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First Solar

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Tymen deJong, First Solar's senior vice president of module manufacturing,[1] fixated yet again on the company's latest 10-K. DeJong had joined the company in January of 2010, at a time when First Solar's future appeared bright. Now, just two years later, First Solar's cost advantage was eroding and deJong was facing challenges that would require tough decisions.

In 2009, First Solar broke cost records by becoming the first photovoltaic (PV) manufacturer to produce panels that generated a megawatt of power at a manufacturing cost of less than $1.00 per watt.[2] The company's proprietary thin-film cadmium telluride technology had made it the largest and lowest-cost producer for nearly a decade. However, the 2011 Form 10-K on deJong's desk revealed a net operating loss of $39 million, the company's first year-end net operating loss in the past seven years. Although revenues were $2.7 billion, revenue growth had slowed from 66% in FY 2009, to 24% in FY 2010, and then to a meager 8% in FY 2011.[3] Much of this slowed growth was attributable to broader trends affecting the entire PV industry. Chinese manufacturers, subsidized by their government, were flooding the market with low-price crystalline-silicon (c-Si) solar panels. Market demand for PV panels was also weakening. The 2008–2009 global financial crisis had squeezed government budgets and weakened the financial positions of many banks. As a result, the once-heavy European solar subsidies were shrinking and the willingness of banks to finance solar projects had virtually disappeared. Silicon raw material prices were also falling. This helped First Solar's competitors, which produced silicon-based panels, but not First Solar, which produced cadmium telluride-based ones.

[1] As of July 2015, Tymen deJong became the chief operating officer (COO) of First Solar.

[2] Watt: a unit of power is defined as 1 joule per second; it measures the rate of energy flow.

[3] First Solar Inc., Form 10 K, 2007.

This case was prepared by Jennifer Ballen, MBA 2017, and Professor Neil Thompson.

As deJong reflected on the company's recent financial slump, he wondered if First Solar's competitive edge had eroded permanently. How should First Solar respond to the threat from the Chinese manufacturers? What could the company do to maintain its cost advantage? Were First Solar's recent acquisitions of down-stream solar panel installers a strategic benefit or a distraction? DeJong knew that to answer these questions, he first needed to better understand the sources of First Solar's competitive advantage and whether these sources were sustainable.

PV Solar Manufacturing and Distribution

Solar Industry History and Evolution

In 1839, nineteen-year old French scientist Edmond Becquerel discovered the *photovoltaic effect*: that shining light on the junction of two dissimilar materials, such as a metal and a semiconductor, creates electric current. This led to Bell Lab's 1954 creation of the first functional solar cell. Early solar cells were inefficient and costly to manufacture, so their use was limited to high-value applications, such as space satellites.[4] By the early 1980s, PV solar cell use had broadened to consumer applications, such as calculators and watches, and by the mid-1990s utility companies had begun using PV solar plants, although costs continued to be higher than nonrenewable energy sources.

At the turn of the 21st century, two major types of solar technologies had emerged: solar thermal and photovoltaic. Solar thermal power plants used sunlight to generate heat that was used to boil water, with the resulting steam driving a turbine to create electricity. But, the fastest growing solar market was photovoltaics: the conversion of sunlight directly into electricity. First Solar produced exclusively photovoltaic panels

Overview of Photovoltaics

By early 2012, there were two dominant technologies used to produce PV solar power: (i) thin-film and (ii) crystalline silicon (c-Si) (**Exhibit 1**). The PV supply chains typically involved the following steps (**Figure 1**).

[4] "Solar Explained: Photovoltaics and Electricity," *U.S. Energy Information Administration,* October 25, 2015.

Figure 1 Steps in the PV Supply Chains

Production Stage	Process for Crystalline Silicon	Process For Thin Film
i) Raw material preparation	Raw silica, often in the form of sand, is purchased and purified.	A substrate (e.g. glass) and semiconductor (e.g. cadmium telluride, CdTe) are prepared by 3rd parties.
ii) Solar wafer production	Silicon is formed into thin circular wafers.	N/A
iii) Solar cell production[5]	Solar wafers are layered to generate electric current when hit by sunlight.	A thin layer of semiconductor is layered on top of the substrate, coated, and then defined with a laser.
iv) Module array production	Solar cells are electrically wired together into solar modules and weatherproofed.	
v) System integration and development	System integrators install completed modules and arrays. For utility customers, integrators also provide financing, engineering, construction, and ongoing maintenance.	

Source: Case writers.

Crystalline silicon was the dominant technology in the market, accounting for nearly 85% of manufactured solar panels over the last decade. Crystalline silicon was used for semiconductors in both electronics and solar cells. In 2001, 20% of total silicon use was allocated towards solar cell production, and 80% towards electronics. By 2010, this had reversed: 80% of total silicon use was for the manufacturing of solar cells. The rapid growth in demand from solar manufacturers increased silicon prices from $50/kg in 2001 to a peak of $475/kg in 2008.[6] In response, crystalline silicon manufacturers raced to improve cell efficiency and reduce the thickness of the silicon wafer, which decreased silicon use in solar cells from approximately 15 grams per watt in 2001 to 5 grams per watt by EOY 2011.[7] From 2008–2011, supply of silicon ramped up, causing prices to plunge from $475/kg back to $65/kg (**Exhibit 2**). Industry experts predicted that silicon prices would continue to decline further in the near future, benefiting First Solar's competitors.

An alternative to crystalline silicon was thin film technology, first commercialized in the early 2000s by First Solar and a small number of other manufacturers. True to its name, thin film technology involved the placement of thin layers of semiconductor material, such as cadmium telluride, on top of inexpensive substrates, such as glass or aluminum. Panels using thin film were typically lower cost and required 98% less semiconductor material than traditional c-Si panels. In 2011, cadmium telluride use in thin film solar panels was approximately 0.1 grams per watt. The price of cadmium telluride varied

[5] "The Difference Between Solar Cells and Solar Panels," *RGSEnergy.com.*

[6] "Mineral Commodity Summaries," *U.S. Geological Survey*, January 2012.

[7] Shyam Mehta, "The Shifting Relationship Between Solar and Silicon in Charts," *Greentech Media*, 2011.

over time, from $48/kg in 2006 to $192/kg in 2011 (**Exhibit 2**). Offsetting thin-film's cost advantage was its historically lower efficiency in converting sunlight into power for most applications (**Exhibit 3**).

The cost of nonrenewable fossil fuel power had historically been lower than that of renewable power. By the end of 2010, ignoring subsidies, it cost utilities approximately $0.15-$0.35/kWh to produce electricity from solar power, $0.08-$0.10/kWh to generate electricity from wind, and $0.06-$0.08/kWh for natural gas.[8] Coal cost only $0.04/kWh, but was the dirtiest form of power. Indeed, many coal plants with remaining useful life were being decommissioned to avoid the environmental and health damage they caused. Natural gas was becoming cost-competitive with coal due to the reduced cost of extracting natural gas through hydraulic fracking,[9] a technique that had increased in use substantially over the past decade. However, natural gas, while cleaner than coal, still produced carbon emissions and posed environmental risks. Historically, the cost of solar was much higher than other forms of power. In 1976, the cost of solar was approximately $2.00/kWh, but this cost was falling substantially as producers learned-by-doing and took advantage of economies of scale (**Exhibit 4**).

Global Market

Over the last decade, PV solar energy had become the fastest-growing power generation technology in the world. Much of this growth was driven by regulatory policies, as solar was still more expensive than traditional fossil fuels. Government incentives typically enhanced the returns for solar providers in two ways: either providing higher prices for solar power suppliers or requiring utilities to purchase a specific amount of solar power.[10] For example, Feed-in Tariffs (FiTs) were widely used, particularly in Europe, and offered solar producers long-term contracts at above-market, government-mandated rates. Another incentive, termed renewable portfolio standards, mandated that certain percentages of the energy produced by utilities be sourced from renewables, such as solar, wind, geothermal, or hydroelectric power. Renewable portfolio standards were used by many states in the United States, most significantly California that had been increasing renewable percentage requirements since 2002.

From 2002–2008, global PV demand increased at an average annual rate of 48%. However, in early 2009 the global financial crisis impacted the solar market, tightening the wallets of financial institutions and decreasing government spending. Existing subsidies allowed demand to continue increasing, but at a slower rate, after 2009. By early 2012, many governments had significantly reduced incentive programs. This was particularly evident in Europe, whose share of overall demand fell, albeit from a

[8] "Electricity Generation Estimates," *U.S. Energy Information Administration and Michigan State University*, April 2011.

[9] Hydraulic fracking is an extraction technique for oil and gas wells in which pressurized liquid is injected into the cracks in rock formations. Once the hydraulic pressure is removed from the well, the remnants of the fracking fluid ease the extraction of oil and gas.

[10] Government incentives came in many different forms including, but not exclusive to: feed-in-tariffs, renewable portfolio standards, quotas, tax credits, tendering systems, net metering, rebates, loans, and production incentives.

high level (**Exhibit 5**). Despite this, the total global PV installed base at EOY 2011 was 65 gigawatts and experts predicted that this would grow by 400-600 gigawatts by 2020.[11]

The biggest change in solar production was the large-scale entry of Chinese producers. In 2001, China comprised less than 1% of overall solar production, but by 2012 Chinese producers were manufacturing nearly 60% of the entire world's supply of PV panels[12] (**Exhibit 6**).

Market Segments

There were three broad markets for solar power: residential homeowners, commercial businesses, and utilities. The residential segment represented 29% of the total market and was predicted to grow to 35% by 2020. Commercial businesses comprised 40% of the market; this segment was expected to shrink to 25% by 2020. The utility market was predicted to be the fastest growing segment, with an expected increase in market share from 31% in 2011 to 40% by 2020. In all three markets there were numerous systems integrators.

The Residential Market In the residential market, PV solar manufacturers sold panels to third-party system integrators, installers, and distributors, who would physically position the panel on a homeowner's roof and connect the panel to the regional electric grid. Residential users were encouraged to adopt solar through investment tax credits and net metering incentives (which encouraged solar operators to sell unused electricity back to utilities).

Residential customers typically did not focus on the technology or maker of their solar panels, but instead on the overall costs and benefits of the installed system. The key criteria for a residential customer purchasing from a panel manufacturer were (in descending order): the levelized cost of electricity (an average cost measure per kWh across the lifetime of the system),[13] installation and distribution costs (expenses that were paid by the homeowner), watts per unit area, and sometimes even aesthetics, as some residential homeowners were concerned about the appearance of highly visible rooftop panels.

The Commercial Market Commercial and industrial businesses seeking to lower their operating expenses and carbon footprints also purchased solar power systems through third party system integrators and distributors. As commercial projects were typically larger in scope and required greater wattage per panel, the primary purchase consideration for commercial businesses was the levelized cost of electricity. When purchasing panels, commercial customers also focused on watts per unit area, installation and distribution costs, and reliability of the technology.

[11] Krister Aanesen, Stefan Heck, and Dickon Pinner, "Solar Power: Darkest Before Dawn," *McKinsey & Company*, May 2012.

[12] Robert Castellano, "China's EV Battery Industry Could Be A Repeat of Solar and Rare Earth Dominance," *Seeking Alpha,* October 25, 2016.

[13] See Glossary for more details.

The commercial and utility markets both financed solar projects with solar leases and power purchase agreements (PPAs), financial contracts between buyers and providers of electricity. With a PPA, the developer was responsible for the design, financing, and installation of the solar system at little to no cost for the customer. The developer also operated and maintained the system over the duration of the contract, typically 10-25 years. In return, the customer purchased the generated energy at a fixed rate from the developer. At contract termination, the customer would either extend the PPA, remove the system, or purchase the system from the developer. PPAs provided an assurance of both volume (all the kWh were sold) and price (as set by the PPA contract).

The Utility Market In contrast to the residential and commercial markets, the utility market encompassed a smaller number of larger-scale projects. For example, in the United States, there were approximately 60 new utility-scale solar projects in 2011, as compared to hundreds of thousands of projects in residential and commercial markets.[14] Some utilities purchased panels directly from PV manufacturers, while others purchased from system integrators and installers. System developers provided a variety of services to utility customers, including:

i. **Project Development:** obtaining land permits, negotiating purchase agreements, transmission interconnection, major engineering, and construction.
ii. **Operations and Maintenance:** subsequent to development, signing long-term contracts to provide on-site operations and maintenance, such as performance analysis, forecasting, contractual and regulatory advice, performance reporting, and inventory management.
iii. **Project Finance:** negotiating and executing power plant sales, raising capital from debt and equity markets, and structuring non-recourse project-level debt financing.
iv. **Engineering, Procurement and Construction:** engineering and designing power plants, developing grid integration, construction management, and procuring component parts from third parties.

The primary purchase consideration for the utility market depended on the placement. In space-constrained areas, the most important factor was typically watts-per-square meter, so that as much power as possible could be generated in small spaces. Utilities that were not space constrained were willing to purchase less efficient panels if the panels had a lower cost per kilowatt-hour. Many utility installations were not space constrained.

A vendor track record of successful and timely installation was typically the next purchase consideration for utilities. PV manufacturers that wanted to sell products to utilities in a certain location would often first establish a relationship with integrators that had a favorable track record in order to better reach that market. Finally, utilities purchased panels based on proven technology and anticipated

[14] "An Analysis of New Electric Generation Projects Constructed in 2011," *Electric Market Reform Initiative and American Public Power Association*, March 2012.

reliability of the system. Feed-in-tariffs were implemented by many governments to encourage demand and required utilities to buy renewable energy at above-market rates. Utilities often passed this incremental financial burden to their customers through a small extra fee on monthly electric bills.

First Solar

Brief Company History

First Solar originated as a glass company in 1984 under the name Glasstech Solar, founded by glass entrepreneur Harold McMaster. In 1990, the company was renamed to Solar Cells, Inc., and then once again in 1999 to First Solar, LLC, after True North Partners purchased a controlling interest in the company and the firm was recapitalized. John Walton, the son of Walmart's founder Sam Walton, and Mike Ahearn (who later became co-founder, Chairman, and the first CEO of First Solar) founded True North Partners. Walton and Ahearn both believed in the power of technology to accelerate sustainability.

On November 17, 2006, First Solar became a publicly-traded company (FSLR), raising $450 million at an initial offering price of $20 per share.[15] First Solar's business model focused solely on component manufacturing at first: designing and producing PV solar cells and modules to sell to project developers, system integrators, and operators of clean energy projects. Beginning in 2007 with a series of acquisitions, First Solar vertically integrated, buying system integrators primarily in the United States. Through its systems business, First Solar controlled the engineering, procurement, construction, operations, maintenance, and development of solar power plants, and at times, project finance.

Manufacturing and Costs

First Solar manufactured PV solar cells and modules using an advanced thin-film cadmium telluride (CdTe) technology, controlling all stages of production entirely in-house which, according to First Solar's 10-K, "…eliminated the multiple supply chain operators and expensive and time consuming batch processing steps that are used to produce crystalline silicon solar modules."

In 2005, First Solar produced its first commercial solar module. First Solar used a proprietary vapor deposition technology to coat glass panels with two thin layers of semiconductor material: first cadmium sulfide, then cadmium telluride. High speed lasers then divided the semiconductor into cells, the fundamental units for absorbing light and converting it into electricity. Solar cells were combined to form solar modules and solar modules were combined to form solar panels to scale up the amount of electricity provided.

Tymen deJong commented on First Solar's use of thin-film:

[15] Nasdaq, First Solar Inc. IPO priced November 17, 2006.

> Most of the early work in photovoltaic generation was done on crystalline silicon, so that's where the R&D investments went. While there was an awareness of thin-film and cadmium telluride, there simply was not that much money being invested in it. There are significant technical challenges in applying cadmium telluride. We figured it out early and, to this day, we have a tremendous amount of IP around how to do that. The barriers to entry to figure this all out are years of R&D and hundreds of millions of dollars in capital expenditures. And, to be fair, all of the early efficiency records were based on c-Si…it looked like a better technology to new entrants. But, if you want to look at thin-film, you have to do all that work yourself. Our company leaders had this vision around CdTe and what we could do.

Historically, First Solar produced all of its modules at its manufacturing plant in Perrysburg, Ohio, which later evolved to also become the company's primary research and development (R&D) center. In April of 2007, First Solar expanded production internationally and began to produce modules at its Frankfurt/Oder Germany plant.

As of 2011, First Solar operated 36 production lines in Perrysburg, Ohio; Frankfurt, Germany; and, Kulim, Malaysia. Of these, the Malaysian plants had the lowest production costs, but the other plants had advantages in terms of R&D or serving particular markets. The company's newest plant was built in Frankfurt, Germany in November of 2011. This was First Solar's second plant in Frankfurt, adding a capacity of 250 megawatts per year to the region. The plant had taken First Solar one year to construct and cost roughly 170 million euros (US $230 million).[16] First Solar also had two plants under construction in Mesa, Arizona and Ho Chi Minh City, Vietnam.[17]

Traditionally, First Solar had operated its plants very close to 100% capacity in order to maximize use of the expensive fixed capital required to produce PV panels. By 2011, however, the increasing market share of Chinese competitors led to First Solar producing only 1.7 gigawatts of panels (approximately 21 million solar modules) despite having the capacity to produce 2.5 gigawatts.

The manufacturing cost per watt for First Solar and its competitors is shown in **Exhibit 7**.

Customer and Market Strategy

The majority of First Solar's early customers were system integrators, developers, and operators, primarily located in subsidy-rich Europe. In 2008, approximately 74% of the company's net sales resulted from Germany alone.[18] In order to diversify, First Solar expanded into direct sales in high-sunshine, non-subsidy reliant markets, primarily selling systems to utilities in Africa, the Middle East, and the Americas.

[16] Jonathan Gifford, "First Solar Inaugurates Second German Plant," *PV Magazine,* November 3, 2011.

[17] First Solar Inc., Form 10-K, 2011.

[18] First Solar Inc., Form 10-K, 2010.

The company first ventured into the systems business in late 2007 with a $34.4 million acquisition of system integrator, Turner Renewable Energy. Further acquisitions of Mission Edison's project pipeline, OptiSolar (a power plant contractor), NextLight Renewable Power (a solar panel developer), and Ray Tracker (a component parts firm), expanded First Solar's presence in the systems market.[19] While First Solar became closer to the customer, these acquisitions also brought with them higher SG&A expenses. From 2009 to 2011, First Solar grew its utility-scale systems business from 5% to 25% of overall sales, narrowing the gap between itself and systems leader, SunPower, which derived 53% of its business from systems in 2010 and 46% in 2011. Chinese manufacturers were largely absent from the systems business. **Exhibit 8** provides additional details.

Financial Strategy

First Solar pursued a conservative financial strategy, borrowing less than its competitors. From 2007–2011, First Solar had an average annual debt of $276 million, whereas SunPower had $687 million, Suntech had $1.7 billion, and Yingli Solar had $1.1 billion. First Solar also consistently kept more cash on hand than competitors, for use in financing promising solar projects. Capacity expansions were typically funded with 50% cash and 50% equity. Bruce Sohn, former President and Board member (2003–2011), commented on First Solar's financial approach:

> The reason we pursued a low leverage strategy was because we wanted a strong balance sheet. This served to both lower borrowing costs [for First Solar customers] and provide confidence to buyers that we would be able to sustain our business for the long-term. We did it by design for those reasons. In contrast, our competitors during this time were levering up and borrowing to expand, and thus had weak balance sheets. People didn't trust those companies. First Solar took the opposite approach.

Exhibit 9 shows both the income statements and balance sheets for First Solar and its main competitors.

Vertical Integration

All PV manufacturers produced solar modules, with several outsourcing various aspects of semiconductor production. Few forward-integrated into systems, so First Solar was unusual in this respect. The company divided its business into two interrelated segments: components and systems. The components business manufactured cadmium telluride solar cells and modules, while the systems business developed those components into complete solar systems. The components segment had historically achieved higher profitability and generated more cash than systems, but the systems business had less margin variability because the provision of ongoing maintenance, engineering, and construction was less dependent on materials prices.

[19] First Solar Inc., Form 10 K, 2007.

Sohn commented on the vertical integration:

> We realized that we could scale our production faster than our customers [the systems integrators] were able to scale their business. Our customers were the constraint and we determined that if we could vertically integrate, especially in places where our customers did not operate, then we could grow significantly faster. This effectively doubled our shipment rate and enabled steep volume growth even during a period of heightened competition.
>
> Having our own utility scale solar business also provided us with the opportunity to optimize overall system design…For several years, First Solar was able to deliver systems that yielded up to 5% better performance than competitors because of our intimate knowledge about the [First Solar] panels.

Competition

United States

Although U.S. customers were initially slower to adopt PV solar power than their European and Asian counterparts, by 2011 U.S. solar installations had grown enormously, doubling from 2009 to 2011. In 2011, the U.S. market share of total global PV installations increased from 5% to 7%. U.S. market share was anticipated to outpace the growth of other nations over the next five years. Reported installed solar capacity from 2010–2011 in the United States was a total of 1,855 megawatts, comprised of 16% residential, 43% commercial, and 41% utility. The utility market had only recently grown in size, while the commercial market had long accounted for over 50% of solar energy growth.[20] As in the rest of the world, the majority of modules produced in the United States used crystalline silicon technology.

In 2011, First Solar controlled approximately 41% of the U.S. market. SunPower was the second largest PV manufacturer, controlling 38.5%, while the remaining 20.5% of the market went to smaller players including Solyndra, SunEdison, SunRun, Evergreen Solar, and Spectrawatt, Inc.[21] SunPower manufactured highly efficient (18.1%–20.1%) and more expensive, solar panels and modules. In 2011, SunPower was suffering a similar fate to First Solar, also recording its first year-end net operating loss since 2007. SunPower's gross margin over the past five years had decreased from 19% in 2007 to 10% at EOY 2011. In April 2011, SunPower sold a 60% controlling interest to the oil company Total for $1.38 billion. Total offered SunPower up to $1 billion of credit over the ensuing five years.[22]

Solyndra, a California-based solar panel manufacturer, also competed in the thin-film market, using a copper indium gallium (di)selenide (CIGS) technology to design and manufacture panels, primarily for

[20] "U.S. Solar Market Insight Report 2011 Year-In-Review," *Solar Energy Industries Association,* 2011.

[21] First Solar, Inc., Form 10K, 2011; SunPower Corporation, Form 10K, 2011.

[22] "Total to Begin Friendly Tender for Up to 60% of SunPower Shares," *Bloomberg*, March 28, 2011.

commercial customers. Although Solyndra had increased production from 30 MW in 2009 to 67 MW in 2010,[23] the company was ultimately forced to declare bankruptcy in September of 2011. Analysts speculated the bankruptcy was due to an over-leveraged balance sheet and tightening credit conditions.

China

In 2009, the Chinese government declared leadership in PV solar production a national priority, ratifying a multitude of solar subsidy programs that transformed China into the world's largest producer of solar panels in just a few short years. Crystalline silicon manufacturers from China began producing quickly, cheaply, and in mass quantities, exporting over 90% of their panels abroad.[24] Chinese manufacturers also had much lower R&D expenditures, typically a third to a half as much as First Solar. Major players in the Chinese market included Suntech, Yingli, and Trina Solar.

The Chinese government subsidized both the demand and supply of PV solar panels. Domestically, the government subsidized demand through a series of initiatives. In March of 2009, China released its first national solar subsidy initiative called "building-integrated photovoltaics," a government subsidy providing up to 20 RMB (US$3) per watt for such systems and 15 RMB per watt for rooftop systems.[25] By July, the program had offered $1.2 billion in subsidies. That same year, China launched its second national solar subsidy program: Golden Sun. This program sought to accelerate the development of utility-scale solar projects, offering a 50% subsidy for building, transmission, and distribution costs. The subsidy increased to 70% for PV projects in remote areas lacking connection to the grid. The government's stated intent was to install over 500 megawatts of solar power in two to three years.[26] A variety of similar subsidies were implemented in the following years. Collectively, the yearly installation of PV panels in China grew more than 1000% from 2009 to 2011.[27]

Chinese subsidization of suppliers is harder to quantify. One 2011 U.S. Department of Energy and Stanford University study attempted to quantify the scale of the advantages of producing in China, including subsidies, low-cost equipment, cheaper labor, and regional supply chain advantages (**Exhibit 10**). This study found that the Chinese cost advantage due to subsidies for PV manufacturers was approximately 18-20% of costs, when compared with a 60 MW crystalline silicon U.S. plant. In 2011, the World Trade Organization (WTO) began an investigation of Chinese subsidies, ultimately concluding that of the 18-20% cost advantage, 1/5 was due to subsidies, most of which manifested in the form of lower depreciation. In other words, the Chinese government was primarily subsidizing the building of new plants rather than ongoing operations.[28]

[23] "2010 Solar Technologies Market Report," *U.S. Department of Energy*, November 2011.

[24] "Why Millions of Chinese-Made Solar Panels Sat Unused in Southern California Warehouses for Years," *Pacific Standard*, June 30, 2015.

[25] It is important to note that this number applies to the entire solar system, not just the panel, and therefore is not comparable to values in Exhibit 2.

[26] Lin Jones, "China's National Solar Subsidy Programs," *China Policy in Focus*, 2012.

[27] Greentech Media Research, PV Pulse, 2008-2011.

[28] Mark Clayton, "China Subsidized Solar Panels, U.S. Finds…" *Csmonitor.com*, March 2012.

Chinese manufacturers produced so many panels over this period that they had to store millions of panels in warehouses in California. Many of these panels sat unused until they became obsolete for the U.S. market.[29] In October 2011, Solarworld, along with six anonymous PV manufacturers, filed an anti-dumping[30] lawsuit with the Department of Commerce and the International Trade Commission, contending that crystalline-silicon Chinese manufacturers were benefiting from illegal subsidies and dumping their modules into the U.S. market. Industry experts had given credence to this anti-dumping lawsuit by accusing Chinese suppliers of selling modules below their bill of materials and contending that the Chinese government was giving free equipment, gifts of land, deferred taxes and other benefits to its domestic manufacturers. The severity of this for First Solar was captured in the company's 2011 10-K Filing:

> In 2011, industry average module pricing declined significantly as competitors reduced prices to sell-through inventories in Europe and elsewhere. If competitors reduce module pricing to levels near or below their manufacturing costs, or are able to operate at minimal or negative operating margins for sustained periods of time, our results of operations could be adversely affected. At December 31, 2011, the global PV industry consisted of more than 150 manufacturers of solar modules and cells. In the aggregate, these (global PV) manufacturers have installed production capacity that significantly exceeded global demand in 2011. We believe this structural imbalance between supply and demand (i.e., where production capacity significantly exceeds current global demand) will continue for the foreseeable future, and we expect that it will continue to put pressure on pricing, which could adversely affect our results of operations.

Bankruptcies

The combination of the flood of inexpensive panels from China and the drop in subsidies in Europe drove down solar prices worldwide, forcing the closure of numerous manufacturing plants, particularly in the United States. On August 15, 2011, U.S manufacturer Evergreen Solar, Inc. filed for bankruptcy, closing at $0.18 on the NASDAQ, a dramatic end to a stock that in 2007 had a price of $113.10 and a promising future. The price of solar wafers, Evergreen Solar's main product, had dropped 35% in the last 12 months.[31] Just one week later, SpectraWatt Inc., backed by Intel Corp. and Goldman Sachs Group, also filed for Chapter 11 bankruptcy.[32] The U.S. solar industry was suffering, and higher-cost producers were being hit the hardest.

[29] "Why Millions of Chinese-Made Solar Panels Sat Unused in Southern California Warehouses for Years," *Pacific Standard*, June 30, 2015.

[30] Dumping: when a foreign producer sells goods or services in domestic country for a price lower than production costs and/or the domestic producer's selling price. The price difference is referred to as the dumping margin.

[31] Nichola Groom, "Solar Company Evergreen Files for Bankruptcy," *Reuters,* August 15, 2011.

[32] Andrew Herndon and Michael Bathon, "Intel-Backed Solar Company Files for Bankruptcy as Prices Slide," *Bloomberg,* August 24, 2011.

In September of 2011, U.S. CIGS[33] manufacturer Solyndra filed for bankruptcy after just six years of operation, resulting in the loss of thousands of jobs. Solyndra's insolvency was also politically charged because just two years earlier the company had received a $535 million loan guarantee from the U.S. Department of Energy, the first-ever loan recipient under the 2009 American Recovery and Reinvestment Act. At the time, U.S. President Barack Obama had publicly praised Solyndra for setting a positive example for the "future" of American energy businesses.[34] Solyndra had also received over $700 million in venture capital funding during its time of operation.[35] Although Solyndra was not considered a major player in the global solar market, its default on a federal loan guarantee carried higher implications than other bankruptcies: Solyndra became a proof of concept for those seeking to diminish loan-guarantees and other incentives for clean energy.

First Solar's Response

Protagonist Prepares for Upcoming Meeting

DeJong was concerned. The quarterly Board meeting was just around the corner and he knew that the company's recent financial underperformance meant he would have to field intense questions from employees and investors. The $413 million loss in 4Q 2011 amounted to a per-share loss of $4.78. Just one year ago, during 4Q 2010, First Solar had earned a $155.9 million ($1.80 per share) quarterly profit.

Could First Solar still be profitable if silicon prices continued to fall? Was the systems business a competitive advantage or a distraction? What changes did First Solar need to make to counter the threat of Chinese entrants? If First Solar was forced to retrench, which market should the company focus on, and would it be able to prevail in that market? Could the company maintain its competitive advantage or would it follow other American solar manufacturers into bankruptcy in the face of these difficult challenges?

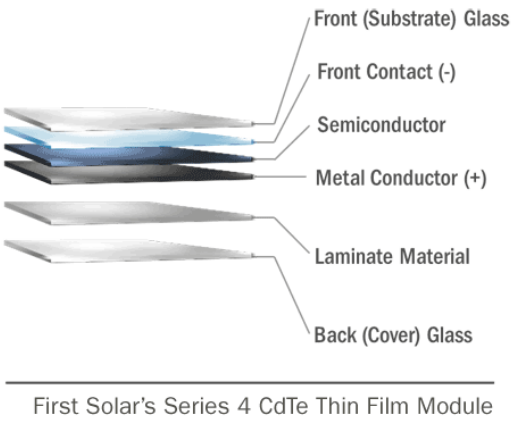
[33] CIGS: short for Copper-Indium-Gallium-Selenide, a technology used to manufacture thin-film solar cells and modules.

[34] Joe Stephens and Carol D. Leonnig, "Solyndra Solar Company Fails after Getting Federal Loan Guarantees," *Washington Post,* August 31, 2011.

[35] Tom Hals, "U.S. Solar Frm Solyndra Files for Bankruptcy," *Reuters,* September 6, 2011.

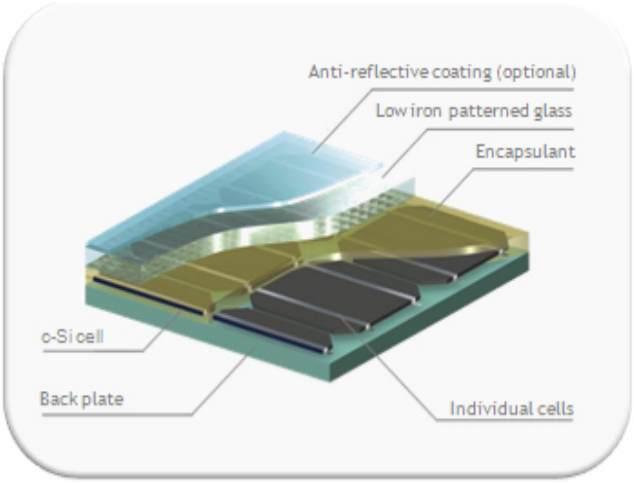
Exhibit 1 Thin-Film and Crystalline Silicon Solar Cells

Thin film



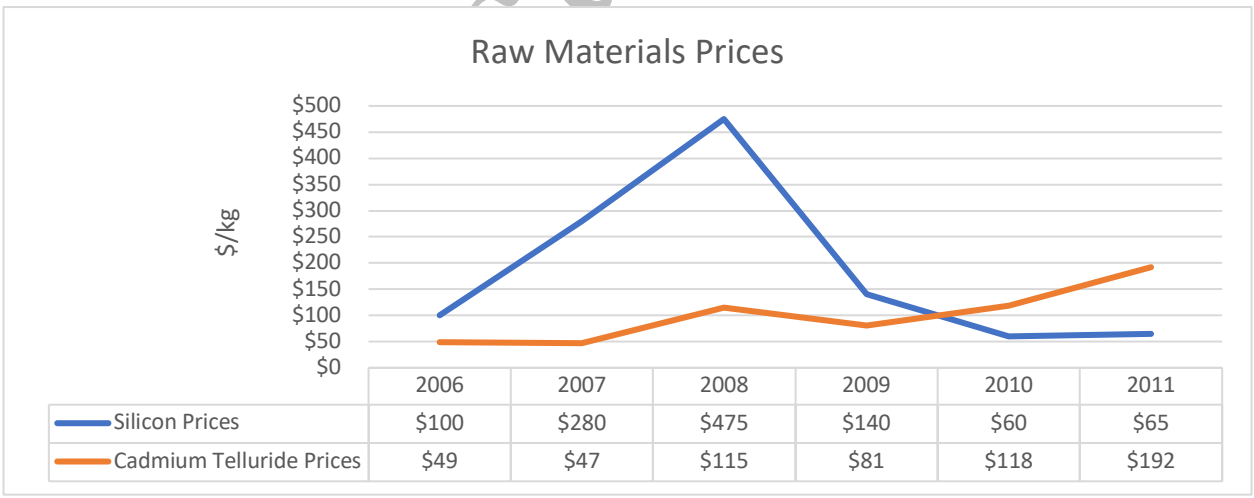
First Solar's Series 4 CdTe Thin Film Module

Crystalline Silicon



Source: First Solar.

Exhibit 2 Raw Materials Prices[36]



	2006	2007	2008	2009	2010	2011
Silicon Prices	$100	$280	$475	$140	$60	$65
Cadmium Telluride Prices	$49	$47	$115	$81	$118	$192

Sources: U.S. Geological Survey, Mineral Commodity Summaries, January 2012; PV Insights.

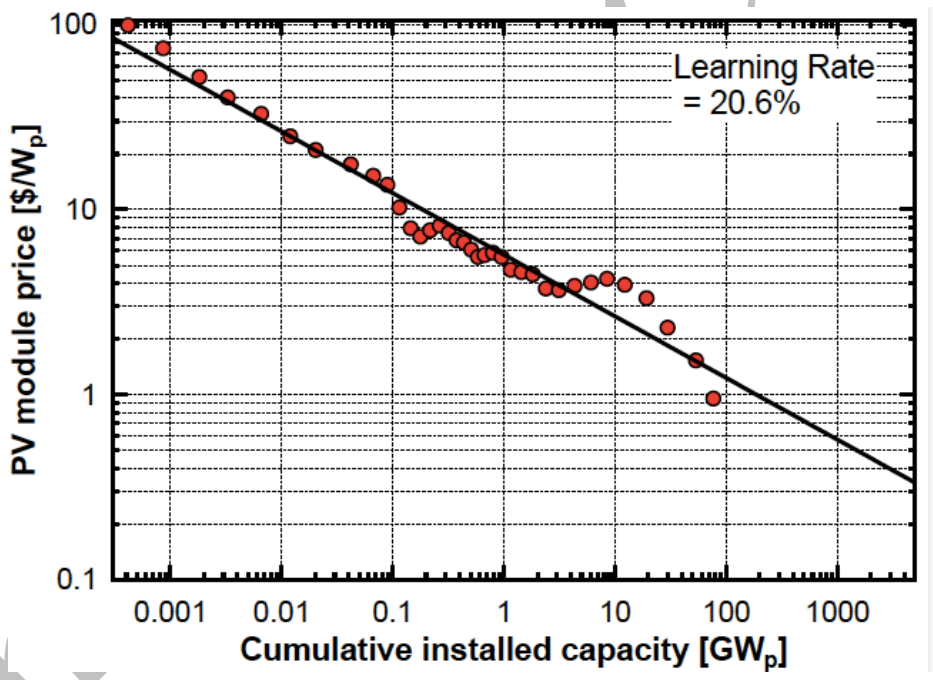
[36] Cadmium telluride prices calculated based on the cost of the two input materials: cadmium and telluride.

Exhibit 3 Module Size and Wattage[37]

Company	Area of Solar Module	Watts per Module
First Solar	8 ft^2	80
SunPower	23.3 ft^2	435
Suntech	13.8 ft^2	190
Yingli	10.76 ft^2	130

Source: Company SEC Form 10-Ks and Annual Reports.

Exhibit 4 Learning Rates[38]

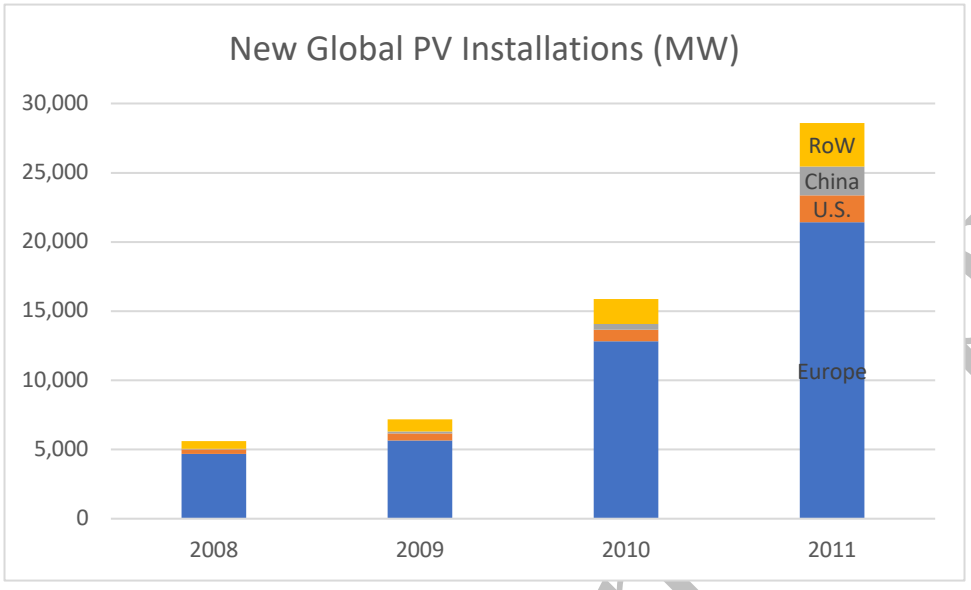


Source: Trancik, Jessika E., Patrick R. Brown, et al. "Technology Improvement and Emissions Reductions as Mutually Reinforcing Efforts: Observations from the Global Development of Solar and Wind Energy." Cambridge, MA: Institute for Data, Systems and Society, Massachusetts Institute of Technology, November 13, 2015. URL: http://hdl.handle.net/1721.1/102237.

[37] "Yingli-Panel Specifications", First Solar 10K, "SunPower_PanelSpecs", "Suntech_Panel Specs"

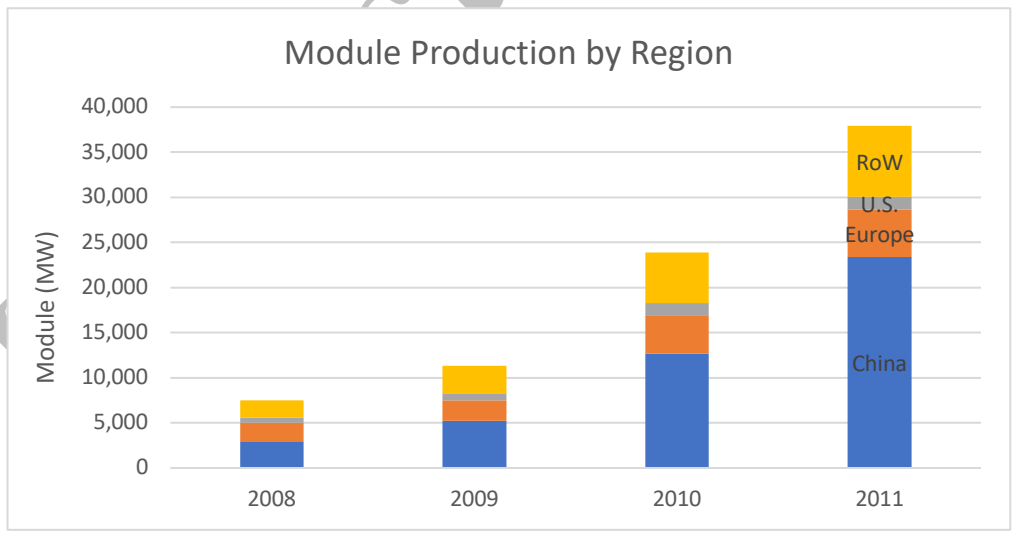
[38] Learning rate: percentage decrease in costs, given a doubling of production.

Exhibit 5 New Global PV Installations



Source: Greentech Media Research, PV Pulse, 2008-2011.

Exhibit 6 Module Production by Region



Source: Greentech Media Research, PV Pulse, 2008-2011.

Exhibit 7 Manufacturing Cost per Watt

FIRST SOLAR	2011	2010	2009	2008	2007
Watts (thousands)[39]	1,700,581	1,400,696	1,066,711	525,841	205,344
Manufacturing Cost Per Watt	$0.75	$0.77	$0.87	$1.08	$1.23

SUNPOWER	2011	2010	2009	2008	2007
Watts (thousands)	1,408,304	999,612	649,509	563,717	234,846
Manufacturing Cost Per Watt	$1.48	$1.71	$1.91	$1.93	$2.67

SUNTECH	2011	2010	2009	2008	2007
Watts (thousands)	2,083,841	1,594,451	705,542	677,289	440,621
Manufacturing Cost Per Watt	$1.26	$1.41	$1.78	$2.14	$2.40

YINGLI	2011	2010	2009	2008	2007
Watts (thousands)	1,630,835	1,082,250	531,422	285,328	144,167
Manufacturing Cost Per Watt	$1.16	$1.14	$1.50	$3.01	$2.91

Source: Company SEC Form 10-Ks and Annual Reports.

[39] Total Capacity Watts

Exhibit 8 Share of Sales in Components and Systems (US$)

First Solar									
2011		2010		2009		2008		2007	
Components	Systems	Components	Systems	Components	Systems	Components	Systems	Components	Systems
74.8%	25.2%	85.2%	14.8%	95.1%	4.9%	95.9%	4.1%	99.3%	0.7%
SunPower									
2011		2010		2009		2008		2007	
Components	Systems	Components	Systems	Components	Systems	Components	Systems	Components	Systems
54.0%	46.0%	46.6%	53.4%	57.1%	42.9%	42.7%	57.3%	40.1%	59.9%
SunTech									
2011		2010		2009		2008		2007	
Components	Systems	Components	Systems	Components	Systems	Components	Systems	Components	Systems
95.8%	4.2%	95.3%	4.7%	94.9%	5.1%	92.8%	7.2%	98.8%	1.2%
Yingli									
2011		2010		2009		2008		2007	
Components	Systems	Components	Systems	Components	Systems	Components	Systems	Components	Systems
99.6%	0.4%	99.5%	0.5%	99.3%	0.7%	99.6%	0.4%	99.9%	0.1%

Source: Company SEC Form 10-Ks and Annual Reports.

Exhibit 9 Consolidated Financial Statements for First Solar, SunPower, Suntech, and Yingli Green Energy

FIRST SOLAR: INCOME STATEMENT *('000s of USD)*					
	31-Dec-11	**31-Dec-10**	**26-Dec-09**	**27-Dec-08**	**29-Dec-07**
Net Sales	2,766,207	2,563,515	2,066,200	1,246,301	503,976
Cost of Sales	1,794,456	1,378,669	1,021,618	567,908	252,573
Gross Profit	**971,751**	**1,184,846**	**1,044,582**	**678,393**	**251,403**
Operating expenses					
Research and Development	140,523	94,797	78,161	33,517	15,107
Selling, general, and administrative	412,541	321,704	272,898	174,039	82,248
Production start-up	33,620	19,442	13,908	32,498	16,867
Goodwill impairment[40]	393,365	-	-	-	-
Restructuring	60,366	-	-	-	-
Total Operating Expenses	1,040,415	435,943	364,967	240,054	114,222
Operating (loss) Income	**(68,664)**	**748,903**	**679,615**	**438,339**	**137,181**
EBIT Margin (%)	-2.48%	29.21%	32.89%	35.17%	27.22%
Foreign currency gain (loss)	995	(3,468)	5,207	5,722	1,881
Interest income	13,391	14,375	9,735	21,158	20,413
Interest expense, net	(100)	(6)	(5,258)	(509)	(2,294)
Other income (expense), net	665	2,273	(2,985)	(934)	(1,219)
Income (loss) before income taxes	(53,713)	762,077	686,314	463,776	155,962
Income tax (benefit) expense	(14,220)	97,876	46,176	115,446	(2,392)
NET INCOME (LOSS)	**($39,493)**	**$664,201**	**$640,138**	**$348,330**	**$158,354**
Net Margin (%)	-1.43%	25.91%	30.98%	27.95%	31.42%

Source: First Solar Inc., SEC Form 10K, 2007-2011.

[40] As stated on First Solar's 2011 10K, Goodwill represents the excess of the purchase price of acquired business over the estimated fair value assigned to the individual assets acquired and liabilities assumed. First Solar does not amortize goodwill, rather tests for impairment at least annually. First Solar recorded a goodwill impairment of $393.4 million during the 4th quarter of 2011 related to its components reporting unit, specifically related to the goodwill that had been allocated to the company's acquisitions of OptiSolar in 2009 and NextLight in 2010.

SUNPOWER CORPORATION: INCOME STATEMENT *('000s of USD)*					
	1-Jan-12	**2-Jan-11**	**3-Jan-10**	**28-Dec-08**	**30-Dec-07**
Revenue					
Utility and power plants	1,064,144	1,186,054	653,531	823,307	464,178
Residential and commercial	1,248,350	1,033,176	870,752	614,287	310,612
Total Revenue	**2,312,494**	**2,219,230**	**1,524,283**	**1,437,594**	**774,790**
Cost of Revenue					
Utility and power plants	967,076	908,326	526,850	659,752	386,532
Residential and commercial	1,117,214	801,011	713,713	428,221	240,507
Total Cost of Revenue	**2,084,290**	**1,709,337**	**1,240,563**	**1,087,973**	**627,039**
Gross Margin	**228,204**	**509,893**	**283,720**	**349,621**	**147,751**
Operating expenses					
Research and development	57,775	49,090	31,642	21,474	23,138
Sales, general, and administrative	319,719	321,936	190,244	173,740	108,256
Goodwill impairment	309,457	-	-	-	-
Other intangible asset impairment	40,301	-	-	-	14,068
Restructuring charges	21,403	-	-	-	-
Total operating expenses	**748,655**	**371,026**	**221,886**	195,214	145,462
Operating Income (loss)	**(520,451)**	**138,867**	**61,834**	**154,407**	**2,289**
EBIT Margin (%)	-22.51%	6.26%	4.06%	10.74%	0.30%
Other income (expense) net					
Interest Income	2,054	1,541	2,109	10,789	13,882
Interest expense	(67,022)	(55,276)	(36,287)	(22,814)	(12,036)
Other, net	(2,344)	98,281	15,964	(26,313)	2,377
Other Income Expense, net	**(67,312)**	**44,546**	**(18,214)**	**(38,338)**	**4,223**
Income (loss) before income taxes and equity in earnings of unconsolidated investees	(587,763)	183,413	43,620	116,069	6,512
Provision for income taxes	(22,099)	(23,375)	(21,028)	(40,618)	22,084
Equity in earnings of unconsolidated investees	6,003	6,845	9,929	14,077	(278)
Income (loss) from continuing operations	(603,859)	166,883	32,521	89,528	28,318
Income from disctd. ops., net of tax	-	11,841	-	-	-
NET INCOME (LOSS)	**($603,859)**	**$178,724**	**$32,521**	**$89,528**	**$28,318**
Net Margin (%)	-26.11%	8.05%	2.13%	6.23%	3.65%

Source: SunPower SEC Form 10K Filing, 2007-2011.

SUNTECH POWER HOLDINGS CO, LTD: INCOME STATEMENT *('000s of USD)*					
	31-Dec-11	**31-Dec-10**	**26-Dec-09**	**27-Dec-08**	**29-Dec-07**
Net Revenues					
PV modules	3,014,000	2,766,300	1,606,300	1,785,800	1,331,700
Others	132,600	135,600	87,000	137,700	16,600
Total Net Revenues	**3,146,600**	**2,901,900**	**1,693,300**	**1,923,500**	**1,348,300**
Cost of Revenues					
PV modules	2,626,200	2,211,900	1,235,600	1,448,200	1,057,600
Others	133,800	146,900	95,700	132,400	16,600
Total Cost of Revenues	2,760,000	2,358,800	1,331,300	1,580,600	1,074,200
Gross Profit	**386,600**	**543,100**	**362,000**	**342,900**	**274,100**
Selling expenses	162,600	118,000	82,100	59,300	30,600
General & Administrative expenses	248,800	125,100	76,900	85,800	44,500
Research & Development expenses	38,600	40,200	29,000	15,300	15,000
Provision for prepayment to affiliates	120,000	8,000	-	-	-
Impairment of goodwill	281,500	-	-	-	-
Impairment of long-lived assets	180,300	54,600	-	-	-
Total operating expenses	1,031,800	345,900	188,000	160,400	90,100
Income from operations	**(645,200)**	**197,200**	**174,000**	**182,500**	**184,000**
EBIT Margin (%)	-20.50%	6.80%	10.28%	9.49%	13.65%
Interest expense	(143,300)	(99,500)	(103,300)	(106,100)	(49,400)
Interest income	7,400	7,600	9,600	32,600	31,200
Other (expense) income, net	(171,300)	(94,400)	11,200	(76,700)	(8,700)
Earnings before income taxes, non-controlling interest and equity in net earnings (loss) of affiliates	(952,400)	10,900	91,500	32,300	157,100
Equity in net earnings (loss) of affiliates	(98,700)	250,800	(3,300)	300	(700)
Income (loss) from continuing operations before tax	(1,051,100)	261,700	88,200	32,600	156,400
Tax expense (benefit)	47,200	(23,800)	(2,500)	(1,600)	(13,200)
Income (loss) from continuing operations before tax	(1,003,900)	237,900	85,700	31,000	143,200
Loss from disctd ops., net of tax	(14,100)	-	-	-	-
NET INCOME (LOSS)	**($1,018,000)**	**$237,900**	**$85,700**	**$31,000**	**$143,200**
Net Margin (%)	-32.35%	8.20%	5.06%	1.61%	10.62%

Source: Suntech SEC Form 10K Filing, 2007-2011.

YINGLI GREEN ENERGY HOLDING CO, LTD: INCOME STATEMENT *('000s of USD)*					
	31-Dec-11	**31-Dec-10**	**31-Dec-09**	**31-Dec-08**	**31-Dec-07**
Net revenues					
Sales of PV modules	2,287,467	1,860,129	1,048,717	1,091,358	550,515
Sales of PV systems	8,537	8,585	7,354	4,043	268
Other revenues	36,090	25,223	6,773	11,673	5,700
Total net revenues	**2,332,094**	**1,893,937**	**1,062,844**	**1,107,074**	**556,483**
Cost of PV modules sales	1,891,594	1,232,002	799,643	857,634	418,868
Cost of PV systems sales	6,876	7,453	5,838	2,820	205
Cost of other revenues	44,409	25,272	6,206	7,762	6,240
Total cost of revenues	1,942,879	1,264,727	811,687	868,216	425,312
Gross Profit	**389,215**	**629,210**	**251,157**	**238,858**	**131,171**
Selling expenses	129,971	118,219	50,916	23,054	15,071
General & administrative expenses	95,763	70,836	60,080	38,369	20,538
R&D expenses	45,267	20,837	27,005	8,391	2,405
Provision for (recovery of) doubtful accounts receivable	6,195	(1,985)	47,271	-	-
Impairment of intangible asset	361,465	-	19,217	-	-
Impairment of goodwill	43,436	-	-	-	-
Provision for inventory commitments	135,321	-	-	-	-
Total operating expenses	817,418	207,907	204,489	69,814	38,014
Income from operations	**(428,203)**	**421,303**	**46,668**	**169,044**	**93,157**
EBIT Margin	**-18.36%**	**22.24%**	**4.39%**	**15.27%**	**16.74%**
Other income (expense)					
Equity in loss of affiliates, net	(1,518)	(95)	(406)	(319)	(152)
Interest expense	(99,578)	(66,365)	(55,133)	(21,868)	(8,888)
Interest income	4,584	2,423	926	1,867	1,867
Foreign currency gains (losses)	(30,264)	(51,245)	5,624	(9,716)	(4,478)
Loss on debt extinguishment	-	-	(35,855)	-	-
Loss from revaluation of derivative	-	-	(33,892)	-	-
Other income	14,902	1,782	1,079	893	-
Earnings (loss) before income taxes	**(540,077)**	**307,803**	**(70,989)**	**139,901**	**81,507**
Income tax benefit (expense)	21,197	(50,524)	4,663	819	(1,772)
NET INCOME (LOSS)	**($518,880)**	**$257,279**	**($66,326)**	**$140,720**	**$79,735**
Net Margin	-22.25%	13.58%	-6.24%	12.71%	14.33%

Source: Yingli SEC Form 10K Filing, 2007-2011.

FIRST SOLAR: BALANCE SHEET *('000s of USD)*					
	31-Dec-11	**31-Dec-10**	**26-Dec-09**	**27-Dec-08**	**29-Dec-07**
Cash and Cash Equivalents	605,619	765,689	664,499	716,218	404,264
Marketable Securities	66,146	167,889	120,236	76,042	232,686
Accounts Receivable, net	310,568	305,537	226,826	61,703	18,165
Inventories	475,867	195,863	152,821	121,554	40,204
Deferred tax assets, net	41,144	388	21,679	9,922	3,890
Prepaid expenses and other current assets	1,113,917	149,094	165,210	91,962	103,300
TOTAL CURRENT ASSETS	**2,613,261**	**1,584,460**	**1,351,271**	**1,077,401**	**802,509**
Property, plant, and equipment, net	1,815,958	1,430,789	988,782	842,622	430,104
Non-current project assets	374,881	320,140	131,415	-	-
Deferred tax asset, net	340,274	259,236	130,515	61,325	51,811
Marketable securities	116,192	180,271	329,608	29,559	32,713
Restricted cash and investments	200,550	86,003	36,494	30,059	14,695
Investment in related party	-	-	25,000	25,000	-
Goodwill	65,444	433,288	286,515	33,829	33,449
Inventories	60,751	42,728	21,695	-	-
Other assets	190,303	43,488	48,217	14,707	6,031
TOTAL ASSETS	**$5,777,614**	**$4,380,403**	**$3,349,512**	**$2,114,502**	**$1,371,312**
Current Liabilities:					
Accounts Payable	176,448	82,312	75,744	46,251	26,441
Income taxes payable	9,541	16,831	8,740	99,938	24,487
Accrued expenses	406,659	244,271	186,682	140,899	76,256
Current portion of long-term debt	44,505	26,587	28,559	34,951	39,309
Other current liabilities	336,571	99,676	95,202	59,738	14,803
TOTAL CURRENT LIABILITIES	**973,724**	**469,677**	**394,927**	**381,777**	**181,296**

Accrued solar module collection and recycling liability	167,378	132,951	92,799	35,238	13,079
Long-term debt	619,143	210,804	146,399	163,519	68,856
Other liabilities	373,506	112,026	62,600	20,926	10,814
TOTAL LIABILITIES	**$2,133,751**	**$925,458**	**$696,725**	**$601,460**	**$274,045**
Stockholders' Equity					
Common stock	86	86	85	82	79
Additional paid-in capital	2,022,743	1,815,420	1,658,091	1,176,156	1,079,775
Contingent consideration	-	1,118	2,844	-	-
Accumulated earnings	1,626,071	1,665,564	1,001,363	361,225	12,895
Accumulated other comprehensive loss	(5,037)	(27,243)	(9,596)	(24,421)	4,518
TOTAL STOCKHOLDERS' EQUITY	**$3,643,863**	**$3,454,945**	**$2,652,787**	**$1,513,042**	**$1,097,267**
Total Liabilities & Stockholders' Equity	**$5,777,614**	**$4,380,403**	**$3,349,512**	**$2,114,502**	**$1,371,312**

Source: First Solar SEC Form 10K Filing, 2007-2011.

SUNPOWER CORPORATION: BALANCE SHEET *('000s of USD)*					
	1-Jan-12	**2-Jan-11**	**3-Jan-10**	**28-Dec-08**	**30-Dec-07**
Cash and cash equivalents	657,934	605,420	615,879	202,331	285,214
Restricted cash & equivalents, current	52,279	117,462	61,868	13,240	-
Short-term investments	-	38,720	172	17,179	105,453
Accounts receivable, net	390,262	381,200	248,833	194,222	138,250
Estimated earnings in excess of billings	54,854	89,190	26,062	29,750	39,136
Inventories	397,262	313,398	202,301	248,255	148,820
Advances to suppliers, current portion	43,143	31,657	22,785	43,190	52,277
Project assets - plants & land, current	24,243	23,868	-	-	-
Prepaid expenses & other current assets	482,691	192,934	104,442	101,735	33,110
TOTAL CURRENT ASSETS	**2,102,668**	**1,793,849**	**1,282,342**	**849,902**	**802,260**
Restricted cash/ equivalents, noncurrent	27,276	138,837	248,790	162,037	67,887
Property, plant, and equipment, net	607,456	578,620	682,344	622,484	377,994
Project assets - plant & land, noncurrent	34,614	22,238	-	-	-
Goodwill	35,990	345,270	198,163	196,720	184,684
Other intangible assets, net	4,848	66,788	24,974	39,490	50,946
Advances to suppliers, net of current	278,996	255,435	167,843	119,420	108,943
Other long-term assets	183,349	178,294	91,580	92,693	61,024
TOTAL ASSETS	**$3,275,197**	**$3,379,331**	**$2,696,036**	**$2,082,746**	**$1,653,738**
Accounts payable	416,615	382,884	234,692	259,429	124,723
Accrued liabilities	234,688	137,704	114,008	136,116	79,434
Billings in excess of estimated earnings	170,828	48,715	17,346	15,634	69,900
Short-term debt	-	198,010	11,250	-	-
Convertible debt, current portion	196,710	-	137,968	-	425,000
Customer advances, current portion	46,139	21,044	19,832	19,035	9,250
TOTAL CURRENT LIABILITIES	**1,064,980**	**788,357**	**535,096**	**430,214**	**708,307**

Long-term debt	355,000	50,000	237,703	54,598	-
Convertible debt, net of current portion	423,268	591,923	398,606	357,173	-
Customer advances, net of current	181,947	160,485	72,288	91,359	60,153
Other long-term liabilities	152,492	131,132	76,822	50,715	21,188
TOTAL LIABILITIES	**$2,177,687**	**$1,721,897**	**$1,320,515**	**$984,059**	**$789,648**
Common stock	100	98	97	86	85
Additional paid-in capital	1,657,474	1,606,697	1,305,032	1,064,916	883,033
Retained earnings (accumulated deficit)	(540,187)	63,672	100,733	67,953	(22,815)
Accumulated Other Compr. Income	8,540	3,640	(17,357)	(25,611)	5,762
Treasury stock	(28,417)	(16,673)	(12,984)	(8,657)	(1,975)
TOTAL STOCKHOLDERS' EQUITY	**$1,097,510**	**$1,657,434**	**$1,375,521**	**$1,098,687**	**$864,090**
Total Liabilities & Stockholders' Equity	**$3,275,197**	**$3,379,331**	**$2,696,036**	**$2,082,746**	**$1,653,738**

Source: Sunpower SEC Form 10K Filing, 2007-2011.

SUNTECH POWER HOLDINGS CO, LTD: BALANCE SHEET *('000s of USD)*					
	31-Dec-11	**31-Dec-10**	**26-Dec-09**	**27-Dec-08**	**29-Dec-07**
Cash and cash equivalents	492,400	872,500	833,200	507,800	521,000
Restricted cash	216,600	142,500	124,900	70,700	94,700
Inventories	516,500	558,200	280,100	231,900	176,200
Accounts receivable, net of ADA	466,600	515,900	384,400	213,100	237,600
Other receivables, net of ADA	14,300	19,000	39,300	46,800	30,700
Advances to suppliers	84,400	84,400	48,800	56,900	61,400
Deferred tax assets, net	21,400	22,600	10,800	7,200	1,700
Amounts due from related partners	67,700	55,100	185,500	101,000	-
Other current assets	206,100	142,200	249,00	86,500	134,200
TOTAL CURRENT ASSETS	**2,086,000**	**2,412,400**	**2,156,000**	**1,321,900**	**1,257,500**
Property plant and equipment, net	1,569,200	1,236,200	777,600	684,500	293,000
Intangible assets, net	23,000	156,000	140,800	176,700	86,000
Goodwill	-	278,000	86,100	87,600	29,800
Investments in affiliates	454,200	545,900	251,400	221,100	1,000
Long-term prepayments	185,100	213,800	188,100	248,800	161,700
Long-term loans to supplier	-	53,000	54,700	84,000	103,300
Amounts due from related parties	67,600	94,100	193,600	278,000	-
Other noncurrent assets	152,200	137,700	135,400	121,200	24,700
TOTAL ASSETS	**$4,537,300**	**$5,127,100**	**$3,983,700**	**$3,223,800**	**$1,957,000**
Short-term borrowings	1,573,400	1,400,800	800,400	638,500	321,200
Accounts payable	555,300	457,000	264,200	117,500	58,900
Other payables	207,200	170,300	126,700	137,600	57,400
Income tax payable	-	66,700	4,300	12,800	7,300
Other current liabilities	273,000	275,200	322,500	70,300	33,300
TOTAL CURRENT LIABILITIES	**2,608,900**	**2,370,000**	**1,518,100**	**976,700**	**478,100**

Long-term bank borrowings	133,300	163,300	138,000	5,900	20,700
Convertible notes	580,900	551,200	516,900	981,200	500,000
Accrued warranty costs	94,100	81,000	55,200	41,400	22,500
Deferred tax liabilities	-	15,600	33,100	38,800	22,100
Other long-term liabilities	167,300	155,800	109,600	96,900	7,700
TOTAL LIABILITIES	**$3,584,500**	**$3,336,900**	**$2,370,900**	**$2,140,900**	**$1,051,100**
Ordinary shares	1,800	1,800	1,800	1,600	1,500
Additional paid in capital	1,148,000	1,134,800	1,114,700	597,100	530,800
Retained earnings	(365,000)	653,600	416,700	412,300	324,100
Accumulated other comprehensive income	161,600	77,500	64,900	63,400	31,600
Suntech Power Holdings Co. Ltd Equity	946,400	1,867,700	1,598,100	1,074,400	888,000
Non-controlling interest	6,400	12,500	14,700	8,500	17,900
TOTAL STOCKHOLDERS' EQUITY	**$952,800**	**$1,880,200**	**$1,612,800**	**$1,082,900**	**$905,900**
Total Liabilities & Stockholders' Equity	**$4,537,300**	**$5,217,100**	**$3,983,700**	**$3,223,800**	**$1,957,000**
TOTAL LIABILITIES	**$3,584,500**	**$3,336,900**	**$2,370,900**	**$2,140,900**	**$1,051,100**
Ordinary shares	1,800	1,800	1,800	1,600	1,500
Additional paid in capital	1,148,000	1,134,800	1,114,700	597,100	530,800
Retained earnings	(365,000)	653,600	416,700	412,300	324,100
Accumulated other comprehensive income	161,600	77,500	64,900	63,400	31,600
Suntech Power Holdings Co. Ltd Equity	946,400	1,867,700	1,598,100	1,074,400	888,000
Non-controlling interest	6,400	12,500	14,700	8,500	17,900
TOTAL STOCKHOLDERS' EQUITY	**$952,800**	**$1,880,200**	**$1,612,800**	**$1,082,900**	**$905,900**
Total Liabilities & Stockholders' Equity	**$4,537,300**	**$5,217,100**	**$3,983,700**	**$3,223,800**	**$1,957,000**

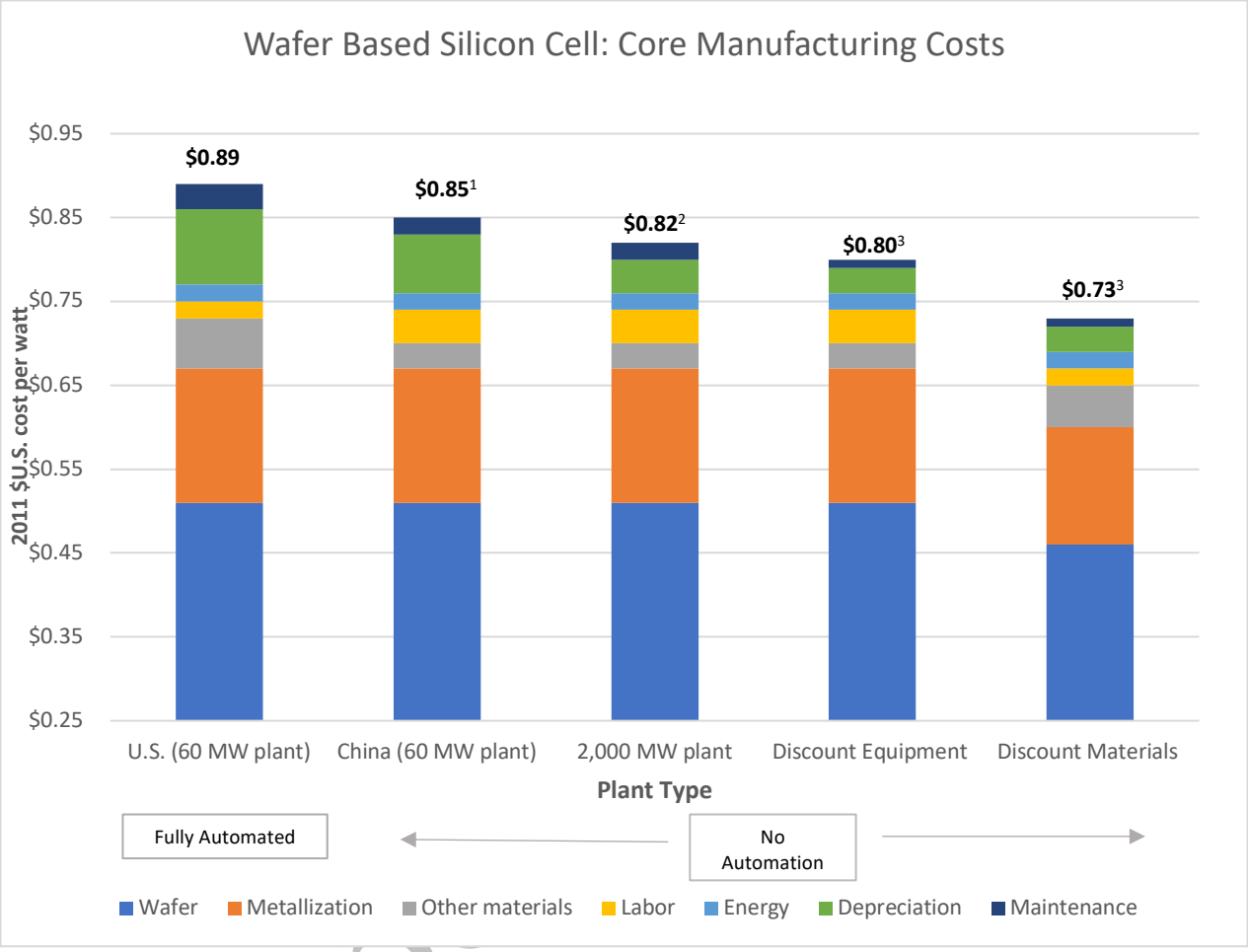
Source: Suntech SEC Form 10K Filing, 2007-2011.

YINGLI GREEN ENERGY HOLDING CO, LTD: BALANCE SHEET *('000s of USD)*					
	31-Dec-11	**31-Dec-10**	**31-Dec-09**	**31-Dec-08**	**29-Dec-07**
Cash	664,300	887,293	475,847	162,538	131,752
Restricted Cash	227,567	97,716	31,526	16,011	982
Accounts receivable, net	338,483	289,291	256,508	214,727	170,656
Inventories	424,366	382,569	243,927	299,118	172,896
Prepayments to suppliers	61,478	86,960	48,266	120,797	144,871
Value-added tax recoverable	150,778	141,187	44,028	67,656	-
Amounts due from & prepayments to related parties	88,268	44,176	44,496	595	51,836
Prepaid expenses & other current assets	68,671	26,423	21,033	7,092	24,691
TOTAL CURRENT ASSETS	**2,023,911**	**1,955,615**	**1,165,631**	**888,534**	**697,684**
Restricted Cash, non-current	-	-	24,579	-	-
Long-term prepayments to suppliers	210,158	76,413	99,373	98,815	87,362
Property, plant, and equipment, net	1,968,443	1,505,145	963,075	496,252	202,866
Land use rights	83,131	54,369	51,943	9,237	7,536
Intangible assets, net	17,539	24,318	30,447	57,569	45,421
Goodwill	-	41,464	40,092	40,112	3,819
Other assets	63,492	7,600	6,540	31,861	7,323
TOTAL ASSETS	**$4,366,674**	**$3,664,924**	**$2,381,680**	**$1,622,380**	**$1,052,011**
Current liabilities:					
Short-term debt + current portion of Long-term debt	1,306,833	887,557	512,903	299,626	172,905
Accounts payable	473,034	375,063	271,351	92,181	21,670
Advances from customers	142,045	151,711	-	7,612	3,036
Amounts due to related parties	38,541	12,800	4,562	1,299	836
Convertible senior notes	22,140	-	189,256	-	-
Other current liabilities	74,893	55,138	38,554	14,001	17,618
TOTAL CURRENT LIABILITIES	**2,057,486**	**1,482,269**	**1,016,626**	**414,719**	**216,065**

Convertible senior notes	-	13,838	14,670	182,031	173,105
Medium-term notes	382,337	151,686	-	-	-
Long-term debt, excluding current	548,451	378,255	110,287	97,172	-
Other liabilities	257,686	82,266	40,861	27,606	10,766
TOTAL LIABILITIES	**$3,245,960**	**$2,108,314**	**$1,182,444**	**$721,528**	**$399,936**
Stockholders' Equity:					
Ordinary shares	1,908	1,800	1,665	1,454	1,355
Additional paid-in capital	1,028,952	971,666	898,180	539,588	496,371
Treasury stock	(19,675)	-	-	-	-
Accumulated OCI	22,085	8,967	1,873	4,979	1,672
Retained earnings	(213,238)	282,852	70,327	150,338	49,203
Total equity attributable to Yingli Energy	820,032	1,265,285	972,045	696,359	548,601
Non-controlling interests	300,682	291,325	227,191	204,493	103,474
TOTAL SHAREHOLDERS' EQUITY	**$1,120,714**	**$1,556,610**	**$1,199,236**	**$900,852**	**$652,075**
Total Liabilities & Stockholders' Equity	**$4,366,674**	**$3,664,924**	**$2,381,680**	**$1,622,380**	**$1,052,011**

Source: Yingli SEC Form 10K Filing, 2007-2011.

Exhibit 10 Core Manufacturing Costs



[1] On level playing field, China advantage < 4%

[2] Government supported export industry, scale is a significant factor

[3] Industry scale has reduced regional supply chain benefits: purchasing power, regional supply chain benefits

Source: "Solar PV Manufacturing Cost Analysis: U.S. Competitiveness in a Global Industry," Stanford University and National Renewable Laboratory, October 10, 2011.

Glossary

Balance of Systems (BOS) costs: the additional component costs of a solar system beyond the modules, such as the costs of installation labor, mounting hardware, wiring, and inverters, which generally comprised over half of the total costs of a utility-scale system.

Grid Parity: occurs when the cost to generate power through solar energy or other alternative source of energy is less than or equal to the cost of purchasing electricity directly from the electrical grid.

Hydraulic fracking is an extraction technique for oil and gas wells in which pressurized liquid is injected into the cracks in rock formations. Once the hydraulic pressure is removed from the well, the remnants of the fracking fluid enable ease of extracting oil and gas, increasing the rate of extraction (source: Investopedia).

Levelized Cost of Electricity (LCOE): the present value of the per-kilowatt hour cost (in real dollars) of building and operating a generating plant over an assumed financial life and duty cycle. LCOE takes into account capital costs, fuel costs, fixed and variable operations and maintenance (O&M) costs, financing costs, and an assumed utilization rate for each plant type (source: U.S. Energy Information Administration).

Manufacturing throughput: the amount of time required for a product to pass through a manufacturing process, thereby being converted from raw materials into finished goods. The concept also applies to the processing of raw materials into a component or sub-assembly.

Net Debt: short-term debt plus long-term debt less cash and cash equivalents.

Net Metering: a system that credits residential and commercial owners of solar systems for excess electricity fed back to the grid. For example, a residential homeowner with a solar panel on his/her roof might generate more energy than required by his/her house. Any excess energy supplied back to the power grid is credited, usually in the form of a reduction from the monthly electrical payment.

Photovoltaic capacity: the maximum power output a solar module is capable of generating.

Photovoltaic effect: the phenomenon in which the incidence of light or other electromagnetic radiation upon the junction of two dissimilar materials, as metal and a semiconductor, induces the generation of an electromotive force.

Photovoltaic efficiency: the amount of sunlight that can be converted into electricity; the conductivity of solar energy.

Physical vapor deposition (PVD): describes a variety of vacuum deposition methods, which can be used to produce thin films. PVD uses physical process (such as heating or sputtering) to produce a vapor of material, which is then deposited on the object, which requires coating.

Power Purchase Agreement (PPA): a financial contract between a buyer and provider of electricity that eliminates up-front installation costs. Developer installs solar system on customer's land for free and the customer purchases electricity from the developer at a fixed rate, typically below the rate provided from the utility, for the duration of the contract.

PPE: Property, plant, and equipment (PP&E) is an account on the balance sheet that represents the sum of a company's purchases of property, manufacturing plants, and equipment to that point in time, less any amortization.

Pure Play: a publicly traded company focused on only one industry or product.

SG&A: an acronym used to refer to Selling, General, and Administrative Expenses, which is a major non-production cost presented in an income statement.

Watt: a unit of power defined as 1 joule per second.