



## Renewable Energy in China: A Necessity, Not an Alternative

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What role does renewable energy play in the world's fastest growing economy? We have all heard about China's prowess as an economic power, but not what its growth means for the country's energy needs in the coming decades. China's burgeoning consumption rate, its increase in heavy industry exports and a construction boom that has led the Chinese to nominate the "crane" as their national bird have fuelled a massive and increasing appetite for energy -- intensified by the government's balancing act of not imposing energy constraints while also seeking more energy sources.

Some predict that China will need up to US\$3.7 trillion in investments to fuel this growth. Its energy use grew by 8.4% in 2007 compared to overall world demand growth of 2.4%. Clearly, exploring alternative energy sources is not a luxury based on environmental concerns, but an absolute necessity to simply provide enough energy for China. According to Yang Fu Qiang of the Energy Foundation, if China uses only traditional energy sources, "it simply will not have enough energy capacity for its population."

Renewable energy in China, therefore, is not an alternative to traditional fuels, but rather an additional supplement. China has fed its growing energy demands for years through coal and oil, and it will certainly continue using those sources at similar levels. Given that coal currently makes up 76% of China's primary energy production, oil makes up 13%, and renewable energy only 8%, the government's plan is to increase renewable energy's percentage contribution so that the absolute amount of energy generated can continue to rise.

So what has the Chinese government done to encourage renewable energy development? Chinese leaders -- from those in the central government to those at local levels -- have worked for years to address China's rising energy needs. This initiative is particularly challenging given that power generation from renewable sources is expensive to implement and cannot yet produce at levels high enough to replace traditional energy sources. Despite these difficulties, the Chinese government has made a strong statement in its intention to integrate renewable energy into China's national energy plans for the 21st century, most notably in the Renewable Energy Law of 2006. The government's goals have been ambitious -- one provision in the law requires 15% of all energy consumed in China to be renewable by the year 2020.

Given that target, which groups in China are ultimately going to lead the charge in developing renewable energy? In terms of funding and investments, the public and private sectors will both play a role. However, the extent to which the Chinese government is driving investments for renewable energy is astonishing. Because of profitability challenges, private investment is currently more focused on specific areas within renewable energy technology -- for example, equipment manufacturing rather than energy production. As a result, China's renewable energy sector is being driven primarily by public-sector spending to meet the goals set by the central government.

### Massive Reserves of Cash

Although traditional Western views do not generally identify the government as the most qualified driver behind cutting-edge technological innovation, Chi Zhang, chief Asia economist at BP China and a leading expert on renewables, notes that the Chinese government has a massive reserve of cash to fund the renewable energy initiative not necessarily driven by profitability or private-sector participation. Concerns regarding consistently loss-making state-owned energy companies represent a very Western



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point of view, he adds. He believes that companies in China must be seen as part of the entire government system rather than as individual commercial entities. This is because the Ministry of Finance "balances the books" for unprofitable companies by funding individual losses at the end of the year. As a result, the government is not particularly concerned with ongoing losses at the individual company level, according to Zhang.

He elaborates on China's ability to fund the renewable energy initiative: "Western countries are efficient, but not always effective. In China, you do not need to worry about efficiency [or lack of money]; you only need to worry about effectiveness." Thus, the Chinese government has the funds to attack the energy issue with brute force and push towards the development of renewables. Given that the Chinese government-led effort is clearly very different from initiatives in many Western countries, it is important to understand China's challenges from a different perspective.

China's renewable energy policies target three areas: hydro, solar and wind. In terms of potential, China's hydro energy future seems almost infinite. Already the global leader in hydro electricity, the country's bountiful landscapes of rivers and streams present an untapped resource that will shape the face of its energy future. Currently, China's hydro energy represents 23% of the nation's growing electricity consumption and is second only to coal-generated electricity. Within this vast "green" promise, hydro energy is classified into two sources: small hydro plants, which produce 25 megawatts or less annually, and large hydro plants, such as the Three Gorges Dam in Hubei, the world's largest hydro-electric power station.

In China, small hydro plants include more than 43,000 stations scattered across the country. The preponderance of these plants is directly related to transmission system needs and governmental tax policies. Although the large hydro plants can generate huge amounts of energy, the current electricity transmission systems prevent efficient transmission to rural countryside villages. As a result, the Chinese government fosters the development of small hydro plants in rural areas through tax incentives and relaxed constraints on bank loans. This environment encourages private companies to invest in the construction of small hydro plants, which then become the major source of small hydro funding. Joint ventures -- such as the Manasi Number One Hydropower Project in Xinjiang, a province in Western China -- are opportunities for private companies like Xinjiang Tianfu Thermal Power and the Tokyo Electric Power Company to build small hydro power stations.

In contrast, large hydro plants are few in number but provide 67.5% of the country's hydro electricity. The construction of these large hydro plants is largely state-driven. According to Zhang, "only the Chinese government has the ability to build large hydro stations because only the government has the resources required to move people from their homes." It follows that the financial backing behind large hydro stations is also government-driven. For example, the financing for the 3.5-GW Ertan Dam Hydropower station in Sichuan province involved substantial equity from three government entities. In addition, several Chinese hydropower projects are also taking advantage of the opportunity to sell Certified Emission Reductions (CER) Certificates to third parties in accordance with the Kyoto Protocol. With plans to open at least 13 major hydro power plants by 2020, it is clear that large hydro will constitute a majority share in China's renewable energy progress.

In order to meet its 2020 goals, experts estimate the total required investment at US\$127.8 billion for large hydro and US\$38.8 billion for small hydro. For large hydro, the government will have to continue to provide direct investment. For small hydro, the government must encourage private investment. Utilizing this government-driven, mixed-financing solution will be crucial in reducing state fiscal pressure. Encouraging the continued growth of localized power generation will also compensate for the inefficiencies in the current Chinese power transmission systems.

Though hydropower remains the capacity leader in China, solar energy stands out as the fastest-growing clean-energy sector. The solar industry is expected to grow 40% per year over the next four years. However, some experts are quick to note that this growth will be less profitable than other areas of clean energy. Shawn Kim of Morgan Stanley Research believes that, "Solar offers a more compelling long-term growth opportunity than wind but at lower returns."

Accordingly, despite mammoth growth prospects, solar energy within China remains an unsustainable energy source given its dependence on government subsidies. The current cost per watt of solar energy

ranges between \$3 and \$4, while the approximate cost of traditional coal energy is as low as \$1. Despite these cost challenges, investors are still betting on Chinese solar equipment manufacturing companies. "Solar remains one of the most promising areas of clean energy for investors today," Kim observes.

As a reflection of this high potential, 10 Chinese solar module manufacturers have been listed on the public markets within the past five years. These companies have been the driving force behind solar in China and have seen the most financial success. Beginning with Suntech's IPO on the NYSE in December 2005, China has seen a series of module manufacturers' IPOs on global markets, including Trina Solar in 2006 and Yingli Green in 2007.

In addition to profitability challenges, solar power faces a number of other difficulties. Limits in the global supply of silicon, a key ingredient in module manufacturing, remains one of the greatest challenges facing solar energy today. As such, wafer manufacturers are feeling pressure from module manufacturers to become more cost-effective. Kim sees the industry moving forward, but only through continued innovation: "Cost reductions through new technologies or increased efficiency should continue to spawn new areas of demand over the coming decade." Many photovoltaic (PV) wafer manufacturers will likely struggle with this inevitable technology shift.

Just as the government plays a crucial role in financing hydropower, it has also committed substantial funding to solar. The need for continued technological innovation means that investment in China's solar energy is expected to total US\$55.9 billion over the next 15 years. In 2007, the National Reform and Planning Commission launched an initiative to further the development of Chinese solar power with a 10 billion RMB (approximately US\$1.46 billion) funding commitment.

As China's energy needs continue to grow, government spending and private investment in solar energy manufacturing will continue to fuel technological advances. For private investors, profitability and the ability to connect energy generation to state power grids will continue to be significant obstacles. Despite the challenges solar energy faces and the ongoing need for government subsidies, experts predict that private investment in solar manufacturing, coupled with government-financed solar innovation, should remain strong.

## **Going with the Wind**

With costs comparable to traditional sources of energy such as oil and gas, wind is seen as the most commercially viable clean energy source in China. Given that current installed wind capacity ranks second largest in Asia and fifth largest in the world, China has been aggressive in exploiting its vast wind resources. By 2020, the country is estimated to have an installed base of wind power totaling 100GW. This substantial growth is due primarily to abundant resources, a strong technology base and, most importantly, heavy government involvement.

The Chinese government has enacted a number of laws encouraging continued wind development. For example, China's Renewable Energy Law of 2006 requires power grid companies to buy all output of local registered renewable energy producers. This has been instrumental in creating an extensive market for wind power. Provincial governments have also been quick to incorporate clear targets for wind power generation capacity in their five-year plans, ensuring the continued growth of China's wind power sector.

On the investment side, wind power is a hot spot for renewable energy investors with the overall required investment estimated at US\$91.1 billion by 2020. Investment is currently dominated by the "Big Five" state-owned power companies and the private players connected with them. These groups will need to face several challenges, including those regarding technical transmission and unpredictable pricing policies.

The division of investment from the public and private sides is determined largely by each group's tolerance for sustained losses. For many government-linked investment groups, developing wind energy at a loss is viable since they can potentially make up their investment over the next five to 10 years. Chinese wind farms help state-linked companies fulfill renewable energy quotas and secure generation resources for the future. Because wind power is expected to contribute 10% of China's electricity by 2020, these public investors can sustain current losses with the promise that they will eventually turn a profit. However, for most private investors the risk is too high to profitably fund wind power in China.

As state-owned enterprises are driving the growth of wind generation capacity, the turbine manufacturing sector is also experiencing a boom. In terms of wind power equipment manufacturing, the sector is dominated by major foreign and JV manufacturers who have established a strong base in China. With the explosive growth in demand for wind power, the wind turbine industry is currently operating at full capacity and cannot keep up with demand.

At the same time, local firms are growing steadily in this market. These local firms are expected to have a competitive quality product at a 10% to 20% lower price compared to foreign rivals. The government has had a role in specifically encouraging the local turbine manufacturing sector. The current Chinese policy aims for 70% of China's wind turbines to be produced locally. Therefore, China-based manufacturers remain one of the most attractive investment opportunities. Despite small "pockets" of opportunity for private investors, it is clear that in wind energy, as in other renewable energy technologies, the Chinese government continues to be the driving force behind development funding.

The Chinese government has the funds and willpower to fuel the renewable energy investments necessary to reach its 2020 goal of 15% percent of energy consumption regardless of whether the private sector participates or not. As the rest of the world comes to terms with China's massive energy needs and corresponding initiatives, it is important to recognize that the Western economic framework for analyzing the energy industry and companies may not apply in China. Multiple priorities for the Chinese government hinge on resolving the energy crisis, including China's energy needs, social stability and environmental concerns. Therefore, the government will continue to push its agenda of making renewable energy a substantial portion of China's overall energy consumption.

As China continues its path as a global economic powerhouse, its massive investments in renewable energy present an unprecedented opportunity for the development of sustainable technologies. Although these initiatives are largely for pragmatic reasons rather than environmental concerns, the coming decades of investment, both public and private, should yield global benefits. The future for renewable energy in China is bright, primarily because it is a necessity, not an alternative.

*This article was written by Joshua Chen, Walter Czarnecki, Emily Di Capua, Mark Julien, Kathie Koo and Denis Zaviyalov, members of the Lauder class of 2010.*

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