuel energy industry (Table 13). Investors included China State Construction Engineering, Sinopec, and China National Offshore Oil Company (CNOOC). The largest Chinese foreign direct investment in 2010 was \$8 billion, made by China State Construction Engineering, in Nigeria's National Petroleum's energy project. In 2010, ownership of investment in energy and power projects varied widely, from 1% of Chesapeake Energy's gas

project in the United States to 51% of Sinterz's power project in Russia.

The remaining three of the 10 largest projects in which China invested in 2010 were a coal transport project in Indonesia, real estate in the Bahamas, and copper in Peru. Chinese banks—including China Export-Import Bank, Industrial and Commercial Bank, and Bank of China—provided 70% of the project financing for Indonesia's coal transportation project. In exchange, China Railways owns 10% of the project and has rights to build and operate the facilities. Similarly, China Export-Import Bank provided \$2.5 million for the Baha Mar Resort in the Bahamas in exchange for China State Construction and Engineering Corporation building and owning a minority equity share.

Overseas Business Strategies and Domestic Renewable Energy Policies

China's national oil companies (NOCs) emerged during the 1980s as the country moved productive assets into state-owned enterprises to enhance efficiency and promote competition. CNPC, Sinopec, and CNOOC, although primarily state owned, established subsidiary firms and listed them on the Hong Kong Stock Exchange. Because of rising domestic demand and peaking domestic oil production capacity, the Chinese NOCs fully embraced the "go global" policy, in which the government encourages Chinese companies to invest and compete in international markets. In particular, Chinese NOCs seek to secure long-term access to energy resources by investing in resource-rich countries around the world.

The Chinese NOCs' foreign investments often involve joint ventures or strategic alliances with international oil companies. These investments are structured through business models that include market-for-resources, long-term loans, service contracts, and equity share investments. For example, Chinese NOCs collaborated with international oil companies—including British Petroleum and Total—to develop fueling stations and refineries across China in exchange for the oil production. In Iraq, Chinese NOCs have won several service contracts in partnership with global oil companies. Although not an equity share model, service contracts typically offer immediate access to resources.³⁰

29 Scissors, Derek, 2011, "China Global Investment Tracker: 2011," The Heritage Foundation.

30 Jiang, Julie and Jonathan Sinto 2011, "Overseas Investments by Chinese National Oil Companies," International Energy Agency.

Chinese NOCs also invest in the energy assets and related infrastructure of international oil companies by offering preferential financing in return for access to output. The China Development Bank (CDB) and the China Export-Import Bank are key joint lenders in such investments. In one recent project, the CDB loaned Russia's Rosneft \$15 billion over 20 years, at an average interest rate of 5.7%, in exchange for 60% of the oil production (9 million tons of oil a year) for CDB to sell at market prices. CDB and China Ex-Im Bank lent an additional \$10 billion to Transneft for the construction of a pipeline between Russia and China. In April 2010, the CDB extended a \$10 billion loan to Venezuela's Economic and Social Development Bank (BANDES) to build freeways and power plants.³¹ Venezuela is a major supplier to China.

In addition to energy assets, China contributes security infrastructure to trading partners rich in fossil energy. According to the book, *China and the Developing World*, to secure its state-run companies' extensive oil investments, China has established extensive military ties with Sudan, supplying "small and sophisticated arms."³² In Pakistan, China is helping to finance and develop the Gwadar port, which allows for a shorter and less risky route for oil from the Persian Gulf region. The oil will be offloaded at Gwadar and transferred to overland oil pipelines destined for China. Similarly, China has provided financing in Burma for overland pipelines. In exchange for such access, China has provided both Pakistan and Burma with weapons.³³

While securing energy resources abroad, China has also adopted policies and incentives to boost domestic renewable energy consumption and manufacturing. The country updated its Renewable Energy Law in 2010, increasing targets for non-fossil-fuel sources to a 15% share of final energy consumption. And to promote foreign investment in the renewable energy market, the government issued a ministerial ruling in April 2010 entitled "Several Opinions of the State Council on Further Utilizing Foreign Capital" (Ruling).

The Ruling outlines incentives to optimize the use of foreign capital investment in renewable energy, in energy efficiency, and in environmental-protection industries. Qualified businesses and foreign investments in these industries are given preferred status. The Ruling also discourages and restricts investment in polluting and high-energy-consuming industries.³⁴

The Ruling also provides incentives to direct increased foreign capital in renewable energy and energy efficiency to central and western China. The government will offer a preferential income tax rate to qualified businesses and will improve administrative services in industry and commerce, taxation, foreign exchange, and social insurance. The government will also promote a favorable environment for these businesses, encouraging commercial banks to locate to the central and western region by setting up development zones, and encouraging mergers and equity investments with domestic companies.

Targets in the Future

While securing energy resources abroad, China has also adopted policies and incentives to boost domestic renewable energy consumption and manufacturing. The country updated its 2006 Renewable Energy Law in 2010, increasing targets for non-fossil-fuel sources to a 15 % share of final energy consumption. In March 2011, this goal was reinforced by Premier Wen Jiabao's "Report on the Work of the Government" and in his draft of China's 12th Five-Year Plan. The Plan sets a mid-range target of 11.4 % non-fossil fuels in primary energy consumption by 2015 and establishes aggressive targets for efficient energy use and emissions reductions. Specifically, the Plan calls for a 16 % reduction in energy consumption per unit GDP and 17% reduction in CO2 emissions per unit GDP.³⁵

To promote foreign investment in the renewable energy market, the government issued a ministerial ruling in April 2010 entitled "Several Opinions of the State Council on Further Utilizing Foreign Capital" (Ruling). The Ruling outlines

31 Jiang, Julie and Jonathan Sinton 2011, "Overseas Investments by Chinese National Oil Companies," International Energy Agency.

32 Eisenman, 2007. *China And the Developing World*.

33 Li, Hao, 2010, "Securing China's oil imports from the Middle East," International Business Times.

34 Ministry of Commerce People's Republic of China, 2010, "Several Opinions of the State Council on Further Utilizing Foreign Capital," MOFCOM.

35 Jiabao, Wen, 2011, "Report on the Work of the Government," (accessed at <http://online.wsj.com/public/resources/documents/2011NPCWorkReportEng.pdf>) Ministry of Commerce People's Republic of China, 2010, "Several Opinions of the State Council on Further Utilizing Foreign Capital," MOFCOM.

incentives to optimize the use of foreign capital investment in renewable energy, in energy efficiency, and in environmental-protection industries. Qualified businesses and foreign investments in these industries are given preferred status. The Ruling also discourages and restricts investment in polluting and high-energy-consuming industries.³⁶

The Ruling also provides incentives to direct increased foreign capital in renewable energy and energy efficiency to central and western China. The government will offer a preferential income tax rate to qualified businesses and will improve administrative services in industry and commerce, taxation, foreign exchange, and social insurance. The government will also promote a favorable environment for these businesses, encouraging commercial banks to locate to the central and western region by setting up development zones, and encouraging mergers and equity investments with domestic companies.

China's 12th Five-Year Plan presents a new set of targets for its energy future. While the goals it presents may very well be attained, one must place these goals in the context of the existing path on which China is propelling itself. The Energy Information Administration's³⁷ that China's primary energy consumption will grow significantly, accounting for 25% of global energy consumption by 2035, up from 20% in 2009. However, the projections do not suggest China's energy mix is on path to diverge much. Fossil fuels are projected to account for 88.5% of primary energy consumption, only slightly less than today's 92%. Coal is projected to provide 62% of China's primary energy in 2035, down from the current mark of 70%.

Non-fossil energy sources are projected to account for 11.5% of primary energy consumption, up from today's 8%. EIA projects non-fossil fuels will provide 11.5% of primary energy in 2035, up from the current 8%. This trajectory would seem to make the new Five-Year Plan goal of 11.4% by 2015 a difficult target to reach.

Conclusion

China's demand for energy has soared in recent decades to meet the needs of its fast-growing energy-intensive industries and will continue to grow for the foreseeable future. As a result, China is conducting an intensive search for all forms of energy—ranging from the highest carbon-dioxide coal to cleaner hydroelectric power—both at home and abroad. Its surging outward FDI is heavily concentrated in energy and power projects.

Like most other countries, fossil-based fuels, mainly coal, are the largest component in China's energy mix, and this is not expected to change anytime soon. Although nuclear energy is currently less than 1% of the country's energy mix, many nuclear power plants are currently being built. And alternative energy sources, although growing rapidly, still account for a negligible share of China's energy consumption. Nonetheless, Chinese manufacturers are major exporters of solar panels and wind turbines.

Chinese energy and power companies enjoy heavy sales volumes, and high profit margins, and are major employers. In addition, Chinese national oil companies, supported by Chinese banks and government agencies, are actively pursuing foreign investment opportunities in fossil-fuel-based energy projects overseas. To secure these reserves, they are using multiple strategies including market-for-resources, equity shares, service contracts, and long-term loans.

China is in the quest of energy. Although investment in clean energy is rising, it is still a long way for clean energy to gain a significant share of China energy consumption.

36 Ministry of Commerce People's Republic of China, 2010, "Several Opinions of the State Council on Further Utilizing Foreign Capital," MOFCOM.

37 *International Energy Outlook 2010*, EIA.

Table 1. Value Added: China, the U.S., and the World, 2008–09³⁸

(in percent)

	China	United States	World
Gross value added at factor cost	100.0	100.0	100.0
Agriculture	11.9	1.2	4.0
Industrial Sector	53.2	21.3	30.2
Mining, construction, electricity, water, gas	14.2	8.2	12.7
Manufacturing	39.0	13.1	17.5
Services (net)	34.9	77.5	65.8

Table 2. GDP and its Components: China, the U.S., and the World, 2009³⁹

	China	United States	World
(Billion current U.S. dollars)			
GDP	\$4,985.5	\$14,119.0	\$58,141.5
Private consumption	1,738.9	10,076.3	34,507.4
Gross domestic investment	2,274.3	2,125.0	12,586.7
Government expenditure	650.3	2,429.9	10,538.4
Exports of goods and services	1,333.3	1,578.4	15,956.6
Imports of goods and services	1,113.2	1,964.7	15,448.3
Changes in inventories	102.0	(126.2)	--
Gross domestic savings	2,596.4	1,612.8	13,034.4
GDP per capita	\$3,744.4	\$45,989.2	\$8,581.5
As percent age of GDP			
GDP	100.0%	100.0%	100.0%
Private consumption	34.9%	71.4%	59.4%
Gross domestic investment	45.6%	15.1%	21.6%
Government expenditure	13.0%	17.2%	18.1%
Exports of goods and services	26.7%	11.2%	27.4%
Imports of goods and services	22.3%	13.9%	26.6%
Changes in inventories	2.0%	-0.9%	0.0%

Table 3. Average Annual Growth of Primary Energy Consumption, 1965–2009⁴⁰

(in percent)

	China	United States	World
1965–1979	7.2	2.8	4.2
1980–1989	4.4	0.4	1.7
1990–1999	3.4	1.4	1.2
2000–2009	8.9	-0.3	2.2

38 Industry corresponds to ISIC divisions 10-45 and includes manufacturing (ISIC divisions 15-37); Databank, World Bank.

39 Databank, World Bank.

40 BP Statistical Review of World Energy, June 2010.

Table 4. Shares of Global Energy Consumption of Top 10 Countries, by Energy Source, 2009⁴¹
(in percent)

Coal	Oil	Natural Gas	Nuclear
China (46.9)	U.S. (21.7)	U.S. (22.2)	U.S. (31.2)
U.S. (15.2)	China (10.4)	Russian (13.2)	France (15.2)
India (7.5)	Japan (5.1)	Iran (4.5)	Japan (10.2)
Japan (3.3)	India (3.8)	Canada (3.2)	Russia (6.1)
S. Africa (3.0)	Russia (3.2)	China (3.0)	S. Korea (5.5)
Russia (2.5)	Saudi Arabia (3.1)	Japan (3.0)	Germany (5.0)
Germany (2.2)	Germany (2.9)	U.K. (2.9)	Canada (3.3)
S. Korea (2.1)	S. Korea (2.7)	Germany (2.6)	Ukraine (3.0)
Poland (1.6)	Brazil (2.7)	Saudi Arabia (2.6)	China (2.6)
Australia (1.6)	Canada (2.5)	Italy (2.4)	U.K. (2.6)

Table 5. Chinese Fossil Energy Production, 1981–2009⁴²

	Coal		Oil		Natural Gas	
	Million tonnes oil equivalent	% of World Production	Million tonnes oil equivalent	% of World Production	Million tonnes oil equivalent	% of World Production
1981	309.9	16.7%	101.2	3.5%	11.5	0.9%
1990	542.6	24.1%	138.3	4.4%	13.8	0.8%
2000	656.7	29.2%	162.6	4.5%	24.5	1.1%
2001	697.6	29.7%	164.8	4.6%	27.3	1.2%
2002	733.7	31.1%	166.9	4.7%	29.4	1.3%
2003	868.4	34.4%	169.6	4.6%	31.5	1.3%
2004	1,012.1	37.1%	174.1	4.5%	37.3	1.5%
2005	1,120.0	38.9%	180.8	4.6%	44.4	1.8%
2006	1,205.1	39.7%	183.7	4.7%	52.7	2.0%
2007	1,282.4	40.8%	186.7	4.8%	62.3	2.3%
2008	1,425.6	42.7%	195.1	5.0%	72.3	2.6%
2009	1,552.9	45.6%	189.0	4.9%	76.7	2.8%

⁴¹ BP Statistical Review of World Energy, June 2010.

⁴² BP Statistical Review of World Energy, June 2010.

Table 6. Shares of Global Renewable Energy Consumption and Capacity of Top 10 Countries by Source, 2009⁴³

(in percent)

Hydroelectric	Wind	Ethanol	Solar	Geothermal
China (18.8)	U.S. (22.0)	U.S. (52.9)	Germany (42.2)	U.S. (28.8)
Canada (12.2)	China (16.1)	Brazil (33.9)	Spain (14.9)	Philippines (17.8)
Brazil (12.0)	Germany (16.1)	China (2.7)	Japan (11.5)	Indonesia (11.2)
U.S. (8.4)	Spain (11.7)	Canada (2.2)	U.S. (7.2)	Mexico (8.9)
Russia (5.4)	India (6.8)	France (1.4)	Italy (5.2)	Italy (7.9)
Norway (3.9)	Italy (3.0)	Germany (1.0)	Korea (2.3)	New Zealand (5.9)
India (3.2)	France (3.0)	Spain (0.6)	Czech Rep (2.0)	Iceland (5.4)
Venezuela (2.6)	U.K. (2.7)	Thailand (0.5)	France (1.6)	Japan (5.0)
Japan (2.3)	Portugal (2.2)	Colombia (0.4)	Belgium (1.6)	El Salvador (1.9)
Sweden (2.0)	Denmark (2.1)	Australia (0.3)	China (1.3)	Kenya (1.6)

Table 7. China's Nuclear and Renewable Energy Consumption & Capacity, 2000–09⁴⁴

	Hydro-electricity (terawatt-hours)	Nuclear (terawatt-hours)	Ethanol (mil. toe)	Wind (capacity in megawatt)	Solar (capacity in megawatt)	Geo-thermal (capacity in megawatt)
2000	222.5	16.7	-	352	19.0	27.8
2001	277.5	17.5	-	406	30.0	27.8
2002	288.0	25.1	0.145	473	45.0	27.8
2003	283.7	43.3	0.400	571	55.0	27.8
2004	353.5	50.5	0.498	769	64.0	27.8
2005	397.0	53.1	0.580	1,264	68.0	27.8
2006	435.8	54.8	0.985	2,588	80.0	27.8
2007	485.3	62.1	1.043	5,875	100.0	27.8
2008	585.2	69.4	1.021	12,121	145.0	24.0
2009	615.6	70.1	1.024	25,853	305.0	24.0

⁴³ BP Statistical Review of World Energy, June 2010. Wind, solar and geothermal are cumulative installed capacity as of the end of 2009.

⁴⁴ BP Statistical Review of World Energy, June 2010. Hydro-electricity and nuclear are consumption levels and ethanol is production level. Wind, solar and geothermal are cumulative capacity as of the end of the year.

Table 8. China's Energy and Power Industry and Other High-Employment Industries, Employment and Number of Enterprises, 2007⁴⁵

Sector	Employment (in thousands)	Number of Enterprises	Employment per Enterprise
Energy and Power Industry	8,933.0	15,472	577
Coal Mining and Dressing	4,597.3	7,066	651
Electricity and Heating Production	2,502.3	5,480	457
Petroleum and Natural Gas Extraction	894.4	175	5,111
Petroleum and Nuclear Processing	789.1	2,199	359
Fuel Gas Production	149.9	552	272
Textile	6,315.4	27,452	230
Communications Equipment	5,660.7	10,400	544
Nonmetal Mineral Products	4,401.3	23,635	186
Electric Machines Manufacturing	4,313.3	18,221	237
Ordinary Machinery Manufacturing	4,068.0	25,195	162
Transport Equipment Manufacturing	4,065.4	13,560	300
Apparel Manufacturing	3,968.2	14,326	277
Raw Chemical Materials and Products	3,690.8	22,318	165
Smelting and Pressing of Ferrous Metals	3,112.1	7,373	422
Metal Products	2,597.1	16,879	154

Table 9. Energy and Power Industry and Other High-Employment Industries, Sales and Profits, 2007⁴⁶

Industry	Sales (billion yuan)	Profits (billion yuan)	Profits/Sales (%)
Energy and Power Industry	3,157.9	350.1	11.1
Coal Mining and Dressing	462.9	45.6	9.9
Electricity and Heating Production	1,305.1	89.9	6.9
Petroleum and Natural Gas Extraction	426.7	185.3	43.4
Petroleum and Nuclear Processing	907.0	25.9	2.9
Fuel Gas Production	56.2	3.4	6.1
Textile	904.2	32.8	3.6
Communications Equipment	1,919.2	60.5	3.1
Nonmetal Mineral Products	727.7	41.8	5.7
Electric Machines Manufacturing	1,139.3	53.3	4.7
Ordinary Machinery Manufacturing	858.1	53.5	6.2
Transport Equipment Manufacturing	1,307.0	77.9	6.0
Apparel Manufacturing	356.4	15.3	4.3
Raw Chemical Materials and Products	1,331.7	83.1	6.2
Smelting and Pressing of Ferrous Metals	1,775.0	99.5	5.6
Metal Products	536.6	22.2	4.1

45 China Monthly Industrial Data, All China Marketing Research Co. (ACMR).

46 China Monthly Industrial Data, All China Marketing Research Co. (ACMR).

Table 10. Energy and Power Industry and Other High-Employment Industries, Assets and Debt Ratio, 2007⁴⁷

Industry	Assets (billion yuan)	Assets per enterprise (billion yuan)	Ratio of Debts to Assets (%)
Energy and Power Industry	8,590.1	1.801	56
Coal Mining and Dressing	1,325.7	0.188	62
Electricity and Heating Production	5,210.1	0.951	57
Petroleum and Natural Gas Extraction	995.5	5.688	41
Petroleum and Nuclear Processing	899.4	0.410	59
Fuel Gas Production	159.4	0.289	57
Textile	1,351.5	0.049	61
Communications Equipment	2,450.9	0.236	62
Nonmetal Mineral Products	1,335.3	0.033	59
Electric Machines Manufacturing	1,596.1	0.088	62
Ordinary Machinery Manufacturing	1,418.4	0.056	61
Transport Equipment Manufacturing	2,445.0	0.180	63
Apparel Manufacturing	431.9	0.030	57
Raw Chemical Materials and Products	2,176.3	0.094	57
Smelting and Pressing of Ferrous Metals	2,881.5	0.166	62
Metal Products	702.0	0.042	58

Table 11. Chinese Outward Foreign Direct Investment, 2005–10⁴⁸

	Total Foreign Direct Investments		Fossil Energy		Power	
	# Projects	\$ millions	# Projects	\$ millions	# Projects	\$ millions
2005	13	\$9,610	6	\$6,550	-	-
2006	26	\$31,940	10	\$13,220	3	\$510
2007	35	\$42,860	4	\$2,400	5	\$5,140
2008	59	\$75,360	14	\$13,950	9	\$8,800
2009	69	\$70,910	17	\$31,900	4	\$3,490
2010	81	\$88,210	22	\$43,070	15	\$13,760
Total	283	\$318,890	73	\$121,090	36	\$31,700

47 China Monthly Industrial Data, All China Marketing Research Co. (ACMR).

48 Scissors, Derek, 2011, "China Global Investment Tracker: 2011," The Heritage Foundation.

Table 12. Top 10 Destinations for Chinese OFDI in Energy and Power, 2005–10⁴⁹

Country	Amount (in millions of dollars)	Number of Energy and Power Projects	Average Amount per Project (in millions of dollars)	As percentage of All Countries
Iran	\$15,010	6	\$2,502	9.8%
Nigeria	\$12,670	3	\$4,223	8.3%
Brazil	\$11,400	4	\$2,850	7.5%
Kazakhstan	\$9,650	4	\$2,413	6.3%
Australia	\$8,360	10	\$836	5.5%
Argentina	\$8,020	3	\$2,673	5.2%
Canada	\$7,860	5	\$1,572	5.1%
Switzerland	\$7,200	1	\$7,200	4.7%
Vietnam	\$5,630	5	\$1,126	3.7%
United States	\$5,400	6	\$900	3.5%
Top 10	\$91,200	47	\$1,940	59.7%
All Countries	\$152,790	109	\$1,402	100.0%

Table 13. Top 10 Chinese Foreign Investment Projects, 2010⁵⁰

Investor	Amount (\$ millions)	Ownership (%)	Partner/Target	Sector	Country
China State Construction Engineering	\$8,000	25	Nigeria National Petroleum	Energy	Nigeria
Sinopec	\$7,100	40	Repsol	Energy	Brazil
China Railways	\$4,800	10	PT Bukit Asam	Coal Transportation	Indonesia
Sinopec	\$4,650	9	ConocoPhillips	Energy	Canada
CNOOC	\$3,100	50	Bridas	Energy	Argentina
Sinochem	\$3,070	40	Peregrino Field	Energy	Brazil
China State Construction Engineering	\$2,500	100 financing	Baha Mar Resort	Real Estate	Bahamas
Minmetals	\$2,500	60	Galeno Project	Metals Copper	Peru
CNOOC	\$2,470	30	Pan American	Energy	Argentina
Sinopec	\$2,450	100	Occidental	Energy	Argentina

49 Scissors, Derek, 2011, "China Global Investment Tracker: 2011," The Heritage Foundation.

50 Scissors, Derek, 2011, "China Global Investment Tracker: 2011," The Heritage Foundation.

Appendix Table A.1. China – Energy Statistics, 2000–2009,
(in quadrillion BTUs, except CO2 emissions in mmt) ⁵¹

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Petroleum										
Production	7.2	7.3	7.5	7.5	7.7	8.0	8.2	8.3	8.4	8.5
Consumption	9.9	10.1	10.6	11.5	13.2	13.7	14.9	15.3	15.9	17.6
Reserves	139.2	139.2	139.2	105.9	105.9	105.9	105.9	92.8	92.8	92.8
Imports	1.2	1.2	1.4	1.6	1.9	1.8	1.9	1.8	--	--
Exports	0.4	0.5	0.6	0.7	0.7	0.9	0.7	0.8	--	--
CO2 Emissions	643	658	693	717	850	889	928	959	995	1060
Natural Gas										
Production	1.0	1.1	1.2	1.2	1.5	1.8	2.1	2.5	2.7	0.0
Consumption	0.9	1.0	1.1	1.2	1.4	1.7	2.1	2.6	2.8	3.2
Imports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.3
Exports	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
CO2 Emissions	50	54	59	63	75	92	111	138	151	171
Coal										
Production	23.8	26.3	31.2	37.5	46.3	50.4	51.9	56.0	62.2	67.1
Consumption	23.1	24.3	29.0	35.2	44.3	48.3	51.1	55.2	60.4	69.2
Imports	0.0	0.1	0.2	0.2	0.4	0.5	0.8	1.1	0.8	2.9
Exports	1.6	2.2	2.1	2.4	2.2	1.8	1.7	1.5	1.3	0.8
CO2 Emissions	2,157	2,258	2,713	3,289	4,165	4,532	4,779	5,159	5,654	6,477
Electricity										
Net Generation	4.4	4.9	5.4	6.2	7.2	8.1	9.3	10.4	11.0	11.8
Net Consumption	4.0	4.5	5.0	5.7	6.7	7.5	8.6	9.7	10.3	--
Renewables										
Elect. generation	2.3	2.9	2.9	2.9	3.5	4.0	4.3	4.3	5.3	--
Biofuels	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Primary Energy										
Production	34.2	37.5	42.8	49.4	59.4	64.4	66.8	71.6	79.1	--
Consumption	36.4	38.4	43.9	51.2	62.9	68.2	72.9	78.0	85.1	--

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