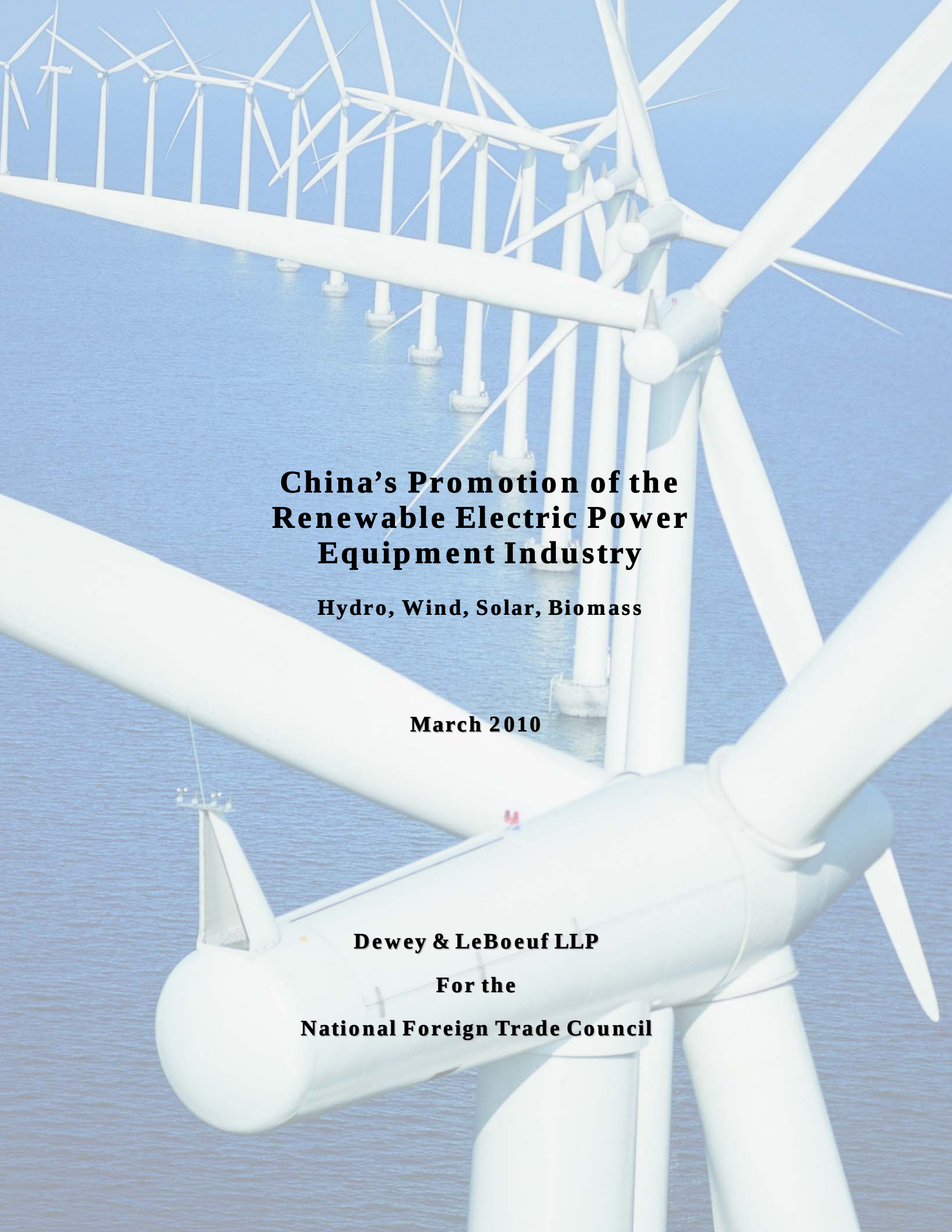

China's Promotion of the Renewable Electric Power Equipment Industry

Hydro, Wind, Solar, Biomass

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Dewey & LeBoeuf LLP

For the

National Foreign Trade Council

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EXECUTIVE SUMMARY

This study examines Chinese government policies promoting the development of industries producing equipment for generating electric power from renewable energy sources (hydro, wind, biomass, solar) to serve electrical grids. Those policies are transforming China into a major production base for renewable energy equipment at the watershed moment at which total global investments in renewable energy power capacity have surpassed investment in fossil fuel power capacity.

China's energy challenge. China's rapid economic growth and urbanization has been paralleled by rising energy consumption. China is now second only to the US in total primary energy consumption and has emerged as a larger generator of energy-generated CO^2 emissions than the US. China faces a dilemma in that its indigenous reserves of oil and natural gas will be depleted within two decades at current rates of extraction, and coal, which accounts for about 75 percent of China's energy production, is a source of pollution and greenhouse gas emissions. Chinese planners are addressing this challenge, in significant part, through a dramatic national effort to promote the development of renewable energy as a larger percentage of China's total energy consumption. Their task is complicated by the fact that the growth potential for hydropower, China's principal source of renewable energy, is increasingly limited by environmental and social problems associated with the construction of large dams. As a result, the Chinese government is prioritizing the development of "new renewables" industries — wind, solar and biomass power.

China imported much of the generating equipment used to construct its hydropower infrastructure, and until very recently China relied heavily on foreign equipment and technology in the wind, solar and biomass sectors. However, Chinese planners have indicated their intention that eventually most or all of the renewable energy equipment installed in China will be made in China, will be based on Chinese-owned intellectual property, and will embody Chinese-developed standards. This objective is being advanced through a sweeping array of laws, regulations and other measures which establish local content requirements for renewable energy projects; equipment procurement preferences for Chinese-owned companies and Chinese-owned intellectual property; and domestic preferences with respect to subsidies, tax breaks, VAT rebates and other incentives promoting renewable energy.

Government measures. China is a centrally-planned economy in which the national government exercises a dominant role. Many of China's industries, including much of the energy sector, are comprised largely of state-owned enterprises (SOEs) which must conform not only to the laws and regulations governing the economy, but to directives from government ministries and the supreme authority, the State Council, with respect to investments, purchasing practices, prices, mergers, research and development, and market entry and exit. Since the beginning of a government program of long run economic reform in 1978, the economy has become somewhat less centralized and the government has made greater use of incentives rather than commands to influence enterprise behavior, but the government's role in the market remains pervasive. Accordingly the priorities and goals expressed in government plans and directives are a

strong indicator of what enterprises will actually do, particularly SOEs. In this respect, a number of measures have been particularly important in promoting the development of the renewable energy sector by directly or indirectly stimulating demand for Chinese-made renewable energy equipment:

- In 2002, China enacted **The Government Procurement Law** which provided that with a few exceptions procurement purchases by government organizations should be limited to domestically-made goods. Although this law does not apply by its terms to SOEs, state-owned wind farms (which dominate renewable power generation in China) are applying the "buy domestic" rule to their equipment purchases, particularly when government funds are used to fund them.

- In 2005, the National Development and Reform Commission (NDRC), an economic planning organization with jurisdiction over energy, issued **The Notice of Requirements for the Administration of Wind Power Construction** which provided that no wind farm could be constructed in China that did not meet a 70 percent local content requirement. This measure increased domestic demand for Chinese-made wind equipment components, induced a number of foreign wind equipment firms to establish manufacturing facilities in China to satisfy the local content requirement, and was credited by Chinese observers with enabling the domestic wind equipment industry to form a complete industrial chain.

- In 2006, China enacted the **Renewable Energy Law**, which established a framework under which utilities were required to pay full price for electricity generated by renewable energy sources while offering consumers of renewables-generated electricity discounted rates. It was amended in 2009 to require utilities to purchase all renewable power generated in China. This measure has encouraged entry into the renewable energy generation business and increased the demand for renewable power equipment.

- In 2006, three Chinese ministries jointly released the **Provisional Measures for the Accreditation of National Indigenous Innovation Products (NIIP)** which provides for a process under which products made with "indigenous" (*e.g.*, Chinese) intellectual property could qualify for "priority" in government procurement and "national key projects that will spend Treasury funds." Because it is proving very difficult for foreign enterprises to qualify for "indigenous" status under this program, the measure effectively leads to application of procurement preferences favoring domestic renewables equipment manufacturers by the SOEs who develop China's renewable energy generation projects.

- In 2007, the NDRC released the **Medium and Long-Term Development Plan for Renewable Energy in China** which required power companies which owned installed capacity of over five GW to have non-hydro

renewable energy installed power capacity accounting for three percent of total capacity by 2010 and eight percent by 2020. This measure triggered a surge of investment in the wind equipment industry, reflecting the fact that wind power equipment was less costly to install and operate than solar and biomass alternatives.

- In November 2008, China implemented a $586 billion economic **Stimulus Package**, allocating a major portion of the government spending to renewable energy projects. A circular jointly released by nine government organizations requires that preference be given to domestic products with respect to stimulus spending. This combination of measures virtually ensures a massive volume of sales of domestically-manufactured renewable energy equipment.

- In 2009, three Chinese Ministries jointly announced the **Golden Sun Demonstration Program**, which will provide investment subsidies equal to 50 percent of the investment cost for grid-connected solar power systems. Although it is too soon to assess the impact of this measure, the subsidy is so large that it is virtually certain to increase the demand for solar power generating equipment.

Although the foregoing measures have been particularly important in fostering China's renewable energy equipment industries, they are part of a larger fabric of laws, regulations and directives which provide for preferential financing, VAT rebates, tax incentives, procurement preferences for Chinese-owned and controlled companies, local content preferences, and R&D subsidies for the renewable energy equipment producers. This vast panoply of government support and protection has triggered a rush of investment in the production of renewable energy equipment.

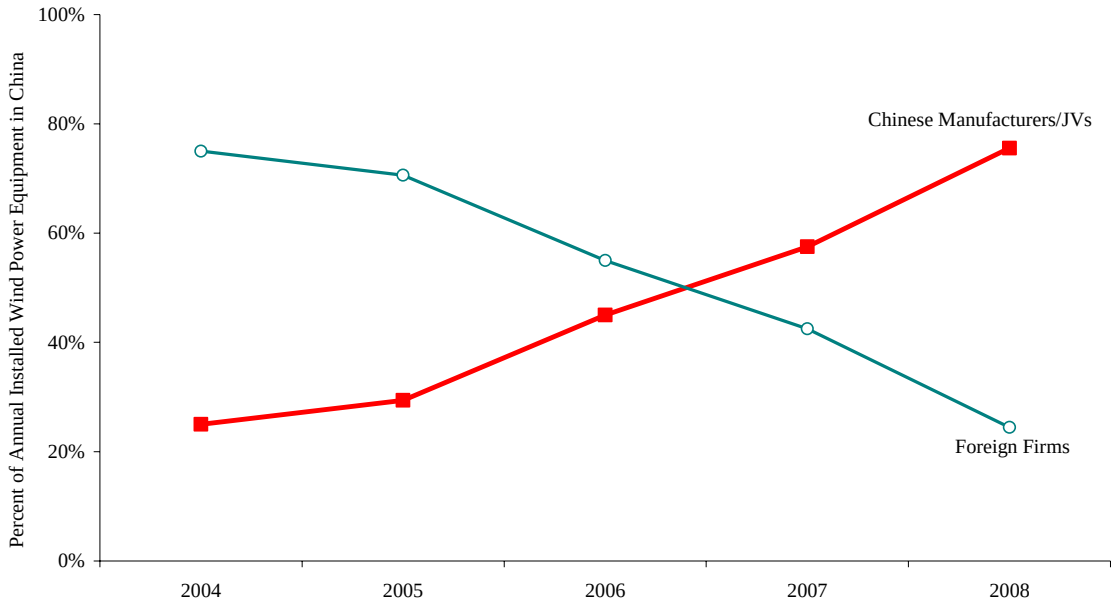
The promise and limits of hydropower. The Chinese government has devoted decades of effort to developing the country's hydropower industry, including the construction of the Three Gorges Dam, the largest dam in the world. Hydropower now generates over 16 percent of the electricity used in China, and China is continuing to build large dams at a rapid pace. Long dependent on imported hydropower generating equipment, China has fostered the development of two domestic equipment producers that are equipping a growing number of dams in China as well as competing in export markets. But dam-building has given rise to environmental and safety problems and has displaced millions of Chinese, with adverse social and political consequences. Chinese planners now intend to reduce the share of renewable energy attributable to hydropower while at the same time massively growing the renewables sector as a whole. In 2007, the Chinese government mandated that all large electric utilities increase their non-hydro renewable power sources to at least three percent by 2010 and eight percent by 2020. As a result, utilities are now the source of a massive demand for renewable-generated electricity.

Wind Power. In the past three years China has seen a veritable explosion of new investment in wind power. In 2007, an estimated 25 companies were producing wind

turbines, with another 40 or 50 planning to add facilities, but by 2009, the number of producers had grown to be over 100. Although a technological and qualitative gap has long existed between Chinese and foreign wind power equipment, Chinese producers are narrowing the gap, absorbing and adapting foreign technology while substantially reducing their dependency on imported parts and components. The development of the Chinese industry has benefited dramatically from government measures favoring procurement of domestically-made equipment, which have ensured the producers a large and growing market for their products.

The NDRC concessions. In 2004, the NDRC introduced the Wind Power Concession Project, a program designed to promote the establishment of very large scale wind farms to generate electricity for national grids. Under this program electric utilities enter into long-term power purchase agreements with wind farm developers with the agreement covering the entire forecast operational period of the wind farm, reducing the risk for the developers. End users of electricity receive a tariff increase to cover the increased cost of wind power. Under this program the NDRC is overseeing construction of a series of "Three Gorges in the Air," mega-wind farms generating ten or more gigawatts (GW) of electricity. The NDRC-sponsored wind farms are forecast eventually to account for most of the wind power produced in China, and therefore represent the principal future market for wind power equipment.

The Foreign Share of China's Annual New Purchases of Wind Power Equipment Has Fallen Significantly



Source: CWEA, *Statistics on Chinese Wind Power Equipment Capacity* (年中国风电装机容量统计), various years.

Domestic preferences. The NDRC has administered its Concession Project in a manner that heavily favors projects using Chinese-made equipment. It established a rule requiring 70 percent local content in all concession projects and another rule to the effect

that no wind farm could be built in China that did not contain equipment that was 70 percent domestic. The NDRC reportedly agreed to rescind "the 70 percent local content rule" following bilateral discussions with the US government in 2009, but it is not clear whether both measures are affected or whether the localization requirements which are pervasive in China's plans directive and other measures will be modified in any way. Preference in the bidding process has reportedly been accorded to Chinese-owned enterprises and companies with "indigenous innovation," *i.e*., Chinese-owned and controlled intellectual property. China's 2008 Stimulus Package, which allocated large sums to large wind power projects, required that preference be accorded to Chinese companies. Since 2005, no foreign firm has sold equipment to a wind farm being established under the auspices of the NDRC Concession Project. The foreign share of China's annual new purchases of wind power equipment fell from 75 percent in 2004 to 24 percent in 2008. Some analysts have estimated that the foreign share will fall to 15 percent in 2009 and to five percent in 2010.

Foreign complaints. Foreign wind equipment producers have complained that the NDRC is effectively excluding them from the Chinese market. The Chinese response has been that there is no intention to discriminate against foreign equipment, but the price of foreign equipment is too high and accounts for the failure of foreign bids. The foreign rejoinder is that when the electricity-generating capability over time of foreign equipment is considered rather than initial nameplate capacity, foreign equipment is actually less costly, reflecting superior long term performance — and Chinese wind farms appear to be generating less electricity relative to installed capacity than their counterparts in other countries. Chinese officials disagree and point out that government procurement preferences are common throughout the world, including in the energy sector.

Solar power. In the solar power sector, Chinese promotional measures have resulted in an influx of investment in the photovoltaic (PV) industry, and in 2008, China became the largest producer of solar panels in the world, accounting for about one-third of global shipments. Virtually all PV panels have been exported, reflecting the fact that few grid-connected solar systems exist in China. In 2009, the Chinese government launched a major effort to establish new grid-connected solar projects in China which will have the dual effect of creating a domestic market for Chinese PV panels and establishing new sources of renewable-generated power. Pursuant to the Golden Sun Demonstration Program, the government will provide an investment subsidy of 50 percent to qualified grid-connected solar power projects.

Biomass power. Although China has implemented wide-ranging efforts to develop biomass energy, grid-connected biomass power generation will be limited to areas with abundant available biomass resources and large scale power generation. China will seek to meet its goals for expanding the use of biomass for electricity production by introducing advanced direct-fired biomass power generation technology which will be connected to the power grid. The government provides a 0.25 yuan per KWh subsidy to biomass power plants, and offers incentives such as risk reserves and tax breaks. The government has created National Bio Energy Co., Ltd. (NBE), a joint venture between the State Grid Corporation of China and Dragon Power Co. Ltd. NBE recently

established a biomass power demonstration project in Shandong, and having proven the technology, NBE is in the process of building at least 40 biomass power plants.

I. INTRODUCTION

This study examines policies the government of China has implemented to promote the development of domestic industries manufacturing equipment for the generation of electric power from renewable energy sources, — hydroelectric, wind, solar and biomass power equipment capable of serving electrical grids.[1] Although governments in the United States, Canada, Europe and Japan have introduced policies to promote renewable energy industries,[2] China's effort is noteworthy for its sheer scale and the speed with which it is being implemented. At the 2009 United Nation's Copenhagen Conference on Climate Change, China announced an aggressive plan to cut down its carbon density, reducing CO^2 emissions per unit of GDP by 40 to 45 percent from 2005 levels by 2020, an objective that presupposes a massive reduction in emissions achievable only through a dramatic increase in use of renewable sources of energy.[3]

China made a major shift in its commitment to renewable energy with the promulgation of a *Renewable Energy Law* in 2005-2006 and the 2007 publication by the National Development and Reform Commission (NDRC), which oversees China's economic development of the *Medium and Long-Term Development Plan for Renewable Energy in China*. For the first time official policy was directed not just at promoting renewable energy consumption but at *increasing the share* of renewable energy in China's rapidly expanding energy supply. The State Council, China's supreme governing body, stated in 2007 that

> *"China gives top priority to developing renewable energy. The exploration and utilization of renewable energy resources plays a significant role in increasing energy supply, improving the energy mix and helping environmental protection and is also a strategic choice of China to solve the contradiction between the energy supply and demand and achieve sustainable development."*[4]

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1 The study does not examine nuclear power, which does not utilize renewable energy, and does not examine policies which address uses of renewable energy not associated with electrical grid, such as biogas fuels for vehicles, solar-heated homes, and wind and solar-generated electricity serving individual buildings.

2 See generally, Joanna Lewis and Ryan Wiser, *A Review of International Experience With Policies to Promote Wind Power Industry Development.* (Energy Foundation China Sustainable Energy Program, 2005); Institution of Electrical Engineers/Chinese Academy of Sciences, *The Research and Proposals on Incentive Policy and Measurements of Chinese PV Market Development and Acceleration* (April 2009).

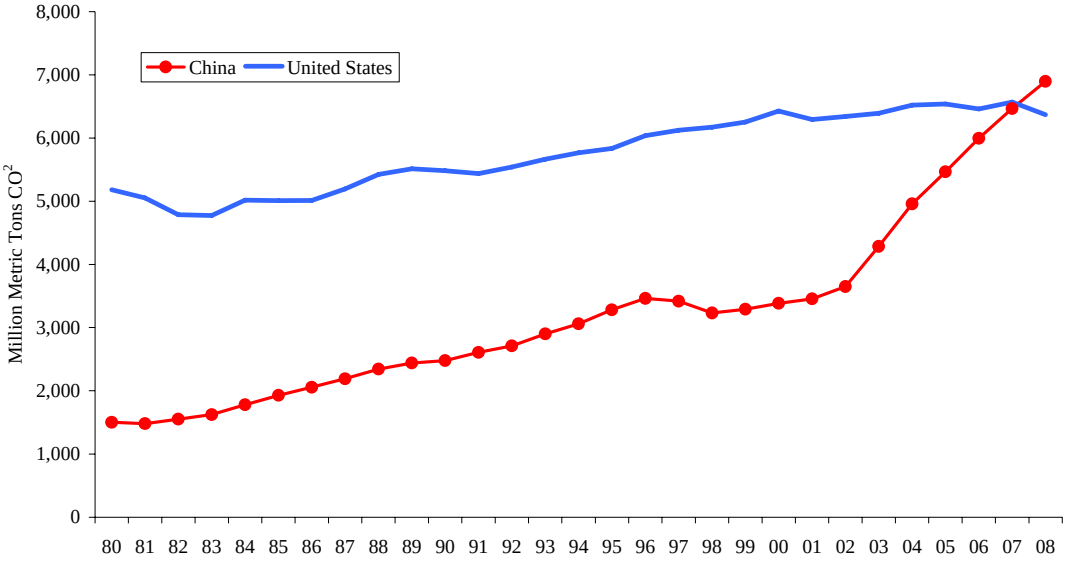
3 Xie Zhua, Vice Chairman of NDRC, "China Challenges Utmost Limit in Emissions," *Renmin Ribao Online* (February 25, 2010). "China Says Goodbye to Mr. No with Dramatic Reduction of Emissions to Fight Global Warming," *Wen Wei Po Online* (December 8, 2009); "In Dealing With Climate Change, China is not 'Mr. No'," *Zhongguo Qingnian Bao Online* (December 11, 2009). "While Attending the Leaders' Meeting of the Climate Change Conference in Copenhagen, Wen Jiabao Comprehensively Elaborates the Chinese Government's Stance and Proposal," *Xinhua* (December 19, 2009).

4 State Council, *China's Energy Conditions and Policies* (December 26, 2007).

China's large population and rapidly expanding economy have made it second only to the United States in total primary energy consumption. But it has surpassed the United States in terms of the total volume of energy-related CO^2 emissions (Figure 1) which is another important factor driving China's renewable energy policy.[5]

China's renewable energy objectives and policies have important global economic significance. If China is successful in meeting its goals it will soon become the global largest site for new investment spending in renewable energy in the world at a time when the world market for renewable energy investment now exceeds that for fossil fuel investments.[6] Currently 75 percent of global renewable energy power capacity is comprised of large hydropower, followed by wind power at 11 percent, small hydro power at seven percent and biomass power generation at five percent (Figure 2). Wind and solar are two of the fastest growing sectors globally as they are in China.

Figure 1: The Enormous Increase in Energy Demand after 2000 Made China a Larger Emitter of Energy-Related CO^2 than the United States



Source: *BP Statistical Review of World Energy 2009* .

China already accounts for significant shares of global renewable energy capacity and production. In 2008, China accounted for 60 percent of the world's small hydro power capacity and 58 percent of global solar water heating (Figure 3). China also had 14 percent of the world's large hydropower capacity, ten percent of wind power capacity

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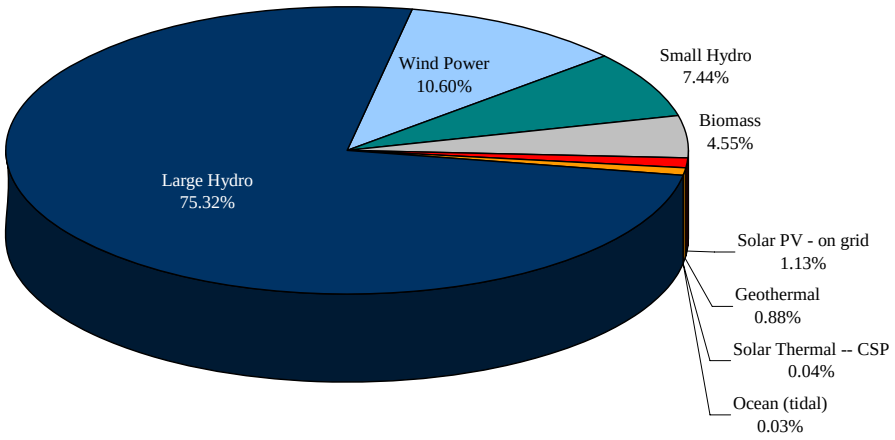
5 China emits much less CO^2 per capita than the US but is much less energy efficient. See Appendix 1.

6 Globally, 2008 was the first year that investment in renewable energy power generation capacity exceeded investment in fossil fuel power generation capacity. The United Nations Environment Programme estimated that approximately $140 billion was invested in renewable energy power generation capacity compared to $110 billion in fossil fuel power capacity.

and seven percent of biomass power capacity. Notably, given China's large solar PV industry, China accounted for less than one percent of solar PV on-grid capacity.

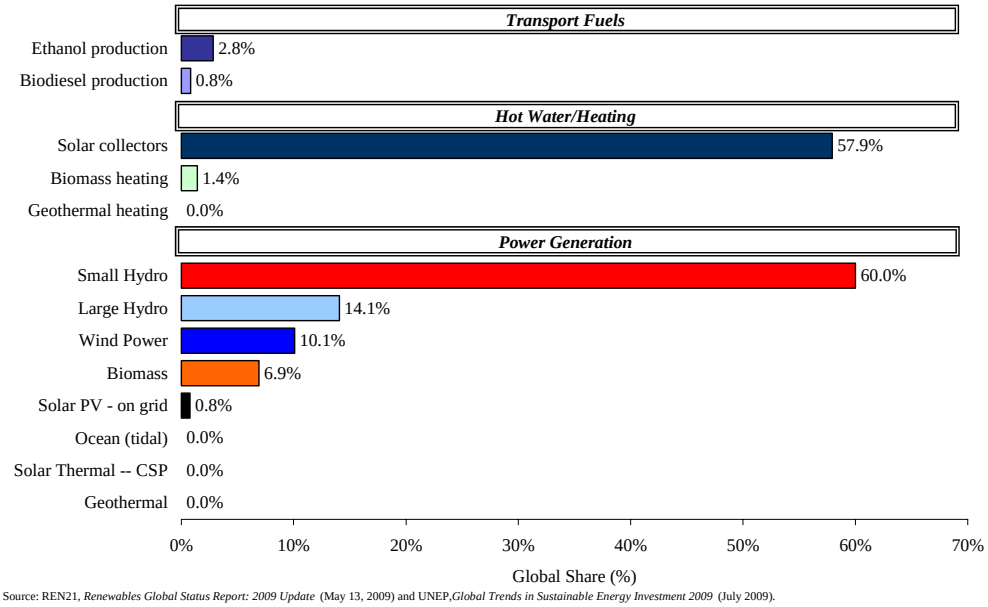
Excluding large hydro power projects, investment spending in renewable energy power capacity in China was $15.6 billion, mostly in new wind projects and some biomass plants. China's share of total global spending on renewable energy will likely increase significantly as the country attempts to meet its ambitious new renewable energy objectives.

Figure 2: Global Renewable Electric Power Capacity by Type 2008
(Share of Total Renewable Electric Power Capacity)



Source: REN21, *Renewables Global Status Report: 2009 Update* (May 13, 2009) and UNEP, *Global Trends in Sustainable Energy Investment 2009* (July 2009).

Figure 3: China Share of Global Renewable Energy Capacity/Production in 2008

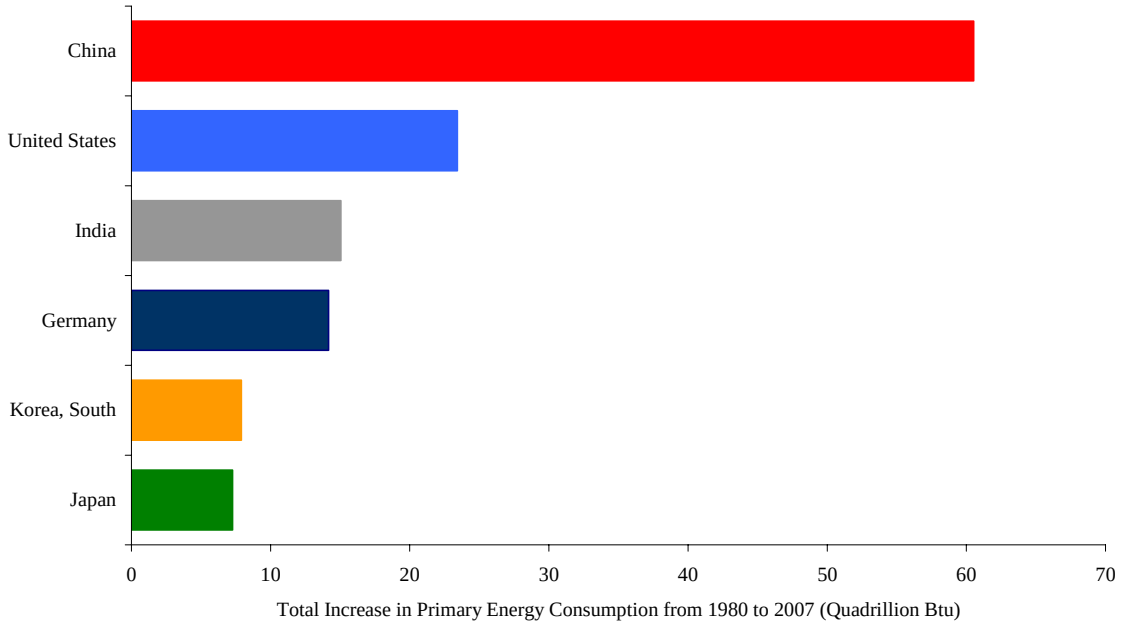


Source: REN21, *Renewables Global Status Report: 2009 Update* (May 13, 2009) and UNEP, *Global Trends in Sustainable Energy Investment 2009* (July 2009).

II. CHINA'S SURGING ENERGY REQUIREMENTS

China's energy requirements have expanded rapidly over the past 30 years with economic growth propelled by industrialization, especially its export oriented production and urbanization. Chinese primary energy consumption increased by more than 60 quadrillion Btu from 1980 to 2007, significantly more than any other country in the world (Figure 4).[7]

Figure 4: China's Primary Energy Consumption Has Increased Dramatically Since 1980



Source: EIA.

China is comparatively resource-poor with respect to traditional energy sources — at current rates of extraction its reserves of petroleum, natural gas and coal will be depleted in an estimated 7, 22 and 72 years, respectively.[8] Coal has historically been the major source of energy in China and remains so today.[9] Coal has increased as a percent of total energy production from 69.4 percent in 1980 to 76.7 percent in 2008. Crude oil has seen a relative decline in its share of total energy production while

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7 China is second in the world in total primary energy consumption behind the United States. The top ten countries account for 60 percent of world primary energy consumption: US, China, Japan, India, Germany, Canada, France, Brazil, South Korea and the UK. Data from Energy Information Agency, International Energy Statistics database.

8 "China Speeds Up Renewable Energy Development," *Xinhua* (September 12, 2006).

9 Chairman Li Peng commented in 1997 that "coal supplies over 70 percent of the energy used in China. Not much change in this situation is expected for a long time to come." *Xinhua* (July 15, 1997); China EnerSave Limited, *Annual Report 2008* (March 23, 2009).

renewable sources (hydro, nuclear and wind power) have increased from 3.8 percent in 1980 to 9.0 percent in 2008.[10]

Table 1: Production of Energy in China by Power Source

Total Energy Production by Source
(Percent of Total Production)

Year	Coal	Crude Oil	Natural Gas	Hydro, Nuclear, & Wind Power
1978	70.3	23.7	2.9	3.1
1980	69.4	23.8	3.0	3.8
1985	72.8	20.9	2.0	4.3
1990	74.2	19.0	2.0	4.8
1991	74.1	19.2	2.0	4.7
1992	74.3	18.9	2.0	4.8
1993	74.0	18.7	2.0	5.3
1994	74.6	17.6	1.9	5.9
1995	75.3	16.6	1.9	6.2
1996	75.2	17.0	2.0	5.8
1997	74.1	17.3	2.1	6.5
1998	71.9	18.5	2.5	7.1
1999	72.6	18.2	2.7	6.6
2000	72.0	18.1	2.8	7.2
2001	71.8	17.0	2.9	8.2
2002	72.3	16.6	3.0	8.1
2003	75.1	14.8	2.8	7.3
2004	76.0	13.4	2.9	7.7
2005	76.5	12.6	3.2	7.7
2006	76.7	11.9	3.5	7.9
2007	76.6	11.3	3.9	8.2
2008	76.7	10.4	3.9	9.0

Source: National Bureau of Statistics of China, *China Statistical Yearbook 2009*, at Table 6-1.

China's energy production has struggled to keep up with the rapid increase in energy demand since 2002.[11] Problems are especially acute during times of extreme weather and, in recent years, brownouts and blackouts have been regular occurrences in east coast cities, particularly during peak summer hours. Significant inefficiencies both

[10] National Bureau of Statistics of China, *China Statistical Yearbook 2009*, at Table 6-1.

[11] In 2010, an NDRC official observed that China experienced a shortage of electric power which began in June 2002 and continued for six years. Zhang Guobao in "How to Turn Crisis into Opportunity in China's Energy Sector," *Renmin Ribao* (January 23, 2010);" China Braces for Summer Power Shortages," *Xinhua* (April 14, 2004); "Coal Rationed in Guangdong, Electricity Shortages in Many Provinces," *AsiaNews* (June 9, 2008); "China's Worsening Electricity Shortage Meets Olympic Games," *ChinaStakes* (July 22, 2008); "2008 Electricity Shortage 'Worst in History'," *Shanghai Daily* (February 5, 2009). See also Karen Fisher-Vanden, Erin T. Mansur, Qiong Wang, "Costly Blackouts: Measuring Productivity and Environmental Effects of Electricity Shortages," (February 9, 2008) at http://cbey.research.yale.edu/uploads/IndustrialProductivity_Wang_20080208.pdf and Kexin Liu, "Wising Up: Smart Grid as New Opening for U.S. China Energy Cooperation," *China Environmental Health Research Brief* (August 2009) at http://www.wilsoncenter.org/topics/docs/wising_up1.pdf .

in transmission and in energy use exacerbate the overall shortage conditions.[12] The problems with China's national power grid are especially significant given the fact that most of China's energy resources are not close to major areas of demand.[13] China's overall energy intensity is much higher than in developed market economies like Japan and the United States. One Japanese analyst has argued that energy conservation is now regarded as "a resource" in China's energy policy making.[14]

The State Council Information Office ("SCIO") issued a *White Paper on Energy* at the end of 2007 that recognized many of these problems. The imbalance between sources of energy supply and energy consumption has resulted in an energy structure characterized by "large-scale transportation over long distances of coal and oil from the north to the south, and the transmission of natural gas and electricity from the west to the east."[15] While coal reserves are abundant "China faces severe geological difficulties in tapping its coal resources" because most of the coal is only available by underground mining and oil and gas reserves are "located in areas with complex geological conditions and at great depths."[16] Coal mining has been the source of numerous disasters with social and political implications.[17] The heavy reliance on coal for energy has been the main cause of pollution and green house gas emissions in China. Rapid expansion of motor vehicle use is further exacerbating air pollution in cities. Thus the policy goals highlighted are energy conservation, energy development — especially renewable sources — and promotion of new energy technologies.[18]

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[12] "One of the key weaknesses of China's existing power grid is the low energy efficiency associated with poor control of generation, distribution and transmission, along with a lack of effective demand management measures." Kexin Liu, "Wising Up: Smart Grid as New Opening for U.S. China Energy Cooperation," *China Environmental Health Research Brief* (August 2009).

[13] Sixty-four percent of coal reserves are in the north and 70 percent of hydropower is generated in the southwest but the largest energy-consuming regions are in the east.

[14] Shoichi Itoh, "China's Surging Energy Demand: Trigger for Conflict or Cooperation with Japan?" *East Asia*, Vol. 25, No. 1 (March 2008).

[15] State Council Information Office, *White Paper on Energy* (December 26, 2007). Policy with respect to renewable energy is based on the *People's Republic of China Renewable Energy Law* that was considered and approved by the tenth session of 10th National People's Congress (NPC) Standing Committee on February 28, 2005. The law took effect on January 1, 2006. A series of matching detailed rules and regulations were issued after the law was issued.

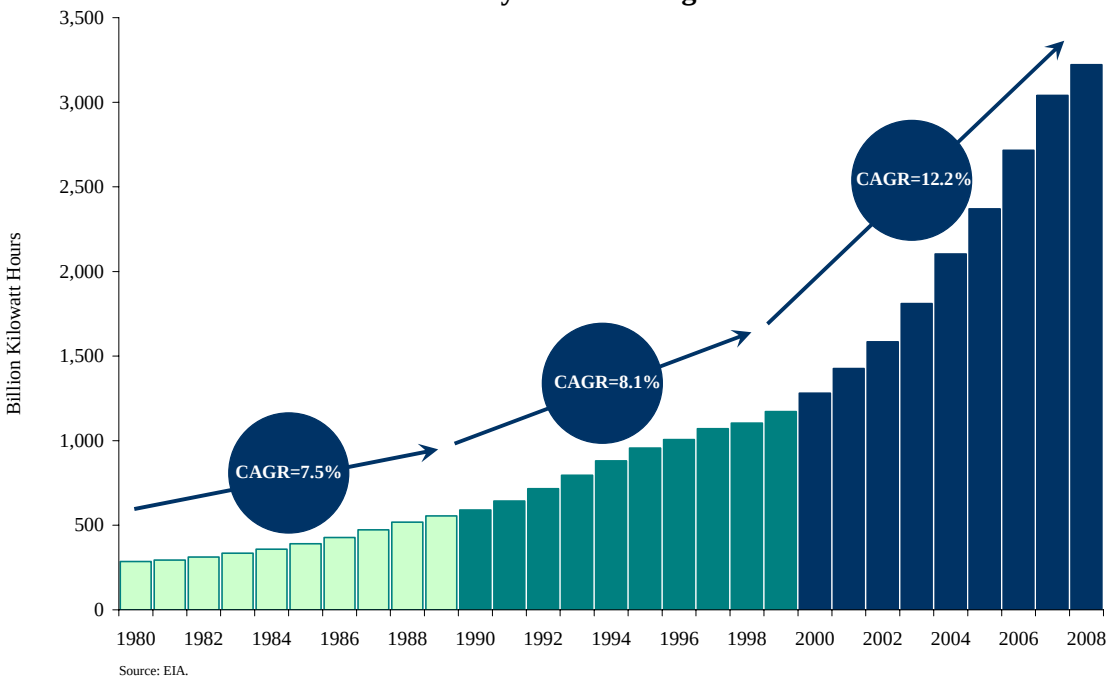
[16] China experienced shortages of natural gas in late 2009. "The root curve of the shortage is the lack of natural gas resources." "CNPC: Natural Gas Production Overloaded to Meet Needs," *Zhongguo Wang* (November 24, 2009). *Id.*

[17] "Xinhua Insight: Deadly Mine Disaster Another Lesson for Coal Hungry China," *Xinhua* (November 24, 2009).

[18] The *White Paper* states that "As a responsible developing country, China attaches great importance to environmental protection and prevention of global climate change. The Chinese government has made environmental protection on fundamental state policy, signed the United Nations Framework Convention on Climate Change, and established the National Coordination Committee on Climate Change. . . . worked out the Management Measures as the Implementation of Clean Development Mechanism Projects, formulated the National Climate Change Program, and adopted a series of proactive policies and measures regarding environmental protection and climate change. China aims to

Chinese energy planners see renewable energy sources both as an environmental issue and a long-term solution to the country's energy needs.[19] Traditional thermal sources for electricity generation — coal, oil and natural gas — all have their limitations as discussed above. Electric power generation, China's principal source of energy, has been accelerating over the past three decades, increasing from a compound annual growth rate of 7.5 percent in the 1980s to 12.2 percent from 2000 to 2008 (Figure 5). China cannot meet its growing electric power demand by relying on conventional thermal and nuclear power sources alone.[20]

Figure 5: China's Net Electricity Generation Accelerated Rapidly in the 21st Century After Joining the WTO



Source: EIA.

This explains the Chinese government's decision to promote and subsidize renewable energy.

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achieve the goal of basically curbing the trend of environmental deterioration, reducing total emissions of major pollutants by 10 percent, and gain visible results in the control of greenhouse gas emissions during its 11th Five Year Plan period (2006-10)." *Id.*

19 State Council Information Office, *White Paper on Energy* (December 26, 2007). On April 20, 2006, Premier Wen Jibao told a gathering of the State Energy Lending Group (SELG) that renewable energy was "strategically important," and he "urged all government departments concerned to take effective measures to accelerate the development of renewable energies." "China Speeds up Renewable Energy Development," *Xinhua* (September 12, 2006).

20 Pan Ziqiang, director of Science and Technology Committee of China National Nuclear Corporation, recently indicated that China's installed nuclear power capacity may top 70 GW by 2020, 75 percent higher than the current target of 40 GW. "China Nuclear Power Installed Capacity May Top 70 GW by 2020," *Xinhua* (November 3, 2009). Nevertheless, even with such growth it is unlikely that China will be able to meet its energy needs with a huge increase in nuclear energy.

"…China is rich in renewable resources. Development of such resources can not only ensure energy supply security, improve energy structure and reduce negative effects on the environment, but also end rural energy poverty. This is where the special significance of developing renewable energy lies in China in contrast to developed countries."[21]

The challenges for China are immense. Conventional thermal sources accounted for over 80 percent of electricity generation in China in 2008 (Figure 6). Hydropower accounted for 16 percent of electricity generation, nuclear power was two percent and wind, biomass and solar together was less than one percent.[22] Given the current energy mix in China, increasing the share of renewable energy sources will require a herculean effort and billions of dollars annually of new investment for a sustained period of time.

The Chinese government's intent to boost renewable energy's share of overall energy supply was expressed as an official policy for the first time in 2005-2006 with the enactment of the Renewable Energy Law and the promulgation of the Eleventh Five Year Plan. The new objective was expressed by the NDRC in the *Medium and Long-Term Development Plan for Renewable Energy in China* ("*Renewable Energy*") published in September 2007. The latter measure stated that:

"The overall objectives for China's renewable energy development in the coming 15 years are: to increase the proportion of renewable energy in total energy consumption, to resolve the problem of lack of electricity of people living in remote off-grid areas and the shortage of fuel for daily life needs in rural areas, to stimulate the utilization of organic wastes for energy, and to promote the development of renewable energy industries."[23]

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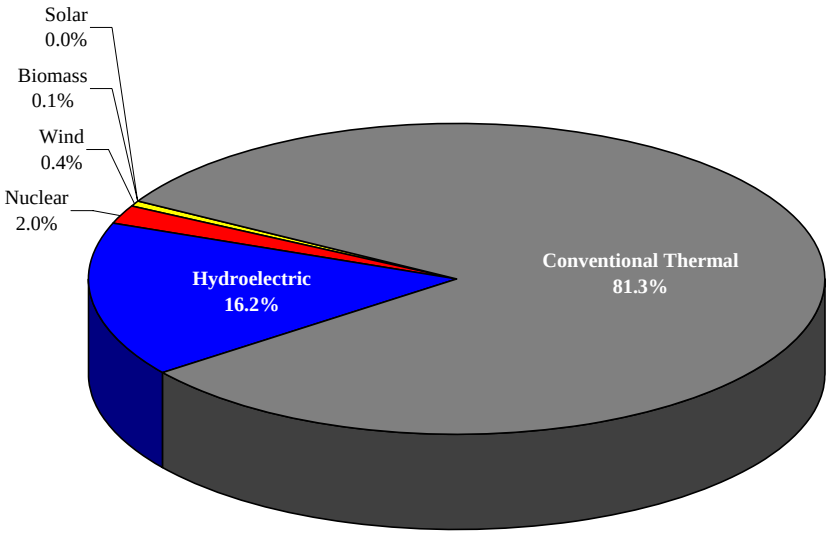
[21] Dan Shi, "Analysis of China's Renewable Energy Development Under the Current Economic and Technical Conditions," *China & World Economy*, Vol. 17, No. 2 (2009) at 95.

[22] Even if China is successful in meeting its current targets for renewable energy, coal will still likely account for at least 60 percent of the power supply by 2020. Gordon Feller, "China's Renewable Energy – Can Clean Renewables Increase Their Share of China's Rapidly Expanding Energy Sector?" *EcoWorld* (January 30, 2007).

[23] NDRC, *Medium and Long-Term Development Plan for Renewable Energy in China* (Abbreviated Version, English Draft) (September 2007) at 5.

Figure 6: Less Than 20 Percent of Electricity Generation in China in 2008 Was from Renewable Sources -- Almost All from Hydro Power



Source: EIA.

China's primary development goal is the progressive replacement of fossil fuel power sources with renewable energy. This represents for China "a development model for renewable energy entirely different from those of the preceding periods; that is, it is on a path of large scale and industrialized development."[24] The NDRC *Renewable Energy* measure established that China would seek to increase the share of renewable energy in total primary energy consumption to 10 percent by 2010 and to 15 percent by 2020. China has reportedly succeeded in achieving a net reduction of 600 million tons of carbon dioxide annually through use of renewable energy.[25]

According to the China Electricity Council, China's power generating capacity rose by 10.2 percent between 2008 and 2009 to a level of 877 GW, a level second only to that of the United States. While grid-connected wind power generating capacity almost doubled between 2008 and 2009, that capacity increase accounted for less than ten percent of the overall capacity increase in 2009, and at the end of 2009 grid-connected wind power still only accounted for less than two percent of the country's total generating

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[24] Dan Shi, "Analysis of China's Renewable Energy Development Under the Current Economic and Technical Conditions," *China & World Economy*, Vol. 17, No. 2 (2009) at 97.

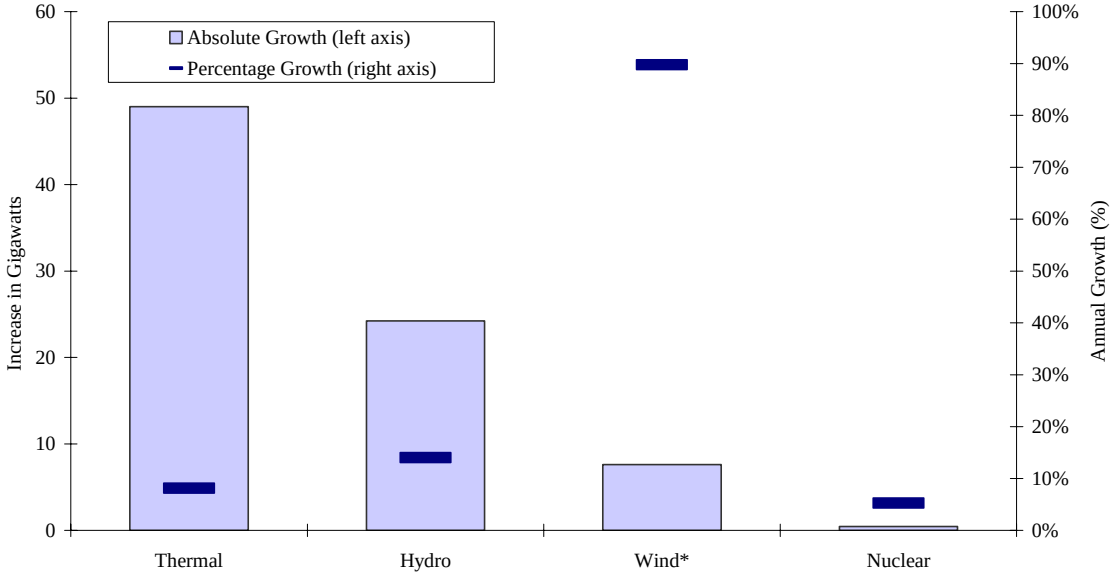
[25] Wu Guihiui, Chief Engineer of China's National Energy Administration, said in December 2009, that the total amount of renewable energy China used in 2008 was the equivalent of 250 million tons of standard coal, or about nine percent of China's total primary energy amount, resulting in a net reduction of 600 million tons of carbon dioxide. "Speeding Up the Pace of Clean Energy Development and Highlighting China's Efforts in Reducing Greenhouse Gas Emissions," *Xinhua* (December 13, 2009). These figures appear to classify nuclear energy as renewable energy. In 2008, nuclear energy accounted for 1.3 percent of China's installed power capacity. *Ibid.*

capacity.[26] As indicated in the Figure 7, while the percentage increase in thermal capacity was much smaller than the percentage increase in wind capacity in 2009, the absolute size of the growth in thermal capacity was far greater than the absolute growth in wind capacity. Similarly, the growth in hydro generating capacity was much smaller than that in wind in percentage terms, but much larger than that in wind in absolute terms.

Just as importantly, the NDRC stated that China would actively promote the development of renewable energy technologies and industries in China so that by 2010 China would have achieved the ability to produce domestically the renewable energy equipment it would require.[27] An objective set out by the NDRC is that by 2020 local manufacturing would be based primarily on "independent" or "indigenous" innovation, meaning that the intellectual property upon which the renewables equipment was based was to be wholly owned by enterprises organized under the laws of China.[28] The NDRC is signaling very clearly that the economic resources that China is using to promote renewable energy will primarily benefit Chinese companies.

Figure 7: The Increase in Wind Capacity Was High in Percentage Terms But Much Smaller in Absolute Terms Than Thermal Power

Growth in Chinese Power Generating Capacity in 2009



Source: China Electricity Council
*Grid-connected

[26] Off-grid wind capacity was almost half the size of grid-connected capacity in 2009.

[27] In 2008, *Renmin Ribao*, the Communist Party's daily journal, observed that "China has become a world leader in the manufacture of solar photovoltaic technology, with its six biggest solar companies having a combined value of over $15 billion. Around 820 megawatts of solar PV were produced in China in 2007, second only to Japan. In the next year China will become the world's leading exporter of wind turbines and it is also highly competitive in solar water heaters, energy efficient home appliances, and rechargeable batteries." "China Pioneers in Renewable Energy," *Renmin Ribao* (September 10, 2008).

[28] NDRC, *Medium and Long-Term Development Plan for Renewable Energy in China* (Abbreviated Version, English Draft) (September 2007) at 6.

Table 2: Current Capacity Targets for China's Renewable Energy Development Program to 2020

Type	2008 Actual	2010 Target	2020 Target
Hydropower	172 GW	190 GW	300 GW
large	121 GW	140 GW	225 GW
small	51 GW	50 GW	75 GW
Wind power	12.2 GW	10 GW	100 GW
Solar PV	0.14 GW	0.3 GW	20 GW
Solar water heating	135 million m^2	150 million m^2	300 million m^2
Biomass power	3.6 GW	5.5 GW	30 GW
Bioethanol	1.5 million tons	3 million tons	10 million tons
Biodiesel	0.08 million tons	0.2 million tons	2 million tons

Source: NDRC, *Medium and Long Term Development Plan for Renewable Energy in China* (September 2007); United Nations Environment Programme, *Global Trends in Sustainable Energy Investment 2009* (June 2009); MangoStrategy LLC, *The China Greentech Report 2009* (September 2009).

The national goal of raising the share of renewable energy in China's total energy mix by 15 percent by 2020 was increased to 20 percent in 2009, based on recent successful developments in renewable energy industries and increasing concern about China's reliance on fossil fuels. The original target for wind power, for example, was to achieve installed capacity of five GW by 2010. China, however, had six GW of installed capacity by 2007, and the 2010 target was changed to ten GW, which was exceeded in 2008. The original target of 30 GW of wind power capacity by 2020 has been increased to 100 GW.[29] The solar photovoltaic capacity target was also increased significantly, from 1.8 GW to 20 GW in the 2009 energy stimulus plan.[30] According to reports in January 2010, the wind and solar targets for 2020 will be revised upward again to 200 GW and 30 GW respectively.[31] In contrast, some observers have questioned whether the current biomass and biofuels targets can be met.[32] The hydropower target has not been changed and remains the largest component in China's renewable energy targets. Referring to the 2020 targets, China's National Energy Agency estimates that by that year,

[29] David Cyranoski, "Beijing's Windy Bet," *Nature* (Jan. 22, 2009) at 364. If achieved, that 100 GW goal could represent as much as five percent of China's total electricity supply. *Id.*

[30] The National Energy Administration is aiming for an installed solar PV capacity of 2 GW by 2011, a 15-fold increase from the 0.14 GW that existed in 2008. Zhang Qi, "China Hikes 2011 Solar Power Target," *China Daily* (July 3, 2009).

[31] "China to Postpone Issuance of New Energy Revitalization Plan," *SinoCast* (January 26, 2010).

[32] *Id.*

annual renewable electricity generation will be equivalent to the energy generated by burning 800 million tons of standard coal.[33]

The most recent projections by the U.S. Department of Energy's Energy Information Agency for China's renewable electricity generation indicate that growth in China's hydropower capacity will level off after 2020 and that wind power will become increasingly important, growing sharply after 2025 (Figure 8). Significant hydro projects that are currently under construction or planned for completion by 2020 include the further expansion of generating capacity at the Three Gorges Dam, the 12.6 GW Xiluodu project on the Jisha River, the 6.3 GW Longtan project on the Hongshui River and the plan of the Ertan Hydropower Development Company to construct 21 facilities totaling a massive 36.6 GW on the Yalong.[34] Once all of this capacity is in place, in addition to numerous small hydro projects, hydropower growth will likely be limited in the future by "extensive water pollution, dwindling water resources and growing concern about the negative effects of large dams."[35]

While there are long-term limits to hydropower expansion, other renewable energy sources face near term barriers to expansion that will need to be addressed for China to achieve its renewable energy targets.

- ***Wind power.*** The most significant obstacle to more widespread use of wind power is grid-connection constraints. The State Electricity Regulatory Commission ("SERC") reported in July 2009 that almost one-third of the wind farms in China are not being used at all in addition to being poorly managed and operating at a loss.[36] The lack of profitability reflects in part the low feed-in-tariffs for many of the wind farms.

- ***Solar PV.*** The most significant obstacle to expanded use of solar power is the current high cost of this energy source. In addition the reliability of the solar panels needs to be improved. The quality of solar panels produced by many Chinese firms has fallen and this has made it difficult for those companies to compete with foreign manufacturers.[37] For thin-

[33] "Speeding Up the Price of China's Clean Energy Development and Highlighting China's Efforts in Reducing Greenhouse Gas Emissions," *Xinhua* (December 13, 2009).

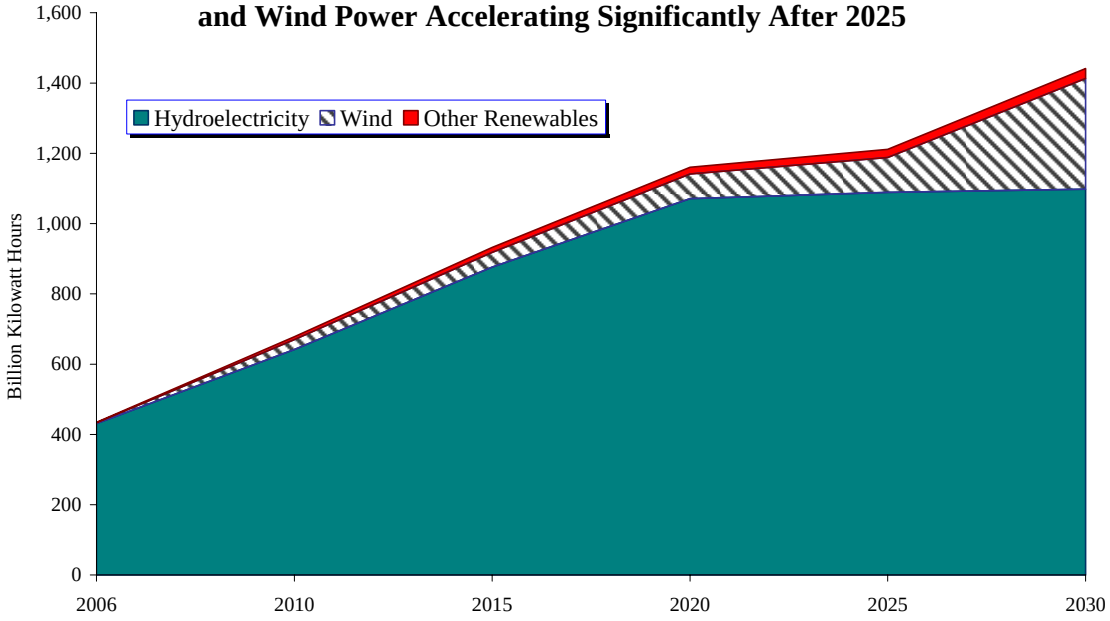
[34] Energy Information Administration, *International Energy Outlook 2009* (May 2009) at 78.

[35] Ryan Rutkowski, "Fair Wind Blows for China's Longyuan Power," *Asia Times Online* (December 2, 2009). See also Dan Shi, "Analysis of China's Renewable Energy Development Under the Current Economic and Technical Conditions," *China & World Economy*, Vol. 17, No. 2 (2009) at 103: "After 2030, China will have to rely on non-hydropower to improve its energy structure, because the exploitable water power will be exhausted."

[36] Zhu Ping, "Development Road to Gold is Paved Green," *China Daily* (October 29, 2009) and "Infrastructure Woes Hamper China Wind Farms' Push for Profitability," *guardian.co.uk* (July 27, 2009).

[37] Zhu Ping, "Development Road to Gold is Paved Green," *China Daily* (October 29, 2009).

Figure 8: EIA Projections of Renewable Electricity Generation from 2010 to 2030 Show Hydropower Leveling Off After 2020 and Wind Power Accelerating Significantly After 2025



Source: EIA.

film PV cells, China continues to rely largely on imported machinery and materials, and also suffers from a shortage of advanced technology.[38]

- ***Biomass and Biofuels.*** Improved feedstock collection and technological advancement are needed for more broad based adoption of these energy sources.[39]

In an effort to promote more rapid adoption of renewable energy China's State Council approved an amendment to the Renewable Energy Law on December 26, 2009 to require electricity grid companies to buy all of the power produced by renewable energy suppliers or face a substantial fine.[40] In mid-2009, China's National Energy Administration announced a subsidized price for solar power of 1.09 yuan per KWh which some consider to be still too low for profitable operations (although the price is almost three times what coal-fired power plants receive).[41] In addition, in November 2009, China's Ministry of Finance announced that it had identified 294 solar power projects eligible for subsidies covering 50 percent of the project costs.[42] Eligible projects

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38 Yotam Ariel, "Chinese Manufacturers Eye Thin-Film, PV Market," *RenewableEnergyWorld.com* (December 14, 2009).

39 REN21, Background Paper: Chinese Renewables Status Report October 2009 at 93.

40 Li Huizi, "China Amends Law to Boost Renewable Energy," *Xinhua* (December 26, 2009).

41 Zhang Qi, "China Hikes 2011 Solar Power Target," *China Daily* (July 3, 2009).

42 Jim Bai and Chen Aizhu, "China Selects 294 Solar Power Plants for Subsidy," *Reuters* (November 15, 2009).

include power generation for large commercial and industrial companies, power stations in remote regions and 35 projects with 306 MW of capacity that would be utility scale plants connected to the grid. The expected cost of the projects was estimated to be about 20 billion yuan (about $2.9 billion).

III. NATIONAL MEASURES PROMOTING RENEWABLE ENERGY EQUIPMENT PRODUCTON

Governments in countries like Germany, Spain, the United States and Denmark have implemented significant promotional measures to encourage the development of renewable energy industries, although implementation has in some cases proven erratic. China's promotional effort is particularly noteworthy because of the government's central role in managing the economy, its ability to implement promotional measures over a very long time horizon, and the degree of importance with which the government accords renewable energy.

The evolution of China's renewable energy equipment industries has been shaped by national and local government plans and other measures to have a normative effect on individual economic actors in the Chinese economy. In addition, the renewable energy sector's growth has also been influenced by certain statutes and implementing regulations affecting the energy sector and the economy as a whole. These plans, statutes and other measures are summarized in this section as they have affected the renewables industry generally. Sector-specific measures have been implemented in several new renewables sectors which are summarized in the discussion of those sectors in Part V infra.

The planned economy. China is a planned economy directed by the national government pursuant to short, medium and long-term plans that set developmental targets and identify and authorize the utilization of various resources to achieve those objectives. Broad national plans are augmented by topical plans (such as plans for development of science); by directives issued by China's supreme governing authority, the State Council; by plans developed by individual Ministries or groups of collaborating Ministries; by sector-specific plans; and by plans developed by provincial and municipal authorities with respect to economic development within their jurisdictions. Plan targets and objectives are modified from time to time to adjust to changes in economic circumstances.

The rule of law. Since 1978, when China's leaders launched the country on a path of long run economic reform, the government has introduced market-based principles into the economy and encouraged greater enterprise autonomy and individual entrepreneurialism. Government bureaucrats' arbitrary intervention with enterprise decision-making has receded, and the domestic market is increasingly governed by laws and regulations of general applicability similar to those found in western market economies. Since 2004, China has promulgated a Property Code, a Labor Contract Law, a Government Procurement Law, an Antimonopoly Law, and an array of individual and corporate tax codes. "[V]irtually every area of business life in China is now covered by a modern statute or regulation."[43] However, the existing legal system is characterized by ambiguities and inconsistent application of a plethora of laws and regulations. China's largest wind power developer warned potential investors in its 2009 Hong Kong IPO that

> *[M]any of [China's] laws and regulations, in particular, the regulatory regime relating to renewable energy*

[43] "China Makes Remarkable Progress in Civil Law Making," *Xinhua Wang* (December 4, 2007).

> *projects, are relatively new and will likely continue to evolve, are subject to different interpretations and may be inconsistently implemented and enforced. In addition, there are only limited volumes of published court decisions that may be cited for reference, and such cases have limited precedential value as they are not binding on subsequent cases.*[44]

Importance of state-owned enterprises. Although recent decades have seen the emergence of a vibrant private enterprise sector, much of China's economy, including the energy sector, is dominated by state-owned enterprises (SOEs) which are owned directly by government ministries, by the state-owned State Assets Supervision and Administration Commission (SASAC), and by provincial and municipal governments. China's electric power grid is operated by SOEs, virtually all electricity generation is attributable to SOEs, and most of China's electric generating and transmission equipment, including renewable energy equipment is produced by SOEs.[45] While both Chinese privately and publicly-owned companies are expected to conform to the parameters of national government plans, measures and guidelines, the pressure on SOEs to do so is particularly pronounced. SASAC, the state holding company, is the controlling shareholder in many SOEs and has the power to nominate and remove directors and senior managers, determine pay scales, grant rewards or punishments to managers, and to set the SOE's strategic course (deciding on mergers, bankruptcy, dissolution, changes in capital and sales of state-owned shares.)[46] The SOEs depend heavily on financing from government-owned banks which base lending decisions on the conformity of business plans with government policies. China's power sector is heavily regulated, and many core aspects of the energy business (including the amount and timing of electricity generation and the setting of tariffs for pricing) "depend upon the receipt of the relevant government authority's approval."[47]

Key government actors. A number of Chinese government organizations play a particularly important role in the energy sector:

- ***State Council.*** The State Council is China's cabinet, chaired by the Premier and comprised of the heads of the principal government departments and agencies. It initiates legislation for the consideration of

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[44] China Longyuan Power Group Corporation Limited, *Global Offering* (November 27, 2009) p. 52 (hereafter cited as "Longyuan *Global Offering* (2009)."

[45] China's electrical grid is operated by five publicly traded power generation SOEs that were formed in 2002 through the breakup of the former State Power Corporation of China. They are China Guodian Corporation, China Datang Corporation, China Hundian Corporation, China Power Investment Corporation and China Huaneng Group.

[46] Decree of State Council, Interim Regulations on Supervision and Management of State-Owned Assets of Enterprises No. 378, Premier Wen Jiabao (May 27, 2003); Articles 13, 17, 23, 25; Barry Naughton, *Top Down Control: SASAC and the Persistence of State Ownership in China*, paper delivered at Conference on China and the World Economy (June 23, 2006).

[47] Longyuan *Global Offering* (2009) p. 52.

the National People's Congress (NPC) and periodically issues "opinions" which have the force of law.

- ***The National Development and Reform Commission (NDRC).*** The NDRC is a macroeconomic management agency charged with overseeing China's economic development. Until 2008, it had the principal responsibility for developing and supervising China's energy sectors. It currently shares jurisdiction with the newly-formed National Energy Commission. The NDRC retains power to set energy prices, to approve large scale energy projects, and to promulgate rules with respect to the operation of power plants.[48]

- ***National Energy Commission (NEC).*** The National Energy Commission was formed in 2008 as a high level discussion and coordinating body under the state council. It has been characterized as a "mini-State Council" because of the large number of senior officials who comprise it, and "the fact that important high-ranking officers in the military will play a part [in the Commission] serves to show that the issue of energy has involved China's core national interests and that the National Energy Commission will be playing an important role in maintaining China's national security."[49]

- ***National Energy Agency (NEA).*** The NEA was formed in 1998 out of the NDRC's Energy Bureau. Although it is formally supervised by the NEC it is staffed by many former NDRC bureaucrats and it is unclear how much autonomy from the NDRC it will enjoy.[50]

- ***Ministry of Science and Technology (MOST).*** MOST supervises science and technology activities in China. It is the principal sponsor of R&D activities in the renewable energy sector.

- ***Ministry of Commerce (MOFCOM).*** MOFCOM oversees China's international trade, foreign investment, market competition and consumer

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[48] Wind power projects with installed capacity of 50 MW or above must be approved by the NDRC. Smaller projects must be approved by provincial authorities subject to review by the NDRC. *Provisions in the Administration of Power Generation from Renewable Energy* (January 5, 2006).

[49] "China Announces the Formation of High-Profile National Energy Commission, and Attention is Drawn to the Fact that High-Ranking Officers from Military are Members of the Commission," *Zhongguo Tongxun She* (January 28, 2010). Premier Wen Jiabao is the director of the National Energy Commission, and Vice Premier of the State Council. Le Keqiang is its deputy director. Participating ministries include the NDRC, the Ministries of Transport, Water Resources, Land and Resources, Environmental and Protection, and the State Electricity Regulatory Commission. The office director of the NDRC will serve concurrently as the office director of the Commission. "News Analysis: New Information Released Regarding Establishment of National Energy Commission," *Xinhua* (February 10, 2010).

[50] See Erica S. Downs, "China's 'New' Energy Administration," *China Business Review* (November-December 2008).

protection. MOFCOM uses tax incentives and special funds to encourage the development of renewable energy.

- ***State Electricity Regulatory Commission (SERC).*** SERC promulgates rules for the power industry, supervises compliance, and issues permits enabling enterprises to engage in the power business.

A. First Measures

The Chinese central government began promoting development of renewable energy during the period of the Ninth Five Year Plan (1996-2000). In 1996, the government promulgated the *New and Renewable Energy Development Program 1996-2000*, an effort which concentrated on use of renewable energy to bring electricity to remote parts of China lacking access to national electrical grids. Development efforts included the planting of forests for firewood, use of biomass to generate biogas, construction of small hydropower stations, and development of solar, wind and geothermal technology.[51] Tibet was in the forefront of this effort, which involved, among other things, establishment of 100,000 solar powered cooking stoves.[52] A UN-supported project featured international training for policymakers and managers in the renewables sectors, demonstration projects, and the formulation of standards.[53]

In 1997, the government issued guidelines with respect to the construction of renewable energy projects, establishing some basic principles that would be carried forward in subsequent government plans and measures:

- "The purpose of issuing the measures is to encourage and support the development of new energy industry in China, promote the build-up of the new energy industry, and accelerate the localization process of new energy equipment production."[54]

- "For the research of new energy technology and the manufacturing of new energy equipment, a method of combining indigenous innovation and import-absorption-innovation shall be adopted so as to carry out the all-in-one unity of technology, manufacturing and trading and to accelerate the localization of equipment."[55]

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[51] Dan Shi, "Analysis of China's Renewable Energy Development Under the Current Economic and Technical Circumstances," *China and the World Economy.*

[52] "Tibet Utilizes Renewable Energy," *Xinhua* (May 5, 1997).

[53] "Project Launched to Promote Renewable Energy Technologies," *Xinhua* (March 9, 1999). Additional funding was provided by the governments of Australia and the Netherlands, as well as the government of China. "PRC Accelerates Development of Renewable Energy," *Xinhua* (April 6, 1999).

[54] Interim Measures for Administrating Capital Construction Project of New Energy, *Ji Jiao Neng* [1997] No. 955, May 27, 1997, Article 1.

[55] *Ibid*. Article 6.

- "New energy capital construction projects with foreign investment, imported equipment and technology (including new energy projects with direct foreign investment) must be examined and approved by the State Planning Commission. No one is allowed to sign official contracts with foreign entities prior to approval."[56]

B. Tenth Five Year Plan (2001-2005)

The Tenth Five Year Plan (2001-05) provided that China would "actively develop new energy and renewable energy such as wind, solar, and geothermal power [and] promote energy saving and comprehensive utilization of technologies."[57] During the period of the Tenth Five Year Plan the government "gradually enhanced its degree of support in renewable energy by providing more financial assistance and putting forward more preferential taxes. [The government] adopted tax relief policies in support of wind power, financial subsidies and preferential tax policies in support of the development of biomass liquid fuel."[58] During this period, the Chinese government reportedly invested $180 million in the development of wind power equipment, and MOST provided funding for developing megawatt-size wind turbines, including variable pitch rotors and variable speed generators. [59]

C. Government R&D programs

The Chinese government has devoted substantial resources to R&D in the energy sector, addressing themes such as clean coal technology, hydrogen and fuel cell technology, energy efficiency and renewable energy. The principle source of funding is the Ministry of Science and Technology, but provincial and municipal governments are also providing support.[60]

1. 863 Program. The 863 Program, or State High Tech Development Plan, is a government-funded R&D program which has the objective of rendering China independent of financial obligations for foreign technologies. Established in 1986, at the behest of four of China's top weapons scientists, the program sought to diversify China's R&D efforts from purely military themes to civilian and dual use technologies, such as satellites, computers, robotics, biotechnology, energy and space exploration. New energy technology themes were incorporated in the 863 program for

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56 *Ibid*. Article 10.

57 10th Five Year Plan of China, Chapter 7.3.

58 11th Five Year Plan for Renewable Energy, Part 1(1).

59 "East China Country Leads China to Develop Wind Power for Economic Growth," *Xinhua* (August 18, 2004).

60 Local governments' contribution to R&D funding can be substantial. In 2006, Shanghai invested 9.5 billion yuan in R&D ($1.5 billion), or 5.2 percent of the Municipality's GDP for the year. World Resources Institute, *An Emerging Revolution: Clean Technology Research, Development and Innovation in China* (Working Paper, December 2009).

the first time during the Tenth Five Year Plan (2001-05) and results were achieved which Chinese policy makers characterized as "major breakthroughs:"[61]

- Large variable speed constant frequency wind power generators of 1.0 and 1.2 megawatts capacity were developed, connected to the power grid; the 1.2 MW generator was expected to comprise the "primary workhorse in the construction of wind farms in China."

- A "quantum leap was made in the development of thin film solar cells, [putting] China very close to the advanced level achieved elsewhere in the world."

- A 6 MW large biomass gasification power plant was built in Xinghua, Jiangsu Province, which was "economically very attractive."

2. 973 Program. The National Basic Research Program or "973 Program" is a government program launched in 1997 to support basic R&D. Since the inception of the program, core areas of focus have been energy, resource conservation, and environmental protection. During the period of the 11th Five Year Plan, one of the program's principal areas of focus was exploration of utility-scale renewable energy and new energy development.[62]

3. International Collaboration. In 2007, the NDRC and MOST initiated the International Science and Technology Cooperation Program in Renewable Energy with two objectives: 1) diversify the sources of China's technology imports, and 2) expedite technology transfer to China from other countries.[63] Pursuant to this program China has signed 103 agreements with 97 countries, many of which relate to renewable energy development. Three priority fields for international technology collaborations are identified as:

- Biomass gasification and power generation

- Solar and PV power generation

- Large high efficiency wind turbines, offshore turbines and offshore wind farms.

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61 "Innovation Can Solve China's Energy Predicaments," *Keji Ribao* (July 13, 2006).

62 MOST, "National Basic Research Program of China (973 Program)," http://www.most.gov.cn/eng/programmes/200610/20061009_36223.htm, World Resources Institute, *Emerging Revolution* (2009) op. cit.

63 The program "aims to identify more channels to introduce overseas cutting-edge technologies" and "aims to help China to bring in overseas talents in the new and renewable energy field and to improve the country's basic research capacities and solve key sci-tech problems." "Renewable Energy Program," *Zhongguo Wang* (November 29, 2007).

D. Government Procurement Law

In 2002, China enacted "The Government Procurement Law of the Peoples' Republic of China," which established a comprehensive set of rules governing procurement by China's government departments, institutions and public organizations.[64] The Government Procurement Law sought to maximize the efficient use of public funds, promote "honest and clean government," and to protect the "legitimate interests of parties to government procurements."[65] The Law provided for procurement procedures which embraced the principles of "openness . . . transparency, fair competition, impartiality and good faith."[66] The Law prohibited practices such as collusion to exclude other potential suppliers and bribery and provided for withdrawal from procurement proceedings by officials with an interest in the suppliers.[67]

Article 10 of the law establishes a requirement that "the government shall procure domestic goods, construction and services, except in one of the following situations:

> *(1) where the goods, construction or services needed are not available with the territory of the People's Republic of China or, though available, cannot be acquired on reasonable commercial terms;*
>
> *(2) where the items to be procured are for use abroad; and*
>
> *(3) where otherwise provided for by other laws and administrative regulations*
>
> *The definitions for the domestic goods, construction or services mentioned in the preceding paragraph shall be applied in accordance with the relevant regulations of the State Council."*

In 2007, the Ministry of Finance released "Measures on Government Procurement of Imported Products," establishing procedures by which the exceptions to the Government Procurement Law's "buy domestic" requirements could be satisfied."[68]

1. Application to SOEs. The extent to which the Government Procurement Law governs procurement of renewable energy services and equipment by SOEs is ambiguous. By its terms the law applies to purchases of goods and services by

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64 Order of the President No. 68, Adopted at the 29th Meeting of the National Peoples' Congress, June 29, 2002, effective January 1, 2003.

65 Government Procurement Law Article 1.

66 Government Procurement Law Article 3.

67 Government Procurement Law, Articles 12 and 5.

68 *Cai Ku* (December 27, 2007), No. 119.

government departments, institutions and public organizations but not SOEs. However, numerous SOEs reportedly apply principles established by the law when making procurement decisions, including the preference for domestic goods and services. Perhaps most significantly, the buy national principles set forth in the Government Procurement Law are being applied to procurement by SOEs of equipment for projects which are funded by government investments. In 2009, as China began to implement a $586 billion economic stimulus plan, the NDRC and eight other ministries jointly released Circular 1361 (May 27, 2009), which provided in pertinent part that with respect to stimulus investments

> *Government investment projects should purchase domestic products, unless these domestic goods, construction engineering or services are not available in China or cannot be acquired on reasonable commercial terms. Projects requiring imported products will need prior approval from relevant government authorities.*[69]

A number of European producers of wind power equipment have protested the Circular, which appears to foreclose their eligibility for wind equipment purchases estimated at $7 billion. The NDRC responded with a statement on its Web site that "purchases for government investment projects count as government procurement, hence priority must be given to home products unless the technologies cannot be obtained under 'reasonable commercial conditions' and 'within the boundaries' of the country."[70] More generally, the Chinese government defends its preferential domestic procurement practices as consistent with international practice (a reference to numerous "buy domestic" procurement rules around the world) and necessary to offset a bias within Chinese government organizations, which often prefer foreign products.[71]

2. Implementing regulations. In January 2010, China's State Council Legislative Affair Office (SCLAO) released draft regulations for comment (by February 5, 2010). The draft regulations contain several provisions affecting the ability of foreign firms to participate in Chinese government procurement projects:

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[69] "Opinions on the Implementation of Decisions on Expanding Domestic Demand and Promoting Economic Growth and Further Strengthening Supervision of Tendering and Bidding Projects," Circular 1361, May 27, 2009.

[70] "Foreign Companies Blowing in the Wind," *Asia Times* (June 11, 2009).

[71] The head of the NDRC commented in 2009 that "Attention should be paid while giving priority to domestic products in government procurement. It is international practice. We cannot simply regard it as trade protection. Government procurement laws vary in different countries, but almost all of them benefit their domestic products." "Why Does Chinese Government Procurement Favor Foreign Products?" *Renmin Ribao* (July 3, 2009).

- Energy saving products and "indigenous innovation projects" will be placed on the government procurement "priority" list, and foreign products will not be included.[72]

- Government procurement of imported products must be verified and approved by the necessary procurement department.[73]

- Necessary qualifications for a government procurement supplier will be posted five days prior to the submission date for bids, which may not allow foreign firms sufficient time to respond.[74]

E. Renewable Energy Law

In November 2005, NDRC Vice Minister Zhang Guobao stated that China would soon enact a Renewable Energy Law and would commit a staggering 1.5 trillion yuan ($184 billion) to the development of renewable energy through 2020, with the objective of raising the renewable percentage of total energy consumption from seven to 15 percent.[75] The Renewable Energy Law was enacted by the National People's Congress in 2005 and became effective on January 1, 2006.[76] "Renewable energy" for purposes of the law referred to "non-fossil energy of wind energy, solar energy, water energy, biomass energy, and ocean energy, etc."[77] The law was designed to accord priority to renewable energy sources when they produced electricity for transmission on the state power grid, to give users of renewable energy price discounts and to share utilization of renewable energy with the whole society.[78]

The enactment of the law was followed by release of implementing measures. The government ordered China's five state-owned power groups to produce five percent of their power from renewable sources by 2010. The law and follow-on measures required utilities to pay renewable energy developers full price for their electricity and gave consumers of renewable-generated electricity discounted rates.[79] A dedicated fund was set up to support the development of new renewables technologies, to construct pilot

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72 Article 9.

73 Article 11.

74 Article 25.

75 "Renewable Energy Gets Huge Outlay," *China Daily* (November 8, 2005).

76 Adopted at the 14th Session of the Standing Committee of the 10th National People's Congress, February 28, 2005.

77 Renewal Energy Law, Article 2.

78 "White Paper: China's Policies and Actions on Climate Change," *Zhongguo Wang* (October 29, 2008).

79 Pursuant to the *Supervision Measures on the Purchase of the Full Amount of Renewable Energy Power by Grid Enterprises* (September 1, 2007), SERC was directed to supervise grid companies' compliance with the mandatory purchase and grid connection obligations established by the *Renewable Energy Law*.

and demonstration facilities, and to develop renewable energy in the countryside.[80] The NDRC issued a *Guidance Catalogue on Renewable Energy Industrial Development* (November 29, 2005) listing 88 types of renewable energy projects eligible for preferential tax treatment or designated funding. Developers of wind energy equipment received an exemption from the value-added tax. Wind turbine operators were entitled to claim emission-reduction credit that could be sold on an international exchange to companies seeking to meet their emissions targets.[81]

In June 2006, the NDRC announced a plan to raise consumer electricity rates by 2.5 cents per kilowatt hour, and a fractional 0.1 percent of the increase would be used to develop renewable energy. This measure implemented a provision of the Law on Renewable Energy which provided that the extra costs of renewable energies should be shared by all end-users of electricity in China.[82]

In December 2009, the National People's Congress enacted an amendment to the Renewable Energy Law which required power companies to buy all power produced by renewable energy. Power enterprises that refuse are subject to fines up to the amount of double the economic loss to the renewable power generator.[83]

F. Eleventh Five Year Plan (2006-2010)

The Eleventh Five Year Plan, released in March 2006, set as an objective for the years 2006-10 an increase in the share of China's total energy consumption accounted for by renewable energy sources. It directed as follows:

- "Encourage production and consumption of renewable energy and increase its share of primary energy consumption by implementing preferential tax and investment policies and mandatory market share policy."

- "Vigorously develop wind energy, build 30 large-scale wind power projects, all of which will be above 100 MW, and form GW level wind power farms in IMAR (Inner Mongolia Autonomous Region), Hebei, Jiangsu and Gansu provinces."

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[80] "China's Policies and Actions for Addressing Climate Change," *Xinhua* (October 29, 2008). Pursuant to the *Interim Measures on Administration of Fund for the Development of Renewable Energy* (May 30, 2006), the Ministry of Finance was authorized to allocate funds from the state budget to provide grants and subsidized loans to unprofitable renewable energy projects that satisfy the criteria established in the NDRC's *Guidance Catalogue on Renewable Energy Industrial Development.*

[81] Renewable Energy Law, Articles 13 and 19-23. "Uncertain Returns, Rules Buffet Wind Power Pioneers," *South China Morning Post* (October 7, 2006).

[82] "China Speeds Up Renewable Energy Development," *Xinhua* (September 12, 2006).

[83] "China Adopts Amendment to Renewable Energy Law," *Xinhua* (December 26, 2009); "Amendment Draft of the Renewable Energy Law," *Zhongguo Xinwen* (August 24, 2009).

- "Accelerate biomass development, support the development of straw, garbage-burning and land-filled gas generated power, build some straw and forest-generated biomass power generation, expand biomass solid forming burning material, ethanol and biodiesel production capability."

- "Installed capacity of wind power connected to grid and biomass power is to reach five GW and 5.5 GW respectively.[84] Actively develop and utilize solar energy, geothermal energy, and ocean energy."[85]

G. The State Council's S&T Guidelines

In June 2006, China's State Council issued "Guidelines for the Medium-and Long-Term National Science and Technology Development Program (2006-2020) ("S&T Guidelines"), establishing a long-term national strategy for the development and utilization of key technologies. One of the "key fields and priority subjects" was "Low-Cost, Mass Development and Utilization of Renewable Energy." The Guidelines stated that

> *We will give priority to researching and developing large-scale wind power generation equipment, technologies and equipment for building coastal and land-based wind farms and areas with high concentrations of wind energy resources in the western regions, high-performance and low-cost solar voltaic cells and technologies to use them, solar thermal power generation technologies, integrated technologies for solar energy buildings, and technologies for developing and utilizing biomass and geothermal energy.*[86]

The Guidelines also spelled out the policy tools China would employ to develop "key" technologies:

- ***Fiscal and tax policies.*** China would encourage enterprises to "increase their R&D investments and enhance their technology innovative capabilities" by "further implementing national preferential tax policies as promoting technological innovation . . . beef[ing] up incentive policies such as those allowing enterprises to make pre-tax deductions for R&D investment; and implement preferential tax policies aimed at promoting the development of new and high-tech enterprises." The state would "encourage enterprises to establish a system of special funds for technology-related R&D." Enterprises would be allowed to "accelerate the

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84 As noted previously, the wind power goal of five GW was easily surpassed and has now been ratcheted up significantly.

85 11th Five Year Plan of China, Chapter 12.4.

86 S&T Guideline, Part III.1. (4).

depreciation of their R&D apparatus and facilities." The government would "provide necessary support in the way of tax policy for enterprises that purchase advanced science research apparatus and facilities."[87]

- ***Government procurement.*** The government stated that it would, "draw up detailed rules and regulations to encourage and protect independent innovation" and "set up mechanisms for coordinating government purchases of products of independent innovation." It stated that "the government will implement a procurement policy to give priority to important new and high technologies and equipment with proprietary intellectual property rights developed by domestic enterprises." The government would "provide policy support to enterprises that purchase domestically produced new and high technologies and equipment."[88]

- ***"Absorption" of imported technologies.*** The Guidelines state that the government will seek to "enhance the absorption, assimilation, and re-innovation of imported technologies" in the key sectors. Concurrently it would "draw up policies to encourage independent innovation and restrict the indiscriminate importation of duplicate technologies."[89]

H. Several Opinions of the State Council on Expediting the Rejuvenation of the Equipment Manufacturing Industry

In July 2006, the State Council released another long-term planning document, "The Several Opinions on Expediting the Rejuvenation of the Equipment Manufacturing Industry" ("Several Opinions").[90] This document identified "major tasks and key breakthroughs" for domestic equipment producers and provided that "more policy assistance and guidance should be given to a batch of key technical equipment that may produce a great impact on and are greatly related to the development of the national economy. . . ."[91] Among the equipment types designated as "key" were "large-sized hydropower units," "super critical thermal power generation units," "high-power wind power generation units, and some other new-type energy equipment."[92] The Several Opinions outlined "measures" that would be undertaken by the government to help domestic equipment makers achieve their objectives. The government would "pay attention to supporting independent innovation projects," *e.g.*, projects based on domestic technology. In examining and approving key construction projects,

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87 S&T Guidelines, Part VIII.1.

88 S&T Guidelines, Part VIII.3.

89 S&T Guidelines, Part VIII.2.

90 Issued by the State Council on February 13, 2006.

91 Several Opinions, Part II.3.

92 Several Opinions, Part II.3(1).

> *The state should rely on a group of projects for domestic production of key technological equipment. Meanwhile the state should also ask the owners of these projects and the manufacturing departments to jointly work out plans for independent manufacturing of equipment.*[93]

Large-sized manufacturers of "key" equipment "should solicit opinions from the relevant departments of the State Council at the time of transferring their controlling stakes to foreign investors."[94] Import tax exemptions for complete sets of foreign-made equipment would be cancelled.[95] Domestic enterprises would continue to enjoy import tax exemptions for key foreign-made parts which were necessary for the development of key equipment, but MOF and the NDRC would conduct "strict examinations and continuously grant preferential import policies within a set period of time in the form of reducing the margin of preference in a step-by-step manner and reducing the tax exemption scope."[96]

With respect to procurement of equipment, the Several Opinions provided as follows:

> *It is imperative to encourage the procurement and use of the first set of homemade key technological equipment. Key state projects built with the first set of domestic key technological equipment can be defined as technological progress demonstration projects and enjoy preferential arrangements.*[97]

In May 2009, the State Council released its "Plan for Modifying and Promoting the Equipment Manufacturing Industry," which identified the promotion of equipment manufacturing in clean technology as one of the ten major tasks of the Plan. The Plan recommends promotion of specific types of "indigenous innovative manufacturing" in the wind power equipment sector, including frequency conversion control systems, bearings and carboform blades. The Plan recommends financial support from the central budget for purchasing "indigenously innovated" equipment.[98]

I. Provisional Measures For Accreditation Of National Indigenous Innovation Products

In December 2006, three Chinese ministries jointly released the Provisional Measures for Accreditation of National Indigenous Innovation Products ("Accreditation

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93 Several Opinions, Parts III.5 and III.6.

94 Several Opinions, Part III.7.

95 Several Opinions, Part III.11.

96 Several Opinions, Part III.13.

97 Several Opinions, Part III.13.

98 State Council, Plan for Modifying and Promoting Wind Power Industry (May 12, 2009).

Measures").[99] The Accreditation Measures provide that "domestic innovative products" can be accredited through an administrative process and that products which are "accredited" are to be "given priority in procurement projects for government and in national key projects that will spend treasury funds."[100] The intellectual property associated with the product must be Chinese.[101] The Accreditation Measures state that consideration should be given by procuring entities as to whether the applicant's products can be substituted for imports.[102]

In January 2008, the Ministry of Finance promulgated a document entitled "Administrative Measures for Government Procurement on Initial Procurement and Ordering of Indigenous Innovation Products," ("Administrative Measures").[103] The new measures apply to initial procurement and ordering activities of government departments, institutions and organizations using fiscal funds.[104] The Administrative Measures establish a process through which the policies spelled out in the 2006 Accreditation Measures will be implemented to certify "accredited" products for initial procurement.[105] Products for initial procurement must satisfy the following requirements:[106]

> *"(1) Shall be indigenous innovation products accredited by related government departments.*
> *(2) Shall comply with the needs of national economic development, and represent the trend of advanced technological development.*
> *(3) Manufacturers and suppliers shall be Chinese enterprises and institutions licensed within the territory of China.*
> *(4) Shall be products which are first introduced to market, temporarily do not possess market competitiveness but enjoy great market potential, and require special support of the government.*
> *(5) Shall enjoy great potential for mass production and high quality.*
> *(6) Shall comply with China's laws, regulations and policies."*

Products that meet these criteria are added to China's "Catalogue of Indigenous Innovation Products for Government Procurement" and are eligible for procurement by

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99 NDRC, Ministry of Science and Technology, and Ministry of Finance.

100 Accreditation Measures, Article 1.

101 Accreditation Measures, Article 4, Sec. 2.

102 Accreditation Measures, Article 4, Sec. 7.

103 MOF Circular No. 120 (2007) promulgated January 3, 2008.

104 Administrative Measures Article 2.

105 Administrative Measures Article 9.

106 Administrative Measures Article 8.

government purchasing entities. Article 14 of the Administrative Measures provides that "any government procurement contract for purchasing the ordered products shall be awarded to Chinese enterprises or institutions licensed within the territory of China. If a consortium is formed for tendering, all members must be Chinese enterprises or institution licensed within the territory of China."[107] On November 15, 2009, MOST and MOF jointly issued a notice which required enterprises registered in China to apply for accreditation of indigenous innovation products, with a filing deadline of December 10, 2009 — a timeline that foreign companies have criticized as difficult or impossible to satisfy.[108]

Foreign-invested Chinese enterprises are not excluded from owning qualified "indigenous" technology by the terms of the Provisional Measures, and MOFCOM has stated that foreign-invested enterprises may qualify for accreditation. However, MOST reportedly issued a directive in 2008 to local governments that to gain accreditation under this program an enterprise must be wholly owned by Chinese nationals or, in the case of a joint venture, majority controlled by Chinese nationals. As a practical matter, most foreign firms find that the requirements for qualifying for certification are difficult or impossible to satisfy.

J. Medium and Long-Term Development Plan for Renewable Energy in China

In September 2007, in order to implement the 11th Five Year Plan's recommendations with respect to renewable energy, the NDRC released the Medium and Long-Term Development Plan for Renewable Energy in China ("Renewable Energy Development Plan") setting forth the guiding principles, objectives and targets, priority sectors, and policies and measures for the development of renewable energy in China, involving hydropower, biomass energy, and geothermal wind and solar energy.[109]

The plan stated that by 2010 China would aim to raise the share held by renewable energy in total energy consumption to ten percent and to 15 percent by 2020.[110] It set the following specific targets for renewables sectors:

- ***Hydropower.*** Installed capacity of hydropower to reach 190 GW by 2010 and 300 GW by 2020.[111]

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[107] Administrative Measures, Article 17.

[108] MOST and MOF, *Notice on the Promulgation of the 0209 National Indigenous Innovation Products Accreditation Program*, Notice 618, November 5, 2009. Notice 618 provided that the Accreditation Program for 2009 would focus on six new technology fields, including renewable energy.

[109] *Fa Gai Neung Yuan* (2001) No. 2174.

[110] Medium and Long-Term Plan, Article 3.2.

[111] Medium and Long-Term Plan, Article 4.1.

- ***Biomass energy.*** By 2010, the installed capacity of biomass power to reach 5.5 GW and by 2020, 30 GW[112]

- ***Wind power.*** By 2010, the installed capacity of grid-connected wind energy will be five GW, and by 2020, 30 GW.[113]

- ***Solar energy.*** By 2010, total capacity of solar power and China will be 300 MW and by 2020, 1.8 GW.[114]

The solar energy goal for 2020 has already been increased to 20 GW and the wind power goal for 2020 has already been increased from 30 GW to 100 GW.[115]

Mandated market share (MMS). Under the Medium and Long-Term Plan, consumption of renewable energy would be stimulated by favorable price policies, mandated market share measures (MMS), government investment, and government concessions. MMS targets were set for non-hydro renewable power generation requiring areas covered by large scale power grids to increase renewables' share of total power generation to one percent by 2010 and over three percent by 2020.[116] Power companies which owned installed capacity of over five GW were required to have non-hydro renewable energy installed power capacity accounting for three percent of total capacity by 2010 and eight percent by 2020.[117] With respect to fiscal support, the Medium and Long-Term Plan directed local authorities to "allocate the necessary funds to support renewable energy development" and provided that the central government would support the development of renewables "through preferential tax policies" and "appropriate favorable tax policies for relevant enterprises."[118]

Localization. With respect to self-sufficiency in renewable energy equipment, the plan provides:

> *On the basis of bringing foreign technology from abroad, the capacity to absorb and innovate should be strengthened so that as soon as possible, self-dependent innovation capabilities are achieved. By 2010, a basic system of renewable energy technologies and industry will have been established, so that equipment capabilities based mainly on domestic manufacturing will have been established. By 2020, a relatively complete renewable energy technology*

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[112] Medium and Long-Term Plan, Article 4.2.

[113] Medium and Long-Term Plan, Article 4.3.

[114] Medium and Long-Term Plan, Article 4.4.

[115] MangoStrategy LLC, *The China Greentech Report 2009* (September 2009).

[116] Medium and Long-Term Plan, Article 5(1).

[117] Medium and Long-Term Plan, Article 5(1).

[118] Medium and Long-Term Plan, Article 5(5).

and industry system will have been established, so that a domestic manufacturing capability based mainly on China's own IPRs will have been established, satisfying the need for deploying renewable energy on a large scale in China.[119]

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Become self-dependent in wind power equipment production in order to make wind power equipment market competitive as soon as possible.[120]

K. The Special Fund for the Development of Renewable Energy (2006)

Article 24 of the Renewable Energy Law provided for the establishment of a "renewable energy development fund" to support the following activities:

1. Scientific and technological research, establishment of standards and pilot projects for the development and utilization of renewable energy;

2. Construction of renewable energy projects for domestic use in rural and pasturing areas;

3. Construction of independent renewable power systems in remote areas and islands;

4. Surveys and assessments of renewable energy resources, and the establishment of relevant information systems; and

5. Localized production of the equipment for the development and utilization of renewable energy.[121]

In the spring of 2006, pursuant to the mandate of the Renewable Energy Law, the Ministry of Finance issued "interim measures" for the administration of the Special Fund.[122] This measure provided that the Special Fund would be allocated in the form of grants and soft loans through the central financial budget to support R&D, promulgation of standards, demonstration projects, and promotion of "localized production of equipment for the development and utilization of renewable energy" with special emphasis on wind, solar and tidal power.[123]

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[119] Medium and Long-Term Plan, Article 5(5).

[120] Medium and Long-Term Plan, Article 6(3).

[121] Renewable Energy Law, Article 24(1) through (5).

[122] Ministry of Finance, Interim Measures of the Ministry of Finance for the Administration of the Special Fund for the Development of Renewable Energy (Issued May 30, 2006), *Cai Jian* [2007] No. 371.

[123] *Ibid*., Articles 2, 3, 8, 17. In June 2009, the Chinese wind equipment producer Sinovel received notification from the NDRC that its "national research project marine wind power equipment research

In 2008, MOF established a Special Fund for the Industrialization of Wind Power Equipment pursuant to the State Council's 2006 Several Opinions on Expediting the Rejuvenation of the Equipment Manufacturing Industry as well as its own 2006 Interim Measures.[124] The Fund was established "for developing renewable energy to support the evaluation and investigation of renewable energy resources, related technological research and development, construction of pilot and demonstration projects, and the development and utilization of renewable energy in the countryside."[125] Pursuant to the 2008 Interim Measures, the government will provide a subsidy to domestic companies that develop new wind turbines, specifically 600 yuan (or roughly $87.41) per kilowatt for the first 50 units produced of any new turbine with a capacity of 1.5 megawatt or more.[126] The subsidy represents roughly five to ten percent of the turbine cost.[127] Only Chinese-funded or Chinese majority-owned companies qualify for the subsidy, which must be shared equally between the manufacturers of key parts and the assembling companies.[128] To be eligible, producers of wind power equipment are required to "possess proprietary intellectual property rights (IPRs) and brands and involve indigenous R&D, jointly developed or re-innovation . . . of imported technologies."[129] The Interim Measures require buyers to purchase blades, gearboxes and generators from Chinese owned or controlled companies as China is considered to be self-sufficient in these categories.[130]

Sinovel Wind Group, one of China's leading manufacturers of wind power equipment, has received RMB 77 million from the "indigenous special fund" in connection with its establishment of the national Marine Wind Power Technology Equipment R&D Center. The company is committing RMB 512 million of its own funds

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center would receive a subsidy of RMB 77 million from the central budget. The funds will be used to develop a large scale wind power generator unit driving set, speed change control system, and a massive data collection and management system. "The Investment of Sinovel will further increase China's localization of marine wind power technology equipment." "Sinovel Receives RMB 77 Million Subsidy from the Central Government," *Zhongguo Kezaisheng Nengyuan* (June 26, 2009).

124 Ministry of Finance, Interim Measures of the Ministry of Finance for the Administration of the Special Fund for Industrialization of Wind Power Equipment (Issued August 2008) *Cai Jian* [2008] No. 476.

125 "White Paper: China's Policies and Actions on Climate Change," *Zhongguo Wang* (October 29, 2008).

126 2008 Interim Measures, Article 8.

127 International Energy Agency, "Renewable Energy Essentials: Wind" (2008) (indicating that in 2007 onshore turbine costs ranged from $1.2 million to $1.8 million per MW); http://www.windustry.org/how-much-do-wind-turbines-cost

128 "Support targest of the Wind Industrialization Special Funds are Chinese invested and Chinese investment controlled enterprises that produce wind power equipment (including whole sets and blades, gear boxes, engines, convertors and bearings." 2008 Interim Measures, Article 3.

129 2008 Interim Measures, Article 6.

130 "Wind power equipment manufacturers applying for the Wind Industrialization Special Fund must meet the following conditions: …. Blades, gear boxes and engines of wind power generator units are manufactured by Chinese invested or Chinese investment controlled enterprises, and manufacturers are encouraged to use convertors and bearings produced by Chinese invested or Chinese investment controlled enterprises." 2008 Interim Measures, Article 6.

to this project as well. The Center's objective is to "develop key technological R&D and testing for large-scale marine and intertribal region wind power turbines."[131]

L. Eleventh Five Year Plan for Renewable Energy

By 2008, it was clear that the targets set for wind power in the NDRC's *Medium and Long-Term Plan for the Development of Renewable Energy* were too conservative and that higher levels of growth were achievable. Accordingly, in March 2008, the NDRC released the Eleventh Five Year Plan for Renewable Energy. This plan established a goal to the effect that by 2010 the consumption of renewable energy was to account for ten percent of China's total energy consumption. The goal for installed capacity of renewable energy sectors doubled the target for wind power that had been set in the 2007 Medium and Long-Term Development Plan for Renewable Energy in China:[132]

Sector	**Previous Targets For 2010 (2007)** ***(gigawatts)***	**New Targets for 2010 (2008)** ***(gigawatts)***
Hydropower	190	190
Wind power	5	10
Biomass energy	3.3	3.3
Solar power	0.3	0.3

Specific support measures spelled out in the plan:

1) Promote renewable energy development policy measures, work to improve and implement such policies as renewable energy-related regulations on power generation connected to the grid, on-grid electricity price and cost sharing as well as policies on financial assistance and tax preferences.[133]

2) Government agencies put forward administrative measures and instruction for a special fund for renewable energy development in accordance with the need for renewable energy development and utilization, arrange necessary financial funding, and support renewable energy equipment localization.[134]

3) Promote the market environment for renewable energy development and utilization. Government agencies are to adopt comprehensive measures

[131] "Shanghai Jiao Tong University and Sinovel Look to Cooperation," *Yang Cheng Wang* (July 20, 2009). <www.0515yc.tv/news/folder17/2009/07/2009-07-2050860.html>

[132] 11th Five Year Plan for Renewable Energy, Section 2(2).

[133] 11th Five Year Plan for Renewable Energy, 5(1).

[134] 11th Five Year Plan for Renewable Energy, 5(2).

such as finance, tax and pricing policies to achieve mandatory market share.[135]

This plan states that the government will support localization of wind power equipment manufacturing and provide special assistance to several domestic wind generation manufacturers that have a large capacity for "technology renovation."[136] The plan also set forth guidelines for promotion of localization of equipment in the hydro and wind power sectors:

- *Localization (of technological equipment): Continue to promote the localization of large-scale conventional hydro generating units and pump-storage generating units, enhance indigenous innovation and technological renovation.*[137]

- *In order to accelerate the scale development of wind power, the government adopts the bidding for concession method to push the development of large-scale wind power, and promote localized production of wind power equipment and indigenous innovation of wind power technologies.*[138]

- *Increase R&D capability in wind generating technology, combine indigenous innovation and technology transfer together with digestion, absorption and re-innovation to build and form the wind power equipment capability with domestic production as main source. During the period of 11th Five Year Plan, continue to promote large-scale application of domestically produced wind generating units that are already in production, and upgrade megawatt level wind generating units.*[139]

- *Support the localization of wind power equipment production. Particularly support several domestic enterprises producing complete wind power equipment unit and with strong technological innovation capability.*

- *Increase the level of wind power technology and equipment production capability. Encourage domestic enterprises to launch indigenous innovation of wind power technology and transfer and re-innovation, support wind power equipment localization and indigenous technology innovation by adopting such methods as bundling equipment producing*

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[135] 11th Five Year Plan for Renewable Energy, 5(3).

[136] *Fa Gai Neng Yjan* (2008) No. 610 (March 3, 2008).

[137] 11th Five Year Plan for Renewable Energy, 3(1).

[138] 11th Five Year Plan for Renewable Energy, 1(1).

[139] 11th Five Year Plan for Renewable Energy, 3(3).

enterprises with the government-invested projects and wind power concession bidding projects.[140]

The ultimate target for wind energy capacity in 2020 has remained in a state of flux. In late 2008, various NDRC officials were quoted to the effect that the target would be raised to 60 or 70 GW or higher.[141] According to the November 27, 2009 prospectus issued in connection with the Hong Kong IPO of the Longyuan Power Group, the NDRC's 2020 target for wind power now stands at 100 GW.[142] According to media reports in January 2010, China's leadership is considering raising the wind target to 200 GW.[143]

M. National Energy Administration Statement of Objectives (2009)

In March 2008, China established the National Energy Administration (NEA), which was tasked with coordinating decision making among the various government organizations with jurisdictions over the energy sector, the develop energy plans, and reviewing and approving or disapproving foreign investments in the energy sector.[144] In June 2009, China's National Energy Administration released a paper entitled *To Change the Mode of Development and Speed up the Restructuring of Energy Industry; To Build a Steady, Economical, Clean and Safe Energy Supply System.* ("NEA Materials"). This paper set forth objectives to be achieved in the energy realm. It stated the following objectives:

> *To actively promote development and utilization of hydropower. To change the way of relocating people for hydropower construction, that is to change the past concept of "emphasizing Construction, Ignoring Relocation" to the present concept of "Relocation First, Construction Second," by which hydropower development can be associated with poverty relief and promotion of local economy; to fully address the environmental issue of hydropower constructions where ecological space is well planned for rivers and ecological issue becomes an important part of hydropower constructions.*
>
> *To promote wind power of larger scale. To adhere to the special wind power licensing system in support of large-scale wind power stations; to promote localization of wind power equipment and gradually build China's own wind*

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[140] 11th Five Year Plan for Renewable Energy, 3.(3).

[141] "Energy Goals to be Overhauled," *South China Morning Post* (December 20, 2008).

[142] Longyuan Power Group *Global Offering* (2009) op. cit. p. 82.

[143] "China to Postpone Issuance of New Energy Revitalization Plan," *SinoCast* (January 26, 2010).

[144] It is unclear how much autonomy NEA will have from the NDRC, although the NEA reports to the State Council directly. Erica S. Downs, "China 'New' Energy Administration" (Brookings 2008).

power industries to formulate a planning and building of several million KW wind power bases in Ganso, Inner Mongolia, Hebei and Jiangsu, according to the requirement of "integration into Major Power Grid and Construction of Large Bases."[145]

To speed up the progress of development and utilization of solar energy. To gradually promote installation of solar water heater in government and commercial buildings which take larger areas and consume more energy; initiate construction of demonstration solar power generation projects; develop demonstration urban roof solar photovoltaic generation applications; promote R&D and industrialization of solar silicon.

To promote development and utilization of biomass. To evaluate biomass resources; organ formulation of the biomass development and utilization program; give support to construct demonstrative biomass development and utilization project.

In January 2010, Shi Lishan, the Deputy Director of the New Energy Department in the National Energy Administration said that "China's government supports the localization of wind power equipment, encourages leading enterprises to become large and powerful and strive to become Chinese wind power enterprises capable of playing an influential role as the international stage." He said that China would "accelerate its wind power planning . . . increase its indigenous innovation, and promote sustainable development of wind power."[146]

N. China Renewable Energy Scale-up Program (CRESP)

The China Renewable Energy Scale-up Program (CRESP) is a collaboration between the Chinese government, the World Bank, and the Global Environment Facility to assist renewable energy development. A sub-program has been established to fund Chinese "wind turbine localization" R&D between 2008 and 2010.[147] Five Chinese companies receiving support under this program have reportedly "gained breakthroughs in developing technology with full intellectual property rights." Each Chinese company is paired with a foreign collaborator that transfers technology to Chinese partners:[148]

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[145] "Materials Provided by National Energy Administration," *Zhongguo Wang* (June 3, 2009).

[146] "National Energy Administration Supports Wind Power Equipment Localization and Gives Control Over Overcapacity" *Shang Wu Di Guo* (January 1, 2010) http://news.swdgw.com/a/949.htm.

[147] *Zhongguo Zheng Quan Pao* (April 9, 2009).

[148] "Wind Power Facility Manufacturing Localizing under Government Support," *China Wind Power Newsletter* (2009).

Chinese company	Foreign partner	Project
Goldwind	Vensys (Germany)	2.5MW direct variable speed turbine
Zhejiang Windey	Hassan and Partners (UK)	1.5MW double feedback turbine
Sinovel	Windtec (Austria)	3MW double feedback turbine
Shanghai Electric	Aerodyn (Germany)	2MW double feedback turbine
Dongfuong Electric	Windtec (Austria)	2.5MW double feedback turbine.

O. Support Plan for Renewable Energy Development

In 2009, the Chinese government was reportedly working on a "Support Plan for Renewable Energy Development." Shi Dinghuan, a member of the Energy Research Commission with the Chinese Academy of Sciences, said in May 2009 that the NDRC was drafting the Support Plan. The Support Plan will build on the 2007 Medium and Long Term Plan for Renewable Energy "with major adjustment in key indices." China originally planned to achieve a wind power capacity of 30 GW by 2020, a target which could be met by 2011.[149] In January 2010, it was reported that the plan goals established in 2009 were "too conservative in light of the impact of the United Nations (UN) Climate Change Conference in Copenhagen and the rapid growth of China's new energy industry in 2009." The new plan reportedly would revise the 2020 targets as follows:[150]

	Current	Revised
Wind	100 GW	200 GW
Solar	20 GW	30 GW

P. Regional Government Measures

The governments of China's provinces, municipalities, and autonomous regions have adopted promotional measures for alternative energy which are designed to implement policy guidance expressed at the national level. These measures set specific goals for sectoral development, provide for financial support from the regional government, and endorse localization of production of alternative energy equipment.

People's Government of Yunnan Province. In 2007, the government of Yunnan Province issued a measure establishing a special fund for renewable energy development.[151] The measure provided that the special fund is to be allocated from the budget of Yunnan Province and will be used to support the development and utilization

[149] Shi Pengfei, Vice Director, Chinese Wind Energy Association in "China Expected to Issue Support Plan for Renewable Energy Development," *Xinhua* (May 5, 2009).

[150] "China to Postpone Issuance of New Energy Revitalization Plan," *SinoCast* (January 26, 2010).

[151] Interim Measures for Administering the Special Fund of the Renewable Energy Development in Yunnan Province, *Cai Jian* [2006] No. 237, issued August 2007.

of renewable energy. One of the four categories for fund support is the promotion of localized production for the development and utilization of renewable energy.

People's Government of Shaanxi Province. In December 2009, the government of Shaanxi Province introduced a measure to "accelerate the development of new energy." Under the subheading "Development of Matching Industry of Solar Energy PV and New Energy Equipment," the measure states as a goal "[T]o increase the technological and research standards for wind power equipment and localized manufacturing standards for wind power generating unit equipment."[152]

People's Government of Hunan Province. In November 2009, the government of Hunan Province issued a measure to accelerate the development of the environmental industry. It stated that one objective was to "encourage the utilization of environmental protection equipment (products)." It stipulated that projects receiving financial support from the provincial government shall give priority to purchase environmental protection equipment (products) that comply with relevant technological requirements in the province, in order to create markets to promote and utilize new environmental protection products and technologies produced in the province.[153] The Opinions state that environmental equipment includes equipment for environmental protection services, comprehensive utilization of resources, and clean products production.

People's Government of Ningxia Hui Autonomous Region. In November 2008, the government of Ningxia Region promulgated a series of development plans which embraced industries such as equipment manufacturing and high and new technologies. In one of these, its stated goals included acceleration of research in large scale wind power equipment, development of design and manufacturing capability for 1 MW and 1.5 MW-level wind power generation key components, as well as production capability for entire units, and acceleration of development of design and manufacturing capability with respect to speed modulation, generators and control systems.[154] In September 2009, the government introduced a new measure which called for research and implementation of the technology for localizing super large-scale hydro turbine blades, as well as giving "priority to developing castings for wind power generators and large scale hydro turbine blades."[155]

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[152] Several Opinions Regarding Further Accelerating the Development of New Energy, *Shan Zheng Fa* [2009] No. 65, issued December 3, 2009.

[153] Opinions Regarding Accelerating the Development in the Environmental Protection Industry, *Xiang Zheng Fa* [2009] No. 36, issued November 2009.

[154] Plans for the Development of the Industrial Cluster of Equipment Manufacturing in the Ningxia Region, *Ning Zheng Fa* [2008] No. 135, issued November 25, 2008.

[155] Plans for a New Round Technological Renovation of Ningxia Industry (2008-2012), issued September 2009.

IV. THE PROMISE AND LIMITS OF HYDROPOWER

For the foreseeable future China's primary source of renewable energy will be hydropower derived from dams on China's rivers. China has engaged in a spectacular dam-building effort, installing not only large dams on major rivers but numerous small dams on tributaries. Notwithstanding government measures to promote utilization of domestically-made hydropower equipment, foreign producers of hydropower equipment have enjoyed extensive sales in China. However, dam-building has given rise to environmental degradation, social dislocation, and political controversy, and China's leaders appear to be scaling back its role as they promote the development of renewable energy.

China has been utilizing hydropower since 1908, when the hydro-generating Shilongba Power Plant was built in Yunnan Province utilizing German technology and equipment.[156] China's first president, Sun Yat-sen, was the original advocate of damming the Yangtze downstream from the Three Gorges segment of the river, a project which was begun by the Nationalist regime in the 1930s before being suspended with the outbreak of war with Japan.[157]

Developing China's vast hydropower potential has been an objective of China's Communist leadership since the Party came to power in 1949. Mao Zedong endorsed the Three Gorges project, and under his tenure a number of major hydroelectric power projects were initiated.[158] Li Peng, who served as China's Premier between 1987 and 1998, was a hydroelectric engineer by training, and championed the Three Gorges project beginning in 1981, when he was serving as the Vice Minister of Power.[159] National and regional governments encouraged the construction of small hydropower generating stations in remote regions of China to serve local electricity needs, and by 1998 nearly 7,000 small units had been established, generating 50 billion KWH, or about 25 percent of the known exploitable hydropower resources in those regions.[160]

Advantages and drawbacks. Hydropower offers dramatic advantages for policymakers confronting shortages of electricity. China has abundant hydropower resources including "significant untapped" resources.[161] In 2007, the NDRC estimated

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156 "Water Pollution Threatens China's Oldest Hydropower Station," *Xinhua* (October 28, 2006).

157 Sun Yat-sen, *The International Development of China* (Hutchinson, 1928).

158 Chairman Mao wrote a popular poem that foresaw "a smooth lake from high gorges," He abandoned the project when tensions with the Soviet Union foreclosed technical support. "Colossal Project Seen as Icon of Reform," *South China Morning Post* (December 16, 2008).

159 Li Peng recounted in a memoir that "there were two reasons why I chose hydropower as the subject of my study [in the Soviet Union]. One was that Vladimir Lenin had said, 'Put hydropower and the Soviet together, and you'll have communism.' The other was that I knew then [1949] that China had the ambition of building the Three Gorges project." "Li Peng's Dam Diary Affirms His Obsession," *South China Morning Post* (September 5, 2003).

160 "Progress in Developing New, Renewable Energy Noted," *Xinhua* (May 7, 1998).

161 "China Mega Reserves Waiting to Be Tapped," *South China Morning Post* (September 4, 2006).

that China had 540 GW of technically exploitable hydropower, 70 percent of which is located in southwest China.[162] Hydropower can deliver substantial amounts of electricity in remote regions not connected to national power grids. Each completed hydropower project effectively replaces what would otherwise be coal-generated electricity, and in contrast to coal, hydropower produces relatively small quantities of greenhouse gas and other airborne pollutants.[163] Hydropower generators that are linked to power grids are capable of regulating peak loads and can be used as backup power sources when an accident occurs.[164]

Hydropower also has certain practical drawbacks. Hydropower projects are capital intensive and must be constructed over an extremely long time frame. Most of China's hydro resources are concentrated in the southwest, and it is necessary to transport hydroelectricity over vast distances.[165] Hydropower is subject to seasonal and climatic variables, so that dry conditions in winter and spring may diminish power generation later in the year.[166] Silt accumulation in dam reservoirs — a problem for virtually every dam — elevates the floor of the reservoir, gradually reducing ability to generate power and control floods.[167] Dams are vulnerable to earthquakes, which are common in regions where Chinese hydropower installations are operating.[168] Hydropower also entails significant environmental, social, and political costs (see below).

The Three Gorges Dam. The Three Gorges Dam project, initiated in 1994 and nearly complete, exemplifies both the potential and limits of hydropower development in China.[169] The Three Gorges Dam generates electricity which will eventually reach

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[162] "Medium and Long Term Plan for Renewable Energy in China," reproduced in *Zhongguo Wang* (September 5, 2007).

[163] Some greenhouse gases are produced by decaying organic matter which gathers in reservoirs behind dams. The Three Gorges Dam reservoir produces about 11 grams of greenhouse gas per kilowatt of power produced, attributable to methane released from wetlands along the Penxi River. "Three Gorges Chief Promises Openness on Greenhouse Gas Study," *Xinhua* (January 22, 2010).

[164] Li Peng, "Electric Power Diary," reproduced in *Renmin Ribao* (July 22, 2005).

[165] Li Peng, "Electric Power Diary," preface reproduced in *Renmin Ribao* (July 22, 2005).

[166] In the winter of 2004-05, 21 Chinese provincial power grids were required to impose blackouts, in part, because a shortage of rainfall had reduced available hydropower. "China Suffers Blackouts Due to Severe Power Shortage in Winter," *Xinhua* (January 21, 2005).

[167] "Mega Dams Meant to Control Situation Will Add to Ecological Woe, Experts Warn," *South China Morning Post* (February 27, 2008).

[168] In the wake of the 2008 8-magnitude earthquake in Sichuan Province, the Ministry of Water Resources indicated that 2,380 dams had been weakened or destroyed by the quake, "posing threats to the lives of millions of people downstream." "Greens Demand Halt to 'Feverish' Dam Building," *South China Morning Post* (June 26, 2008).

[169] The total cost of the Three Gorges project has been estimated at about 180 billion yuan (about $30 billion). Sources of funding included policy loans from the state-owned China Development Bank, the Three Gorges Dam Construction Fund, loans from state-owned Chinese commercial banks, loans from foreign banks, revenue generated by the early stages of the Three Gorges project, and profits from the Gezhouba Dam, a hydropower project that had been completed in 1988.

22,500 MW.[170] The dam improves navigability on the Yangtze and provides storage space for floods downstream, contributing to flood control.[171] The Three Gorges project has reduced the need for coal consumption by an estimated 31 million tons per year, cutting the atmospheric emission of 100 million tons of greenhouse gas as well as large quantifies of dust, sulfur dioxide, mercury, nitric oxide and carbon monoxide.[172] By 2007, with the substantial completion of the Three Gorges project, the annual installed capacity of hydropower in China was 145 GW, generating 482.9 billion KWh of electricity per year, making China first in the world with respect to hydropower capacity and hydro-generated electricity.[173]

Foreign participation in China's hydropower development. In 1994 China's Ministry of the Electric Power Industry issued a Notice regarding power equipment which provided that in the hydropower equipment sector:

> *[China] Shall pay attention to digestion and absorption while importing advanced technology and equipment, and gradually put localization into practice.*[174]

In 1997, Premier Li Peng, whose background was in the electric power sector, stated that

> *In the future, when using foreign funds and, in particular, funds from international monetary organizations or funds raised from the market, we should purchase electric power generating equipment made in China as best we can. Meanwhile, we should make efforts to improve both the quality and supporting capability of equipment made in China, do a good job in providing after-sales services, and enhancing their competitiveness.*[175]

The Eleventh Five Year Plan for Renewable Energy, promulgated in 2008, calls for promotion of "localization of large-scale conventional hydro generating units and pump-storage generating units, enhanc[ing] indigenous innovation and technological renovation."[176]

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[170] The dam body was completed in 2006, and the remaining dam components had been installed by late 2008. The dam currently holds 32 main generators with a capacity of 700 MW each, and several others will be installed by 2011. "Three Gorges Turbogenerators Working at Full Capacity," *Xinhua* (October 18, 2006).

[171] "Three Gorges Dam to Play Major Role in Flood Control," *Xinhua* (August 10, 1998).

[172] "Three Gorges Project to Help Curb Greenhouse Effect," *Xinhua* (September 11, 1997).

[173] "White Paper: China's Policies and Actions on Climate Change," reproduced in *Zhongguo Wang* (October 29, 2008).

[174] Notice of Ministry of Electric Power on Policy for the Electric Power Industry" (issued September 19, 1994) *Dian Ji* [1994] No. 562.

[175] Li Peng, "China's Policy on Energy Resources," *Xinhua* (July 15, 1997).

[176] Section 3(1).

Despite this policy emphasis, foreign owned companies have historically played an extensive role in the development of the Chinese hydroelectric power market.[177] *Xinhua* commented in 1999 that China's plan to increase its installed hydropower capacity by five million KWh per year from 2000-2010 "will provide a vast potential market for foreign enterprises and consortia."[178] Most of the turbines utilized in the Three Gorges hydroelectric project were produced by foreign-owned companies.[179] A French company, Alstom, "is by far the unparalleled leader in China's hydropower market."[180] In addition to its participation in the Three Gorges project, Alstom is to supply four 8000 MW turbine generators – the largest hydro units in the world – to the Xiangjiaba hydroelectric project, situated on the lower reaches of Jinshajiang River, a main tributary of the Yangtze River.[181] Alstom also is supplying six 360 MW turbines to the Ahai hydro power project, four 600 MW hydro generators and auxiliary equipment to the Li Yuan hydro power project, and six 379 MVA generators to the Ludila project.[182] Voith Hydro and Siemens have also supplied turbines and generators, respectively, to the Longtan and Xiluodu hydroelectric projects, two other major hydroelectric projects completed in recent years.[183]

Most of the major foreign hydroelectric turbine producers have production facilities in China. Alstom now produces hydro generators and turbines in Tianjin, GE builds in Hangzhou, while Siemens-Voith manufactures its hydro equipment in Shanghai.[184]

Evolution of the domestic hydropower equipment industry. In 1998, sources at the China State Power Corporation indicated that the government would give priority to

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[177] Foreign financial institutions also played a major role in China's hydropower development. In 1999, Chinese officials indicated that foreign funds totaling nearly $4 billion were being used to construct 23 major hydropower projects with a generating capacity of over 18 million kw. "PRC Hydropower Capacity to Add 5 Million kw Yearly," *Xinhua* (January 29, 1999).

[178] "PRC Hydropower Capacity to Add 5 Million kw Yearly," *Xinhua* (January 29, 1999).

[179] Of the initial fourteen 700 MW turbines installed on the left bank of the Yangtze river, eight were supplied by Alstom, three were supplied by Voith Hydro (Germany), and three were supplied by General Electric. The electric generators used in the project were supplied by ABB's power division (now part of Alstom), Siemens and General Electric. The second phase of the project involved the installation of twelve more 700 MW turbines on the right bank of the Yangtze. Some of those additional turbines were supplied by Harbin Electric Machinery (a Chinese company), which gained enough expertise working with Alstom during the first phase of the Three Gorges project to produce China's first 700 MW turbine in 2007. http://www.probeinternational.org/three-gorges-probe/three-gorges-dam-building-industry-goes-global

[180] "Alstom Builds its Largest Global Hydro Power Base in China," *Xinhua* (September 13, 2005).

[181] "Alstom Hydro Contracts Contribute to Secure Energy Supplies to China's East Coast" (April 20, 2009). http://www.cn.alstom.com/home/media_center/alstom_china_news/ The other four turbines for that project are to be supplied by a Chinese supplier. *Id.*

[182] "Alstom Hydro Contracts Contribute to Secure Energy Supplies to China's East Coast" (April 20, 2009). http://www.cn.alstom.com/home/media_center/alstom_china_news/

[183] Voith Hydro Web site (accessed December 8, 2009).

[184] http://www.probeinternational.org/three-gorges-probe/three-gorges-dam-building-industry-goes-global.

developing large hydropower pumping and generating equipment, including extra-large generators with a capacity of 700,000 kw.[185] In 1999, China's first domestically made 550,000 kw hydropower generating unit went into operation at the Estan Hydropower Station in Sichuan Province.[186]

China's leading hydroelectric turbine manufacturers – Dongfang Electrical Machinery and Harbin Power Equipment – gained expertise in the area by working with foreign-based turbine producers during the Three Gorges project, a collaboration undertaken at the insistence of the Chinese government.[187] Having gained experience from the Three Gorges project, Dongfang and Harbin have gone on to equip several domestic hydro projects and a growing number of overseas projects.[188] Dongfang and Harbin both produced roughly 7,000 MW of hydroelectric turbine capacity in 2008.[189]

Growing controversy. Dam building is politically controversial within China, reflecting the fact that dams displace residents, create a range of environmental problems and in some cases alter the conditions for agricultural activity. According to a 2005 report by *Ching Chi Jih Pao*, an independent Hong Kong-based economic daily, since the formation of the PRC a total of 16 million Chinese have been relocated as a result of large-scale hydropower construction projects, of which "10 million are still living in poverty," and "constitute a hidden danger for social stability."[190] Over a million residents were displaced for the Three Gorges project alone.[191] Major protests by local residents over hydropower projects have occasionally turned violent.[192] Emblematic of the political divisions large scale dams have fostered in China, in 1992 a third of the

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185 "Being Given Priority for Large Hydropower Equipment," *Xinhua* (April 26, 1998).

186 The Estan project involved a total of six 550,000 generators. The first two were produced by Canada General Electric, the second two jointly by Canada GE, Harbin Electrical Machinery Works and Donfung Electric Machinery Works. The fifth and sixth were produced by the Chinese firms alone. "PRC's First Domestic-Made Super Generator Operational," *Xinhua* (September 22, 1999).

187 *Id.*

188 *China International Business*, as quoted at http://www.probeinternational.org/three-gorges-probe/three-gorges-dam-building-industry-goes-global.

189 http://www.probeinternational.org/three-gorges-probe/three-gorges-dam-building-industry-goes-global.

190 "Peasants Who have Lost Their Land are Reduced to Poverty and Driven Onto the Streets, Constituting Hidden Danger," *Ching Chi Jin Pao* (June 21, 2005). In interviews with responsible officials from the NDRC, Chinese reporters were told that "reservoir construction over the years has … spawned tens of millions of relocated residents." "Officials Explain State Council Directive on Moving People from Reservoir Areas," *Xinhua* (August 14, 2006).

191 "China's Top Legislator Urges More Efficient Support for Three Gorges Migrants," *Xinhua* (December 7, 2006).

192 In 2004, China suspended work on a dam project in Sichuan Province after "two people were reportedly killed and scores injured as tens of thousands of people clashed with armed police in a string of protests … over the building of the Pobugou Dam. …" "China Suspends Dam Project, Fires Cadre After Clashes," *Agence France-Presse* (November 19, 2004).

delegates to the National People's Congress refused to endorse the Three Gorges project, despite intensive government lobbying.[193]

Problems associated with large scale hydropower have become increasingly evident during the past decade. In 2003, two prominent Chinese engineers urged the government to close the huge Summer Gorge Dam on the Yellow River, completed in1961 with Soviet assistance, because it was raising soil beds and unleashing devastating floods.[194] An ambitious plan to build 13 hydroelectric dams on the Nujiang River in Yunnan Province has met with strong objections because the dams would allegedly "destroy thousands of rare plants and animals."[195] Chinese-built hydropower projects on the upper reaches of the Mekong River have allegedly caused water fluctuations and degradation of the river's ecology, affecting relations with the downstream nations of Vietnam, Laos, Thailand and Cambodia.[196]

In 2007, Chinese officials began acknowledging that the Three Gorges project was spawning problems like landslides and water pollution that could become severe. The government was also reportedly planning a new relocation program that was as much as four times larger than the original one.[197] The Vice Mayor of Chongqing, a major city adjacent to the Three Gorges reservoirs, said that the shore of the reservoir had collapsed in 91 places, and a total of 36 square kilometers had "caved in." Chinese officials taking part in a 2007 conference in Wuhan said that the project had exerted a "notably adverse" impact on the environment of the Three Gorges reservoir, and that "if no preventive measures are taken, the project could lead to catastrophe."[198] In 2009, people on the

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[193] One dissenting delegate recalled later that "I didn't think the time was ripe for the dam because many technical problems had to be studied thoroughly. It should not have been built in such big rush." Lei Hengshun, now a professor at Chongqing University, in "Colossal Project Seen as Icon of Reform," *South China Morning Post* (December 16, 2008).

[194] "Dam Should be Shut Down, Engineers Say," *South China Morning Post* (November 3, 2003).

[195] "Assessment of Dam Project Urged," *South China Morning Post* (March 12, 2004). The Nujiang is one of the most biologically diverse areas in the world, harboring 25 percent of China's plant species and half of its animal species. The UN designated the region a world heritage site in 2003. "Proposed Dam May Leave Poor High and Dry," *South China Morning Post* (June 14, 2004).

[196] "New Dam Plan Sparks Warning," *Bangkok Post* (December 25, 2006).

[197] "Chinese Dam Projects Criticized for Their Human Costs." *New York Times* (November 19, 2007). According to one report, as many as 4 million additional people will be relocated from the area around the dam, reflecting the fact that "the reservoir's seasonal water fluctuations have unsettled the delicate geology of the area, raising landslide and other risks." "China's Three Gorges Dam Increases Risks of Landslides, Soil Erosion," *Agence France-Presse* (November 27, 2007).

[198] "China Warns of Environmental 'Catastrophe' from Three Gorges Dam," *Xinhua* (September 6, 2007). However, Wang Xiaofeng, the Deputy Director of the Three Gorges Construction Committee, said in May 2007, that the environment in the Three Gorges dam area was stable, that water in the gorges was drinkable, and that only half the volume of sediment in the dam area had been observed, reflecting preventive measures. "Three Gorges Dam Has Minimal Impact on Environment: Official," *China Daily* (March 9, 2007).

lower reaches of the Yangtze were suffering from "the worst drought in 60 years" and local officials said that the Three Gorges dam was "making it worse."[199]

Reflecting these developments, dam-building has begun to encounter obstacles within the Chinese bureaucracy. In 2005, China's State Environmental Protection Administration (SEPA), long "regarded by many as toothless," ordered a halt to 30 multibillion dollar construction projects on environmental grounds including the Xiluodo Hydropower Station on the upper Yangtze, second only in size to the Three Gorges station.[200]

The search for viable alternatives. In 2005, former Premier Li Peng, one of China's foremost advocates of hydropower, cited the operational, political and environmental problems associated with hydropower and cautioned that "to achieve a balance in electricity supply, it would be proper for hydropower to make up no more than one-third of the power in a power grid at the provincial level or regional level."[201]

Until the early 2000s, the Chinese government frequently extolled solar, wind, biomass and geothermal generation of electricity, but these sources of renewable energy received a relatively small proportion of the resources the government devoted to the energy sector. Together with small hydropower plants, solar and wind energy were seen as promising methods for delivering electricity to remote parts of China that lacked access to electricity grids.[202] In March 2007, *Xinhua* reported that "Chinese political advisers have voiced views against excessive hydropower development to save the nation's rivers from potential environmental damage." Liu Duhong, former vice director of the maritime bureau in the Ministry of Communications and five other members of China's top political advisory body, the National Committee of the Chinese People's Political Consultative Conference, blamed low water levels and increased pollution in the middle and lower reaches of the Yangtze on the dozens of dams which had been built on the river's tributaries. The advisors

> *Suggested the governments set up strict environmental conservation criteria for the approval of new dam projects and further boost the development of energy resources like wind power and nuclear energy.*[203]

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199 "Three Gorges Dam Making Drought Worse," *South China Morning Post* (October 29, 2009).

200 "China's Environment Agency Wins Major Battle Against Powerful Polluters," *Xinhua* (February 2, 2005).

201 Li Peng, "Electric Power Diary," preface reproduced in *Renmin Ribao* (July 22, 2005).

202 *Xinhua*, the state news agency, summarized China's main achievements in renewable energy in terms of numbers of households using solar stoves and solar heaters, the deployment of household wind generators, and use of biogas by rural households. "Achievements Scored in Developing Renewable Energy," *Xinhua* (April 23, 2007).

203 "Political Advisors Oppose Excessive Hydropower Development," *Xinhua* (March 12, 2007).

The future of hydropower. Today, China has the world's largest hydroelectric power infrastructure, with installed hydropower capacity of 150 gigawatts, and total hydroelectric consumption of 132.4 million tons of oil equivalent (or roughly 583 terawatt-hours of electricity).[204] That figure represented roughly 19 percent of the world's hydroelectric consumption in 2008.[205] China's hydroelectric consumption also grew faster than that of any other major hydroelectric market in 2008, rising by over 20 percent.[206] China's hydropower generating capacity is targeted to reach 190 gigawatts in 2010.[207]

Although China remains strongly committed to expanding hydropower generation, the NDRC's *Medium and Long Term Development Plan for Renewable Energy in China* provides that with respect to the percentage of electricity generated by renewable sources, hydropower will shrink from 91 percent of the total in 2008 to 66.6 percent in 2020. That plan also excludes hydropower from the mix of renewable energies, the ratio of which power companies were directed to increase to eight percent by 2020.[208] Nevertheless, *total* generation of hydropower is planned to increase by 174.4 percent, reflecting an ongoing massive build-out of new hydro capacity. In 2006, a Chinese hydropower official said that a dozen new hydropower plants would be constructed on the upper Yangtze over the next 20 years, with a total installed capacity of 90.2 million kilowatts.[209] In a 2008 white paper on climate change, the State Council stated that China should "quicken the pace of constructing large hydropower stations on the precondition that the environment is well protected and adequate relocation of the local residents is ensured. Medium and small hydropower stations will also be developed where local conditions permit."[210]

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[204] Figures are for 2008. International Hydropower Association, http://www.probeinternational.org/three-gorges-probe/three-gorges-dam-building-industry-goes-global.

[205] BP, *BP Statistical Review of World Energy* (June 2009) at 38.

[206] *Id.*

[207] "China's Road to Energy Security," *Xinhua* (October 4, 2008).

[208] Renewable sectors included in this computation are hydro, solar, wind, and biomass power. Solar water heating, bioethanol and biodiesel are excluded because they do not generate electricity for the grid.

[209] "China to Build Dozen More Hydropower Plants on Yangtze River," *Xinhua* (June 12, 2006).

[210] State Council, "China's Policies and Actions for Addressing Climate Change," reproduced in *Zhongguo Wang* (October 29, 2008).

V. DEVELOPMENT OF CHINA'S "NEW RENEWABLES" SECTORS

In 2008, the Climate Group, an international nonprofit organization working to address climate change, released a study which concluded that China has emerged as the world's leading producer of energy from renewable resources and would overtake developed countries in creating clean technologies.[211] The Chinese government forecast that in 2009, China led the world not only in installed capacity but total investment in renewable energy. To a considerable extent these developments reflect the impact of China's giant hydropower projects and the continuing installation of small hydropower facilities.[212] However, China's renewable energy profile is increasingly defined by "new renewable" sources of electricity — solar, wind and biomass power. China has emerged as a world leader in the manufacture of solar photovoltaic technology, and is forecast to become the world's leading exporter of wind turbines. China's leaders view these dramatic developments as a reflection of supportive government policies.[213]

A. Wind Power

The catalyst for the expansion of China's new renewables sectors was the requirement established by Article 5(1) of the NDRC's *Medium and Long-Term Plan for Renewable Energy Development in China* in September 2007 to the effect that power companies with over five GW of production capacity must build enough non-hydro renewable power sources to comprise three percent of installed capacity by 2010 and eight percent by 2020. Wind power has been the principal beneficiary of this requirement, reflecting the fact that wind power plants are about 50 percent less expensive to install than solar plants and easier to operate than biomass plants. The NDRC's 2007 mandate was only one of many measures adopted to promote wind power in China. The cumulative effect of these measures was described in 2009 by Shi Lisan, the Deputy Director of the New Energy Department in the National Energy Administration:

> *In recent years, with the support of the Renewable Energy Law and other related policies the spread of wind power development has obviously accelerated, especially the adoption of concession bidding and the combination of market-led guidance and government support, all of which*

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[211] Climate Group, *China's Clean Revolution*.

[212] China's installed capacity for small hydro facilities accounts for half of the world's total. "China Pioneers in Renewable Energy," *Renmin Ribao* (September 10, 2008).

[213] *Renmin Ribao*, a newspaper published by the Chinese Communist Party's Central Committee, commented in 2008 that "it is manifest to all that supportive government policies investing billions of dollars in energy efficiency and renewables are driving huge levels of innovation in China." "China Pioneers in Renewable Energy," *Renmin Ribao* (September 10, 2008).

has largely enhanced the scale and development of wind power.[214]

1. Early development. Chinese central and regional authorities have long recognized that wind energy is a partial alternative to coal-based technologies and have sought to promote its development and use. Beginning in the early 1980s, the Inner Mongolia Autonomous Region (IMAR), where wind is generally steady and without turbulence, pioneered in the development of wind power that could supply a dispersed rural population, developing small wind generators to charge batteries and power home appliances.[215] In 1986, the IMAR government offered the first known subsidy for the development of local renewable energy equipment, a financial incentive of 200 yuan per wind turbine or PV panel and 50 yuan per battery to consumers who bought equipment manufactured in the IMAR.[216] Other regional governments offered similar incentives, which increased demand for local production and proved "successful in creating a domestic industry of wind turbine manufacturers."[217] By 1999, roughly 40 Chinese companies were producing wind turbines, for the most part small 100w units used in single households.

China began to develop utility-scale wind power in 1986, when it imported and installed three 95KW turbines manufactured by Vestas of Denmark. In contrast to small turbines, where a vibrant domestic industry existed, China had little manufacturing capability with respect to utility-scale wind turbines and was almost entirely dependent on imports from Europe. In 1987, the central government established a special fund to provide low interest loans to promote the development of nationwide wind power projects.[218] In 1989 the first megawatt-scale wind farm was established at Dubuncheng, in Xinjiang Autonomous Region. In 1994, what was then the Ministry of Electric Power issued a policy notice calling for "gradually realizing localization of 300KW wind power units."[219]

a. Ninth Five Year Plan. During the period of the Ninth Five Year Plan the government issued measures to promote the development of the "new

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[214] "News Analysis: Does Overcapacity Exist in the Wind Power Industry?" *Renmin Wang* (November 19, 2009) http://finance.people.com.cn/GB/1043056.html.

[215] By 1995, IMAR accounted for 90 percent of China's roughly 150,000 small-scale turbines. Inner Mongolia has an estimated 40 percent of China's total of 230 million kilowatt-hour wind potential. "China's Wind Power Industry: Blowing Past Expectations," *Renewable Energy World* (June 16, 2008).

[216] Herdsmen who applied for the subsidy went to one of the IMARs local "new energy offices" and got coupons which they took to the local manufacturer to exchange for their turbines. Debra J. Lew, "Alternatives to Coal and Candles: Wind Power in China," *Energy Policy* (2000).

[217] Lew (2000) op.cit.

[218] Ministry of Science and Technology, State Department Planning Commission and State Economic and Trade Commission, *Evaluation of Policies Designed to Promote the Commercialization of Wind Power Technology in China* (May 15, 2002) p. 49 *("Commercialization of Wind Power in China").*

[219] Notice of Ministry of Electric Power on Policy for the Electric Power Industry (September 19, 1994) *Dian Ji* [1994] No. 562.

energy" industry and to "accelerate the localization process of new energy equipment production:"

> *For the research of new energy technology and manufacturing of new energy equipment, a method of combining indigenous innovation and import-absorption innovation shall be adopted so as to carry out the all-in-one unity of technology, manufacturing and timing to accelerate the localization of equipment.*[220]

The Ministry of Science and Technology subsidized R&D to develop technologies for 600 KW turbines, and a prototype machine was approved at the national level and installed at a wind farm. Chinese annual installed capacity surged during the Ninth Five Year Plan, with total megawatts increasing from five in 1996 to 35 in 2000. A Chinese government report concluded that

> *The boom in China's wind power industry from 1996-1998 was chiefly the result of government attention and support. The State Economic and Trade Commission supported the construction of three wind farms, with a total installed capacity of 80 MW. … In addition, the former Ministry of Power issued the 1994 "Provisions for On-Grid Wind Farm Management" which not only stipulated that power companies were required to purchase all the electricity produced by wind farms, but also specified that the difference between the price of wind power and the average price of conventionally generated power should be absorbed by the grids. There is no doubt that this policy was enormously helpful in promoting the development of wind power in China.*[221]

b. Ride the Wind Program. Under the Ninth Five Year Plan, China's State Development and Planning Commission (now the NDRC) initiated the Ride the Wind (Chengeng) Program to promote a model of "demand created by the government, production by joint venture enterprise, and ordered competition in the market." The program featured joint ventures between Chinese and foreign companies for 600 KW and 660 KW wind generators with European firms being offered the ability to participate in wind farm development in return for technology transfers.[222] Technology transfers under this program started with a 20 percent local content

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[220] Interim Measures for Administering Capital Construction Projects of New Energy (issued May 1997), *Ji Jiao Neng* [1997] No. 955.

[221] Commercialization of Wind Power in China (2002) op-cit. p. 21.

[222] One of the "relevant policies" was to "encourage foreign investors to jointly invest in China's development of wind power technology and equipment and accelerate the localization process." Notice of Guidance for Accelerating the Localization of Wind Power Equipment (issued February 20, 2000). *Guo Jing Muo Zi Yuam* [2000] No. 122.

requirement which was expected to increase to 80 percent as Chinese learning grew. The loans funded establishment of demonstration wind farms with a capacity of 8MW or greater. By 2000, the Ride the Wind Program had established four demonstration wind farms with a total installed capacity of 73MW. The program was seen as only a limited success, reflecting the fact that foreign firms could not select their partners and were paired with enterprises selected by the Chinese government.[223]

In 1999 the former State Economic and Trade Commission (SETC) issued a policy statement on promoting the development of wind power:

> *[China] must accelerate the localization process of wind power equipment production. Electricity power administration agencies at all levels and electricity power enterprises shall vigorously support wind power equipment localization efforts. Wind power equipment manufacturers shall guarantee quality, improve technology standards and lower manufacturing costs. In the case of the same level of quality and prices, wind power projects that use domestically manufactured equipment shall be given priority to establish the projects and to be incorporated into the power grid.*[224]

To support the development of domestic wind power equipment manufacturing, SETC established the National Debt Wind Power Program, which provided government loans at subsidized rates of interest to wind farm owners who purchased qualified, locally-made wind power components for new-generation projects.[225]

c. Localization efforts. The Chinese government stated in 2000 that one of the main factors limiting the development of domestic wind power was "dependence on imported wind turbines, low design capacity, and the fact that key parts, such as turbine blades could not be manufactured domestically." Accordingly, one of the key national research programs since the 1980s has been to conduct R&D into large wind turbines and their connection to power grids. By 2002, the government reported,

> *Following the principles of introducing foreign technology, assimilating it into the Chinese market, and learning to*

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[223] One foreign bid was won by Nordex Balcke Dürr, which was to receive royalties on the first 100-200 MW of turbines produced by its partner, Xian Aviation Company (Germany), after which the latter was free to produce the technology itself. The other bid was won by Made (Spain) with the support of a $200 million concessional loan by the Spanish government. By the end of 2000, two locally manufactured turbines had been installed, 600 KW turbine produced by the Nordex-Xi'an Aero Engine Group and a 600 KW turbine from the MADE-Yituo Group. Debra Lew and Jeffrey Logan, *Incentives Needed to Energize China's Wind Power Sector* (monograph, March 2001).

[224] SETC, Notice of Several Opinions as Future Promoting the Development of Wind Power (issued December 29, 2009) *Guo Jing Mao Diau Li* [1999] No. 1286.

[225] Implementation Plans for National Debt Wind Power Program, *Zi Yuan* [2000] No. 046, December 28, 2000.

> *make similar equipment domestically, Chinese manufacturers have begun to master the technologies needed for the production of large wind turbines. The main equipment needed for wind power generation can now be manufactured domestically.*[226]

During the Ninth Five Year Plan turbine equipment purchased for projects approved by the NDRC was required to contain at least 40 percent local content. Chinese companies began to exceed this threshold:

- Xinjiang Wind Energy Company (XWEC) was the first Chinese company to manufacture commercial large-scale wind turbines with primarily Chinese components. By 2001, XWEC was producing turbines with 78 percent locally manufactured components.[227]

- Beijing-based Wandion Ltd. designed and built a 600 KW wind turbine with a localization rate of 80 percent.

- As of 2002, two joint ventures, the MADE-Yituo Group Enterprise and Xian Weide Wind Power Co., had achieved localization rates exceeding 40 percent and were moving toward 70 percent.[228]

2. The NDRC wind power concessions. In 2004, the National Development and Reform Commission launched the Wind Power Concession Project, with a 20 year time horizon. Concession projects established through this program have progressively increased in size and are now forecast to account for the majority of China's wind power in the future.[229]

The NDRC concession program seeks to promote the establishment of large wind farms benefiting from economies of scale which would make possible reductions in the in-grid tariffs. Each wind farm established under this program was originally required to have a capacity of at least 100 MW. Under the Concession Project, government-owned power grid companies sign long term power purchase agreements with wind power project investors with the term of the agreement covering the total forecast operational period of the wind project, reducing the risk for the operators. "The concession agreement between the government and project investors guarantees the power purchase agreement." End users of power receive a tariff increase to cover the added cost of wind

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[226] Commercialization of Wind Power in China (2002) op. cit. p. 21.

[227] XWEC bought a license from Jacobs of Germany to manufacture 600 KW turbines and began production in 1998. Debra Lew and Jeffrey Logan, *Incentives Needed to Energize China's Wind Power Sector* (monograph, March 2001).

[228] Commercialization of Wind Power in China (2002) op. cit. p. 22.

[229] EU Chamber of Commerce in China, European Business in China Position Paper 2009/2010 (2009) p. 112.

generated power. The government supports the concessions by waiving import tariffs and VAT on equipment and accessories used to establish the wind farms.[230]

a. ***Local content requirements.*** Local content was a central element of the NDRC Concession Project from its inception. Effective in September 2004, developers bidding on concession projects were required to demonstrate the ability to employ wind power technology with 70 percent local content. In addition, local content percentages above the minimum requirement of 70 percent were a key determinant in selection of winning projects.[231] In selecting winning projects under the NDRC concessions, local content percentages were responsible for a designated percent of the scores used to evaluate bids (20 percent in 2005 and 35 percent after 2006).[232] Finally, during and after 2006, wind farm investors bidding on NDRC concession projects were required to bundle their proposals with wind turbine suppliers whose equipment would be utilized, with the designation of domestic equipment collaborators seen as likely to enhance prospects for a successful bid.[233]

In July 2005, the NDRC issued "The Notice of Requirements for the Administration of Wind Power Construction," which stated that the localization ratio of wind power equipment must exceed 70 percent, and that wind power stations that do not meet this standard will not be allowed to be built in China.[234] This measure effectively extended the 70 percent localization requirement used in the concession program to all wind farms in the country. The measure was subsequently credited with enabling the Chinese wind equipment industry to form a "complete industrial chain."[235]

Initially the NDRC concessions appeared to represent a major opportunity for foreign wind equipment suppliers. Denmark's Vestas, the world's largest manufacturer of wind power equipment, won its first major order in China in 2005, when it secured an order for 50 2.0-MW wind generators valued at 450 million kroners ($84 million) in conjunction with one of the NDRC's concession projects. At the time this appeared to be a dramatic positive development. The Copenhagen *Politiken* commented that

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230 "China's Wind Power Future," *Energy Pulse* (August 7, 2006).

231 China Wind Power Report (2009), p. 8.

232 Government of Australia, Renewable Energy Law in China: Issues Paper (June 2007), p. 39; Joanna I. Lewis, A Review of the Potential International Trade Implications of Key Wind Power Industry Policies in China (monograph prepared for the Energy Foundation of China Sustainable Energy Program).

233 A report on the concession program prepared jointly by the China Renewable Energy Industry Association, Greenpeace and the Global Wind Energy Council commented in 2007 that "[I]n 2006, it was further decided to bundle the bidding between developers and their chosen wind turbine suppliers. The wind concession programme has therefore played a significant role in promotion of wind power development as well as domestic production of wind turbines."

234 NDRC "The Notice of Requirements for the Administration of Wind Power Construction," *Fa Gai Neng Yuan* (July 2005), No. 1204, Section 3.

235 "Much of this progress in forming a complete [wind power equipment] industrial chain was attributed to the 70 percent localization requirement promulgated by NDRC in 2005." "Debate Over Excess Capacity Blows Up in China's Wind Power Sector (2)," *Xinhua* (November 23, 2009).

> *With its first major order with China on the books, Vestas has kicked open the door of a potentially enormous market. … Vestas Director Sven Sigaard abandoned some of the customary Jutland modesty when he assessed the significance of the order from China. "Wind energy is expected to play an increasing role in the overall energy supply – including in China – and we have great expectations regarding the Chinese market … As a result, Vestas has already taken the next step begun by establishing its own factory in China. The company already has a sales office in China and is now following up with a blade factory. "Opening a blade factory in China is part of our strategy to expand our production base close to new markets."*[236]

Although Vestas continues to hold the largest foreign market share, a number of western companies have invested in wind power equipment manufacturing projects in China.[237]

b. ***Exclusion of foreign firms.*** Despite promising prospects, since 2005, no single foreign wind turbine manufacturer has won an NDRC concession tender.[238] As a result, foreign producers have been relegated to the non-NDRC segment of the wind power market, which is declining as a percentage of the wind power market. "Foreign [wind equipment] players' market share has dropped as domestic manufacturers have learned the technology and installed a much larger capacity." Vestas, which had entered China with great expectations, "installed 406 megawatts of new turbines [in 2007], less than 12 percent of the 3,500 MW that came on line and significantly below the 25 percent market share it enjoyed just two years ago" that is, in 2006.[239] The Trade Council of Denmark in Beijing commented on the NDRC Concession Program in 2009:

> *NDRC would like to see that all big wind farm projects go to central government as concession tendering programs, where foreign companies like [Denmark's] Vestas rarely have a chance to win. … Concession tendering program*

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[236] "Vestas Prepares to Conquers China," *Politiken* (January 3, 2005).

[237] In 2006 Germany's REpower Systems AG concluded an agreement with China's North Heavy Industry Corporation to form a joint venture to produce MM70 and MM82 series wind generators in Inner Mongolia, REpower-NHIC Wind Power Equipment Co. Ltd. REpower holds 50.1 percent share; NHIC, 33.34 percent; and Hariston Energy Limited of the UK, 16.65 percent. "German Wind Power Giant Opens Equipment JV in China," (September 7, 2008).

[238] EU Chamber of Commerce in China, *European Business in China Position Paper 2009/2010* (2009).

[239] "Vestas Feels Heat as Wind Turbine Rivals Cut Prices," *South China Morning Post* (April 10, 2008). Despite its disappointing experience, in March 2009 Vestas announced that it had increased its investment in its Chinese subsidiary by $90 million to fund expansion of manufacturing capacity for wind turbine blades and to reduce its reliance on imports from Europe. "Wind Turbine Maker Vestas Increases China Investment by 90 Mln USD," *Xinhua* (March 7, 2009).

> *run by NDRC has been proved to be a negative system to foreign companies.*[240]

Part of the problem facing foreign equipment suppliers is the criteria used by Chinese power companies in selecting equipment to be used by the wind power operating companies. The Chinese government states that foreign equipment is not selected because it is more expensive than domestic equipment. However the bid evaluation committees consider only the initial turbine price, and do not factor in quality, long term performance, and expected internal rate of return over a 20-25 year project life cycle.[241] According to European producers, differences in cost alone "cannot explain why international companies" which are "the world's most competitive wind turbine manufacturers" are "being deselected by bidding evaluation committees due to 'technical reasons.'" They complain that

> *[I]t is a reality for foreign companies that they are being left in the dark when it comes to the actual bidding process of these national tenders – many of which are being fully organized and determined before the actual bidding documents are being released.*[242]

Shi Pengfei, Vice President of the Chinese Wind Energy Association (CWEA) concurs with foreign producers that bid criteria based on price per unit of nameplate capacity rather than actual output of electricity over time produces anomalous results. He commented in 2009 that

> *It's no use to erect turbines that don't work or produce little electricity. Performance should be measured by the output of wind-generated electricity, rather than megawatts of installations. The industry is overheated. The mechanism of government decision-making on wind issues is not so scientific.*[243]

While the bid criteria reportedly change from round to round of concession agreements, a five percent or greater preference is accorded to wind equipment produced

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[240] "Wind as a Resource in North China." *China Wind Power Newsletter* (April, 2009).

[241] The EU Chamber of Commerce in China commented in 2009 that "the concession model was supposed to promote competition that would allow the government to develop the wind industry at competitive prices. The competing wind power developers have remained large SOEs that are required to fulfill their Renewable Energy Share quota in installed capacity rather than in electricity output. Therefore, they tend to submit bids with extremely low tariffs and very poor profitability, which are based on over-estimations of wind resources, high expectations of electricity generation, and underestimations on the cost of wind turbines and their service costs. This puts domestic private and foreign companies at a disadvantage and undermines the original goal of sustainable wind power development." EU Chamber of Commerce in China, *European Business in China Position Paper 2009/2010* p. 113, (2009).

[242] *Ibid.*

[243] "Chasing China's Wind Power, With Pure Heart," *Xinhua* (October 6, 2009).

by a "domestic" enterprise. Chinese companies that are majority foreign-owned are not "domestic" for these purposes and are thus placed at a disadvantage. In addition, recently a five to ten percent bid preference has reportedly been extended to wind equipment manufacturers who own certified "indigenous" intellectual property. While technically Chinese subsidiaries of foreign firms can own indigenous IP, the rules associated with qualification confront most foreign firms with insurmountable hurdles.[244]

In the spring of 2009, all multinational manufacturers of turbines bidding on NDRC wind power concession projects were disqualified on technical grounds within three days of bidding. European wind turbine manufacturers have reportedly stopped bidding for some contracts "after concluding their bids would not be seriously considered."[245] The fact that these companies had invested in China and met local content requirements did not appear to make them "Chinese" for bidding purposes.[246] "It seems the central government has decided this must be awarded to Chinese manufacturers and not foreigners who have invested big in China," said the President of the EU Chamber of Commerce in China.[247] In a September 2009 white paper the EU Chamber of Commerce in China commented that "the use of bidding requirements to bar international (wind turbine) companies from competing is a cause for grave concern for those players who have all invested heavily in the market to live up to stringent local content requirements."[248] In February 2010, Suzlon Energy's China CEO Paulo Fernando Soares said that it is "unbelievable, unusual and unnatural" that global wind energy equipment firms were not winning the major central government wind power contracts. "There's clearly a favorable treatment for local Chinese companies."[249]

Although foreign wind equipment producers are largely foreclosed from participation in the NDRC-administered national wind power projects, they have enjoyed better access to some projects being developed by regional Chinese governments, private

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[244] In December 2009, over 30 industry groups from the US, Japan, the EU, Canada and South Korea released a critique of China's indigenous innovation regime, stating that the rules "impose onerous and discriminatory requirements on companies seeking to sell into the Chinese government procurement market and contravene multiple commitments of China's leadership to resist trade and investment protectionism." A spokesperson for China's Foreign Ministry responded that "the indigenous innovative product accreditation project is in line … with international rules." "PRC FM Spokesman Defends Against Criticism of High-Tech Procurement Rules," *Agence France-Presse* (December 15, 2009).

[245] "Drawing Critics, China Seeks to Dominate in Renewable Energy," *Renewable Energy* (July 14, 2009). Six multinationals bid on concession projects and all of their bids were thrown out on vague grounds such as "insufficient data."

[246] Paolo Fernando Soares, the China CEO for India's wind turbine maker Suzlon Energy which operates a factory in Tianjin, commented in 2009 that "they want to promote local industry. But the question is, what is local? More than 95 percent of my employees are Chinese. I'm an investor here, a producer here, and pay taxes here. So why is this different? "Tower of Power," *Time* (October 23, 2008).

[247] "Buy Chinese Policy Could Handicap Foreign Wind Turbine Makers," *BusinessGreen.com* (June 18, 2009).

[248] "Tower of Power," *Time* (October 23, 2009).

[249] "East Wind Prevails Again," *Hindustan Times* (February 7, 2010).

developers, and even SOEs. No central government approval is required for wind power projects below 50 MW capacities. Because local governments and SOEs care about performance, efficiency, and the ability to generate power over time, these smaller projects continue to represent a good market for foreign wind equipment. In addition, some foreign equipment makers can sell to wind development projects in which they participate:[250]

- Vestas disclosed in December 2009, that it had received an order to deliver 20 units of its V90.2.0 MW to China Datang Renewable Power Co., part of the state-owned China Datang Corporation.[251]
- Gamesa is collaborating with Wolanchabu City, in the Inner Mongolia Autonomous Region (IMAR), to construct a 49.5 GW wind farm.[252]
- In January 2010, GE disclosed contracts to supply 88 1.5 MW wind turbines to China's HECIC New Energy Co., Ltd., a major wind energy developer.[253]
- In 2009, India's Suzlon Energy Ltd. received an order for 99 MW worth of wind turbines from Honiton Energy Group, a privately-owned wind energy developer operating in Inner Mongolia.[254]
- In 2009, Germany's Nordex secured contracts to supply 22 1.5 MW wind turbines to the Chinese utility Ningxia Electric Power.[255]

Foreign firms have continued to invest in China with respect to local manufacturing of wind power equipment. In 2009, Vestas completed buildout of a factory in the Tianjin Economic Technological Development Area (TEDA) which represents Vestas' largest integrated wind power production base in the world.[256] Vestas indicated in 2009, that it would continue investing in China to achieve a total investment of $439 million.[257] In 2009, South Korea's Daewoo Shipbuilding & Marine Engineering

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[250] Wang Xiao-guang, the head of MOF's "China Government Purchasers" magazine, commented in 2009, that "certain local governments often much prefer to purchase expensive overseas products, and even publicly refuse to purchase domestic products." "Chinese Government Requires that Stimulus Investment be Spent on Domestic Products," *China News Wrap* (June 15, 2009).

[251] "Vestas to Deliver 20 Wind Turbines to China Datang," *M2 Equitybites* (December 26, 2009).

[252] "Gamesa Seeing About Inner Mongolia Wind Power Projects," *SinoCast* (October 28, 2009).

[253] "GE to Support Growth in Wind Energy Sector in China," *Datamonitor* (January 15, 2010).

[254] "Suzlon Unit Bags Orders for Wind Turbines," *Business Line* (July 10, 2009).

[255] "Nordex to Supply 33 MW Wind Turbines to Niagxia Electric Power," *Datamonitor* (October 22, 2009).

[256] TEDA new release, "Vestas' Worlds' Largest Integrated Wind Power Production Base Built in TEDA," (October 19, 2009).

[257] "Wind Power Equipment Maker to Invest $439 Mln in China," *Asia in Focus* (October 16, 2009); "World's Leading Wind Power System Maker Adds Investment in China," *Asia Pulse* (October 15, 2009).

indicated it was likely to establish a plant to manufacture wind power equipment in China in 2010.[258]

c. ***Domestic preferences in the 2008 stimulus package.*** In November 2008, China announced a $586 billion economic stimulus package. A substantial proportion of the stimulus was allocated to renewable energy, including major new wind power concessions involving 25 contracts for turbines valued at over $7 billion. A circular released by the NDRC and eight government ministries and commissions required that preference be given to domestic products.[259] The stimulus plan itself provided with respect to the equipment manufacturing industry (which includes wind power equipment)

> *Equipment localization is not only related to the equipment manufacturing industry's own development, it is even more related to the state's economic security. The plan clearly points out that accelerating stimulation of the equipment manufacturing industry requires reliance on the state's key construction projects and large scale development of major technology equipment localization work.*[260]

d. ***The ban on smaller turbines.*** In the sixth round of bidding for NRDC wind power concession projects launched in March 2009, the government restricted the use of turbines below 1,000 kilowatts for most wind projects in China. The new rule excludes "850-kilowatt designs, a popular size for European manufacturers."[261] In 2009, the European Chamber of Commerce in China stated that

> *[The restriction] reduces the range of turbine options available for developers and undermines investment opportunities for a number of European manufacturers …. The newly imposed restrictions on KW will not only increase the risk of installing turbines that are unsuitable and inefficient, it will also easily do harm to the true development of a sustainable and reliable wind power sector and industry. This is why no other country in the world has established national turbine size restrictions.*[262]

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258 "Korean Shipbuilder Daewoo to Build Wind Turbines in China," *Recharge* (November 27, 2009).

259 NDRC Circular 1361, "Opinions on the Implementation of Decisions on Expanding Domestic Demand and Promoting Economic Growth and Further Strengthening Supervision of Tendering and Bidding for Construction Projects," (May 25, 2009). "Chinese Government Requires that Stimulus Investment be Spent on Domestic Products, *Sina News Portal* (June 15, 2009).

260 "Ten Major Plans, Ten Major Highlights – Focusing on Ten Major Industries with Adjustment and Stimulus Plans," *Xinhua* (March 16, 2009).

261 "China Builds High Wall to Guard Energy Industry," *New York Times* (July 13, 2009).

262 EU Chamber of Commerce in China, *European Business in China Position Paper 2009/2010* (2009) p. 208.

e. ***"Three Gorges in the Air."*** In August 2009, under the auspices of the NDRC and National Energy Administration, China undertook construction of the first of a series of ten GW "Three Gorges in the Air" wind farms in Gansu Province, at an investment cost of 120 billion yuan ($17.6 billion).[263] China currently has plans for a series of these mega-wind farms:

Province	Capacity (GW)
Gansu	12.7
Xinjiang	10.8
Inner Mongolia (2)	57.8
Jiangsu	10.0
Heibei	10.8
Jilin	23.0

f. ***The 2009 JCCT agreement.*** In October 2009, the 20th session of the US-China Joint Commission on Commerce and Trade (JCCT) convened in Hangzhou, China and reached accords on several issues with potential to affect foreign firms operating in China's renewable energy markets. According to the JCCT Fact Sheet on the government procurement agreement released after the meeting:

> *China agreed to remove local content requirements on wind turbines…China will require that products produced in China by foreign invested enterprises (FIEs) are treated as domestic products and will issue rules in this regard…China committed to submit a revised offer as early as possible in 2010 to accede to the GPA.* [264]

In November 2009, the National Energy Administration indicated that it would cancel the 70 percent localization requirement for wind power equipment "soon," but no timetable was set. State media reported in January 2010, that the NDDRC had "scrapped" the 70 percent local content requirement.[265] Shi Lishan, an official in the National Energy Administration, said that

> *This regulation was formulated at the initial stage of China's wind power equipment development to protect domestic enterprises. Through development in the past years, domestic enterprises have increased their manufacturing capability and are able to join international enterprise to participate in fair competition in the market.*[266]

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263 "China Starts Building its First 10 Million KW Wind Power Station," *Xinhua* (August 8, 2009).

264 US-China Joint Commission on Commerce and Trade (October 29, 2009).

265 "China Scraps Limits on Foreign Wind Turbine Parts," *Agence France-Presse* (January 12, 2010).

266 "Shi Pengfei: Cancellation of the 70% Localization Rate of Wind Power Equipment has Not Much Effect on the Industry," *Ji Dian Shang Bao* (undated) www.meb.com.cn/diangqil/html/?2944.html.

Chen Danghui, technical director of Sinovel, China's largest wind equipment producer, commented that "Now that we have grown up, the cancellation of the [local content] requirement will not have any impact on us. I think the cancellation is better for the entire industry, if all the enterprises compete in a free and fair market." Concurring in this view, Shi Pengfei, Vice President of the China Wind Power Association, stated that "We have basically set up an industrial chain. Chinese equipment prices are cheap. Even foreign businesses are ready to buy them in the Chinese market."[267] Wu Gang, President and CEO of Xijiang Goldwind Science and Technology, said that "the cancellation of the 70 percent localization policy can benefit competition domestically but also encourage domestic enterprises to go international." Wu Gang said that because China cancelled its protectionist policy first, it reduced the possibility of encountering protectionist policies in other countries "when China's companies develop their markets overseas."[268]

The NDRC's revocation of the local content requirement for wind farms may rescind one Chinese measure creating a preference for domestic equipment, but China has not indicated that it will modify the numerous other measures affecting the renewable energy sector which establish preferences for domestic equipment, domestic enterprises, and domestic IP. In December 2009 — after the JCCT agreement — China amended the Renewable Energy Law, and could have eliminated Article 25(5), which provides that the Renewable Energy Development Fund is to be used to promote "localized production of the equipment for the development and utilization of renewable energy." It did not do so. Moreover, in January 2010, an official of the New Energy Administration – which had stated in November 2009 that the 70 percent local contest requirement would be rescinded – stated that "China's government supports the localization of wind power equipment."[269]

3. North China Electric Power University.

In 2005, at the "strong recommendation" of the NDRC, China's Ministry of Education authorized the establishment of a four-year degree program in wind energy at the North China Electric Power University (NCEPU) to address the need for skilled workers in the wind energy sector. The President of NCEPU said that "Our program is high profile. We are not going to turn out ordinary technical workers. Wind graduates will be able to carry out work related to the design, manufacture and operation of wind turbines and plants, to do experimental research, and to contribute to investment decisions and project management." NCEPU set a goal of 120 managers by 2010.[270]

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[267] "Debate Over Excess Capacity Blows Up in China's Wind Power Sector (2)," *Xinhua* (November 23, 2009).

[268] "Wind Power Industry Steps Into Full Competition Era," *Zhongguo Zhenyquan Bao* (February 4, 2010).

[269] "National Energy Administration Supports Wind Power Equipment Localization and Gives Control over Overcapacity," *Shang Wu Di Guo* (January 1, 2010) http://news.swdgw.com/a/94914html.

[270] It also indicated it would establish a national wind energy laboratory and an "Asian Wind Power Training Center." "China Short of Wind Power Talent," *Xinhua* (September 24, 2006).

4. The NDRC capacity targets.

In 2007, China's central government mandated that all power companies with over five GW of production capacity increase their non-hydro renewable power sources to at least three percent of installed capacity by 2010 and at least eight percent by 2020. This measure stimulated a massive demand for wind farms by utilities and triggered a surge of investment in the wind equipment industry.[271] Capacity expansion has far exceeded announced government targets and the government has been forced to revise the target a number of times. The NDRC issued its first target for wind power in September 2007 in its *Renewable Energy Mid and Long Term Development Plan*. The target for 2010 was initially five GW, later revised to ten GW. This level, as already discussed, was exceeded in 2008. The 2020 target was initially set at 30 GW, revised in May 2009 to 100 GW, and the NDRC reportedly may further revise the target upwards to 150 GW, in part due to the effects of stimulus funds being injected into renewable energy.[272]

5. Defense industry measures.

In 2007, China's Commission of Science Technology and Industry for National Defense issued a notice to China's defense industry stating that the industry should:

> *Develop the wind power equipment industry by using the comparative advantages in the area of technology and equipment in the science and technology industry for national defense, facilitate the military's rapid development and advancement of the wind power equipment industry in order to build the national economy.*[273]

CTIND was a ministry-level organization reporting directly to the State Council which formulated science and technology plans for national defense and supervised industrial R&D that was contracted with the People's Liberation Army General Armaments Department. (In 2008 many of CTINDs responsibilities were folded into a new organization within the Ministry of Industry and Information Technology.[274]) The Notice set forth several objectives for China's "military industrial enterprises":

- By 2015 build eight to ten producers of "key [wind turbine] components manufactured with leading national standards and annual production capacity of RMB 20 billion." Enterprises were to "master key technologies and form complete indigenous innovation capability,

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271 "Wind Turbine Sector on Road to Overcapacity," *South China Morning Post* (November 12, 2007).

272 Kevin Mo, "Go With Wind: China to Dramatically Boost Its Wind Power Capacity, Again," *Greenlaw* (July 29, 2009) 18 Nov. 2009 http://www.greenlaw.org.cn/enblog/?p=1538.

273 Notice of the Commission of Technology and Industry for National Defense (CTIND) as Guidance for the Development of the Wind Power Equipment Industry in the Science and Technology Industry for National Defense 2007-2020 (2007) 97448. ("CTIND Notice") "China Encourages Military Industrial Enterprises to Produce Wind Power Generators," *Xinhua* (September 19, 2007).

274 The new organization is the State Administration for Science, Technology and Industry for National Defense (SASTIND).

strengthen R&D of follow-on products, build the industrial platform for component products, and realize the goal of leading the domestic market while opening up the international market."[275]

- By 2020 build two or three wind turbine unit manufacturers with leading national standards and annual capacity of 2,000 wind turbine units. By 2010 these manufacturers were to "reach advanced domestic and localization rates greater than 75 percent…[by 2015] equip with the capability of indigenously designed 2 MW-level wind turbine (including wind turbines for marine wind farms) and put mass-production of indigenous brand products into practice, achieve domestic standards of the highest level, and achieve localization rate of more than 80 percent…[B]y 2020, equip with the capability of completely indigenously designed three to five MW-level wind turbines and put mass-production into practice… ."[276]
- "Build the wind power equipment industry for national defense with an outstanding competitive capability and obvious military characteristics that meet market demands."[277]

6. Tariff and VAT measures.

Chinese wind farms are eligible for a 50% VAT rebate.[278] In January 2008, China implemented a tariff and VAT rebate program for imports of parts and raw materials used in the manufacture of wind turbines, "in a bid to support domestic companies to develop and manufacture large-size wind power generating units with single-rated capacity of not less than 1.2 megawatts." The funds related to "domestic enterprises" were to be "injected into the R&D and production of new products and form independent investment capacity." Companies seeking to qualify for rebates were expected to sell over 50 wind power-generating units (excluding control system, converter and gear box) and over 150 blades per year.[279] On May 1, 2008, China eliminated the tariff-free importation of wind turbines with stated capacity of less than 2.5 MW.[280]

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[275] *CTIND Notice*, Part III (2).

[276] *CTIND Notice*, Part III (1).

[277] *CTIND Notice*, Section III.

[278] China's largest wind farm operator, Longyuan Power, stated in its 2009 IPO disclosure that "Pursuant to the Notice on Value-Added Tax Policy Regarding Comprehensive Utilization of Resources and Other Products, we are entitled to a tax rebate equivalent to 50% of the VAT payable by our wind power business during the Trade Record Period and we continue to enjoy such tax rebate." Longyuan *Global Offering* (2009) op. cit. p. 97.

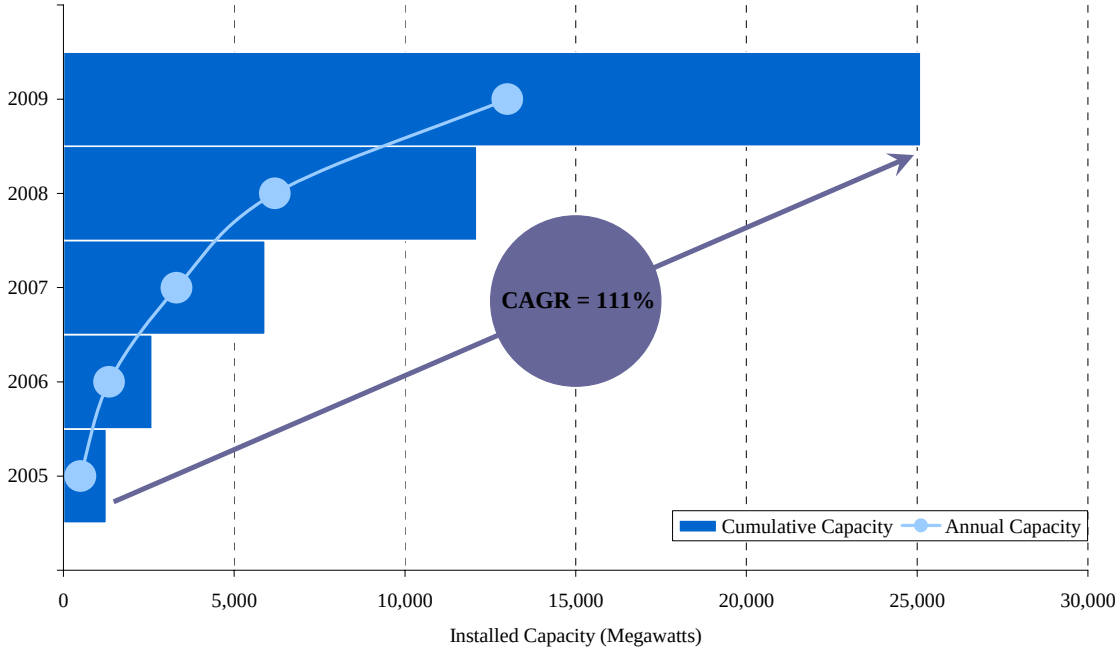
[279] "China Cuts Tariffs on Wind Power Parts & Raw Materials," *SinoCast* (April 25, 2008).

[280] MOF, Notice of Ministry of Finance on Adjusting Tax Policies Concerning Imported Large-Power Wind Power Generator Set, Key Parts, and Materials (April 14, 2008), *Cai Guan Shui* [2008] No. 36.

7. The surge in installed capacity.

During the Eleventh Five Year Plan, China's installed wind power capacity increased from 1,260 MW in 2005 to 25,104 MW in 2009 (Figure 9)[281] – experiencing a China ranked eighth in the world in installed capacity in 2005, but was third in the world by 2009 (Figure 10), and will almost certainly be second by the end of 2010.

Figure 9: China Cumulative and Annual Wind Power Capacity 2005 to 2009

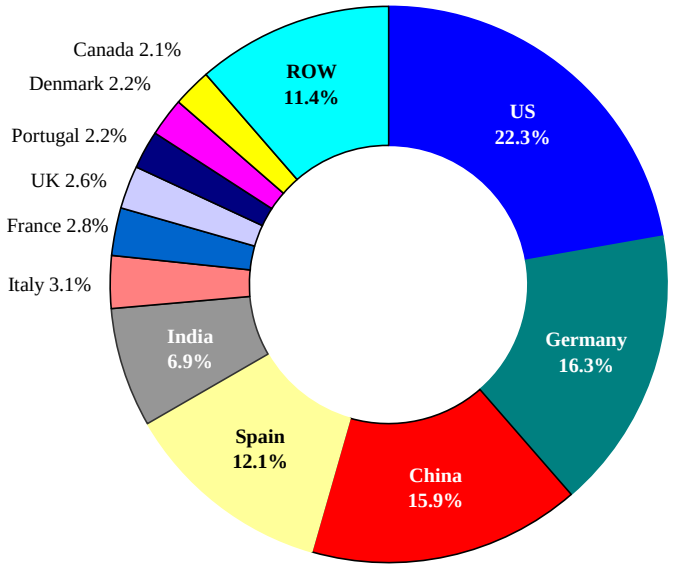


Source: GWEC, *Global Wind 2008 Report and "Global Wind Power Boom Continues Despite Economic Woes," (February 3, 2010).*

Between 2005 and 2009 China added 23,844 MW of new wind power capacity. Only the United States added more wind capacity over that period (26,010 MW). (Figure 11).

[281] Global Wind Energy Council *("GWEC")*, "Global Wind Power Boom Continues Despite Economic Woes," (February 3, 2010).

Figure 10: 2009 Global Installed Wind Power Capacity by Country
(Total Installed Capacity = 157.9 GW)



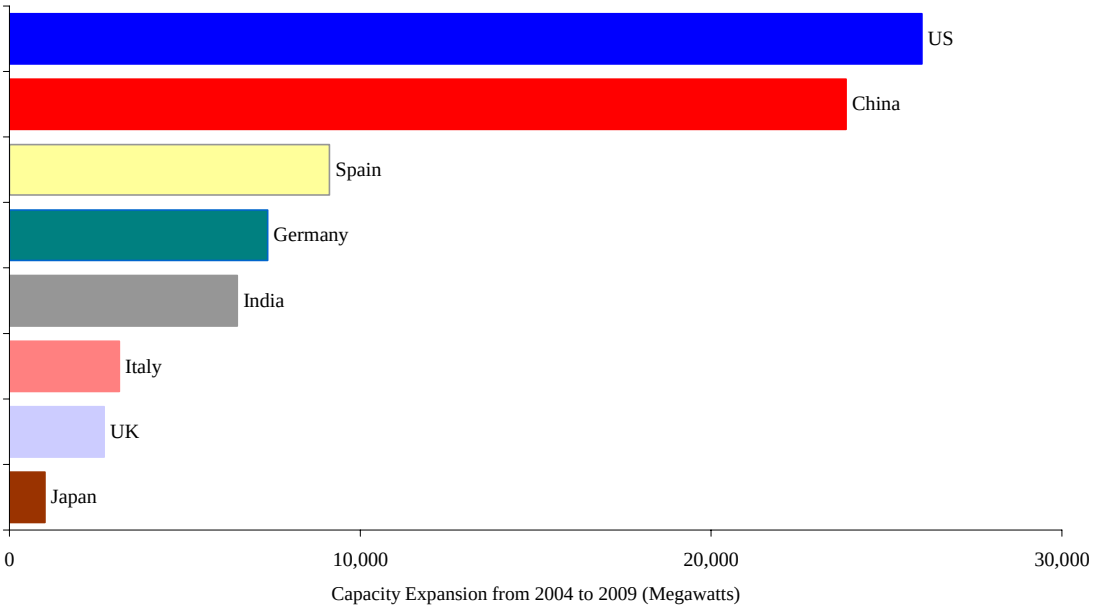
Source: GWEC, *"Global Wind Power Boom Continues Despite Economic Woes," (February 3, 2010)*.

The surge in investment is attributable to the priority which the Chinese government has placed on renewable energy.

> *Companies, state-owned or private, domestic or foreign, are . . . eager to embrace [renewable energy] projects . . . out of belief that the energy sector is a gold mine . . . if not "is," surely "will be." And for some companies, state-owned enterprises in particular, the government's wishes are another driver. On a number of public occasions this year, NDRC Deputy Minister Zhang Guobao said a certain proportion of the products of big energy developers would have to come from renewable sources.*[282]

[282] "China Speeds Up Renewable Energy Development," *Xinhua* (September 12, 2006).

Figure 11: China Was Second Only to the United States in Terms of Wind Power Capacity Expansion From 2005 to 2009



Source: GWEC, Global Wind 2008 Report and "Global Wind Power Boom Continues Despite Economic Woes," .

In 2007, wind power was "booming on the mainland, but industry analysts feared an investment frenzy being driven by political factors rather than economic returns might undermine the green energy cause." China's installed capacity of wind power generators easily exceeded five gigawatts by the end of 2007, three years ahead of the government's 2010 target, and was forecast to reach as much as 50 gigawatts by 2020. However, Shi Pengfei, Secretary General of the China Wind Energy Association, warned that "most investments were politically motivated and had a high risk of backfiring." He said that some officials in charge of projects were more interested in having wind power facilities *per se* than in their output of electricity:

> *Some officials are only concerned about showing their willingness to answer the central government's call to use renewable energy. They don't calculate how much it costs, what the output is, or whether it is worthwhile.*[283]

The investment rush into wind power equipment has led industry analysts to warn of overcapacity and a looming shakeout. In 2007, China had an estimated 25 turbine makers with "40 or 50 planning to open factories shortly."[284] By 2009, over 100 wind turbine manufacturers were operating in China. Ni Weidou, a member of the Chinese Academy of Engineering, commented in 2008 that "the industry is growing too fast. I

[283] "Wind Power Could be Booming for Wrong Reasons, Expert Warns," *South China Morning Post* (November 3, 2007).

[284] "Wind Turbine Sector on Road to Overcapacity," *South China Morning Post* (November 12, 2007).

can't help but worry."[285] The State Council warned in August of overcapacity and directed banks not to lend to projects seen as redundant or of low quality. One analysis concluded that "the mainland's wind power turbine industry is headed for a major consolidation with fewer than ten out of more than 100 manufacturers likely to survive the shake-out.[286] In October 2009, the Chinese government reportedly decided not to approve new projects in the wind power industry, citing overcapacity, and financial institutions were "prohibited from lending to projects that have not been approved."[287] Shi Lishan, Deputy Director of the New Energy Department in the National Energy Administration, said that China would "strictly control" capacity growth in the wind power industry in the hope of developing through mergers three to five enterprises "entering into the top ten in the global wind power industry."[288]

8. Domestic industry problems.

While China's installed wind capacity has risen very rapidly over the past few years, much of that capacity apparently is not being utilized. In 2008, reportedly up to a third of all of China's installed wind capacity remains unconnected to the country's electric grid.[289] Moreover, China's net electricity generation from wind in 2008 represented no more than 40% of the country's functional installed wind generating capacity.[290] That capacity utilization rate was down from 58% in 2005, and is significantly lower than the corresponding capacity utilization rates in other major wind markets (Figures 5 and 6).[291]

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[285] "Wind Power Industry Expands, But Profits Still Elusive," *Xinhau* (August 14, 2008).

[286] "Wind Power Turbine Makes Head for Industry Shake-Out," *South China Morning Post* (September 22, 2009).

[287] "China To Block Expansion Projects in Industries with Excess Capacity," *Xinhua* (October 20, 2009).

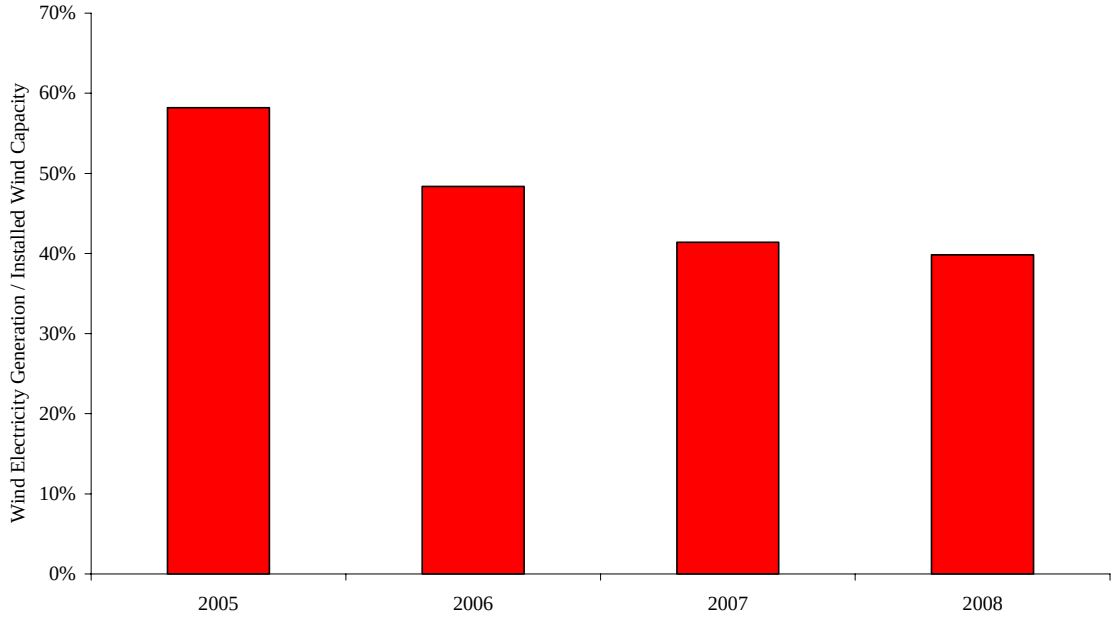
[288] "Wind Power Industry Steps into Full Competition Era," *Zhongguo Zhengquan Bao* (February 4, 2010).

[289] "China Green Energy Goes to Waste in Distribution Bottleneck," *Xinhua* (December 23, 2009) http://carbonnation.info/2009/09/15/chinas-grid-limited-wind-energy-potential/. Much of China's wind capacity is located far from population centers and utilities are not properly incentivized to build out the infrastructure necessary to connect wind energy capacity to the grid. "Weaknesses in China's Wind Power," *Forbes* (July 20, 2009) http://www.kellogg.northwestern.edu/Departments/International/InternationalFocus/Article/Winds_of_Change.aspx.

[290] Total functional generating capacity is determined by multiplying stated installed capacity by (365*24*0.3), where 30% represents the assumed efficiency rate. As noted, roughly a third of China's installed capacity may be unconnected to the electric grid. In addition, the efficiency of China's wind turbines may be closer to 20% than 30% – the standard in other major wind markets. David Cyranoski, "Beijng's windy bet," *Nature* (Jan. 22, 2009) at 373.

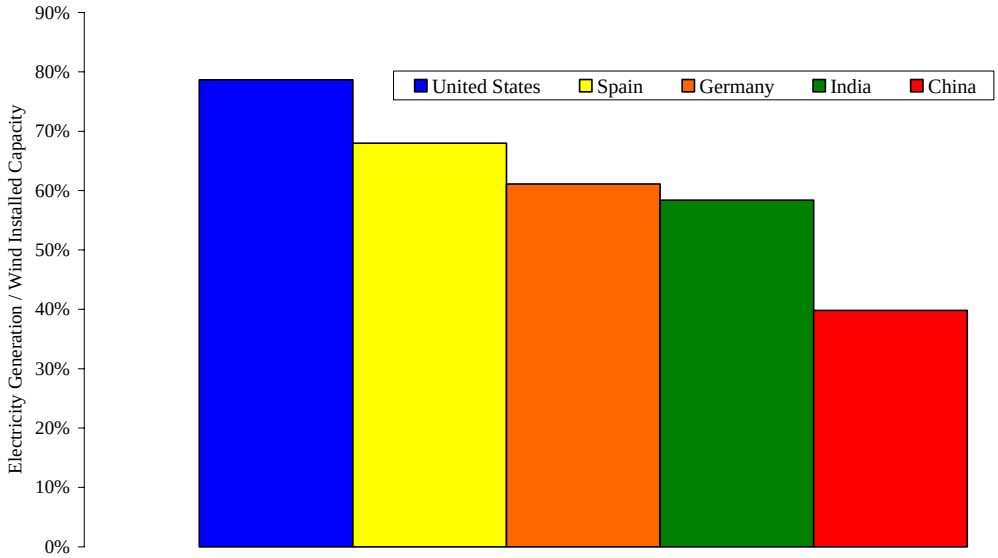
[291] Again, to the extent that a sizeable portion of China's installed wind capacity in unconnected to the electrical grid, the Chinese capacity utilization figures shown in these charts may in fact significantly overstate the actual Chinese capacity utilization rate. On the other hand, if the capacity factor of Chinese turbines is closer to 20% than to 30%, then the country's total functional generating capacity may be lower than calculated here, and the capacity utilization ratios may be somewhat understated.

Figure 12: China's Wind Power Capacity Utilization Has Been Falling



Source: U.S. Dept. of Energy, Energy Information Agency, GWEC, *Wind Power Report 2008*

Figure 13: China's Wind Capacity Utilization Was Well Below That Of Other Major Wind Power Markets in 2008



Source: U.S. Dept. of Energy, Energy Information Agency, GWEC, *Wind Power Report 2008*

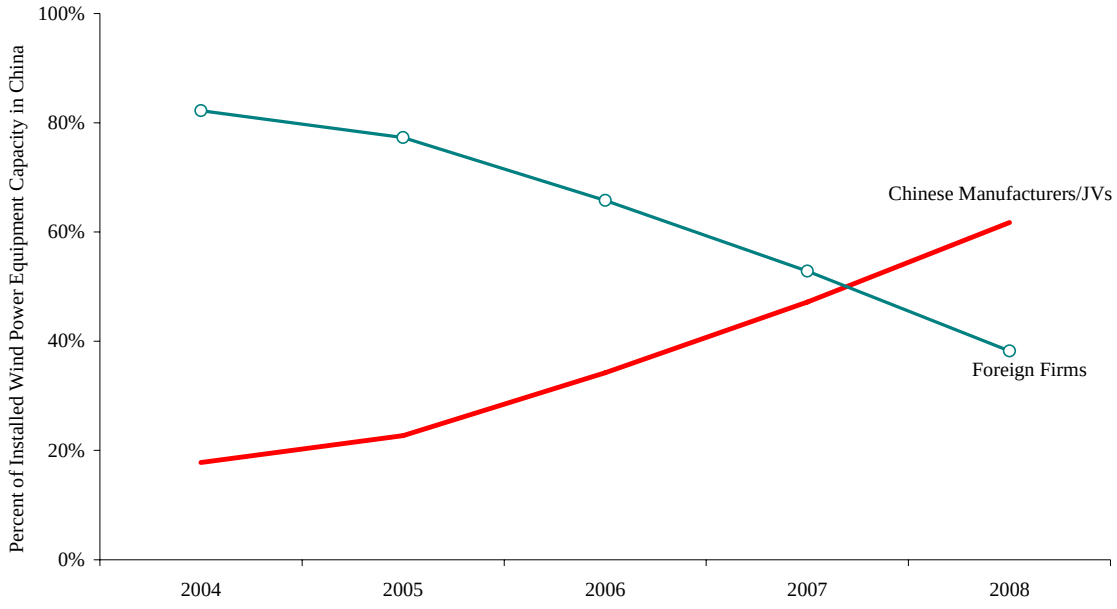
In 2008, reports surfaced about equipment problems in China's wind power industry. Some domestically produced power units failed to pass testing, and some imported components were incompatible with domestic projects while costing 20-30 percent more than Chinese products. Qin Haiyan, Secretary the of China Wind Energy Association, said that

> *Quite a number of wind power projects were built without a correct evaluation of usable wind resources, which led to losses. It is common to see power plants waiting for qualified equipment. Some projects could be thus postponed for as long as 18 months.*[292]

9. The decline in foreign market share.

Although Chinese demand for wind power equipment has been increasing rapidly, the foreign share of that growing market has plummeted. From 2004 to 2008, Chinese companies have increased their share of cumulative installed wind power equipment capacity from 18 percent to 62 percent (Figure 14).

Figure 14: Policies to Promote Local Manufacturing Were Successful
Share of Cumulative Installed Wind Power Equipment Capacity in China



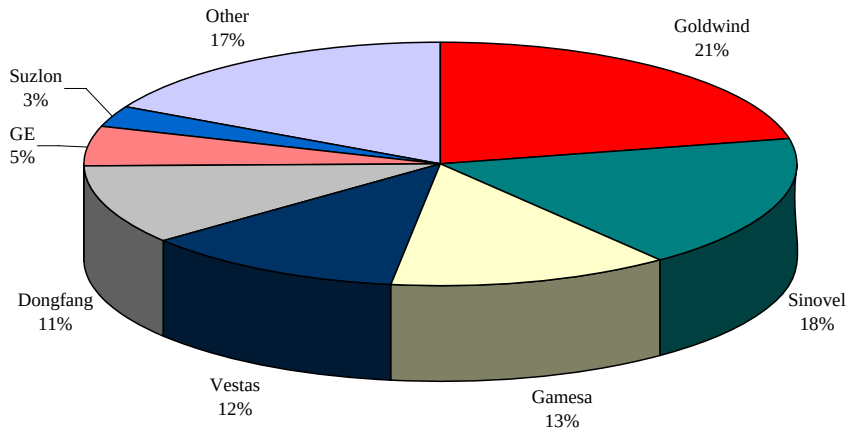
Source: CWEA, *Statistics on Chinese Wind Power Equipment Capacity* (年中国风电装机容量统计), various years.

The three major Chinese companies – Goldwind, Sinovel and Dongfang Electric – accounted for half of cumulative installed capacity in 2008 but almost 58 percent of new

[292] "Wind Power Industry Expands, But Profits Still Elusive," *Xinhua* (August 14, 2008).

capacity installed in 2008.[293] Gamesa, Vestas and GE were the largest foreign companies supplying the domestic market (Figure 15). While foreign firms accounted for 38 percent of cumulative installed equipment capacity at the end of 2008, they accounted for only 24 percent of capacity added in 2008. There are currently about 80 firms producing or developing wind turbines in China (Appendix 2). The rapid expansion of producers in China in recent years has led some of China's leading wind power companies to lobby the government to slow the growth of wind turbine companies because of alleged overcapacity in the industry.[294] This led to a joint warning issued by the NDRC, MIIT and eight other departments that the country's economic recovery could be hampered with chaotic expansion in certain industrial sectors, including wind power equipment.[295]

Figure 15: Chinese Manufactures Account for 62 Percent of 2008 Installed Wind Turbine Capacity in China



Source: CWEA, *Statistics on Chinese Wind Power Equipment Capacity in 2008* (2009).

The foreign share of China's annual new purchases of wind power equipment fell from 75 percent in 2004 to 24.4 percent in 2008. China International Capital Corp. Ltd. has estimated that the foreign share of new equipment sales will drop to 15 percent in 2009 and to five percent in 2010.[296] Foreign suppliers complain that "despite jumping through hoops to meet localization rules requiring 70 percent of their equipment to be sourced and built domestically, they are still unable to win orders from state projects like

[293] Company specific market share data are from CWEA, *Statistics on Chinese Wind Power Equipment Capacity in 2008* (2009).

[294] "Debate Over Excess Capacity Blows Up In China's Wind Power Sector," *Xinhua* (November 23, 2009).

[295] "Backgrounder: China's Industrial Overcapacity Issue," *Xinhua* (December 27, 2009).

[296] "Foreign Wind Power Generator Market Share Drops in China," *SinoCast* (June 11, 2009).

Rudong [one of the world's largest wind farms], which form the bulk of China's ambitious wind build-up over the next decade."[297]

10. Current domestic production of wind turbines.

Data on Chinese production of wind turbines is not available. However, in 2009 China added roughly eight GW to 13 GW of new wind capacity.[298] That figure may be taken as a proxy for Chinese wind turbine production in 2009. Chinese exports of wind turbines are likely to have accounted for not more than three percent of total wind turbine capacity produced in China in 2009,[299] while imports of wind turbines are likely to have accounted for less than 0.5 percent of total apparent consumption of wind turbines capacity installed in the Chinese market in 2009. Thus, trade currently accounts for a relatively small share of the Chinese wind turbine market. However, that could change if overcapacity in the Chinese market continues or worsens – in which case, Chinese turbine producers may seek to rapidly and significantly increase their exports. Sinovel President Han Junliang said in November 2009 that "the next goal of Sinovel is to achieve at least 30 percent international market share in the near future."[300]

The wind turbines produced by Chinese producers tend to be smaller than those produced by foreign producers. According to Dr. Zhangbin Zheng, senior economist at Asian Development Board, the average size of turbines produced by Chinese producers in 2008 was 1.07 MW, while the average size of turbines produced by European and US producers was 2 MW.[301] However, it seems apparent that China is intent on expanding its production of larger wind turbines, and the average size of wind turbines produced by Chinese firms is likely to continue increasing over the next several years.

Historically wind turbines produced by Chinese producers have tended to be of lower quality than those produced by foreign companies. Keith Li, wind power analyst at CIMB GK in Hong Kong says that wind farm operators in remote regions are already complaining of poor quality turbines which require more frequent maintenance.[302] ProcurAsia, a service firm that assists companies in obtaining industrial products and

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297 "Foreigners Swept Aside as Wind Power Blows Through China," *Reuters* (June 5, 2009).

298 China Daily, "China to have world's second biggest power capacity" (Dec. 26, 2009); http://cccme.mofcom.gov.cn/aarticle/zhongyswhd/200911/20091106603656.html.

299 Through the first eleven months of 2009, China actually exported more wind turbine units to the United States than any other country. However, the average unit value of those turbine units was only $4,284, while the average unit value of turbines exported by Denmark and Japan (the two largest exporters in terms of value) were $952,590 and $1,062,222, respectively. These values strongly suggest that the turbines being exported by China to the United States are very small and are likely all for household, rather than commercial, use.

300 "Sinovel Wind Power's 3MW Marine Turbine Operates Well," *Zhongguo Jiancai Bao* (November 12, 2009).

301 http://social.windenergyupdate.com/industry-insight/foreign-turbine-manufacturers-struggle-cash-chinese-wind-market.

302 http://social.windenergyupdate.com/industry-insight/foreign-turbine-manufacturers-struggle-cash-chinese-wind-market.

high-tech equipment in Asia, has also determined that there are quality issues with many small- to mid-size wind turbines produced by Chinese companies.[303] Indeed, according to research performed by the Kellogg School of Management, field data suggests that Chinese turbines significantly lag behind foreign products in quality, to the extent that the long-term revenue sacrificed from lower quality (as measured by turbine capacity factor) outweighs the upfront cost savings.[304] That quality deficiency may explain, at least in part, why Chinese turbine producers have thus far been unable to generate many export sales to the major wind markets in Europe and the United States.[305]

At the same time, China has made great strides in developing its own wind power technological expertise. According to the Chinese Wind Energy Association ("CWEA"), in 2008, there were 20 independently-developed types of wind turbines and ten jointly-developed turbines in China, up from four and eight, respectively, in 2007.[306] The Chinese industry lags technologically behind foreign wind equipment producers in several important categories, including offshore wind equipment, control systems, and software supporting turbines.

11. Restrictions on Foreign investment in wind power projects.

The existence of foreign-invested wind farms in China represents a potential alternative market for foreign wind equipment manufacturers. China has taken the position that foreign investment in renewable energy is encouraged. However, a number of policies inhibit foreign investment in the wind power sector.

a. ***Clean development mechanism.*** China prohibits companies that are less than 51 percent Chinese owned from taking advantage of the Clean Development Mechanism, which allows developed countries to offset their carbon reduction commitments under the Kyoto Protocol by investing in sustainable energy projects in developing countries.[307] In 2005, the NDRC and MOST jointly promulgated the *Measures for Operation and Management of Clean Development Mechanism Project* (CDM Measures), which provided that

> *Only companies wholly-owned or controlled by Chinese parties may carry out CDM projects in the PRC. Consequently, a company controlled by foreign parties does not qualify for PRC government's approval for a CDM project.*[308]

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303 www.procurasia.com/?sty=337.

304 http://www.kellogg.northwestern.edu/Departments/International/InternationalFocus/Article/Winds_of_Change.aspx.

305 *Id.*

306 China Daily, "Debate on overcapacity blows up in China's wind power sector" (Nov. 24, 2009).

307 "China's Wind Power Potential," *Nature* (January 21, 2009).

308 Longyuan *Global Offering* (2009) op. cit., p. 93.

Chinese wind farm operators characterize the carbon payments as important sources of additional revenue – "it's like food from heaven. It suddenly comes down one day but you don't know when it will stop."[309] In late 2008, the State Council reported that CDM projects have effectively boosted the development of China's renewable energy."[310] As of the end of January 2010, China had 732 CDM projects registered at the UN, 144 of which were wind-related. As indicated in the table below, among the ten largest wind-related CDM projects registered in China over the past two years, all of the turbines employed were made in China, and most, but not all, of the turbines employed were manufactured by Chinese companies.

10 Largest Chinese Wind-Related CDM Projects Registered Between Jan. 2008 and Jan. 2010

Registration Date	Project Name	Stated Installed Capacity	Turbine Manufacturer(s)
Jan. 28, 2009	CGN Inner Mongolia Huitengliang	300 MW	Oriental Turbine Factory
May 12, 2009	Inner Mongolia Baotou Bayin	201 MW	Goldwind Science and Technology Co., Ltd.
Nov. 23, 2009	Hebei Shangyi Qijiashan	199.5 MW	Sinovel (30%), GE Energy (70%)
Dec. 29, 2008	CECIC HKC Danjinghe	200 MW	Zhejiang Windey Wind Generating Engineering Co., Ltd.
Jan. 26, 2009	Jilin Tongfa	100.3 MW	Gamesa
Dec. 13, 2009	Jiangsu Qidong Dongyuan	100.5 MW	Nantong CASC Wanyuan Acciona Wind Turbine Manufacture Co., Ltd.
Sep. 17, 2008	Shibeishan	100.2 MW	Xinjiang Gold Wind Technology Co. Ltd.
Jul. 5, 2008	Inner Mongolia Wudaogou	50.25 MW	Xinjiang Gold Wind Technology Co. Ltd.
Jan. 25, 2009	Sinohydro Inner Mongolia Ximeng Honggeer	49.5 MW	Goldwind Science and Technology Co., Ltd.
Nov. 4, 2008	Inner Mongolia Chifeng Dongshan Phase II	50 MW	Vestas Co., Ltd.

12. ***Registered capital requirements.*** The typical registered capital requirement for a foreign or Sino-foreign wind power project is a minimum of 33 percent, whereas the requirement for Chinese companies is ten percent. This difference was

[309] "China's Fierce Kyoto Rules Irk Foreign Investors," *Planet Ark* (September 25, 2006).

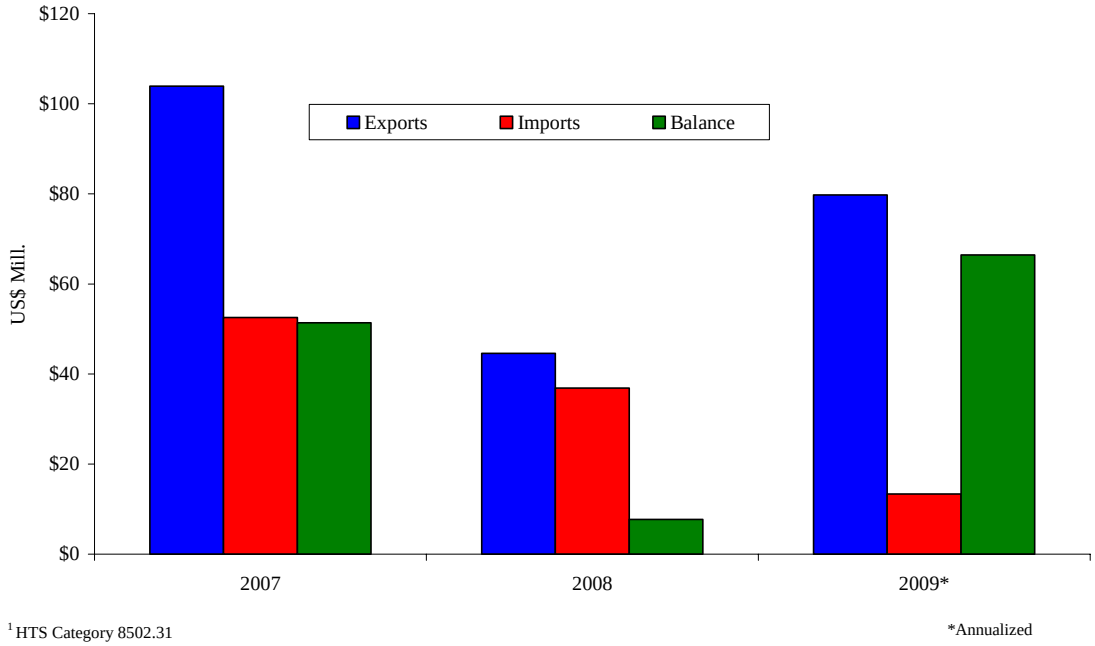
[310] State Council, China's Policies and Actions for Addressing Climate Change (October 2008).

traditionally regarded as a trade-off against the benefit received by foreign-invested enterprises through a VAT refund policy. Effective January 1, 2009, the VAT refund was rescinded but the differences between Chinese and foreign minimum capital requirements remains.[311]

13. Chinese trade in wind turbines and towers.

Not withstanding the fact that China is now a major player in the worldwide wind power market, Chinese trade in wind turbines is relatively small – far smaller than is the case for either the United States or Europe.[312] While the Chinese trade balance in wind turbines is positive, that is primarily because imports of wind turbines into China have plummeted since 2007 and in 2009 likely totaled less than US$15 million (Figure 9).

Figure 16: Chinese Trade in Electric Wind Generating Sets[1] with U.S. and Europe



[1] HTS Category 8502.31

*Annualized

The total value of Chinese exports of wind turbines to the United States and Europe (which together account for over 75% of the worldwide non-Chinese wind market[313]) is likely to be roughly US$80 million in 2009. Unfortunately, no data on the

311 EU Chamber of Commerce in China, *European Business in China Position Paper 2009/2010* (2009) p. 209.

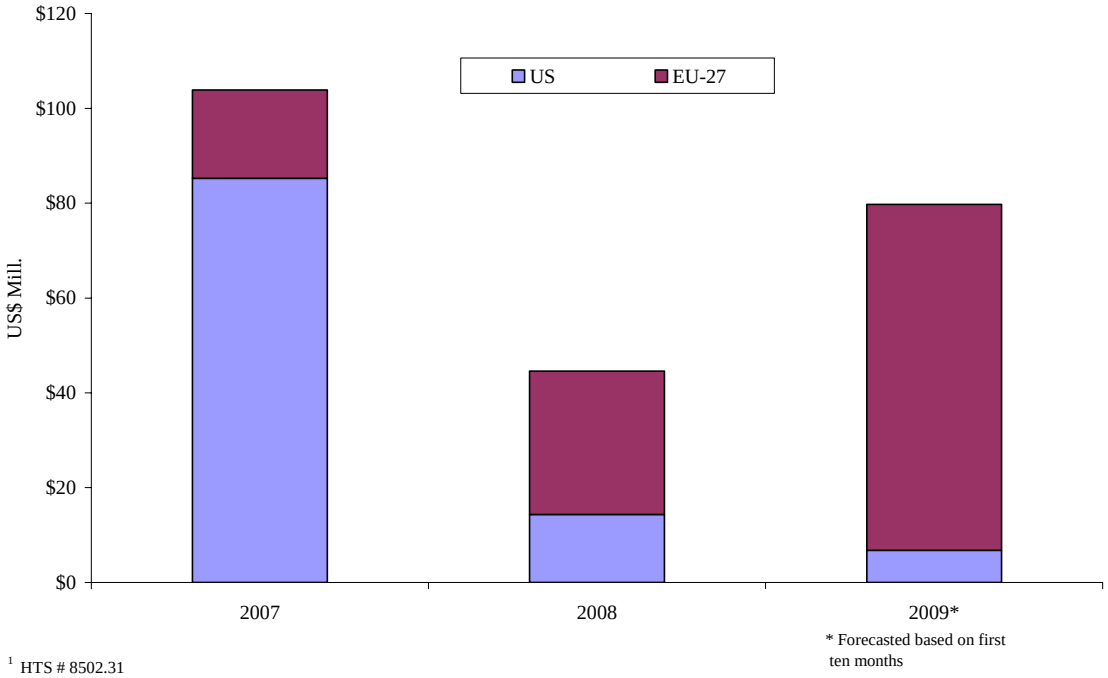
312 Chinese export data in this paper are based on import statistics of the country of destination given the significant discrepancies between Chinese export data and the import data of its trading partners. US import statistics list $14.3 million of imports from China for wind generating sets (HS# 8502.31) in 2008 while Chinese trade statistics list $107.9 million in exports to the United States in 2008.

313 Global Wind Energy Council, *Global Wind 2008 Report* at 9.

wattage associated with those exports is available. It is estimated that the Chinese wind equipment market is worth roughly $8.6 billion annually.[314] If so, exports to the United States and Europe represent less than 1 percent of that value. While Chinese exports of wind turbines to Europe appear likely to have increased significantly in 2009 (at least in value terms), Chinese exports of wind turbines to the United States have fallen precipitously over the past two years, and are now virtually non-existent (Figure 10).

However, there is reason to believe that China will begin to significantly ramp up exports of wind turbines in the near future. The growth in Chinese production of wind turbines already outpaces the country's ability to utilize such turbines effectively, and that is likely to become even more the case in the coming years.[315] Goldwind recently

Figure 17: Imports of Electric Wind Generating Sets[1] from China



[1] HTS # 8502.31

entered into its first American wind power project, providing three 1.5 MW wind turbines to a Pipestone, Minnesota project.[316]

In 2008, Goldwind and Dongfang accounted for roughly 13 percent of the worldwide wind turbine market, according to Danish research firm BTM Consult. While

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314 http://cleantech.com/news/5176/vestas-unveils-integrated-wind-power.

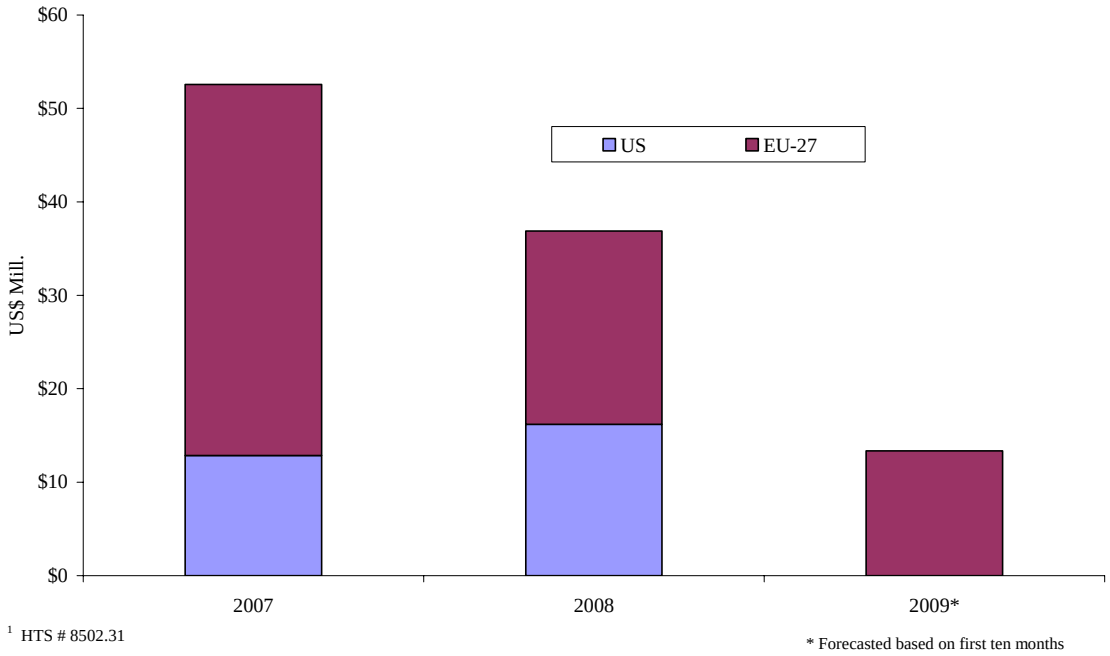
315 Associated Press, "Chinese wind power companies target global markets" (Dec. 6, 2009) *as published on Yahoo! Green;* Bloomberg, "China May Increase Wind Turbine Exports, Morgan Stanley Says" (Nov. 20, 2009); China Daily, "Goldwind to spread wings overseas for growth" (Dec. 15, 2009) (noting that Goldwind expects overseas markets to "account for 20 to 30 percent of our business over the next three to five years.")

316 *Id.*

that market share was well behind Vestas (20 percent) and General Electric (19 percent), China's share was based almost entirely on sales within the Chinese market.[317] Moreover, there is every reason to believe that the market share accounted for by the Chinese producers was higher in 2009 and will grow in the coming years.

The total value of Chinese imports of wind turbines from the United States and Europe (which together account for over 75% of the worldwide non-Chinese wind market[318]) is likely to have been less than $10 million in 2009. No data on the wattage associated with those imports is available. It is estimated that the Chinese wind equipment market is worth roughly $8.6 billion annually.[319] If so, imports from the United States and Europe represent only about 0.1 percent of that value. Chinese imports of wind turbines from the United States are now essentially non-existent, while Chinese imports of turbines from Europe are likely to be 80% lower in 2009 than they had been in 2007.

Figure 18: Exports of Electric Wind Generating Sets[1] to China



China is a major exporter of towers and lattice masts used in wind projects.[320] Indeed, Chinese exports of such products to the United States and Europe are likely to total roughly $315 million in 2009, up from $84 million in 2007 (Figure 19). Iron and

317 *Id.*

318 Global Wind Energy Council, *Global Wind 2008 Report* at 9.

319 http://cleantech.com/news/5176/vestas-unveils-integrated-wind-power.

320 HTS Category 7308.20.

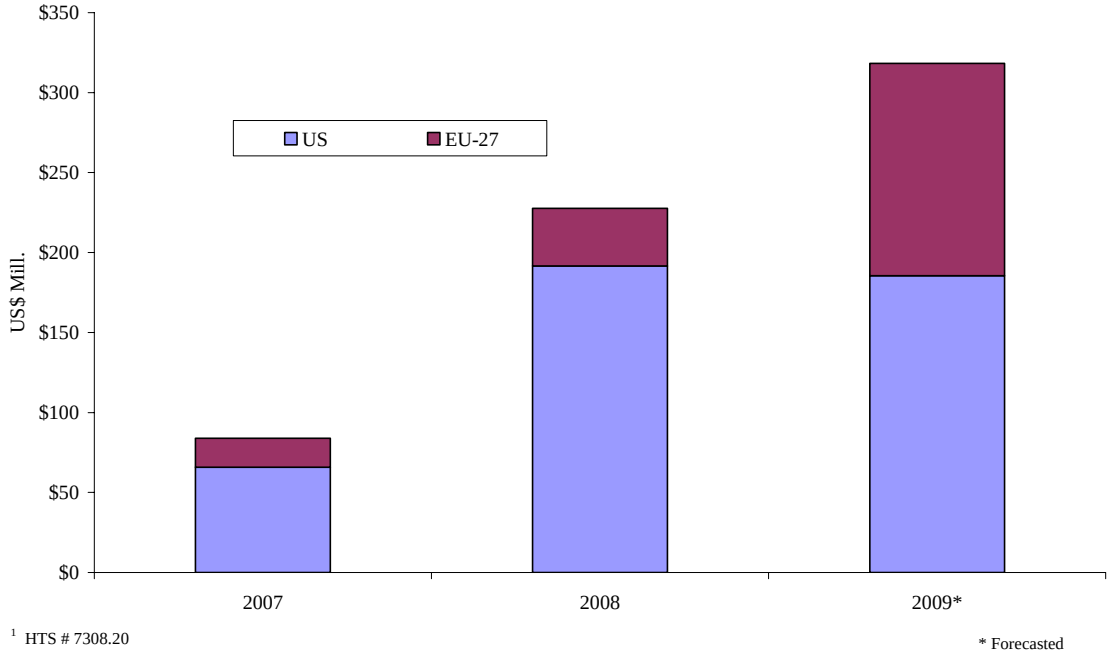
steel, and their production may require less technology than does the production of wind turbines.

In late 2009, A-Power Generation Systems, a Chinese producer of distributed power systems, announced that a joint venture comprised of Shenyang Power Group, Cielo Wind Power (a Texas-based wind power developer) and U.S. Renewable Energy Group (an investment group specializing in renewable energy) would develop a 600 MW wind farm in Texas using turbines supplied by A-Power from China. This would mark the first significant export of Chinese wind power equipment to a developed country market.

B. Solar Power

In 2008, China became the largest producer of solar panels in the world, shipping 2,600 megawatt peak of photovoltaic ("PV") panels, which was roughly one-third of worldwide total PV cell shipments.[321] Growth in Chinese production of PV cells has far

Figure 19: Imports of Iron and Steel Towers and Lattice Masts[1] from China



outstripped the growth of the installed solar capacity in China, meaning that the vast majority of PV devices produced in China are exported.[322]

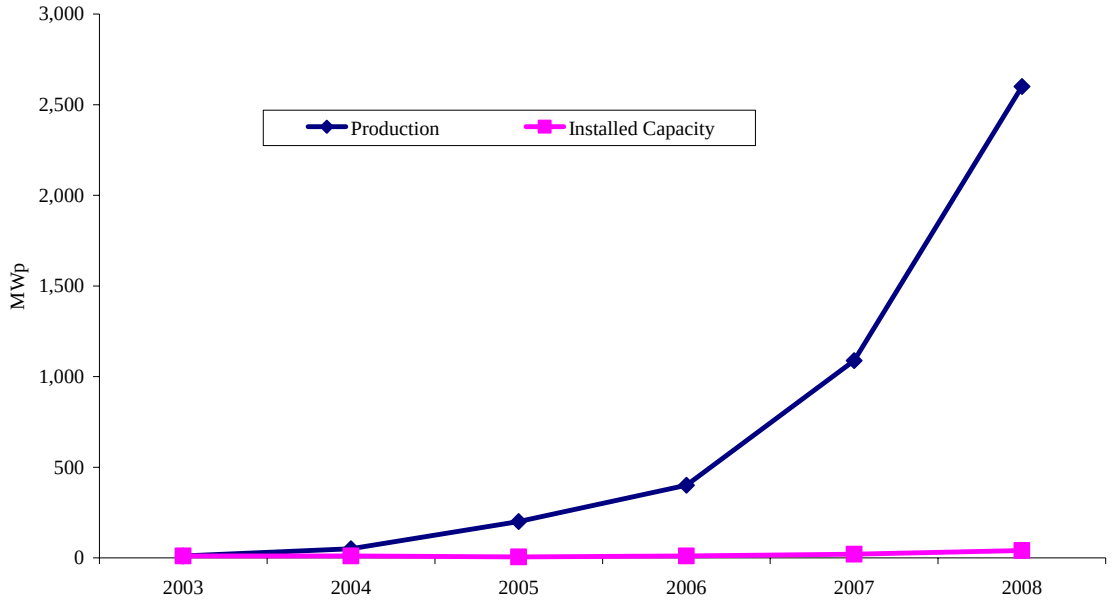
[321] NDRC, Nov. 20, 2009 Presentation. "MWp" refers to megawatt peak, or the peak potential megawatt capacity.

China's domestic market for PV cells is very small. In 2008, China's installed PV capacity accounted for roughly 0.73% of total worldwide installed PV capacity.[323]

1. Chinese Government Measures to Expand the Domestic PV Market.

The Chinese government is attempting to boost the size of the domestic PV market by encouraging the establishment of domestic grid-connected and off-grid solar energy projects. On March 23, 2009, the "Executive Management Rules for Government Subsidies of PV Building Projects" were issued by the Ministry of Finance ("MOF") and Ministry of Construction ("MOC"). Those rules make clear that building integrated PV

Figure 20: Growth in Chinese PV Production Has Massively Outstripped Growth in Installed PV Capacity



Source: NDRC (Nov. 20, 2009)

("BIPV") projects are to be preferred and encouraged, and establishes a subsidy of 20 yuan/Wp for such projects. For building attached PV ("BAPV") projects, the rules establish a subsidy of 15 yuan/Wp.[324] After evaluating nearly 600 applications from 30 provinces, the MOF and MOC in October 2009 approved 111 projects under this program.

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322 http://english.cctv.com/program/bizchina/20090927/102243.shtml. "China's Photovoltaic Industry: Exporting on the Cheap," *Energy Tribune* (Sept. 3, 2009) http://www.energytribune.com/articles.cfm?aid=2262.

323 European Photovoltaic Industry Association ("EPIA"), *Global Market Outlook for Photovoltaics Until 2013* (April 2009) at 6.

324 EPIA and SEIA, Seizing the Solar Solution: Combating Climate Change Through Accelerated Deployment, (Dec. 2009) at 11.

Those 111 projects cover 91 MW of approved PV capacity, and entail a total cost to the Chinese government of 1.27 billion yuan.[325]

a. Golden Sun Demonstration Program. On July 21, 2009, the MOF, together with the Ministry of Science and Technology ("MOST") and National Energy Administration ("NEA"), jointly announced the "Golden Sun Demonstration Program." That program calls for at least 600 WMW of PV capacity to be installed China-wide, and at least 20 MW of PV capacity to be installed in each province, within the next three years. Grid-connected solar systems are due to receive a subsidy from the central government under the program equal to 50 percent of investment cost, while off-grid projects will receive a 70 percent subsidy.[326] Key components of the solar projects, such as panels, inverters, and batteries must be certified by authorized institutions, and all of the PV systems must meet the requirements issued by the National Grid Company.[327] In addition, the government has stipulated that prices to be paid for crystalline silicon panels shall be capped at RMB 14 ($2) per watt, and prices paid for amorphous silicon panels shall be capped at RMB 9 ($1.32) per watt.[328] The government further stipulated that monocrystalline silicon panels used in the program must have at least 15 percent efficiency, while multicrystalline panels used in the program must have at least 14 percent efficiency, and amorphous silicon thin films must have at least 6 percent efficiency.[329]

In November 2009, MOF announced that 314 projects involving over 630 MW of installed capacity had been approved under the Golden Sun program. Of those 314 projects, 261 are BIPV projects involving 290 MW of capacity, 35 are large-scale power projects involving 295 MW of capacity (which will feed electricity to the grid), and 18 are off-grid PV projects involving 46 MW of capacity.[330] The construction costs associated with the projects under the Golden Sun program is forecast to be roughly RMB 20 billion (or roughly $2.93 billion).[331]

The Chinese government also has discussed creating a feed-in tariff, which would allow solar power plant operators to sell electricity at government-set, premium prices.

b. Large scale solar projects. Two large solar power plants are being built in the western plateau provinces of Qinghai and Yunnan.

- China Technology Development Group Corp. and the privately-owned Qinghai New Energy Group are jointly developing a gigawatt-level solar

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[325] *Id*.

[326] *Id*. "Solar Takeoff!" *Solar Feeds* (July 22, 2009).

[327] *Id.*

[328] http://www.greentechmedia.com/articles/read/here-comes-chinas-3b-golden-sun-projects/.

[329] http://www.greentechmedia.com/articles/read/here-comes-chinas-3b-golden-sun-projects/.

[330] *Id*.

[331] http://www.greentechmedia.com/articles/read/here-comes-chinas-3b-golden-sun-projects/.

station in Qinghai which the developers claim will be the largest in the world when completed. The project entails an initial investment of about $146 million. The government of the Haixi Autonomous Prefecture of Mongolia and Tibet, nationalities where the project is located, have agreed to help the two companies acquire land, subsidies, and project approvals from the central government.[332]

- The government of Yunnan Province is beginning the construction of a 166 megawatt solar plant with an investment of over $1.3 billion.[333]

2. Chinese PV Cell and Panel Producers.

The major Chinese producers of PV cells and their shares of total Chinese PV device production in 2008 are shown below:

In 2009, Suntech remained the largest Chinese producer of PV cells (and the second largest producer of such cells worldwide, behind US-based First Solar) with an estimated production of 595 MW.[334] Yingli Green Energy and JA Solar remained the second and third largest Chinese producers of PV cells in 2009, with estimated production of 430 MW and 400 MW, respectively.[335]

Company	2008 Production (MWp)	Share of Total Chinese Production
Suntech Power	498	19.2%
Yingli Green Energy	282	10.8%
JA Solar	277	10.7%
Trina Solar	209	8.0%
Solarfun	189	7.3%
China Sunergy	111	4.3%
Canadian Solar	108	4.2%
Changzhou Yijing	100	3.8%
Ningbo Solar	97	3.7%
Jetion Solar	65	2.5%
CHINA TOTAL	**2600**	

Source: NDRC, Nov. 20, 2009 Presentation.

[332] "Solar Power Plants to Spring Up in China," *Xinhua* (January 10, 2009).

[333] *Ibid.*

[334] http://www.pvsociety.com/article/339645-First_Solar_Will_Be_No_1_Cell_Producer_This_Year_iSuppli_Says.php.

[335] http://www.pvsociety.com/article/339645-First_Solar_Will_Be_No_1_Cell_Producer_This_Year_iSuppli_Says.php.

While Spain was the largest PV market in the world in 2008 that changed in 2009 as the Spanish government, wishing to slow down the booming market and control over-expansion, put in place a strict cap which allows only a 500 MW annual market from 2009 to 2011.[336] Accordingly, in 2009, Germany had the largest PV market in the world, followed by the US. However, the US PV market is the fastest growing major market in the world and is likely to be the largest PV market beginning in 2010 or 2011.[337] The Chinese PV market currently is one-twentieth to one-tenth the size of the US PV market.[338]

As much as a billion yuan has flooded into the Chinese photovoltaic industry in the past three years, leading to an investment bubble.[339] By the first half of 2009, there were roughly 50 companies constructing, expanding or preparing polycrystalline silicon production lines in provinces such as Sichuan, Yunnan, Henan and Jiangsu. Chinese polysilicon production capacity in 2009 is over 60,000 tons, and in 2010 it is forecast to be between 140,000 and 170,000 tons.[340] In stark contrast, demand for PV panels has fallen precipitously in the wake of the global financial crisis. Global demand for polysilicon in 2010 is expected to be just 80,000 tons.[341] As a result, many Chinese manufacturers have large stockpiles of polysilicon with few orders.[342]

With the impact of the global financial crisis, European countries — especially Spain — significantly scaled back their government support of the solar power industry in 2009, leading to a sharp reduction in the global demand for photovoltaic devices. As a result, Chinese photovoltaic firms received fewer orders than expected, and most companies were forced to significantly reduce or even stop production. Many companies which bought high-priced raw materials also suffered huge losses. Under this situation, domestic companies in 2009 faced fierce competition and a Hobbesian choice: If they

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[336] European Photovoltaic Industry Association ("EPIA"), *Global Market Outlook for Photovoltaics Until 2013* (April 2009) at 8.

[337] European Photovoltaic Industry Association ("EPIA"), *Global Market Outlook for Photovoltaics Until 2013* (April 2009) at 6.

[338] European Photovoltaic Industry Association ("EPIA"), *Global Market Outlook for Photovoltaics Until 2013* (April 2009) at 6.

[339] In October 2009, Fulbright Securities General Manager Francis Lun Sheung-nim said that investors were blindly chasing after Chinese stocks with renewable power concepts. "It is surprising that punters are still blindly speculating on solar as wind power-related stocks. The reality is that there are over-investments in solar energy projects in China." "RBI Soars on News of Venture into Solar Energy," *South China Morning Post* (October 3, 2009). http://en.chinagate.cn/features/earth/2009-08/28/content_18419484.htm.

[340] "China's Photovoltaic Industry: Exporting on the Cheap," *Energy Tribune* (Sept. 3, 2009); http://en.chinagate.cn/features/earth/2009-08/28/content_18419484.htm.

[341] http://en.chinagate.cn/features/earth/2009-08/28/content_18419484.htm.

[342] "China's Photovoltaic Industry: Exporting on the Cheap," *Energy Tribune* (Sept. 3, 2009). http://www.energytribune.com/articles.cfm?aid=2262.

stopped production, they would suffer huge losses from upfront investment; if they continued to manufacture, they would bear huge deficits.[343]

As noted above, sizeable amounts of excess capacity also exist in the Chinese polysilicon industry. According to the Chinese Ministry of Industry and Information Technology ("MIIT"), capacity utilization in the Chinese polysilicon industry is only 26 percent, while the capacity implementation rate (actual capacity vs. planned capacity) is only 55 percent[344] meaning that installed production capacity is likely to expand significantly in the coming years.[345]

Excess capacity also exists with respect to PV cells and panels, but many local governments have been pushing for more PV production. In August, the China National Energy Bureau took the unusual step of suggesting that the development of PV production capacity be decreased. At the State Council working meeting on August 26, 2009, Premier Wen Jiabao pointed out that it is time for "the redundancy in production capacity of wind energy and solar energy to be controlled." Given these developments, it seems very likely that the growth of the PV business in China will slow.

On September 25, China's Ministry of Industry and Information Technology (MIIT) said that it would strengthen regulation over the Chinese PV industry. The MIIT and relevant government branches reportedly intended to look into PV enterprises across the country and release guidelines on the development of China's polysilicon industry.[346] The majority of Chinese PV production is of silicon devices, with thin film devices accounting for roughly 30% of total production.[347] Silicon devices tend to be more efficient in their production of solar energy than are thin film devices, but thin film devices generally are cheaper to produce per MWp, depending on the cost of polysilicon.[348] Indeed, despite the fact than polysilicon prices in China dropped by almost 85 percent between 2008 and late 2009 (from $480 per kilo to $60 per kilo), thin-film production still retained a production cost advantage of roughly 20 percent at the end of 2009.[349] In addition, it is expected that Chinese production costs for thin-film PV cells

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343 http://en.chinagate.cn/features/earth/2009-08/28/content_18419484.htm

344 MIIT Nov. 30, 2009 Presentation on "China's Photovoltaic Industry Development Status" (Slide 9).

345 MOST disputes reports of overcapacity in the PV and polysilicon industry. It issued a report in 2009 stating that of the more than 50 polysilicon companies established to date, only 10 were capable of producing polysilicon. MOST states that "it is the new energy enterprises that support the argument about surplus capacity, for fear of a large number of newcomers competing and reducing their profits." "MOST: No Surplus Capacity in New Energy," *Zhongguo Wang* (November 18, 2009); "Two Ministries Clash Over Solar Panel Industry," *South China Morning Post* (November 18, 2009).

346 http://english.people.com.cn/90001/90778/90857/90860/6768957.html.

347 MIIT, Presentation on "China's Photovoltaic Industry Development Status" (Slide 16), (November 30, 2009).

348 http://www.solarbuzz.com/technologies.htm.

349 Yotam Ariel and Coco Liu, "Chinese Manufacturers Eye Thin-Film PV Market" *RenewableEnergyWorld.com* (December 14, 2009).

will continue to drop as Chinese producers are putting more resources into R&D.[350] However, Chinese thin-film production costs reportedly remain well above those of the leading US thin-film producer (First Solar).[351] Moreover, it is unclear if Chinese thin-film PV cells have yet increased their efficiency enough to make those cells cheaper than silicon cells on a cost-per-kilowatt of energy produced basis.[352]

3. Production of PV Cells and Modules by Foreign-Owned Entities.

Although there does not appear to be any significant production by foreign-owned PV firms in the Chinese PV market, several foreign initiatives are under way. In May 2009, Germany's SolarWorld AG entered into a licensing agreement with Suntech Power Inc. under which the Chinese company was to manufacture solar power modules on behalf of SolarWorld AG with the German solar company providing input materials and technological know-how.[353]

In September 2009, US-based First Solar Inc. (the world's leading and lowest cost producer of PV cells) announced that it plans to build the world's largest solar plant at Ordos City, in Inner Mongolia, China. That plant will represent the first major foray by a US company into China's solar energy sector. Under a memorandum of understanding with the Chinese government, First Solar will build a two gigawatt power plant, enough to power about three million Chinese households. The company will also consider building a new manufacturing plant in China.[354] First Solar will begin constructing a 30 megawatt demonstration project in June 2010 in Ordos. The second and third phases call for 100 megawatt and 870 megawatt projects that will be completed in 2014. A final 1,000 megawatt installation will be finished in 2019.[355] Solar projects have so far been built on a smaller scale, and the First Solar project will be a test of whether the technology behind the plant – which will be 30 times the size of the largest current plant – can be scaled up. The size of the new project is comparable to a nuclear power plant, and so would be a revolutionary breakthrough.[356]

First Solar's deal with Ordos City is contingent on plans by the Chinese government to create a solar-power subsidy program, for example, in the form of above-market tariffs that utilities would pay for solar power. First Solar's CEO, Mike Ahearn, said he and others expect that the Chinese solar tariffs will be between 15 and 25 cents a

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350 *Id.*

351 *Id.*

352 Recent reports indicate that thin-film modules remain more expensive per watt of electricity produced than silicon-based PV modules. Justin Moresco, "Driving down thin-film costs," *RenewableEnergyWorld.com* (Dec. 17, 2009).

353 http://www.solarworld.de/3679.html?L=1.

354 http://www.reuters.com/article/GCA-GreenBusiness/idUSTRE5874XC20090908.

355 http://www.reuters.com/article/GCA-GreenBusiness/idUSTRE5874XC20090908.

356 http://www.reuters.com/article/GCA-GreenBusiness/idUSTRE5874XC20090908.

kilowatt-hour, fairly low compared to solar tariffs in other countries like Germany and Spain, but probably sufficient to make the solar power plant competitive with traditional sources of electricity.[357]

In November 2009, Evergreen Solar announced that it planned to shift its production of solar panels from Massachusetts to China in mid-2010.[358] The move, which is aimed at establishing manufacturing capacity for 500 MW per year, is being undertaken through a strategic partnership with the Wuhan Provincial Government and a Chinese PV manufacturer, Jiawei Solar (Wuhan).[359]

4. Chinese Exports of PV Devices.

Between 2007 and 2008, the value of Chinese exports of photosensitive semiconductor devices to Europe rose by 155%[360]. Due to the marked decline in the size of the Spanish PV market in 2009, the value of Chinese exports of photosensitive semiconductor devices[361] to Europe as a whole was lower during the first ten months of 2009 than it had been during the first ten months of 2008. However, the value of Chinese exports of such devices to Germany (the largest PV market in the world) during the first ten months of 2009 was 4.3% higher than it had been during the first ten months of 2008, after rising 89% between 2007 and 2008.[362]

In August 2009, two major German producers of PV cells – SolarWorld AG and Conergy – filed a complaint with both the German government and European Union authorities complaining about subsidization of the Chinese PV industry and requesting that an antidumping investigation of Chinese PV exports be initiated.[363] In the first nine months of 2009, Conergy's sales in the German market were down 59% from the same period in 2008, while SolarWorld AG's sales in the German market were 56% higher than they had been in the first nine months of 2008.[364] However, SolarWorld's total sales

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357 http://blogs.wsj.com/environmentalcapital/2009/09/08/first-solar-to-build-2-gigawatt-solar-power-plant-in-china/.

358 http://seekingalpha.com/article/171748-evergreen-solar-plans-to-move-u-s-panel-production-to-china.

359 "Evergreen Solar Shifts Manufacturing to China, Targets US $1/W in 2012," *PV-tech.org* (May 1, 2009).

360 HTS Category 8541.40. Note that this category includes, but is broader than ,solar cells and devices.

361 HTS Category 8541.40. Note that this category includes, but is broader than, solar cells and devices.

362 Eurostat External Trade Data. "China's Photovoltaic Industry: Exporting on the Cheap," *Energy Tribune* (Sept. 3, 2009). http://www.energytribune.com/articles.cfm?aid=2262. *See also* "Chinese Solar Firm Revises Price Remark", *New York Times* (Aug. 26, 2009). http://www.nytimes.com/2009/08/27/business/energy-environment/27panel.html?_r=1.

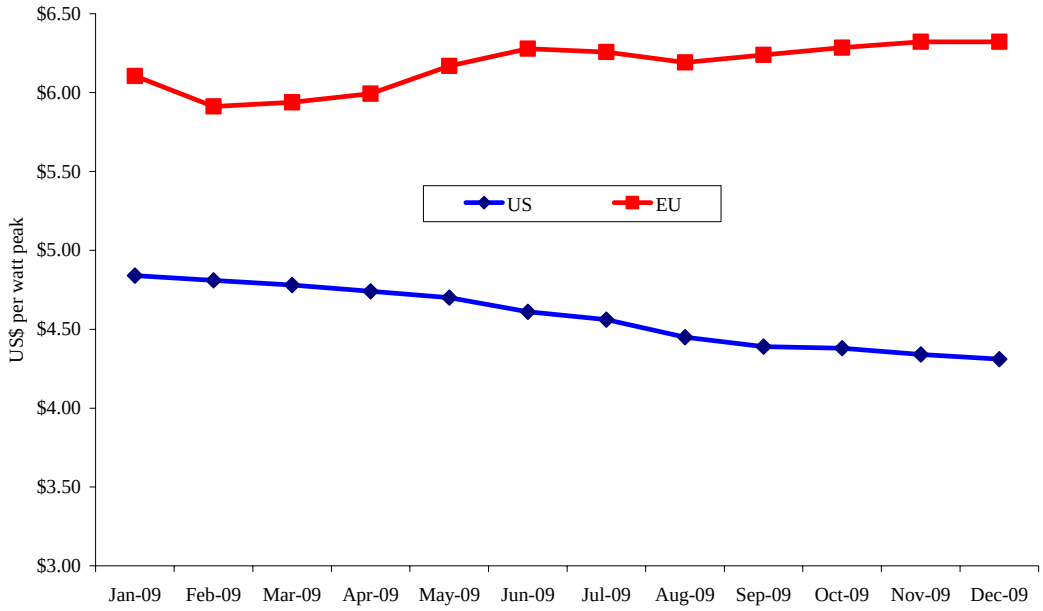
363 "China sets up panel to cope with anti-dumping on photovoltaic products in Germany," *Global Times* (Sept. 21, 2009); "Conergy, Solarworld Seek Protection From Chinese Price Dumping," Bloomberg.com (Aug. 21, 2009).

364 Conergy and SolarWorld AG Third Quarter 2009 Reports.

in 2009 topped €1 billion, up from €900 million in 2008,[365] suggesting that that company is still expanding sales despite the import competition. To date, no antidumping investigation has been initiated by the European Union, and the Chinese industry has mounted a vigorous campaign against such an investigation.[366] Moreover, after contracting during the first half of the year, the German solar market expanded rapidly in the last half of 2009. In late November, market research company iSuppli forecast that Germany would install 2.5 GW of solar panels by the end of 2009[367](roughly on a par with 2008), while the German Solar Industry Association (BSi) forecast that up to three GW of solar capacity could be installed in Germany by the end of 2009.[368] Thus, Germany is likely to account for roughly half of worldwide PV demand in 2009.[369]

Exports of Chinese PV cells to the United States have grown dramatically. The value of US imports of PV modules and panels from China during the first eleven months of 2009 was 67 percent higher than the value of such imports during the first eleven months of 2008, and totaled roughly $340 million.

Figure 21: Comparison of Retail PV Module Prices
125 Watts and above



Source: Solarbuzz Consultancy Reports

365 http://www.thestreet.com/story/10656016/1/solarworld-hits-sales-peak-sector-spikes.html?cm_ven=GOOGLEN.

366 "China sets up panel to cope with anti-dumping on photovoltaic products in Germany," *Global Times* (Sept. 21, 2009); NDRC Presentation (Nov. 20, 2009).

367 *Industrial Info Resources*, "Solar Market Sees Brighter Future" (Nov. 29, 2009).

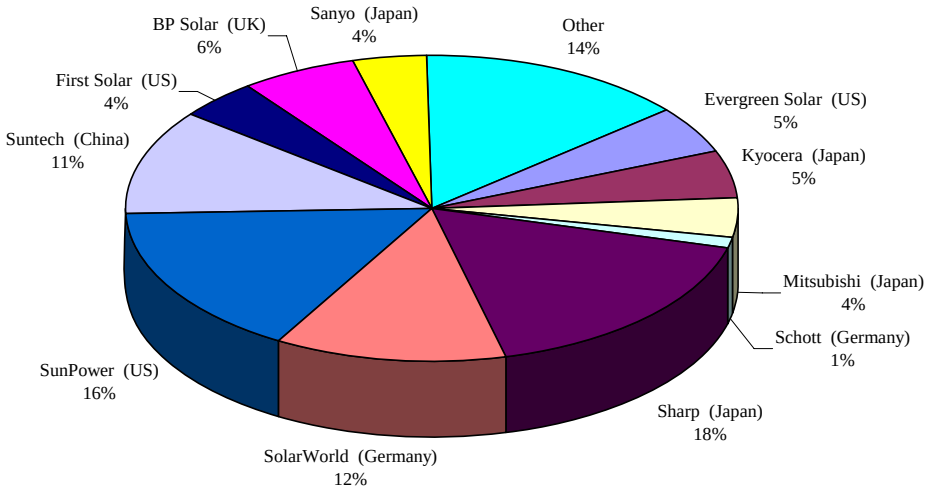
368 *Id.*

369 *Id.*

The U.S. PV market apparently is growing faster than the European market (or even than the German market), and could become the largest PV market in the world within a few years' time.[370] Retail PV module prices are significantly lower in the United States than in Europe.

While no data on US national market share is available, data pertaining to the California solar market (which is by far the largest solar market in the United States and accounts for over 60 percent of the total US market) indicates that Suntech (the largest Chinese producer of PV cells) accounts for roughly 11 percent of that market.

Figure 22: Share of California Solar Market: 2009



Source: California Solar Statistics (as compiled by Barclays Capital and reproted by PV Tech).

C. Biomass Power

China has an abundance of biomass resource and the government intends to promote significantly greater use of biomass for power generation in the coming decades.[371] In addition to agricultural waste from existing arable land, there are about

[370] http://www.gtmresearch.com/report/the-united-states-pv-market-project-economics-policy-demand-and-strategy.

[371] Li Jingjing, Zhuang Xing, Pat DeLaquil and Eric D. Larson, "Biomass Energy in China and Its Potential," *Energy for Sustainable Development*, Vol. V, No. 4 (December 2001). Biomass resources include agricultural residues, animal manure, wood wastes from forestry and industry; residues from food and paper industries, municipal green wastes, and sewage sludge. Biomass resources also include dedicated energy crops such as short-rotation coppice (eucalyptus, poplar, willow), grasses, sugar crops (sugar cane, beet, sorghum), starch crops (corn, wheat) and oil crops (soy, sunflower, oilseed rape, iatropha, palm oil). Organic wastes and residues have been the major biomass sources so far, but energy crops are gaining importance and market share. With re-planting, biomass combustion is a carbon-neutral process as the CO^2 emitted has previously been absorbed by the plants from the

100 million hm^2 of forest and land that can be used to develop energy agriculture and energy woods.[372] The energy bureau of the NDRC has estimated that there will be 800 million tons coal equivalent ("tce") of biomass resources in China by 2030.[373] Crop residues from rice, wheat and corn currently account for well over half of all biomass resources in China. Biomass resources, unlike traditional thermal sources in China (coal, oil, natural gas), are widely distributed and power plant type and scale can be tailored to the availability of the biomass resource. Electricity can then be provided directly to nearby consumers or connected to the grid, depending on the circumstances. Grid-connected biomass power generation will be limited to areas with an abundance of biomass resources and large scale of power generation.

Table 3: Potential Available Biomass Resources in China

(100 million tce)

	2006	**2010**	**2020**	**2030**
Agricultural residues	0.69	0.88	1.43	2.34
Forestry residues	0.63	0.71	0.91	1.16
Animal Dung	1.07	1.21	1.55	1.98
Industrial organic wastes	0.39	0.44	0.57	0.73
MSW	0.025	0.03	0.07	0.15
Energy crops	—	0.04	0.25	0.34
Energy forest	—	0.05	0.82	1.32
Total	**2.8**	**3.4**	**5.6**	**8.0**

Source: NDRC, Energy Bureau, Energy Research Institute, *China Renewable Energy Development Overview – 2008* (2008).

1. China's Biomass Power Objectives.

The *Medium and Long-Term Development Plan for Renewable Energy in China* established a goal for biomass power of 5.5 GW by 2010 and 30 GW by 2020.[374] Some

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atmosphere. Residues, wastes, and bagasse are primarily used for heat & power generation. Sugar, starch and oil crops are primarily used for fuel production.

[372] Chinese Academy of Sciences, Guangzhou Institute of Energy Convection, *Consultation on Biomass Power Generation Technology Improvement*, GoC/World Bank/GEF, China Renewable Energy Scale-Up Program (April 2005).

[373] NDRC, Energy Bureau, Energy Research Institute, *China Renewable Energy Development Overview 2008* (2008). Another analysis has estimated within the next 30 years China can develop at least 2 billion tons of biomass resource equivalent to one billion tce. Chinese Academy of Sciences, Guangzhou Institute of Energy Convection, *Consultation on Biomass Power Generation Technology Improvement*, GoC/World Bank/GEF, China Renewable Energy Scale-Up Program (April 2005).

[374] The majority of these power generation targets are for biomass power based on agricultural and forestry wastes and energy crop plantations (4 GW in 2010 and 24 GW in 2020). Large biogas projects on livestock farms are slated for 1 GW and 3 GW of capacity for 2010 and 2020 respectively while power

analysts have questioned whether China can reach the 30 GW target by 2020. Ryan Wiser, of the Center for Resource Solutions, says that biomass projects are not being added rapidly enough to meet the target. "There are rumors that {China's} 30-gigawatt goal will be reduced in the not-too-distant future to reflect a more realistic deployment path."[375]

Currently China has between three and four GW of biomass power generating capacity installed, although much of this is likely not connected to the power grid but is used on a local basis.[376] China intends to meet its goals for expanding the use of biomass for electricity production through the introduction of internationally advanced direct-fired biomass power generation technology that will be connected to the power grid. Almost all of these plants will be built in rural areas and will use straw and other agricultural waste as inputs.[377] The first such plant entered commercial operation in east China's Shandong Province on December 1, 2006, with an installed generating capacity of 25 MW.[378] By the end of 2008 China had installed about 600 MW of direct-fired biomass power generation capacity.[379] Over 200 MW of additional capacity was added in 2009, bringing the total number of direct-fired biomass power generation plants to 48 with an installed capacity of over 800 MW.[380] An additional 37 plants are under construction or under consideration, representing more than 800 MW of additional generating capacity. The majority of the biomass power plants are concentrated on the east coast in the provinces of Jiangsu, Jilin, Henan and Shandong.

China is also trying to increase the volume of municipal solid waste that is used to generate electric power. The Chinese government has established a long-term goal to increase the amount of municipal waste that is used in waste-to-energy generation from one percent in 2002 to 30 percent by 2030. The Asian Development Bank recently signed an agreement to lend up to $200 million to China Everbright International Limited to develop waste-to-energy plants in secondary cities across China.[381]

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generation targets based on municipal solid waste are 0.5 GW and 3 GW. NDRC, *Medium and Long-Term Development Plan for Renewable Energy in China* (September 2007).

375 Lisa Gibson, "Bioenergy World Leaders," *Biomass Magazine* (December 2009).

376 REN21, Renewables Global Status Report 2009 Update (2009).

377 Approximately 700 million tons of straw (equal to 500 million tons of coal in energy potential) are produced in China as waste residue from agricultural production, but only a very small percentage of this has been utilized for heat or power generation. The common method of direct burning for heating and cooking by the local farmers has resulted in heavy air pollution and very low heating efficiency rates.

378 "China's First Biomass-Fired Power Plant Goes into Operation," *Xinhua* (December 2, 2006). The typical size of these plants is ten times smaller (from 1 to 100 MW) than coal-fired plants because of the scarce availability of local feedstock and the high transportation cost.

379 REN21, *Background Paper: Chinese Renewables Status Report* (October 2009) at 47-48.

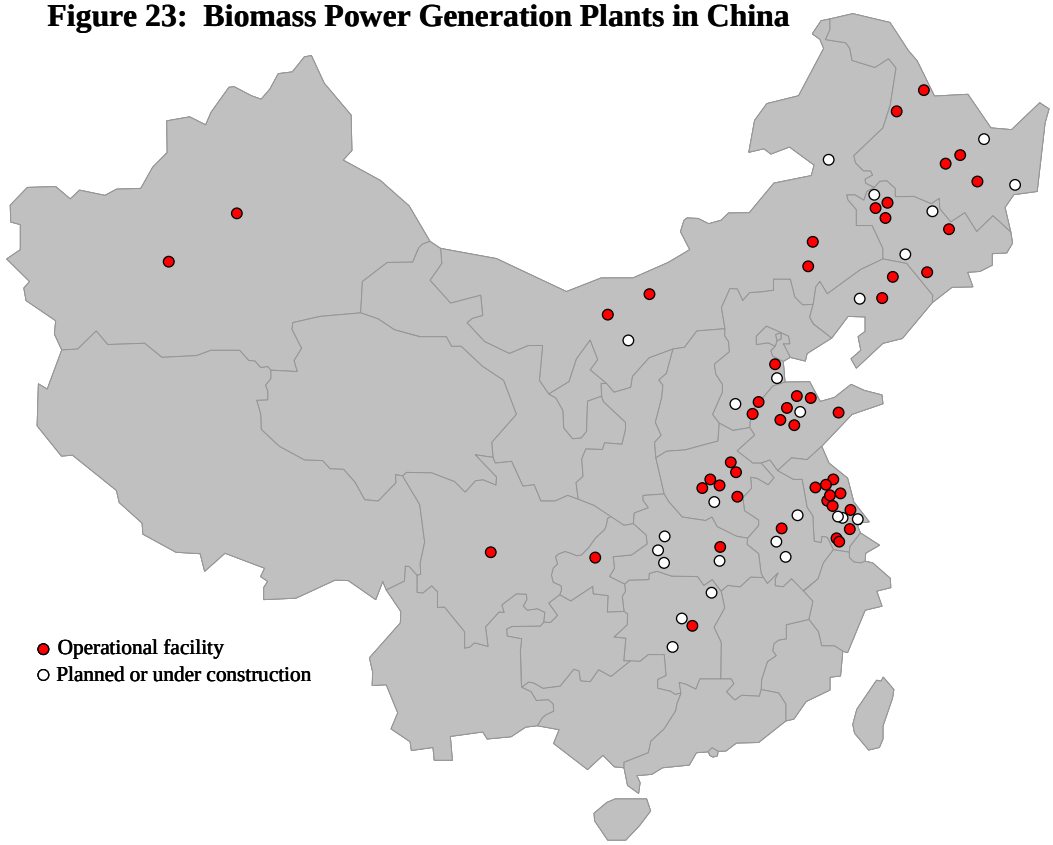
380 Asia Biomass Energy Cooperation Promotion Office (Japan), "Construction of Biomass Power Stations in China" (December 2009) at http://www.asiabiomass.jp/.

381 Asian Development Bank, "ADB Supports Clean Waste-to-Energy Project in the PRC," (September 3, 2009).

2. Government Support for Biomass Power.

The NDRC announced a package of policies at the end of 2006 to encourage the development of the bio-energy and bio-chemical industries. The package of policies included risk reserves, subsidies and tax breaks to encourage development of these

Figure 23: Biomass Power Generation Plants in China



Source: Asia Biomass Energy Cooperation Promotion Office, "Construction of Biomass Power Stations in China," (December 2009).

industries, including biomass production.[382] The policy announcement was jointly issued by the NDRC, the Ministry of Finance, the Ministry of Agriculture, the State Administration of Taxation and the State Forestry Administration.

The Chinese Government currently provides a 0.25 yuan subsidy per KWh to biomass power plants.[383] On December 26, 2009 the National People's Congress adopted an amendment to the renewal energy law that requires all grid companies in China to purchase all the power produced by renewable energy generation facilities.[384] The amendment aims to increase the proportion of renewable energy produced and connected to the grid. Power companies refusing to purchase power produced by renewable energy

[382] "China to Provide Subsidies to Bio-Energy Sector," *Xinhua* (December 1, 2006).

[383] Lisa Gibson, "Bioenergy World Leaders," *Biomass Magazine* (December 2009).

[384] Li Huizi, "China Amends Law to Boost Renewable Energy Law," *Xinhua* (December 26, 2009).

generators, including biomass power generation, are supposed to be fined up to an amount double that of the economic loss suffered by the renewable energy company.

3. National Bio Energy Co., Ltd.

It appears that China intends to meet its biomass power generation goals in large part through the operations of the National Bio Energy Co., Ltd. ("NBE"), a joint venture between the State Grid Corporation of China and Dragon Power Co., Ltd. NBE built the first biomass power generation plant in Shanxian, Shandong Province using central boiler system technology and engineering expertise from the Danish company Burnmeister & Wain Energy A/S.[385] The Shanxian biomass power plant was the first demonstration project involving power generation using biomass in China.[386] The electricity produced by the plant, predominately from cotton straw, is supplied to the Shandong provincial power grid which is part of the North China grid system. Having proven the technology, NBE has received government approval to construct at least 40 biomass power plants and already has close to 30 plants operating or under construction.[387] A number of these plants sell greenhouse gas emission reduction credits to international companies like Electricite de France under the Clean Development Mechanism.[388]

A much smaller presence in the China biomass power generation industry is the publicly traded Singapore based company China EnerSave Limited. China EnerSave builds, owns and operates biomass power plants and waste-to-energy plants as well as converts coal-fired plants to biomass inputs. The company currently operates four biomass power plants in China.

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[385] The company also licensed technology for soft straw boilers from Bioener, a European subsidiary of the Japanese firm Takuma. Dragon Power acquired Bioener from Takuma in 2009.

[386] Shanxian is one the richest biomass resource cities in China and most of the agricultural waste resources had been dumped and were not otherwise utilized.

[387] "China Dragon Power to Build 30 Biomass Plants by 2010," *Reuters* (November 21, 2008); "Biomass-Fired Power Plant Starts Operation in Northeast China," *Xinhua* (November 5, 2007). "China Bio-Energy Joint Venture Plants Yield 2.6 Bln KwH Green Power," *Xinhua* (January 8, 2009); Yu Tianyu and Qi Taren, "A Green Dragon Spreads Its Wings Across China," *China Daily* (September 3, 2009).

[388] "Biomass-Fired Power Plants Start Operation in NE China," *Xinhua* (November 5, 2007).

VI. Conclusion

China has emerged as one of the world's leading producers of energy from renewable resources. China now is among the world leaders not only in installed renewable energy capacity, but also total current investment in renewable energy. While to a considerable extent these developments reflect the impact of China's giant hydropower projects and the continuing installation of small hydropower facilities, China's renewable energy profile is increasingly defined by "new renewable" sources of electricity — solar, wind and biomass power. China has emerged as a world leader in the manufacture of solar photovoltaic technology, and could become the world's leading exporter of wind turbines.

China's leaders view these dramatic developments as a reflection of their supportive government policies. The degree of concentration of government policy on renewable energy sources both for consumption and production is unequalled by any other government. Given the central role of China's government in its economy as compared with any other economy, this policy emphasis, and the measures taken for their implementation, is bearing substantial fruit by any objective measure.

An important strand in this policy effort is to move China toward self-sufficiency in renewable energy – from the innovation to commercialization and production. Of necessity, this emphasis and its results have economic consequences for the world as a whole at several levels. As carbon intensity of production of goods and impact on the atmosphere become an increasing focus in foreign capitals, Chinese progress will be monitored with interest, may be emulated, and where there are shortfalls in results, may provoke less positive reactions.

Where questions of market access through trade and investment arise, the policies described above, whether practiced by China or in similar forms by its trading partners, will shape both others' national policy decisions with respect to trade and investment, as well as shaping emerging global rules on these subjects, if and when they are achieved.

Massive investment, major initiatives, and measures affecting trade and investment in a major country always result in substantial changes in trade flows and patterns of investment that might otherwise prevail. For example, at present, China consumes very little of its PV production, but its investment in this sector has caused it to be a major producer and hence exporter – with well over 90 percent of China's PV production being exported at present. This has already caused one major European market to consider trade measures. And several European markets either have already or soon will significantly scale back consumption subsidies for PV.

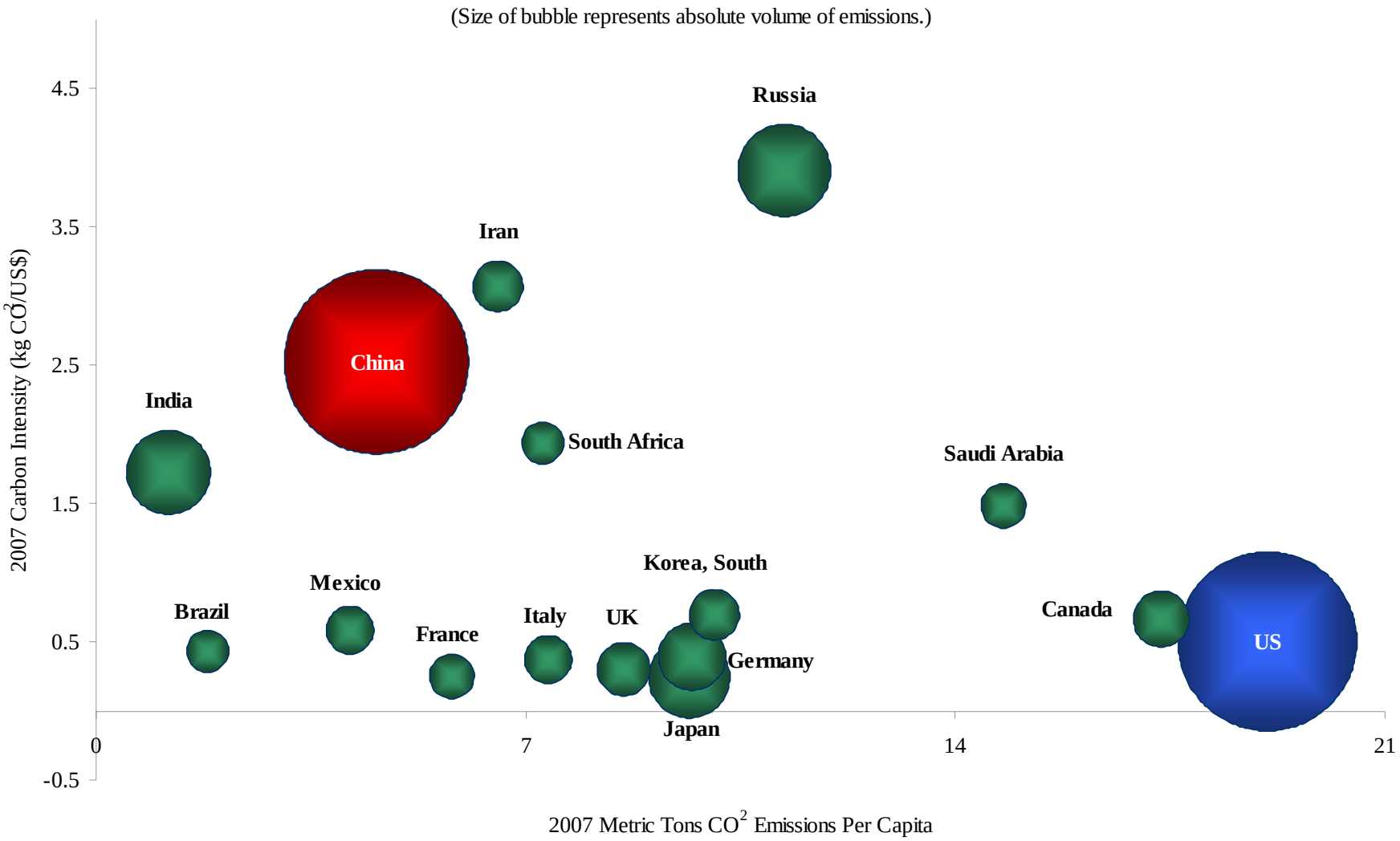
China's imports of wind turbines have plummeted in recent years, and the country's exports of turbines could rise dramatically as the promotion of the wind sector in China continues. The other traded goods sector in renewables is with respect to hydropower, and here foreign producers will continue to lose sales in China as the Chinese market becomes more saturated and demand falls off.

Where China is a policy innovator, as it is with its National Indigenous Innovation Policy, this can have a profound effect on both trade and investment, as well as on government policy and the international trading system.

It would be too facile to predict that trade friction is a necessary final result from one major country's promotional policies and measures. Policies and measures evolve. Current official interpretations of policies and measures are not necessarily definitive or permanent where they exclude or limit foreign participation. China's outward bound foreign investment position is at an early stage and may, as it grows, affect both investor and host country policies. Technological breakthroughs, commercialization and production are not fully predictable as to when and in what country they will take place. However, it is more likely than not that major government policy emphasis backed by measures — including bringing to bear massive resources — will bring about results. China has placed a large bet on enhancing domestic innovation and production of renewable energy and related equipment. There is no reason whatsoever to discount the public pronouncements of its officials and its official statements of policy as representing anything other than current policy and objectives, nor to underestimate the likelihood of their achievement.

This paper does no more or less than attempt to record a history up to the present Chinese plans for the renewable energy sector without speculation as to the likelihood of success or the impact on trade and investment going forward. Those chapters are yet to be written.

Appendix 1: China and the United States are the Two Largest Emitters of CO^2 — The US Is More Energy Efficient But China Emits Much Less Per Capita



Source: International Energy Agency, *CO^2 Emissions from Fuel Combustion* (2009).

Appendix 2: Wind Turbine Companies in China By Ownership Type

	Company Name	Turbine Technology	Technical Parameters	Production Stage	Source of Technology
		State Owned Enterprises			
1	Sinovel Wind Power Technology Co., Ltd.	Variable Speed Control, Pitch Regulated System	1500 kW /70m/77m	Mass Production	Technology License (Germany Flender)
2	Dongfang Steam Turbine Co., Ltd.	Variable Speed Control, Pitch Regulated System	1500 kW /70m/77m	Mass Production	Technology License (Germany Repower)
3	Goldwind Science and Technology Co., Ltd.	Fixed Speed Control, Pitch Regulated System,Variable Speed Control, Pitch Regulated System (Direct Drive)	1500 kW /70m/77m	Mass Production	Improved Design, Based on Vensys 1200 kW Turbine Technology
4	Zhejiang Windey Wind Power Engineering Co., Ltd.	Fixed Speed Control, Pitch Regulated System Variable Speed Control, Fixed Pitch Regulated System (active stall) Variable Speed Control, Pitch Regulated System	1500 kW /70m/77m, 800kW/54m, 750 kW/49m	Machine Design	Technology License (Germany Repower), Improvement of Imported Technology, Own Design (checked by GH, England)
5	Baoding HuiDe Wind Power Engineering Co., Ltd.	Fixed Speed Control, Pitch Regulated System	1000 kW /55m	Mass Production	Technology License (Germany Flender)
6	Zhejiang Hewind Power Co., Ltd.	Variable Speed Control, Pitch Regulated System, Fixed Speed Control, Pitch Regulated System	1500 kW /70m/82m, 780 kW /50m	Machine Design, Small Batch Production	Joint Design (Germany Aerodyn), Independent R&D
7	Shanghai Electronic Wind Power Equipment Co., Ltd.	Variable Speed Control, Pitch Regulated System, Variable Speed Control, Pitch Regulated System	1250 kW /62m/64m, 2000 kW /87m/93m	Machine Design, Mass Production	Technology License (UK EU ENERGY WIND, former German DEWIND), Joint Design (Germany Aerodyn)
8	Harbin Wind Power Equipment Co., Ltd.	Variable Speed Control, Pitch Regulated System (Direct Drive)	1200 kW /57m	1 Prototype	Independent R&D
9	Beijing North re-Turbine Electric Co., Ltd.	Variable Speed Control, Pitch Regulated System	2000 kW /80m	Prototype Trial Production	Technology License (UK EU ENERGY WIND, former German DEWIND)
10	China's CSR Zhuzhou Electric Locomotive Research Institute.	Variable Speed Control, Pitch Regulated System	1650 kW /70m/77m	1 Prototype	Joint Design (Austria Windtec)
11	State Power United Power Technology Co., Ltd.	Variable Speed Control, Pitch Regulated System	1500 kW /77m/82m	3 Prototypes	Joint Design (Germany Aerodyn)
12	CSIC (Chongqing) Haizhuang Windpower Equipment Co., Ltd.	Variable Speed Control, Pitch Regulated System, Variable Speed Control, Pitch Regulated System	850 kW /56.3m, 2000 kW /87m/93m	2 Prototypes, 1 Prototype	Technology License (Germany Frisia), Joint Design (Germany Aerodyn)
13	Harbin Hafei Industry Co., Ltd.	Variable Speed Control, Pitch Regulated System (Semi-Direct Drive)	1500 kW /70m	Prototype Trial Production	Independent R&D
14	Technology License (Sweden Delta).	Prototype Trial Production	1000 kW /52m	Prototype Trial Production	Technology License (Sweden Delta)

	Company Name	Turbine Technology	Technical Parameters	Production Stage	Source of Technology
15	Lanzhou Electric Co., Ltd.	Variable Speed Control, Pitch Regulated System	1000 kW /60m	Prototype Trial Production	Domestic Technology Transfer (Shenyang Industry University)
16	Daqing Rehao Energy Group	Variable Speed Control, Pitch Regulated System (Direct Drive), Variable Speed Control, Pitch Regulated System	1500 kW /57m, 1500 kW /70m/77m	Prototype Trial Production, Prototype Trial Production	Domestic Technology Transfer (HEC), Domestic Technology Transfer (Shenyang Industry University)
17	Ningxia Yinxing Energy Co., Ltd.		1000 kW /61.4m	Prototype Trial Production	Technology License (Japan Mitsubishi)
18	Baoding Tianwei Wind Power Technology Co., Ltd.	Variable Speed Control, Pitch Regulated System	1500 kW /65m	Machine Design	Joint Design (United Kingdom GH)
19	Harbin Steam Turbine Co., Ltd	Variable Speed Control, Pitch Regulated System	1250 kW /64m	Negotiations	Technology License （Germany Dewind）
20	Sany Heavy Industry Group	Variable Speed Control, Pitch Regulated System	1500 kW /70m/77m	Machine Design	Domestic Technology Transfer (Shenyang Industry University)
21	Jiangxi Green Aiwen New Energy Co., Ltd.	Variable Speed Control, Pitch Regulated System	1500 kW	Machine Design	In the Process of Technology Introduction from Germany
22	Sinosteel Xi'an Machinery Co., Ltd.	Variable Speed Control, Pitch Regulated System (Direct Drive)	1500 kW /70m/77m	Machine Design	Domestic Technology Transfer (Shenyang Industry University)
23	Shenyang Tenwin New Energy Equipment Co., Ltd.	Variable Speed Control, Pitch Regulated System	1500kW	Machine Design	Independent R&D
24	Nantong Dongyuan Wind Power Technology Development Co., Ltd.	Variable Speed Control, Pitch Regulated System	1500 kW, 2000Kw	Prototype Trial Production	Domestic Technology Transfer (Shenyang Industry University) (Zhejiang University
25	Zhejiang Tianjie New Energy Co., Ltd.	Variable Speed Control, Pitch Regulated System	TJ77-1500	Prototype Trial Production	Domestic Technology Transfer (Shenyang Industry University)
26	Shandong Guofeng Wind Power Equipment Co., Ltd.	Variable Speed Control, Pitch Regulated System	1500 kW	Under progress	Europe Technology Transfer
27	Shengguo Tongyuan （Beijing） Technology Co., Ltd.	Variable Speed Control, Pitch Regulated System	SG 1500kW	Prototype Trial Production	Independent R&D
28	XJ Group Corporation	Variable Speed Control, Pitch Regulated System	2000kW	Prototype Trial Production	Germany Technology Transfer
29	Fengdian Energy Technology Co., Ltd.	Variable Speed Control, Pitch Regulated System （Double-Fed ）	1500kW	Prototype Trial Production	Domestic Technology Transfer (Shenyang Industry University)
30	Henan Senyuan Group	Variable Speed Control, Pitch Regulated System	1000-1500kW	Under Progress	Independent R&D
31	Shenyang Blower Group Wind Power Co. Ltd.	Variable Speed Control, Pitch Regulated System （Double-Fed ）	2000kW	Under Progress	Technology Transfer (American Superconductor Co.)
32	Hebei Jidong Concrete Group Co. Ltd.	Direct Drive	1500kW	Under Progress	National Electric Power Generation Equipment Engineering Center

	Company Name	Turbine Technology	Technical Parameters	Production Stage	Source of Technology
33	Taiyuan Heavy Industry Group	Variable Speed Control, Pitch Regulated System （Double-Fed ）	1500kW	Prototype Trial Production	Shenyang Industry University Technology Transfer
34	Shanxi Diesel Engine Heavy Industry Co., Ltd.	Variable Speed Control, Pitch Regulated System （Double-Fed ）	1500kW	Prototype Trial Production	Technology Transfer
35	Beijing Nengyou Technology Co. Ltd.	Variable Speed Control, Pitch Regulated System （Double-Fed ）	1500kW	Prototype Trial Production	Shenyang Industry University Technology Transfer
36	China First Heavy Industry Group	Direct Drive	2000kW	Under Progress	Technology Transfer
37	Inner Mongolia Aerospace Wanyuan Wind Power Manufacturing Co., Ltd.	Variable Speed Control, Pitch Regulated System (Direct Drive)	900kW	Small Batch Production	Holland EWT Technology
38	Tangshan Zhengxin Group Caofei Yongneng Wind Power Technology Co., Ltd.	Variable Speed Control, Pitch Regulated System (Direct Drive)	2000kW	Prototype Trial Production	Shenyang Industry University Technology Transfer
39	Shandong Luke Wind Power Equipment Co., Ltd.	Variable Speed Control, Pitch Regulated System (Direct Drive)	1500kW	Prototype Trial Production	Shenyang Industry University Technology Transfer
40	Baoji Diesel Machinery Co., Ltd.	Variable Speed Control, Pitch Regulated System （Double-Fed ） Semi-Direct Drive	1500kW, 3000kW	Prototype Trial Production	Shenyang Industry University Technology Transfer
41	Liaoning Petroleum Equipment Manufacturing Co.	Variable Speed Control, Pitch Regulated System （Double-Fed)	1500kW	Prototype Trial Production	Independent R&D
		Joint Ventures			
1	Nantong space Wanyuan Acciona Wind Power Equipment Manufacturing Co., Ltd.	Variable Speed Control, Pitch Regulated System	1500 kW /70m/77m	Mass Production	Spain's Acciona Group
2	Nordex (Yinchuan) Wind Power Equipment Manufacturing Co., Ltd.	Variable Speed Control, Pitch Regulated System	1500 kW /70m/77m	Mass Production	Germany's Nordex
3	Xianweide Wind Power Equipment Co., Ltd.	Fixed Speed Control, Pitch Regulated System	600 kW /48m	Not Manufacturing Anymore	Shanxi
4	XEMC Wind Power Co., Ltd.	Variable Speed Control, Pitch Regulated System (Direct Drive)	2000 kW /72m/82m	Prototype has been installed, four units produced	Technology License (originally Zephyros)
5	Hafei in Harbin Wind Power Equipment Co., Ltd.	Variable Speed Control, Pitch Regulated System (Semi-Direct Drive)	1000 kW /56m/60m	1 Prototype	Finland WINWIND
6	REpower North Wind Power Equipment Co., Ltd.	Variable Speed Control, Pitch Regulated System	2000 kW /82m	1 Prototype	Germany's REpower
7	Guangxi Yinhe Awandis Wind Power Co., Ltd.	Variable Speed Control, Pitch Regulated System (Direct Drive)	2500 kW	Prototype Trial Production	Independent R&D
8	Jiangsu Futian Nuodewende Wind Power Co., Ltd.	Hydraulic Transmission Type	850kW, 1600kW	Prototype Trial Production	Technology License from Germany

	Company Name	Turbine Technology	Technical Parameters	Production Stage	Source of Technology
9	Weifang Ruiqineng Machinery Co., Ltd.	Variable Speed Control, Pitch Regulated System (Direct Drive)	1500kW	Prototype Trial Production	Technology License from Germany
	Wholly Foreign Owned Enterprises				
1	GE Energy (Shenyang) Co., Ltd.	Variable Speed Control, Pitch Regulated System	1500 kW /70m/77m	Mass Production	GE U.S.
2	Gamesa Wind Power (Tianjin) Co., Ltd.	Variable Speed Control, Pitch Regulated System	850 kW /52m/58	Mass Production	GAMESA Spain
3	Vestas Wind Power Equipment (China) Ltd.	Variable Speed Control, Pitch Regulated System	2000 kW /80m/90m, 1250 kW /64m/66m	Mass Production	VESTAS Denmark
4	Shenyang Jinxiang Electric Machine Co., Ltd.	Active Stall	225kW, 750kW	Prototype Trial Production	Independent R&D
5	Holland United Energy Co., Ltd	Variable Speed Control, Pitch Regulated System (Direct Drive)	1600 kW	Prototype Trial Production	Technology License from LASTER Germany
6	Suzlon Energy (Tianjin) Co., Ltd	Variable Speed Control, Fixed Pitch Regulated System / active stall	1500 kW /82m	Mass Production	SUZLON India
7	Foshan Dongying Fengying Wind Power Equipment Co., Ltd.	Variable Speed Control, Fixed Pitch Regulated System	800kW, 2000kW	800kW prototype	Independent R&D Technology License from Denmark
8	Hanwei Wind Power Equipment (Daqing) Co. Ltd.	Variable Speed Control, Pitch Regulated System	1500 kW	Machine Design	Independent R&D
9	Jingang Machinery (Nantong) Co., Ltd	Variable Speed Control, Pitch Regulated System （double-fed ）	2000kW	1 prototype	Shenyang Industry University Technology Transfer
10	Visionenenergy Ltd	Variable Speed Control, Pitch Regulated System	1500 kW	Machine Design	Independent R&D
	Privately Owned Domestic Enterprises				
1	Shenyang Huachuang Wind Energy Co., Ltd.	Variable Speed Control, Pitch Regulated System	1000 kW /55m, 1500 kW /70m/77m	One Prototype, 2 Prototypes	Independent R&D
2	Jiangsu Xinyu-Wind Power Equipment Co., Ltd.	Variable Speed Control, Pitch Regulated System	1500 kW /70.5m, 2000 kW	Mass Production	Domestic Technology Transfer (Shenyang Industry University)
3	Nantong Kailian Wind Power Equipment Co., Ltd.	Variable Speed Control, Pitch Regulated System	2000 kW /82m	1 Prototype	Independent R&D
4	Inner Mongolia Huiquan Environment Power Co., Ltd.	Fixed Speed Control, Pitch Regulated System (permanent magnet high-speed)	750 kW /50m	1 Prototype	Independent R&D
5	Guangdong Mingyang Wind Power Technology Co., Ltd.	Variable Speed Control, Pitch Regulated System	1500 kW /77m/83m	1 Prototype	Joint Design (Germany Aerodyn)
6	Po Southern Machine Manufacturing Co., Ltd. Wuxi	Variable Speed Control, Pitch Regulated System	2000 kW /82m	Prototype Trial Production	Independent R&D
7	Shanghai Wind Power Stock Co., Ltd.	Variable Speed Control, Pitch Regulated System (Direct Drive)	1000 kW /52m	Prototype Trial Production	Independent R&D

	Company Name	Turbine Technology	Technical Parameters	Production Stage	Source of Technology
8	Shenyang Yuanda Group	Variable Speed Control, Pitch Regulated System	1500 kW	Machine Design	Independent R&D
9	Zhongren Investment Co., Ltd.	The Vertical Axis (Direct Drive)	1500 kW /58m	Prototype Trial Production	Independent R&D
10	Liaoning Fan Bao Warren Co., Ltd.	Fixed Pitch stall-type	1000 kW	Machine Design	Independent R&D
11	Yatu (Yangjiang) Wind Power Equipment Co., Ltd.	Fixed Speed Control, Variable Pitch Regulated System	750kW/48m, 1500kW/77m	750kW Under Operation, 1500kW In the Design Process	Independent R&D
12	Suzhou Tepu Wind Power Technology Co., Ltd.	Fixed Speed Control, Variable Pitch Regulated System/ active stall	750kW, 2000kW	750kW Prototype	Independent R&D ,Technology License from Germany
13	Inner Mongolia Jiuhe Energy Technology Co., Ltd.	Variable Speed Control, Pitch Regulated System （Double-Fed ）	2000kW	Prototype Trial Production	Technology License from Windrad Germany
14	Jiangsu Tiandi Wind Power Equipment Co., Ltd.	Variable Speed Control, Pitch Regulated System	1500kW	1 Prototype	Independent R&D
15	Beijing Sound Environment Group Co., Ltd.	Variable Speed Control, Pitch Regulated System	1500kW	Prototype Trial Production	Independent R&D
16	Shandong Changxing Group Co., Ltd.	Variable Speed Control, Pitch Regulated System （Double-Fed ）	850kW, 2000kW	Mass Production	Independent R&D
17	Beijing Guojing Electric Manufacturing Co., Ltd.	Variable Speed Control, Pitch Regulated System	1300 kW /62m	2 Prototypes	Independent R&D
18	Guangzhou ENGGA Wind Power Equipment Manufacturing Co., Ltd.	Fixed Speed Control, Pitch Regulated System	750 kW /48m	2 Prototypes	Independent R&D
19	Jiangsu Zhongke Dadi Wind Power Technology Co. Ltd.	Variable Speed Control, Pitch Regulated System （Direct Drive & Permanent Magnet)	1500kW, 2000kW	Under Progress	Technology License from Germany

Source: China Wind Power Center