

## **China Renewable Energy and Sustainable Development Report<sup>1</sup>**

China's extraordinary economic growth and heavy reliance on increasingly expensive foreign oil, the vast environmental toll that is one of the most apparent costs of China's economic success, persistent rural poverty in China and periodic power shortages all have impressed upon Beijing that renewable energy must be a large part of China's economy if China is to both complete its economic transformation and achieve "energy security".

China rapidly has moved along the path of renewable energy development. In 2005 China had the world's largest total investment in renewable energy sources (excluding large scale hydropower plants) with expenditures of \$6 billion dollars U.S. and the largest installed capacity of renewable energy with 37000 MW of installed capacity. With wind-power investment of \$600 million dollars U.S. in 2006 and total installed capacity of 2300 MW, China is now the eighth largest wind-power producer in the world; Chinese analysts estimate that the total potential wind power generating capacity in China is in excess of 1 million MW, equal to the power generating capacity of 50 Three Gorges Projects and Chinese policymakers have set an ambitious goal of putting in place 20000 MW of wind power by 2020. With an additional 1500 MW or more of new wind capacity to be built in China during the 11<sup>th</sup> Five Year Plan period, China will be halfway to that goal by 2010; in those five years investment in wind power capacity development will exceed 10 billion Yuan/year. Biomass energy from agricultural waste, straw and waste from cities alone may exceed 500 million MT of coal equivalents. In the near-term China plans to develop 120000 MW's of renewable energy by the year 2020; this would account for 12% to 16% of China's total installed energy producing capacity that year. China's ambitious growth target for renewable energy production will require an investment of approximately 800 billion Yuan (~\$100 billion U.S.D.) by 2020. In the long term China has set an objective of having 30% or more of its total energy requirements satisfied by renewable sources by 2050.

Our goal at the China Renewable Energy and Sustainable Development Report is to provide authoritative, timely, informative and useful information about the emerging renewable energy and sustainable development sectors in China for global companies who have products and services to sell to or buy from China's rapidly growing renewable energy and sustainable development sectors and other policy makers, NGOs and interested parties. Drawing from original Chinese language materials of Chinese companies, industry associations, central and local government agencies and non-governmental organizations, the China Renewable Energy and Sustainable Development Report will cover developments in China's solar, wind, bio-fuel, bio-mass, small hydroelectric and other renewable energy sectors, including regular features on investment, growth, local and national laws and regulations, leading Chinese companies, industry meetings, tradeshow, exhibitions and

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conferences and business opportunities. For more information about subscribing to the China Renewable Energy and Sustainable Development Report, please contact us at [lou@chinastrategiesllc.com](mailto:lou@chinastrategiesllc.com). For more information about China Strategies, LLC, please visit us at [www.chinastrategiesllc.com](http://www.chinastrategiesllc.com).

### *China's Solar Power Industry*

The Chinese government has recently announced that large new buildings will all utilize photovoltaic power generating technology.

More than 400 persons from China, Germany, Spain, Italy and other countries that produce and use solar energy attended the SNEC International Solar Energy and Photovoltaic Power Conference in Shanghai recently.

[Suntech Power Holdings Co., Ltd.](#), which has its headquarters in Wuxi has invested 300 million Yuan in Shanghai's Pujiang High Tech Park to construct a silicon thin-film solar battery manufacturing facility. According to Sutech's CEO, compared with the conventional silicon wafer-based batteries, the silicon thin-film solar power battery uses only 1% of the silicon of the former technology; because of this the cost of production is much lower---\$1.5 U.S.D./watt compared with \$4-\$5 U.S.D./watt for the conventional technology. The thin-film technology also is an improvement over the existing technology because it is more easily integrated into buildings and more esthetically appealing.

The city of [Jinzhou in Liaoning Province](#) (located across the Bohai Sea from Dalian and southwest of the capital of Shenyang) is on track to attract more than 13 photovoltaic power companies by the end of 2007. These solar power companies, which have a combined output value of 3 billion Yuan, are a result of the concerted effort by the city of Jinzhou to build a photovoltaic power industry that eventually will have output value of 10 billion Yuan. The companies which Jinzhou has successfully attracted to its photovoltaic industry park with financial and other incentives, include the Jinhua (Golden China) Smelting 1000 tpy polycrystalline silicon and new century Shiying glass low cost polycrystalline silicon project; the Huachang Polycrystalline 100 MW Solar Energy Battery; the Sunlight Power 180mm wafer cutting technology research project; and the solar power energy conserving light project.

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### *China's Wind Power Industry*

Recently the government of Liangze County, [Yunnan Province](#) entered into an agreement with the Yunnan Power Investment New Energy Development Co., Ltd. providing for the investment of 2 billion Yuan to construct the province's largest wind farm, which when complete will have an installed capacity of 200 MW. The wind farm, which is called Dahai Liangzi, will be located at Dahai Caoshan on the highest peak of the Wumeng Mountains, which is 4017 meters above sea level. The project will be split into phases with construction on the 48 MW, 500 million Yuan, first phase to commence in March 2008. The Yunnan Power Investment New Energy Development Co., Ltd., which is a wholly owned subsidiary of the Yunnan Power Investment Co., Ltd., is involved in developing alternative energy projects, including in bio-energy, wind power, small hydropower and solar power; the company presently is developing a total of 300 MW of renewable energy.

The Zhejiang Province Energy Group Co., Ltd. was selected by bid process to develop a 13.5 MW wind farm project in [Dongtou, Zhejiang Province](#). Dongtou, a small island in the Wenzhou Bay, has good wind resources; wind power in Dongtou is an average of 3 meters/second/year for a total of 7525 hours and wind power density is 346-watts/square meter.

Researchers at the Jiangsu Province Macroeconomic Research Institute have advocated that large-scale wind power should be directly used to provide electric power to industries, which are large consumers of power, such as the primary aluminum industry. Jiangsu Province has a project to build a 1250 MW wind farm as a key 11<sup>th</sup> Five Year Plan Period project for approximately 10 billion Yuan. Research conducted at Qinghua University appears to confirm the viability of wind power providing for about 81% of the electric power requirements of an aluminum smelter, with the remaining power being supplemented by the power grid. With the 1250 MW of wind power that Jiangsu Province is building, a 300,000-tpy primary aluminum smelter could be constructed. Ten thousand MW of installed capacity would produce 25 billion Kwh, enable the construction of a 1 million tpy primary aluminum smelter and bringing about a reducing in carbon dioxide emissions of 1875kg. The primary aluminum industry is both a voracious consumer of energy and a significant contributor to harmful emissions. Every MT of primary aluminum requires the consumption of 15,000 kwh of power and causes the emission of 1.6 to 1.8 MT of carbon dioxide; if the emissions from coal fired plants also is included that 1 MT of primary aluminum would account for 14 MT of carbide emissions.

### *China's Hydropower Industry*

According to statistics released by the [Ministry of Water Resources of the People's Republic of China](#), there was an additional 6000 MW of new hydroelectric power generating capacity installed in 2006 in rural China. As of the end of 2006, total installed capacity of hydroelectric power in rural China had reached 50,000 MW, which capacity is now contributing 150 billion kwh/year to China's energy requirements. In 2007 China will complete another 6000 MW of hydroelectric power and have under construction 20,000 MW of additional hydroelectric power. According to Tian Zhongxing, the Chairman of the Ministry of Water Resources for all of the 11<sup>th</sup> Five Year Plan period, there will be a total of 400 new rural counties which will develop small-scale hydroelectric power, bringing the total number of Chinese counties using small-scale hydroelectric power to nearly 2000. Small-scale hydropower accounts for 128,000 MW or 20% of total potential hydroelectric power capacity in China.

Total installed capacity of small to medium hydroelectric power plants in [Guangxi Province](#) already has reached 5000 MW and the amount of power which Guangxi Province's hydroelectric plants generate contribute 35% of the provinces total energy requirements. In 2007 there will be another 500 MW of small to medium sized hydroelectric power generating capacity constructed in Guangxi Province. In large part through hydroelectric power development, in the next two years Guangxi Province will resolve lack of power for 69,000 households.

### *China's Bio-Mass Energy and Bio-Fuels Industries*

Presently China has dozens of bio-diesel companies, which cumulatively produce in excess of 100,000 tpy. The principal bio-diesel producers include Hainan Zhenghe Bio Energy Co., Ltd., Sichuan

Guchen Youzhi Chemical Co., Ltd., Fujian Zhuoyue New Energy Co., Ltd., etc. Since 2006 bio-diesel production has cropped up in Shanghai, Fujian, Jiangsu, Anhui, Chongqing, Xinjiang and Guizhou, among other places and has taken the form of private, state-owned and even foreign owned enterprises. Contrasted with previous years when the scale of development of bio-diesel was small (10,000 tpy or less), new plant developments are of a larger scale. For example the Anhui Guofeng Bio-Energy Co., Ltd. is investing 500 million Yuan to develop a 600,000-tpy bio-diesel plant (the first stage 50,000-tpy production line went into operation in November 2006). Another example is the 750,000-tpy bio-diesel project being developed by the Nanjing Qingjiang Bio-Energy Science and Technology Co., Ltd. In all there are nearly 100 bio-diesel projects under construction or in planning; cumulatively these projects' output will total in excess of 3 million tpy. The principal raw materials for the new bio-diesel production in China are domestically produced rapeseed oil and imported palm oil. China presently also uses used cooking oil and other vegetable oils.

China's bio-diesel development is in its early stages characterized by an incompleteness and lack of organization in industrial policy, technical standards, sales channels, production techniques, equipment, environmental evaluations, etc. China hasn't yet standardized its macro-economic policies with respect to the bio-diesel industry, but it is now formulating and will soon issue *{State Standards for the Use and Adjustment of Bio-Diesel Fuels}*.

### **Laws and Policies Governing Renewable Energy and Sustainable Development in China**

In a recent interview Xu Xiaoping, the Bureau Chief of the Energy Bureau of the [National Development and Reform Commission](#) spoke about energy development during China's 11<sup>th</sup> Five Year Plan period (2006-2010). As of the end of the 10<sup>th</sup> Five Year Plan period in 2005 China's output of non-renewable energy totaled 2.06 billion MT of coal equivalents, a 59.6% increase over 2000 output; by 2005 China already had become the world's second largest producer of energy. In 2005 energy consumption in China totaled 2.25 billion MT of coal equivalents, also the worlds second largest. Xu Xiaoping indicated that coal production in 2005 totaled 2.19 billion MT and that there was a certain amount of consolidation and rationalization in the industry. As of 2005 total installed capacity of electric generating capacity was 508,000 MW and output of electricity totaled 2.47 trillion kwh that same year. In 2005 crude oil production in China totaled 180 million MT and natural gas output totaled 50 billion cubic meters. Renewable energy development had already progressed by the end of the 10<sup>th</sup> Five Year Plan period; in 2005 total installed capacity to generate wind energy had already reached 1260 MW, the coverage area for solar hot water appliances totaled 80 million square meters and capacity to produce bio-fuels had risen to more than 6 million MT.

In speaking of the challenges facing China in regards to energy development in the 11<sup>th</sup> Five Year Plan period, Xu Xiaoping first emphasized that relative per capita lack of energy resources would be a large challenge. Another challenge to China's further energy development is structural according to Xu Xiaoping; China's coal sector as a percentage of total non-renewable energy is 42% larger than the worlds average. This heavy reliance on coal results in severe environmental and social problems for China. The third significant challenge for China is improving energy conservation; because of the stage of development that China is in now, high energy consumption industries account for a large percentage of

China's GDP so that it is imperative for China to increase energy efficiency and reduce energy consumption, but that process will be a long one. A fourth challenge for China with respect to its energy sector is China's relatively underdeveloped scientific and technological resources, which continue to lag behind the developed world. The fifth major challenge for China in the energy area is safety; this area includes coalmine safety and other safety issues in oil and gas production. The sixth significant challenge facing China's energy sector is problems surrounding providing energy to villages in China; these sets of issues include the fact that there are more than 10 million Chinese who do not have access to electric power and the often-spotty access to power among tens of millions of other rural Chinese.

In the interview Xu Xiaoping also described both the demands and the development objectives that China is pursuing during the 11<sup>th</sup> Five Year Plan period. Mr. Xu outlined a number of broad themes of energy development in China over the next five years including the importance of energy conservation, reliance on the development of domestic sources of energy to enhance China's energy security, further development of oil and gas as well as renewable energy resources, while acknowledging the central role coal continues to play in China's energy mix, environmental protection, including reducing the ecological impact of coal exploration and mining, emphasizing international cooperation.

By 2010 China's non-renewable energy consumption will be held to approximately 2.7 billion MT of coal equivalents, a 9.5% increase over the level of energy consumption during the 10<sup>th</sup> Five Year Plan period. With respect to coal exploration and extraction, in the next five years China will be emphasizing environmental and ecological remediation of coal lands, reduction of the ecological impact of coal exploration and extraction, speeding up the development of large scale coal districts and the development of several large-scale coal companies (100 million MT output), strengthening the overall efficiency of coal mining, speeding up the development of coal seam methane, strengthening clean coal production, etc. With respect to the further development of electric power, some of the goals of the 11<sup>th</sup> Five Year Plan period according to Mr. Xu include developing 600 MW class power stations.

With respect to Beijing's goals for renewable energy development during the 11<sup>th</sup> Five Year Plan period, Xu Xiaoping said that the efforts would include promoting the construction of thirty 100 MW or greater large-scale wind farm projects and create 1000 MW wind farm "bases" in [Inner Mongolia](#), [Hebei](#), [Jiangsu](#) and [Gansu](#) Provinces as well as building approximately 5000 MW of grid connected wind power. The second renewable energy related goal of the Chinese central government is to speed up the development of bio-energy by supporting the development of crop waste and municipal waste to energy projects as well as waste source methane production, build a group of crop waste and forest materials bio-mass power plants, expand bio-fuels production, including fuel ethanol and bio-diesel; the goal of this aspect of renewable energy development is to build 5500 MW of bio-mass power generation installed capacity by the end of the 11<sup>th</sup> Five Year Plan. The third objective of the Chinese government with respect to renewable energy development is to further develop solar power, geo-thermal and ocean power generation. In order to support the development of renewable resources Beijing will put in place preferential financial, tax and investment policies and compulsory market share requirements to encourage the production and consumption of renewable energy and increase the percentage of all energy produced and consumed in China that is renewable energy. Xu Xiaoping also indicated that there would be specific goals for

rural power development, including strengthening the construction of small-scale rural hydropower plants and power grids, local wind power, biomass and solar projects. By 2010, Beijing plans to have 300,000 small-scale wind turbines in place in rural areas of China, have 40 million households using methane gas, 50 million square meters of solar powered hot water heaters and 1 million solar-powered stoves in use. Plans also call for having 50 “green power demonstration” counties by 2010 and gradually resolve the problem of lack of power for the population living in remote areas of China.

### ***Business Opportunities in China's Renewable Energy Industry***

The Guangxi Kewen Bid Solicitation Co., Ltd. is conducting an open domestic bid solicitation through June 12, 2007 for a survey and evaluation of the geo-thermal resources in the Luoman district of [Liuzhou, Guangxi Province](#).

The Foreign Economic and Trade Bureau of [Zhang Wu County, Liaoning Province](#) (northwest of Liaoyang) seeks a foreign investor to build a 2 billion Yuan (~\$270 million dollars U.S.) wind farm. The contact person is Chen Shukui whose e-mail address is [zw-csk@163.com](mailto:zw-csk@163.com).

The Business Promotion Bureau of [Linze County, Zhangye City, Gansu Province](#) (located approximately halfway between Wuwei and Yumen) seeks an investment of 250 million Yuan (\$33.7 million dollars U.S.) in the form of a cooperative or equity joint venture or a wholly foreign owned enterprise (WFOE) to build a 25 MW power plant fueled by 150,000-200,000 tpy of corn stalks and other agricultural waste. The contact person is Du Jianyong whose phone is (86) (936) 552-4285.

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### ***CDM Projects and Other Foreign Participation in China's Renewable Energy Sector***

The [United Nations Industrial Development Organization's](#) International Solar Energy Technology Promotion and Transfer Center Project was preliminarily approved by the Chinese State Investment Projects Evaluation Center and is now ready to be submitted for bids. The International Solar Energy Technology Promotion and Transfer Center will occupy 23,638 square meters of space, including buildings having a total of 13,976 square meters under roof, including research labs, conference center, international training center and administrative offices. The center, which was established in December 2005 in Gansu Province, principally is engaged in research, utilization, international cooperation and training and technology consulting and exchange with respect to renewable energy technologies, especially solar energy technologies.

The world's first household waste composting CDM project is underway in [Wuzhou, Guangxi Province](#). Using a BOT (Build, Operate and Transfer) format, the 160 million Yuan project, which is a collaboration between the city government of Wuzhou city and a German company, obtained the approval of both the NDRC and the German Bureau of the Environment as well as the International Certification Organization, which certified CDM projects under the auspices of the United Nations. Wuzhou city, which is located in eastern Guangxi Province near the border of Guangdong Province, is typical of smaller Chinese cities; with a population of 500,000, Wuzhou produces approximately 360

tpd of household waste and 80% of the solid waste will be used in the process. The BOT CDM project is a project of the Wuzhou Derun Environmental Protection Industries Co., Ltd.

### *Renewable Energy and Sustainable Development Conferences*

The [2007 China International Solar Energy and Photovoltaic Engineering Exhibition](#) will be held at the Beijing International Exhibition Center June 25-29, 2007. The sponsors of the exhibition include the Asia Renewable Energy Association, the China Energy Enterprises Management Association and the China Foreign Trade and Economic Cooperation Enterprise Association.

The [2007 Fourth China \(Nanjing\) Solar Energy Products, Photovoltaic Products and Renewable Energy Exhibition](#) will be held from September 23 through September 25, 2007 at the Nanjing International Exhibition Center in Nanjing, Jiangsu Province. The sponsors of the exhibition include the State Solar Energy Hot Water Appliances Quality Inspection Center (Wuhan) and the editorial board of the China Renewable Energy Institute's {Solar Energy} magazine.

### *Developments in Environmental Protection and Energy Conservation in China*

On June 4, 2007 the National Development and Reform Commission released [China's Climate Change Programme](#), a sixty-three-page document that states China's positions on climate change and China's anticipated participation in efforts to combat global warming. Among other sections China's Climate Change Programme details the effects of climate change on China's environment and highlights China's efforts to mitigate the damage to the environment from global climate change. China's Climate Change Programme was immediately [criticized](#) in the west for its failure to adopt carbon emissions caps.

On June 3, 2007 Beijing released the [{Notice of the State Council Concerning Publishing the Comprehensive Work Plan for Energy Conservation and Emissions Reductions}](#). Among other things, the Work Plan provides for a mechanism to evaluate the energy efficiency of proposed new buildings and prohibits developers from proceeding with projects that do not meet energy efficiency standards. The Work Plan also revealed that Beijing will put forth a fuel oil tax and will be researching the imposition of an environmental tax. The Work Plan squarely places the onus of responsibility for energy conservation and emissions reductions on local officials and the same will be enforced by increased oversight by central government ministries, including the publication of progress reports for individual localities in meeting energy conservation and emissions reduction goals. The Work Plan also creates a State Council-level Energy Conservation and Emissions Reduction Leadership Group, which will be responsible for overall planning and implementation of the work of energy conservation and emissions reduction. The Energy Conservation and Emissions Reduction Leadership Group will be established in the National Development and Reform Commission and be responsible for day-by-day operations, though the work of pollution reductions will continue to be carried out by the [State Environmental Protection Administration of China](#). Before June 30, 2007 each ministry of the central government and all enterprises controlled by the central government must submit their own energy conservation and emissions reduction plan to the Leadership Group. Among other tasks the Leadership Group will oversee the process of scrapping outdated industrial enterprises, especially in the following

industries: power generation, steel, building materials, primary aluminum, iron alloys, coking coal, coal, and flat glass. The Work Plan also requires cities at the county-level and higher to develop comprehensive plans for the reduction, recovery and reuse of waste, including through the development of waste to energy facilities.

In a recent interview Xu Xiaoping, the Bureau Chief of the Energy Bureau of the [National Development and Reform Commission](#) spoke about energy conservation and emissions discharge reduction goals during China's 11<sup>th</sup> Five Year Plan period (2006-2010), which are now embodied in the Comprehensive Work Plan for Energy Conservation and Emissions Reductions released by the State Council on June 3, 2007. The goal of the central government is to reduce energy consumption per unit (10,000 Yuan) of GDP from 1.22 MT of coal equivalents consumed in 2005 to 0.98 MT of coal equivalents by 2010. In the same time frame Beijing seeks to foster the reduction in sulfur dioxide emissions by a total of 8.4 million MT, reduce water consumption per unit of GDP by 30% and bring the rate of water pollution remediation up to no less than 70%. In order to accomplish these goals China will gradually scrap small, heavily polluting and outdated coalmines and replace them with newer equipment and processes. The Chinese government also will close 50,000 MW of small coal-fired power plants and develop 600 MW class power plants using advanced environmental technologies.

The [Aluminum Company of China \(Chalco\)](#) is now constructing a 200,000-tpy secondary aluminum plant in Qingdao. When complete Chalco's secondary aluminum plant will save 2.8 billion kwh of power and 2 million MT of water compared to what power and water inputs are required to produce the same amount of primary aluminum. The Chalco secondary aluminum plant also will save approximately 1.2 million MT of bauxite and other solid materials. Chalco may complete the Qingdao secondary aluminum plant by the end of 2007. In the next five Chalco also will build a scrap aluminum recovery system. The ultimate goal of Chalco is to have secondary aluminum account for 10% of total aluminum output.

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By 2008 the [Aluminum Company of China \(Chalco\)](#) will have zero discharges of wastewater from its facilities, according to statements made by Liu Xiangmin, the Vice-Chairman of Chalco at the Guiyang energy conservation and emissions reduction workshop held by Chalco in late April—early May. In 2006 Chalco used a total of 2.23 billion MT of water, including 184 million MT of new water resources. Chalco's alumina plants' consumption of new water resources declined in 2006 to 4.89 MT per MT of alumina from 7.4 MT per MT of alumina in 2001. In the same period the 15 primary aluminum smelters that are part of Chalco brought about a decline in new water usage from 23.36 MT per MT of primary aluminum produced to 6.3 MT per MT of primary aluminum produced. The rate of reuse of water by Chalco smelters is now 91.7%. Liu Xiangmin pointed out that though there has been a large aggregate decrease in new water usage across Chalco's 25 companies, those savings have been very uneven. The range for alumina refineries in 2006 was consumption of new water of 7.72 MT per MT of alumina refined at the high end to a low of 2.87 MT per MT of alumina refined. With regards to primary aluminum smelters under Chalco control, the range was 10MT of new water consumed for every MT of primary aluminum produced at the high end of the range to 3.2 MT of new water consumed for every MT of primary aluminum produced. This evidences that there are additional savings that can be produced by the Chalco companies.



### *China's Energy Production and Consumption*

In 2006 coal accounted for 69% of the 2.46 billion MT of coal equivalents that comprised China's total energy consumption. Renewable energy comprised 7.5% of total energy consumption in China in 2006 or 180 million MT of coal equivalents. This level of consumption of renewable energy in 2006 resulted in the reduction of approximately 3 million MT of sulfur dioxide and the conservation of 1 billion square meters of water.

Between 2005 and 2030 China will account for 23% of the world's investment in power, spending \$1.2 trillion U.S.D. in that period.

In a report to the Thirty-first Meeting of the Eighth People's Congress of the Tibetan Autonomous Region, Wang Qinghua, the Chairman of the Electric Power Industry Bureau of the Tibetan Autonomous Region, said that by the end of the 11<sup>th</sup> Five Year Plan period the Tibet Autonomous Region will have total installed electric generating capacity equaling 1200 MW and that electric power coverage will be 90% of the population of Tibet. In order to achieve this result, which would essentially end the period where many Tibetans were without electricity, will require resolving the power needs of an additional 900,000 Tibetans.