

# Clean Technology China: A New Phase

## Overview of the Market and the Future of Foreign Investment

The development of the “Clean Tech” industry in China is no longer news. More recently, a heated debate has emerged as to whether the renewable energy industry in China is the latest market bubble, or is really just in the early stages of its growth. Which side is right? Are there any promising investment opportunities left for investors still considering entering the game? How should foreign investors approach the market?

This article from ChinaVest provides one perspective on these issues. The conclusions are mixed: while several segments of the “Clean Tech” industry have most likely reached their peak, there are new and potentially lucrative opportunities emerging. First, a brief overview of the development of Clean Tech in China:

### **1. Recognizing the Problem (1990s):**

China realizes the importance of renewable energy and environmental protection. The government enacts several laws and financial incentives to encourage investment in this sector.

### **2. The First Wave (late 1990s through 2006):**

Investors rush in, encouraged by the market potential and preferential policies. Sectors such as solar panels, biofuels, and wind energy see the entry of dozens of domestic and foreign producers. Many of these companies lack sustainable competitive advantages, but recognize a near-term profit opportunity. Many of these entrants are pure low-cost export plays.

### **3. The Herd (past 1-2 years):**

Investment continues, but some investors become less enthusiastic about China's renewable energy industry, and judge it to be a fad. The proliferation of "me-too" companies, discussions of consolidation and decreased growth prospects become common.

### **4. The Future (present and next 5-10 years):**

Consolidation becomes the primary path to sustained growth and profitability in segments such as solar energy, wind power, and biofuel. However, a new class of opportunities emerges in truly unique technologies and applications. Foreign investors are required to look harder for quality opportunities, and begin to contribute to the emergence of a world-class industry serving an increasingly domestic market.

**This most recent stage presents significant potential returns for foreign investors that invest time in developing a deep understanding of the domestic market, and in building relationships with experienced local partners to uncover unique, harder-to-find opportunities.**

## Defining Clean Technology

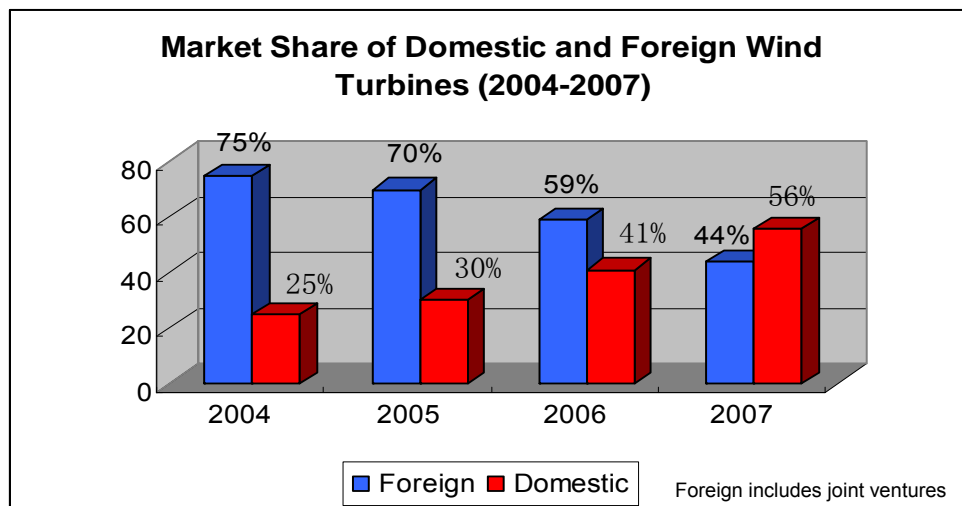
The term “clean technology” refers to a diverse range of products, services and processes that harness renewable materials and energy sources, dramatically reduce the use of natural resources, and cut or eliminate emissions and wastes. Clean tech includes not only renewable energy sources (solar power, wind power, biological power, etc.), but also renewable fuels (biomass, bio-diesel, hydrogen fuel, and coal gasification), environmental technology and controls (technologies to remove pollutants from the air, water, and soil), materials and resource efficiency, sustainable transportation (including hybrid vehicles), agriculture, and water and waste management.

## Overview by Sector

### Wind Power

Wind power is the conversion of wind energy into useful form through the use of wind turbines. In China, some wind power is connected to the electrical grid, while in other more remote areas (particularly Inner Mongolia) electricity generated by turbines is used locally. By replacing coal-fired generating capacity, every 10,000 MW of wind installed can reduce CO<sub>2</sub> emissions by approximately 33 million metric tons (MMT) annually. China has a 3.22 million MW potential, over 1 million MW of which can be developed.

- By the end of 2007, China had already surpassed its 2010 midterm goal of 5 GW installed capacity by adding 3.4 GW of new wind power capacity to bring total installed capacity to over 6 GW. This represents an increase of 156% compared with the wind capacity installed during 2006 and a 134% increase of the total installations. Wind power now provides approximately 1% of China's energy production.
- Renewable Energy target (according to the *Renewable Energy Mid-term and Long-term Development Plan* issued by the NDRC Energy Bureau): 30 million GW by 2020
- In April 2008 the government began refunding VAT and import duties on core wind power turbine parts and materials. The rebate will be backdated to Jan 1.
- Competitive Landscape: The NDRC approval process for large-scale projects (>50 MW) favors the commercial development of domestic manufacturers. In order to receive approval from the NDRC for a wind power project, 70% of the wind turbine components should be made in China. There are now over 40 Chinese manufacturers involved in wind energy, and in 2007 they surpassed their foreign competitors to gain control of the domestic market.



Source: "2007 China Wind Power Report," China Environmental Science Press

- Recent events in the industry:
  - May 5, 2008 - Aureos China Fund (ACF), invested US\$5 million in Qingdao Land of State Power Environment Engineering Co Ltd (QGLD), a wind energy and environmental protection company.
  - March 17, 2008 - Guangdong province plans to build China's largest offshore wind project, producing 1.25 million KW over a span of 240 square kilometers of sea. The wind project will be co-sponsored by Lufeng Municipal government and Guangdong Baolihua New Energy Stock Company Limited.
  - Jan 6, 2008 - Guangdong Ming Yang Electric Group Company Limited in China signed a contract with Green Hunter Energy in Texas for 72 sets of cold-weather wind turbines, a shipment valued at US\$97 million. Each turbine will produce 1.5 MW of electricity and is the first shipment of its kind to be brought from China to the United States. The contract also requires Green Hunter Energy to import 150 turbines a year from Ming Yang Wind Power Technology beginning in 2008.
- Opportunities: Over the past decade China has seen a massive influx of foreign investment in its wind power industry. For investors who are interested in manufacturing wind turbines parts, now may not be the right time. Domestic production has increased dramatically in recent years, and if growth continues at these rates, manufacturers may soon be faced with overcapacity. Investors interested in the future of China's wind power market may consider identifying and investing in new offshore wind projects. Until last year all of China's installed wind power capacity came from onshore wind farms. However China has recently begun to explore the benefits of building offshore wind farms, and has said that in the future offshore wind farms will be a key part of its renewable energy program. Offshore wind speeds are higher and more stable than onshore wind, and offshore wind farm sites are typically closer to the major electricity load centers in eastern China. With wind turbines located 30 miles off the coasts, it is estimated that Chinese sea winds could generate up to 750 GW.

## Solar Power

Solar energy includes both solar thermal power (which heats water) and photovoltaic (PV, which provides electricity). Due to China's fast-growing rural market and the low technical threshold of solar thermal products, the solar thermal power industry achieved astonishing development during the past decade. On the other hand, China's photovoltaic industry, being much more reliant on high-end technology development, faces more hurdles.

- In 2006, domestic global solar power production totaled 2.5 million KW, about 370,000 KW of which came from China. By the end of 2006, China's total installed capacity of solar power was 80,000 KW.
- Renewable Energy target: 2 GW installed solar energy capacity and 300 million square meters of solar water heat by 2020.
- Recent events in the industry:
  - In 2008 Goldman Sachs Group Inc., together with CDH Investments, invested about US\$100 million in solar water heater manufacturers in China
  - In February 2008 Nantong Qiangsheng Photovoltaic Technology Co. Ltd. began making thin-film solar cells. The company is using a new production line in Nantong, Jiangsu, which has the biggest production capacity in China.
- Opportunities: Despite immense growth in recent years, China's solar power industry may be approaching a tipping point. The market for solar thermal power has already matured well past its growth stage, and the combination of solar module oversupply and polysilicon shortages may soon result in a shrinking of the solar PV market. Instead, investors with interest in the solar industry should look to the future, advances that will occur over the next five years, and consider the development of alternative solar technologies, such as Concentration PV (CPV) and thin film solar panels, which may provide more efficient power generation.

## Hydro Power

Hydro power is the most widely used form of renewable energy. Although large hydroelectric installations generate most of the world's hydroelectricity, small-scale hydro schemes (<10 MW) are particularly popular in China, which has over 50% of the world's small hydro capacity. The resources that have been most thoroughly explored in China are tidal energy, wave energy, thermal gradient energy, tidal current energy, and salinity gradient energy.

- At the end of 2007 China had an installed hydro power capacity of 145 GW, approximately 18% of the country's total energy production.
- China's largest tidal power station, Jiangxia Tidal Power Station, was installed in Zhejiang province in 1980 and reached a capacity of 4000 kW in 2007.
- Two large hydro projects are currently under construction in China: the Three Gorges Dam (18.2 GW) and the series of dams on the Yellow River (15.8 GW)
- Renewable Energy target: Achieve 70% exploration degree with installed capacity of 290 GW by 2020
- Recent events in the industry:
  - Feb, 2003 – GE Power systems acquired 90% ownership of Kvaerner Power Equipment Co. Ltd of Hangzhou, one of the leading suppliers of hydropower equipment in China. The new company is called GE Hydro Asia.
  - Oct, 2004 – GE Energy receives contracts of over US\$38 million to supply equipment for two new hydro plants in China: the Xi Xia Yuan hydroelectricity facility on the Yellow River and the Jinzaqiao hydropower station on the Jinzao River. The equipment will be manufactured by GE Hydro Asia
- Opportunities: The geopolitical and environmental fallouts from the construction of the Three-Gorges Dam and other large hydro projects have made China's hydro power industry relatively unpopular among foreign investors. However, for investors with access to advanced hydro technologies that may help reduce the environmental impact of these large projects, there may be opportunities available to improve on the projects China is currently undertaking.

## Nuclear Power

As of 2008, China has 11 nuclear reactors in commercial operation, six under construction, and several more about to start construction. More than 16 provinces, regions and municipalities have announced intentions to build nuclear power plants in the 12<sup>th</sup> 5-year plan (2011-2015), for which they will put together firm proposals with reactor vendors by 2008 and submit them the NDRC for approval before 2010.

- In 2007 China's active reactors produced 62.862 billion KW-hours of electricity, a 14.61% increase over 2006 and 2.3% of total energy production. Total nuclear installed capacity increased by 30% in 2007 to reach 9.078 million KW.
- Ambitious development program: The NDRC's goal is for over 40 GW of installed capacity by 2020, and a further increase to 120-160 GW by 2030. China aims to be self-sufficient in reactor design and construction, though the country is starting to rely heavily on imported uranium to fuel its nuclear power program.
- Reaching the 2020 target will require total investment of RMB450 billion (US\$64 billion) (*NDRC announcement, Xinhua News*)
- Recent events in the industry:
  - Electricite de France (EdF) will take a 30% share in the Taishan nuclear plant project as a joint venture partner with CGNPC in the Taishan Nuclear Power Company which will oversee the building, and then own and operate the plant. The plant is expected to begin operation in late 2015.
  - In November 2007 France's Areva secured the largest commercial nuclear power contract to date, agreeing to sell China two reactors and to provide atomic fuel for nearly two decades. The deal was valued at EUR8 billion.

- In July 2007 China reached an agreement with Westinghouse Electric Co. – owned by Japan’s Toshiba Corp - to build four nuclear power plants in China and transfer core technologies for third-generation AP1000 reactors. The first of these reactors will be built in Sanmen city, Zhejiang Province, and will be put into commercial operation at the end of 2013. Though specific terms were not disclosed, the deal was estimated to be worth approximately US\$5.3 billion.
- In September 2007 Samen Nuclear Power Co. signed a \$521 million contract with Mitsubishi Heavy Industries and partner Harbin Power Equipment Co. for two steam turbine generators of 1200 MW. In January 2008 Shandon Nuclear Power Co. Ltd ordered the same for their Haiyang plant.
- Opportunities: With rising oil prices and concern about the potential impact of fossil fuels on the environment increasing, talk of a nuclear-energy solution is increasingly common. In China, the State Council officially approved a plan to expand the country’s installed capacity by 23 million KW by 2020, ensuring that that nuclear power will take a significant position in China’s future energy landscape. In 2007 it was announced that three state-owned corporations, the China National Nuclear Corporation (CNNC), China Guangdong Nuclear Power Holding Company (CGNPC) and China Power Investment Corporation (CPI), have been approved to own and operate nuclear power plants. Although any other public or private companies (including foreign investors) are limited to minority shares in new projects, nuclear power may still present opportunities to improve the instability of fossil fuel supplies by providing new technologies and services to China’s growing industry.

## Bio Energy

Bio energy, also known as biofuels, refers to sources of energy derived from biological materials. The category also includes biomass, or, the organic materials used to create bio energy (ie. corn stalks, rice hulls, and peanut shells). The main form of bio energy used in China is methane gas.

- Electricity generation by bio energy is expected to reach 5 GW by 2010, and 30 GW by 2020.
- Renewable Energy target: 20 GW installed capacity of biomass and annual bio fuel production capacity of 2 million tons by 2020. Total bio fuel capacity of 6 million tons by 2010 and 15 million tons by 2020. Target of 50% use of ethanol-blended gasoline by 2010.
- Recent events in the industry:
  - The US new-energy firm General Biodiesel announced plans to launch four projects in Beijing, Shanghai, Guangzhou, and Wenzhou of East China’s Zhejiang Province. The planned initial investment for the four projects is about \$500,000, and after a year the company will increase its total investment to \$100 million.
  - Guizhou Zhongshui Energy launched its first biodiesel refinery in December 2007. The facility currently uses waste cooking oil to produce biodiesel but plans to switch to oil from Tung oil trees this year.
  - Jan 26, 2008 - Tiger Ethanol International’s subsidiary, Xinjiang Yajia Distillate Co., signed an LOI to grow sugar beet for biofuel feedstock in southern China. Tiger Ethanol is planning to convert sugar beet juice into ethanol and refined sugar and biomass into fertilizer.
  - Dec 31, 2007 - PetroChina announced plans to invest \$109 million for a non-grain ethanol plant to be built in Nanchong, Sichuan.
- Opportunities: At present, a combination of barriers in China may mean that an investment in the bio energy presents serious challenges for foreign investors. In 2007, the government released a moratorium on biofuels produced from corn and other food crops, and despite unprecedented oil prices, price caps on fuels in China actually makes biofuel a more expensive, and thus unpopular, alternative to fossil fuels. For investors with a strong interest in bio energy, there may still be opportunities to contribute technological expertise, and it will important to keep a close eye on the food shortage problem, as it may correct itself in the near future.

## Water Treatment

China is currently in the midst of its most severe water shortage. Over 70% of the country's fresh water is polluted, and only 46.3% of that polluted water is treated, leaving China's per capita water resources at a mere fifth of the world average. In an effort to correct this growing problem, Beijing encourages private companies, including foreign investors, to participate in water supply and treatment projects, and plans to invest \$130 billion in water and waste water treatment from 2006 to 2010. The primary technologies for water treatment used in China are: Activated Carbon Technology, Chlorine Oxidation, Ecological Sanitation, and Activated Sludge and Aerobic Biofilm Reactors.

- China's water treatment market is currently valued at US\$14.2 billion, and the demand for water treatment products (chemicals, equipment and supplies) is expected to grow 14.1% annually through 2010.
- China's 11<sup>th</sup> Five-Year Plan promotes more efficient use of water, greater rates of water recycling in industrial settings, more aggressive treatment of waste water, and provision of safe water to a larger number of citizens via municipal water supply facilities.
- Recent events in the industry:
  - August 2007 - Veolia Water purchases Tianjin Water Co. at RMB2.18 billion for 49% equity
  - August 2007 – Sino French Water purchases Yangzhou Water Co. at RMB 895 million for 49% equity
  - Suez Environment plans to invest US\$158 million annually in sewage treatment and water projects in China over the next five years
- Opportunities: For investors looking to operate a water treatment facility in China, there are a number of barriers that may make it difficult to generate large returns. In developed areas, although there is income to bear costs, the market is crowded and competition is high. In rural areas there is need and incentive, but price caps on water limit potential profits. China's water treatment industry is, however, a very promising market for foreign water companies looking to sell their equipment, technology and expertise abroad. Due to relatively high installation costs of secondary and tertiary levels of treatment, most of China's water treatment facilities only provide primary treatment. By applying new technologies to China's water treatment projects investors can help to increase efficiency and cost-effectiveness, while also taking advantage of other benefits (energy capture, nitrates).

## Clean Coal

Clean coal is the process of chemically washing coal of its minerals and impurities, removing sulfur dioxide, and making the carbon dioxide in the flue gas economically recoverable. The coal industry uses the term "clean coal" to describe technologies designed to enhance both the efficiency and the environmental acceptability of coal extraction, preparation and use.

- Last month China surpassed the USA to become the world's largest emitter of carbon dioxide. China relies on coal to meet 70% of its energy needs and erects an average of one coal-fired power plant every 7-10 days.
- Four major technologies being used in China:
  1. Coal liquefaction (synthetic oil) – Expected profits of US\$30-45 per barrel, but enormous water consumption.
  2. Syngas & Integrated Gasification Combined Cycle (IGCC) – high cost (10-25% higher than standard coal-fired power generation)
  3. Supercritical Coal-fired Power Plant:
    - 2X600MW plant operational near Shanghai (Shidongkou) since 1990
    - 2x900MW Waigaoqiao phase II plant, turbine equipment from Siemens
    - 2x1000MW Waigaoqiao phase III plant (ultra-supercritical)
    - 4x1000MW Yuhuan plant (ultra-supercritical)
  4. Fluidized bed combustion (FBC, atmospheric and pressurized)

- Renewable Energy target: The NDRC said China will cut sulfur dioxide emissions at coal-fired power plants by 61.4% to 5.05 million tons in 2010, from 13 million tons in 2005. In order to achieve this goal, a total capacity of 137,000 MW at existing plants will need desulfurization equipment in that period.
- Recent events in the industry:
  - Last month Australia announced plans to invest US\$63 million in the development of clean coal technologies in China. The investment is part of an Australian initiative to set up a new bilateral, ministerial-level partnership with China for the development of clean technologies.
  - Synthesis Energy Systems (SYMX) re-listed on NASDAQ, begins syngas production in Shandong, February 2008.
- Opportunities: China's gas and oil reserves are not nearly enough to meet needs; new oil reserves in 2007 reached 1.21 billion tons, but oil consumption grew 16.5% in the same period. The country's future, therefore, depends on coal. At present there are still not enough clear market incentives for many coal producers to adopt clean coal technologies. Although the government has yet to issue formal policies to encourage a clean coal technology in coal-fired power plants, however, it has said it will provide plants that have pollution-reducing equipment with favored access to the electricity grid.

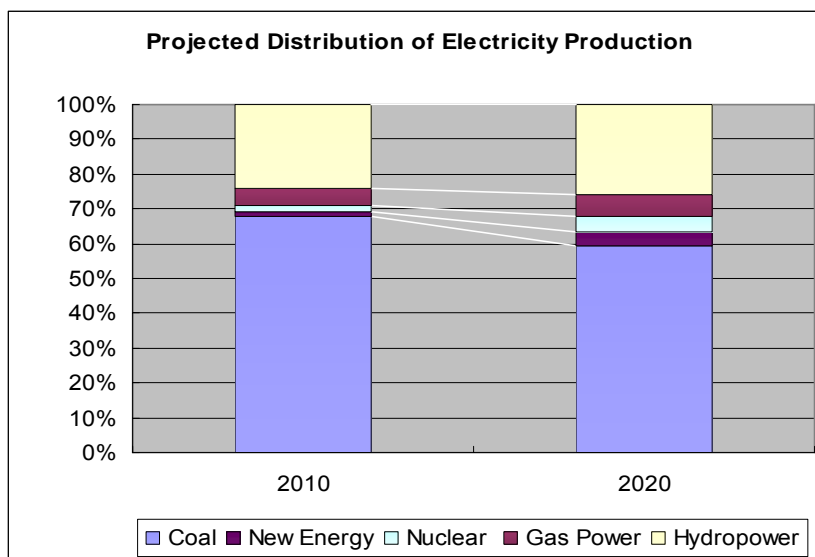
### **Carbon Credits**

Under the Kyoto Protocol's Clean Development Mechanism (CDM), companies or governments in rich nations can fund emissions-cutting projects in developing countries to get carbon credits to offset their own pollution or to sell to others. The global market for carbon credits is expected to grow by 56% in 2008.

- Credits must be approved by the Chinese government and the United Nations before they can be traded.
- Events in the industry:
  - May 5, 2008 - Italian power company Enel SpA, the biggest single buyer of carbon credits in China, signed a deal to source US\$232 million of carbon credits from the parent of China's Wuhan Iron and Steel.
  - May 6, 2008 – American International Group Inc. (AIG) announced the completion of its US\$4 million funding for carbon credit projects in China and the US. The projects will generate more than 620,000 metric tons of carbon credits. The offsets from the China projects will be registered and retired in the China Beijing Equity Exchange.
  - April 25, 2008 – Leading global carbon asset developer Camco Group has reached an agreement to buy 1 million tons of CO2 emissions from the world's largest stainless steel producer Taigang Stainless Steel Co by late 2009
  - March 5, 2008 - Electricity generator China Huadian Group said it signed a carbon credit deal with Credit Suisse International and Arreon Carbon UK Ltd. Under the agreement, Credit Suisse and Arreon will buy carbon credits generated by Huadian's 300-MW wind farm in northern China's Inner Mongolia region, among others.
- Opportunities: China's growing energy demands and disintegrating environment indicate that the country's need for clean technologies will extend far into the future. Carbon credit may be an ideal way for financial investors without industry expertise to gain access to China's clean tech market.

## China Clean-Tech Goals and Regulations

- Renewable Energy Law (2006): Establishes capacity goals and provides legal guarantees and support for the application of wind energy, water energy, solar energy and biomass energy. It mandates power producers to increase their ownership of non-hydro renewables to 3 percent by 2010 and 8 percent by 2020. It also says that grid enterprises are obliged to fully purchase electricity from renewable energy.
- Renewable Energy Law Development Goals:
  - Renewable energy to account for 10% of all energy consumption by 2010
  - Develop 120,000 MW's of renewable energy by 2020, to account for 12% to 16% of China's total installed energy producing capacity that year
  - Renewable sources to satisfy 30% or more of total energy requirements by 2050
- Reaching growth targets for renewable energy production will require an investment of approximately RMB2 trillion (≈USD263 billion) by 2020 alone, inclusive of government spending (*China Renewable Energy and Sustainable Development Report*)
- MOFCOM's 2007 Catalog for Foreign Investment encourages foreign investment in clean energy production, renewable energy research and development, industries that protect the environment, and production of environmentally friendly components for other manufacturers. This means that majority foreign ownership is often possible in these segments, and that deals can typically be approved by local government bodies without requiring central government approval.
- The catalogue also encourages foreign investment in the production and supply of electric power and gas, as well as in the construction and operation of thermal power plants with a single-generator capacity of 600,000 KW and above, power stations burning clean coal, hydropower stations mainly used for electricity production, nuclear power stations in which the Chinese side holds the dominant share, as well as power stations with renewable energy or new energy resources.
- A separate Catalog (the "Western Catalog"), published in 2000 and amended in 2004, provides further incentives for investment in China's Central and Western provinces. The incentives, which include tax reductions and waivers, apply to investment in areas such as water-saving technologies, gas and water supply, and coal processing technologies.
- The Energy Conservation Law was passed in October 2007 and became effective April 2008. The law bans the use of energy-intensive equipment, provides tax incentives for investors in energy-saving technologies and projects, and establishes energy consumption standards for construction projects.



## ChinaVest

The previous information provides a brief overview of ChinaVest's research on the growing demand for clean technology in China. Clean technology is an industry that has received significant attention from investors in recent years, and our goal is to provide insight into China's current and future role in the global clean tech market, as well as to identify specific investment opportunities in a variety of sectors. ChinaVest's research includes detailed analysis of the Chinese market for clean technologies such as wind power, solar power, nuclear power, biomass, biofuel, hydropower, water treatment, clean coal, and carbon credit, etc.

ChinaVest's research team consists of a group of bilingual professionals with diverse industry backgrounds, outstanding research skills and a genuine commitment to excellence. We perform this research in concert with our investment banking group at the behest of our clients. This research includes: in-depth market and sector studies, thorough analysis of prospective M&A targets and JV partners, and proactive monitoring and evaluation of the current Chinese regulatory environment.

For more information about ChinaVest's knowledge and experience in the clean technology industry, please feel free to contact our office.

### How Can We Help?

Founded in China by Americans over a quarter century ago, ChinaVest is a leading merchant bank with offices in Shanghai, Beijing, Hong Kong and San Francisco. We have operated in China longer than almost any other firm, and during this time we have worked with, or been a financial advisor to, some of the world's largest corporations. In addition, ChinaVest has managed and invested almost half a billion dollars in more than 60 companies in greater China with exits on the Hong Kong Stock Exchange, Taipei Stock Market, and NASDAQ, as well as 20 strategic sales. We serve a range of clients in the following categories:

**Clean Energy firms:** Manufacturers of clean technology systems have looked to China as an efficient production base for components and complete systems. Many also realize China's potential as a market for these products. ChinaVest assists firms, ranging from midsize technology providers to large multinationals, find and evaluate equity investment, project finance, and M&A opportunities.

**PE and VC investors:** With new China-focused funds launching daily, competition for quality investments has become fierce. ChinaVest leverages its broad network of contacts throughout China to help private equity funds source and evaluate investment targets, starting with an exhaustive search and screening, and culminating in a thorough analysis and due diligence process.

**Fund Managers:** There is limited research available on Chinese clean energy companies listed on US, Hong Kong, Singapore, and London stock markets. Reports that are available are often published by firms with limited or no direct contact with the company. ChinaVest offers a range of company- and sector-specific research based on reliable firsthand knowledge.

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