A REPORT OF THE CSIS HILLS PROGRAM ON GOVERNANCE

China's Competitiveness

Myth, Reality, and Lessons for the United States and Japan

CASE STUDY: *Suntech*

January 2013

Author

Nathaniel Ahrens

50 YEARS | CHARTING OUR FUTURE

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CASE STUDY: SUNTECH

By Nathaniel Ahrens

Introduction

The growth of the Chinese economy, particularly in the last 20 years, has been staggering. Until recently, most of this growth had come from producing labor-intensive, low-value-added goods. Today, however, Chinese competitiveness is no longer confined to lower-end production. In fact, Chinese policymakers are laser focused on helping Chinese firms move up the industrial value chain. Moreover, policymakers have made explicit the goal of assisting the international expansion of Chinese firms in a desire to "go global" and have made efforts to build internationally recognizable brands commensurate with China's growing global clout. These policy goals have at times struck decidedly nationalistic and protectionist tones, raising concerns globally in both corporate and government sectors. Government encouragement of international expansion is also driven by the desire to reduce China's foreign exchange reserves, which have become a subject of heated domestic and international criticism.

Now, a number of Chinese companies have emerged to challenge traditionally dominant international firms. This overall study looks at the cases of five such firms, examining the factors that led to their rise, their current state of competitiveness in relation to their international peers, and the policy implications. It is not meant to be an academic discussion of the nature of competitiveness, nor an investment analysis with latest-quarter data—all these companies are growing rapidly and present moving targets. We take a relatively straightforward approach to what it means to be competitive, looking at traditional metrics of corporate performance such as sales growth, profitability, and market share trends and comparisons over the last few years. We acknowledge that individual companies may determine competitive success differently and over varying periods of time; some are more market driven and concerned with quarterly results, while others may be less concerned with the short-term traditional indicators of success.

Market involvement by the Chinese government may also result in misleading competitiveness indicators. Firms may be more concerned with initial market share gain than with near-term profitability. While this is not an atypical strategy for new market entrants, government policies can play an outsized role in encouraging this type of strategy when viewed as part of the competitive landscape. Since long-term success is a flexible concept that is difficult to measure, we are focusing on the current competitiveness of

these firms. But in doing so we are also investigating the factors that led to the rise of these companies and the likely sustainability of these competitive advantages. We also examine the influence of government policies on competitiveness and their longer-term implications. Finally, we look at the relationships these companies have with the United States and Japan to give an indication of the interconnected nature of their operations and history.

About Suntech

Suntech Power Holdings Co., Ltd. is the world's largest producer of solar panels, with 1,572 megawatts (MW) of photovoltaic (PV) panels shipped at the end of 2010 and estimates for 2,200 MW by the end of 2011. According to the company, Suntech has offices or production facilities in every major market and has delivered more than 13,000,000 solar panels to thousands of companies in more than 80 countries around the world. Suntech brands itself as being able to offer high conversion efficiency, quality of manufacture, and strong warranties to secure a competitive advantage in the solar market. While Suntech's markets have primarily been in Europe, especially Spain and Germany, its market share in both China and the Americas is growing rapidly. The company employed around 20,000 people as of early 2012, but saw its market capitalization drop from around $600 million to $150 million over the course of the year.

Suntech's Rise

Suntech was founded in 2001 in Wuxi, China, but its story begins before that in Australia. Dr. Zhengrong Shi, the current chairman and CEO of Suntech, left China to study in Australia. His studies at the Shanghai Institute of Optics landed him at the University of New South Wales (UNSW) in 1989, where he studied under Martin Green, a renowned expert in solar technologies.[1] Shi researched solar cells and rapidly earned his PhD. At the university he earned 15 patents.[2] In 1995 he was offered a job at Pacific Solar Pty., Ltd., an Australian firm doing work with thin film technology.

At this point, the Chinese government had been trying unsuccessfully for many years to establish PV manufacturing bases, so it started to look abroad for experts who had been trained overseas.[3] Looking to come back to China, Shi developed a business plan that he shopped around to individuals in various cities. Wuxi, in Jiangsu Province, enticed Shi with $6 million in return for a 75 percent equity stake. The remaining 25 percent went to Shi, with a possible additional 5 percent contingent upon future company

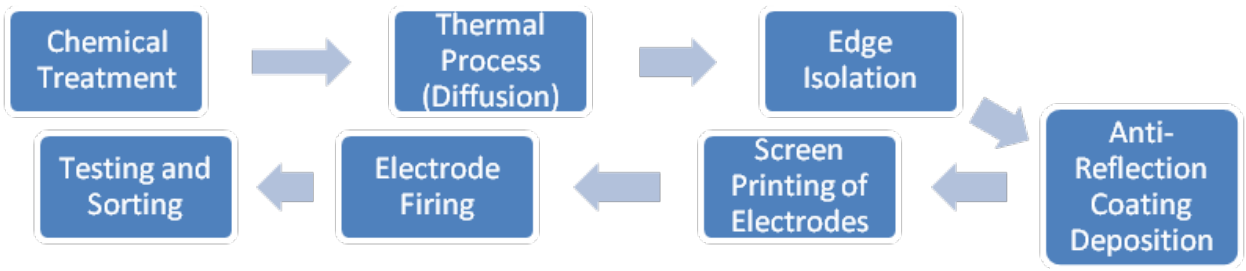
[1] Green, Martin, "Heroes of the Environment: Shi Zhengrong," *Time*, October 17, 2007, http://www.time.com/time/specials/2007/article/0,28804,1663317_1663322_1669932,00.html.
[2] Richard Vietor, *Suntech Power*, HBS Case 9-710-013 (Boston: Harvard Business School Publishing, 2011), 2.
[3] Center for Energy and Environmental Markets, University of New South Wales, "Suntech Power Case Study," 21, http://www.ceem.unsw.edu.au/content/userDocs/5SuntechCaseStudy.pdf.

performance.[4] Shi's shares were valued based upon his investment of $400,000, plus $1.6 million in technology contributions.

With assistance from Stuart Wenham, the director of the ARC Centre for Excellence in Advanced Silicon Photovoltaics and Photonics at UNSW, the production line and plans were arranged.[5] Much of the production line equipment was turnkey, so it was the transfer of human capital that was really the critical piece. By 2002, Suntech was already producing PV cells and was profitable from this first year of operations on. In this first year, Suntech had a production capacity of 2 MW of cells, which was ramped up to 8 MW in 2003, 35 MW in 2004, 82 in 2005, and 160 MW in 2006.[6]

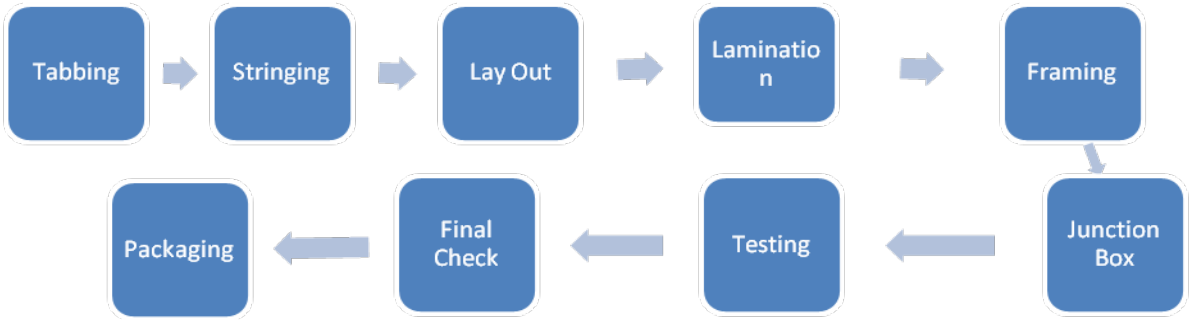
Due to the availability of turnkey equipment (much of it available used), out of the starting gate the efficiency of Suntech's cells was not far from that of its competitors. Suntech was at 14.5 percent efficiency (measured as the percentage of sun energy that hits a solar cell that subsequently gets turned into electricity), while more experienced international players were averaging about 15.5 percent.[7] Initial challenges were with quality control of wafer production, as silicon costs made up about 80 percent of Suntech's manufacturing cost, but these challenges were quickly overcome and Suntech achieved quite a high yield.[8] Without a major disadvantage in efficiency, Suntech was able to focus on reducing manufacturing costs.

Suntech's core business is based upon manufacturing PV cells and modules. The cells produced by Suntech are both monocrystalline and polycrystalline. An overview of the process, based on Suntech's 2010 annual report, is shown below:[9]



[4] Vietor, "Suntech Power," 2.
[5] Center for Energy and Environmental Markets, "Suntech Power Case Study," 22.
[6] Ibid., 24.
[7] Ibid.
[8] Ibid.
[9] Suntech Power Holdings Co., *2010 Annual Report 20-F*, April 29, 2011, 38, http://phx.corporate-ir.net/External.File?item=UGFyZW50SUQ9NDI2NzM1fENoaWxkSUQ9NDQyNzAxfFR5cGU9MQ==&t=1.

The cells then get combined into modules (which constitute the majority of Suntech revenues), as follows:



Suntech has placed consistent emphasis on improving wafering technology and increasing capacity. By the end fiscal year (FY) 2011, Suntech planned to have 50 percent of its wafers produced in house.

Suntech's commercial development was rapid. The company went from $85 million in revenue in 2004 to almost $2 billion in 2008.[10] Suntech also recognized that there would soon be much more intense competition from new entrants. Initially the company looked into upstream expansion, but realized after a couple of bad investments that this was the wrong strategy. Moving downstream, however—into distribution, systems integration, and even investment—would give the company better control over channels and allow greater sensitivity to developments and shifts in market demands.[11] From the time of Suntech's founding to 2008, the majority of demand was in Europe, and primarily in Germany and Spain, due to the two countries' respective renewable energy policies.

In 2007, 51 percent of Suntech's revenue came from Germany and 35 percent from Spain. The United States made up just 6 percent, and the rest of the world 8 percent. The Spanish market grew in 2008 to 38 percent, and Germany shrank to 30 percent, though both markets expanded in dollar terms. The United States and China both came in at about 7 percent, and Japan at only 0.3 percent. In 2009 the Spanish market essentially disappeared, with revenues suddenly only 3 percent and real dollar value down from $718 million to $60 million in 2009 and $84 million in 2010. Germany and Italy continued to grow, as did the United States, which went from about 7 percent of revenues in 2008 to 15 percent in 2010, growing from $142 million to $443 million. The economic crisis has severely hit the solar market, particularly by cutting demand in Europe, as have antidumping tariffs in the United States. Suntech has also been hit

[10] Vietor, "Suntech Power," 8.
[11] Ibid., 9.

with issues of fraud related to its Global Solar Fund financing (see later in this study). If these funds turn out not to exist, it could add another $680 million in debt.[12]

Growth in China has been very sluggish, representing only 7 percent of revenues in 2008 to 5 percent in 2010. Revenues went from $134 million to only $154 million over this time. This is expected to pick up, however, as China launches a feed-in tariff. There are also expectations that the Chinese government will come to the aid of ailing Chinese solar companies, including Suntech. The inclusion of solar power in the government's list of "strategic emerging industries" (under the category of new energy sources) raised the likelihood of further policy support, but has also resulted in overinvestment and overcapacity in the sector. The global supply glut and antidumping tariffs, combined with Suntech's high debt load (currently $2.3 billion), lead to the conclusion that if Suntech is to survive, it is likely to need substantial government financial support and significant domestic Chinese market encouragement (i.e., massive government-induced solar deployment). Consolidation in the Chinese market is probably also necessary.

Since the beginning of the research for this case study, Suntech stock has dropped precipitously and the company is now in danger of being delisted. In August 2012 Suntech replaced Shi as CEO with David King, the former chief financial officer. The ongoing competitiveness of Suntech will depend not on the company's innovative capacity and technology but on debt, governance, and market demand.

Shareholder Composition

While the initial investment came from the Wuxi municipal government, shortly after this initial investment other investors were brought in to take the shares off the government's hands. These investors included Jiangsu Little Swan Group, Wuxi High Tech Venture Capital Co., Wuxi Guolian Trust & Investment Company, Wuxi Shuixing Group, Wuxi City Innovation Investment Company, and Wuxi Shanhe Group. These investors exited their investment prior to the 2005 initial public offering on the New York Stock Exchange, as Suntech formed a company headquartered in the British Virgin Islands to privatize and recapitalize Suntech. This was most likely due to government pressures to exit due to the complications of state-owned shares of firms listed overseas . In these transactions the original state investors realized a return on their original investment of 13.3 times.

At the end of 2010, Shi Zhengrong held 30.4 percent of the company. There are no known Chinese government shareholders or obligations, other than loans that could be called by Chinese banks. This is something to keep an eye on, however, as Suntech negotiates its debt issues.

[12] Cardwell, Diane, "Soured Deal Another Blow for Chinese Solar Company," *New York Times*, July 30, 2012.

Current Strategy

Suntech increased its cell and module production capacity from 1.8 gigawatts (GW) at the end of 2010 to 2.5 GW by the end of 2011, but is currently reducing capacity. The company targets shipments of 1.8-2 GW in 2012.[13] It does not have plans to move further upstream into polysilicon production, though it does have equity investments in a number of upstream suppliers.[14] This gives Suntech a relatively stable hold on its supply chain, though it is still exposed to some firm-level and market risk. It seems likely that Suntech will retain its middle "value" ground, between the lower-cost, lower efficiency of First Solar and the premium, higher-efficiency products of Sunpower. Suntech also has a small premium over the low-cost Chinese manufacturers Yingli and Trina. The main issues for Suntech are reducing debt burden, reducing operating costs, and reducing production costs. Further pressure on margins is a concern, as oversupply and duties and tariffs take their toll.

Competitiveness Indicators

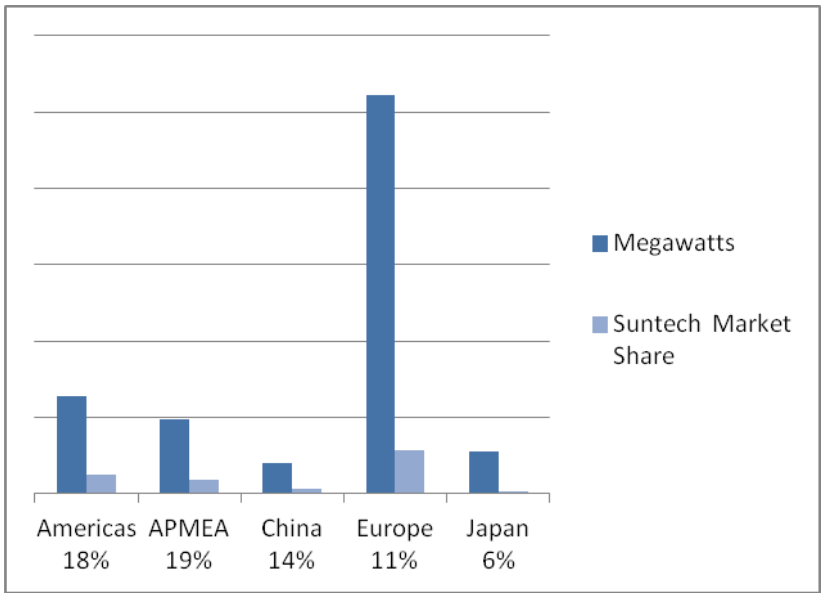
One straightforward way to compare Suntech's competitiveness to that of its peers is to look at its recent performance in terms of market share, sales, and profitability.[15] In this case, we compare Suntech with First Solar and Sun Power, on the basis of annual data.

Market Share

- Number one solar panel maker (by output) in the United States and China.
- World's largest manufacturer of crystalline silicon PV modules.
- Maintains a strong position in established markets, while continuing to diversify into regions that will drive the next stage of growth in the solar industry.
- Achieved a leading market share in the Americas and was selected to supply a 150 MW (AC) project for Sempra Generation, just down the road from Suntech's new Arizona manufacturing facility.
- Continues to gain ground in key growth markets such as Australia, China, Japan, India, and Thailand.

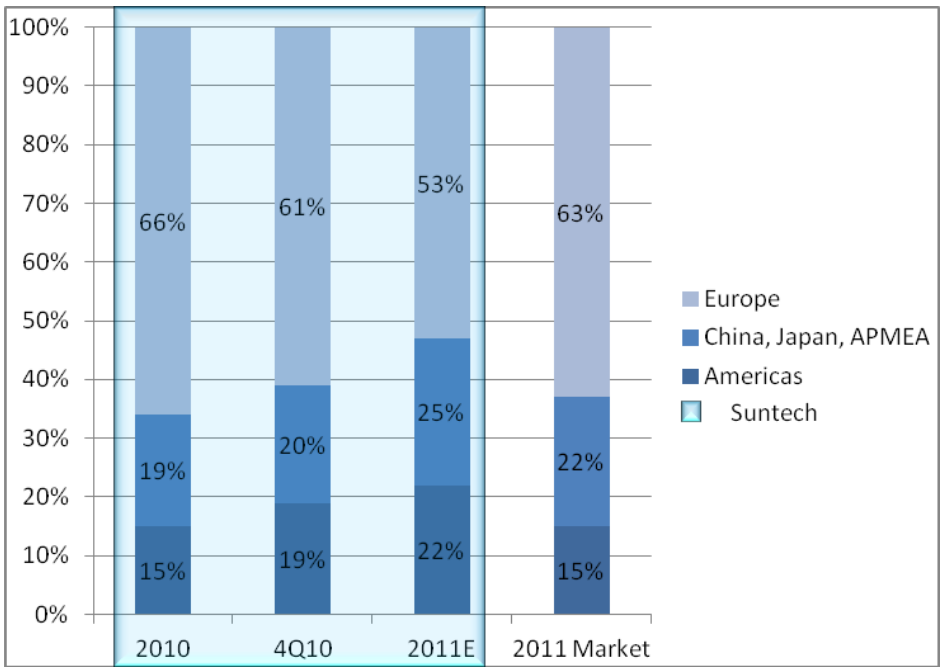
[13] Company press release, http://ir.suntech-power.com/phoenix.zhtml?c=192654&p=irol-newsArticle&ID=1730567&highlight=.
[14] Wayne Chang, "Suntech Power Holdings Co. Ltd.," Brean Murray Carret & Co., analyst report, March 8, 2011, 7.
[15] The figures used in the graphs and tables are based on company documents unless otherwise noted.

2011 Projected Market Share



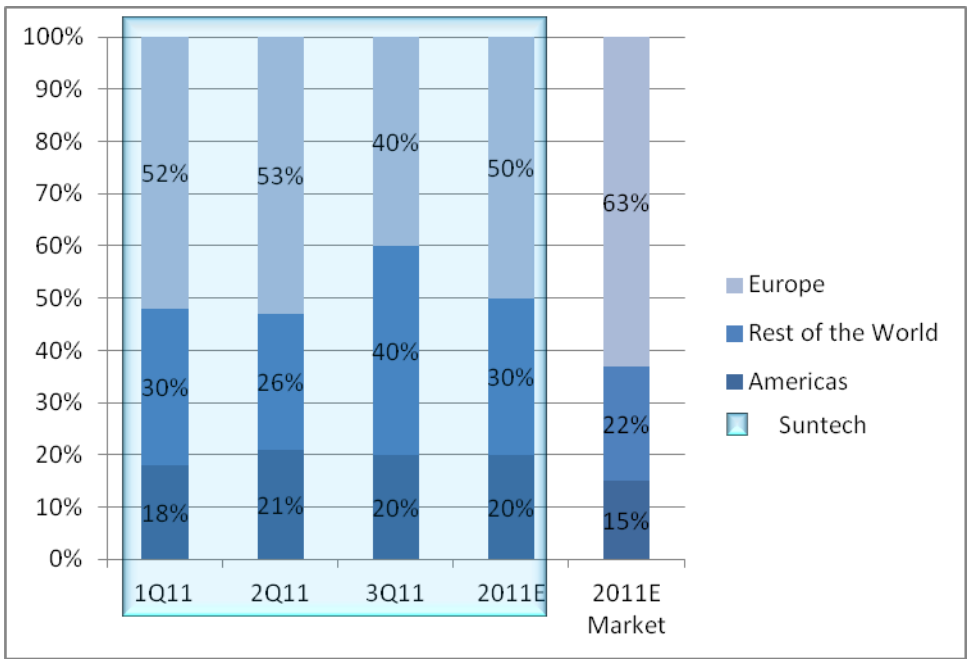
Source: Company documents.

Revenue Distribution versus Market

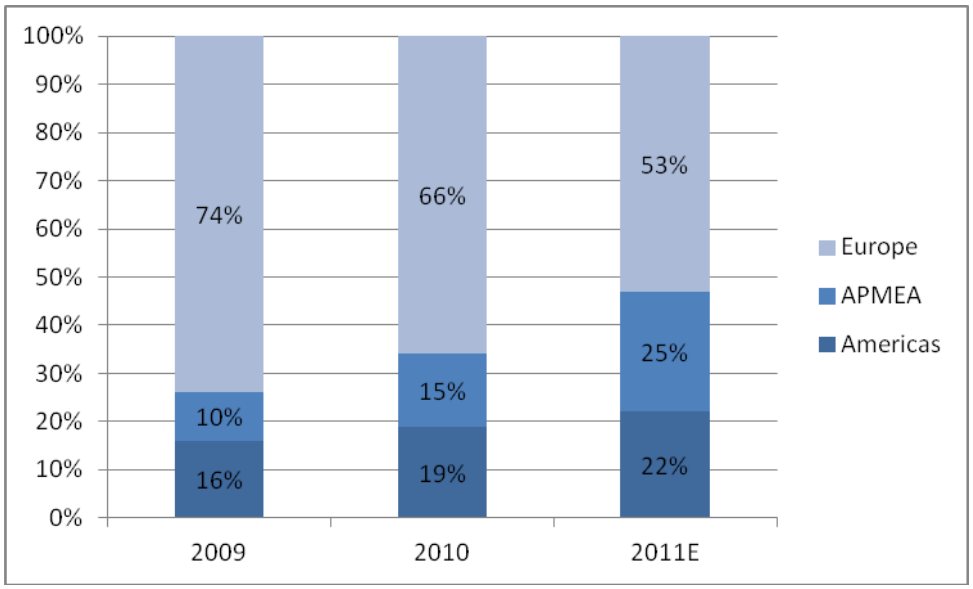


Source: Company reports.

China is becoming a significant market for Suntech, with 22 percent of the firm's third-quarter FY 2011 revenue coming from China, and expectations for growth to double over the next year (year-on-year).

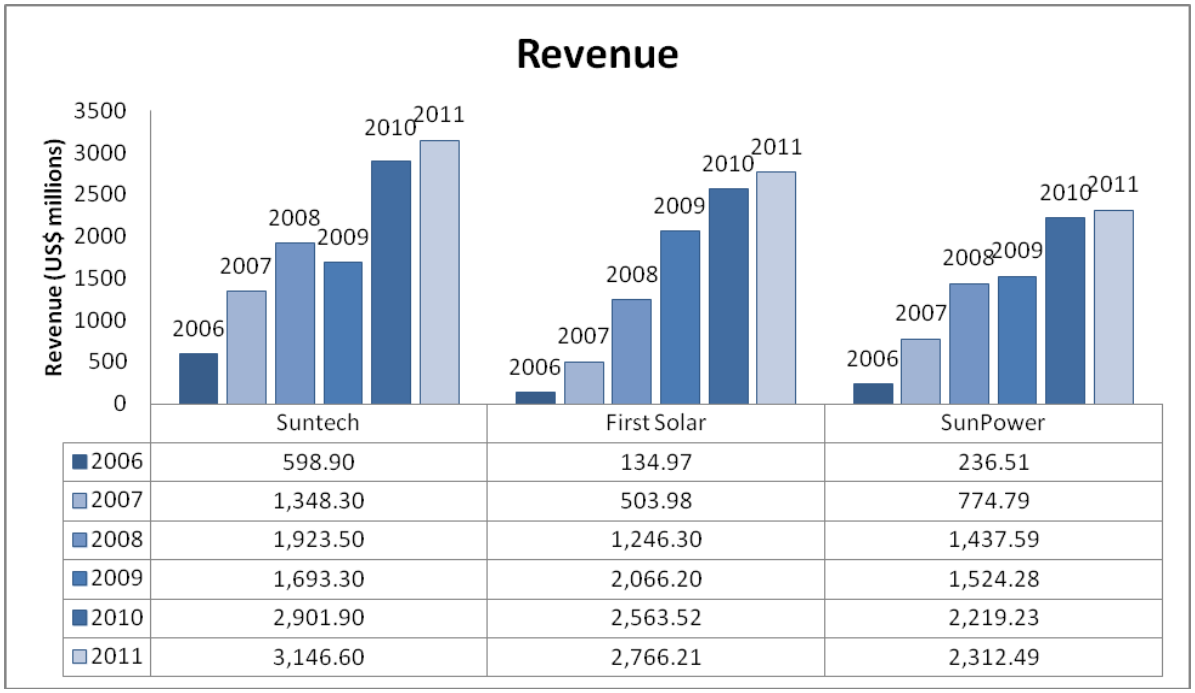


Source: Company documents



Source: Company documents.

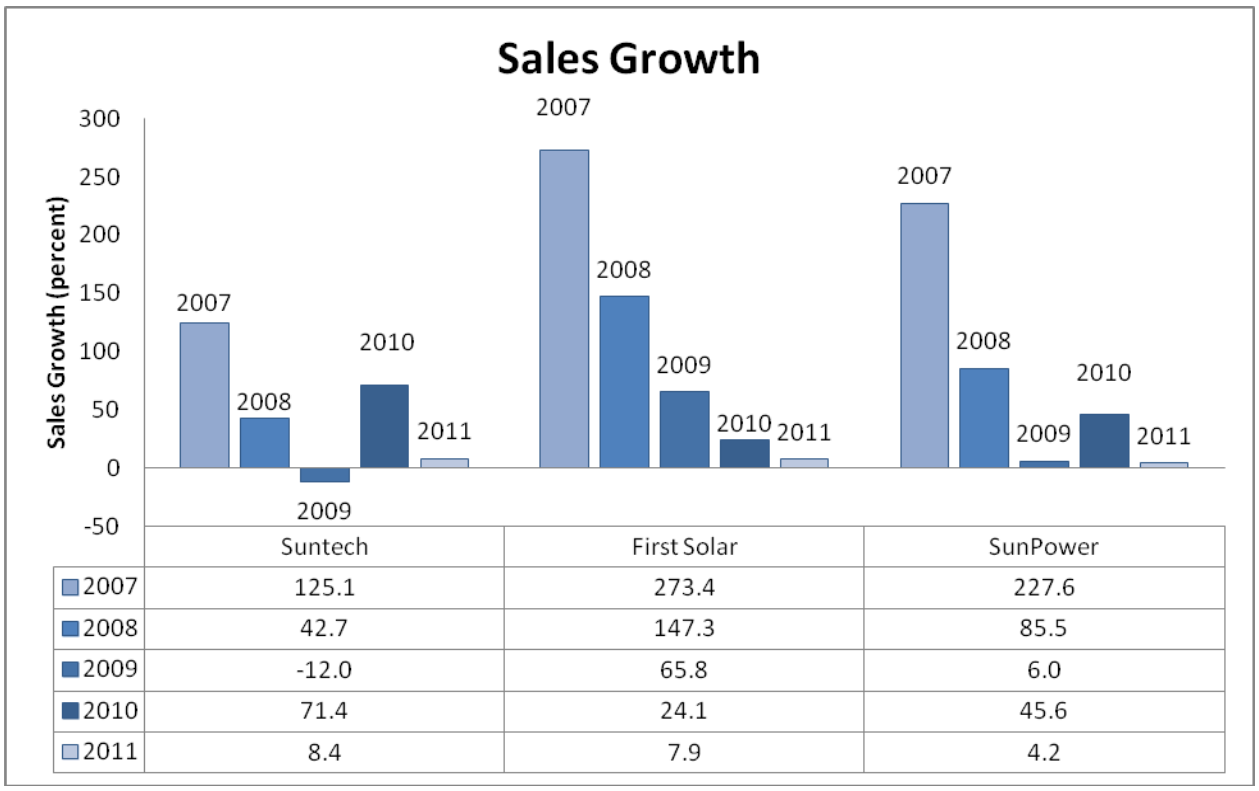
Sales



	Suntech	First Solar	SunPower
2006	598.90	134.97	236.51
2007	1,348.30	503.98	774.79
2008	1,923.50	1,246.30	1,437.59
2009	1,693.30	2,066.20	1,524.28
2010	2,901.90	2,563.52	2,219.23
2011	3,146.60	2,766.21	2,312.49

Source: Company documents.

Suntech is currently the global revenue leader in the solar panel manufacturing industry. Estimates for FY 2011 sales are 2 GW.



	Suntech	First Solar	SunPower
2007	125.1	273.4	227.6
2008	42.7	147.3	85.5
2009	-12.0	65.8	6.0
2010	71.4	24.1	45.6
2011	8.4	7.9	4.2

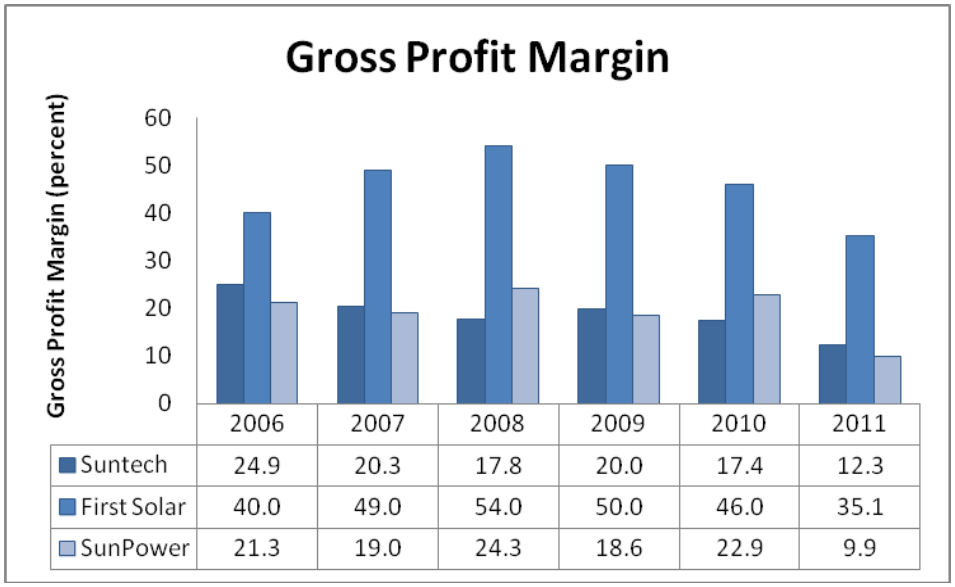
Source: Company documents.

Declining average sales prices hurt Suntech in 2009, but its shipments and margins that year actually improved over 2008 (see below).

Profitability

Through the end of 2010, Suntech was profitable, with respectable margins. In 2011, however, Suntech's profitability took a huge hit, and it has had multiple quarters of negative operating cash flow. These losses are mainly attributed to falling prices due to industry overcapacity, losses sustained in closing down thin-film operations, substantial foreign exchange losses, and charges due to severance of wafer supply agreements (due to falling prices). In 2011, net indebtedness increased to around 147 percent. Recently the debt-to-equity ratio has been estimated as high as 2.8.[16]

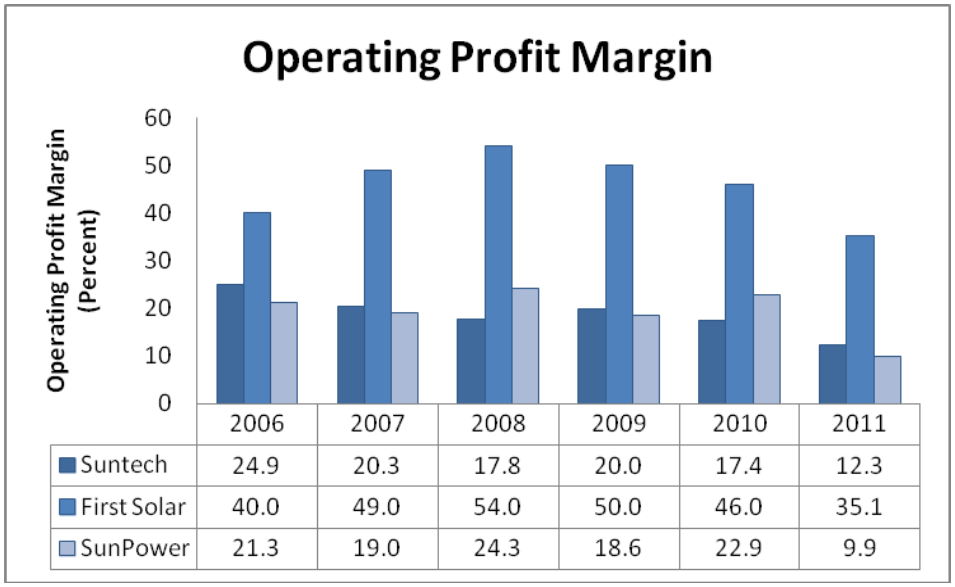
As seen below, First Solar boasts much higher margins than Suntech and Sunpower. First Solar's use of cadmium-telluride technology instead of silicon and its vertical integration have allowed it to retain much higher margins than its silicon-based competitors. This is likely to remain the case, but as polysilicon prices drop, competitors become more vertically integrated, and average sales prices continue to fall, the result will be downward pressure on First Solar's margins.[17] A weak FY 2011 with negative net profits and the closure of two of its major European plants in Germany already shows the erosion of this advantage. In a hotly contested market with overcapacity and low-cost competitors like Suntech, First Solar's competitiveness is already hurting; analysts report that the company's production operates at 70 cents a watt, whereas the figure for its competitors is an estimated 65 cents a watt.[18]



	2006	2007	2008	2009	2010	2011
Suntech	24.9	20.3	17.8	20.0	17.4	12.3
First Solar	40.0	49.0	54.0	50.0	46.0	35.1
SunPower	21.3	19.0	24.3	18.6	22.9	9.9

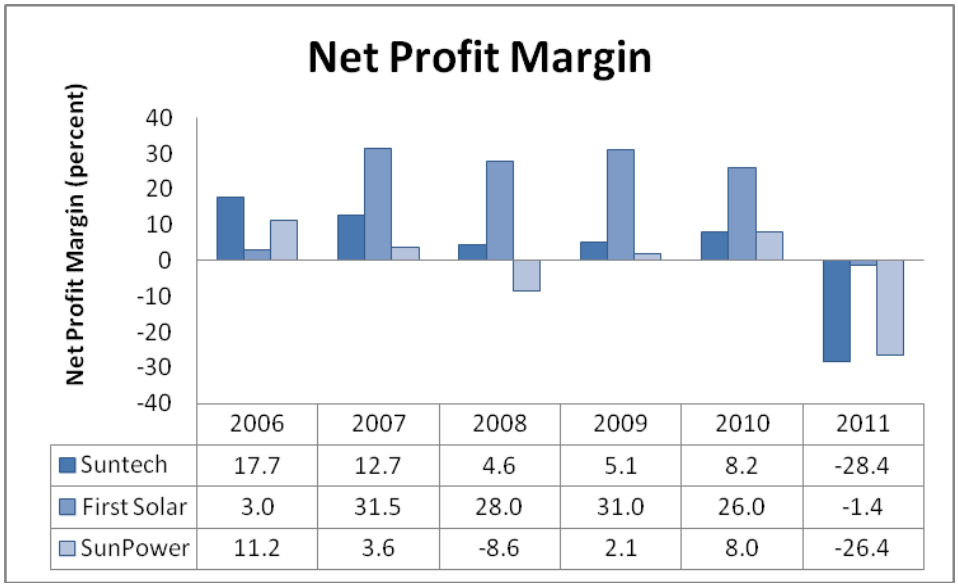
Source: Company documents.

[16] Ehren Goossens, "Chinese Solar Giants Likely to Get Bailout: Experts," Bloomberg, November 12, 2012, http://www.bloomberg.com/news/2012-11-12/china-solar-giants-likely-to-get-state-bailouts-experts.html.
[17] Energy Infrastructure Intelligence Group, "Supplier Integration: A Decline in Margins," *Foresight*, August 2011, http://marketing.poweradvocate.com/webfm_send/476.
[18] See http://www.bloomberg.com/news/print/2012-04-23/first-solar-reaches-record-low-as-analyst-questions-model.html.



	2006	2007	2008	2009	2010	2011
Suntech	24.9	20.3	17.8	20.0	17.4	12.3
First Solar	40.0	49.0	54.0	50.0	46.0	35.1
SunPower	21.3	19.0	24.3	18.6	22.9	9.9

Source: Company documents.



	2006	2007	2008	2009	2010	2011
Suntech	17.7	12.7	4.6	5.1	8.2	-28.4
First Solar	3.0	31.5	28.0	31.0	26.0	-1.4
SunPower	11.2	3.6	-8.6	2.1	8.0	-26.4

Source: Company documents.

It is worth noting that Suntech's net profit margins in 2010 were higher than its operating profit due to investment income from its Global Solar Fund (GSF). As margins decline on module sales, this fund income could be strategically important, but it also may raise red flags for some analysts if accounts

receivable from GSF grow. Currently there is little transparency about GSF's operations and holdings. Recent revelations of probable fraud may make this whole point moot.[19]

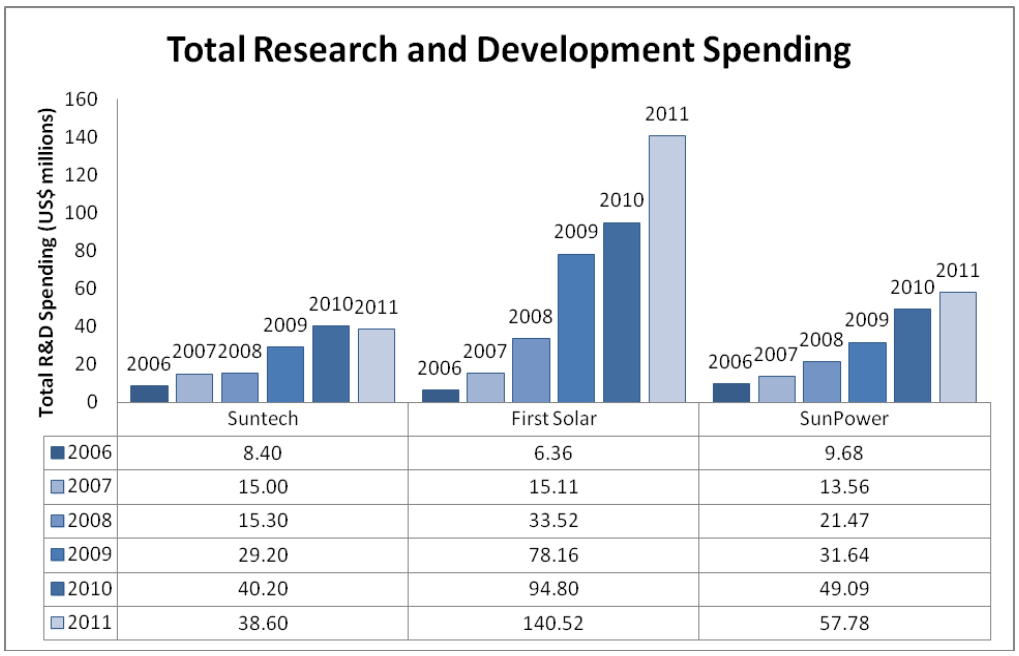
In April 2012, a Suntech executive announced that the company predicted a profitable fourth quarter of FY 2012 for the entire industry. This optimistic assessment is based on the influence of stabilizing polysilicon prices and solar companies' drive to slash their inventories.[20] However, it is unlikely that these trends will be able to counter the serious issues of overcapacity and uncertain global demand. Indeed, all three major competitors recorded negative net margins in 2011. This raises questions about whether this sort of state-directed industrial policy creates too much risk in the system as soon as overall market conditions deteriorate.

Research and Development

Suntech has its roots in PV technology research and development, beginning with the work of Shi Zhengrong in Australia, and over the company's history its research-and-development (R&D) operations have grown greatly in both size and scope. Now, according to the company, Suntech has 450 personnel involved in R&D, including 264 PV technology experts. It has cooperative relationships with a number of universities, including the Center of Excellence for Photovoltaic Engineering at UNSW; the Swinburne University of Technology in Australia (nanoplasmonic PV cell development); Zhongshan University in Guangzhou, China; and Shanghai Jiaotong University in Shanghai; as well as Zhengzhou University, Nanjing Aeronautic University, and Jiangnan University. That said, while research efforts have led to significant manufacturing and efficiency improvements, Suntech's current products are still fairly commoditized (in terms of product differentiation), depending more on scale and reliability than cutting-edge R&D.

[19] Samuel Shen and Stephen Jewkes, "Italian Road to China's Suntech Fraud Was Paved with Warnings," Reuters, August 6, 2012.

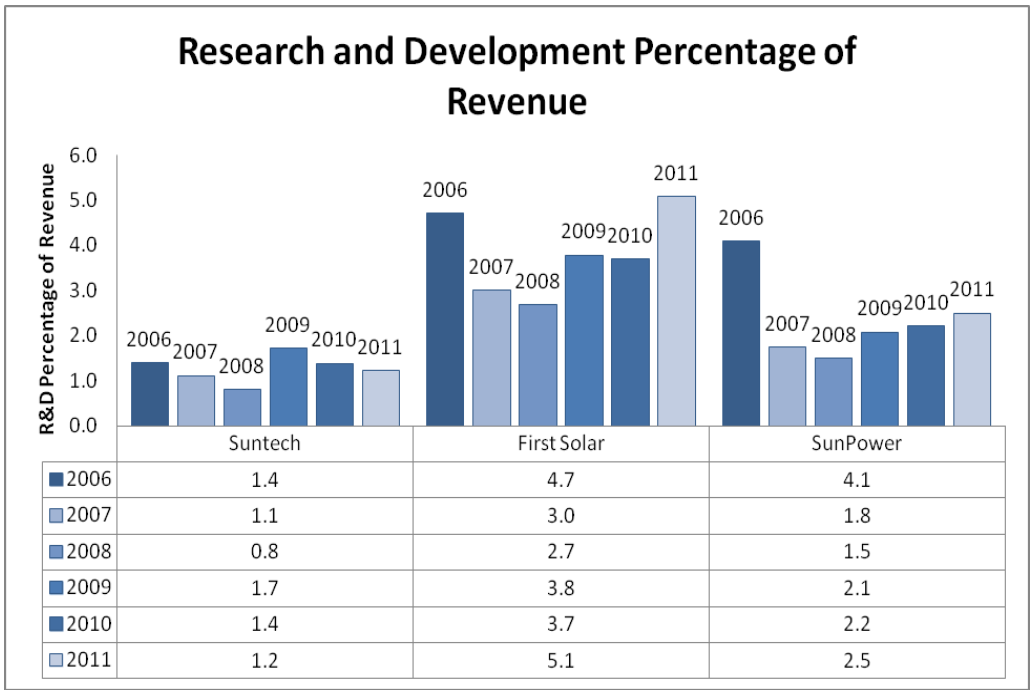
[20] See http://www.reuters.com/article/2012/04/03/us-suntech-idUSBRE83206420120403?feedType=RSS&feedName=businessNews&utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+reuters%2FbusinessNews+%28News+%2F+US+%2F+Business+News%29.



	Suntech	First Solar	SunPower
2006	8.40	6.36	9.68
2007	15.00	15.11	13.56
2008	15.30	33.52	21.47
2009	29.20	78.16	31.64
2010	40.20	94.80	49.09
2011	38.60	140.52	57.78

Source: Company documents.

It is likely that because much of Suntech's R&D is done either in China or in cooperation with universities like UNSW, its R&D costs are lower than some of its competitors. Suntech is also less focused than some competitors on cutting-edge research and more on making process improvements and cutting costs.



	Suntech	First Solar	SunPower
2006	1.4	4.7	4.1
2007	1.1	3.0	1.8
2008	0.8	2.7	1.5
2009	1.7	3.8	2.1
2010	1.4	3.7	2.2
2011	1.2	5.1	2.5

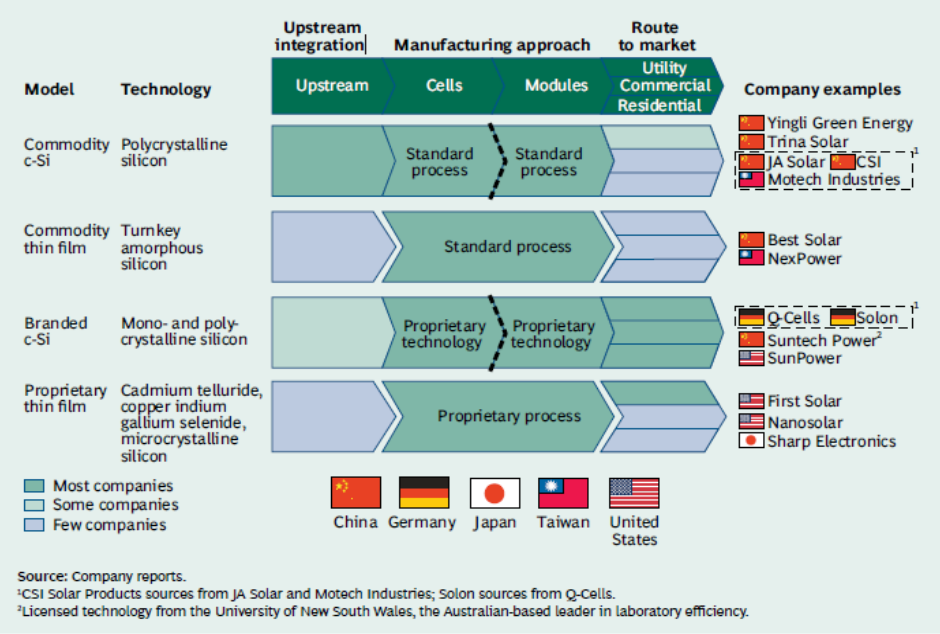
Source: Company documents.

Competitive Advantages

Technology improvements, lowered production costs, and government subsidies drive the solar industry. Production costs and technology improvements are the main ways to gain a competitive advantage within the industry, although different markets have different priorities (some look for higher efficiency and some for lower costs). Government market subsidies, like feed-in-tariffs, affect all companies in roughly the same way, while production subsidies naturally favor some firms over others. China has made concerted efforts to establish China as a solar technology base, with national policies that encourage the entire China-based solar-related manufacturing industry and some local government policies that favor specific domestic companies.

Technology Improvements

The two primary technology choices for solar cells are crystalline silicon (c-Si) and thin film. Design can be either off-the-shelf (commoditized) technology or proprietary. Suntech and Sunpower use proprietary c-Si, while First Solar uses a proprietary thin film based on cadmium-telluride. BCG produced the following useful diagram:



Source: Larry Alberts et al., "Sunrise in the East: China's Advance in Solar PV-and the Competitive Implications for the Industry," Boston Consulting Group, December 2010, 4, http://www.bcg.com/documents/file68429.pdf.

Suntech's technology is more efficient than that of First Solar, but less than that of Sun Power. First Solar tends to be more competitive in large-scale solar farms, whereas Suntech's c-Si-based technology is more competitive in smaller-scale commercial and residential applications, where decreased footprint and higher efficiency are more highly valued.

Suntech's next-generation solar cell technology is called Pluto, which goes into its solar modules called HiPerforma. Developed by UNSW, Pluto boasts efficiency in the 19 percent range for monocrystalline and 16.5 to 17.5 percent for multicrystalline.[21] In 2010 Suntech produced 50 MW of Pluto-based modules and planned to quadruple that in 2011.

Suntech is also working with the Swinburne University of Technology in Australia to develop nanoplasmonic solar cells that are twice as efficient and run at half the cost of those currently available.[22] Swinburne contributed $3 million to the venture, with Suntech pledging a further $3 million over the course of the collaboration. The research received a $5 million grant from the Australian government.

Lowered Production Costs

- *Scale:* With over 2.4G W of manufacturing capacity, Suntech is the largest module manufacturer in the world. Economies of scale allow Suntech to lower margins and squeeze out manufacturing efficiencies.

- *Local equipment:* Suntech has control over much of its production processes through self-designed or modified equipment. Suntech acquired the German firm KSL-Kuttler in 2008 to help design specialty equipment and improve automation. In 2008, Suntech's semiautomated production lines cost a fraction of similar lines in the United States that depended on off-the-shelf equipment.[23] That said, Suntech still relies on a fair amount of foreign machine tools, such as wire saws, furnaces and ovens, quality control systems, and screen printing machines.

- *Vertical integration:* Vertical integration is a key to margin sustainability in the solar industry.[24] While Suntech's vertical integration seems to allow it to both control the overall cost and secure access to most parts of the supply chain, in reality this is a virtual integration, as much of the access to silicon is subject to firm and market risk (long-term supplier agreements and partial

[21] Chang, "Suntech," 8. Also see Mark Osborne, "Suntech Grabs Multi-Crystalline Module Efficiency World Record," *PV Tech*, August 19, 2009, http://www.pv-tech.org/news/suntech_grabs_multi-crystalline_module_efficiency_world_record.
[22] "Nanoplasmonic Solar Cells Twice as Efficient as Current Solar Cells," Azonano.com, April 6, 2009, http://www.azonano.com/news.aspx?newsID=10757.
[23] Frost & Sullivan, "2008 Global Solar Energy Development Company of the Year Award," http://partsonsale.com/Suntech_wins_Frost_Sullivan.pdf.
[24] "Asia Solar," Nomura Equity Research, April 5, 2011, 3.

equity investments). Suntech is also expanding production via joint venture so as to expand capacity in a cost-effective manner (also allowing Suntech to decrease demand in a more flexible manner if oversupply becomes an issue). Suntech established a JV with Wuxi Industrial Development Group and Wuxi New District E&D Group, investing $60 million for a 40 percent stake in the manufacturer, but getting 600 MW of annual cell capacity in 2011 and another 600 MW the following year.[25] Further control over wafering costs should also come from the acquisition of Rietech.

- *Silicon access:* Silicon inventories have been a critical factor in the solar industry, as fluctuations in prices can have a dramatic effect on margins. Suntech does not produce silicon, but it has long-term contracts with and equity investments in a number of silicon suppliers. Half of its silicon comes from overseas, 30 percent from the United States.[26] Given that polysilicon is such a large part of the cost of a module, its price is highly important to Suntech's viability. China's polysilicon production is now greatly expanding, and will likely take share away from the United States, probably creating a supply glut.

- *Labor:* According to Suntech, labor is only 3–4 percent of the cost of making crystalline solar panels. Increased automation meant that in 2008 Suntech needed four workers per MW of production capacity, and in 2010 only needed 1.49 workers.[27] Low-cost Chinese labor should not be a significant competitive advantage, though it is a factor when combined with other discounts. Another important aspect of labor, however, is the concentration of human capital. A trained and experienced workforce allows for the spread of competition and the growth of the industry. This should become a considerable competitive advantage for the entire Chinese solar industry.

- *Energy cost:* Actual energy costs for specific industries are difficult to obtain, as preferential rates are provided to certain companies. Energy prices are determined by the type of consumer, amount of consumption, and region of China, and a large company like Suntech would pay an official rate of $0.091 to $0.098 per kilowatt-hour (kWh) in Jiangsu as of December 2011.[28] According to estimates by IEA and DBS, industrial electricity tariffs over the last few years (2007–

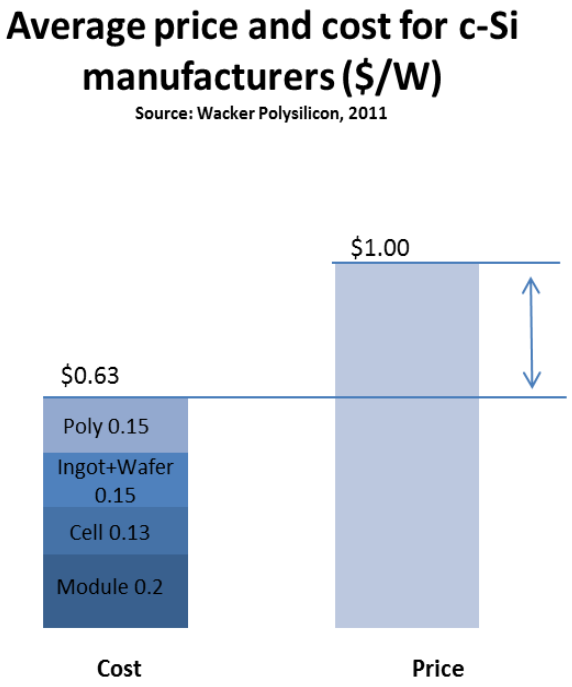
[25] Ucilia Wang, "Suntech's Art of War Strategy," *PV Magazine*, December 2010, http://www.pv-magazine.com/news/details/beitrag/suntechs-art-of-war-strategy--factory-jvs--in-house-production-and-project-investments_100001721/

[26] "China-US Solar Trade War has Complex Arguments," China Energy Intelligence and Communication, November 25, 2011, http://www.energychinaforum.com/news/57281.shtml

[27] Kevin Bullis, "Chinese Solar Companies Thrive on Manufacturing Innovations," *Technology Review* (MIT), July 6, 2011, http://www.technologyreview.com/business/37954/.

[28] He Yifan, "江苏省最新销售电价表" (Jiangsu Province Most Recent Energy Consumption Price Table), Zhongguo Dianli Xinxi Wang (China Energy Information Network), December 6, 2011, http://www.12398.gov.cn/openinfo/gongDianSubUnit.action?unitid=7569&catalogid=2605.

11) ranged from $0.105 to $0.117 per kWh, which would put them in line with U.S. prices, but cheaper than Europe.[29] Electricity cost is a very significant component for polysilicon production, which could mean cheaper inputs for Suntech if local electric tariffs are significantly lower than they are internationally.

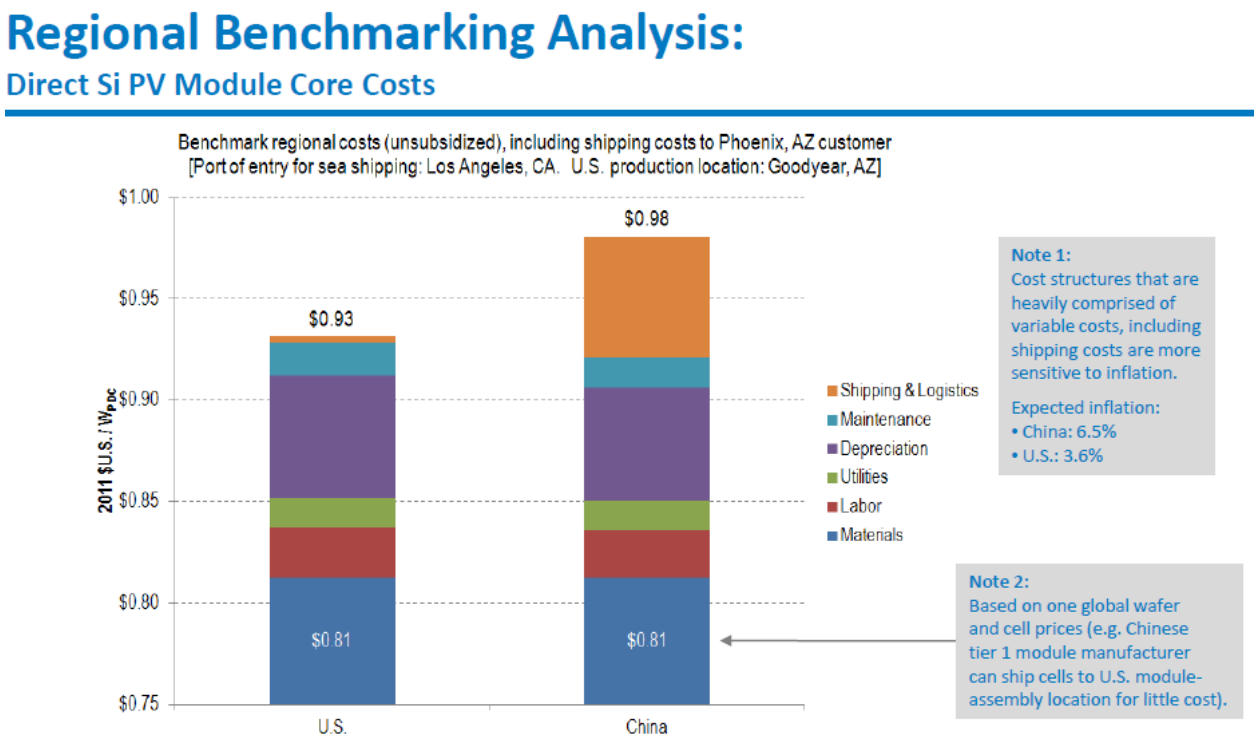


- *Investment and project finance:* Suntech is the majority shareholder in GSF, a European-based fund that invests in companies that own or develop solar projects. This not only provides an outlet for Suntech products but also allows Suntech to reap the gains from the portfolio companies' performance. It also allows investment in some potential customer projects that need supportive financing. In 2010 Suntech realized of $250 million in equity income from GSF. It also shipped a total of $313.2 million in solar panels to investee companies in 2009 and 2010.[30] This is something to watch, however, because a fund like this could also be used to inflate sales. It is also increasingly likely, however, that recent fraud issues may have an impact on the ongoing viability of this entity.

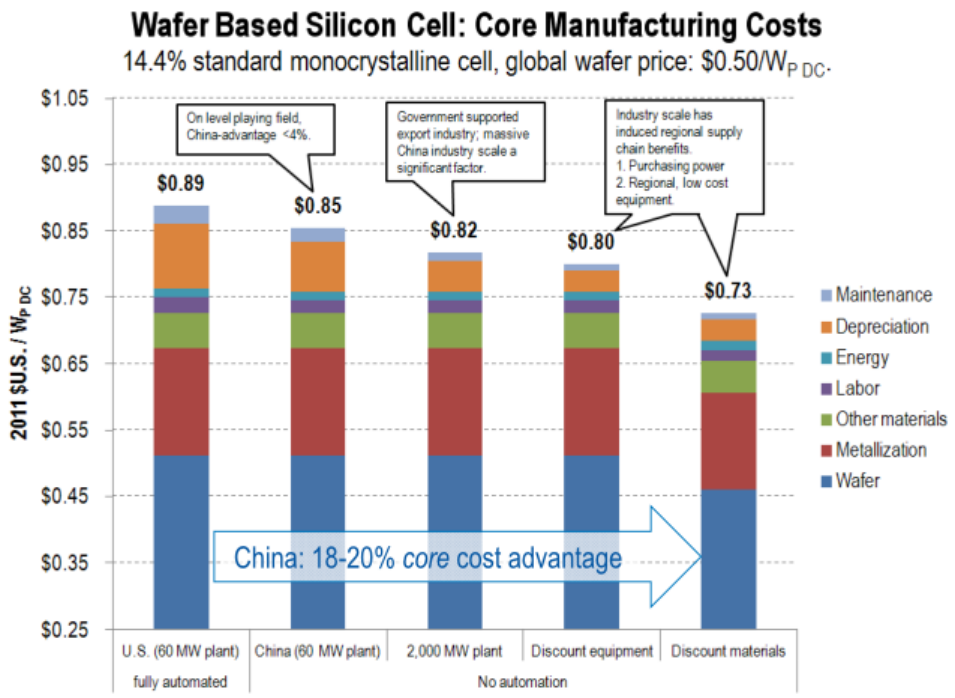
[29] See http://www.iea.org/papers/2011/Integration_of_Renewables.pdf; and https://www.dbsvresearch.com/research%5Cdbs%5Cresearch.nsf/(vwAllDocs)/17F0CBCF95C2A3324825789600198A4F/$FILE/CN_110520.pdf.

[30] Suntech Power Holdings Co., *2010 Annual Report.*

- *Transportation cost:* With regard to most of its major export markets, one area where Suntech does not have a distinct advantage is transportation costs. According to estimates by the U.S. National Renewable Energy Laboratory, China enjoys a 1–2 percent cost advantage, not accounting for shipping. When shipping costs are included, however, using the cost of transporting material from Shanghai to the West Coast of the United States as an example, these figures put China at 5 percent cost disadvantage. Local manufacturing in key markets will be increasingly important for Suntech and other Chinese firms.



Source: Alan Goodrich, Ted James, and Michael Woodhouse, "Solar PV Manufacturing Cost Analysis: U.S. Competitiveness in a Global Industry," presented at Precourt Institute for Energy, Stanford University, October 10, 2011, Stanford, Calif. Reprinted with permission from National Renewable Energy Laboratory, http://www.nrel.gov/docs/fy12osti/53938.pdf.



Source: Alan Goodrich, Ted James, and Michael Woodhouse, "Solar PV Manufacturing Cost Analysis: U.S. Competitiveness in a Global Industry," presented at Precourt Institute for Energy, Stanford University, October 10, 2011, Stanford, Calif. Reprinted with permission from National Renewable Energy Laboratory, http://www.nrel.gov/docs/fy12osti/53938.pdf.

Government Support

The most contentious aspect of Suntech's development, and that of the entire Chinese PV cell manufacturing industry, has been the accusations of unfair government support leading to decisive competitive advantage. At the most basic level, the Chinese government has targeted the solar industry as a key industry for development. One of the primary ways in which this is done is through inclusion in the five-year plans, the most recent of which, the 12th, outlined seven strategic industries. One of these is alternative energy, including solar. This provides a powerful signal to local governments and banks. Local governments all compete to make these industries pillars of the local economy, and banks are encouraged to lend to these industries. There are many other ways, however, in which all levels of the Chinese government can encourage industry-wide and firm-specific development.

The U.S. International Trade Commission antidumping and countervailing duties investigation brought by SolarWorld Industries America (the U.S. subsidiary of the German firm Solarworld AG) references a

long list of possible subsidies provided by the Chinese government. The U.S. Department of Commerce lists the following possibly countervailable subsidies included in the investigation:[31]

LIST OF RELATED CHINESE SUBSIDIES

I. Grant Programs
   - A. Export Product Research and Development Fund
   - B. Subsidies for Development of "Famous Brands" and "China World Top Brands"
   - C. Sub-Central Government Subsidies for Development of "Famous Brands" and "China World Top Brands"
   - D. Special Energy Fund established by Shandong Province
   - E. Funds for Outward Expansion of Industries in Guangdong Province
   - F. Golden Sun Demonstration Program

II. Government Provision of Goods and Services for Less Than Adequate Remuneration ("LTAR")
   - A. Government Provision of Polysilicon for LTAR
   - B. Government Provision of Aluminum for LTAR
   - C. Government Provision of Power for LTAR

III. Government Provision of Land for LTAR

IV. Policy Lending to the Renewable Energy Industry

V. Income and Other Direct Tax Exemption and Reduction Programs
   - A. "Two Free, Three Half" Program for Foreign Invested Enterprises ("FIEs")
   - B. Income Tax Reductions for Export-Oriented FIEs
   - C. Income Tax Benefits for FIEs Based on Geographic Location
   - D. Local Income Tax Exemption and Reduction Programs for "Productive" FIEs
   - E. Tax Reductions for FIEs Purchasing Chinese-Made Equipment
   - F. Tax Offsets for Research and Development by FIEs
   - G. Tax Refunds for Reinvestment of FIE Profits in Export-Oriented Enterprises
   - H. Preferential Tax Programs for FIEs Recognized as High or New Technology Enterprises
   - I. Tax Reductions for High and New-Technology Enterprises Involved in Designated Projects
   - J. Preferential Income Tax Policy for Enterprises in the Northeast Region
   - K. Guangdong Province Tax Programs

VI. F. Indirect Tax and Tariff Exemption Programs
   - A. Value Added Tax ("VAT") Exemptions for Use of Imported Equipment
   - B. VAT Rebates on FIE Purchases of Chinese-Made Equipment
   - C. VAT and Tariff Exemptions for Purchases of Fixed Assets Under the Foreign Trade Development Fund Program

VII. Export Credit Subsidy Programs

VIII. Export Guarantees and Insurance for Green Technology

Source: U.S. International Trade Administration.

Not all these are applicable to Suntech; in fact, only a few of these seem to be real factors in Suntech's development. There are, however, a number of areas worthy of examination, including early direct government investment (the Wuxi model, access to financing, government project incentives, taxes, and, provision of goods, services, and land for less than adequate remuneration (LTAR):

[31] "Crystalline Silicon Photovoltaic Cells, Whether or Not Assembled into Modules from the People's Republic of China: Initiation of Countervailing Duty Investigation," 76 FR 70966, November 16, 2011, available at http://federalregister.gov/a/2011-29624.

- *Wuxi model:* The Wuxi government clearly played an important role in the early stage of Suntech's development. The government invested (or essentially pooled) $6 million as start-up capital. The Wuxi government also actively searched for projects and encouraged Suntech to apply for funding from national and local sources. Suntech ended up amassing about RMB 39 million (approximately $5.5 million) in financial aid (which it did not need to pay back).[32] From 2001 to 2005, Wuxi helped Suntech get 11 projects, 1 in 2001, 1 in 2005, and 9 between 2003 and 2004. Its accumulated funding from provincial governments' technology departments was about RMB 20 million.[33] In light of Suntech's recent troubles, at the end of September 2012 the mayor of Wuxi arranged a $31.7 million loan to cover immediate debt issues.

- *Financing:* One of the primary complaints about the Chinese solar industry is that it is backed by cheap money from the government. Examining Suntech's financials, however, makes this concern seem exaggerated. Suntech claims that its average debt rate is 6 percent. According to Suntech's filings with the U.S. Securities and Exchange Commission, their interest rates from the Bank of China and China Development Bank range from a low of the 3-month London Interbank Offered Rate (LIBOR) plus 2.6 percent to a high of 4.86 percent (per annum). Suntech also has a loan from the Bank of Shanghai, the rate of which is not listed, but Suntech had not drawn on the loan by the end of 2010. These borrowing costs do not seem abnormal. First Solar lists a variety of borrowing rates in its annual report, including 4 percent, 3-month LIBOR plus 2.74 percent, and credit facilities at LIBOR plus 2.25 percent. That said, when inflation is taken into consideration, the real cost of borrowing in China is negative. For domestic firms, this is a strong incentive to borrow and invest in capital equipment and land.

  As far as the project financing made available to Suntech customers, the U.S. Export-Import bank also finances projects in this manner. In August 2011, the Ex-Im Bank approved an$ 84.3 million loan to Reliance Power of India to purchase solar modules from First Solar at an interest rate of around 3.96 percent. This financing is critical in maintaining a financing edge over international competitors. For example, in India, the funding cost of capital for these projects is estimated at 13.3 percent.[34] As another comparison, Solyndra's loans were around 6 percent.[35]

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[32] Liu Xiao and Bao Sheng, "Qianxi zhengfu zhaoshang guannian de zhuanbian: Wuxi shande dianli jituan dailai de qishi yu sikao" (Analysis of the Transformations in Government Policy to Attract Businesses: Lessons from Wuxi Suntech Power), *Journal of Hubei University of Economics (Humanities and Social Sciences)* 6 (June 2009): 9–10.
[33] He Yifan, "首富，政府造" (New richest man, made by government), *Zhong Guo Qi Ye Jia* (China Entrepreneur) 266 (March 20, 2006).
[34] Natalie Obiko Pearson, "Reliance Power to Buy First Solar Panels for U.S.-Backed Project," Bloomberg, September 4, 2011, http://www.bloomberg.com/news/2011-09-05/reliance-power-to-buy-first-solar-panels-for-u-s-backed-project.html.

While Suntech has a much-publicized nonbinding loan agreement with China Development Bank of $7.33 billion, it has only drawn on a small portion of this. It is more an indication of the readiness of China Development Bank to enter into further financing agreements with Suntech. This ready access to finds actually may be more important than the actual rate itself. Suntech is currently extraordinarily laden with debt. Its net debt as of March 31, 2012, was approximately $2.3 billion, with quarterly interest expenses of $35.7 million. While this debt load is a critical concern, access to further funds and an ability to either renew short-term debt or convert short-term debt to long-term debt may make servicing this debt possible—which almost certainly would not be the case for a company from somewhere else without government support. Local governments in China have influence over bank lending, and while there may be concern about the short-term health of a company like Suntech, Suntech's importance to local employment, local gross domestic product and contributions to foreign direct investment, and strategic industry development should provide sufficient government incentive to encourage further lending flexibility. The provincial government of Jiangsu has a particular interest in supporting Suntech. According to Shi Zhengrong, the Jiangsu PV industry is valued at RMB 200 billion, accounting for 60 percent of China's PV production, and employs 170,000 local people.[36] Again, this is why the mayor of Wuxi stepped in recently with funding support.

[35] Sally Bakewell, "Chinese Renewable Companies Slow to Tap $47 Billion Credit," Bloomberg, November 16, 2011, http://www.bloomberg.com/news/2011-11-16/chinese-renewable-companies-slow-to-tap-47-billion-credit-line.html.
[36]"扎实工作 稳中求进"(Solid work while maintaining stability), *Zhongguo Renmin Gongheguo Zhongyang Renmin Zhengfu*, Central government of the People's Republic of China, http://www.gov.cn/ldhd/2011-12/20/content_2024915.htm.

SUNTECH'S BANK FINANCING

- April 2009: Five-year syndicated loan facility agreement led by China Development Bank and Bank of China, restricted to the purchase of fixed assets. It has a maximum borrowing amount of $198.5 million and bears interest at 6-month LIBOR plus 3.5 percent per annum. The facility is secured by Suntech's existing fixed assets. Suntech drew down $118.5 million in 2009, of which $1.5m has been paid as of December 31, 2010.[37]
- May 2010: Three-year credit loan facility agreement with Bank of China, restricted to the purchase of fixed assets. It has a maximum borrowing amount of $54.3 million and bears interest of 4.86 percent per annum. The company drew down $42.9 million in 2010.
- October 2010: Three-year, long-term loan facility agreement with Bank of Shanghai, restricted to the purchase of fixed assets. It has a maximum borrowing amount of $60.7 million. None of the credit facility had been drawn down as of December 31, 2010.[38]
- December 2010: One-year loan facility agreement with China Development Bank for utilization in daily operations. It has a maximum borrowing amount of $220 million and bears interest at the 3-month LIBOR plus 2.6 percent per annum. Suntech had drawn down $205 million of the loan by December 31, 2010.
- December 2010: Five-year, long-term loan facility agreement with China Development Bank, restricted to the purchase of fixed assets. It has a maximum borrowing amount of $60 million and bears interest at the 6-month LIBOR plus 3.3 percent per annum. The company had drawn down $20 million of the loan by December 31, 2010.
- January 2011: Three-year credit loan facility agreement with China Development Bank. It has a maximum borrowing amount of $130 million to be used for working capital and an interest rate of LIBOR plus 2.92 percent. All $130 million had been drawn down as of December 2011.
- July 2011: Credit facility agreement for 1.5-years with the Bank of China. The facility has a maximum borrowing amount of $436.5 million, including $7.14 million for working capital and $429 million for trade finance. The facility bears interest at 6.56 percent. The company has drawn down $7.14 million for working capital and $359 million for trade finance as of December 31, 2011.

- *The Golden Sun and Solar Roof programs:* Instituted by the Chinese government in 2009, these programs provide up-front subsidies for solar installations. The Solar Roof program promotes smaller-scale building-integrated photovoltaic and rooftop installations. The Golden Sun program

[37] Suntech data from 2010 20-F SEC filing and 2011 20-F SEC filing.

[38] Current information will not be available until the release of the annual SEC filings in May 2012.

subsidizes larger-scale projects, with a 50–70 percent subsidy of the cost of installation, transmission, and distribution. At least half the Golden Sun subsidies went to small to medium-sized firms, which needed a lifeline after the global financial crisis; for larger firms, Golden Sun pilots served more as a chance for a demonstration than a real significant source of revenue.[39] This subsidy moved to a fixed tariff per watt in 2011, probably to counter the bloated cost claims that were being submitted. These programs, which emphasize installation, did not resolve the problem of grid pricing. The advent of the feed-in tariff should have a much more significant impact on the overall adoption of solar energy than these earlier programs have and is likely to be the policy that investors and producers were waiting for to stimulate Chinese demand. The feed-in tariff announced in August 2011 was set at RMB 1 per kWh but could go down to RMB 0.8 by 2015.[40]

- *Tax structure:* According to Suntech's 2010 20-F filing with the U.S. Securities and Exchange Commission, Suntech America is subject to the U.S. federal corporate income tax at a rate of 35 percent and the California state corporate income tax at a rate of 8.8 percent. Suntech Japan is subject to Japan's corporate (national) as well as corporate inhabitant and enterprise (local) taxes, which result in a total rate of approximately 40.69 percent. Suntech Power Investment in Singapore is subject to a flat rate corporate income tax of 17 percent on its chargeable income. Suntech Power International in Switzerland is subject to a corporate income tax of approximately 6 percent.

  As of 2007, the standard enterprise income tax for both foreign-invested and domestic Chinese companies was 25 percent. Most of Suntech's subsidiaries located in China receive preferential tax treatment because they fall under "encouraged" areas. As "new and high-technology companies," they enjoy a 15 percent preferential enterprise income tax rate. Only two of its subsidiaries are taxed at the standard rate of 25 percent.[41]

  In 2011 there was concern that Suntech's wafer subsidiary Rietech Solar would have to face the 25 percent standard Chinese corporate income tax. This would have increased the overall tax rate to 20 percent for the year. In its most recent annual report, however, Suntech has made clear that it has resolved the Rietech taxation issue at least for now, and that the subsidiary will enjoy a 15 percent tax rate through 2013.

  China's Enterprise Income Tax laws contain a number of important benefits. High-technology companies are eligible for a tax rate of 15 percent, and companies that produce renewable energy goods can be exempt from corporate income taxes for the first three years, followed by a 50 percent

[39] Ying Yuan, "Burned by the Sun," *Southern Weekend*, March 24, 2010, translated on Chinadialogue, http://www.chinadialogue.net/article/show/single/en/4232.
[40] "China to Double Solar Capacity by Year End: Report," Reuters, August 12, 2011, http://www.reuters.com/article/2011/08/13/us-china-solar-idUSTRE77C0AR20110813.
[41] Shenzhen Suntech Power Co., Ltd. and Suntech Energy Engineering Co., Ltd.

reduction the following three years. Considering that it may take one of these companies a couple years to turn an operating profit, this is a considerable benefit. R&D expenditures also have a 150 percent deduction or amortization benefit. Purchases of certain related equipment are also exempt from import taxes. There are also income tax credits for domestic equipment purchases.

Value-added tax (VAT) rebates are another contentious area of tax support. China first started its export tax rebate policy in 1985, as stipulated by its "Regulations on Import and Export Duties of the People's Republic of China."[42] The rebate was meant to compensate exporting enterprises for their indirect taxation in the production and distribution phases. In 1994, China based the system on VATs.[43] VAT refunds (either the entire 17 percent or part of it) can be applied to different export-oriented industries as a way to encourage or assist them. As China attempts to move up the industrial value chain, these VAT refunds have been reduced or eliminated for low-end products, and shifted to strategic industries like solar. Companies that are in target industries in certain economic zones get exemptions from import duties and some VATs while receiving VAT export tax rebates, a very significant set of advantages. This rebate policy allows Chinese goods to enter foreign markets at real cost price and therefore helps China's export-led growth.[44] Often these rebates serve as the main source of profit for Chinese firms. These VAT and export tax refund programs were continued and expanded after the financial crisis, as both the national and local governments were concerned with a contraction in external demanding hurting export industries. Jiangsu Province increased the existing export tax rebate most recently in December 2011.[45] Because Suntech is a large company and a high- and new-technology company, such rebates are available to it, and the company states that it makes use of economic incentives like rebates.[46] Suntech does not disclose to what extent it uses VAT and export rebates, but they are important enough that the company claims a reduction in such incentives "may have a material adverse effect on our business and prospects."[47] In Wuxi, home to Suntech's headquarters and the bulk of its Chinese operations, export tax rebates totaled an estimated $5.79 billion in 2009 and $2.24 billion in the first half of 2011.[48]

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[42] State Council of China, "Regulations on Import and Export Duties of the People's Republic of China," Novexcn.com, http://www.novexcn.com/import_export_duties.html.

[43] Cui, Zhiyuan, "China's Export Tax Rebate Policy," *China: An International Journal* 1, no. 2 (September 2003): 339–49.

[44] Ibid.

[45] Ye Pan, "江苏："出口退税"优惠政策助力企业转型升级"(Jiangsu: Export Tax Incentives Help Companies Advance"), Xinhua Net, December 19, 2011, http://www.js.xinhuanet.com/xin_wen_zhong_xin/2011-12/19/content_24364879.htm.

[46] Suntech 2010 filing, 6.

[47] Ibid.

[48] Figures for 2009 are from Wuxi State Taxation Bureau, "八千余户企业受惠出口退税 三年累计 600 余亿元," (8,000 Companies benefit from export tax rebate of more than 60 billion), 无锡市国家税务局, April 22, 2010,

Analysts in China have asked for more aggressive government action in terms of subsidies and preferential tax concessions to help solar energy companies, especially in light of the current subsidy rollback in Europe, the trade issues in the United States, and the entry of new competitors. They believe that China's energy tax policy is not as flexible or effective as other countries' because it is limited to simple tax cuts rather than additional tools such as production tax credits, tax deferrals, consumer tax incentives, and so on—not enough to outweigh the high risks that renewable energy startups face. Other suggestions include broadening import tax breaks to cover all the high-technology parts that companies need to import.[49]

- *Provision of goods, services, and land for "less than adequate remuneration" (LTAR):* In its complaint to the U.S. International Trade Commission, SolarWorld claims that polysilicon, aluminum, power, and land are provided at LTAR levels. At present, this is difficult to quantify. Polysilicon prices are often lower in China, but due primarily to the recent expansion in production. It is also unlikely that LTAR polysilicon, aluminum, and power give Suntech a measurable advantage. Cheap land has most certainly been dangled by various regions to attract manufacturing. The impact of subsidized or LTAR land is that it provides companies with healthy balance sheets in their early days that facilitate leveraging for further financing.

  Whether Suntech received any of these benefits is unclear, though its land leases were most probably acquired at less than market rates. Currently, its land use rights are valued at $36.9 million, a significant item on its balance sheet. Regardless of discounts, land for factory construction is certainly cheaper in China than in the United States or Europe, and the construction of factory facilities is cheaper and more efficient. Combined with relatively easy access to credit, scaling up manufacturing is much easier in China than in the United States, Japan, and Europe.

Response to the 2008 Financial Crisis

- To help Suntech, the local tax department gave a refund of RMB 800 million in December 2008. The Wuxi tax department, having already used up the city government's export tax refund sources, asked upper-level tax departments to supplement the Suntech refund. This was said to make up for a three-year "accounting error" by Suntech, where it paid more export taxes than needed.[50]

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http://www.jswx-n-tax.gov.cn/xwsd/gsyw/130103.shtml. Figures for 2011 are based on Wuxi State Taxation Bureau, "江阴国税"一二三"唱好出口退税歌" (Jiangyin '123 Tax' Receives Praise), August 2, 2011, http://www.jswx-n-tax.gov.cn/xwsd/gsyw/136735.shtml.

[49] Ma Yaochong and Han Guohui, "可再生能源税收政策" (On renewable energy tax policy), 金卡工程·经济与法 (January 2011), 272–73.

[50] "Shuishou Xinzheng Chengwei Wuxi Qiye Jishi Yu," (税收新政成为无锡企业"及时雨"), [New tax deals bring timely benefits to Wuxi Enterprises], Wuxi Taxation Bureau, http://www.jswx-n-tax.gov.cn/xwsd/gsyw/83097.shtml.

- Using Wuxi as a model, the national government allowed high-technology industries to enjoy a 10 percent tax concession from the Chinese Enterprise Income Tax's uniform corporate income tax of 25 percent. In other words, Suntech kept its preferential tax rate of 15 percent. The government also provided corporate income tax credits for domestic equipment investment, reinvestment tax refunds, software and service outsourcing industry export tax rebates, and a policy of "refund first, audit and write off later." [51]

- Suntech's 2009 calculations (according to then–chief financial officer Amy Yi Zhang): For annual sales of $2 billion and profit of RMB 1.5 billion, the 15 percent rate meant that Suntech saved RMB 150 million in taxes, and Wuxi's new monthly tax refund policy meant that Suntech could get monthly export tax rebates of RMB 100 million. With the then-current interest rate, Suntech's annual cost savings totaled RMB 6 million.[52]

- The International Monetary Fund helped Suntech to restructure its balance sheet as capital markets dried up and project financing withered by providing $50 million in quasi-equity. Suntech also raised $270 million from public markets, lengthened the maturity of debt obligations, and obtained loans of $100 million from the Bank of China and the China Development Bank.[53]

[51] Ibid.

[52] Ibid.

[53] "IFC Suntech Power Holdings," December 5, 2011, http://www.climatefinanceoptions.org/cfo/node/66.

The following comparison of manufacturing subsidies was done by the U.S. National Renewable Energy Laboratory:

Manufacturing Subsidies by Country

	U.S. Loan Guarantee, Manufacturing Tax Credit	U.S. State Subsidies	China
Domestic proprietorship required?			Yes
Sales/Value Added Tax waiver?	Yes	Yes	
Property tax credits	100%	100%	N/A
Subsidized cost of debt	4.0%	3.0%	3.0-4.5%
Subsidized debt limit (D/ D+E)	60%	60%	80%
delay in processing subsidized debt	2 years	<1 year	<1 year
Facilities grant		100%	100%
Land grant			Discount purchase (land use rights)
Training grant (millions USD)	$0.5-4.5	$0.5-4.5	
Effective Corporate income tax rate	28%	28%	21%
Income tax credits	30% MTC *Cash Grant in lieu*	State: 5-7 year holiday	20 year holiday

Source: "Solar PV Manufacturing Cost Analysis: U.S. Competitiveness in a Global Industry," Alan Goodrich, Ted James and Michael Woodhouse, presented at the Stanford University: Precourt Institute for Energy, 10 October 2011, Stanford, California, are reprinted with permission from National Renewable Energy Laboratory, http://www.nrel.gov/docs/fy12osti/53938.pdf.

However, after the completion of the initial draft of this report, the International Trade Commission and Department of Commerce announced final tariff rates for Suntech.[54] The result was 31.73 percent for antidumping and 14.78 percent for countervailing duties (subsidies). Details have not been fully released, but in terms of countervailing duties, because China is not considered a market-economy, many of the benchmarks likely came from Thailand and elsewhere.

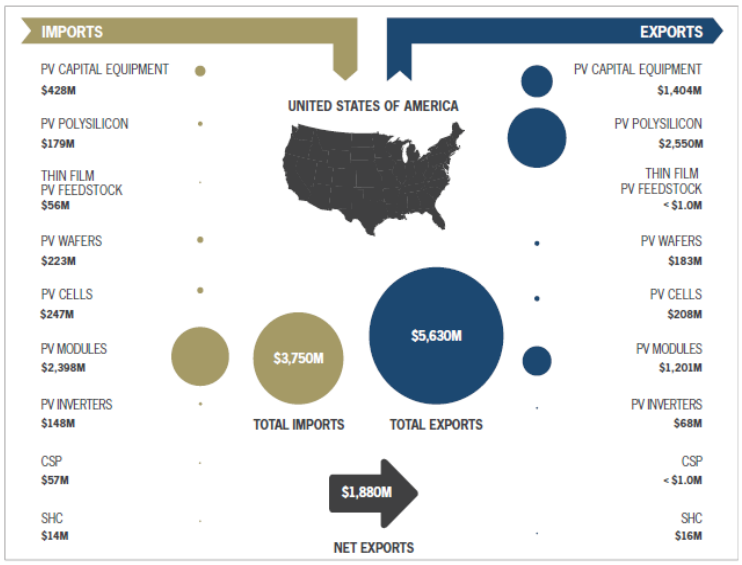
Value and Trade Flows

An important part of the discussion about the rise of Chinese solar companies like Suntech has to do with who is capturing the value. Much focus is on the solar modules, in which vertically integrated Chinese companies have a distinct and growing lead. But a solar module also depends on inputs, tooling, and

[54] See http://ia.ita.doc.gov/download/factsheets/factsheet_prc-solar-cells-ad-cvd-finals-20121010.pdf.

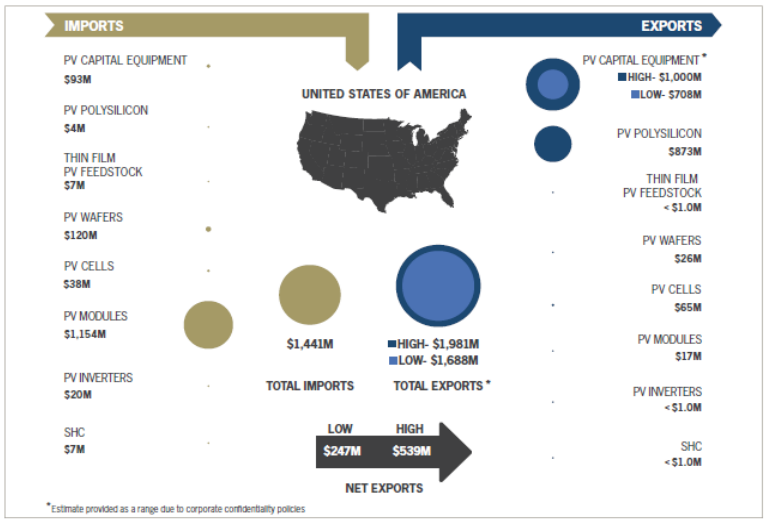
installations, all of which result in a significant amount of the value from U.S. solar installations residing in the United States.

Greentech Media's 2010 study for the Solar Energy Industries Association assessing the solar energy trade presents the following graphic to show the import-export relationship:[55]



Source: GTM Research, International Trade Commission

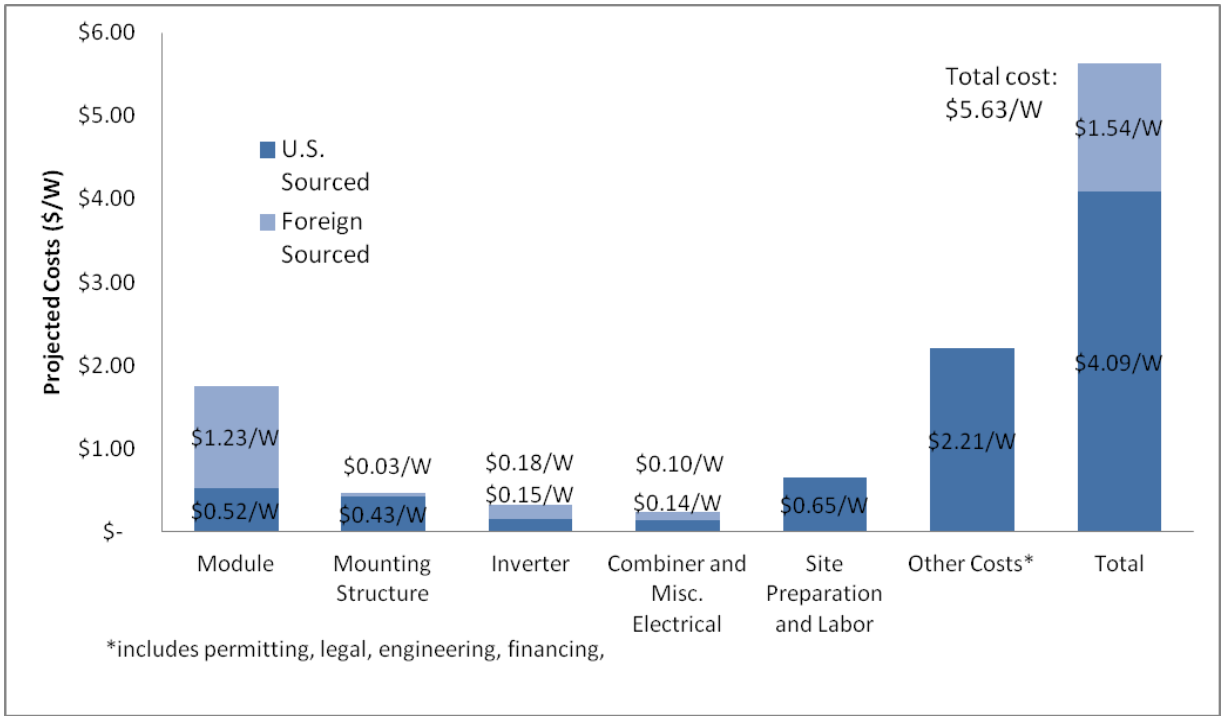
In 2010 the United States was a net exporter of solar products and had a positive solar trade balance with China. The United States exported polysilicon and PV capital equipment, and imported PV modules (the United States also exports modules, but has an overall trade deficit in them). United States–China trade flows for 2010 are estimated as follows:



Source: GTM Research

[55] Greentech Media, "U.S. Solar Energy Trade Assessment 2011," 2011.

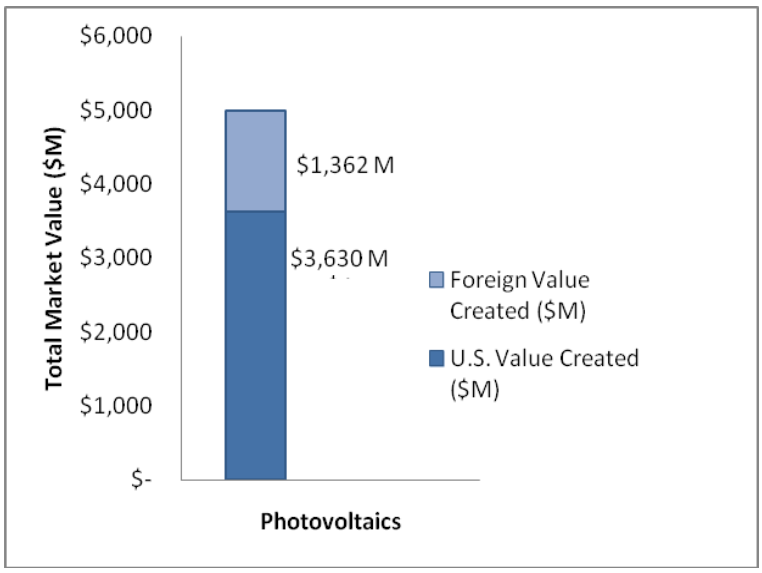
This will likely change when results come out for 2011; however, as the U.S. market for modules grew, which should lead to increased module imports, and manufacturing capacity growth slowed in China, one could reasonably expect slowing capital equipment sales.[56]



Source: GTM Research, 2010.

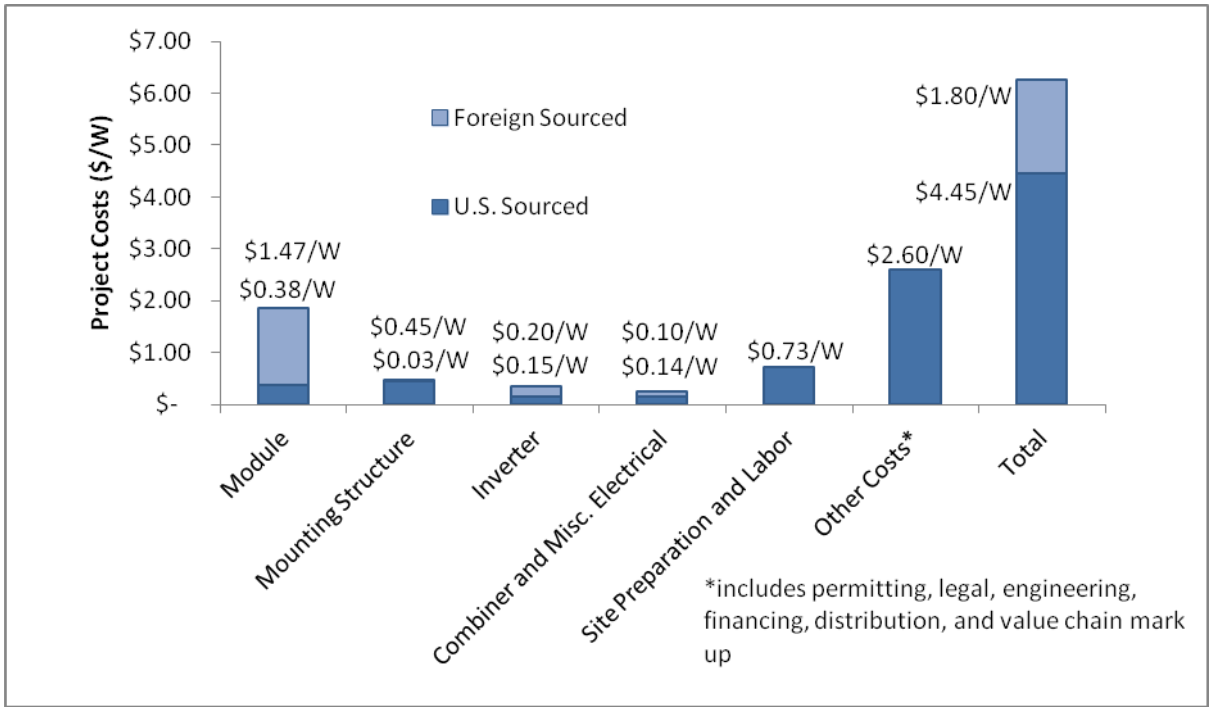
According to Greentech Media Research, in 2010 U.S. solar installations created a direct value of $6 billion, of which $4.4 billion accrued to the United States. Of that, $3.6 billion was attributed to solar PV (see below).

[56] Thanks to Shayle Kann of Greentech Media Research for pointing this out.



Source: GTM Research, 2010.

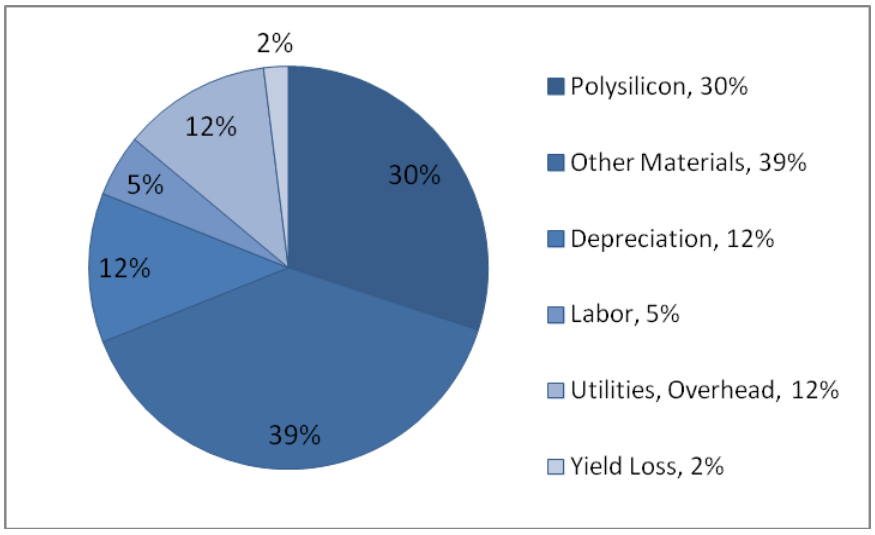
In a U.S. installation of a PV module, 30 percent of the value accrues to the United States, mainly from polysilicon, some module assembly, capital equipment, glass manufacturing, labor, and markup.[57] The cost breakdown for crystalline silicon systems in the United States is as follows:



Source: GTM Research, 2010.

[57] Greentech Media, "U.S. Solar Energy," 9.

In breaking down the cost structure of a Chinese-made crystalline silicon module, GTM Research provides the following breakdown:



Source: GTM Research, 2010.

Much of the depreciation should be attributed to equipment from outside China, though this is hard to verify due to the unwillingness of companies to share information about their equipment.

If labor is a small part of production costs, and capital equipment comes from the United States and Germany, then China must have an advantage in taxes, permitting, and factory inputs like land and utilities or other raw materials. The scale of Chinese factories and the speed at which they are permitted and built are significant advantages. And while countries, provinces, states, and municipalities globally provide incentives to establish manufacturing in their jurisdictions, the combination in China of access to land, ease of obtaining financing, low labor costs, tax incentives, and lower input costs make China a highly attractive place to set up module manufacturing.

Suntech's Relationship with Japan and the United States

Suntech relies on Japan and the United States in three major ways. The first is the original R&D of PV technology. Japan and the United States played key roles in the initial development and commercialization of this technology. While much of this happened decades ago, it is important to note the origin of the original research. China is still dependent in most areas on original research from the rest of the world.

Second, Suntech has been dependent for its growth on foreign markets, primarily Germany and Spain. In coming years, the United States and Japan will be very important growth markets. The United States was the fourth-largest market for solar last year—behind Germany, Italy, and Japan—and most analysts had

forecast 2011 U.S. demand of 1.5 to 1.6 GW.[58] Suntech is set to make deep inroads in Japan after the adoption of feed-in tariffs in June 2012. The company previously said that it hoped to reach 10 percent market share in Japan if a feed-in tariff is adopted. It is currently fourth, behind Sharp, Kyocera, Panasonic, and Mitsubishi.[59] Suntech built a 117,000-square-foot facility in Goodyear, Arizona, with 50 MW capacity, giving Suntech a substantial U.S. presence. Products produced there qualify for assistance under the American Recovery and Reinvestment Act. Suntech sells through a distribution network in the United States of over 400 dealers and expects the U.S. solar market to double in 2011. Suntech hopes to retain a U.S. market share of 20 percent.

Suntech is also dependent on polysilicon and capital equipment from the United States and Japan. Precision tooling is in many ways the core technology behind what is a fairly commoditized production process. While tweaks and improvements can be made in the plant, machinery is the critical foundation, and improvements in this technology, like decreasing wafer thickness, will drive efficiency improvements. Efficiency in turn drives down balance of system costs. Providers of key capital equipment from the United States are Applied Materials (wire saws and screen printing equipment), GT Solar (furnaces), Intevac (cell processing equipment), KLA Tencor (wafer inspection equipment), Kayex (crystal grower furnaces), and Despatch (ovens and other manufacturing equipment). There are also numerous German, Swiss, and other European firms providing related equipment. Chinese corporate income tax credits for domestic equipment purchases, however, seek to counter this trend.

Suntech has also collaborated with National Semiconductor, which provides chipsets for improving power output,[60] and with California-based Tigo Energy to increase energy production.[61] Suntech purchased SunFab equipment from Applied Materials to produce amorphous thin film panels, but dropped that product line after these products were found to be too costly and inefficient for Suntech's purposes.[62] In 2008 Suntech acquired MSK Corporation, Japan's largest PV manufacturer and one of the top ranked in building-integrated photovoltaics, adding to Suntech's technology and market access.

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[58] Nichola Groom and Matt Daily, "Suntech Sees Stronger U.S. Solar Growth," Reuters, October 17, 2011, http://www.reuters.com/article/2011/10/17/us-suntech-idUSTRE79G6MM20111017.

[59] Mayumi Negishi, "Suntech: Sure of 10 percent Japan Market Share in 2012," Reuters, June 21, 2011, http://www.reuters.com/article/2011/06/21/us-japan-summit-suntech-idUSTRE75K0J020110621.

[60] "National Semiconductor and Suntech Collaborate to Develop 'Smart Panel' Technology," National Semiconductor, October 5, 2010, http://www.national.com/news/item/0,1735,1492,00.html.

[61] "TIGO ENERGY and SUNTECH Sign Collaboration," Israel Cleantech Ventures, October 5, 2010, http://www.israelcleantech.com/portfolio_news_item.asp?ID=75&t=TIGO-ENERGY%C2%AE-and-SUNTECH-Sign-Collaboration-.

[62] Michael Kanellos, "Suntech Abandons Thin Film Solar, Wafer Experiments," Greentech Solar, August 6, 2010, http://www.greentechmedia.com/articles/read/suntech-abandons-thin-film-experiments.-revenue-up-for-2q/.

Key Findings

- The ability to rapidly scale production of a relatively commoditized product has been key to Suntech's success. In terms of solar panel production, China has the edge in scale and America has the edge in innovation. The United States should not lose sight of this. Considerable investment is required from both the government and private sector to maintain America's advantage in this field.

- Companies move to where doing business is easiest and cheapest. The solar industry is a wonderful example of how an industry that is not highly dependent upon cheap labor was able to thrive in China and do so without a significant Chinese domestic market. It is a story not about technological advantage, but rather the ease of starting and growing a business. Lowering corporate taxes, providing other tax breaks and incentives, and streamlining approval processes (both for manufacturing and project development) can go a long way to encourage local manufacturing.

- Having a domestic market is important for capturing value. While the majority of solar modules are manufactured in China, the United States and Japan are still able to capture significant downstream value in domestic solar installations. Much of this value is more sustainable than panel production. One of the most effective ways for the U.S. and Japanese governments to capture more value and create more jobs is to incentivize the adoption of solar energy via feed-in tariffs. This will also feed back into the benefits of local production, leading to an increase in skilled workforce, and the start of a virtuous cycle.

- Capital equipment research and development is important. Module production in China is still fairly dependent upon foreign capital equipment, especially from the United States and Germany. This is a specialized part of the value chain, enabling producers of such equipment to retain their competitive advantage. This cannot continue indefinitely if all production of modules moves away from where the capital equipment is made. Module producers provide important feedback to manufacturing equipment makers.

- There are real dangers in badly targeted government incentives. While some sector-specific policy incentives can be beneficial (and demand-side incentives are probably necessary in emerging industries like solar), Chinese government encouragement (both national and local) of the *manufacture* of solar cells, modules, and polysilicon has resulted in overleveraging, overcapacity, and global spillover effects. These incentives distort important market mechanisms, and the danger of overcapacity is real, as overall prices plummet and endanger otherwise healthy companies. Margins get squeezed as prices drop, and companies are further threatened by less healthy new entrants that offer lower quality goods at cheaper rates. While the market can deal

with this in long-term and still maintain a healthy (consolidated) solar sector, it is often fatal for individual firms in the near-term. It can also affect upstream suppliers who may suddenly cease to be viable.

- It is the *access* to large amounts of credit, as opposed to small differences in interest rates, which may be the single most important factor in firm-level development, as this advantage allows a company to grow and scale production when its competitors cannot. This has been especially evident during the financial crisis. This debt, however, may turn out to be too much of a burden for Suntech. The viability of the company no longer depends upon whether sales pick up fast enough to allow it to service its high level of debt, but rather on what terms it can strike with banks and government to roll over or forgive its debt.

ABOUT THE AUTHOR

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