Solyndra 2011 Case Study

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Despite approximately $1 billion in private equity investment and over $500,000 in U.S. federal loan guarantees, Solyndra, a startup with an innovative approach to solar energy, filed for bankruptcy protection in September 2011. It is astounding to many that a company that had so much potential—innovative technology, rapidly-growing industry, impressive financial backing, government support—could fall so short and so fast.

The Solyndra case is interesting because it uniquely captures the confluence of technology, business models, policy, and a changing landscape in global competition. It is of value to students of business and technology in the classroom, executives in the board room, and policy makers in the halls of government.

Solyndra's failure begs the questions: What happened at Solyndra within this rapidly-growing market? And, what can be learned from this case to avoid mistakes of this type by executives and policy makers in future?

Case questions about business considerations:

- What happened at Solyndra?
- What did Solyndra management do right and wrong?
- Would you have invested in Solyndra's second factory? Why or why not?
- What is your assessment of Solyndra's operational measures?

Case questions about policy considerations:

- What is your assessment of the U.S. Government Department of Energy loan guarantee program?
- How does China support innovation and/or job creation?
- What other ways can public funds to support innovation? Which of these is likely to be most effective at creating jobs and/or advancing innovation?

Background

Since its founding in 2005, the background of Solyndra's dramatic case include the following factors:

- **A new product line:** Solyndra offered a new photo-voltaic (PV) product line intended for easier and lower-cost installations for flat rooftops. This product strategy was intertwined with a gamble on a new geometry for the panels: cylindrical vs. flat.

- **Copper indium gallium (di)selenide (CIGS):** Thin film CIGS proved to be an additional larger gamble on Solyndra's supporting PV technology to be used with this new geometry. CIGS was an alternative to another lightweight thin film technology such as cadmium telluride (CdTe) or more traditional crystalline silicon technology.

- **Strategy for a changing market:** Solyndra was challenged with developing a market strategy as a new player entering into an existing market that saw accelerated growth, but was also capital-intensive and experiencing rapid decreases in the cost of competing technologies. We note, for example, that prices of key ingredient polysilicon used by most Chinese manufacturers dropped 89% between 2009 and mid-2011. We also note at the time of this writing that U.S. competitor First Solar is the lowest cost PV supplier, and the company uses a CdTe thin film technology.

- **National agenda:** The backdrop of Solyndra's case includes a national strategic agenda that focused on encouraging a new clean energy industry while at the same time wanting to create jobs during a time of high unemployment.

- **Changing global landscape:** Meanwhile, a global competitive landscape has emerged in which resources of competitors are influenced not only by investors and markets, but also by strategic priorities and policies of the nations that host the companies; e.g., the China Inc. phenomenon and Europe's subsidies and tax incentives.

In late 2009, in order to scale its business, Solyndra filed an S-1 to raise capital on the public markets to build a new fabrication facility. With the downturn in the public equity market, however, the company withdrew this S-1 and changed its plans. However, the company successfully went forward in developing its Fab 2 Phase I using funds from the U.S. Department of Energy (DOE) loan guarantees program.

The $535 million in federal loan guarantees was not able to forestall the company's eventual demise, and in September 2011, Solyndra filed for Chapter 11 bankruptcy in Delaware federal court. However, the company was not the only U.S. solar company to recently fold. Just weeks earlier, SpectraWatt and Evergreen Solar both filed for Chapter 11, while BP Solar shut down its U.S. manufacturing facility in 2010.

Exhibit: Solyndra 200 Series Product

200 SERIES

The Ideal Solution for Large Rooftops

SOLYNDRA®
The new shape of solar™

Light Weight and Simple Installation Means Fast Projects and Low Cost

The 200 Series requires no tools for installation. The lightweight panels install without penetrations or array grounding, making this the easiest and fastest to install rooftop solar system yet. Ideal for older or "value engineered" buildings, the low distributed roof load is less than 3 pounds per square foot. Snap-together mounts dramatically lower labor costs and shorten project times for large rooftop solar installations. This minimizes business disruption and makes it a simple process should you need to move the system for future roofing, retrofit or ownership changes.

Higher Power

Improved light collection makes the 200 Series our most powerful panel yet, especially when combined with a white "cool roof". Individual panels are rated up to 220 Wp.

Low LCOE and Increased ROI

The ease of installation, low balance-of-system cost and higher power with the 200 Series provides significantly lower levelized cost of electricity and contributes to strong return on investment for the customer.

Proven Solyndra Technology

Solyndra panels capture direct, diffuse and reflected sunlight across a 360-degree photovoltaic surface. Solyndra panels can be placed in virtually any orientation and significantly closer together than conventional tilted panels. The unique cylindrical design allows wind to flow through the panels and as a result no additional ballast or penetrations are required in winds up to 208 kph (130 mph). Designed for maximum performance in the rooftop environment, Solyndra panels offer superior wind, soiling and snow performance.

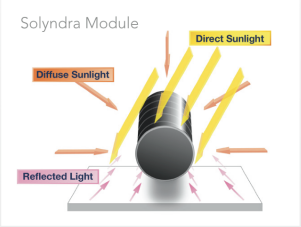

Exhibit: Solyndra Excitement

Solyndra's Estimated Market Cap Up to $2B: Report[1]

GigaOm.com by Katie Fehrenbacher, March 19, 2010

According to Next Up!, Solyndra's revenue ramp went from generating $6 million in revenues in 2008 to $100 million in revenues in 2009. The report written, Solyndra's production and sales growth could lead to a market cap of between $1.76 and $2 billion. Next Up! Research's projected market cap for Solyndra is based on a variety of data, including that Solyndra will have a 50 percent compound annual growth rate for revenues between 2010 and 2015, compared to a more modest 30 percent growth rate for the rest of the solar market.

The report also claims that the installation costs for Solyndra can range between $0.50 and $0.75 per watt, which it says is about half that for other solar panels with a flat geometry, and that cost advantage could translate to better pricing and thus share gains. Next Up! Research also predicts that Solyndra will have a price per share of $6.54 – $7.44 for the common shares.

In $ millions	Ticker	Mkt Cap	Revenues		EV/Revenues		Secular Growth Rate	EBITDA Margin
			CY10E	CY11E	CY10E	CY11E		
Solar Cell / Module Manufacturers								
First Solar	FSLR	$9,259	$2,748	$3,396	3.1	2.5	20%	25%
Suntech	STP	$2,549	$2,109	$2,549	1.4	1.2	20%	15%
Solarfun	SOLF	$355	$697	$836	0.7	0.6	15%	10%
SunPower	SPWR.A	$1,882	$2,070	$2,691	1.0	0.8	20%	15%
Evergreen	ESLR	$266	$352	$454	1.5	1.1	20%	15%
JA Solar	JASO	$818	$874	$1,006	0.9	0.8	20%	15%
Canadian Solar	CSIQ	$893	$1,151	$1,272	1.0	0.9	20%	10%
Q-Cells SE	QCE	$1,158	$1,539	$1,840	1.2	1.0	20%	15%
China Sunergy	CSUN	$187	$405	$430	0.6	0.6	10%	10%
			MEAN		**1.3**	**1.1**	**18.3%**	**14.4%**
			MEDIAN		**1.0**	**0.9**	**20.0%**	**15.0%**

Source: Capital IQ, NeXt Up Research Estimates

Press Quotes about Solyndra's High Potential:

The Solar Energy Industries Association reported in Sept 2011[2] that the solar PV market grew by 69 percent during the second quarter of 2011, compared to Q2 of 2010. The group said:

[1] http://gigaom.com/cleantech/solyndras-estimated-market-cap-up-to-2b-report/

- "The U.S. remains poised to install 1,750 megawatts of PV in 2011, double last year's total and enough to power 350,000 homes."
- The industry employs about 100,000 people. "Solar employs more Americans than coal mining or iron and steel manufacturing,"
- Grid-connected PV installations in Q2 2011 grew 69 percent over Q2 2010 and 17 percent over Q1 2011 to reach 314 megawatts (MW), enough electricity to power nearly 63,000 homes.
- Cumulative grid-connected PV in the U.S. has now reached 2.7 Gigawatts, enough to power 540,000 homes.

"And with 30 billion square feet of flat roofs in America, this could be quite a market for cheap, clean electricity. Solyndra just announced, in fact, that they've got $1.2 B in contracts throughout Europe and America, and I can't imagine that going anywhere but up."[3]

Solyndra Statements Showing Strong Momentum

- 1,166 employees and growing; 49 open jobs on website
- Exporting more than 50% of product -- 14th largest shipper from the Port of Oakland, more than 1,000 containers this year and over 1,000 installations in more than 20 countries
- Our second quarter [2011] was our biggest ever in terms of megawatt volume. Over 100MW shipped, more than 700,000 panels. Revenues grew from $6 million in 2008 to $100 million in 2009 to $140 million in 2010. For this year, ending in January [2012], revenues are projected to nearly double again. In 2011, shipments are expected to double over 2010.
- Factory output is on target to reach 300 MW.
- Solyndra's U.S. market growth is ahead of plan with a healthy pipeline.
- We have projects underway or installed with 3 of the U.S. top 10 retailers and discussions in progress with several more, and are seeing repeat business from major customers.
- Doubled U.S. sales and marketing team in past 6 months[4]

Solyndra Statements and Expectations affecting the U.S. Economy :

In March, 2009, Solyndra estimated the following about a new production facility.

- The construction of this complex [Fab 2] will employ approximately 3,000 people.
- The operation of the facility will create over 1,000 jobs in the United States.
- The installation of these panels will create hundreds of additional jobs in the United States.
- The commercialization of this technology is expected to then be duplicated in multiple other manufacturing facilities.[5]

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[2] http://www.seia.org/cs/news_detail?pressrelease.id=1592

[3] http://www.ecofriendlymag.com/general-green-news/tubular-solar-panels-slash-costs-boost-efficiency/

[4] http://www.greentechmedia.com/articles/read/doe-loan-guarantee-solyndra-omb-and-house-energy-and-commerce-drama-live-fr/

[5] http://energy.gov/articles/obama-administration-offers-535-million-loan-guarantee-solyndra-inc

Exhibit: Technology and Market Information

From Solyndra's March 2010 S1 Filing

Photovoltaic Technology Overview

Silicon Based Photovoltaic Systems

There are two main types of photovoltaic technology, crystalline silicon and thin film. Historically, crystalline silicon has been the most common semiconductor material used in solar panel fabrication. In 2008, 86% of all photovoltaic system shipments used crystalline silicon technology, according to iSuppli. The various crystalline silicon solar panel manufacturing processes involve cutting refined, semiconductor-grade silicon ingots into solar wafers, connecting the wafers in series and packaging them into solar panels. The highest laboratory conversion efficiency achieved by the National Renewable Energy Laboratory, or NREL, as of November 2009 is conversion 20.4% for multi-crystalline solar cells and 25.0% for single crystalline cells. From 2003 to 2009, growth in the market for crystalline silicon photovoltaic systems was negatively impacted by the limited availability of refined silicon, the basic feedstock used in their manufacture. High demand from the photovoltaic and microelectronics industries led to a global shortage of silicon, increasing the price of polysilicon, with the spot price of polysilicon climbing from $30 per kilogram, or kg, in 2003 to $463/kg in 2008, according to New Energy Finance. This price increase, combined with other technological factors, created challenges for crystalline silicon systems to produce electricity at a cost that is comparable to those of traditional fossil fuel sources. As manufacturers of silicon have increased factory capacity, prices for silicon have significantly decreased, though they are not back to previous lows. For example, in 2009 the weighted-average polysilicon long-term forward contract price was $78/kg, and the spot price for polysilicon was approximately $65/kg in October 2009, according to New Energy Finance. Many solar photovoltaic manufacturers have elected to use crystalline silicon technology because it offers the highest cell efficiency and has the benefit of a manufacturing process that is well developed. However, as a more mature technology, we believe the rate of technology or efficiency improvements for crystalline silicon manufacturers will be significantly slower than comparable improvements in thin film technologies and efficiencies.

Thin Film Photovoltaic Systems

Thin film photovoltaic technology has recently emerged as an attractive alternative to crystalline silicon technology. Thin film technologies use approximately 1% of the thickness of active photovoltaic material compared to typical silicon wafers used in crystalline silicon solar panels, which can reduce the raw material cost of modules. Thin film technologies offer certain advantages over conventional crystalline photovoltaic systems. Commodity raw materials used by thin film manufacturers typically represent a significantly smaller percentage of cost of goods sold, so raw material price volatility has a relatively smaller impact on thin film solar panel manufacturing costs. Thin film technologies also generate more electrical energy across a variety of environments, including high temperature and low light, than crystalline silicon solar modules with the same nameplate panel power rating. Nameplate panel power rating is expressed in watts per panel and represents the watt-peak capacity of photovoltaic panels measured under standard test conditions. As a result of these advantages, thin film is expected to account for 31% of the global solar panel market in terms of megawatts, or MW, installed by 2013, up from 14% in 2008, according to iSuppli.

There are three primary thin film photovoltaic technologies: amorphous silicon, cadmium telluride, or CdTe, and copper indium gallium diselenide, or CIGS. Among these thin film photo voltaic technologies, CIGS currently enables the highest photovoltaic conversion efficiency, which results in higher watts per square meter of panel. The differences in efficiency among these thin film technologies, based on the highest

laboratory conversion efficiency achieved by the NREL as of November 2009 are described below. These efficiency levels are measured using individual cells, referred to as "champion cells," that are designed within a laboratory environment to achieve the highest cell efficiencies possible.

- Amorphous silicon demonstrated the lowest efficiency characteristics of the three primary thin film technologies, with NREL's champion cell at 12.5%.
- CdTe demonstrated higher efficiency characteristics than amorphous silicon, with NREL's champion cell at 16.7%.
- CIGS demonstrated the highest efficiency characteristics of all three thin film technologies, with NREL's champion cell at 20.0%.

The process by which champion cells are produced is typically not cost-effective for commercial manufacturing. As a result, conversion efficiencies of commercially available photovoltaic systems are lower than champion cell conversion efficiencies due to technical factors and manufacturing processes. In addition, under real-world operating conditions, a typical photovoltaic system operates outside of standard test conditions for much of the time and the conversion efficiencies of solar panels generally decrease when operating outside standard test conditions.

Many factors influence a manufacturers' decision to select one thin film technology over another, including efficiency, environmental considerations, manufacturing process scalability, manufacturing equipment costs and real-world performance over time.

Illustration: Solyndra Thin Film Technology from Solyndra web site.

Commercial Rooftop Photovoltaic Solar Market

According to market data from Navigant Consulting PV Services, from 1996 through 2009, rooftop installations, both residential and commercial, were approximately 61% of all grid-connected photovoltaic installations. Of the rooftop market, we believe that commercial rooftops represent a significant opportunity. We believe that solar electricity generation systems installed on commercial rooftops will enable the large-scale deployment of distributed solar generation in the United States and abroad. Based on market data from Navigant Consulting, Freedonia Group and Ecofys, we estimate that there are approximately 4.5 billion square meters of commercial rooftop area in the United States and Europe and approximately 11 billion square meters of commercial rooftop area worldwide. We believe that less than 1% of commercial rooftops are currently covered with solar panels, representing a vast, underutilized resource for the generation of solar electricity. According to NREL, cumulative rooftop photovoltaic system installations in the United States alone are projected to grow from 733 MW in 2007 to 7,492 MW in 2015, representing a CAGR of 34%.

The commercial rooftop market offers several advantages compared to the large-scale centralized solar market segment, which typically utilizes ground mounted commercial and utility-scale systems. Installing photovoltaic systems where power is consumed avoids significant transmission capital expenditures associated with centralized electricity generation systems and reduces transmission congestion in the electric grid during periods of peak demand. For example, in California, the cost of building 13 major new power lines to connect the Mojave Desert to coastal metropolises would be over $15.7 billion, according to an August 2009 report by the California Renewable Energy Transmission Initiative. Moreover, distributed generation systems reduce energy losses to the end users associated with transmission and distribution of electricity from centralized large-scale electric plants. The relatively smaller scale of rooftop systems compared to large ground-based systems may also allow for higher certainty of project financing, given that rooftop projects are less exposed to project financing market limitations experienced by multi-billion dollar utility-scale solar projects. The commercial rooftop market benefits from an established worldwide installation and sales channel, which accelerates project deployment relative to utility scale ground mounted systems. Together these attributes enable a large scale of photovoltaic systems to be installed across multiple commercial rooftops in a matter of weeks or months, as compared to centralized generation sources which can require years of regulatory approvals, expensive environmental impact studies and construction before being placed in service, all of which can result in delays or project cancellations. Furthermore, commercial rooftop photovoltaic systems generally compete with the retail price of electricity whereas ground-based systems compete with the wholesale price of electricity in the United States.

Utility companies are beginning to take advantage of the benefits of commercial rooftop distributed generation solutions, as evidenced by the implementation of various utility-scale commercial rooftop incentive programs. For example, in June 2009, Southern California Edison Company obtained approval to cover 65 million square feet of commercial rooftops with 250 MW of photovoltaic technology. In November 2009, Public Service Electric and Gas Company, a New Jersey utility, announced that it has invested $515 million in the financing of approximately 80 MW of commercial rooftop projects. Pinnacle West Capital Corporation, an Arizona utility, also recently announced its intent to invest at least $500 million over the next few years to develop solar-power generation and expand its rooftop solar program to include more residential customers. Commercial rooftop solar programs have been announced by other U.S. utilities, including the City of Los Angeles Department of Water and Power, Progress Energy, Florida Power & Light Company, and Duke Energy Corporation, among others, and we expect this trend to continue.

Market Overview

The commercial rooftop photovoltaic market has evolved in response to various government incentives that support the solar industry. The market for photovoltaic systems in the United States is supported by federal and state-level financial incentives, including tax incentives, cash grants, capital cost rebates, performance-based incentives, feed-in tariffs, net metering, tax incentive programs and low interest loans. In 2008, the U.S. government enacted legislation that extended a 30% investment tax credit for solar installation through 2016, and provided taxpayers the option to receive a cash grant in lieu of the investment tax credit through 2011. <u>These federal tax incentives have has the largest impact of all government incentives on the economics of photovoltaic installations in the United States.</u> As a consequence of the financing structures required to fully utilize federal tax incentives, the majority of commercial rooftop photovoltaic installations in the United States are owned by third-party investors. These third-party investors earn a return by leasing access to building rooftops from building owners and selling solar electricity to the building occupant under long term Power Purchase Agreements, or PPAs. Building occupants are often enterprises such as manufacturers, wholesaler-distributors and big-box retailers, which benefit from a PPA by offsetting their electricity purchases, by reducing their electricity

costs over the term of the PPA, and by establishing a financial hedge against potential future retail electricity price increases without substantial capital expenditure. In addition to the PPA model, some enterprises elect to purchase photovoltaic systems outright to install on their own rooftops in order to realize similar benefits.

The photovoltaic market structure in many European countries is markedly different than in the United States because rather than offering tax credits, governments in these countries have established feed-in-tariffs. Feed-in-tariffs require utilities to purchase the entire output of rooftop and other solar installations at above-market rates that are set by the governments. In contrast to the U.S. market, where electricity generated on a commercial rooftop is typically consumed by the tenant of the building that hosts the photovoltaic system, in Europe the electricity is typically sold to a utility under a feed-in tariff program. Therefore in Europe, the typical photovoltaic system owner is a third-party investor that earns a return by leasing access to building rooftops from building owners and selling the solar electricity produced by the photovoltaic system to the utility. Feed-in tariff structures vary significantly from country to country with respect to rates, terms, aggregate installation volume maximums and other variables. Typically, feed-in tariffs offer a fixed rate schedule for a period of 15-20 years, with initial rates established at the time of the photovoltaic system installation and thereafter declining on a pre-defined schedule. Governments typically guarantee the full 15 to 20 year payment liability of the utilities when the utilities enter into long-term PPAs. Feed-in tariff programs have been considerably more effective than tax-based incentives in achieving the objective of large volumes of photovoltaic system installations, with countries such as Germany, Spain, Italy, and Belgium developing the largest markets for photovoltaic installations worldwide in recent years due to their feed-in tariff programs. Governments outside of Europe have also moved to implement feed-in tariff incentive programs, including certain states in Australia and the Ontario province of Canada.

Photovoltaic system owners can structure long-term financing for projects utilizing different financing alternatives. In the United States, the form of long-term financing for commercial rooftop photovoltaic systems is dependent upon the entity structure that a third-party owner utilizes to offer a particular PPA. Typically, photovoltaic system owners finance projects with a combination of equity and long-term debt. In Europe, photovoltaic system owners generally obtain term debt financing from commercial banks with a maturity date tied to the date that the applicable feed-in tariff expires. Other sources of long-term financing may be available from various export credit agencies. For example, for international purchasers of solar panels manufactured in the United States, direct loans and loan guarantees for up to 18 years may be available from the Export-Import Bank of the United States.

The primary system owners of commercial rooftop photovoltaic systems are third-party investors, enterprises, government entities and utility companies. These system owners typically purchase photovoltaic systems from value-added resellers. Value-added resellers generally earn a margin upon deployment of a completed photovoltaic system. Along with design and installation services, value-added resellers may also be involved in other areas of the system value chain, such as project financing, leasing, operation and related services.

Factors that Influence the Decision to Purchase a Commercial Rooftop Photovoltaic System

There are several factors that influence the decision to purchase a commercial photovoltaic system.

Levelized Cost of Electricity

We believe that the decision to purchase any commercial rooftop photovoltaic system is motivated in large part by the desire to achieve the lowest levelized cost of electricity per kilowatt hour, or LCOE, in order to maximize return on investment. As defined in the formula below, the LCOE of a photovoltaic system is the

ratio of a system's total life cycle cost, which is the sum of the installed cost plus the present value of the total lifetime cost of the system, to its total lifetime energy output. LCOE is a metric used to evaluate the economics of competing technologies relative to each other and to the retail price of utility-based electricity. Our LCOE formulation does not include financing costs, which are unique to each system owner.

$$\text{LCOE (\$/kWh)} = \frac{\text{Installed Cost + Total Lifetime Cost of Systems (\$)}}{\text{Total Lifetime Energy Output (kWh)}}$$

There are three principal ways to lower LCOE: (i) decrease installation costs, (ii) decrease the lifetime cost of a system and (iii) increase the lifetime energy output of the system.

- Installed Costs. Installed costs are comprised of costs of the solar panels and balance of system costs. Balance of system costs include hardware such as inverters, mounting racks and ballast, cables, grounding and wiring, as well as installation labor, engineering and overhead costs.
- Lifetime Costs. Lifetime costs are comprised of ongoing operating and maintenance costs net of tax or government incentives. Operating and maintenance costs include costs of cleaning solar panels, monitoring performance, repairing systems and performing ongoing maintenance. Another lifetime cost includes removal of the rooftop photovoltaic systems when a building's roof is replaced, and subsequently reinstalling the photovoltaic system on the new roof. For photovoltaic systems installed on existing rooftops, a roof replacement will frequently be required at least once over the lifetime of a photovoltaic system.
- Lifetime Energy Output. The lifetime energy output of a photovoltaic system depends on the collection and conversion of sunlight into electricity over the lifetime of the system, which in turn depends on the total nameplate panel power rating of the system, the real-world conditions under which the system will operate and the performance characteristics of the panels and electrical components under these conditions. Total nameplate panel power rating of the system is a function of the nameplate panel power rating of the panels and the number of panels that can be installed on a given area of rooftop. The performance characteristics of the panels are a function of the product design and the characteristics of the materials used in the panel, particularly the semiconductor material, and affect the conversion efficiencies and rate of degradation of output over the system's lifetime. System layout can affect performance due to shadowing, ventilation, directional orientation and the electrical wiring. Real-world conditions that can affect lifetime energy output include the location and design of a photovoltaic system, insulation, soiling and weather conditions such as temperature and snow.

Impact on Building Rooftops

Conventional tilted roof mounted photovoltaic systems typically require numerous rooftop penetrations or ballast, or both, to secure panels in place on the roof to withstand wind conditions. Rooftop penetrations can invalidate a rooftop warranty and cause permanent structural impact. In addition, mounted or ballasted rooftop photovoltaic systems may be too heavy to be supported by certain rooftops, precluding the installation of conventional photovoltaic systems.

System Integrator Motivations

System integrators often have significant influence on the selection of photovoltaic products for commercial rooftop photovoltaic systems. When recommending specific technologies, system integrators are motivated to meet the needs of their customers, while at the same time maximizing their workforce productivity by using products that require less training and time to install. Faster installation times also reduce working capital requirements of system integrators, allowing them to pursue a greater number of solar projects within a given year. System integrators are also motivated to install the largest-sized system for any given rooftop because they typically generate higher profits on larger systems.

Exhibit: Solyndra Bankruptcy Announcement

SOLYNDRA SUSPENDS OPERATIONS TO EVALUATE REORGANIZATION OPTIONS

August 31, 2011 — Solyndra LLC, the American manufacturer of innovative cylindrical solar systems for commercial rooftops today announced that global economic and solar industry market conditions have forced the Company to suspend its manufacturing operations. Solyndra intends to file a petition for relief under Chapter 11 of the U.S. Bankruptcy Code while it evaluates options, including the sale of the business and licensing of its advanced SIGC technology and manufacturing expertise. As a result of the suspension of operations approximately 1,100 full-time and temporary employees are being laid off effective immediately.

Despite strong growth in the first half of 2011 and traction in North America with a number of orders for very large commercial rooftops, Solyndra could not achieve full-scale operations rapidly enough to compete in the near term with the resources of larger foreign manufacturers. This competitive challenge was exacerbated by a global oversupply of solar panels and a sever compression of prices that in part resulted from uncertainty in governmental incentive programs in Europe and the decline in credit markets that finance solar systems.

“We are incredibly proud of our employees, and we would like to thank our investors, channel partners, customers, and suppliers, for the year of support that allowed us to bring our innovative technology to market. Distributed rooftop solar power makes sense, and our customers clearly recognize the advantages of Solyndra systems,” said Solyndra’s president and CEO, Brian Harrison. “Regulatory and policy uncertainties in recent months created significant near-term excess supply and price erosion. Raising incremental capital in this environment was not possible. This was an unexpected outcome and is most unfortunate.”

Customers who have implemented Solyndra solutions can be assured that their systems will generate economical, clean, solar power for decades.

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Exhibit: Public News Commentary

Sept. 14, 2011, 3:34 p.m. EDT

Solyndra clouds a national priority
Commentary: Anger over bad policy threatens basic research

By MarketWatch

SAN FRANCISCO (MarketWatch) — The road to hell is paved with good intentions. Solyndra is one of them.

The story began in 2009 with a push by the White House to supercharge a start-up solar power company in Fremont, Calif. Today it's the subject of a thorny congressional hearing in Washington into what went wrong.

Solyndra, two years after receiving $535 million in federal loan guarantees, went bust on Aug. 31. FBI agents paid the company a visit a week later, carting off documents that will likely reappear in court at some point down the road.

There's no end to the anguish and anger over the Obama administration's decision to pump taxpayer money into a company that it hoped would be a flagship for a new, environmentally friendly energy industry with the potential to create lots of jobs here at home. If it had been a success, there would have been no hearing. But it failed.

Critics are quick to point out that Solyndra exposes a flawed, even dangerous move by the federal government to pick favorites instead of letting the marketplace sort out which companies and which technologies survive.

But there's another side to this story that's being drowned out by all the angry noise: Government funding for basic research.

There's currently not much appetite in Washington for increased spending of any kind. With unemployment, poverty and a stagnant economy on the political front burners, standing up for science is not a safe path to re-election.

But playing it safe is not always the right course. Sure, basic scientific research takes forever, often hits dead-ends, and the true value of its findings is not always immediately clear. But it is the most basic building block in the quest for knowledge, and government funding has helped the United States achieve fantastic results with far-reaching applications that transcend the profit motive. Just look at the legacy of the space program.

There's a growing view in Congress that the government has no business funding research of any kind, that it's a task best left to industry. But that puts profit before knowledge and risks bottling their discoveries in patents. It's a short-sighted view that the United States can't afford to take, especially in the realm of energy.

If the Solyndra debacle results in further federal spending cuts to researchers, those cuts would simply add more paving stones to that road we really don't want to take. –Jim Jelter

Negative Press Quotes and Examples of Solyndra's Quick Demise[6]:

- Alex Brudny, a mechanical engineer at Solyndra LLC until two weeks ago, says he wondered why the Obama administration gave the California company $535 million in loan guarantees.
- "To a majority of us, it looked like a political stunt," Brudny, 59, said in a telephone interview. "The product was not as good as we counted on, and things were not really going well, and it was just a matter of time to me."
- Sangita Patel arrived for work at Solyndra the day it announced it would file for bankruptcy protection to find reporters camped out on the front lawn. She didn't share Brudny's sense of foreboding. "Total shock," the manufacturing engineer said of her reaction when a colleague in the parking lot told her their employer had announced it was shutting down.
- "The day before was a perfectly normal day," Patel, who declined to give her age, said yesterday as she emerged from a workshop at a job fair in Union City, about 12 miles (19 kilometers) from Solyndra's headquarters. "No sign or no rumors about anything."

[6] http://www.bloomberg.com/news/2011-09-16/solyndra-collapse-foreseen-by-some-workers-a-shock-to-others.html

Exhibit: Operational and Financial Data

From Solyndra's March 2010 S1 Filing

Statement of Operations

	Period from May 10, 2005 (date of inception) to December 31, 2005	Fiscal Years Ended December 30, 2006	December 29, 2007	January 3, 2009	January 2, 2010
		(in thousands, except share data)			
Consolidated Statements of Operations Data:					
Revenue	$ --	$ --	$ --	$ 6,005	$ 100,465
Cost of revenue(1)	--	--	--	44,435	162,166
Gross profit (loss)	--	--	--	(38,430)	(61,701)
Research and development(1)	840	19,927	85,859	125,499	84, 591
Sales and marketing(1)	178	574	2,677	4,838	9,317
General and administrative(1)	289	5,829	23,279	21,221	21,541
Asset impairment charges	--	--	--	31,610	--
Loss from operations	(1,307)	(26,330)	(111,815)	(221,598)	(177,150)
Interest expense	(17)	(494)	(6,906)	(12,444)	(1,576)
Interest income	--	1,184	2,829	1,870	282
Other income (expense), net	--	(1,532)	1,764	107	5,949
Net loss	**$ (1,324)**	**$ (27,172)**	**$ (114,128)**	**$ (232,065)**	**$ (172,495)**
Deemed dividend on preferred stock	--	--	--	(10,452)	--
Net loss attributable to common stockholders	**$ (1,324)**	**$ (27,172)**	**$ (114,128)**	**$ (242,517)**	**$ (172,495)**
Net loss per share (basic and diluted)(2)	**$ (0.13)**	**$ (6.69)**	**$ (16.55)**	**$ (23.85)**	**$ (13.30)**
Weighted-average common shares (basic and diluted) (2)	**10,000**	**4,063**	**6,898**	**10,167**	**12,972**
Pro forma loss per share (basic and diluted)(2)					**$ (0.90)**
Weighted-average common shares used in pro forma calculations (basic and diluted)(2)					**190,766**

Since inception, the Company has funded its operations primarily through private placements of preferred stock, bridge loans, term loans and revolving credit facilities. Through January 2, 2010, the Company has raised an aggregate of approximately $970 million through equity financings (see Note 12).

Consolidated Balance Sheet

	December 31, 2005	As of December 30, 2006	December 29, 2007	January 3, 2009	January 2, 2010
		(in thousands)			
Consolidated Balance Sheet Data:					
Cash, cash equivalents and short-term Investments	$ 38	$ 52,838	$ 148, 276	$82,223	$50,265
Working capital	(1,383)	71,096	50,695	40,711	(2,758)
Property, plant and equipment, net	59	4,663	107,988	204,340	375,873
Total assets	127	83,457	283,888	319,095	683,216
Long-term debt, net of current portion	-	3,945	-	-	140,856
Redeemable convertible preferred stock	-	97, 689	311, 616	630,859	961,270
Total stockholders' deficit	(1,324)	(28,215)	(141,829)	(368,487)	(532,295)

Cost of Capital

	Fiscal Years Ended		
	December 29, 2007	January 3, 2009	January 2, 2010
Risk-free interest rate	**4.41%-4.68%**	**1.67%-3.31%**	**1.79%-2.71%**
Expected terms (years)	**6.3**	**6.0-6.3**	**6.0-6.3**
Volatility	**83.5%**	**66.3%-81.5%**	**65.0%**
Expected dividends	**0.0%**	**0.0%**	**0.0%**

Discussion of Business Operations

Since our inception in May 2005 until early 2007, we focused our efforts primarily on research and development relating to our photovoltaic systems and related manufacturing equipment processes. Beginning in early 2007, we began installation of manufacturing equipment and development of manufacturing processes for high-volume production of our solar panels at our first manufacturing facility, which we refer to as Fab 1. Our photovoltaic systems were certified by the Canadian Standards Association and VDE (the German Association for Electrical, Electronic and Information Technologies) to Underwriters Laboratories Inc. and the International Electro-technical Commission standards in the first half of 2008. We commenced low-volume commercial production and shipments of our solar panels in July 2008. For the remainder of 2008, we expanded into a full-scale, replicable, highly automated production like for Fab 1 and achieved an annualized production run rate of 7.8 megawatts, or MW, at the end of 2008. During 2009, we continued installation of additional full-scale production equipment at Fab 1, which had an annualized production run rate of 54 MW during our fiscal month ended January 2, 2010. Annualized production run rate is expressed in MW and equals the aggregate nameplate panel power ratings of the panels we produced in our most recent fiscal month, multiplied by 12. Nameplate panel power rating is expressed per watts per panel and represents the watt-peak capacity of photovoltaic panels measured under standard test conditions for our panels. We primarily sell our photovoltaic systems to value-added resellers, including system integrators and roofing materials manufacturers, and to a lesser extent to system owners. These value-added resellers typically resell our systems for use by photovoltaic system owners, which include third-party investors, enterprises such as manufacturers, wholesaler-distributors and big-box retailers, government entities and utility companies. Over 80% of our sales through the fiscal year ended January 2, 2010 have been to customers located in Europe, with the balance primarily to customers located in the United States. We expect that a significant portion of our sales will continue to be to customers located in Europe for the foreseeable future given the availability of local government incentives for solar products. Since commencing commercial shipment of our photovoltaic systems, our results of operations have benefited from the Euro's strength against the U.S. dollar relative to historical levels.

From July 2008, when we commenced commercial shipment of our photovoltaic systems, through the fiscal year ended January 2, 2010, we generated $106.5 million in revenue. Our revenue has grown from $6.0 million for the fiscal year ended January 3, 2009 to $100.5 million for the fiscal year ended January 2, 2010. Total sales measured in MW have increased from 1.6 MW for the fiscal year ended January 3, 2009 to 30.0 MW for the fiscal year ended January 2, 2010. We have incurred significant operating and net losses since our inception, as we have continued to invest significantly in expansion of our production capacity to lower our manufacturing cost per watt and meet customer demand. In addition, we continue to invest in sales and marketing resources in order to enable us to further penetrate the commercial rooftop market. We have funded these activities through private placements of our preferred stock and, to a lesser extent, with borrowings under promissory notes, revolving lines of credit and a loan guaranteed by the DOE.

From our inception, through the fiscal year ended in January 2, 2010, we have invested in excess of $135 million in our research and development activities, which are focused on improving the performance of our existing systems as well as improving manufacturing processes to maximize production throughput and yield. As of January 2, 2010, we had an accumulated deficit of $557.7 million and expect to continue to incur substantial operating and net losses for the foreseeable future. [See "Liquidity and Capital Resources" and Note 1 to Notes to Consolidated Financial Statements]

Our future financial performance will depend on our ability to increase revenue while continuing to reduce our manufacturing cost per watt. Our future revenue growth will depend on our ability to expand our production capacity

and continue to increase the sales to the commercial rooftop market, as well as external factors, such as the availability of government incentives and financing capital for our customers and system owners. Our ability to continue to reduce our manufacturing cost per watt will primarily depend on our ability to increase our production volumes through improvements in our manufacturing yield and throughput, construction of additional manufacturing facilities, and installation of additional manufacturing equipment, which we expect to reduce our fixed manufacturing costs on a per-watt basis.

Manufacturing

We manufacture our solar panels and perform all manufacturing steps ourselves at Fab 1. We are in the process of expanding the capacity at Fab 1 and expect to reach an annualized production run rate of 110 MW by the fourth fiscal quarter of 2010, assuming achievement of planned product development objectives and manufacturing process improvements. Throughout the construction, build-out, expansion and operation of Fab 1, we have made significant advancements in our production processes, facility design and equipment design and manufacturing. We expect to benefit from these advances as we further expand our production capacity.

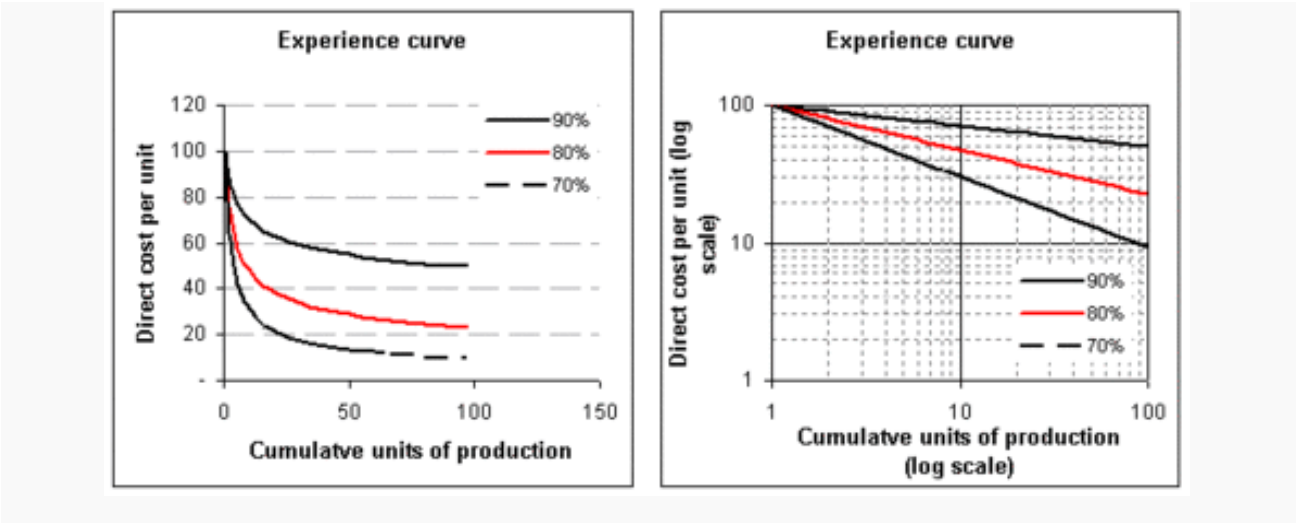
In September 2009, we commenced the construction of our second manufacturing facility, which we refer to as Fab 2, after securing a $535 million loan from the Federal Financing Bank guaranteed by the U.S. Department of Energy, or, DOE, under its loan guarantee program for innovative clean energy technologies, which we refer to as the DOE guaranteed loan facility. We expect to construct Fab 2 in two phases, with each phase expected to have an annualized production run rate of 250 MW, assuming achievement of planned product development objectives and manufacturing process improvements. The guaranteed loan amount constitutes 73% of the expected aggregate project costs of the first phase of Fab 2, which we refer to as Phase 1. We expect project costs for Phase 1 to total approximately $733 million, and we expect the first production output from Phase 1 to be in the first quarter of 2011. We expect Phase 1 to have an annualized production run rate of 250 MW by the end of the first half of 2012, assuming achievement of planned product development objectives and manufacturing process improvements.

We intend to use the proceeds of this offering to finance the second phase of Fab 2, which we refer to as Phase II. We believe that Phase II represents a significant opportunity to further expand our production capacity and reduce our costs of manufacturing. We estimate that the costs for Phase II will be approximately $642 million, which amount includes building expansion and improvements, manufacturing equipment, certain sales, marketing and other start-up costs, and a contingency reserve of approximately $53 million. On September 11, 2009, we applied for a second loan guarantee from the DOE, in the amount of approximately $469 million, to partially fund Phase II. If we are unable to obtain the DOE guaranteed loan in whole or in part, we intend to fund any financing shortfall with some combination of proceeds of this offering, cash flows from operations, debt financing and additional equity financing.

Exhibit: Experience Curve, Wikipedia:

The experience curve effect is broader in scope than the learning curve effect encompassing far more than just labor time. It states that the more often a task is performed, the lower will be the cost of doing it. The task can be the production of any good or service. Each time cumulative volume doubles, value added costs (including administration, marketing, distribution, and manufacturing) fall by a constant and predictable percentage.

In the late 1960s Bruce Henderson of the Boston Consulting Group (BCG) began to emphasize the implications of the experience curve for strategy. [3] Research by BCG in the 1970s observed experience curve effects for various industries that ranged from 10 to 25 percent.



These effects are often expressed graphically. The curve is plotted with cumulative units produced on the horizontal axis and unit cost on the vertical axis. A curve that depicts a 15% cost reduction for every doubling of output is called an "85% experience curve", indicating that unit costs drop to 85% of their original level.

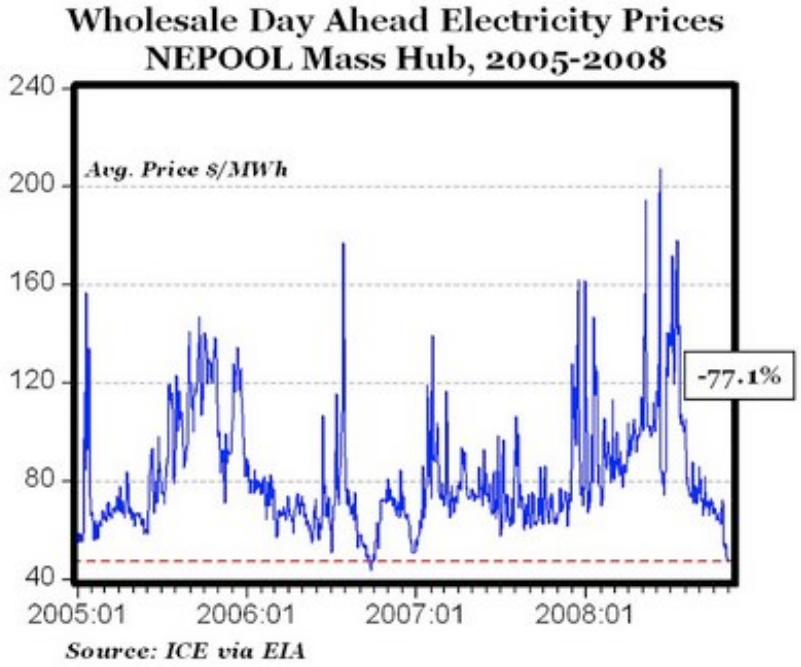
Mathematically the experience curve is described by a power law function sometimes referred to as **Henderson's Law**:

$$C_n = C_1 n^{-a}$$ [4]

where

- C_1 is the cost of the first unit of production
- C_n is the cost of the *n*th unit of production
- n is the cumulative volume of production
- a is the elasticity of cost with regard to output

Exhibit: Wholesale and Retail Prices



Retail Prices:

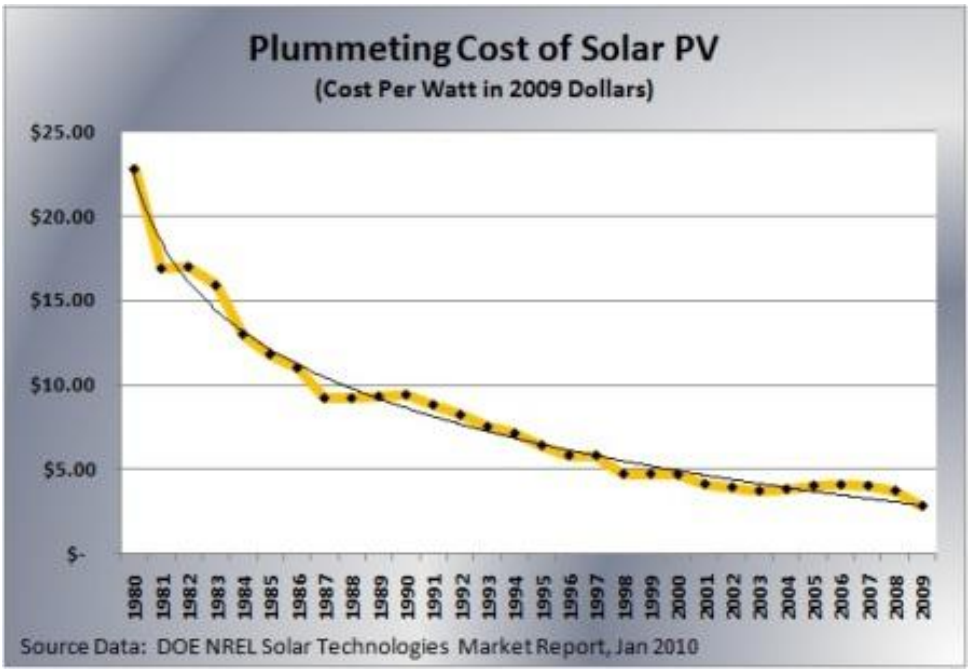
Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, 1998 through 2009
Released: November 23, 2011, Data in Cents per Kilowatthour

Period	Residential	Commercial	Industrial	Transportation	Other	All Sectors
1998	8.26	7.41	4.48	NA	6.63	6.74
1999	8.16	7.26	4.43	NA	6.35	6.64
2000	8.24	7.43	4.64	NA	6.56	6.81
2001	8.58	7.92	5.05	NA	7.2	7.29
2002	8.44	7.89	4.88	NA	6.75	7.2
2003	8.72	8.03	5.11	7.54	NA	7.44
2004	8.95	8.17	5.25	7.18	NA	7.61
2005	9.45	8.67	5.73	8.57	NA	8.14
2006	10.4	9.46	6.16	9.54	NA	8.9
2007	10.65	9.65	6.39	9.7	NA	9.13
2008	11.26	10.36	6.83	10.74	NA	9.74
2009	11.51	10.17	6.81	10.65	NA	9.82

www.eia.gov

Exhibit: Industry Prices of PV through 2010

Industry Prices



Cost of Materials for Silicon based PV Providers:

Figure. IHS iSuppli outlook for the cost of silicon + non-silicon content, gross margins and prices from top-tier module players, covering the second quarter for each year from 2011 to 2014
http://www.electroiq.com/articles/pvw/2011/06/solar-pv-cost-per-watt-below-1.html

Exhibit: DOE Loan Program Information

INNOVATION FOR AMERICA'S ENERGY, ECONOMIC, AND NATIONAL SECURITY[7]

In his State of the Union address, President Obama said that America faces "our generation's Sputnik moment" and that we need to out-innovate, out-educate and out-build the rest of the world to capture the jobs of the 21st century. "In America, innovation doesn't just change our lives. It's how we make our living." Through innovation in promising areas like clean energy, the United States will win the future and create new industries and new jobs. To lead in the global clean energy economy, we must mobilize America's innovation machine in order to bring technologies from the laboratory to the marketplace. The Department of Energy (DOE) is on the front lines of this effort. To succeed, the Department will pursue game-changing breakthroughs, invest in innovative technologies, and demonstrate commercially viable solutions.

The President's FY 2012 Budget supports three strategic priorities:
· **Transformational Energy:** Accelerate the transformation to a clean energy economy and secure U.S. leadership in clean energy technologies.
· **Economic Prosperity:** Strengthen U.S. science and engineering efforts to serve as a cornerstone of our economic prosperity and lead through energy efficiency and secure forms of energy.
· **Nuclear Security:** Enhance nuclear security through defense, nonproliferation, naval reactors, and environmental cleanup efforts.

The Financing Force Behind America's Clean Energy Economy[8]

The Department of Energy's Loan Programs enable DOE to work with private companies and lenders to mitigate the financing risks associated with building out commercial-scale clean energy projects, thereby encouraging the broader and more rapid growth of the sector. The Loan Programs Office is one of the largest and most active project finance operations in the world and, since 2009, has supported a robust, diverse portfolio of more nearly 40 projects. Projects include the world's largest wind farm, several of the world's largest solar generation facilities, one of the country's first commercial-scale cellulosic ethanol plants, and the first new nuclear power plant in the U.S. in the last three decades. Collectively, these projects plan to employ more than 60,000 Americans, create additional tens of thousands of indirect jobs, provide enough clean electricity to power three million homes, and save more than 300 million gallons of gasoline a year. Many of these projects are first-of-a-kind that, when completed, can be replicated entirely but the private sector across the U.S., creating even more jobs and increasing our nation's ability to compete successfully in this critical field on a global basis.

Some of the projects LPO supports include:

- The nation's first nuclear power plant in the last three decades. (Vogtle)
- The world's largest wind farm. (Shepherds Flat)
- One of the nation's first cellulosic ethanol power plants. (POET's Project Liberty)
- The largest rooftop solar project in our nation's history. (Project Amp)
- Several of the world's largest photovoltaic generation facilities when completed, including the largest in the world. (Agua Caliente)
- Several of the world's largest concentrating solar power (CSP) generation facilities that will triple the nation's currently-installed CSP capacity.
- Solar manufacturing plants that will help reduce the cost of solar power, one by up to up to 50% per panel. (1366, Solopower)
- The nation's first purpose-built wheelchair-accessible vehicle that will run on compressed natural gas. (VPG)

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[7] http://www.cfo.doe.gov/budget/12budget/Content/FY2012Highlights.pdf

[8] A list of current DOE loans an projects is available at https://lpo.energy.gov/?page_id=45

Exhibit: Technology Primer on Thin Film vs. Polycrystalline[9]

There are three general families of photovoltaic (PV) solar panels on the market today. They are **single crystal silicon, polycrystalline silicon,** and **thin film**. This article will help you to understand the differences between polycrystalline silicon and thin film that are relevant to the system designer and owner.

Polycrystalline cells are made from similar silicon material except that instead of being grown into a single crystal, they are melted and poured into a mold. This forms a square block that can be cut into square wafers with less waste of space or material than round single-crystal wafers. As the material cools, it crystallizes in an imperfect manner, forming random crystal boundaries. The efficiency of energy conversion is slightly lower. This merely means that the size of the finished module is slightly greater per watt than most single crystal modules. The cells look different from single crystal cells. The surface has a jumbled look with many variations of blue color. In fact, they are quite beautiful like sheets of gemstone.

In addition to the above processes, some companies have developed alternatives such as ribbon growth and growth of crystalline film on glass. Most crystalline silicon technologies yield similar results, with high durability. Twenty-five-year warranties are common for crystalline silicon modules. Single crystal tends to be slightly smaller in size per watt of power output, and slightly more expensive than polycrystalline.

The construction of finished modules from crystalline silicon cells is generally the same, regardless of the technique of crystal growth. The most common construction is by laminating the cells between a tempered glass front and a plastic backing, using a clear adhesive similar to that used in automotive safety glass. It is then framed with aluminum.

The silicon used to produce crystalline modules is derived from sand. It is the second most common element on earth, so why is it so expensive? The answer is that, in order to produce the photovoltaic effect, it must be purified to an extremely high degree. Such pure "semiconductor grade" silicon is very expensive to produce. It is also in high demand in the electronics industry because it is the base material for computer chips and other devices. Crystalline solar cells are about the thickness of a human fingernail. They use a relatively large amount of silicon.

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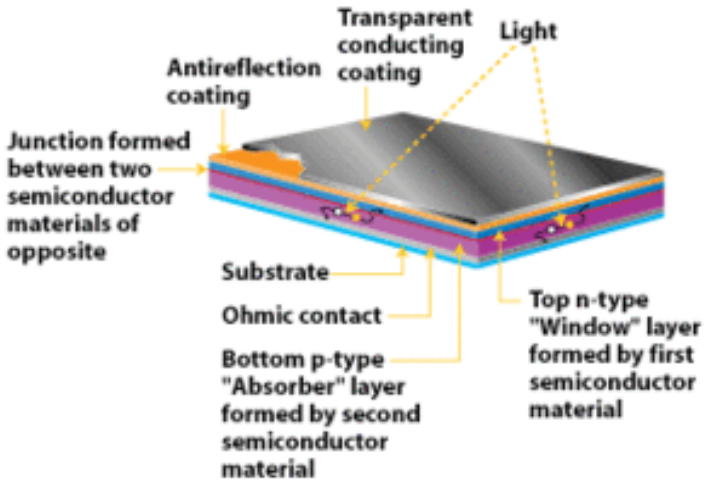
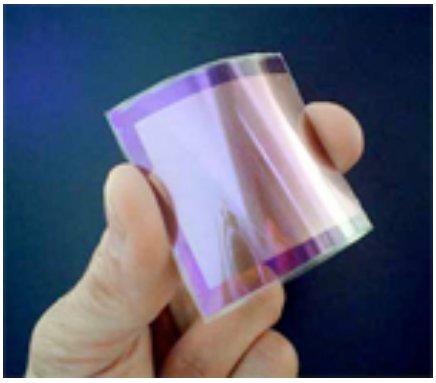
[9] http://www.wholesalesolar.com/Information-SolarFolder/celltypes.html
http://www.wholesalesolar.com/pdf.folder/guide.pv.installation.pdf
http://www.solarbuzz.com/going-solar/understanding/technologies

Thin Film Technologies[10]

Imagine if a PV cell was made with a microscopically thin deposit of silicon, instead of a thick wafer. It would use very little of the precious material. Now, imagine if it was deposited on a sheet of metal or glass, without the wasteful work of slicing wafers with a saw. Imagine the individual cells deposited next to each other, instead of being mechanically assembled. That is the idea behind thin film technology. (It is also called amorphous, meaning "not crystalline".) The active material may be silicon, or it may be a more exotic material such as cadmium telluride.





Thin film panels can be made flexible and light weight by using plastic glazing. Some flexible panels can tolerate a bullet hole without failing. Some of them perform slightly better than crystalline modules under low light conditions. They are also less susceptible to power loss from partial shading of a module.

The disadvantages of thin film technology are lower efficiency and uncertain durability. Lower efficiency means that more space and mounting hardware is required to produce the same power output. Thin film materials tend to be less stable than crystalline, causing degradation over time. The technology is being greatly improved, however, so I do not wish to generalize in this article. We will be seeing many new thin film products introduced in the coming years, with efficiency and warranties that may approach those of crystalline silicon.

PV experts generally agree that crystalline silicon will remain the "premium" technology for critical applications in remote areas. Thin film will be strong in the "consumer" market where price is a critical factor.

[10] http://en.wikipedia.org/wiki/Thin_film_solar_cell