



US-CHINA MARKET REVIEW

SPRING 2012



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A COLLABORATIVE REPORT BY:



**American Council On Renewable Energy
(ACORE)**

www.acore.org

Lesley Hunter, Primary Editor & Contributor
Tom Weirich, Contributor
Liz Brody, Contributor
Ann Jung, Contributor



**Chinese Renewable Energy Industries Association
(CREIA)**

www.creia.net

Liu Ying, Editor & Contributor
Li Junfeng, Contributor

SECTION AUTHORS:



U.S. Policy

Holland & Hart LLP
Ashley K. Wald
akwald@hollandhart.com



U.S. Finance

Kaye Scholer LLP
Madeleine M.L. Tan
mtan@kayescholer.com



U.S. Market Focus

Goldwind
Nancy Cook
ncook@goldwindamerica.com



China Policy

Covington & Burling, LLP
Scott Livingston and William J. Friedman
sdlivingston@cov.com
wfriedman@cov.com



中国绿色科技
China Greentech Initiative
Strategic Insights, Industry Collaboration, Market Accelerator

China Finance

China Greentech Initiative
JCGTI@china-greentech.com



China Market Focus

Oerlikon Solar
Christopher O'Brien
christopher.obrien@oerlikon.com

US-CHINA PROGRAM

The US-China Program (USCP) of the American Council On Renewable Energy (ACORE) is dedicated to increasing understanding of the U.S. and Chinese renewable energy markets and fostering public and private sector partnerships between our two countries.

ACORE members who are leading voices in the U.S. and Chinese renewable energy industries are invited to join USCP as partners. Our partners actively shape program direction through consultation with other partners, the USCP strategic advisors, and ACORE staff.

We thank the USCP partners for their special effort toward this Spring 2012 US-China Market Review.



DuPont
Stanley Merritt
Stanley.D.Merritt@usa.dupont.com



GCL-Poly Energy
Shell Jiang
Shelljiang@gclsolarenergy.com



Goldwind
Colin Mahoney
cmahoney_ext@goldwindamerica.com



Hudson Clean Energy Partners
Michael Conti
michael.conti@hudsoncep.com



IBM
Rolf Gibbels
rgibbels@us.ibm.com



Troutman Sanders LLP
Edward Epstein
edward.epstein@troutmansanders.com

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U.S. MARKET REVIEW

■ U.S. POLICY: THE ANTI-DUMPING CASE AGAINST CHINESE SOLAR MANUFACTURERS AND IMPLICATIONS FOR THE U.S. SOLAR INDUSTRY

Ashley K. Wald

Holland & Hart LLP

SUMMARY

In October of last year, SolarWorld Industries America, Inc., a U.S. manufacturer of solar cells and panels, along with six other U.S. solar manufacturers, filed an anti-dumping petition with the U.S. International Trade Commission and the U.S. Department of Commerce. The petition alleges that Chinese panel manufacturers have been receiving illegal subsidies and are dumping their product in the U.S. The petitioners argue that unfair trade practices are driving U.S. manufacturers out of business and are taking jobs away from American employees. The case has moved beyond preliminary investigations by both agencies and will be decided later this year.

While some commentators have applauded what they see as a necessary effort to level the trade playing field with Chinese manufacturers and to protect U.S. businesses and jobs, others are worried about the negative effects that this case and a potentially broader trade dispute with China could have on the U.S. solar and renewable energy industries, as well as on consumers and rate-payers. For example, they worry that those

who export to China the very silicon used to make solar panels and other valuable raw materials will be harmed by retaliatory actions by the Chinese government, and that both China and the U.S. could miss the opportunity to continue to push down the price of solar energy, which could have a chilling effect on the development of solar projects around the world.

This article summarizes the status of the pending trade case and the arguments on both sides of the debate.

INTRODUCTION

A recent anti-dumping case before the U.S. International Trade Commission (USITC) and the U.S. Department of Commerce (USDOC) that could have a significant impact on the U.S. solar industry (and beyond) has generated significant interest and discourse. Where one “resides” in the U.S. solar industry supply chain leads to very different views on the merits and impact of the trade case.

I. STATUS OF THE ANTI-DUMPING CASE

On October 19, 2011, SolarWorld Industries America, Inc., a manufacturer of solar cells and panels in the U.S.,¹

¹ See <http://www.solarworld-usa.com/about-solarworld.aspx>.

along with six other (unnamed) U.S. solar manufacturers that collectively form the Coalition for American Solar Manufacturing (CASM),² filed a complaint with the USDOC and the USITC³ against Chinese manufacturers of crystalline silicon photovoltaic cells,⁴ regardless of whether the cells had been assembled into solar modules.⁵ The petitioners allege that Chinese solar panels are being “dumped” into the U.S. market, meaning that they are being sold below market or “normal” value (i.e. the price for which the Chinese manufacturer is selling its solar panels in domestic markets).⁶ The petition also alleges that Chinese manufacturers have benefitted from unfair subsidies, loans, and other benefits from the Chinese government at the expense of the U.S. solar manufacturing industry, which has closed factories and watched its global market share diminish.⁷

Procedurally, the USDOC conducted an initial investigation and determined on December 13, 2011 that it would continue to pursue the claim. A preliminary decision by the USDOC on dumping margins was initially expected on January 12, 2012 but was postponed until March 27, 2012. On March 9, 2012, the decision was again postponed until May 17, 2012.⁸

Substantively, on January 27, 2012, the USDOC found that there had been “massive imports of solar cells”⁹ from Suntech, Trina and other producers or exporters of Chinese solar cells and panels over a relatively short time period towards the end of 2011,¹⁰ which constitutes what the USDOC deems as “critical circumstances.” If the USITC also makes a determination of “critical circumstances” in its final ruling,¹¹ this finding could allow the USDOC to impose dumping duties starting at an earlier date than would otherwise apply.¹² On March 20, 2012, the USDOC addressed the question of countervailing duties (also called “anti-subsidy duties” because they are intended to offset the effect of subsidies) by issuing a preliminary decision that the Chinese government is subsidizing Chinese solar manufacturers, and ordered the imposition by U.S. Customs and Border Protection of tariffs on Chinese manufacturers of 2.90–4.73%.¹³ Modules, laminates, and panels produced in a third-country from cells produced in China are also covered by the decision. Final tariffs will be decided in June.

The USITC found on December 13, 2011 that there is a “reasonable indication” that the practices of importers of Chinese cells are hurting the U.S. solar industry.¹⁴ A final injury determination by the USITC is expected in July. To date, all of the rulings by the USDOC or USITC have been in favor of the U.S. manufacturers.

2 See <http://www.americansolarmanufacturing.org>.

3 The USITC’s role is to determine whether there is injury or a threat of injury to a U.S. industry; the USDOC’s role is to determine whether dumping is taking place and to evaluate the “margin” between the dumped price and normal value.

4 Thin film solar cells, other types of solar energy generating equipment, and other forms of solar technology (e.g. solar thermal technology, etc.) are excluded from this case.

5 Petition for the Imposition of Anti-dumping and Countervailing Duties: Crystalline Silicon Photovoltaic Cells, Whether or Not Assembled into Modules, from the People’s Republic of China (October 19, 2011), page 1.

6 See http://www.wto.org/english/tratop_e/adp_e/adp_info_e.htm.

7 “China Investigation Moves Forward,” Solar Industry Magazine, January 12, 2012.

8 See <http://www.forbes.com/sites/greatspeculations/2012/03/09/chinese-solar-firms-get-a-breather-as-import-tariff-ruling-is-delayed>.

9 Department of Commerce, International Trade Administration (C-570-980), January 27, 2012.

10 The exporters have countered that any surge during that period was in response to developers wanting to qualify for the Section 1603 cash grant, which expired on December 31, 2011.

11 See <http://www.greentechmedia.com/articles/read/China-U.S.-Solar-Trade-Claim-Update>.

12 The starting date of suspension of liquidation of an item and the posting of a cash deposit or bond is the date of publication of an affirmative preliminary determination in the Federal Register. In anticipation of high preliminary dumping duties, the importer may deliberately import and stockpile large quantities of a product under investigation in order to avoid the possible payment of anti-dumping duties. Usually, an importer can import a product that is under investigation in a trade case without risk of liability for duties during the period between the date of the publication of the initiation of an investigation and the date of an affirmative preliminary determination. However, as an anti-circumvention measure, the dumping regulations provide for a 90-day retroactive suspension of liquidation under “critical circumstances.” If imposed, the duties would have been applied retroactively to all imports of cells and modules from Chinese exporters that were brought into the U.S. starting on Dec. 3, 2011.

13 See <http://thehill.com/blogs/e2-wire/e2-wire/217091-us-imposes-tariffs-on-chinese-solar-imports>.

14 See http://www.usitc.gov/secretary/fed_reg_notices/701_731/701_481_notice12132011sgl.pdf.

II. IMPLICATIONS FOR THE U.S. AND GLOBAL SOLAR INDUSTRY

While the focus of the USDOC and USITC investigations is on the legality of the trade practices, not the advantages or disadvantages for U.S. companies,¹⁵ the U.S. solar industry has, not surprisingly, reacted strongly both for and against the trade case.

According to CASM, “[a]t least 12 domestic producers have undertaken layoffs, gone bankrupt, or closed plants in all regions of the country over the past two years”¹⁶ as a result of what CASM believes to be unfair trade practices by Chinese manufacturers. CASM further states that Chinese manufacturers caused:

*“market pricing in the United States to collapse in 2011 — with an average worldwide price decline of 40% — despite a growing market for these goods, [...] [which] has had a devastating impact on the U.S. solar cell and panel industry, resulting in shutdowns, layoffs, and bankruptcies throughout the country.”*¹⁷

In addition, the well-publicized bankruptcy of Solyndra (which came on the heels of the bankruptcies of several other U.S. panel manufacturers) was also blamed by some, including Energy Secretary Steven Chu, on unfair competition from Chinese manufacturers.¹⁸

Today, three-fifths of the world’s solar panels are produced in China.¹⁹ Approximately 95% of those panels are exported, many of them to the United States.²⁰ Some studies indicate, however, that the U.S. solar industry runs a trade surplus with China, selling equipment and other exports — including the very silicon used to make the disputed panels — to Chinese solar companies.²¹

One group that has been actively speaking out against the trade case is the Coalition for Affordable Solar Energy (CASE).²² CASE argues that the imposition of duties would amount to protectionism, which could have a negative impact on “more than 5,000 American solar companies, mostly small businesses, and cost more than 100,000 American jobs.”²³ CASE argues that should duties be imposed, there would be a loss of American solar exports (silicon, in particular) and that this would hamper U.S. manufacturers’ ability to sell silicon, raw materials, and solar equipment around the world, including to China. In addition, CASE argues that if cheaper Chinese solar panels were no longer available to the U.S. market, the price for solar energy could rise, reversing the recent trend that has enabled the price of solar energy to become increasingly competitive with other technologies, including traditional fuel sources.

Commentators siding with the petitioners in the trade case retort that if Chinese manufacturers eventually do force U.S. panel manufacturers out of the market, the very competition that drove panel prices down by more than 30% in 2011 would be replaced by a monopoly of Chinese manufacturers that would push prices back up, to the detriment of virtually all players in the solar industry and, ultimately, of all retail consumers of electricity.²⁴

In anticipation of the imposition of import duties by the USDOC, many Chinese manufacturers had already started to move their operations to other countries, including Taiwan and Korea, where solar cells and panels can be produced, assembled, and then imported to the U.S. without being subject to the duties that may result from this case.²⁵ Price quotes for both trade-compliant

15 See <http://www.forbes.com/sites/jenniferkho/2011/12/06/foul-or-fair-u-s-solar-firms-debate-china-solar-subsidies/>.

16 See <http://www.americansolarmanufacturing.org/news-releases/01-30-12-casm-critical-circumstances.htm>.

17 See <http://www.americansolarmanufacturing.org/fact-sheet/>.

18 See <http://www.csmonitor.com/Business/Latest-News-Wires/2011/0907/Bankruptcy-for-Solyndra.-Is-it-China-s-fault>.

19 Arabic Knowledge @ Wharton, “Is China’s Solar Industry Heading for an Eclipse?” December 20, 2011.

20 George Haley and Usha Haley, “Bringing Solar Manufacturing Back,” The Hill, February 7, 2012.

21 Arabic Knowledge @ Wharton, “Is China’s Solar Industry Heading for an Eclipse?” December 20, 2011.

22 See <http://coalition4affordablesolar.org/>.

23 Ibid.

24 See <http://www.triplepundit.com/2011/12/chinese-trade-war-solar-panels-killed-solyndra/>.

25 It should be noted that these non-Chinese manufacturing operations are not immune from a separate dumping investigation if U.S. petitioners can present evidence that their sales are also below normal value.

and non-trade-compliant modules available for Q2 2012 delivery through the end of the year are rumored to already be available.²⁶ In anticipation of being charged with retroactive tariffs, companies like Trina Solar had already begun to put aside \$3.3 million to cover duties on shipments that were made in December 2011.²⁷ Following the USDOC's March 20, 2012 decision, a cash deposit or bond will now be required by U.S. Customs and Border Protection for all importers of Chinese solar panels.²⁸

Meanwhile, the next fronts on the apparent "green energy trade war" with Chinese manufacturers are taking shape. There is speculation that SolarWorld AG, the parent of SolarWorld Industries America, Inc. in Germany, will file a trade complaint against Chinese manufacturers that sell panels to the European Union. China, too, has indicated that its Ministry of Commerce will conduct an investigation as to whether the U.S. unfairly used subsidies to the detriment of the Chinese renewable energy industry, including whether the U.S. dumps silicon in China.²⁹ A petition from a coalition of U.S. wind power companies filed in late December 2011 seeks an investigation into dumping by Chinese and Vietnamese manufacturers of utility-scale wind towers.³⁰ Most recently, in March 2012, the U.S., along with members of the European Union and Japan, threatened

to bring a trade case to the World Trade Organization based on allegations that China is violating international trade rules through its restrictions on the export of rare earth minerals, which are frequently used in various renewable energy technologies.³¹

CONCLUSION

The trade case against Chinese solar manufacturers has the potential to impact not only the parties that are directly involved but also the U.S. and global solar industries as a whole. Trade issues related to the U.S. solar industry, which already faces challenges from other policy uncertainties, will persist for some time and will require close monitoring and clear thought. The industry's best and brightest should be encouraged to seek a prompt, balanced resolution of these issues.

ABOUT THE AUTHOR

Ashley K. Wald is an associate with the Energy and Infrastructure group at Holland & Hart LLP. Her practice focuses on renewable energy project development and finance. Holland & Hart LLP has grown into a full-service law firm of more than 400 lawyers in 15 offices across the Rocky Mountain region and in Washington D.C. The author wishes to thank Tuukka Hess, Ivan Koves, and Mark Safty for their insight and comments.

26 See <http://www.greentechmedia.com/articles/read/solar-trade-war-it-just-doesn't-matter>.

27 See <http://www.forbes.com/sites/greatspeculations/2012/03/09/chinese-solar-firms-get-a-breather-as-import-tariff-ruling-is-delayed>.

28 See <http://thehill.com/blogs/e2-wire/e2-wire/217091-us-imposes-tariffs-on-chinese-solar-imports>.

29 See <http://www.nytimes.com/2011/11/26/business/energy-environment/china-looking-into-us-policies-in-renewable-energy-trade.html>.

30 On December 29, 2011, a trade case on behalf of the Wind Tower Trade Coalition was filed against Chinese and Vietnamese producers of utility-scale wind towers.

31 See <http://www.reuters.com/article/2012/03/13/us-china-trade-eu-idUSBRE82C0JU20120313>.

■ U.S. FINANCE: FINANCING RENEWABLE ENERGY PROJECTS IN THE U.S.: CASE STUDIES AND OPPORTUNITIES

Madeleine M.L. Tan

Kaye Scholer LLP

OVERVIEW

The development and rapid growth of renewable energy projects in the U.S. have been driven largely by government incentives, most of which take the form of a tax credit. Investors in wind farm projects have benefited from production tax credits (PTCs), and investment tax credits (ITCs) have offered solar project investors the ability to claim a certain percentage of their investment in the capital cost of the project as an immediate credit. Such tax credits opened up investments in renewable energy projects to a class of investors known as tax equity investors. Immediately following the financial crisis, corporate profits declined significantly and reduced the number of tax equity investors who could benefit from such tax credits. To mitigate this, the Obama administration introduced the 1603 Cash Grant in Lieu of Tax Credits program to fill the gaps left by tax equity investors who exited the market. (The program expired at the end of 2011.) Statistical evidence has shown that the administration's cash grant program kept the pace of renewable energy development in the U.S. active throughout 2009, 2010, and 2011. With the gradual stabilization of the U.S. economy and a corresponding increase in corporate profits, we have witnessed the return of some tax equity investors and the emergence of new entrants in the renewable energy market. It is unclear, however, whether the new entrants will have sufficient capacity to fill the gap left by the expiration of the cash grant program. Added to this is the uncertainty surrounding the extension of the PTC for wind, which is scheduled to expire at the end of 2012. Additionally, there are concerns regarding the availability of debt to finance renewable energy projects in light of the continuing Eurozone crisis. Despite the uncertainties, the wind and solar markets are robust, and there is an increasing interest in tapping the capital markets and investors in the private placement markets for funding needs.

In January 2012, the American Wind Energy Association (AWEA) reported that, at the close of 2011, there were over 100 wind projects under construction across 31 states in the United States and Puerto Rico, representing a generating capacity of approximately 8,320 megawatts (MW). With the impending expiration of the PTCs, there is a great rush in the early part of 2012 to either break ground on wind projects or complete those that broke ground in the fourth quarter of 2011. According to Bloomberg New Energy Finance, the U.S. invested \$55.9 billion in solar development in 2011, up 33% from the previous year. The pace of solar development is expected to continue, although it too faces the prospect of the expiration of ITCs by the end of 2015.

Of note, Terra-Gen Power recently launched a bank-only \$600 million financing scheme to support the next 300 MW of development at its Alta Wind Project. BrightSource Energy also announced that it may seek more than \$1 billion in bank debt and bonds for its concentrating solar project in California. In addition, Topaz Solar Farms, LLC (Topaz) — a project company owned by MidAmerican Energy Holdings Co. (MidAmerican) through its subsidiary MidAmerican Renewables, LLC — issued \$850 million of investment grade-rated bonds in a private placement for its solar photovoltaic (PV) farm in California.

TOPAZ SOLAR FARM CASE STUDY

The Topaz transaction demonstrates that there is a new group of investors who are willing to provide long-term financing for renewable energy projects. The 550 MW Topaz project is under construction in San Luis Obispo County, California and will use thin film PV panels manufactured by First Solar. Topaz's indirect parent, MidAmerican, will contribute 40% of equity for construction costs. Topaz had initially approached the

market with a \$700 million issuance of Series A Notes set to mature in September 2039 to finance the project. It was reported that the initial issuance was oversubscribed and was ultimately enlarged to \$850 million. The Series A Notes were reportedly priced at 5.75% and were issued at par, with 90% of orders from insurance companies. Topaz obtained investment-grade ratings for its Notes from three rating agencies: Fitch (BBB-), S&P (BBB-) and Moody's (Baa3).

The Topaz bonds are interesting because of their long, 25-year tenor, maturing just 6 months prior to the maturity date of the power purchase agreement (PPA) entered into by Topaz with Pacific Gas & Electric Co. (PG&E). Such tenor would generally be too long for the bank loan market. For example, in late 2011, as the credit markets in Europe began to tighten, an existing long-term bank loan on a wind project was restructured and the tenor was reduced from 18 years to 10 years, with pricing at LIBOR + 275 bps (up from 237.5 bps), with increased up-front fees. By tapping the capital markets, Topaz was able to reach a new group of investors, such as insurance companies, who were able to make long-term investments. The 25-year PPA, under which Topaz will sell 100% of its output to PG&E, provides the project with a defined long-term revenue stream, and its fixed-price feature mitigates price risk. The strong credit quality of the purchaser PG&E (rated A3 by Moody's) also supported the rating on the bonds.

Other features of the transaction that facilitated Topaz in obtaining an investment-grade rating on the Notes included:

- Strong support from a credit-worthy sponsor (MidAmerican is rated BBB+ and had committed to provide up to 100% of the construction cost if no debt could be raised, thus ensuring that construction could be completed even if no Notes were sold);
- The extensive experience and good reputation of First Solar as the panel manufacturer and of its division, First Solar California, Inc., as the engineering, procurement, and construction contractor and operator (EPC Contractor); and

- The fact that the PPA would be effective for any amount of capacity that achieved commercial operation prior to its guaranteed commercial operation date.

The transaction demonstrates an increasing interest in renewable energy projects that provide long-term, stable revenues from the sale of power to utilities.

SECURITIZATION MARKET

Another potential market that renewable energy sponsors could tap is the securitization market. From an issuer's perspective, securitized debt — similar to the privately placed bonds in deals such as Topaz — has the potential to provide better pricing and a longer tenor than bank loans. For investors, securitized debt backed by revenue payments linked to renewable energy assets could provide higher yields than the securitized debt of on-the-run assets. Unlike project bonds like those in the Topaz case, however, securitization offers the sponsor the ability to ring-fence the renewable energy assets into a separate, limited-purpose, debt-issuing entity and to obtain financing through bonds that are rated higher than those of the sponsor or the operating company. Note that in the Topaz transaction, MidAmerican was rated BBB+, whereas the project bonds were rated BBB- (and its equivalent of Baa3 by Moody's).

Previous securitization of renewable energy assets has involved wind farms, but a securitization of solar assets has yet to be completed. Even though solar may be a new asset class, securitizations of operating assets generally are not new to the rating agencies or investors in asset-backed securities. There have been several prior securitizations by operating lessors of aircraft, freight railcar, and shipping container portfolios, and such transactions offer guidance as to appropriate structures for potential issuances of securitized debt in the solar area.

It is important to note however, that there are several challenges to bringing a successful securitized deal to market. In addition to risk retention rules under Dodd-Frank, there could potentially be substantive disclosure

requirements for various ABS asset classes, and it should be expected that disclosure of historical performance data will be a requirement for any such rules. This could be challenging for most sponsors since long-term operating data for solar facilities in the U.S. are not yet available.

ABOUT THE AUTHOR

Madeleine Tan is a Partner in Kaye Scholer's Structured Finance group and is Co-Head of the firm's Energy group. Her practice focuses on the development and financing of alternative energy projects such as wind farms, utility-scale solar projects, distributed generation solar installations, and biofuel projects, among other

renewable energy projects, as well as conventional energy projects. She has advised equity investors, sponsors and lenders. In addition, she has in-depth experience with current partnership and leasing structures employed in the U.S. in financing renewable energy projects and has advised on cross-border transactions covering multiple jurisdictions in the U.S., Latin America, Europe, Asia and Australia.

Kaye Scholer LLP provides strategic counsel and legal services to the Fortune 500, middle-market companies and government entities on a full range of US and international matters Founded in New York in 1917, Kaye Scholer's 450 lawyers regularly advise on matters across multiple legal jurisdictions, including the U.S., U.K., E.U. and China.

■ U.S. MARKET FOCUS: CHINESE OEMS IN THE NORTH AMERICAN WIND MARKET — THE 4P'S REVISITED

Nancy Cook

Goldwind

OVERVIEW

Like many of the world's wind power markets, the North American wind energy industry finds itself in flux. Within the European Union, the once flourishing onshore market has slowed considerably due in large part to policy uncertainty and an overall economic malaise. As a result, much of the European market has been forced to refocus efforts offshore. Meanwhile, while many expect the Chinese wind industry to maintain a sustained growth trajectory, Chinese original equipment manufacturers (OEMs) are bracing as the government updates its mechanisms for promoting growth, shifting targets from installed capacity to annual wind power generation, and modifying guidance on project finance. And while many in the North American wind industry remain optimistic, there is no doubt that the lack of a federal renewable energy policy and the detrimental effects of natural gas pricing on long-term power purchase agreements (PPAs) has caused the U.S. wind market to experience a significant tightening in recent years.

Despite these uncertainties, however, there are more OEMs in the market than ever. An environment with fewer projects and more players requires the industry to shift its focus to mastering a new set of "P's": project pipeline, performance, policy, and people. This paper will examine the four P's in relation to Chinese OEMs in the North American wind market.

PROJECT PIPELINE

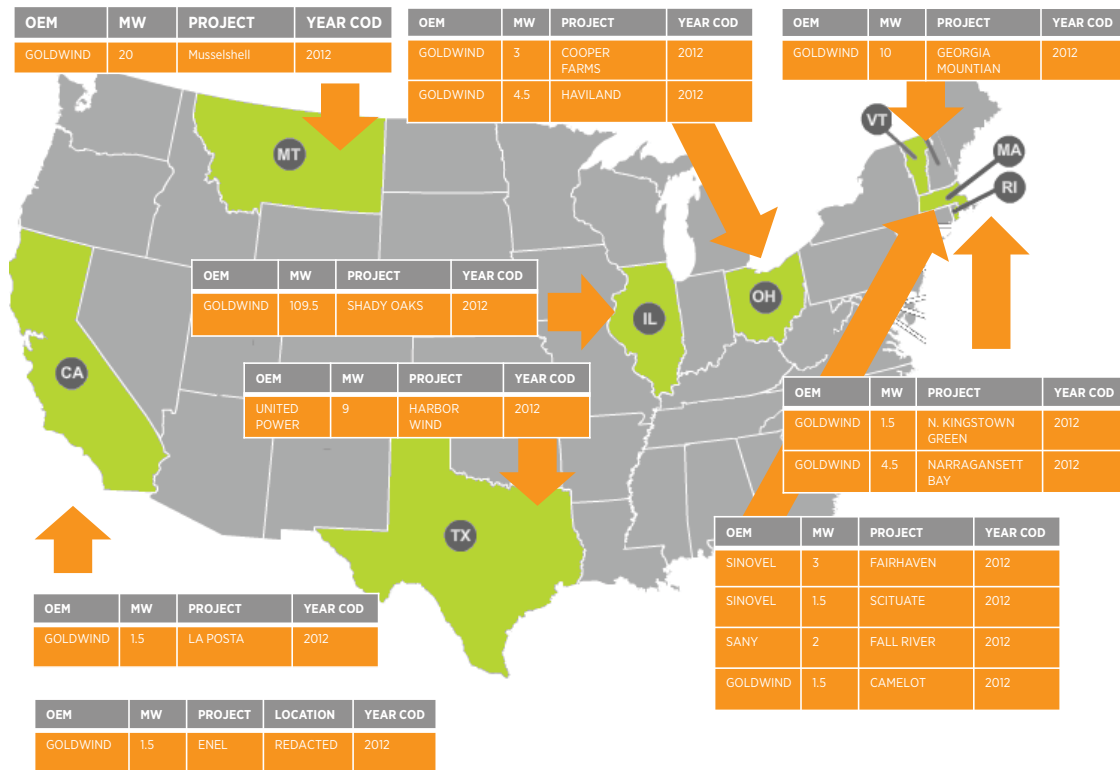
The U.S. wind industry closed out 2011 with 34.05 megawatts (MW) of commissioned Chinese wind capacity in nine separate wind farms, representing seven different OEMs (Figure 1). The development of small-scale pilot projects has been the preferred entrance strategy among Chinese OEMs, offering manufacturers a controlled proving ground for the initial deployment of their technology in the U.S. market.

Even in challenging market conditions, Chinese OEMs have still been effective in gaining acceptance among independent power producers (IPPs) and developers, taking in over 173 MW of orders during 2011. All 14 of these publicly announced projects, which span seven U.S. states, are either under development or construction, with anticipated 2012 commercial operation dates (COD).

FIGURE 1: LIST OF CHINESE OEMS WITH PROJECTS IN THE U.S.³²

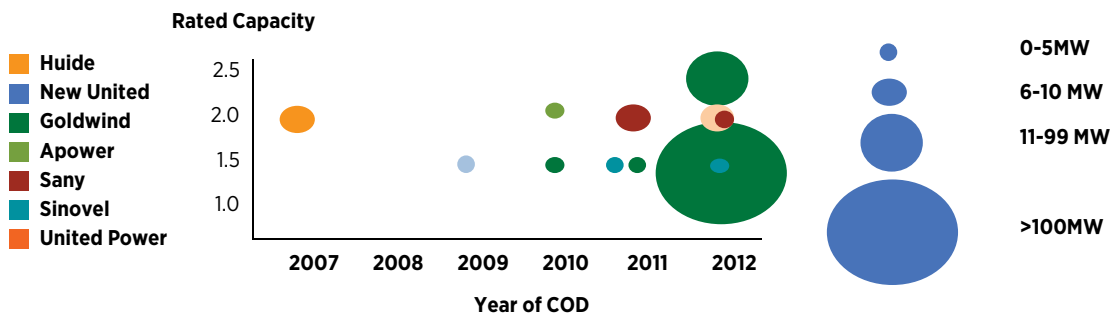
Supplier	State	Capacity (MW)	Project Name	Year Online
Huide	TX	10 MW	Lubbock	2007
New United	MN	1.5 MW	Prior Lake	2009
Goldwind	MN	4.5 MW	Uilk	2010
A-Power	TX	2.05 MW	Spinning Star	2010
Sany	TX	10 MW	Ralls	2011
Sinovel	MA	1.5 MW	Delauri	2011
Goldwind	IA	1.5 MW	Traer	2011
Goldwind	IA	1.5 MW	Little Cedar	2011
Goldwind	IA	1.5 MW	Story City	2011

32 IHS Emerging Energy Research On-point: China OEM's to surpass 150MW of US Wind Installations in 2012. February 27th 2012.

FIGURE 2: MAP OF CHINESE WIND PROJECTS SCHEDULED FOR OPERATION IN 2012³³

While historically the turbine technology offered by many of the Chinese OEMs has included smaller MW models than those offered by the incumbent OEMs, 2011 order activity mirrors the overall industry trend towards larger rated capacity models, with all Chinese OEMs offering products larger than 1.5 MW. The benefits of larger nameplate wind turbines include minimizing crane

and installation resources, reducing visual impact, and maximizing energy output, especially on pad-constrained sites. Wind farm developments moving increasingly towards load centers, along with the abundance of future re-powering projects and further reductions in top-head mass through technological innovation, will encourage the trend towards higher rated capacities.

FIGURE 3: WIND PROJECT CAPACITY BY COMMERCIAL OPERATION DATE (COD)³⁴

³³ Content: IHS Emerging Energy Research On-point: China OEM's to surpass 150MW of US Wind Installations in 2012. Visual: <http://www.dsireusa.org/> DSIRE, database of state incentives for renewable energy.

³⁴ IHS Emerging Energy Research On-point: China OEM's to surpass 150MW of US Wind Installations in 2012. February 27th 2012.

PERFORMANCE

According to GL Garrad Hassan, a “commercially proven” turbine is one which has achieved at least 100 turbine-years of experience in the North American market operating at an availability level of 95% or greater. While U.S. banks and developers may not explicitly rely on the GL Garrad Hassan qualification of “commercially proven” to determine commercial viability, this level of operational experience is considered a general minimum standard. Therefore, multiple commercial deployments across geographically diverse regions are necessary not only to satisfy the 100 equivalent turbine years of operational experience necessary to be deemed “bankable” but also to showcase the OEM’s ability to execute on supply chain and operation and maintenance (O&M) strategies.

Success will lie with those market entrants who are able to balance the use of proven platforms that satisfy the aforementioned performance threshold with product innovation. The U.S. market is particularly thirsty for technologies which have room to mature and thus further reduce the overall cost of energy. These products, both mechanical and process-based, are establishing a foothold in the mainstream turbine market thanks to innovative foresight and the buy-in of early adopters. Some examples of this type of innovation include:

- ▶ **PM Generators:** Permanent magnet generator technology offers enhanced generator efficiency, especially when performing below rated capacity at low wind speeds. Further design refinements will result in the continued reduction of both weight and cost.
- ▶ **Gearless Solutions:** Direct drive technology solves size and weight issues associated with traditional drive train systems by drastically reducing torque density. Furthermore, its mechanical simplicity, due to a lack of high speed rotational parts, increases lifetime operating reliability and reduces O&M costs.
- ▶ **Increased Hub Height:** Taller towers permit the utilization of larger rotor diameters. The generally

improved wind resources at higher hub heights and the wider swept area of larger blades result in improved turbine efficiency and increased annual energy production.

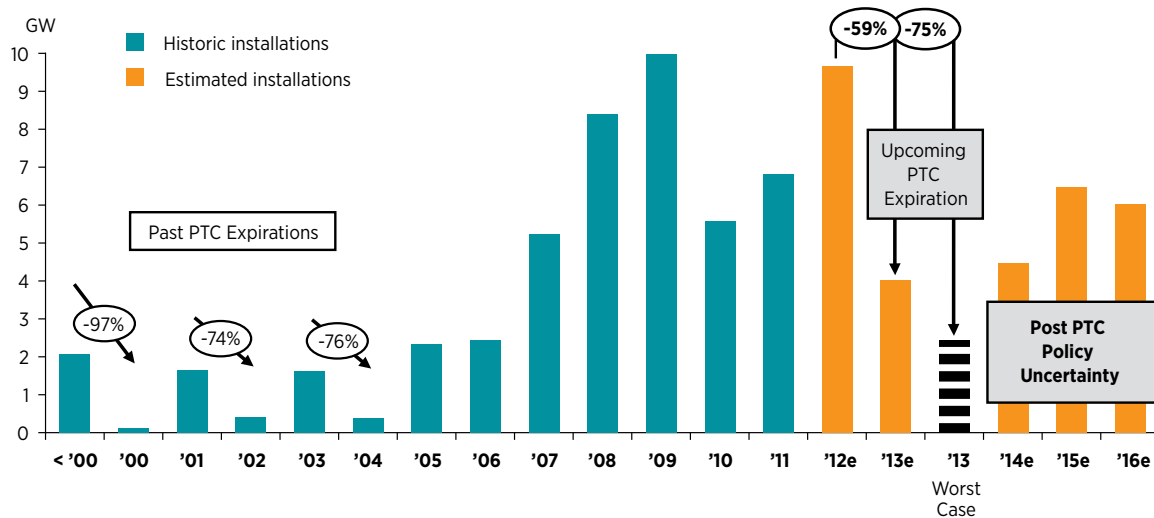
- ▶ **Blade Design:** Airfoil design remains one of the most powerful means to dial up annual energy production per installed wind turbine generator (WTG). Continued improvements through weight reduction, noise abatement, and manufacturing consistency will result in increasingly efficient technologies.
- ▶ **Condition-Based Maintenance:** This business-case approach to wind turbine maintenance integrates weather forecasting, condition monitoring systems, traditional supervisory control and data acquisition (SCADA) data, variable power prices, availability of labor and spare parts, and overall service history into a holistic maintenance philosophy. This strategy utilizes sophisticated planning to balance maintenance with production in order to maximize revenue.

With the maturation of these innovations, the competitiveness of wind compared to other sources of power generation will continue to improve.

POLICY

Of course, support for research and development aimed at improving the efficiency of both new and existing technologies will ensure that wind remains a viable component of any long-term national energy policy. Both policy-makers and the industry, however, remain somewhat divided on which policy structures will best support the industry’s continued, long-term growth. Certainty is the common thread among policy considerations, enabling the industry’s supply chain to make investment decisions that facilitate the expansion of domestic wind generation.

Most of the incentive schemes that have advanced the U.S. wind industry to date require periodic re-authorization. This has resulted in a boom-and-bust cycle for the financing, development, and installation of

FIGURE 4: PROJECTED IMPACT OF PTC EXPIRATION ON U.S. WIND INSTALLATIONS³⁵

wind capacity. The production tax credit (PTC) has been allowed to expire multiple times over the past decade, significantly disrupting the industry's ability to plan, invest, and expand. Moreover, historically, expiration of the PTC has led to drops in annual MW installations of between 70 and 100% (Figure 4).

Although improving tax equity markets and the PTC's past success augur well for the growth of the wind industry, weak utility demand and low natural gas prices continue to place downward pressure on the market. Certainty, provided on a federal level, remains the most fundamental market need.

PEOPLE

For a Chinese OEM working to enter the U.S. market, the task of navigating politically charged, hyper-competitive waters can be daunting. Job creation remains one of the most highly energized topics as the U.S. approaches the 2012 presidential elections. According to the American Wind Energy Association (AWEA), the U.S. wind industry

supported 85,000 and 75,000 direct and indirect jobs in 2009 and 2010, respectively. With all eyes on future industry employment rates and wind's potential to compete in a non-PTC environment, the extent to which OEMs work locally becomes critical.

Strong local sourcing partnerships permit new entrants to increase supply flexibility while contributing positively to U.S. job creation. According to a Bloomberg New Energy Finance report published in April of 2011, upon entering the U.S. market, "Chinese firms will need a team with U.S. development experience to navigate local complexities. The U.S. permitting process varies from state to state and is significantly different from foreign markets. It is very difficult for foreign developers to develop large-scale projects in the U.S. without a local partner or consultant."³⁶ Additionally, an organically grown U.S. team allows any foreign entrant to be close to the customer, minimize response times, and buffer and manage challenges arising from cultural and time zone differences.

³⁵ MAKE Consulting Q4/2011 Market Outlook Update

³⁶ Bloomberg New Energy Finance April 21st 2011: "Coming to America? New Asian Turbine Exports to the United States".

LOOKING AHEAD

It is highly likely that China will maintain its leadership position in the global wind market. Chinese OEMs are poised to become the world leaders in global installed capacity. While it is unlikely that this will be the case in North America in the short term, it is clear that Chinese OEMs are establishing track records of success with an increasingly sophisticated customer base. Chinese OEMs will certainly earn a piece of the U.S. market, but the multi-million dollar question remains: just how big will the pie be?

ABOUT GOLDWIND

Goldwind, the second largest turbine manufacturer in the world, is the leader in PMDD technology with over a decade of operational experience. With operations across four continents, Goldwind offers a turnkey menu of services including R&D, project development, turbine manufacturing, supervision & after-sale service - with the ability to offer financing solutions through its global network of Goldwind companies and extensive, global resources. Goldwind's headquarters for North and South America are based in Chicago, Illinois.

Nancy Cook holds the position of Director of Marketing & Strategy for Goldwind USA Inc. and is responsible for leading the company's product & branding strategy. Prior to joining Goldwind, Nancy spent three and a half years with Spanish wind turbine manufacturer Gamesa, working in a similar role.

CHINA MARKET REVIEW

■ CHINA POLICY: RENEWABLE ENERGY AND CHINA'S FIVE YEAR PLANS

Scott Livingston and William J. Friedman

Covington & Burling, LLP

Companies looking to invest in China's renewable energy sector will be encouraged by the pronounced trend of government support for reliance on renewable energy. The selection of "new energy,"³⁷ "energy conservation," and "clean energy vehicles" as three of the seven strategic emerging industries, and their promotion within the national and industry-specific 12th Five Year Plans (FYPs), promises a growing market for renewable energy goods and services in China over the coming decade. While China's market for renewable energy is well worth pursuing due to its unique state-led development model and its stated desire to create "national champions" in renewable energy, careful selection of in-country partners is key.

I. CHINA'S 12TH FYP BUILDS ON THE STRATEGIC EMERGING INDUSTRIES INITIATIVES

In 2010, China's State Council released the *Decision of the State Council on Accelerating the Fostering and*

Development of Strategic Emerging Industries (the "SEI Decision"). The SEI Decision targeted seven strategic emerging industries to receive priority in national development: a group which includes "new energy," "energy conservation and environmental protection," and "clean energy vehicles."³⁸

China's focus on encouraging innovation in these industries was confirmed with the release of the nation's 12th Five Year Plan (the 12th FYP) in March 2011. The 12th FYP sets national policy for China's economic and social goals and strongly influences the decisions of key regulatory authorities, policymakers, and the business leaders of China's powerful State-owned Enterprises (SOEs).³⁹ Over the course of the recently concluded 11th FYP, for example, China's emphasis on clean energy development resulted in investment of RMB 2 trillion toward domestic energy efficiency and environmental protection measures, raising the global competency of Chinese industries in solar and wind power and helping

37 "New energy" is technically broader than renewable energy (including clean coal and non-conventional gas) but includes a significant renewable energy component.

38 The strategic emerging industries are: new energy, biotechnology, new-generation information technology, high-end equipment manufacturing, advanced materials, clean energy vehicles, and energy-conservation and environmental protection.

39 SOEs are business entities established and supervised by central and local governments. They frequently function as tools for implementing state policy. Estimates indicate eight SOEs account for 70% of revenues in the power sector and are responsible for 90% of power output. US-China Economic and Security Commission. "An Analysis of State-owned Enterprises and State Capitalism in China." 26 October 2011. http://www.uscc.gov/researchpapers/2011/10_26_11_CapitalTradeSOEStudy.pdf

make China the world's largest producer of photovoltaic cells.⁴⁰ For foreign companies that can structure their market entry and operations in accordance with the requirements of the 12th FYP, economic opportunities are plentiful.

The release of the national 12th FYP furthered the call for the development of the strategic emerging industries and included a number of economic goals targeting renewable energy, including:

- ▶ A focus on the development of key technological equipment for efficient energy conservation; advanced environmental protection; and resource recycling, products and services
- ▶ A focus on the development of new-generation nuclear energy and solar energy utilization; photovoltaic and photo-thermal power generation; and wind power technological equipment, intelligent power grids, and biomass energy
- ▶ Construction of solar energy power stations with a total installed capacity of over 5 million kilowatts (kW), with a focus on Tibet, Inner Mongolia, Gansu, Ningxia, Qinghai, Xinjiang, and Yunnan
- ▶ Increased growth in new strategic industries as a percentage of GDP from 5% in 2010 to 8% by 2015 and 15% by 2020⁴¹

The 12th FYP is further supplemented by provincial and industry specific FYPs that specify in greater detail the general goals enumerated in the national FYP.

In December 2011, The National Energy Administration (NEA) released *China's 12th Five Year Plan for Energy Technology* (Energy FYP). The Energy FYP seeks to "provide a technological base for the development of the strategic emerging industries" by 2015 through achievement of the following scientific and technical development objectives:

- ▶ Assimilate and absorb third generation nuclear technologies and foster independent intellectual property rights for nuclear reactor design and manufacturing of key technology
- ▶ Improve solar cell efficiency; achieve low cost, large-scale industrial application; and develop 100 megawatts (MW) multi-type solar energy integration and grid connection technology with proprietary intellectual property rights
- ▶ Master the technology for design and manufacturing of 6-10 MW wind turbines and key components

On February 24, 2012, the Ministry of Industry and Information Technology released the *12th Five Year Plan for the Solar Photovoltaic (PV) Industry* (Solar PV FYP), which contains the following targets:

- ▶ By 2015, to achieve PV module costs of 7000 RMB/kW, PV system costs of 1.3 RMB/kW, and power generation costs of 0.8 RMB/kW
- ▶ To enhance enterprise innovation ability and ensure emergence of flagship enterprises with mastery of advanced core technologies
- ▶ By 2015, to create an annual production capacity of 5 gigawatts (GW) in leading solar cell enterprises and ensure that at least one PV solar company surpasses annual sales revenue of RMB 100 billion; that three to five PV companies surpass sales revenue of RMB 50 billion; and that three to four PV special equipment enterprises surpass annual sales revenue of RMB 1 billion.

Announced on December 15, 2012, the *12th Five Year Plan for Renewable Energy Development* will soon be released by the NEA. Its provisions are expected to identify a series of targets for renewable energy in China including the following:

40 US-China Economic and Security Commission. "Backgrounder: China's 12th Five-Year Plan." 24 June 2011. http://www.uscc.gov/researchpapers/2011/12th-FiveYearPlan_062811.pdf

41 A more complete discussion of the 12th FYP may be found in the Spring 2011 ACORE US-China Quarterly Market Review.

- Development of a globally competitive renewable energy industry with use of wind, solar, thermal, biomass, and other non-fossil energy development to generate the power equivalent of 480 million tons of coal by 2015
- By 2015, installed wind power capacity of 100 GW with annual electricity output of 190 billion kilowatt hours (kWh) (from 62 GW and 80 billion kWh, respectively, in 2011)
- By 2015, installed solar power capacity of 15 million kW with annual electricity output of 20 billion kWh (from 2 million kW and nearly 1 billion kWh, respectively, in 2011)

Reports indicate that China is prepared to invest RMB 3 (\$480 billion) in the clean energy and energy conservation/environmental protection sectors over the next five years.

II. CURRENT MARKET CONCERNS

The selection of the strategic emerging industries and choices regarding national development policy set out in the FYPs must be understood not only as drivers of China's state-directed, capitalist economy but also as part of a domestic self-strengthening narrative. It has been a near constant during China's economic rise that foreign technology should be attracted, studied, and then deployed domestically for China's own economic advantage.

This drive is manifested in China's quest to develop domestic "national champions," who are to be world leaders in their chosen industries. As stated in the SEI Decision:

*To hold an advantageous position in future international competition, we must accelerate the fostering and development of strategic emerging industries, control the key and core technologies and related intellectual property rights, and enhance our capability for independent development.*⁴²

Echoing this sentiment last December, Liu Qi, Deputy Director of the National Energy Administration, stated that "in the initial stages of China's international renewable energy cooperation, China's main concern is access to foreign capital support and the introduction of international advanced technologies."⁴³

This remark points to the tremendous opportunity for foreign investors in the renewable energy sector to market their technology and services within China. To the extent that foreign capital support and technology can further China's own domestic development goals, foreign investors can expect to find willing partners among local businesses. As a result, regulatory approvals and preferential financing or tax treatment may be more readily available to spur investments within China.

At the same time, China's drive to create "national champions" and its continued insistence on "indigenous innovation" counsels caution for prospective market entrants. While potential SOE partners may bring advantageous relationships that promote joint business interests, these potential partners' other interests may not fully align with those of their international partners. Companies in many industries, including renewable energy, have reported misappropriation of intellectual property by SOEs and their affiliates.⁴⁴ Indeed,

42 Decision of the State Council on Accelerating the Fostering and Development of Strategic Emerging Industries (October 10, 2010), Article 3.

43 Xinhua News. "12th FYP for Renewable Energy Decided - A Leap From Quantity to Quality." 16 December 2011. <http://energy.people.com.cn/GB/16629061.html> ("在可再生能源国际合作初期，中国主要关注的是获得国外资金支持和引进国际先进技术")

44 See, e.g., Bloomberg. "China Corporate Espionage Boom Knocks Wind Out of U.S. Companies" 15 March 2012. <http://www.bloomberg.com/news/2012-03-15/china-corporate-espionage-boom-knocks-wind-out-of-u-s-companies.html>

intellectual property rights to innovative technologies remain a central concern in the U.S.-China bilateral trade relationship,⁴⁵ while an unsettled regulatory environment and lack of government transparency continue to confront American companies operating in China.⁴⁶

During the last thirty years of its economic development, China has perfected a highly efficient model under which foreign capital and technology is fed and subsumed into the national economic engine. Development of the strategic emerging industries is likely to continue this trend; although, savvy foreign partners may also reap significant benefits along the way.

ABOUT COVINGTON & BURLING, LLP

Covington's Beijing office counsels companies on matters across a wide range of areas, including market entry and expansion, licensing of technology and other intellectual property rights, compliance, and due diligence with respect to mainland China companies and firms. It also provides analysis of Chinese government public policy, legislative and regulatory initiatives affecting industries in which its clients operate, and related government liaison work. Its work in Beijing integrates seamlessly with the advice and expertise of its colleagues around the world, including its many lawyers with extensive transactional and senior government experience in our D.C., London, and Brussels offices.

⁴⁵ See, e.g., United States International Trade Commission. "China: Intellectual Property Infringement, Indigenous Innovation Policies, and Frameworks for Measuring the Effects on the U.S. Economy. November 2010. <http://www.usitc.gov/publications/332/pub4199.pdf>

⁴⁶ The American Chamber of Commerce in Shanghai. "China Business Report: Executive Summary." 2012. http://www.amcham-shanghai.org/NR/rdonlyres/E3337DDB-28FD-457D-96B7-2C77E21A2A90/15432/CBR_2011_Exec_Summary.pdf (Full report available to member companies)

■ CHINA FINANCE: CHINA'S RENEWABLE ENERGY FINANCING BOTTLENECK

China Greentech Initiative (CGTI)

SUMMARY

China's rapidly growing utility-scale wind and solar capacity will require trillions of RMB in funding from 2012 to 2020. To finance the country's ambitious renewable installation targets, China will need a variety of financing models.

Given the high cost of renewable energy projects, it is perhaps not surprising that limited funding sources have become a bottleneck for project development. Debt, such as bank loans and bonds, is currently the main source for wind and solar financing, but good terms are only available to the largest enterprises or state-owned enterprises (SOEs), with little project financing needs. Direct government support for wind and solar includes tax credits, feed-in tariffs, preferential land-use policies, and low-interest loans. However, the renewable energy surcharge is currently insufficient to fund the high cost of renewable energy projects. In summary, although China has become the world leader in wind manufacturing and

installation, and although solar installations are set to boom, the overall financing environment is unclear.

Government targets will drive increased renewable energy investment through 2020

Using current government targets for onshore and offshore wind, solar photovoltaics (PV), and concentrating solar power, CGTI estimates that China could invest roughly RMB 2 trillion on wind and solar projects between 2011 and 2020.⁴⁷ The costs are weighted towards the period from 2016 to 2020 when targets for rather costly offshore wind and solar become more important.⁴⁸ However, limited funding sources have become a bottleneck for wind and solar project finance, potentially slowing the rate of development.

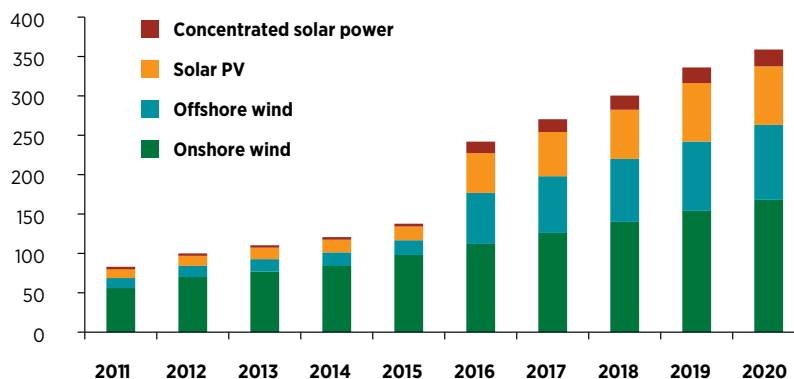
THE RENEWABLE ENERGY FINANCING BOTTLENECK

Wind and solar energy projects present unique risks to financiers

The rapid growth of China's wind and solar renewable

energy projects masks a complicated financing picture. Although both wind and solar capital costs have fallen rapidly over the past few years, the risks of these projects remain elevated compared to conventional energy projects. Wind and solar projects have unique risks at each stage, from planning and construction to operation. Projects that rely on Certified Emissions Reduction (CER) credits have additional risks related to realizing income

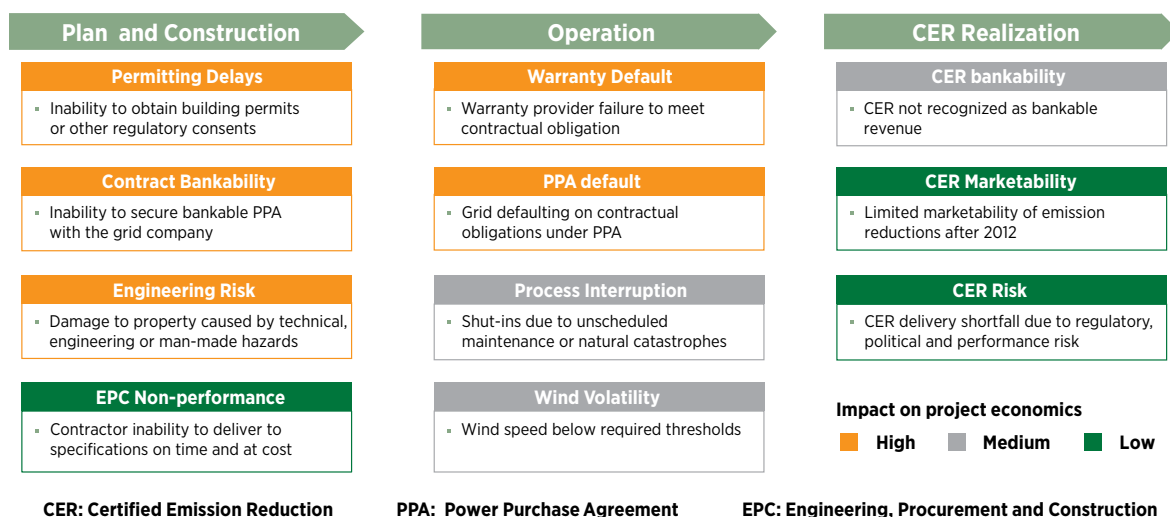
FIGURE 5: ESTIMATED ANNUAL INVESTMENT IN UTILITY-SCALE WIND AND SOLAR PROJECTS, BILLION RMB, 2011-2020



Note: Calculation based on released wind and solar targets in 2015 and 2020; Unit system cost: onshore wind: RMB 7/W, offshore wind: RMB 16/W, solar PV: RMB 13/W, and 60% of total target is assumed to be utility scale power stations, CSP: RMB 15/W

⁴⁷ CGTI analysis

⁴⁸ These estimates assume constant prices for the four categories of wind and solar power: RMB 7/W for onshore wind, RMB 15/W for offshore wind, RMB 13/W for solar PV, and RMB 15/W for concentrating solar power.

FIGURE 6: RISK PROFILES FOR WIND POWER PROJECT LENDERS AND FINANCIERS

Sources: UNEP, e-learning course on Insurance Risk Management for Renewable Energy Project; CGTI analysis

from this source. Figure 6 illustrates the scope of risks faced by project lenders and financiers for a typical wind power project.

Loans, bonds, and IPOs are the main source of funds for wind and solar to date

“Many people wonder whether financing is still a bottleneck for wind development in China, like it is in other countries. The short answer is yes, it’s still a problem,” said Hisaka Kimura, head of private-sector infrastructure finance at the Asian Development Bank, as quoted by Recharge News.⁴⁹ There are several reasons why financing channels in China are limited. First and foremost, China’s renewable energy push has been led by SOEs, which have large balance sheets, readily-available connections to local governments, and the ability to garner low-cost financing from state-owned banks. Bank loans, bond issuances, and issuing public equity are the most popular financing methods. Compared to other countries, China has less funding from private equity and venture capital (PE/VC), insurance, and pension funds. China also relies on a

renewable surcharge rather than a system of renewable energy certificates (RECs).

Bank loans currently provide about 80% of wind and solar project funding. Among commercial banks active in providing such loans, China’s Top 4 (Industrial and Commercial Bank of China, Agricultural Bank of China, Bank of China, and China Construction Bank) provide the largest share. Pudong Development Bank, the Hongkong and Shanghai Banking Corporation (HSBC), and Standard Chartered have also been active in this market. In 2010, HSBC offered the first non-recourse project financing for a wind farm project in Jilin province.⁵⁰ Commercial loans tend to have shorter terms than those in developed economies and have interest rates between 6 and 8%.⁵¹

Development banks have also provided project funding, including China Development Bank, the World Bank and the Asia Development Bank. Such funds are long-term, low-interest (3–4%) loans open to both SOEs and private companies.⁵² The downside of these loans is their limited

49 Stromsta, Karl-Erik, “China’s Big Five squeeze out wind developers,” *RECharge News*, Jul. 26, 2010, www.rechargenews.com

50 HSBC, “Baicheng wind farm project,” www.hsbc.com, accessed on Feb. 1, 2011

51 CGTI interviews

52 Ibid

availability, as well as long application periods and a complex project assessment process.

Given recent central government efforts to tighten credit, developers have turned to the nascent mainland and Hong Kong bond markets to raise capital. In mainland China in 2011, state-owned energy companies issued more than RMB 100 billion in bonds. Terms ranged from 2 to 10 years, and coupon rates were 4 to 6% depending on maturity. Funds raised went to a mix of conventional and renewable energy projects, with the bulk going to conventional energy. Huaneng, Huadian, and Guodian were the main issuers. The drawback of this funding method is that, generally, it is only available to large SOEs.

Recently, Hong Kong has emerged as a popular alternative to mainland bond issuances. So-called "dim sum" bonds in 2011 had coupon rates of 4.5–6.4%. Primary issuers in the energy category were China Wind Power and Longyuan. However, compared to the mainland bond market, the dim sum market is small, with only RMB 63 billion issued in 2011, of which only an estimated 6% was for wind and solar development. Still, the bonds' high liquidity and low issue cost, plus the attractiveness they offer to investors anticipating a continued appreciation in the RMB, may make this market more attractive in the coming years.⁵³

Equity issuances on the Hong Kong stock exchange are another important source of funding for renewable energy development in China. In 2009–2010, four state-owned wind developers launched initial public offerings: Guodian's Longyuan Power, Huaneng Renewable Energy, China Datang Corporation Renewable Power, and China Suntien Green Energy. These four SOEs raised over US\$28 billion to meet installation targets; newly released

feed-in tariffs helped their valuations. China Wind Power and China Power New Energy Development held two smaller, earlier wind IPOs in Hong Kong. Huadian's Fuxin Energy and Guodian Technology & Environment both plan Hong Kong IPOs for 2012.

Given the predominance of large SOEs in renewable energy development, it is perhaps not surprising that the private sector has had less of a role in this area than it has had in the developed world. For example, in the U.S., VC and PE firms have invested in renewable energy development, with many VC firms focusing on pre-construction projects or early-stage development activities. Examples of such investments in the U.S. include Austin Ventures' \$14 million investment in Lincoln Renewable Energy, a project developer, to conduct permitting, siting, and interconnection to ready projects for construction.⁵⁴ CleanPath Ventures also invested \$800 million in multiple projects,⁵⁵ and Good Energies Capital invested \$37 million in Agile Energy.⁵⁶

Examples of types of financing available outside China that could expand funding channels include funding from insurance companies, pension funds, and renewable energy certificates. The following are specific cases exploring how these channels have been used elsewhere:

- ▶ In 2011, Munich Re invested €40 million in 40 wind turbines in Germany.⁵⁷
- ▶ Munich Re also co-invested with KKR to purchase a 49% stake in solar power plants owned by T-Solar Global SA.⁵⁸
- ▶ On April 1, 2011, PensionDanmark and PKA, two of Denmark's largest pension funds, invested \$1 billion in an offshore wind farm in Denmark.⁵⁹

53 Law, Fiona, "HSBC Banker: More Renewable Energy Firms Likely to Sell Offshore Yuan Bonds," *The Wall Street Journal*, May 4, 2011, www.online.wsj.com

54 Wesoff, Eric, "Solar Project Developer LRE Closes \$14M VC Round," *Greentech Solar*, Jan. 6, 2011, www.greentechmedia.com

55 Roxborough, Shannon, "CleanPath to Pour \$800 Million Into Solar Farms," *Energy Boom*, Jun. 22, 2011, www.energyboom.com

56 Wesoff, Eric, "Solar Developer Agile Energy Gets \$24M More in VC Funding," *Greentech Solar*, Jun. 10, 2011, www.greentechmedia.com

57 Suess, Oliver, "Munich Re Plans to Invest in Wind, Solar Parks to Boost Returns," *Bloomberg*, Jun. 23, 2011, www.bloomberg.com

58 Howley, John, "Private Equity and Insurance Firms Bet Big on Renewable Energy," *Green Conduct News*, Jul. 22, 2011, www.greenconduct.com

59 Quilter, James, "Pension funds invest in Denmark's biggest offshore project," *Windpower Monthly*, Mar. 28, 2011, www.windpowermonthly.com

RECs are another potential channel for funds to meet renewable targets. RECs are traded, intangible assets created by the government to ensure utilities meet renewable energy targets. Each utility is given a specific target for renewable energy generation, and these utilities have the opportunity to procure the power directly through power-purchase agreements or building utility-owned renewable plants, or they may purchase RECs from third parties on the open market. Any excess credits the utility generates can be sold on secondary markets. RECs have the advantages of widening participation in renewable energy development while helping decrease costs through open competition. On the other hand, RECs can also make renewable energy development more risky, since the price of RECs fluctuates over time.

THE PATH AHEAD

China has embarked on an ambitious plan to develop its renewable resources, and this plan has already attained some major successes: China has become the world's largest wind power producer, as well as the largest manufacturer of wind and solar equipment. To reach the country's ambitious installation targets for 2015 and 2020, policy makers will have to grapple with whether to

expand the financial playing field and open development to a wider variety of players—including private domestic and foreign developers, as well as financial players—or to continue to rely on SOE banks and energy companies to construct this vital infrastructure. Although the current market is constrained, however, some changes, such as Hong Kong IPO financing and bond issuances for wind developers, are already underway.

ABOUT THE CHINA GREENTECH INITIATIVE

Founded in 2008, the China Greentech Initiative (CGTI) Partner Program has rapidly grown to become the only China-international collaboration platform of 100+ organizations, focused on identifying, developing and promoting green technology solutions in China. Partnering organizations are technology buyers and sellers, service providers, investors, policy makers and influencers. Built on two cornerstones, strategic market research and a community of 500+ decision makers, CGTI provides participating organizations with three core areas of benefit: world class market insights that enable better decisions, meaningful relationships that lead to business opportunities, and thought leadership and education that position participants as leaders in China's greentech markets. Please visit www.china-greentech.com for more information.

■ CHINA MARKET FOCUS: MARKET OPPORTUNITY FOR THIN FILM IN CHINA

Chris O'Brien

Oerlikon Solar

EXECUTIVE SUMMARY

Over the past several years, China has moved into a leadership position in the global solar photovoltaics (PV) industry, with dramatic scale-up and cost reduction in PV component manufacturing, as well as dramatic scale-up in the pace of deployment of PV systems in China. The Chinese government has identified solar PV as one of the country's key strategic industries, and it has supported the growth of the market in China with both ambitious long-term targets and stable short-term investment incentives. While the last major PV manufacturing capacity investment cycle in 2010-11 was focused largely on wafer-based PV technologies, the next investment cycle in China will likely be different, with a much greater share of investment supporting new and expanded thin film manufacturing capacity in China. Thin film technology leaders have succeeded in maintaining a low production cost advantage even as market prices have fallen rapidly.

INTRODUCTION

China has been at the forefront of a set of dynamic trends that have reshaped the global market for PV over the past few years. The country has become the leading world supplier of PV cells and modules and has more recently become one of the largest end-markets for solar PV. Traditional wafer-based crystalline PV technology has dominated recent investments in manufacturing and installations, but thin film technologies are likely to play a much more significant role in the next investment cycle, due to advances by leading global technology suppliers to drive down costs and improve product quality. Government policies have played an important role in accelerating investments in and market growth for PV in China, and falling prices have narrowed the gap

considerably between the cost of PV energy and the cost of conventional fossil-fired electricity generation.

RECENT POLICIES TO INCREASE DOMESTIC MARKET FOR PV IN CHINA

In addition to becoming the leading region for PV manufacturing, China has also taken dramatic steps to increase the domestic market for PV over the past few years, with a series of national and provincial policies aimed at accelerating investment into PV projects of all sizes. The key policy drivers are outlined below.

12th FIVE YEAR PLAN

The 12th Five Year Plan, announced in March 2011, included some notable new commitments for solar deployment and manufacturing in China. The National Development and Reform Commission increased the country's 2020 cumulative PV deployment target from 20 gigawatts (GW) to 50 GW, and the PV industry was identified as one of the seven "strategic industries" outlined in the plan.

UNIFIED FEED-IN TARIFF

In 2011, the government introduced a Unified Feed-in Tariff (FiT) to support PV market growth in China. All grid-connected projects approved after July 1, 2011 are eligible to receive a FiT of RMB 1 per kilowatt hour (kWh) (\$0.16/kWh). Projects located in Tibet are eligible for a higher FiT of RMB 1.15/kWh. There is no cap on the FiT, and there is no differentiation between large and small grid-connected projects.

GOLDEN SUN PROGRAM

The Golden Sun program was launched in 2009, intended to support the installation of 500 megawatts (MW) of solar capacity by 2012. The program did not provide a FiT but instead provided an up-front subsidy

equal to 50% of the installed cost of the PV systems. The program also mandated that utilities use the electricity generated by the PV systems to offset demand.

REMARKABLE MARKET GROWTH

2011 saw remarkable growth in the end market for PV systems in China, increasing approximately five times the amount installed in 2010, which was about 500 MW. The growth was attributable to several factors, including the newly-introduced policies outlined above, the rapid decline in the price of PV systems, and the slowing growth of end-market demand in European markets.

IMPACT OF POLICIES ON THIN FILM MARKET

Renewable energy policy in China is evolving in a promising way for the future development of thin film end markets in China. The uniform feed-in tariff structure introduced in 2011 has created a bias toward installations that deliver the lowest cost energy, which are typically large-scale, ground-mounted PV projects. This type of market is well suited to thin film technologies. This advantage is even greater for systems installed in high-temperature regions, as thin film technologies have an

advantageous “temperature coefficient”, meaning that they deliver more energy at high temperatures than comparably-rated, wafer-based crystalline modules.

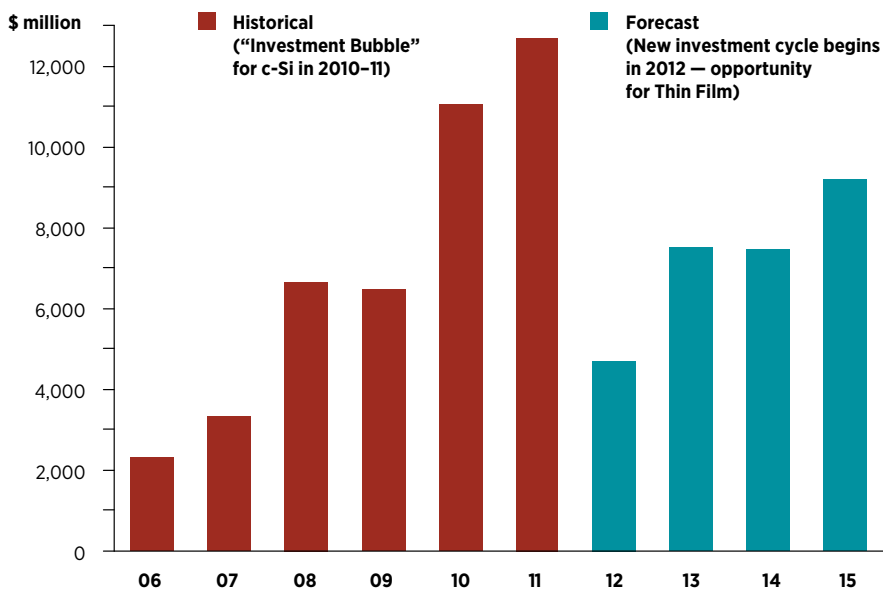
INVESTMENT BUBBLE OF 2010–11

An unprecedented rush of investment into new or expanded manufacturing capacity for traditional wafer-based crystalline PV modules led to China’s assuming global leadership in manufacturing capacity. At the same time, this investment bubble led to a sharp drop in prices that compressed margins in 2011 and 2012. Many of the PV manufacturing plants built in 2010 and 2011 are struggling to remain competitive today due to the drop in market prices. Leading wafer-based PV manufacturers in China are moving quickly to reduce production costs but have not been able to keep pace with the drop in prices. Consequently, most are reporting operating losses in today’s market, resulting in significant operating losses since Q3 2011.

THIN FILM IS COMPETITIVE CHOICE FOR NEXT INVESTMENT CYCLE

Looking ahead to the next investment cycle for PV manufacturing capacity expansion in China, it is

FIGURE 7: PV EQUIPMENT SPENDING



Source: SolarBuzz Equipment Quarterly, Jan 2012

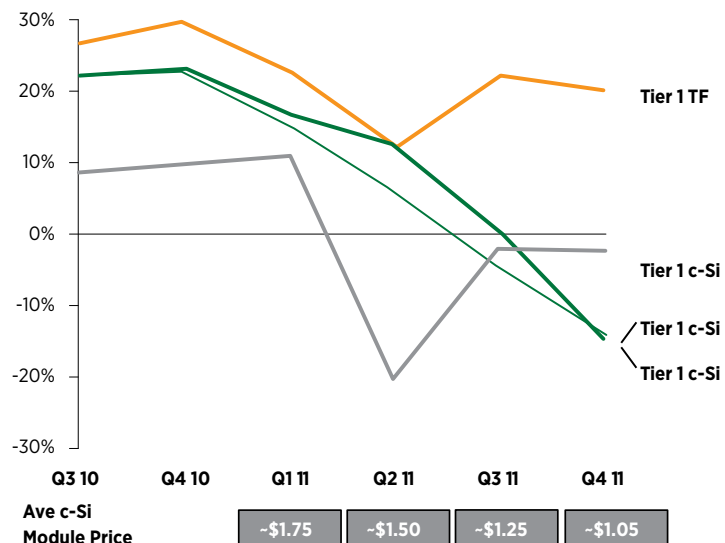
likely that thin film manufacturing will play a much more significant role, given some thin film technologies’ inherently simpler manufacturing process. Since leading thin film technology suppliers have dramatically improved the performance and reliability of thin film silicon technology, investors can be confident that thin film technology will be competitive in near- and medium-term markets.

Figure 9 shows a comparison among reported PV module production costs for several leading PV companies during the 4th quarter of 2011. Also shown is the announced cost of ownership for the latest turnkey manufacturing line for thin film silicon PV from Oerlikon Solar, the market leader in this segment. Further cost reductions are expected from both wafer-based PV manufacturers and thin film PV manufacturers and technology suppliers. It is significant to note, however, that the competitiveness of the thin film silicon production costs shown below are based on a production line with only 140 MW of annual production capacity, while the costs for the more mature wafer-based suppliers are based on production volumes that are in many cases more than 10 times higher.

INCREASING THIN FILM R&D AND INNOVATION IN CHINA

In addition to China's growing leadership in PV manufacturing and its fast-growing domestic market for PV installations, companies in China are also investing heavily to accelerate PV technology innovation to further

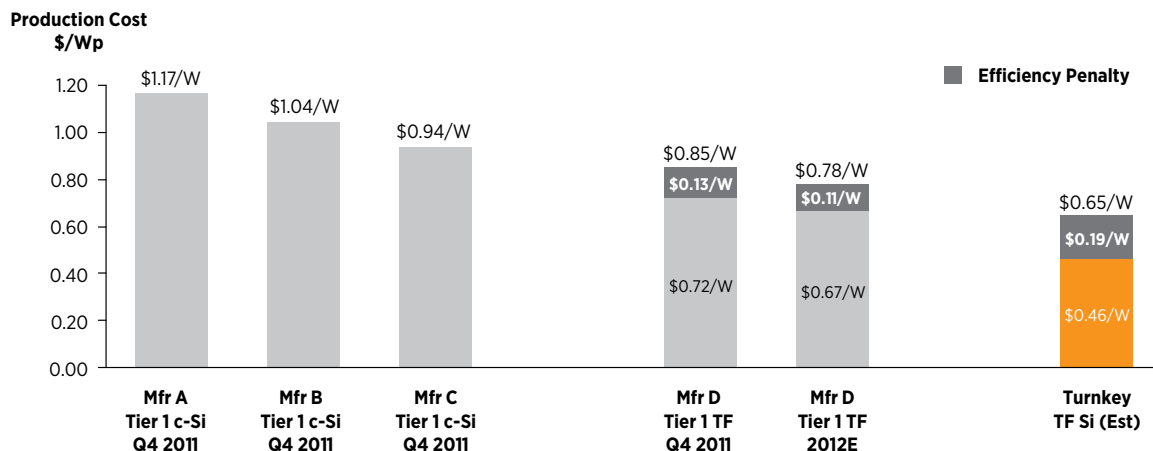
FIGURE 8: EBIT MARGIN FOR SEVERAL LEADING PV MANUFACTURERS



Data sources: Q4 earnings releases, Oerlikon Solar estimates

decrease costs and increase PV performance. While most of the recent research activities have focused on wafer-based crystalline PV technologies, there is also increasing interest and investment in China for thin film research and development (R&D). As an example of this shift, in December 2011 the International Cooperation Center of the China Renewable Energy Society (CRES) announced a Memorandum of Understanding (MOU) with Oerlikon Solar to collaborate on thin film silicon technology in China. Announced in Beijing, this strategic partnership marked the start of a joint effort to capitalize

FIGURE 9: PV MODULE PRODUCTION COSTS FOR LEADING MANUFACTURERS



Data sources: Q4 earnings releases, Oerlikon Solar estimates

on the benefits of the Oerlikon's thin film silicon solar technology with an emphasis on China, including:

- ▶ Research on thin film solar power electricity generation
- ▶ Support for and participation in demonstration projects undertaken by the International Cooperation Center for CRES government policy advisory
- ▶ Organization of forums such as the 2012 "Conference on Thin Film Solar Power Cell Technology"

CONCLUSION

China has declared and demonstrated a commitment to develop solar PV as a strategic industry domestically. At the same time, the country has increased deployment of PV to meet an increasing portion of its fast-growing demand for electricity. The rapid PV industry growth and widespread adoption of solar PV in China has been remarkable, and the country's long-term commitment to solar PV, as evidenced by the increased 2020 targets included in the 12th Five Year Plan, provide a level of market certainty that will continue to attract new investment. Investment in new manufacturing capacity

is recovering from an "investment bubble" in 2010-11 that was driven primarily by large-scale wafer-based PV manufacturing plants in China. The next investment cycle will be different, however, and low-cost thin film technologies will comprise a much larger share of new manufacturing investment in China. Ongoing innovation in thin film PV technologies has succeeded in maintaining competitively low production costs for thin film silicon and certain other thin film technologies. Finally, an increasing portion of thin film R&D will take place in China, evidenced by agreements such as the recent MOU between China's CRES and Oerlikon Solar.

ABOUT THE AUTHOR

Chris O'Brien is a member of the Advisory Board for ACORE and is the Head of Market Development for Oerlikon Solar. Oerlikon Solar is a global supplier of advanced manufacturing equipment and manufacturing lines for low-cost thin film silicon solar PV modules. Chris has held senior management positions with leading solar PV and other energy companies and trade associations for over 20 years. He holds an engineering degree from Dartmouth College and an MBA from Stanford University.

US-CHINA COLLABORATION UPDATE

■ GOVERNMENT COLLABORATION



Los Angeles Mayor Antonio Villaraigosa (left) and Chinese Vice President Xi Jinping (right) visit the Port of Los Angeles on February 17. At the Port, Vice President Xi met with employees of China Shipping, which is undertaking a major expansion project of their terminal within the Port of Los Angeles. Image Courtesy LA Mayor's Office of Economic and Business Policy.

XI JINPING'S VISIT TO THE U.S.

As the United States and China look to the green economy to drive growth in the coming years, both direct cooperation and diplomacy aimed at fostering fair competition will be crucial. As 45 CEOs stated in a collective letter to President Obama on February 13, 2012 "We are at a crucial time in the development and growth of the solar industry with broad benefits

for both countries and the rest of the world..... We are hopeful that you and Vice President Xi will discuss the mutual interests that America and China have in regard to expanding the use of solar technology." The CEOs represent companies from 19 states and are engaged in all segments of the solar industry, from polysilicon manufacturing to solar installations.⁶⁰ At a February 14, 2012 luncheon for Chinese Vice President Xi Jinping, hosted by Secretary of State Hillary Clinton and Vice President Joseph Biden, Secretary Clinton stated that cooperation between the U.S. and China is "imperative to addressing the many vexing challenges we face, from countering proliferation, to addressing climate change, to promoting global economic security."⁶¹ Vice President Xi echoed this sentiment at a meeting at the U.S. Chamber of Commerce, before American and Chinese CEOs: "The economic agendas of the two countries have a lot to offer to each other, and there is space for our cooperation in energy, environmental protection, biomedicine, advanced manufacturing and infrastructure."⁶² Xi had stated earlier at the same White House luncheon that communication and cooperation on the environment could serve to

60 "US Solar CEOs Call on Obama to Negotiate with China," Solar Novus Today, February 13, 2012, accessed March 21, 2012, http://www.solarnovus.com/index.php?option=com_content&view=article&id=4328:us-solar-ceos-call-on.

61 "Vice President Biden and Secretary Clinton Host Chinese Vice President Xi," DipNote Blog, February 15, 2012, accessed March 20, 2012, http://blogs.state.gov/index.php/site/entry/clinton_china_vp.

62 "Remarks by Vice President Biden and Chinese Vice President Xi to U.S. and China CEOs," The White House, Office of the Vice President, February 14, 2012, accessed March 20, 2012, <http://www.whitehouse.gov/the-press-office/2012/02/14/remarks-vice-president-biden-and-chinese-vice-president-xi-us-and-china->.

“cement the basis of cooperation and broaden bilateral ties.”⁶³ There is also growing awareness of the need for energy policies in both countries to complement each other rather than to clash, as the global community turns increasingly to China and the U.S. to shape the dialogue on international climate change.

The China Shipping Group’s Los Angeles terminal, one of the final stops on Xi’s tour, provides an example of this kind of cooperation. During Xi’s visit to the terminal on February 17, 2012, California Governor Jerry Brown and Los Angeles Mayor Antonio Villaraigosa praised the terminal’s success in the fields of both energy efficiency and environmental protection, and Xi noted its efficient use of propane as a clean alternative.⁶⁴ Finally, the State Department used the occasion of Xi’s visit to expand the U.S.-China EcoPartnerships Program, which focuses on strengthening subnational environmental ties in the public, private, and civic sectors. At the city level, Hefei, the capital of Anhui Province, and Columbus, Ohio are the latest addition to the program, bringing the total number of EcoPartnerships to 15.⁶⁵

RESEARCH AND DEVELOPMENT

Finally, even as recent years have seen focus shift away from research, development, and demonstration (RD&D), research institutes in both the U.S. and China have signed agreements on several cutting-edge projects this year. In February 2012, the National Energy Administration and National Development and Reform Commission established China’s first renewable energy think tank, the China National Renewable Energy Center (CNREC). CNREC has named clean energy scientists,

experts, and analysts from several countries to its consulting committee. Dr. David Kline, of the Strategic Energy Analysis Center at the National Renewable Energy Laboratory, represents the United States on the committee.⁶⁶ To date, the Center has already released two studies on biogas and the market size for waste-to-energy (WTE) technologies in China. As China grapples with issues arising from mechanized agriculture and urban waste disposal, biogas and WTE represent a potentially fruitful avenue for Chinese renewables.

On March 19, 2012, the School of Energy Research at Xiamen University in Fujian Province announced a partnership with several international firms, including the Department of Energy’s Lawrence Berkeley National Laboratory (LBNL), to build and research direct-current microgrids on Xiamen University’s campus. The research project could revolutionize the way building energy use in China is created, stored, and managed, with the potential to introduce renewable technologies onsite and mobile and online energy management software systems.⁶⁷ The project is part of LBNL’s DC Power for Data Centers of the Future initiative.⁶⁸

Two utility companies, Duke Energy and China’s Huaneng Energy Group, have also received funds from the U.S.-China Clean Energy Research Center (CERC) to pursue a 3-year project researching low-cost carbon capture and storage technologies.⁶⁹ The U.S.-China Clean Energy Research Center was established in 2009 by U.S. President Barack Obama and China’s President Hu Jintao in order to support joint research and development on clean energy technology.⁷⁰

63 “Chinese, US presidents hold talk on ties,” *Global Times*, February 15, 2012, accessed March 20, 2012, <http://www.globaltimes.cn/NEWS/tabid/99/ID/695980/Chinese-US-vice-presidents-hold-talks-on-ties.aspx>.

64 “Xi Jinping Inspects China Shipping Group’s Los Angeles Terminal,” Ministry of Foreign Affairs of the People’s Republic of China, February 17, 2012, accessed March 20, 2012, <http://www.fmprc.gov.cn/eng/zxxx/t906991.htm>.

65 “Expansion of U.S.-China EcoPartnerships Program,” United States Department of State Media Note, Office of the Spokesperson, February 15, 2012, accessed March 20, 2012, <http://www.state.gov/r/pa/prs/ps/2012/02/184027.htm>.

66 Juan, Du, “China sets up first renewable-energy think tank,” *China Daily*, February 24, 2012, accessed March 21, 2012, http://www.chinadaily.com.cn/bizchina/2012-02/24/content_14686084.htm.

67 “Xiamen University Partners with Leading Technology and Energy Providers to Build China’s First Direct-Current Microgrid,” Marketwatch, *The Wall Street Journal*, March 19, 2012, accessed March 20, 2012, http://www.marketwatch.com/story/xiamen-university-partners-with-leading-technology-and-energy-providers-to-build-chinas-first-direct-current-microgrid-2012-03-19?reflink=MW_news_stmp.

68 See <http://dcdatacenters.com/>

69 “Duke Energy & China Huaneng sign CCS research agreement,” Carbon Capture Journal, February 18, 2012, accessed March 20, 2012, <http://www.carboncapturejournal.com/displaynews.php?NewsID=898>.

70 See <http://www.us-china-cerc.org/>

■ PRIVATE SECTOR COLLABORATION

In the beginning of 2012, U.S. and Chinese companies signed agreements to build large-scale renewable projects, improve solar panel construction, and develop electric vehicles. While large and state-owned Chinese companies continued their recent trend of investing in overseas energy markets, U.S. companies welcomed investment as an opportunity to establish research projects.

JOINT VENTURES

Murphy-Brown, a subsidiary of Smithfield Foods, and Beijing Helee Bio-Energy (HELEE), a subsidiary of DQY Agriculture Technology Co., Ltd., announced the formation of a joint biogas venture in February 2012. The project will adopt core technologies from HELEE and is estimated to produce 3.5 million cubic meters of methane annually, with a power generating capacity of 1 megawatt (MW). The project will not only produce 7 million kilowatt hours (kWh) of electricity per year but will also cut 42,000 tons of CO₂ emissions annually.⁷¹



Liansheng Miao, chairman and chief executive officer of Yingli (left) and Dave Miller, president of DuPont Electronics & Communications (right), sign a \$100 million strategic agreement for solar materials and technology collaboration. Image courtesy of DuPont.

ACQUISITION

Since December 2011, State Grid, China's state-owned utility company, has been in talks to acquire an 80% stake in global power producer AES Corp's U.S. wind energy assets, representing approximately 1.1 gigawatts (GW) of capacity. The assets are estimated to be worth \$1.65 billion. State Grid has been actively expanding overseas, purchasing controlling stakes in utility companies in Portugal and Brazil. China Investment Corporation, China's sovereign wealth fund, already holds a 15% stake in AES, meaning the deal could face political hurdles in the U.S.⁷²

INVESTMENT

In addition to its joint venture with NRG Solar, China's GCL-Poly released a joint statement with Bank of America Merrill Lynch (BOAML) in February 2012 stating that it plans to use the bank as a long-term source of funding for its U.S. projects. At present, BOAML is financing the construction of a 15-site, 5 MW solar installation in California by GCL Solar. This is an example of GCL Solar's continuing efforts to establish a firm presence as a photovoltaic (PV) developer both in China and in the U.S.⁷³

American Jianye Greentech Holdings, Ltd., announced on March 7, 2012 that it will invest in Gulf Coast Energy Inc. (GCE) to build a blending factory for biofuels in Alabama. The factory will produce and distribute 30 million gallons of alcohol-based fuel per year, and this new partnership will build on GCE's wood waste-to-ethanol demonstrated technology. American Jianye plans to use this project as a stepping stone to accelerate business development in the United States.⁷⁴

71 "China and US Firms Sign Biofuel Deal," *The Bioenergy Site*, February 20, 2012, accessed March 21, 2010, <http://www.thebioenergysite.com/news/10496/china-and-us-firms-sign-biofuel-deal>.

72 Xu, Wan and Don Durfee, "China's State Grid in talks to Buy AES' U.S. wind assets: sources," Reuters, February 27, 2012, accessed March 20, 2012, <http://finance.yahoo.com/news/China-State-Grid-talks-buy-rb-917004133.html>.

73 Lee, Andrew, "Bank of America to be 'long-term funder' of China's GCL-Poly," *RECHARGE*, February 15, 2012, accessed March 21, 2012, http://www.rechargenews.com/business_area/finance/article303458.ece.

74 Aylott, Chris, "China Biofuel Company Invests in Alabama," *Emerging Money*, March 8, 2012, accessed March 21, 2012, <http://emergingmoney.com/china/china-biofuel-company-invests-in-alabama-ajgh/>.

BUSINESS

GE announced in late February 2012 that it will provide its ecomagination-qualified Jenbacher gas engines to power China's largest landfill gas (LFG) power generation project. The LFG project is owned by Laogang Renewable Energy Co., a joint venture formed by Veolia and the Shanghai Environmental Group. This

project will support China's 12th Five-Year Plan — in which the country has pledged to invest more than RMB 260 billion in the waste treatment industry, including waste-to-energy initiatives — and also improve the living conditions in local areas by reducing greenhouse gas emissions and producing energy.⁷⁵

RECENT U.S.-CHINA PRIVATE SECTOR COLLABORATION

U.S. FIRM	CHINESE FIRM	COLLABORATION
Dupont Corp.	Suntech Power Holdings Co., Ltd.	The two companies will make improvements in backsheets construction and study how this affects longevity and power outputs of solar modules. DuPont has also promised to help Suntech improve its supply chain, and the companies have pursued “co-marketing” to help educate customers and partners down the value chain. ⁷⁶
Hudson Clean Energy Partners	GSE Investment Corp.	Hudson acquired a minority interest in the China-based GSE Investment Corporation, a premier operator of solid waste-to-energy and tap water/wastewater treatment projects. The acquisition, which is Hudson's first investment in China, will allow GSEI to launch several expansion and greenfield projects and accelerate its near-term growth. ⁷⁷
Premier Power Renewable Energy Inc.	Chaori Solar USA, LLC (Shanghai Chaori Solar Energy Science & Technology Co.)	A \$27.6 million contract announced in February 2012 between Premier and investment-focused Chaori Solar USA will build three high-performance, utility-scale solar power plants in New Jersey. Premier will provide engineering, procurement, and construction services using panels from San Jose-based SunPerfect Solar Inc. ⁷⁸
DuPont Corp.	Yingli Green Energy Holding Co.	Yingli Green Energy Holding Co. will purchase \$100 million of solar material from DuPont Co., including photovoltaic metallization pastes and protective backsheet films. ⁷⁹

75 “GE Gas Engine Technology to Power China's Largest Landfill Gas Project,” *Power Engineering*, February 25, 2012, accessed March 21, 2012, <http://www.power-eng.com/news/2012/02/26/ge-gas-engine-technology-to-power-china-s-largest-landfill-gas-project.html>.

76 Montgomery, James, “Suntech, DuPont to Collab on Solar Backsheets, Supply Chain,” *RenewableEnergyWorld.com*, February 3, 2012, accessed March 21, 2012, <http://www.renewableenergyworld.com/rea/news/article/2012/02/suntech-dupont-to-collab-on-solar-backsheets-supply-chain>.

77 “Hudson Clean Energy Partners Acquires Minority Interest in China-Based GSE Investment Corporation; GSEI Leads China's Fast-Growing Environmental Protection Industry,” Market Watch, *The Wall Street Journal*, February 15, 2012, accessed March 21, 2012, <http://www.marketwatch.com/story/hudson-clean-energy-partners-acquires-minority-interest-in-china-based-gse-investment-corporation-2012-02-15>.

78 Glover, Mark, “Premier Power Lands New Jersey Project,” *The Sacramento Bee*, March 9, 2012, accessed March 21, 2012, <http://www.sacbee.com/2012/03/09/4323674/premier-power-lands-new-jersey.html>.

79 Goossens, Ehren, “China's Yingli to Buy \$100 Million in Solar Products From Dupont,” *Bloomberg Businessweek*, February 14, 2012, accessed March 21, 2012, <http://www.businessweek.com/news/2012-02-14/china-s-yingli-to-buy-100-million-in-solar-products-from-dupont.html>.

Solar Power, Inc. (SPI)	China Development Bank Corp. (CDB)	SPI, which is 70%-owned by LDK Solar Co., announced in January 2012 that it had received \$44 million from the state-owned CDB. The funding is slated for projects in New Jersey that the company is building for U.S. developer KDC Solar, LLC. LDK also received \$20 million in financing from the CDB for two projects that SPI will develop and build in California. ⁸⁰
NorthWestern Energy Corp.	Goldwind USA Inc. (Goldwind Science & Technology Co., Ltd.)	In January 2012, Goldwind USA acquired the 20 MW Musselshell Wind Project in Montana from Volkswind USA. The project allows Goldwind to increase market penetration of its permanent magnetic drive technology in the U.S. NorthWestern Energy has arranged construction, power purchase, and interconnection agreements with Goldwind. ⁸¹
NRG Solar, LLC (NRG Energy Inc.)	GCL-Poly Energy Holdings Ltd.	GCL-Poly Energy and NRG Solar announced the formation of Sunora Energy Solutions 1, LLC, in early February 2012. Further information on this joint venture has yet to be disclosed. Each of the shareholders hopes to substantially enhance financial returns by combining GCL-Poly's performance-optimized PV system equipment and NRG's proprietary advanced racking. ⁸²
Satcon Technology Corp.	China Great Wall Computer Group Co., Ltd. (GWCC) (China Electronics Corp.)	Satcon announced in February 2012 that it had signed a five-year agreement with GWCC. The agreement covers commercial sales, as well as a marketing and distribution relationship in the Chinese market. The deal will allow Satcon to bring its utility-scale inverter technology to an estimated 14 GW of utility-scale projects under development in China. ⁸³
Emcore Corp.	San'an Optoelectronics Co., Ltd.	In February 2012, Suncore Photovoltaics Co., Ltd., a joint venture between Emcore and San'an, broke ground on its Huainan factory, which will deliver an estimated 200 MW of solar PV components and subsystems in its first phase. The capacity of the components is expected to reach 1 GW annually over the next five years. ⁸⁴
Onyx Service & Solutions Inc.	Optimum Solar Corp.	In January 2012, Onyx announced that it had signed a Memorandum of Understanding with Optimum Solar. Onyx plans to acquire 25% of Optimum, which co-developed the "Plug-N-Play" all-in-one solar panel system. Onyx hopes to gain engineering and manufacturing expertise through the acquisition. ⁸⁵

80 Goossens, Ehren, "LDK Solar Gets \$64 Million in China Funding for U.S. Projects," *Bloomberg New Energy Finance*, January 5, 2012, Online, Accessed: March 20, 2012, <http://bnef.com/News/51330>

81 Tournemille, Harry, "Goldwind Acquires Montana's Musselshell Wind Project from Volkswind," *Energy Boom*, January 19, 2012, Online, Accessed: March 20, 2012, <http://www.energyboom.com/wind/goldwind-acquires-montanas-musselshell-wind-project-volkswind>

82 "GCL-Poly Energy and NRG Solar Form Joint Venture," *Solar Buzz, Solar Market Research and Analysis*, February 6, 2012, accessed March 21, 2012, <http://www.solarbuzz.com/node/3687>.

83 "Satcon, Great Wall Computer Announce Strategic Sales and Manufacturing Partnership to Expand Satcon's Leadership Position in China's Utility Scale Solar Market," *Business Wire*, February 7, 2012, accessed March 21, 2012, <http://www.businesswire.com/news/home/20120207005553/en/Satcon-Great-Wall-Computer-Announce-Strategic-Sales>.

84 Robinson-Avila, Kevin, "Emcore's solar joint venture in China starts production," *New Mexico Business Weekly*, March 1, 2012, accessed March 21, 2012, <http://www.bizjournals.com/albuquerque/news/2012/03/01/emcores-solar-joint-venture-in-china.html>.

85 "ONYX signs MOU to Acquire 25% of 'Plug-N-Play' Co-Developer," *Business Wire*, January 25, 2012, Online, Available: <http://www.businesswire.com/news/home/20120127005192/en/ONYX-Signs-MOU-Acquire-25>

