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For Required Disclosures, please see page 50.

Investing in Solar Now

Outlook

- **A Profitable Energy Tech Sector:** The photovoltaic (PV) solar industry has emerged as a high growth, rapidly expanding industry generating profits throughout the supply chain. We believe profits in the solar industry are here to stay, as both public and government support will likely remain strong until product costs organically compete with grid electricity. We estimate gross profits across the core silicon PV supply chain (from silicon to installation) will be ~$7.7 billion in 2007, growing to ~$11.5 billion in 2011. Our estimates exclude profits from thin-film PV, which we estimate will grow from ~6.5% of the market in 2007 to 19% in 2011, and does not include equipment makers and derivative industries.
- **Demand Growth Dramatic, but Not Yet Organic:** RBC has developed a proprietary demand forecast model derived by geography. We estimate that ~1.7 gigawatts (GW) were installed in 2006, increasing to ~9.3 GW installed in 2011, an estimated five-year CAGR of ~40%. Demand, however, is not organic and not limitless, as it is still dependent on government subsidy programs even though companies throughout the supply chain are adding capacity, seemingly in a vacuum as if demand is not a consideration.
- **Installed Cost Will Rival Traditional Grid Rates in Six to Eight Years:** Using bottom-up capacity and utilization rates at each stage of the supply chain, we estimate the total industry average installed cost for PV solar will decline from ~$7.37/watt in 2007 to ~$4.40/watt in 2011, reaching organic competitiveness to grid electricity without incentives in 2012-2014 depending on the region.

Thesis

- **Oversupply Likely Within Supply Chain:** We believe silicon supplies will balance to demand levels in the second half of 2008, with rapidly falling spot silicon rates in 2009+. Similarly, we believe current industry solar cell expansion plans are too aggressive given the current demand outlook. While 2007 demand will still support current cell production, 2008+ will force new entrants and smaller players to run at utilization rates below 70%.
- **Margin Compression Will Drive Vertical and Capacity Consolidation:** We believe margins will compress throughout the supply chain, most dramatically affecting new silicon producers, smaller cell and module producers and independent installers. We believe oversupply dynamics will force increased vertical integration and capacity consolidation M&A in 2008-2010.
- **Technology Trends Favor Low-Cost Producers, with Some Exceptions:** We forecast silicon price declines and emerging thin-film products will drive increased focus on low-cost manufacturers, benefiting Asian producers. While the industry will continue to be dominated by standard commoditized products, some technology-differentiated companies are well positioned to benefit from long-term industry trends.

Four Investment Strategies

1. **Play the Supply Chain** – Margin trends across the supply chain
   Strategy: Silicon producers reaching pricing peak, larger solar cell producers attractive at right valuations, avoid module pure plays.
2. **Play Technology Differentiation** – Companies with unique products levered to LT trend.
   Strategy: High-efficiency silicon cells or thin-film attractive long term, but valuations a concern. We see several private thin-film companies in pipeline that could be attractive.
3. **Play Globally –** Manufacturing cost trends in industrialized nations versus low-cost Asia
   Strategy: Leading and emerging Chinese producers (with access to silicon) vs. German producers.
4. **Play Within a Geography –** Pair trades based on fundamentals within Germany or China

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Solar Industry Outlook

A Profitable Energy Tech Sector

Investors in the energy technology sector over the past two to three years have witnessed a pronounced shift in the quantity and quality of investable companies and technologies targeting the next generation of energy supply. As recently as two years ago, the bulk of public and private companies available for investment were speculative research and development companies with new technologies that promised more efficiency, less emissions or ways to generate and deliver energy beyond traditional fossil fuel sources. While technologies such as fuel cells, superconductors and flywheels will likely find profitable end markets one day through continued cost reductions, investments in these sectors requires technological due diligence, an element of faith and a willingness to endure several years of cash burn before profits are at hand.

The solar industry (along with select other energy tech sectors such as wind and biofuels), on the other hand, is generating significant profits today throughout the supply chain, primarily for one reason: it has captured the attention and support of both the public and governments. The Holy Grail for new energy technologies is the outlook that one day, costs will rival today's status quo of energy production. The raw cost of installed solar still exceeds the cost of grid electricity by double. But aggressive government incentive programs that seek to build scale in the industry and accelerate the industry's cost-reduction curve have helped offset costs and improve the economics for the end customer. The final result is the demand for solar has exploded within the last couple of years, attracting several new companies into the industry as profits have grown.

We believe profits in the solar industry are here to stay. The industry is likely six to eight years away from the point at which the core technology is cost comparable on an organic basis, opening up solar to increasingly compete in the entire electricity market without the need for incentive programs. We also believe that public and policy support is sufficient across a range of geographies to support the current cost disconnects until that point is reached. As the industry matures through its current phase of scaling up into the next phases of vertical and capacity consolidation, the cost basis for an installed solar solution will continue to decline.

The challenge, and the goal of this report, is to guide the investor on how to navigate a rapidly changing industry.

Our focus in this report is on photovoltaic (PV) solar technology, products which directly convert the radiation from the sun into electricity. We address both silicon-based solar and thin-film technologies, which use a variety of alternative metal substrates. Although there are several other emerging technologies such as concentrated solar products that use mirrors and the heat of the sun to generate electricity, the bulk of the industry is currently, and we believe will continue to be, dominated by photovoltaic technology.

Exhibit 1: Comp Sheet of Solar Businesses with Market Cap > 100M USD

Company	Reuters Ticker	Hdqtrs	YTD Return	RBC Rating	RBC Risk	US$ Equiv. Price	Market Cap	Enterprise Value	Reuters Estimates	Revenue (2007E)	Revenue (2008E)	EPS (2007E)	EPS (2008E)	P/E (2007E)	P/E (2008E)	EV / Sales (2007E)	EV / Sales (2008E)
Solar Grade Silicon Producers						**Converted to $U.S. Equivalents per Closing Day's Exchange Rate ($000's) except Share**											
MEMC Electronic Materials Inc	wfr	USA	47.0%	SP	AA	$57.54	$12,902	$12,094		$1,923	$2,285	$3.08	$3.57	18.7x	16.1x	6.3x	5.3x
Wacker Chemie	de;wch	Germany	35.6%			$182.72	$9,530	$9,911	X	$5,006	$5,446	$9.52	$10.15	19.2x	18.0x	2.0x	1.8x
Tokuyama Corporation	jp;4043	Japan	0.2%			$15.19	$4,188	$4,388	X	$2,449	$2,585	$0.61	$0.75	25.0x	20.2x	1.8x	1.7x
Silicon Producer Avg. Comps														*21.0x*	**18.1x**	**3.4x**	**2.9x**
Solar Silicon Cells & Modules																	
SunPower Corp	spwr	USA	60.2%	SP	Spec	$59.55	$4,603	$4,388		$691	$1,014	$1.15	$1.71	51.8x	34.8x	6.4x	4.3x
Evergreen Solar Inc	eslr	USA	35.9%	UP	Spec	$10.29	$713	$747		$62	$68	($0.30)	($0.11)	NA	NA	12.1x	11.1x
Q-Cells	de;qce	Germany	59.5%			$74.05	$5,513	$5,276	X	$985	$1,414	$1.67	$2.31	44.4x	32.1x	5.4x	3.7x
Ersol Solar Energy	de;es6	Germany	29.0%			$80.87	$792	$775	X	$209	$438	$1.52	$5.72	53.3x	14.1x	3.7x	1.8x
Solon	de;soo.a	Germany	76.3%			$56.66	$524	$567	X	$625	$898	$2.03	$2.64	27.8x	21.5x	0.9x	0.6x
Solar-Fabrik	de;sfx	Germany	127.0%			$29.92	$266	$272	X	$174	$227	$1.08	$1.49	27.7x	20.1x	1.6x	1.2x
Industrialized Country Avg. Comps														*41.0x*	*24.5x*	*5.0x*	*3.8x*
Motech Industries Inc OTC	tw;6244	Taiwan	1.6%			$12.28	$1,769	$1,754	X	$465	$660	$0.74	$0.96	16.5x	12.8x	3.8x	2.7x
E-Ton Solar Tech Co Ltd OTC	tw;3452	Taiwan	1.3%			$16.86	$679	$673	X	$217	$374	$0.98	$1.54	17.2x	10.9x	3.1x	1.8x
Suntech Power Holdings Co Ltd	stp	China	10.9%			$37.73	$5,565	$5,359	X	$1,038	$1,531	$1.04	$1.59	36.3x	23.7x	5.2x	3.5x
Trina Solar Ltd	tsl	China	216.3%			$59.79	$1,268	$1,180	X	$271	$588	$1.65	$3.58	36.2x	16.7x	4.4x	2.0x
JA Solar Holdings Co Ltd	jaso	China	N/A	OP	Spec	$26.38	$1,156	$1,046		$295	$603	$1.02	$1.56	25.9x	16.9x	3.5x	1.7x
Solarfun Power Holdings Co Ltd	solf	China	33.0%			$15.55	$746	$603	X	$276	$408	$0.78	$1.13	19.9x	13.8x	2.2x	1.5x
Canadian Solar Inc	csiq	China	9.9%			$11.52	$314	$273	X	$217	$318	$0.55	$0.89	20.9x	12.9x	1.3x	0.9x
Asian Country Avg. Comps														*24.7x*	*15.4x*	*3.3x*	*2.0x*
Total Silicon Cell/Module Avg. Comps														*31.5x*	*19.2x*	*4.1x*	*2.8x*
Thin Film Modules																	
First Solar Inc	fslr	USA	113.3%			$63.64	$4,416	$4,168	X	$327	$574	$0.32	$0.92	198.9x	69.2x	12.7x	7.3x
Energy Conversion Devices Inc	ener	USA	5.6%			$35.88	$1,418	$1,099	X	$109	$228	($0.25)	$0.50	NA	71.8x	10.0x	4.8x
Thin Film Average Comps														*198.9x*	*70.5x*	*11.4x*	*6.0x*
Solar Systems & Distribution Specialists																	
Conergy	de;cgy	Germany	9.8%			$72.40	$2,389	$2,358	X	$1,624	$2,328	$2.31	$4.18	31.4x	17.3x	1.5x	1.0x
Solon	de;soo.a	Germany	76.3%			$56.66	$524	$567	X	$625	$898	$2.03	$2.64	27.8x	21.5x	0.9x	0.6x
Phoenix Sonnenstrom	de;ps4	Germany	21.4%			$26.22	$159	$152	X	$270	$355	$0.98	$1.53	26.7x	17.1x	0.6x	0.4x
Sunways	de;sww	Germany	31.4%			$12.47	$161	$169	X	$230	$293	$0.15	$0.63	83.0x	19.8x	0.7x	0.6x
Carmanah Technologies Corp	ca;cmh	Canada	(3.1)%			$2.56	$109	$105	X	$70	$87	$0.05	$0.11	47.7x	23.8x	1.5x	1.2x
Systems / Distributor Avg. Comps														*43.3x*	*19.9x*	*1.0x*	*0.8x*
Integrated Solar Players																	
Renewable Energy Corporation ASA	no;rec	Norway	46.5%			$28.01	$13,841	$13,041	X	$1,066	$1,564	$0.64	$0.92	43.9x	30.5x	12.2x	8.3x
SolarWorld	de;swv	Germany	31.5%			$85.50	$4,776	$4,515	X	$927	$1,264	$2.51	$3.43	34.0x	24.9x	4.9x	3.6x
Integrated Solar Avg. Comps														*39.0x*	*27.7x*	*8.6x*	*6.0x*

Source: Company reports and RBC Capital Markets estimates

Solar Industry Outlook

Demand Growth Dramatic, but Not Yet Organic

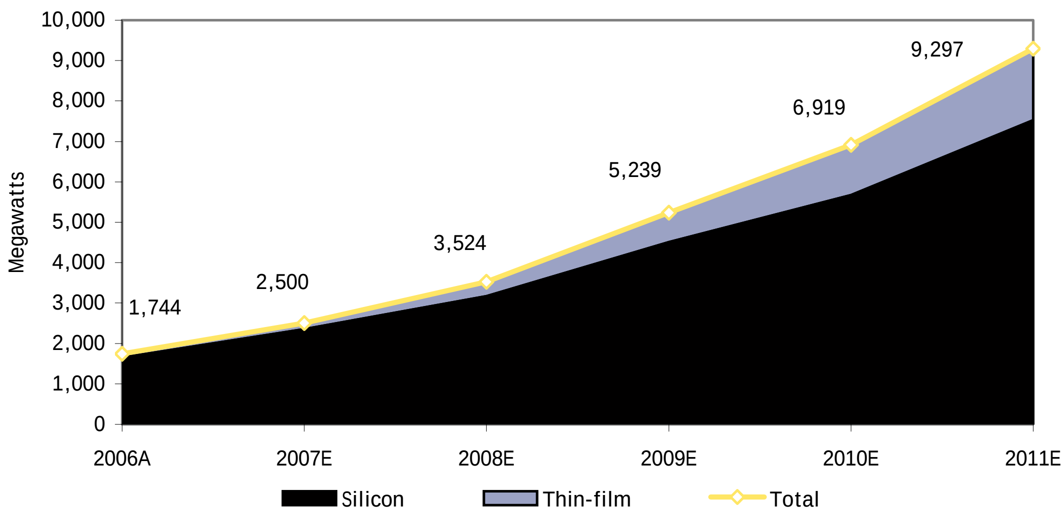
The solar industry is, by all accounts, an emerging industry. Based on 2004 data from the EIA and EPIA, only ~0.03% of all electricity generated worldwide was from PV solar. While overall the market penetration of solar in the electricity market still remains very small, the interest in the public for environmental reasons and governments for energy security and diversification reasons is driving a rapid increase in demand.

RBC had developed a proprietary demand forecast model derived by geography. We detail our assumptions and the macro drivers required to meet industry expectations later in the report. We estimate that ~1.7 gigawatts (GW) were installed in 2006, increasing to ~9.3 GW installed in 2011, representing an estimated five-year CAGR of 40%. While we estimate silicon-based solar accounted for ~95% of solar installations in 2006, we expect thin-film solar technologies, given their lower costs and more flexible physical characteristics, to approach ~19% of installations by 2011.

Demand for solar has increased recently for a combination of reasons, but the primary driver is the increase in government incentive programs. Japan and Germany have led the way, but we believe several other countries will likely be starting or expanding similar incentive programs.

What we think is critical for the solar investor to remember is that today and for the near future, the demand for solar panels is not organic and ***not limitless***, even though companies throughout the supply chain seem to be adding capacity in a vacuum as if demand is not a consideration.

Exhibit 2: RBC Solar Energy Demand Forecast



Source: Solarbuzz and RBC Capital Markets estimates

Solar Industry Outlook

Installed Cost Will Rival Traditional Grid Rates in 6-8 Years

Solar installations cost about double what would be economical for customers if government incentives did not exist. We estimate the average installed cost worldwide for solar to be ~$7.37/ watt installed in 2007E, declining to ~ $4.40/ watt in 2011E. We project that it will not be until 2012-2014, when the installed price approaches ~$3.50/kW, that solar will compete organically with the cost of grid electricity. Numerous variables must be taken into account to estimate when grid parity is reached at any particular location, the most important being the sun's strength at that location, the cost of the technology and the competing price of electricity from the local utility. But as costs for solar continue to decline, more and more regions of the world will develop into organic solar demand markets, eliminating the need for government incentives to drive further growth.

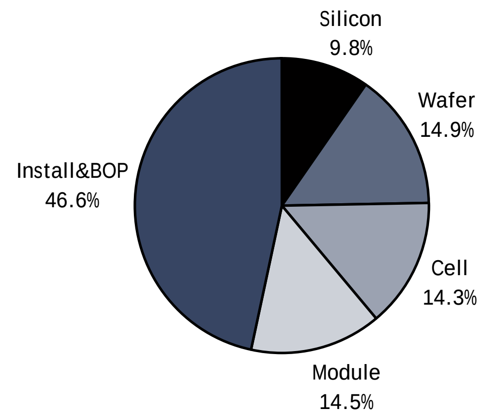
We believe that public and government support is sufficient to support the solar industry until this cost inflection point is reached.

Exhibit 3: RBC Estimate of Solar Industry Margin Trends

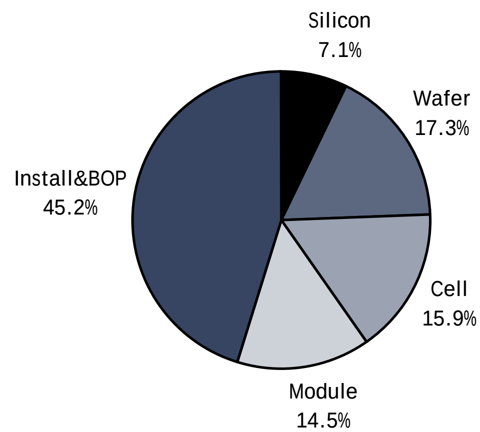
Source: Company reports and RBC Capital Markets estimates

Exhibit 4: RBC Estimate of Percentage of Installed Solar Costs – 2007 & 2011

RBC Estimate of Installed Module Cost Breakout – 2007E



RBC Estimate of Installed Module Cost Breakout – 2011E



Source: Company reports and RBC Capital Markets estimates

RBC Solar Industry Thesis

Oversupply Likely Within the Supply Chain

Our RBC solar supply/demand model incorporates a bottom-up approach of industry capacity and costs at every step of the silicon PV supply chain, from raw silicon, through wafers, cells, modules and installation, combined with a top-down demand model based on geography. We believe that even assuming robust continued demand growth driven by increased government incentive programs, the amount of capacity additions announced throughout the solar supply chain will lead to oversupply in 2008 and beyond, with capacity utilization rates falling.

Our analysis leads us to believe silicon supplies will balance to demand levels in the second half of 2008, with rapidly falling spot silicon rates in 2009 and beyond. Similarly, we believe current industry solar cell expansion plans are too aggressive given the current demand outlook. We forecast that while 2007 demand will likely still support current expected cell production, 2008 and beyond will force new cell entrants without secured sales contracts and smaller players to run at capacity utilization rates below 70%.

Margin Compression Will Drive Vertical and Capacity Consolidation

We believe the solar industry will experience margin compression throughout the supply chain as we enter an oversupply environment in the second half of 2008 and on. Instead of price collapses to match supply, however, we believe that because demand is not organic and is still fundamentally based on set IRR returns tied to government incentives (until the industry reaches organic grid parity competitiveness in 2012-2014), the industry is more likely to experience vertical integration, capacity consolidation that will delete some expansion plans, and lower capacity utilization rates for smaller players.

Vertical Integration: We believe the solar industry will increasingly see M&A activity in the 2008-2010 timeframe, as producers attempt to consolidate profits and find cost synergies. With projected end-market prices falling as quickly as technology achievements reduce costs, maintaining the gross margins of today will be increasingly challenging for pure-play solar companies exposed to only one segment of the supply chain.

Capacity Consolidation: We believe that given the constrained supply today, combined with the uncertainty of end-market demand, industry entrants at every level of the supply chain, from silicon to cells and modules, are announcing and adding capacity assuming seemingly endless demand. Given our demand model, our conclusion is twofold:

First, we believe silicon producers, as commodity providers, will see pronounced declines in spot pricing in 2009 and beyond, with incumbent producers that have secured locked-in set price contracts most immune to the cycle.

Second, we believe the industry will witness increased M&A activity in the roll-up of solar cell capacity as potential oversupply risks force some smaller players to abandon announced capacity expansion plans and seek the volume-buying protection of larger players who will be seeking market share gains.

Technology Trends Favor Low-Cost Producers, with Some Exceptions

We believe as silicon raw material cost becomes a much lower percentage of COGS, solar cell manufacturers with lower overall costs will generate superior margins in the long term. As silicon wafers inevitably become thinner, more automation will be required, favoring tech-capable players. While the bulk of the solar cell market will consist of commoditized-type standard panels, some technology leaders pursuing differentiated products, whether it be high efficiency or unique form factors, or companies attempting to brand their products directly to customers, will retain a market and profit advantage.

RBC Solar Industry Data Model & Assumptions

Exhibit 5: RBC Estimate of Solar Industry Supply-Demand Interplay

Demand Breakout	**2006A**	**2007E**	**2008E**	**2009E**	**2010E**	**2011E**
Demand (MW) for Silicon PV	1,648	2,350	3,171	4,506	5,673	7,530
Demand (MW) for Thin-film PV	96	150	352	734	1,245	1,766
Solar PV Demand (MW)	**1,744**	**2,500**	**3,524**	**5,239**	**6,919**	**9,297**
Module production						
Module (MW) Production for Silicon	1,573	2,781	4,191	5,681	7,052	8,228
Module (MW) Production for Thin-film	130	234	504	961	1,504	1,778
Demand/Supply Imbalance						
Demand/Supply Imbalance for Silicon Modules	(76)	431	1,020	1,175	1,378	697
Implied Silicon Module Capacity Utilization (Industry Avg.)	*105%*	*84%*	*76%*	*79%*	*80%*	*92%*
Demand/Supply Imbalance for Thin-film Modules	34	84	152	228	258	11
Implied Thin-film Module Capacity Utilization (Industry Avg.)	*74%*	*64%*	*70%*	*76%*	*83%*	*99%*
Silicon Cell Production						
Silicon Cell Baseplate Capacity at End of Year (MW)	3,658	5,582	7,780	9,693	11,311	11,892
Silicon Cell Annual Production (MW)	1,829	3,234	4,817	6,530	8,013	9,142
Assumed Efficiency Loss Combining Cells into Modules	*14%*	*14%*	*13%*	*13%*	*12%*	*10%*
Silicon Demand/Supply Imbalance						
Silicon Annual Production (MT)	35,645	43,254	57,877	84,415	97,400	105,050
Demand for Silicon for Semiconductors (MT)	24,000	26,000	29,000	33,000	34,500	35,500
Silicon Production Available for Solar (MT)	**11,645**	**17,254**	**28,877**	**51,415**	**62,900**	**69,550**
Assumed Industry Avg. Silicon Usage for Solar (g/w)	10.2	9.6	9.0	8.6	8.2	7.8
Silicon Production Available for Solar (MW)	**1,142**	**1,797**	**3,209**	**5,978**	**7,671**	**8,917**
Silicon-only Solar Demand (MW)	1,648	2,350	3,171	4,506	5,673	7,530
Demand/Supply Imbalance for Silicon (MW)	(506)	(553)	37	1,473	1,997	1,386

Source: Company reports and RBC Capital Markets estimates

Four Strategies for Solar Investing

Strategy #1: Play the Supply Chain

Our thesis is that oversupply is likely in the 2008+ timeframe for silicon-based solar PV, most notably affecting silicon and cell producers. We see announcements practically daily of new entrants or capacity expansion plans for both of these capital-intensive segments. However, we remain cautious of extrapolating financial projections for these companies based on such announcements given our outlook that demand growth, although robust at 40% CAGR, is dependent on varying political considerations across the world. The goal of government incentive programs is to drive industry costs down to spur an organic market, not create endless profits for every new entrant far into the future. While profits have been healthy since 2005 and we expect them to remain so through 2007 as industry capacity ramps to meet the artificially created demand ramp, we fully expect gross margins to compress across the supply chain.

We believe that despite our outlook that margins will compress from today's levels, silicon, wafer, and cell producers, as segments requiring the most capital and technical know-how, will still produce higher margins than the low value add and low barrier to entry module and installation segments.

Silicon: We favor incumbent producers, especially those that have locked in forward returns on any capacity expansions with fixed-price contracts. However, we believe even fixed-price contracts are at risk for renegotiation as cell customers experience their own oversupply and declining margins. We are wary of new entrants or niche players focused on recycled or metallurgical silicon or any speculative capacity expansions given our outlook that the amount of silicon available for the solar market will be oversupplied in the second half of 2008, with dramatic price declines in 2009+.

Wafers: We believe wafer producers will maintain relative strength in margins as the market grows to 2011 as the barriers to entry are large and the technical expertise required is significant. Very few silicon wafer pure plays exist, but we favor wafer producers vertically integrated with cell production as one of the best strategies to pursue competitive cost minimization in a future commoditized product market.

Cells: We believe cell capacity, according to the already announced expansions from industry players, will outstrip demand as soon as 2008. We favor larger, established cell producers as we believe this oversupply will force smaller players to either abandon intended expansions or operate at very low utilization rates. We believe the industry will see capacity consolidation in 2008 as larger players acquire assets from smaller new entrants at attractive prices, gaining market share and increasing their negotiating leverage for raw materials. Finally, we believe cell producers that have established intelligent silicon contract strategies that enable them to build scale in 2007-2008, but take advantage of reduced prices in 2009+ will have a long-term cost advantage.

Modules: Overall, we continue to remain cautious on investing in the low barrier to entry, labor-dominated module segment. Although tech trends involving thinner silicon wafers will likely require increased automation in this segment, and some companies argue that "lights out" operations with the ability to be located at demand sites instead of where the cells are manufactured will save transportation costs, we do not believe the R&D and capex required for this trend will deliver better gross margins within the next five years.

Installation: The installation segment is dominated by mom-and-pop operations throughout the world, with a few large companies as exceptions. These large companies can achieve cost leverage by standardizing toolsets and logistics and winning large projects through financing and service options. But for the most part, the segment will likely remain dominated by roofers and electricians. Even though we project module prices to fall significantly from 2007-2011, we believe the pricing power for installers will be limited as low barriers to entry will only increase the competition and number of players.

Strategy #2: Play Tech Differentiation

The solar industry has a strong, powerful incumbent group of technology players (crystalline silicon) as well as a growing number of industry challengers testing, commercializing and marketing their new technology.

The bulk of the solar market is dominated by standard commoditized module products based on solar cells that generate electricity at 15% to 17% efficiency. The core technology for silicon PV is derived from the space industry development of the 1960s and 1970s, with steady improvements in efficiency and manufacturing. We see three primary strategies that some tech-development solar companies pursue to differentiate themselves in the market: superior designs for cells that are more efficient (i.e. Sunpower) with the aim to demand a price premium; cost-reduction strategies with wafer technology that uses less silicon (i.e. Evergreen Solar); or cost-reduction strategies that do not use silicon at all (i.e. thin-film companies such as First Solar).

We believe each strategy requires significant technical due diligence combined with an understanding of how each potential tech advantage may materialize given long-term energy macro trends and solar industry trends specifically.

We believe the next wave of solar investments will be dominated by a focus on emerging thin-film technologies. There are a large number of private companies funded by VCs pursuing new technical designs and manufacturing techniques with the goal of undercutting the price of silicon PV significantly.

A thin-film solar module is the basic name for a group of different PV module technologies. Rather than growing, slicing and treating a crystalline ingot, as with crystalline silicon, a PV material can be created by sequentially depositing thin layers of the different materials into a very thin structure. The resulting thin-film devices require very little silicon material and have the added advantage of being easy to manufacture.

Several different deposition techniques are available; and all of them are potentially cheaper than the ingot-growth techniques required for crystalline silicon. Best of all, these deposition processes can be scaled up easily so that the same technique used to make a small laboratory cell can be used to make a very large module.

As our RBC silicon supply-demand model indicates, we are estimating that in 2011, thin-film modules will represent ~ 19% of total, worldwide PV installs. However, the impact of thin films on global silicon supply is almost negligible given that the leading thin-film modules use less than 1% of the semiconductor material that crystalline silicon modules use. As a result, even if thin-film market shares were to exceed 20%, the concerning incremental impact to the solar business would not be on silicon supplies – but rather on module pricing, as we predict that thin film at a 20% share in 2010-2011 would create a significant oversupply scenario for the silicon cell and module supply chain – forcing ASPs down.

We present a detailed review of the thin-film marketplace starting on page 42. Here we have provided a generic overview of thin-film module advantages vs. crystalline silicon modules:

- **Cost:** Thin-film manufacturers can produce solar modules with approximately 1% of the semiconductor material used for crystalline silicon modules, thus creating a material cost advantage.
- **Simplified module production:** Most thin-film manufacturers can create modules from large, cheap superstrates with a continuous manufacturing process. While many thin-film manufacturers can perform all manufacturing steps in a continuous process, the crystalline silicon manufacturing process is much more disconnected and extensive.
- **Product performance:** Some thin-film modules can perform better in a wider variety of environments, including high temperature and low light. However, do not confuse performance here with PV efficiency because silicon modules, on average, possess a conversion efficiency that is more than double that of an average thin-film module.

Strategy #3: Play Globally

On a regional basis, we observe two groups of solar cell producers emerging: industrialized nations and Asian. Today, for example, many established European and American cell manufacturers benefit from lower COGS as a result of advantageous silicon pricing from fixed-price contracts established within the last couple of years. On the other hand, most Asian cell producers possess less competitive silicon supplies (which inflates COGS) but manufacture with a lower operating cost structure. We believe that within the next 24 months, as additional silicon supplies drive down raw material costs, the long-term driver of profit margins will be operating cost structure. Hence, over time, Asian producers (most notably Chinese producers) stand to benefit.

We believe the primary cost advantage is not necessarily direct labor costs (which is a relatively low portion of COGS), but is dominated by the reduced infrastructure costs of land, construction costs and other facility costs, and indirect labor costs. We also have seen tax and capital incentives offered by Asian countries such as China as competitive as those offered by North American and European governments.

We believe that as the solar industry continues to scale and is dominated by standard commoditized products, the long-term beneficiaries will be the low-cost marginal producer. As many Chinese producers have proven they can implement technology advances to maintain tech parity with the rest of the industry, we believe the solar industry will evolve such that it resembles any other tech or non-tech industry where manufacturing costs dominate the cost structure of the industry.

We believe an investment strategy that seeks to pair Asian producers long vs. European producers will benefit long term as P/E multiples for Asian producers converge and eventually surpass their European competitors.

Exhibit 6: Asian vs. European Costs of Production

Solar Cell COGS Breakout - Sample Asian Producer

(All costs are per watt)

	2007E	2010E
Silicon Wafer Cost	$2.10	$1.65
Manufacturing Cost	$0.29	$0.28
Depreciation Cost	$0.10	$0.10
Total	**$2.49**	**$2.03**

Solar Cell COGS Breakout - Sample European Producer

(All costs are per watt)

	2007E	2010E
Silicon Wafer Cost	$1.55	$1.50
Manufacturing Cost	$0.55	$0.52
Depreciation Cost	$0.10	$0.10
Total	**$2.20**	**$2.12**

Source: Company reports and RBC Capital Markets estimates

Strategy #4: Play Within a Geography

We believe the final strategy is for investors to invest across a range of companies located within a particular geography such as Germany or China. The end market for solar products is global and fungible, with pricing generally homogeneous for all players. However, every company has specific fundamentals that determine its long-term margin profile: silicon raw material strategy (raw material costs), manufacturing costs, capacity utilization rates and breakage yields, technical differentiators and vertical integration profile.

As we believe that manufacturing costs will be one of the primary determinants as the industry evolves to the next phase, investing within a particular geography can allow the investor to eliminate this trend as a variable.

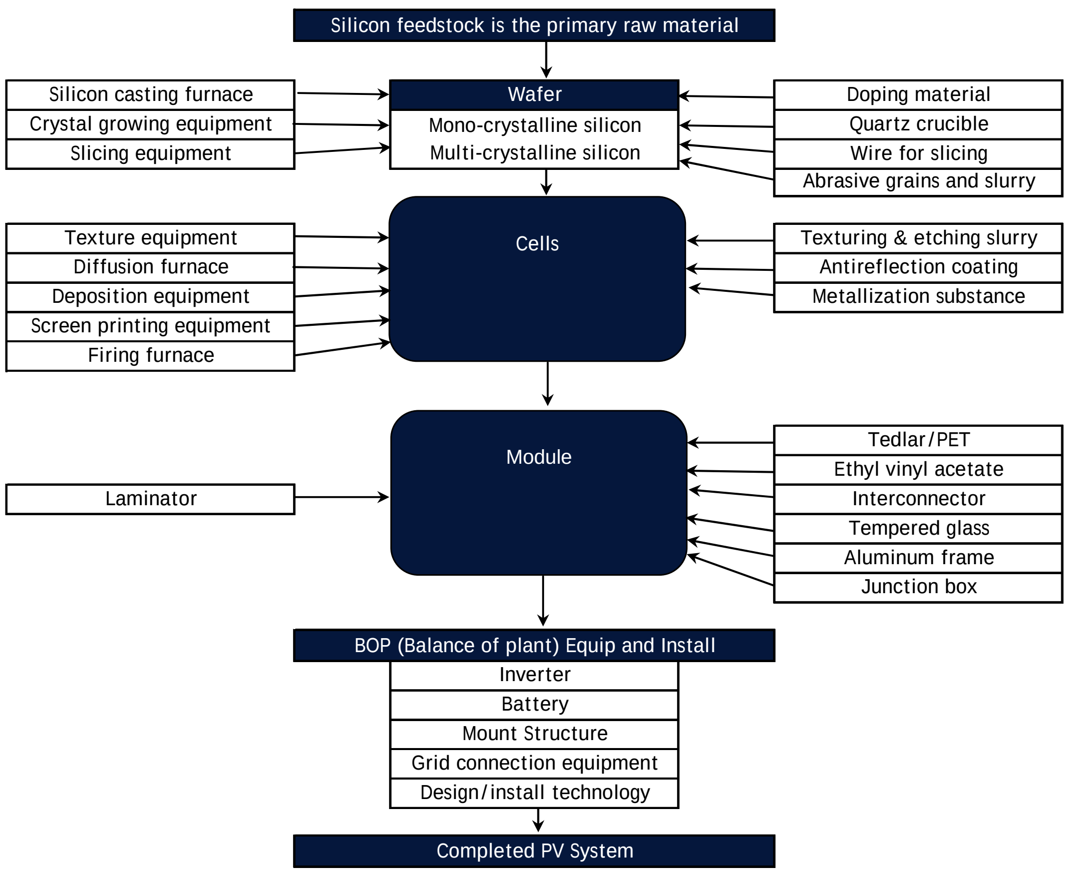
RBC Capital Markets

The Solar Industry Today

Overview

In just the last few years, the seeds for fertile solar growth have started to flourish – globally. The growth that started in Germany and Japan is flowing over into other European and Asian countries, as well as the U.S. What we find interesting is that most of the installed solar capacity has occurred in regions with below-average solar irradiation (Germany and Japan) but above-average government subsidy and supporting legislation. The argument for solar power is strong – just not cheap – yet. PV (photovoltaic) solar electricity production is pollution-free, does not produce greenhouse gases, does not tap into finite fossil fuel resources and can be easily integrated into the urban infrastructure, close to major demand needs. However, despite the positive qualities, solar electricity costs are currently higher than electricity generated by a natural gas or coal-fired facility. There is light at the end of the solar, "grid-parity" tunnel, though. Existing technologies (silicon-based solar cells) will benefit from the de-bottlenecking of core supply-chain inputs, economies of scale, and leverage of ever-improving intellectual capital and processing methods. Also, newer technologies (thin-film solar cells) offer a lower total installed cost for end users by sacrificing power density. In the end, with the continued commitment of industry participants (producers, buyers, policymakers), we believe solar power will continue to become a cheaper power source. We do not believe the most aggressive renewable energy laws have seen their peak globally. Nor do we believe that solar producers have reached the theoretical limits of existing technology and production methods.

Exhibit 7: Crystalline Silicon Solar Cell Supply Chain



Source: RTS Corporation and RBC Capital Markets estimates

Industry Drivers

The confluence of such geopolitical factors as energy security/independence, greenhouse gas emissions regulation, and basic energy supply and demand management have sparked a global interest in renewable energy – with solar power a potential solution and focus of legislation in European, American and Asian governments, to name a few.

- **Environmental –** Recent concern over GHGs (global greenhouse gas emissions) and their impact on global warming has sparked policymakers in leading industrial nations to adopt CO_2 (carbon dioxide) and NOX (nitrous oxide) reduction standards on everything from chemical and coal-fired generation plants to motor vehicles. Given solar power's emissions-free electricity generation, numerous Annex I (developed) countries are leveraging solar power to help supplement a small portion of their energy supplies in an attempt to meet certain provision of the Kyoto Protocol. The Kyoto Protocol went into effect in 2005, although the major emissions producers such as the U.S., China and India did not sign the agreement.
- **Energy Security and Independence –** The majority of all transportation fuels and electric power produced for residential, commercial and industrial uses is based on combustion of fossil fuels – predominantly coal, natural gas and crude oil derivatives. While most energy experts agree that there is sufficient fossil fuel supply to meet global energy demand for decades to come, it is generally believed that the cost to extract and process oil will keep increasing. If we combine the former attribute with the ever-present threat of crude oil supply disruptions (the primary feedstock for transportation fuels) resulting from geopolitical risk, most industrialized and developed countries feel compelled to diversify their energy supply base with energy sources that possess a lower correlation to global politics, security threats and other region-specific disputes.
- **Energy Demand –** Quite simply, as global thirst for energy increases, industrialized and emerging countries need more supply. Given many of the environmental and security risks noted above, a host of nations are encouraging the use of alternative energy sources (solar, wind, fuel cells, etc.) for energy production to eliminate much of the uncertainty associated with fossil fuels. Additionally, because solar energy can be harnessed in a variety of ways (on a residential roof, in a field, on the side of a commercial office building) there are almost an infinite number of power generation sources throughout the urban and rural environments.

Solar Demand

Exhibit 8: Silicon PV Residential Installation

Source: Photowatt International

Exhibit 9: Silicon PV Commercial/Industrial Installation

Source: Schott Solar GMBH

Introduction

Government incentives aimed at creating grid parity between solar and fossil fuel-based power are currently supporting the solar industry and driving recent volume growth. The increasing investment and resultant increase in solar capacities serves to advance the incubation period necessary for new solar technologies to commercialize, assist existing technologies in achieving economies of scale, and ensure that ancillary solar supplies expand capacities to support the rapid acceleration of solar installations.

As long as nations representing the majority of the world's energy consumption (i.e. America, China, Japan and industrialized Europe) continue to support the solar industry in its quest for grid parity, we believe that solar is on track to reach grid parity in some regions by 2012.

Exhibit 10: Demand Split by Residential + Commercial/Industrial

	2006A	2007E	2008E	2009E	2010E	2011E
Residential	1,288	1,821	2,540	3,689	4,761	6,333
% of Total	*74%*	*73%*	*72%*	*70%*	*69%*	*68%*
Commercial	456	679	983	1,551	2,157	2,964
% of Total	*26%*	*27%*	*28%*	*30%*	*31%*	*32%*
Total	**1,744**	**2,500**	**3,524**	**5,239**	**6,919**	**9,297**

Source: RBC Capital Markets estimates

Exhibit 11: Demand Split by Silicon/Thin Film

	2006A	2007E	2008E	2009E	2010E	2011E
Silicon	1,648	2,350	3,171	4,506	5,673	7,530
% of Total	*94.5%*	*94.0%*	*90.0%*	*86.0%*	*82.0%*	*81.0%*
Thin-film	96	150	352	734	1,245	1,766
% of Total	*5.5%*	*6.0%*	*10.0%*	*14.0%*	*18.0%*	*19.0%*
Total	**1,744**	**2,500**	**3,524**	**5,239**	**6,919**	**9,297**

Source: RBC Capital Markets estimates

Like Most Capital Allocation Decisions, Economics Key

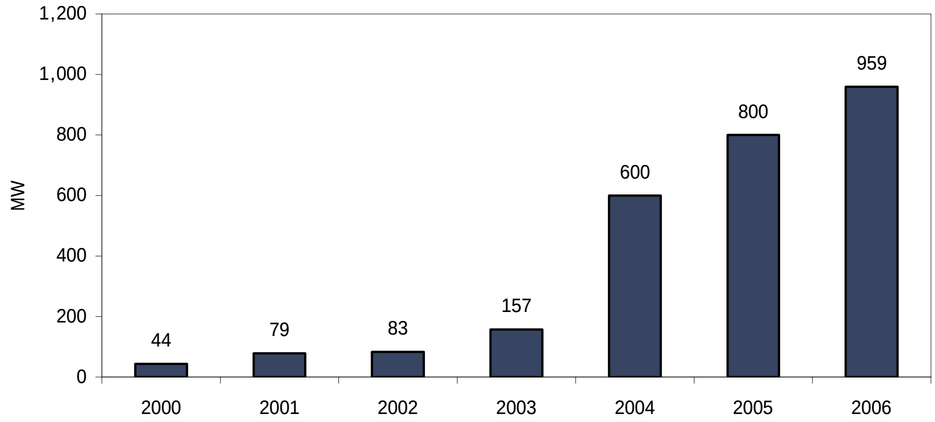
While we know that historical trends are not always an indicator or future results, we believe that the historical growth pattern of Germany's solar market is indeed a pattern that can and will be replicated in other markets globally. Quite simply, the implementation of aggressive feed-in-tariff programs created an attractive investment opportunity for owners of both residential and commercial on-grid systems in Germany; therefore, we believe countries that build an environment where solar investors can view a solar system as an attractive investment medium will realize the most substantial installations.

The two pieces of German legislation that enabled solar buyers to realize a competitive IRR on their capital investment were the "100,000 Roofs" program rolled out in 1999 and the REL (Renewable Energy Law) introduced in 2000. Under both laws, solar buyers could obtain a low 1.9% p.a. interest loan with a two-year grace period and a buy-back rate of ~0.5 euros per kWh guaranteed for 20 years.

Per EPIA, the response to both programs bundled together was so advanced that the 2000 PV loan budget of ~92 million euros was exhausted by more than 4,000 system applications received the year it was introduced. In addition, the average size of a system grew to ~5.18MW – a sign that commercial/industrial buyers were now investing in centralized, on-grid systems. With a new source of income, farmers with real estate could rent their land to investors via large PV systems and then secure revenue for 20 years or more – an attractive alternative revenue stream.

Using the 2004 feed-in-tariff rate of 57.4 euro cents per kWh and system cost of ~6,200 euros per installed kilowatt, we estimate that grid connected solar system could generate in excess of a 7% IRR over 20 years – an attractive proposition versus other annuity investment options. In the end, the low-interest loans and aggressive buy-back rates for solar formed the foundation for Germany's ~67% CAGR growth from 2000 through 2006. Further, we believe that other countries' solar incentives are approaching the economics typically associated with German installations and will enable those same countries to experience CAGR growth in the range of 30% 40% range, or more. The former phenomenon will ultimately provide the crux of our solar demand projections covered in Exhibits 17-20.

Exhibit 12: German Solar Growth



Source: EPIA

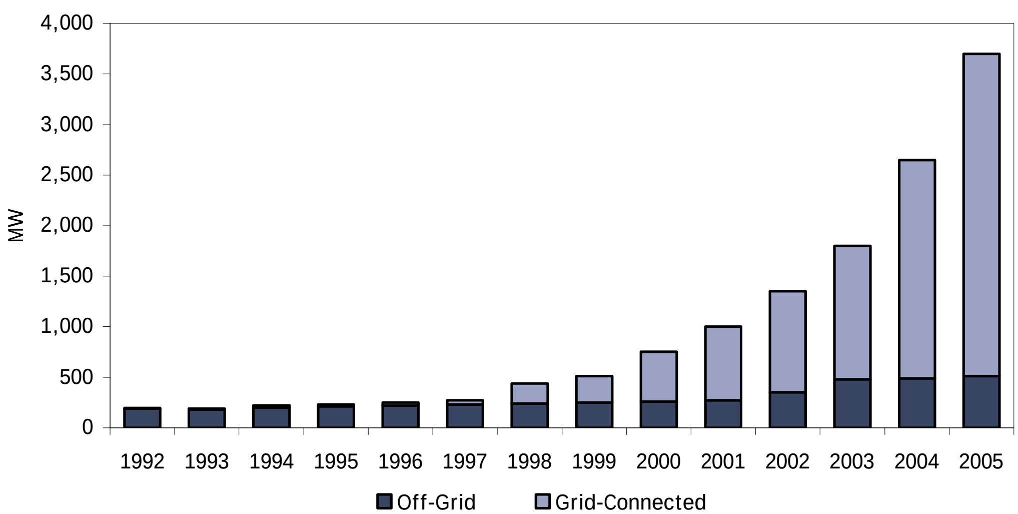
Grid-Connected PV The Growth Driver

Without grid interconnection standards, the ability to sell electricity into the utility system is effectively neutralized. Hence, recent solar growth has been dominated by grid-connected PV (photovoltaic) systems. The term "grid-connected" or "on-grid" simply means that the solar installation is electrically connected to the primary utility grid – with the ability to sell unused solar electricity back to the distribution system. Further, grid-connected power is typically separated into two primary categories: grid-connected distributed and grid-connected centralized.

Distributed systems are comprised primarily of residential and commercial applications (i.e. a manufacturing facility with solar panels that double as an energy source for operations and revenue source when all power is not consumed). Such systems may be integrated into or installed on the actual customer facility (home, building) and then tied into the local meter/junction box.

Based on historical EPIA estimates, we observe that the on-grid marketplace has and will account for the majority of solar system installations. We agree with this assessment for one primary reason: solar system owners want the ability to make money on their unused electricity generation and this cannot be achieved without a grid-interconnect and supporting utility standards to do so. We recognize that there will always be applications for off-grid solar installs to support rural energy needs; however, this will not be the demand-controlling marketplace.

Exhibit 13: Grid-Connected vs. Off-grid Installed PV Growth



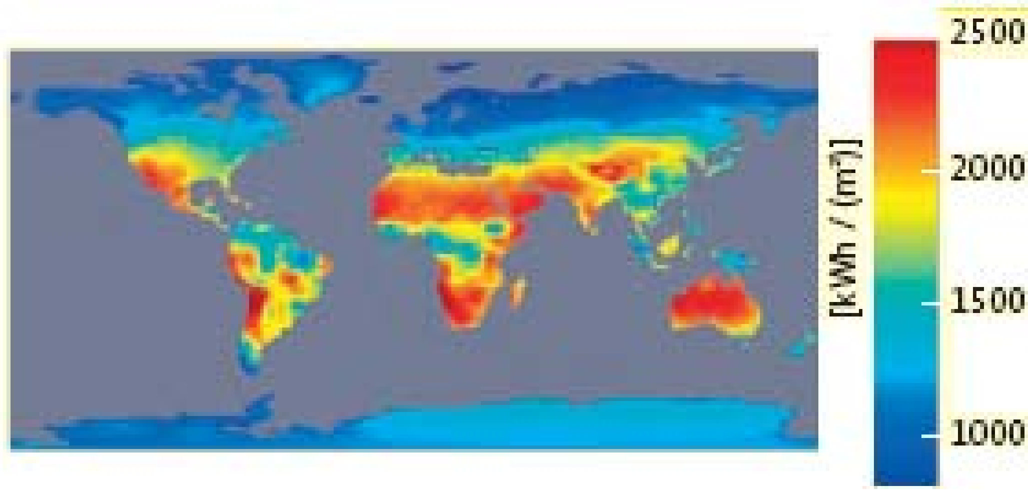
Source: EPIA

Superseding Germany's PV Growth Pattern

While any country would indeed need to experience a "perfect storm" to exceed cumulative PV installs that took place in the German marketplace from 2000-2006 (~2.7GW), we believe it is certainly possible. If we hold all solar demand catalysts constant (solar legislation, system owner tax rates, module supply and efficiencies, prowess of system design and installation, etc.), but change the geographic location of the solar system install – we believe, depending on the location, there could be a significant economic upside for the solar buyer.

Why is the *location* important? Location of solar power systems is important due to global variations in irradiation. Global surveys estimate that the average square meter of land is exposed to enough sunlight each year to generate between 1,600kWh and 1,800 kWh of power every year. Essentially, the more solar energy contained in any area, the more potential solar electricity that can be harvested. As depicted in Exhibit 14, we find that the average irradiation in Europe, the leading solar continent (in terms of growth prospects), to be ~1,200 kWh per square meter, whereas the U.S. Southwest (Arizona, Southern California) is pushing 2,000 kWh per square meter. We believe it is also important to note that the two other European countries poised for explosive solar growth, Spain and Italy, possess regional irradiation characteristics superior to those of Germany. Some estimates pin Madrid and Rome with ~40% and ~30% higher kW per square meter than Germany's southern-most territories, respectively.

Exhibit 14: Global Variations in Irradiation



Source: ISET and EPIA

Quantifying "Location Economics": Germany vs. California

To understand the potential impact of regional irradiation differences, we have run a simple IRR sensitivity analysis. Below are our model assumptions and results. We've found that the IRR of a solar power system installation in California (~12%) is more than double that of an equivalent German installation (~5%) based on solar irradiation factors alone.

Exhibit 15: IRR Sensitivity Demonstration

Model Assumptions	
Installed PV System Cost:	5,000 Euros/kW
System size:	3 kW
System/deprecation life:	20 years
2007 German Roof Tariff:	.4921 Euros/kWh
Inverter replaced in year 10 @ 700 Euros/kW	

Regional Effective Operating Hours	
Germany:	1,051
California:	1,700

IRR of Regional Solar Power System	
Germany:	5.27%
California:	11.80%

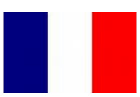
Source: RBC Capital Markets estimates

Exhibit 16: RBC Forecast of Solar Demand by Geography

Europe	2006A	2007E	2008E	2009E	2010E	2011E	07-11 CAGR	Cum Installed Over 5 Yrs
Germany	959	1,141	1,256	1,381	1,478	1,522	*7.5%*	6,778
Spain	64	115	207	373	504	680	*55.9%*	1,880
Italy	29	63	138	303	455	683	*81.7%*	1,642
France	17	37	67	98	117	141	*39.2%*	460
Others	68	150	217	315	363	436	*30.7%*	1,480
Subtotal	**1,137**	**1,506**	**1,885**	**2,470**	**2,917**	**3,462**	*23.1%*	12,241
YoY Growth	*25.6%*	*32.5%*	*25.1%*	*31.0%*	*18.1%*	*18.7%*		
United States								
California	103	186	334	602	831	1,146	*57.6%*	3,099
New Jersey	15	22	32	46	60	78	*37.3%*	238
Nevada	13	19	27	39	53	71	*39.9%*	208
Others	8	17	37	81	133	219	*88.3%*	487
Subtotal	**139**	**244**	**431**	**767**	**1,076**	**1,514**	*57.9%*	4,032
YoY Growth	*35.2%*	*75.0%*	*76.7%*	*78.3%*	*40.2%*	*40.7%*		
Asia								
Japan	285	428	641	962	1,318	1,805	*43.4%*	5,154
Korea	30	66	146	321	561	982	*96.2%*	2,076
China	60	72	86	104	124	149	*20.0%*	536
Others	43	84	135	216	302	423	*49.7%*	1,159
Subtotal	**418**	**650**	**1,008**	**1,602**	**2,305**	**3,360**	*50.8%*	8,925
YoY Growth	*4.1%*	*55.4%*	*55.1%*	*58.9%*	*43.9%*	*45.7%*		
Rest of World	50	100	200	400	620	961	*76.1%*	2,281
YoY Growth	*0.0%*	*100.0%*	*100.0%*	*100.0%*	*55.0%*	*55.0%*		
Total	**1,744**	**2,500**	**3,524**	**5,239**	**6,919**	**9,297**	**38.9%**	**27,479**
YoY Growth	*19.5%*	*43.3%*	*41.0%*	*48.7%*	*32.1%*	*34.4%*		

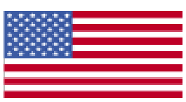
Source: EPIA, Greenpeace "Solar Generation" 2006 and RBC Capital Markets estimates. Actuals include some estimates.

Exhibit 17: RBC Demand Growth Assumptions by Geography (Grey indicates RBC selection)

Europe	Slow	Base	Advanced
Germany			
	- Roof tariff reduces > 8% p.a. - Open space / field install tariffs reduce > 9.5% p.a.	- Roof tariff reduces 5% p.a. (from '07 49c Euro/kWh) - Open space / field install tariffs reduce > 6.5% p.a. (from '07 37.96/kWh)	- Roof tariff reduces <2% p.a. - Open space / field install tariffs reduce < 4% p.a. - Current tariff structure extended beyond 2009
	Growth Assumptions 2007 - 2009: 5% 2010 - 2011: 2%	Growth Assumptions 2007E 2008E 2009E 2010E 2011E 19.0% 10.0% 10.0% 7.0% 3.0%	Growth Assumptions 2007 - 2009: 14% 2010 - 2011: 7.5%
Spain			
	- Solar install limit of 400MW not increased	- Solar install limit of 400MW increased to between 1500MW & 2000MW with current tariff structure	- Solar install limit of 400MW removed or increased beyond 2000MW with current or better tariff structure
	Growth Assumptions 2007 - 2009: 30% 2010 - 2011: 10%	Growth Assumptions 2007E 2008E 2009E 2010E 2011E 140.0% 40.0% 20.0% 10.0% 15.0%	Growth Assumptions 2007 - 2009: 80% 2010 - 2011: 35%
Italy			
	- Solar permit and application problems worsen	- Cumulative PV cap stays at current level of 1200MW	- Significant revision of solar permitting and application processing standards - Additional increase of installed MW cap of 1500MW
	Growth Assumptions 2007 - 2009: 55% 2010 - 2011: 25%	Growth Assumptions 2007E 2008E 2009E 2010E 2011E 200.0% 73.0% 54.5% 20.0% 25.0%	Growth Assumptions 2007 - 2009: 120% 2010 - 2011: 50%
France			
	- Tariffs reduced to 15c/kWh residential PV and 20c/kWh for industrial PV - Reduction of national RPS goal to 18% from 21% by 2010	- Tariffs maintained at 22.5c/kWh residential PV and 30c/kWh for industrial PV - RPS goal stays at 21% by 2010	- Tariffs increased to 25c/kWh residential PV and 35c/kWh for industrial PV - Increase of national RPS goal to 25% from 21% by 2010
	Growth Assumptions 2007 - 2009: 70% 2010 - 2011: 45%	Growth Assumptions 2007E 2008E 2009E 2010E 2011E 120.0% 80.0% 45.0% 20.0% 20.0%	Growth Assumptions 2007 - 2009: 80% 2010 - 2011: 45%
Rest of Europe			
	- Greece, Portugal reduce tariff structure - Lack of solar legislation development in other regions	Status Quo	- Greece, Portugal extend and increase tariff structure significantly (term extensions, slower tariff reductions)
	Growth Assumptions 2007 - 2009: 60% 2010 - 2011: 40%	Growth Assumptions 2007E 2008E 2009E 2010E 2011E 120.0% 45.0% 45.0% 15.5% 20.0%	Growth Assumptions 2007 - 2009: 85% 2010 - 2011: 55%

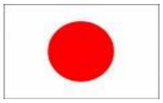
Source: RBC Capital Markets estimates

Exhibit 18: RBC Demand Growth Assumptions by Geography (Grey indicates RBC selection)

United States		Slow	Base	Advanced
California				
		- Limited extension of Federal solar-specific ITC and net-metering standards	- Energy bill extended, but a "watered-down" version of HR 550; lack of common net-metering standards	- Full adoption of energy bill similar to HR 550 and "SOLAR" act - Increase in 3GW PV goal
	Growth Assumptions	2007 - 2009: 30% 2010 - 2011: 15%	2007E 80.0%; 2008E 70.0%; 2009E 54.5%; 2010E 10.0%; 2011E 15.0%	2007 - 2009: 80% 2010 - 2011: 38%
New Jersey				
		- Limited extension of Federal solar-specific ITC and net-metering standards	- Energy bill extended, but a "watered-down" version of HR 550; lack of common net-metering standards	- Full adoption of energy bill similar to HR 550 and "SOLAR" act (or similar financial and net-metering policies) - Increase in overall RPS of 20% by 2020 & 1.5GW solar requirement.
	Growth Assumptions	2007 - 2009: 25% 2010 - 2011: 20%	2007E 35.0%; 2008E 30.0%; 2009E 30.0%; 2010E 20.0%; 2011E 20.0%	2007 - 2009: 45% 2010 - 2011: 30%
Nevada				
		- Limited extension of Federal solar-specific ITC and net-metering standards	- Energy bill extended, but a "watered-down" version of HR 550; lack of common net-metering standards	- Full adoption of energy bill similar to HR 550 and "SOLAR" act (or similar financial and net-metering policies) - RPS advances beyond 20% by 2015 and 5% PV minimum
	Growth Assumptions	2007 - 2009: 30% 2010 - 2011: 20%	2007E 50.0%; 2008E 30.0%; 2009E 30.0%; 2010E 25.0%; 2011E 25.0%	2007 -20'09: 45% 2010 - 2011: 35%
Rest of USA				
		- Limited extension of Federal solar-specific ITC and net-metering standards	- Energy bill extended, but a "watered-down" version of HR 550; lack of common net-metering standards - Increase in current, state RPS goal of ~7.3GW by 2020	- Full adoption of energy bill similar to HR 550 and "SOLAR" act (or similar financial and net-metering policies) - Increase in current, state RPS goal of ~7.3GW by 2020
	Growth Assumptions	2007 - 2009: 50% 2010 - 2011: 30%	2007E 150.0%; 2008E 60.0%; 2009E 60.0%; 2010E 25.0%; 2011E 30.0%	2007 - 2009: 115% 2010 - 2011: 65%

Source: RBC Capital Markets estimates

Exhibit 19: RBC Demand Growth Assumptions by Geography (Grey indicates RBC selection)

Asia	Slow	Base	Advanced
Japan			
	- Change in integration of PV with pre-fab building production - Severe reduction in current R&D solar budget - Reduction of 4.8GW installed PV goal	- Japan mainstains current METI solar budget structure with primary dollars allocated to industrial scale R&D and system testing - Pre-fab home builders continue to integrate PV systems into new designs and key banks offer reduced mortgage rates to PV integrated homes	- Increase in Sunshine Target from 4.8GM - Re-allocation of current from funding for R&D and centralized solar system use back to residential reimbursement - Outright increase in PV budgets
	Growth Assumptions 2007 - 2009: 15% 2010 - 2011: 10%	Growth Assumptions 2007E 2008E 2009E 2010E 2011E 30.0% 40.0% 40.0% 40.0% 35.0%	Growth Assumptions 2007 - 2009: 50% 2010 - 2011: 37%
Korea			
	- Reduction of 1.3GW installed goal by 2012 to ~1GW - Reduce PV tariff to 40-50c/kWh and/or lessen tariff duration to ~10-12 yrs - Elimination of low interest loans	- Reduction of 1.3GW installed goal by 2012 - Reduce PV tariff to 40-50c/kWh and/or lessen tariff duration to ~10-12 yrs - Elimination of low interest loans	- Increase of solar goal to > 2.5GW - Increase of feed-in-tariff structure to 80c/kWh - Extension of low interest loan funding program with reduced rate (~2.5-3%)
	Growth Assumptions 2007 -20'09: 95% 2010 - 2011: 60%	Growth Assumptions 2007E 2008E 2009E 2010E 2011E 120.0% 90.0% 90.0% 65.0% 20.0%	Growth Assumptions 2007 - 2009: 120% 2010 - 2011: 75%
China			
	- Lack of centralized direction regarding current low, state-mandated feed-in-tariff rates - No enforcement of current RPS and carbon emission curtailment goals	- Increase of solar goal of 450MW by 2010 - Advancement of 8GW goal by 2020.	- Increase of solar goal of 450MW by 2010 - or advancement of 8GW goal by 2020. Combined with: - Centralized policy of solar system subsidy and grid-interconnect standards - Enhanced monitoring of renewable energy accountabilities
	Growth Assumptions 2007 - 2009: 20% 2010 - 2011: 20%	Growth Assumptions 2007E 2008E 2009E 2010E 2011E 80.0% 80.0% 65.0% 35.0% 38.7%	Growth Assumptions 2007 - 2009: 85% 2010 - 2011: 55%

Source: RBC Capital Markets estimates

Exhibit 20: RBC Demand Growth Assumptions by Geography (Grey indicates RBC selection)

Rest of Asia

Slow	Base	Advanced
- Indian continues with only rural PV subsidy programs - Thailand's National Renewable Energy Policy not strong enough to support 300,000 rooftop program	- India develops a budget for urban PV - Thailand implements a National Renewable Energy Policy with enhanced RPS and/or tariff structure	- Indian advances rural PV subsidy programs (100% for non-electrified) and significant budget for urban PV with some form of tariff structure - Thailand implements a National Renewable Energy Policy with enhanced RPS and/or tariff structure targeting "on-grid" apps
Growth Assumptions 2007 - 2009: 25% 2010 - 2011: 25%	Growth Assumptions 2007E 2008E 2009E 2010E 2011E 95.0% 60.0% 60.0% 40.0% 40.0%	Growth Assumptions 2007 - 09: 90% 2010 - 2011: 65%

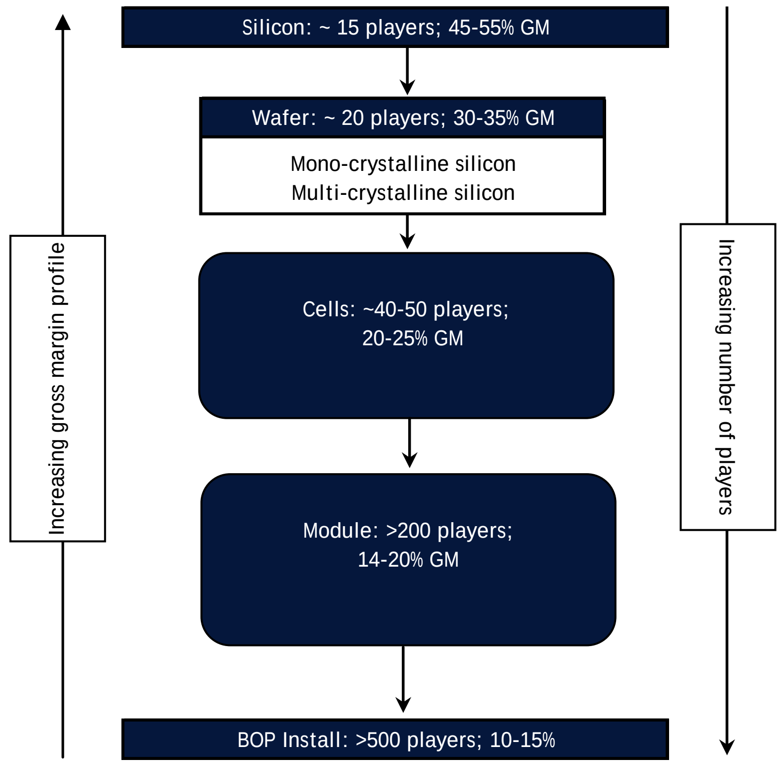
Rest of World

Slow	Base	Advanced
- Australia does not extend their "PV Rebate Progamme 4" set to expire in 2007 - No major PV traction in S. America (Brazil, et al)	- Limited extension of Australian "PV Programme 4" (no major solar credit increases) - Brazil (or other S. American major) adopt aggressive PV policies with financial subsidies to support more "on-grid" growth.	- Major overhaul of "PV Programme 4" (multi-year extension with more aggressive federal subsidies - max reimbursement beyond AUD 4k for residential and commercial system) - Multiple S. American countries implement competitive solar subsidy programs incl. system reimb. terms and RPS
Growth Assumptions 2007 - 2009: 50% 2010 - 2011: 39%	Growth Assumptions 2007E 2008E 2009E 2010E 2011E 90.0% 65.0% 65.0% 39.0% 39.0%	Growth Assumptions 2007 - 2009: 100% 2010 - 2011: 55%

Source: RBC Capital Markets estimates

The Solar Supply Chain for Silicon-based Panels

Exhibit 21: Installed Solar System – Silicon Panels



Source: RTS Corporation and RBC Capital Markets estimates

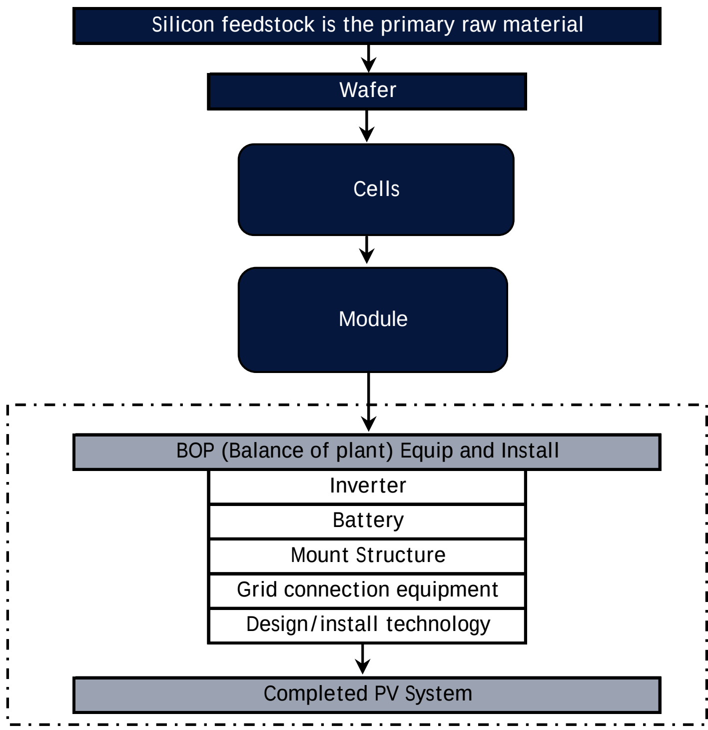
Supply Chain - Installers

PV System Design and Installation

Description

Companies that install solar modules operate at the very end of the supply chain. These companies perform a variety of end-user functions including, but not limited to, site prep, system analysis and design, load and financial client calculations, maintenance, and physical module and BOP construction and parts procurement and integration.

Exhibit 22: PV Installers in the Supply Chain



Source: RTS Corporation and RBC Capital Markets estimates

The more than 1,000 global installers dwarf the handful of raw silicon producers at the beginning of the silicon module supply chain. We believe the disparity between both ends of the silicon supply will continue to persist as new nations increase PV installations and new installation companies are formed. The intellectual and financial capital needed to form a PV system design and installation firm are low, representing low barriers of entry and ease in business model replication.

Segment Trends

Trends within the PV system design and installation segment are regional and are very much linked to the nature of the urban real estate marketplace. Factors like roof space, government subsidies and building architecture can vary both between and within countries.

We believe the dynamic found within Japan's urban, residential home building marketplace to be a great example of how regional factors can influence the PV system and installation process. Not only is urban Japanese real estate some of the most expensive in the world, but Japan also possesses some of the most aggressive emissions and clean energy support programs in the world. Layer the former two facts in with high seismic activity, and the structure of urban housing takes a very different view than – say – a new, residential installation in Billings, MT.

Companies like Panahome Corp, Sekisui Heim and Misawa Homes each create varying combinations of new, pre-fabricated homes with advanced structural steel frames (to meet aggressive seismic codes), “zero-emissions” features that can include fuel cells, advanced heat pumps, ventilation housing and integrated PV systems/substrates. The latter feature is perhaps the most interesting in that the roofs (for the eco-friendly home) may be pre-built with stainless (or other material) that will simplify the final PV module installation by the on-site PV installer. Not only does this integrated home-PV system encourage the implementation of PV systems in the new residential marketplace (help with emissions-reduction goals) but it also helps reduce the final PV system cost via “value-engineering”. Over the long run, as roof space and home building dynamics approach that of Japan (high real estate demand, low supply), and PV continues to gain traction in new urban markets, we believe that other homebuilders will find ways to integrate PV system planning into their designs via materials selection and other mechanisms.

Beyond real estate dynamics, installers are also aggressively developing unique module-placement and mounting elements as a means of differentiation. Unfortunately for a PV module, the sun does not shine at an optimal angle 100% of the day, decreasing the amount of recoverable solar energy for consumption. To help maximize energy conversion (beyond the capabilities of cell and module technology), companies like Powerlight have developed tiles that second as thermal insulation, possess single-axis tilt structures that minimize panel space and boost energy output, and other modular roof supports that offer enhanced module tilt and installation ease. In a PV installation marketplace with many competitors offering similar services, any tangible and/or quantifiable characteristic that cannot be replicated by a competitor will enable market share improvement – like Powerlight’s module support and roofing structures.

In summary, installation segment trends are categorized as follows:

- Migration towards building-integrated products
- Increasing use of “tilt and turn” panels (as opposed to static, flat panels)
- Increased efficiency via tool standardization
- Overall logistics improvements
- Increasing scale

Technical Challenges

The goal of almost every solar company (irrespective of supply-chain function) is to drive down component costs to enable grid-competitive, subsidy-free solar electricity. However, the challenge may be greatest for system installers in that many of the system components and grid equipment are primarily mass-produced pieces without significant ability to reduce costs. Additionally, installation processes and labor rates will most likely be static in the long term. As our system and margin projections indicate, we believe that non-module costs like labor and BOP equipment will not decline as significantly as price levels. In the end, we believe the majority of electricity price reduction for a PV system will need to occur in the silicon through module component – not in installation.

Installers included in Exhibit 23 below perform the following, minimum functions, per ENF’s filter (a solar information company with offices in Europe and China):

- Install panels on buildings either as part of the building, or mounted onto the roofs – with the installation supplying the building's primary power requirements.

- or -

- Install panels as part of power stations (free-standing panels in a field) producing electricity for the utility grid.

Exhibit 23: Global Installer Outlook

Global Installers	Locale
Phoenix Sonnenstrom AG	Germany
Conergy AG	Germany
Solon AG	Germany
Sunpower Co. Ltd.	Japan
Tenesol	France
Pevafersa	Spain
Enereco SRL	Italy
KPE	Korea
Powerlight	US
Suntechnics	US
Akeena	US

Europe: ~ 741 instal			
Austria	4	Turkey	3
Greece	21	France	88
Sweden	4	Portugal	6
Belgium	3	UK	65
Italy	64	Germany	313
Switzerland	10	Spain	124
Denmark	5	Other Europe	15
Netherlands	16		

Asia Pacific: ~308 in		Americas: ~375 installers	
China	67	Argentina	18
Japan	90	Brazil	12
India	30	Canada	41
Australia	58	USA	281
Other Asia Pacific	63	Other Americas	23

Other: ~21 installers	
Africa	16
Middle East	5

Source: ENF and RBC Capital Markets estimates

Derivative (Feed-in Industries)

While not directly involved in PV system design and installation, there are a host of firms that indirectly participate in global solar growth. In Exhibit 22, we list the typical BOP equipment devices. The most expensive BOP equipment is grid-tie inverters, which convert raw electrical power (DC) from the PV source into high-quality power (AC) required by the home, business or utility grid. Inverter prices can vary substantially based on rating, regional electrical specifications and volume purchased. Hundreds of corporations (large and small) manufacture inverters.

Other BOP equipment pieces include junction boxes, batteries, cable and wiring, metal framing, mounting systems and other, basic construction materials.

Installation Supply & Demand Outlook

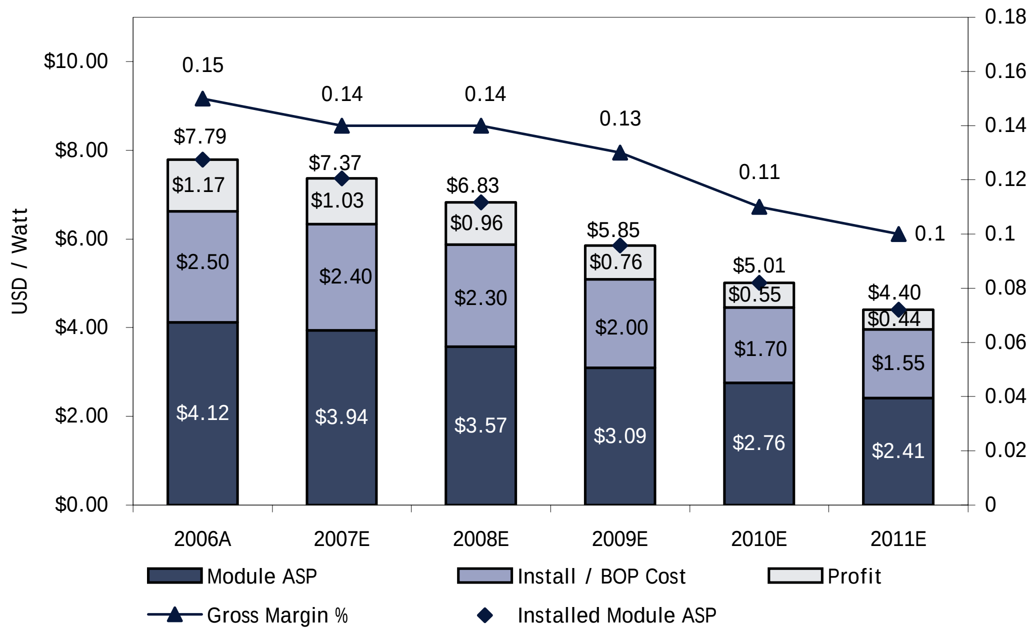
Exhibit 24: RBC Estimate of Global Installation Demand/Supply (MW)

	2006A	2007E	2008E	2009E	2010E	2011E
Module Demand (MW)	1,744	2,500	3,524	5,239	6,919	9,297
Module Production (MW)	1,703	3,016	4,695	6,642	8,555	10,005

Source: RBC Capital Markets estimates

Installation Pricing and Margin Outlook

Exhibit 25: Global Installer Financials



Source: Company reports and RBC Capital Markets estimates

Supply Chain - PV Module Production

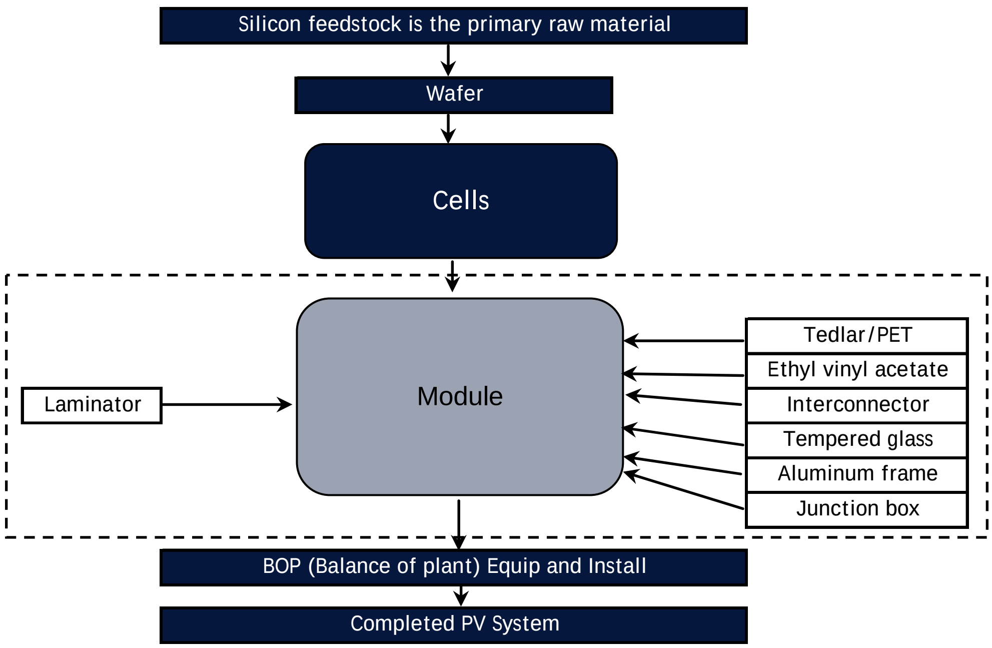
Description

There are two types of solar modules sold today: silicon and thin film. A silicon-based module consists of a series (typically 72) solar cells wired together in an array, laid flat, laminated with a plate of glass and enclosed with an aluminum frame.

The process to produce a saleable thin-film module is dramatically different. In the silicon world, the best example of an "integrated" module producer is REC in Sweden. REC not only produces its own silicon and ingots, but also fabricates the cell and fastens those cells into an encased and electrified module. In contrast, the most typical module operations occur in China. Most Chinese module producers have demonstrated an ability to run a lean, cheap operating model focused on repetition and scale. In the solar game, where cost reductions are critical, China is poised to become a leading global solar supplier as companies such as JA Solar leverage close working relationships with a multitude of local module suppliers to drive down production costs and streamline the transition from cell to completed module.

We believe the number of global module producers will continue to increase – driven mainly by new silicon module operations in Asia and new thin-film operations scattered in numerous countries. Most importantly, we do not believe that module production capacity, quality or know-how will limit world PV installations. In contrast, we believe that increased automation, quality control and enhanced performance will lead to lower module and PV system costs.

Exhibit 26: Module Producers in the Supply Chain



Source: RTS Corporation and RBC Capital Markets estimates

Segment Trends

Module production trends take two different paths based on the technology involved. For silicon-based modules, current efforts are focused on securing/diversifying silicon and cell feed stocks, tweaking supply chain operations, promoting R&D and enhancing operational efficiencies. We have summarized the major silicon-based module trends below:

- Creative branding via exclusive product agreements with leading dealer and installation companies;
- Capacity expansion to leverage economies of scale;
- Diversifying solar cell supply channel mix;
- Stacking long-term cell supply contracts;

- Leveraging toll manufacturing arrangements based on unexpected, excess cell and/or wafer manufacturing capacity;
- Migration towards in-house cell manufacturing;
- Consistent innovation and enhanced module efficiency through R&D; and,
- Migration from semi-automated manufacturing model into fully automated manufacturing processes to enhance operating and cost efficiency.

For thin-film modules, current efforts are focused on operational scale, production automation and R&D. The primary hurdle for most thin-film modules is low conversion efficiency. Typically, for non-field based installations, the surface area needed to generate adequate power exceeds that available on the roof, or other building surface. Hence, most thin-film producers are still heavily investing in R&D to enable residential users to consider their use. Until such time, the majority of thin-film modules will form PV systems in areas where surface area is of no concern. Lastly, because of the extra space needed to generate power, the PV system will incur additional BOP costs per watt versus an equivalent silicon-module system – just one more reason for thin films to demonstrate conversion efficiency gains.

Primary thin-film module trends:

- Migration towards continuous and scalable production process;
- Increased amount of facility process replication in new production lines; and,
- Rigorous R&D investment focused on module efficiency gain.

Technical Challenges

Most thin-film technologies are still relatively new and possess a number of technical challenges – namely long-term reliability and performance. The significant loss of conversion efficiency when lab cells are transitioned into commercial-scale modules is troublesome. NREL reports that for certain CIGS and CdTe modules, the efficiency loss when moving from a lab cell to a production-scale module can be more than 50%. Concerning long-term reliability, there have been significant engineering gains to prevent cell degradation under exposure to sunlight. However, there are a number of steps in module construction that can impact degradation at commercial-scale production – from poor encasement to edge sealing.

Exhibit 27: Global Module Player Outlook

Top Global Module Players	Locale
Schott Solar	Germany
SolarWorld AG	Germany
Solon AG	Germany
Kyocera	Japan
Sharp	Japan
Sanyo	Japan
Isofoton	Spain
Suntech	China
Sopray Solar	China
Sunpower Corp.	US
BP Solar	US

Europe: ~ 107 m			
Germany	36	Spain	11
Italy	12	Other Europe	48

Asia Pacific: ~ 191 module producers			
China	153	India	15
Japan	12	Other	11

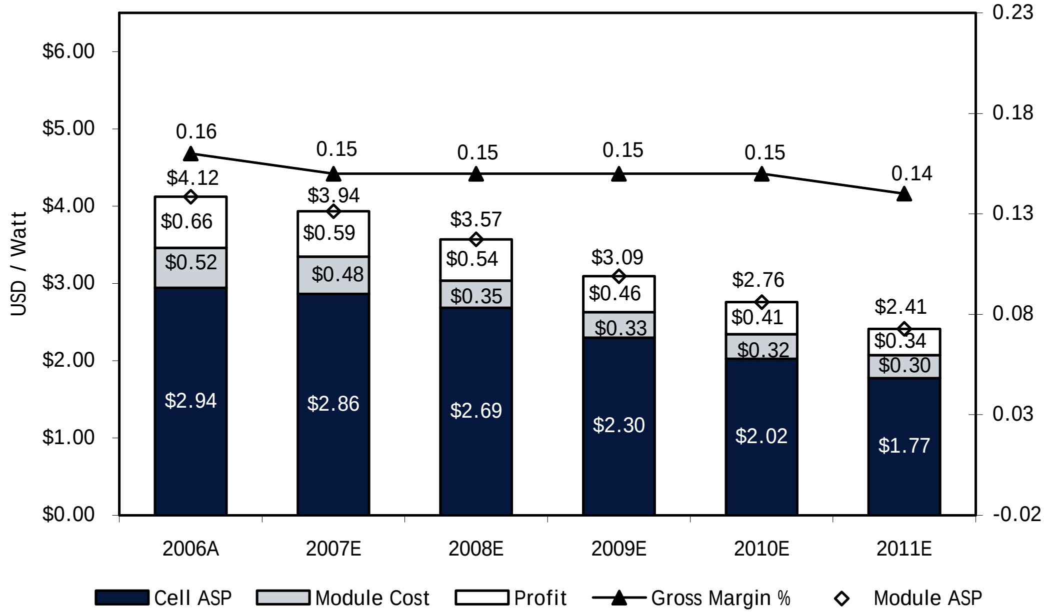
Americas: ~18 module producers			
USA	15	Other	1
Canada	2		

Other: ~4 modul	
Africa	3
Middle East	1

Source: ENF and RBC Capital Markets estimates

Module Pricing and Margin Outlook

Exhibit 28: Global Module Producer Financials



Source: Company reports and RBC Capital Markets estimates

Supply Chain - Cells

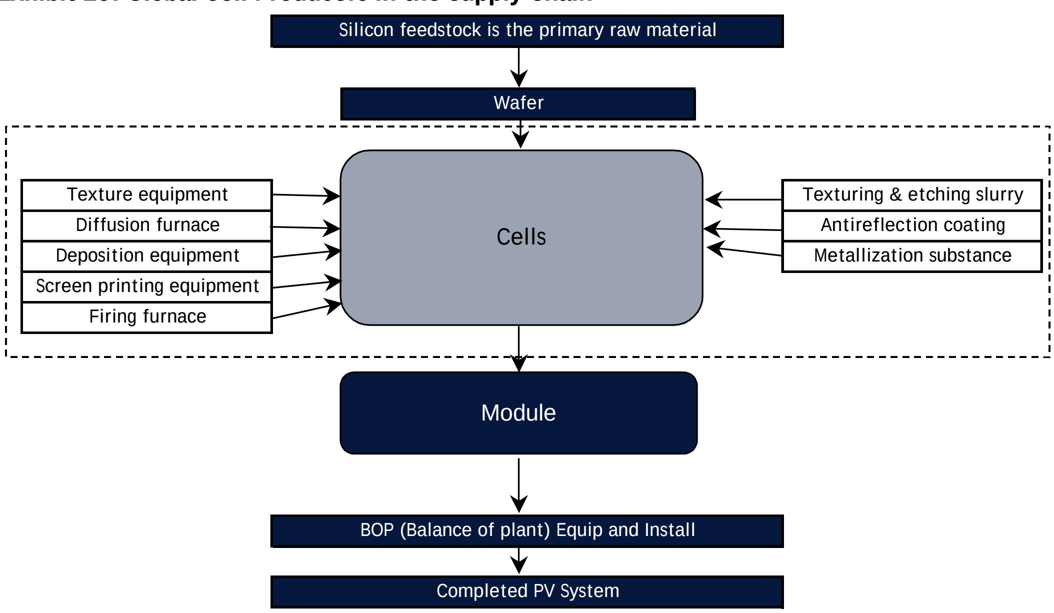
Description

The activity in the silicon cell production space is perhaps the most dynamic in the entire supply chain. Capacities are ramping up significantly within the factories of the world's major, incumbent producers in Germany and China, while new cell producers are entering the game. We believe that until the silicon imbalance is resolved and the competitive balance is restored between cell producers with and without access to competitive silicon contracts there will be a profitability rift in the cell business. In other words, the cell producers with existing fixed-price silicon contracts and lean operating models are able to generate superior gross margins in the near term. Moreover, the competition between European and Chinese cell producers will be fierce as all seek to ramp capacity quickly, increase yields, and raise cell efficiency faster.

Given that cell producers reside in the middle of the supply chain, these are often the companies that will seek to move up and/or down the supply chain in an attempt to achieve additional competitive advantage. We project that cell production capacity will be sufficient to meet module demand needs through 2011as the barriers to entry and value added for module production are lower than for cells.

The barriers to entry into the cell business are much higher than those for module production, mainly due to the advanced equipment and production machinery needed to transform a raw silicon wafer into a quality cell ready for interconnection in a module. While there are several companies that can provide complete, turn-key cell-production designs and deposition and furnace machinery, the capacity of such all-in-one designs is typically too low to allow the cell producer access to significant economies of scale.

Exhibit 29: Global Cell Producers in the Supply Chain



Source: RTS Corporation and RBC Capital Markets estimates

Segment Trends

PV cell players are working aggressively to strategically maximize profit margins and lead the drive for cell cost reductions. Interestingly enough, both goals will likely be achieved simultaneously. Via merger, acquisition or organic capital investment, cell producers are becoming more and more vertically integrated. The industry has seen cell producers establish in-house module production capacity as well as move all the way down into installation. Overall, the common theme in supply-chain movement is to reduce system costs by gaining more control of process flow and procurement economics.

RBC Capital Markets

In addition to supply-chain integration and management, cell producers are implementing core, cell-production tactics aimed at improving manufacturing economics – irrespective of what happens at the wafer or module stage.

Technical Challenges

We believe that core cell manufacturing improvement tactics can be summarized as follows:

- **Production:** Increase cell throughput and line run-time and minimize breakage rates.
- **Economies of scale:** Incremental cost decreases with increased production volumes.
- **Higher cell efficiency:** Leads to cost reduction at all supply levels.
- **Reduction in cell thickness:** Increases wafer output and lowers cell-input cost.

Exhibit 30: Global Cell Producer Outlook

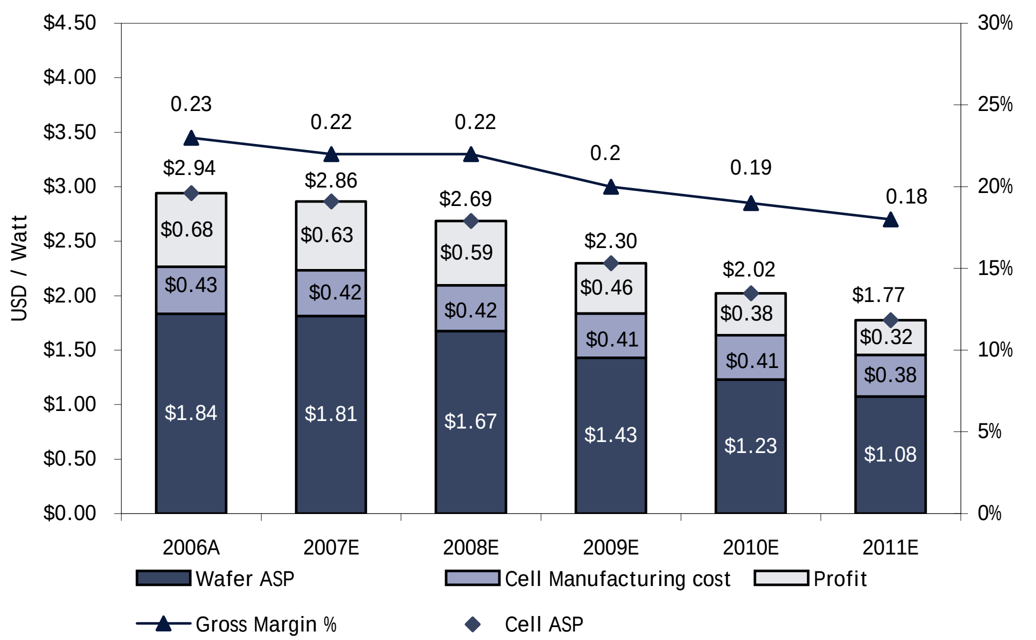
Top 2006 Cell Producers (MW)	2006A	Country
Sharp	462	Japan
Q-Cells	253	Germany
Motech	176	Taiwan
Kyocera	162	Japan
Mitsubishi Electric	118	Japan
Suntech	174	China
BP Solar	105	US
Sanyo	133	Japan
Schott Solar	102	Germany
Sunpower Corp	63	US

Europe: ~ 20 cell producers			
Germany	6	Spain	2
Italy	2	Other Europe	10
Asia Pacific: ~ 42 producers			
China	22	India	7
Japan	6	Other	8
Americas: ~10 cell producers			
USA	8		
Canada	2		
Other: ~2 cell producers			
Middle East	2		

Source: ENF and RBC Capital Markets estimates

Cell Pricing and Margin Outlook

Exhibit 31: Global Cell Producer Financials



Source: Company reports and RBC Capital Markets estimates

Exhibit 32: Global Silicon Cell Producers

PV Cell Producer	2006A	2007E	2008E	2009E	2010E	2011E
Sharp	462	620	702	710	710	710
Q-Cells	253	430	569	676	810	860
Suntech	174	286	360	460	740	900
Sanyo	133	184	278	350	350	380
CEEG Nanjing PV-Tech Co. LTD PRC	59	190	290	470	560	600
Kyocera	162	240	240	252	320	420
Motech	176	240	252	310	360	400
BP Solar	105	182	290	508	612	710
Mitsubishi Electric	118	198	230	230	230	230
Solar Fun Technology	29	140	224	328	360	360
Baoding Tianwei Yingli New Energy Resources	25	88	220	340	500	500
Sunpower Corp	63	128	240	379	418	478
Schott Solar	102	136	160	160	160	160
JA (JingAo) Solar	15	95	184	231	275	275
Deusche Cell (owned by Solar World AG)	42	78	152	160	160	160
E-Ton Solartech Co. Ltd. Taiwan	37	90	150	160	200	200
Isofoton	57	86	130	130	130	130
ErSol Solar Energy AG	25	56	122	220	260	260
ShellSolar (owned by SolarWorld AG)	63	80	88	152	292	340
Gintech	33	52	84	130	260	300
Yunnan Tianda PV Co LTD	7	42	76	100	100	100
DelSolar Co. Ltd. (subs of Delta Electronics)	28	44	63	78	90	90
Evergreen Solar	3	15	22	63	128	194
EverQ JV	6	43	106	165	235	280
CSI Cells Co. LTD (Canadian Solar)	4	29	72	100	100	100
Shenzhen Topray Solar Co LTD	24	42	50	50	50	50
REC ScanCell (Subsidiary of REC Group)	9	45	81	245	340	410
FirstSolar Sunways AG	-	9	46	46	46	46
Photovoltech	24	33	52	81	85	85
Photowatt	27	40	40	40	42	50
Neo Solar Power Corp	-	8	44	60	60	60
Wuxi Shangpin Solar Energy Science & Tech LTD	2	14	30	30	30	30
Solartech Energy	-	6	33	52	84	100
Solar EnerTech Corp	-	4	24	42	60	100
Big Sun Energy	-	4	28	66	90	90
Advent Solar	-	4	21	25	25	25
Shanghai Solar Energy Science & Tech Co.	10	10	10	10	10	10
SMIC (Semiconductor Manuf Int'l Corp)	1	6	10	10	10	10
PSE (KPE)	6	10	10	10	10	10
Mosel Vitelic Inc	-	2	14	30	30	30
SOLARTEC	0	2	7	7	7	7
Shanghai Topsun	0	2	2	2	2	2
Trina Solar	-	20	110	150	170	270
ARISE Technology	-	-	16	80	80	80
Conergy AG	-	10	80	215	275	275
Environment Energy Services	-	-	10	50	50	50
GE Energy	-	-	-	-	100	500
Annual Cell Production Capacity	**2,286**	**4,043**	**6,022**	**8,163**	**10,017**	**11,427**

Source: Company reports and RBC Capital Markets estimates

Supply Chain - Wafer Production

Description

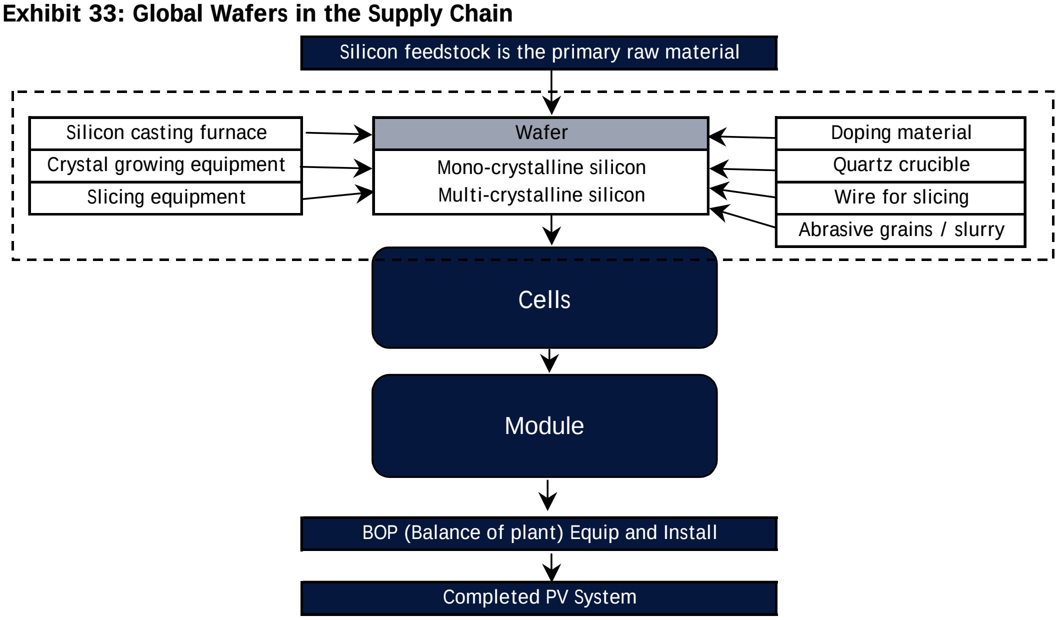
Wafer producers possess a significant amount of leverage in the solar supply chain in their ability to dramatically impact an important solar power metric: grams of silicon needed per watt of power.

The majority of all silicon wafers processed today are based on ingot growth using the Czochralski method of physically pulling molten silicon into a solid cylinder that can then be cut into base wafers. The main competitor to traditional ingot growth and wafer slicing is Evergreen Solar's String Ribbon technology that involves a very different mechanical process and final grams per watt metric. PV cells based on traditional ingot growth and slicing currently use anywhere from 10 to 11 grams of silicon per watt, whereas the String Ribbon technology can produce for anywhere from five to six grams of silicon per watt. Instead of forming an ingot and then cutting the conditioned ingot using a wire saw (resulting in silicon wastage with each cut), Evergreen Solar pulls two electrified wires through a silicon melt interface, resulting in two long, thin ribbons of silicon. The ribbons are then harvested, cut and prepared for final conditioning – a process resulting in minimal silicon loss.

The processes and resultant technology involved in wafer production continue to advance. As cell manufacturers work to increase efficiencies and minimize defects, they require silicon wafers produced within tighter bands of design specification. Further, because silicon wafers can vary in diameter, surface features, composition, purity levels and crystalline structure, the use of advanced polishing, deposition, and test equipment and input materials is crucial. As depicted in Exhibit 33, there are several steps involved in producing saleable wafers requiring numerous machines and skilled engineering and manufacturing personnel.

Overall, the barriers to entry in wafer production are high, stemming mainly from high-capex equipment and processing machinery, skilled labor and R&D personnel, and other intellectual capital necessary for manufacturing products in an environment with tightening quality standards.

Exhibit 33: Global Wafers in the Supply Chain



Source: RTS Corporation reports and RBC Capital Markets estimates

Segment Trends

The trends for wafer and cell producers are similar: simultaneously investigate supply chain migration benefits coupled with internal production improvement. Primary wafer trends are as follows:

- **In-house ingot and wafer production (vs. wafer only):** Results in lower wafer breakage and shorter processing cycle times.
- **Increasing use of local ingot suppliers:** Results in lower breakage and shorter processing cycle times.
- **Reduction of wafer thicknesses:** Allows for more wafers per ingot.
- **Increasing adoption of silicon-reclamation programs:** When combined with virgin silicon, it results in lower-cost ingot and final wafers.
- **Maximizing processing yields:** Increase the amount of useable feedstock from each ton of wafers processed.
- **Optimize feedstock combinations:** Enables maximization of production yield and unit cost.
- **Transition into more advanced wafer slicing and conditioning equipment:** To enable efficient migration into lower-thickness wafers, producers will need to invest in machinery and components that can both maintain production throughput and wafer quality while churning out thinner, more fragile wafers.

Technical Challenges

The combination of migrating to thinner wafers while incorporating new silicon feedstocks (such as metallurgical silicon) will prove to be a challenging exercise for most wafer players. As multiple operating variables change in tandem, it will be critical for manufacturers to realize the benefit of new equipment investment via lower grams per watt of silicon and lower costs. We believe the more successful players will be those that can most directly minimize silicon feedstock costs while maximizing wafer production per ingot (via thickness reduction). Further, it may be necessary for wafer players to adjust their supply-chain logistics by either moving into ingot growth or sourcing more silicon from local suppliers.

Exhibit 34: Global Wafer Producer Outlook

Top 10 Wafer Players	Locale
REC	Germany
SolarWorld AG	Germany
Schott Solar	Germany
PV Crystalox	Germany
Sumitomo	Japan
Photowatt Int'l	France
ASI (Ersol)	Switzerland
Renesola	China
Trina Solar	China
Jinglong Group	China
MEMC	US

Europe: ~ 17 wafer producers			
Germany	9	Spain	1
Sweden	1	Other Europe	6

Asia Pacific: ~ 27 wafer producers			
China	20	India	2
Japan	2	Other	3

Americas: ~4 wafer producers	
USA	3
Canada	1

Other: ~11 wafer producers	
Russia	5
Other	6

Source: Company reports and RBC Capital Markets estimates

Derivative (feed-in) Industries

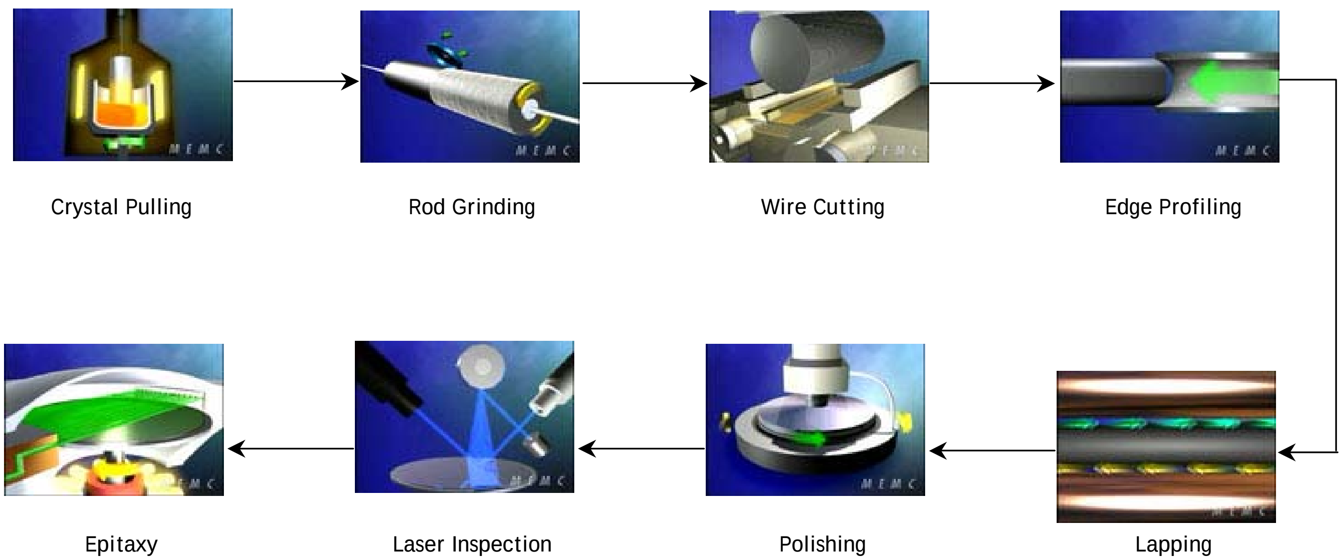
The primary processing steps involved in transforming an ingot into a market-ready wafer are shown in Exhibit 36. Given the various steps involved in wafer processing, there is a tremendous amount of finely tuned machinery and advanced software needed. Below is a basic summary of equipment, materials and software needed to operate a leading wafer production facility:

Exhibit 35: Major Input Equipment/Materials Used in Wafer Production

Equipment:		Materials:	
	Grinding		Slurry
	Cutting		Polishing liquids
	Lapping		Saws
	Polishing		Etching reagent
	Testing		
	Sorting		
	Inspection		

Source: Company reports and RBC Capital Markets estimates

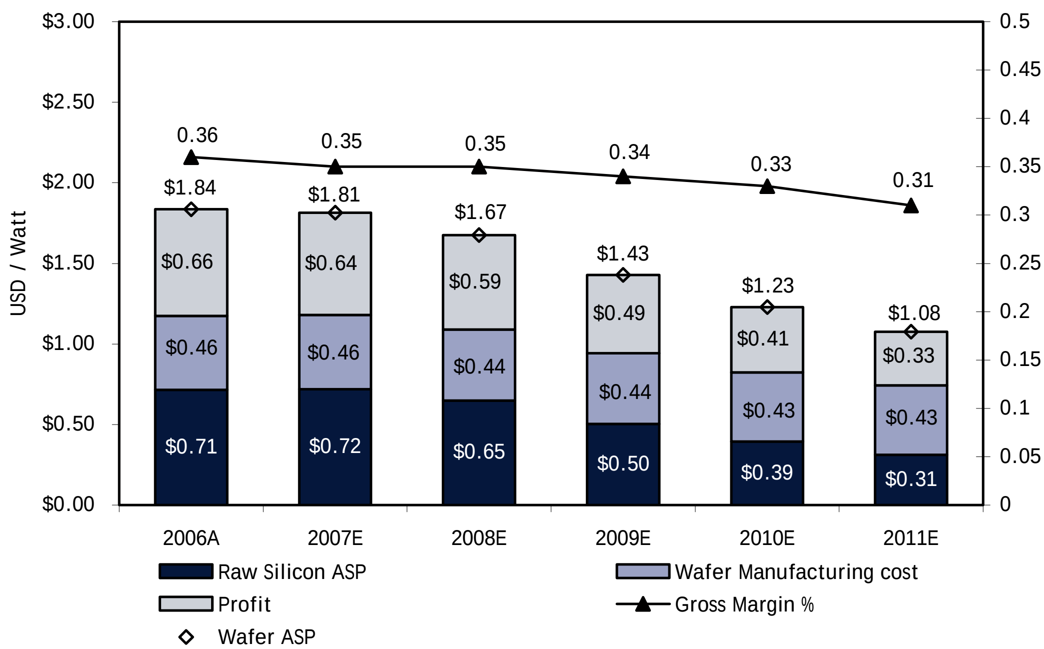
Exhibit 36: Standard Ingot Through Wafer Production Process



Source: MEMC and RBC Capital Markets estimates

Wafer Pricing and Margin Outlook

Exhibit 37: Global Wafer Producer Financials



Source: Company reports and RBC Capital Markets estimates

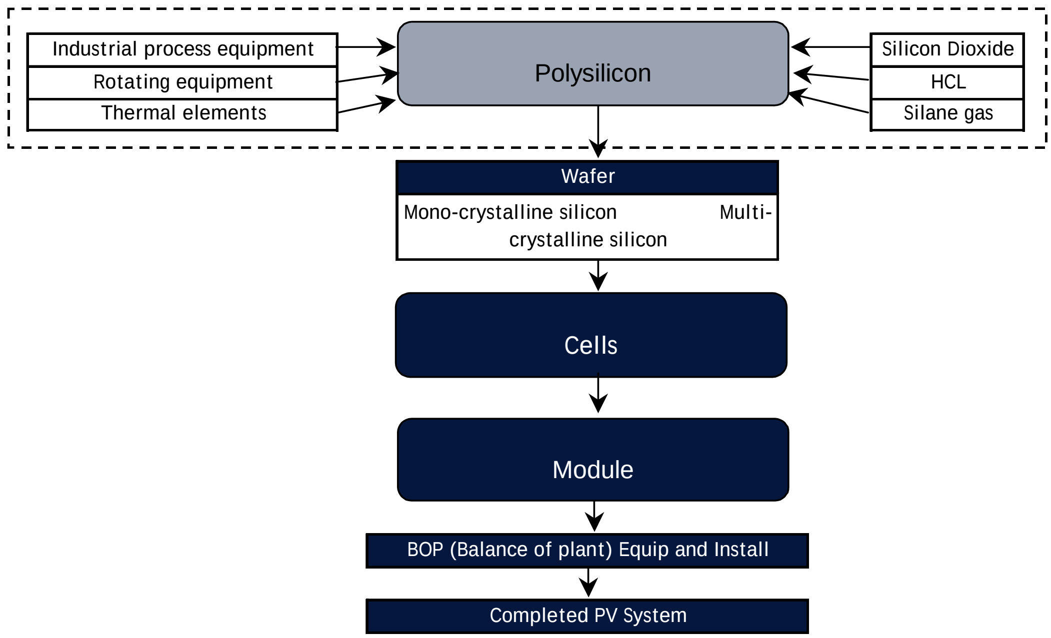
Supply Chain - Silicon Production

Description

There are two primary technologies used in silicon production today: the TCS (trichlorosilane)-based Siemens process and silane-based FBR (fluidized bed reactor) process. The technologies differ in terms of introduction/use of gases and overall energy consumption. Some producers assert that the FBR process uses significant less energy per kg of silicon produced given their continuous (not batch) processes and hot vs. cold wall mixing technique; however, approximately 70% to 80% of all silicon produced utilizes the TCS-based Siemens process.

Regardless of production process used, the financial and construction scope of a new silicon production facility is immense. The capex required to establish a green-field production facility is the highest in the solar business given the immense infrastructure and program planning and engineering design needed to build the actual production plan. Exhibit 39 lists the sheer volume of man hours and raw materials needed to build a high volume silicon plant.

Exhibit 38: Global Silicon Producers in the Supply Chain



Source: Company reports and RBC Capital Markets estimates

Segment Trends

We observe two trends from new-entrant silicon producers with a high probability of bringing significant volumes of raw polysilicon to market within announced timelines, both related to risk mitigation:

1. The new silicon-producing entity is formed via joint venture by two or more solar companies from varying parts of the supply chain.
2. The new silicon-producing entity has a strong background in the capital-intensive process engineering and chemical production business.

Additionally, we observe other groups of producers focusing on silicon reclamation and recycling and the entrance of metallurgical grade (MG) silicon production. While both methodologies will certainly add volume to the supply system, their full impact on the marketplace is difficult to quantify. In the last year, companies like Elkem, ARISE, SolarValue and JFE Steel have announced intentions to produce a lower-purity MG-grade silicon for the PV industry. How quickly the lower-purity MG-grade silicon will be adopted by the PV industry is unknown. Currently, the technology provides the best cost-reduction potential for silicon used in PV cells via the ability for producers to ramp capacity quickly for what is a low energy use silicon production process. However, given the lack of large-scale production history for MG-silicon and the uncertainty surrounding the material's use in higher-efficiency cells, we remain cautious about adding 100% of the announced MG-silicon capacity to future projections. Most wafer and cell producers possess technology and processes that are based on standardized input variables that, when changed slightly, could impact their end product and resultant profitability. Hence, in the case of metallurgical-grade silicon, we believe that many cell producers will need to complete their full diligence on the use of the material in their processes before full-on adoption.

Technical Challenges

The challenges present in the silicon business are different for each style of producer (i.e. incumbent producer vs. new producer vs. MG-silicon producer). For the incumbent producer (i.e. REC or Wacker), much of their effort will be focused on debottlenecking, minimization of energy use and overall process streamlining as capacities ramp.

The challenges for new producers such as JSSI or SilPro concern how quickly they can achieve a steady-state operating model with minimal downtime and mechanical interruption. Additionally, the profitability of the new producers' capital investment (silicon production) will be dramatically impacted by how closely they can follow their own construction path and timeline (minimization of delays and unforeseen expenses and equipment flaws).

Lastly, the MG-silicon producers face an entirely different set of technical challenges, namely the timeline for widespread adoption of their silicon into industry-standard wafer and cell production. The sooner standards are set and verified by leading producers for MG-silicon use, the quicker cell producers can migrate their pilot plants (based on lower-grade MG-silicon) to commercial status.

Exhibit 39: Example of Project Components for New Silicon Facility

Capital Required:	$600B	**Execution Time:**	~ 3 years
Total Man-hours:	3,000,000	**Materials:**	15,000 CY concrete
- Construction	1,800,000		5,500 tons steel
- Engineering	710,000		40 mi piping
- Construction Mgt.	250,000		300 mi electrical wiring
- Owner Eng/Ops	200,000		14,000 instruments
			900 pieces mechanical equip.

Source: REC and RBC Capital Markets estimates

Exhibit 40: RBC Forecast of Silicon Production End of Year Capacity

Incumbent Polysilicon Producers	2006E	2007E	2008E	2009E	2010E	2011E	RBC Probability
Tokuyama	5,400	5,400	5,400	8,200	8,200	8,200	95%
Sumitomo Titanium	900	1,300	1,300	1,300	1,300	1,300	99%
Mitsubishi	2,850	2,850	3,150	3,300	3,300	3,300	95%
Hemlock Semiconductor	10,000	12,000	14,500	16,000	18,000	24,000	95%
REC	5,800	5,800	8,000	12,500	13,500	13,500	95%
Wacker	5,500	8,800	10,000	12,700	14,500	14,500	95%
MEMC	3,800	5,500	8,000	8,000	8,000	8,000	95%
Incumbent Production End of Year Capacity	**34,250**	**41,650**	**50,350**	**62,000**	**66,800**	**72,800**	

New Entrant Polysilicon Producers	2006E	2007E	2008E	2009E	2010E	2011E	
DC Chemical	-	-	-	1,500	3,000	3,000	70%
Isofoton et al.	-	-	-	2,500	2,500	2,500	70%
Silicium de Provence SAS (Econcern & Solon AG)	-	-	500	3,000	3,000	3,000	70%
JSSI (Joint Solar Silicon Gmbh & Co)	-	-	850	850	850	850	70%
Becancour Silicon Inc	-	300	300	1,000	1,000	1,000	70%
Hoku Scientific (Hoku)	-	-	200	1,500	1,500	1,500	70%
M.Setek	-	1,100	3,000	3,000	6,000	6,000	70%
E'Mei	200	200	200	300	300	300	70%
JiangSu NanTong Economic Dev't District	-	-	1,500	2,500	4,000	4,000	70%
SiChuan XinGuang GuiYe	-	1,260	1,260	1,560	1,560	1,560	70%
Nitol Group (on track for 4Q08 production)	-	-	-	500	500	500	55%
Prime Solar	-	-	-	4,000	7,000	7,000	55%
Crystal	60	660	1,200	1,200	1,200	1,200	55%
Global PV Specialists	-	-	1,000	2,000	2,000	2,000	55%
Daquan	-	-	-	1,000	2,000	2,000	55%
Xinguang	-	-	-	1,000	2,000	2,000	50%
LuoYangZhong Gui	300	300	500	1,500	2,000	2,000	50%
YunNan Ailixin Silicon Tech Ltd.	-	-	125	1,500	4,000	7,000	15%
JianXi XinShiDai High Tech Energy Ltd.	-	-	500	2,000	3,000	3,000	15%
NingXia Eastern Tantalum Industry	-	-	500	1,000	1,000	1,000	15%
GuangXi GuiDong Power	-	-	375	750	1,000	1,000	15%
HongKong JingYi Group	-	-	375	750	1,000	1,000	15%
HaiNan YangPu Econ Dev't District	-	-	375	750	1,000	1,000	15%
ShuangYaShan, HeiLongjiang	-	-	500	1,000	1,000	1,000	15%
WuHai City, Inner Mongolia	-	-	500	1,000	1,000	1,000	15%
XianNing, Hubei Province	-	-	500	1,000	1,000	1,000	15%
JiNing, ShangDong province	-	-	500	1,000	1,000	1,000	15%
BengBu, AnHui province	-	-	500	1,000	1,000	1,000	15%
BaoTou, Inner Mongolia	-	-	500	1,000	1,000	1,000	15%
HuaiBei (DeHong State)	-	-	500	1,000	1,000	1,000	15%
YangZhou, JiangSu Province	-	-	500	1,000	1,000	1,000	15%
ZhangJiagang, JiangSu province	-	-	500	1,000	1,000	1,000	15%
Shanghai LingGuang Stock Co.	-	-	100	200	200	200	15%
New Entrant Production End of Year Capacity	**560**	**3,820**	**17,360**	**44,860**	**60,610**	**63,610**	

Source: Company reports and RBC Capital Markets estimates

Exhibit 41: RBC Forecast of Silicon Production End of Year Capacity

Recycled Polysilicon Producers	2006E	2007E	2008E	2009E	2010E	2011E	RBC Probability
Sharp Corporation	-	-	-	1,000	1,000	1,000	80%
Canadian Solar	-	-	20	20	20	20	80%
Silicon Recycling Services	-	40	40	40	50	50	80%
Renesola	35	50	50	50	50	50	80%
Recycled Production End of Year Capacity	**35**	**90**	**110**	**1,110**	**1,120**	**1,120**	

Metallurgical Silicon Producers	2006E	2007E	2008E	2009E	2010E	2011E	RBC Probability
Elkem	-	-	1,500	4,000	4,000	5,000	30%
ARISE	-	-	-	-	2,000	2,000	30%
Scheuten SolarWorld Solizium GmbH (JV)	-	-	-	1,000	1,000	1,000	30%
SolarValue	-	850	2,000	4,400	4,500	4,500	30%
JFE Steel	-	-	-	100	100	100	30%
Dow Corning	800	800	3,000	3,000	3,000	7,000	30%
Metallurgical Production End of Year Capacity	**800**	**1,650**	**6,500**	**12,500**	**14,600**	**19,600**	

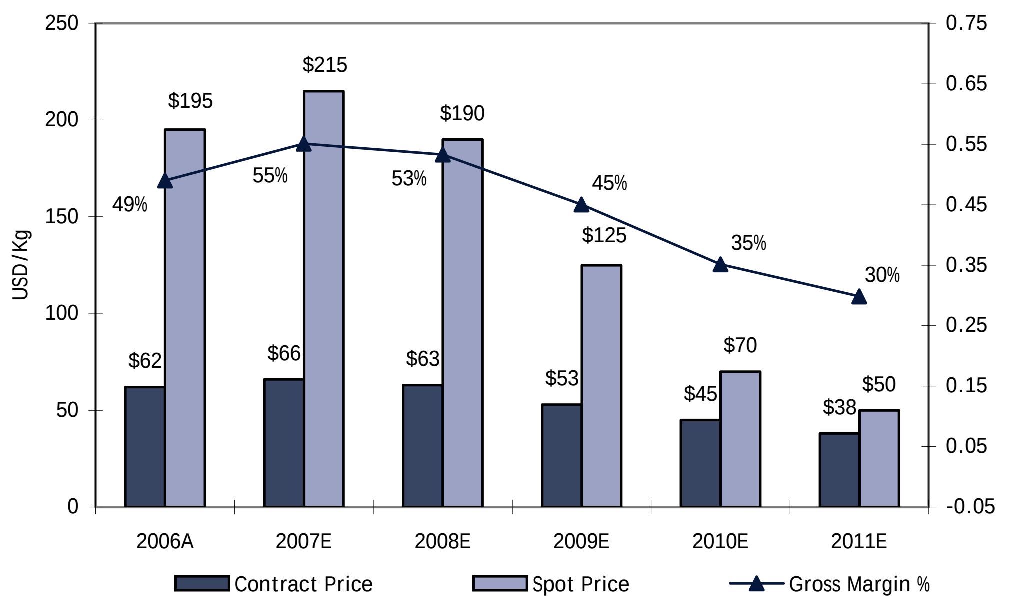
Source: Company reports and RBC Capital Markets estimates

Exhibit 42: RBC Forecast of Silicon Production End of Year Capacity

	2006E	2007E	2008E	2009E	2010E	2011E
Total Production End of Year Capacity (MT)	35,645	47,210	74,320	120,470	143,130	157,130
RBC Estimate of Annual Production (MT)	35,645	43,254	57,877	84,415	97,400	105,050

Source: Company reports and RBC Capital Markets estimates

Exhibit 43: Silicon Price and Margin Trend Graph



Source: Company reports and RBC Capital Markets estimates

Solar Thin-film Technology

Overview and Analysis

As solar producers focus on running a profitable operation in a demand-rich environment, there are only a few key strategies for reducing costs and getting closer to grid parity. The technology that is currently ramping up volume and commercialization is thin-film-based module. Moreover, these modules leverage each and every opportunity listed below:

- Higher module efficiency. The higher the watts, the greater the divisor in any monetary projection and the lower the unit cost.
- Greater volume of production to spread sizable fixed plant, equipment and manufacturing support costs on per unit basis.
- Manufacturing yield and efficiency.
- Lower material costs.

Currently, PV modules may be divided into two broad categories: wafer-based crystalline silicon and thin films. Thin-film modules include amorphous silicon, CIGS and Cd-Te. Coating entire sheets of glass or steel substrate with thin layers of semiconductor materials is the most common way to produce a thin-film module. So, rather than growing, slicing and treating a crystalline ingot, as with crystalline silicon, a PV material can be created by depositing thin layers of the different materials into a very thin structure – in what is typically a simple and efficient manufacturing process.

Several different deposition techniques are available, and all of them are potentially cheaper than the ingot-growth techniques required for crystalline silicon. Crystalline silicon involves slicing the ingot to make wafers, chemically etching and polishing the wafers to remove saw damage, attaching electrical connections to the wafers, laying out the wafers, electrically connecting the wafers and encapsulating the connected wafers to form a module. Of course, the wafer raw materials are expensive and the manufacturing process is labor-intensive, requiring high-energy input.

Amorphous Silicon Modules

The primary advantages of amorphous silicon thin-film modules are:

- Better temperature coefficients resulting in a greater percentage of rated power production at higher ambient temperatures.
- Minimal feedstock availability issues.
- Do not experience broken connections due to inter-cell contact failure.
- Produce more power on cloudy days in low light conditions.

The primary disadvantages of amorphous silicon thin-film modules are:

- Lower cell efficiencies.
- Lower cell efficiencies over time (cell degradation). In a twist, exposure to sunlight is actually the culprit causing cell degradation.

CIGS Modules

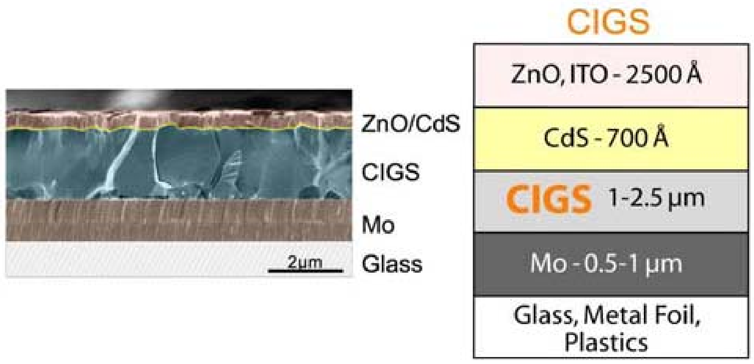
The primary advantages of CIGS thin-film modules are:

- High efficiencies.
- Little environmental and waste-handling restrictions.
- Do not experience broken connections due to inter-cell contact failure.
- Produce more power on cloudy days in low light conditions.

The primary disadvantages of CIGS silicon thin-film modules are:

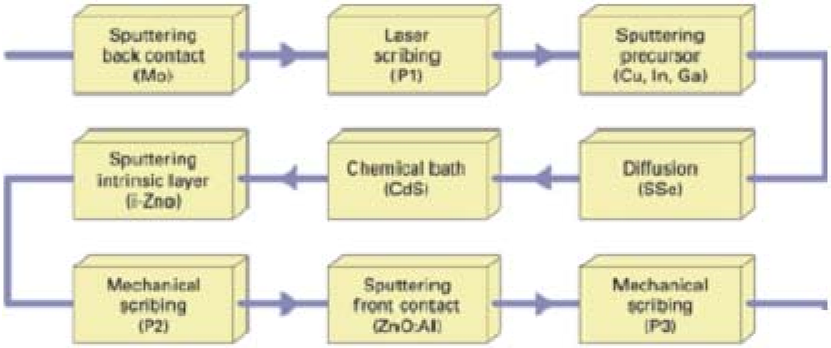
- Lower cell efficiencies.
- Lower cell efficiencies over time (cell degradation). In a twist, exposure to sunlight is actually the culprit causing cell degradation.

Exhibit 44: CIGS Cross Sections



Source: Johanna Solar Technology and RBC Capital Markets estimates

Exhibit 45: CIGS Manufacturing Process



Source: Johanna Solar Technology and RBC Capital Markets estimates

CdTe Modules

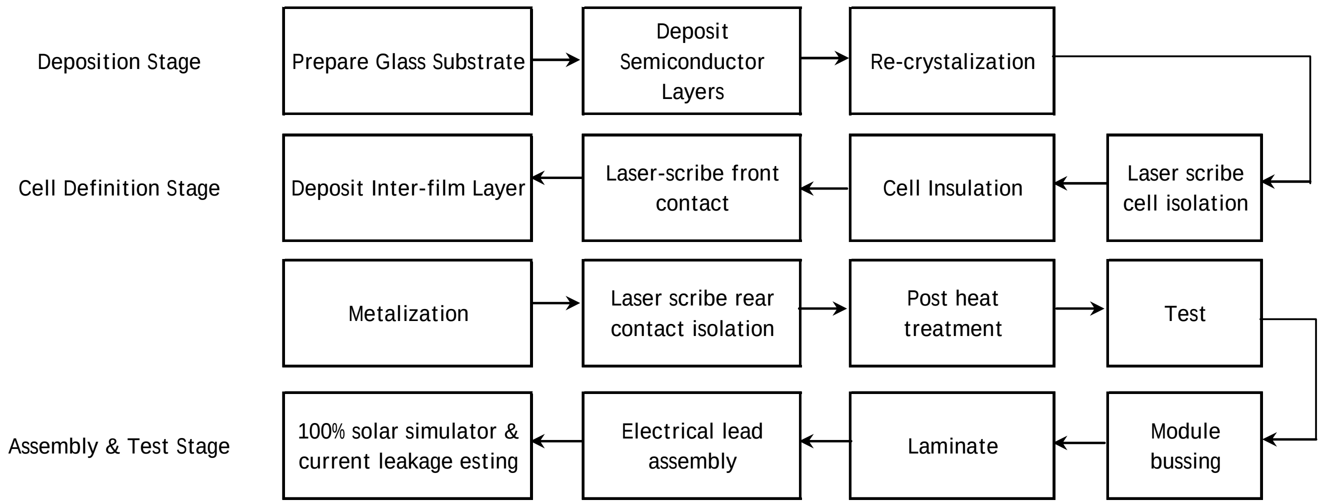
The primary advantages of CdTe thin-film modules are:

- Low cost.
- Minimal feedstock availability issues.
- Do not experience broken connections due to inter-cell contact failure.

The primary disadvantages of amorphous silicon thin-film modules are:

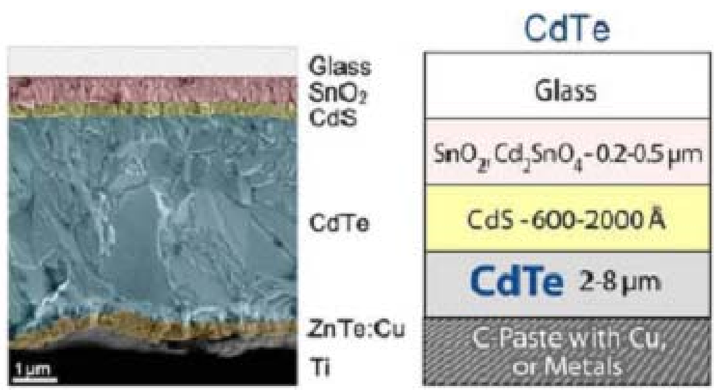
- Lower conversion efficiency.
- Difficulty in customizing modules.
- Potential for performance degradation.
- Cadmium deemed toxic by some health officials and policy makers, potentially limiting access to some high-volume applications.
- Potential for superstrate glass fracturing prior to deployment due to high-temperature processing necessary for crystal formation.

Exhibit 46: CdTe Processing Steps



Source: First Solar and RBC Capital Markets estimates

Exhibit 47: CIGS Cross Sections



Source: Johanna Solar Technology and RBC Capital Markets estimates

Exhibit 48: Thin-film Technology Comparison

Technology	Common Technology Pros	Common Technology Cons
CIGS/CIS thin-film	Highest thin-film efficiency	Short experience
10-13% avg. module efficiency	Better path to increase efficiency	Availability of indium
	Flexible substrates	
CdTE thin-film	Low cost	Toxicity of CdTe
8-10% avg. module efficiency	Scalability	Difficult path to increase efficiency
a-Si thin-film	Lower cost	Low performance
5-7% avg. module efficiency	Good at low light levels	Performance instability
	Good at high temp	Uses toxic gases
	Excellent for BIPV	Difficult path to increase efficiency

Source: Company reports and RBC Capital Markets estimates

Exhibit 49: Global Thin-film Companies

CdTe Thin-Film	CIGS/CIS Thin-film	a-Si Thin-film
First Solar	Global Solar	Schott Solar
Primestar Solar	Miasole	Uni-Solar
AVA Solar	Energy PV	Applied Materials
Solar Fields	Ascent Solar	PowerFilm
Canrom	ISET	Energy PV
Ascentool	ITN Energy Syst.	MV Systems
Antec Solar	Daystar	XsunX
	Nanosolar	Ersol
	Heliovolt	Innovalight
	Solo Power	Solexant
	Solyndra	Nano PV
	RESI	Helio Grid
	Light Solar	Proto Flex
	Dow Chemicals	New Solar Ventures
	Showa Shell	Energy Photovoltaics
	Honda	Kaneka
	Wurth Solar	Sharp
	Sulfur Cells	Fuji
	Aleo Solar	Mitsubishi Heavy Industries
	Johanna Solar Tech	Kanto Sanyo
	Solisbro	ICP Solar Tech
		Sinonar
		Soltech
		Bangkok Solar

Source: NREL and RBC Capital Markets

Solar Capital Inflows

New investment has closely following the solar industry's growth pattern (~20% from 2005 to 2006). Moreover, both public and private money continues to pour into the solar industry – irrespective of region.

- **2006 Solar IPOs:** The number of public offerings in 2006 was again robust, with close to $1 billion raised in the public markets. The capital inflows supported a host of solar supply-chain players and technologies with operations in multiple countries.

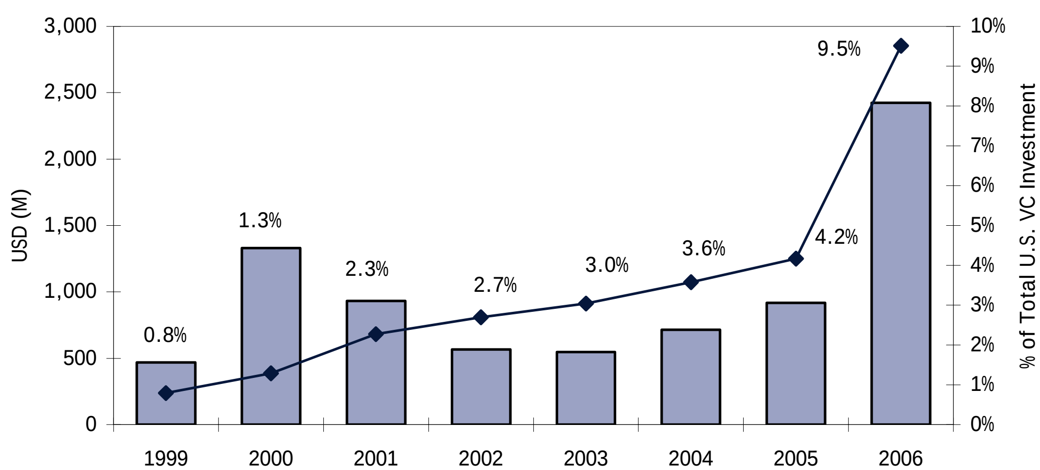
Exhibit 50: 2006 IPO List

Company	Product	Money Raised	Locale
Renesola, Ltd.	Silicon wafers	~$50M	China
Canadian Solar, Inc.	Silicon modules	~$82M	China
Trina Solar, Inc.	Silicon modules	~90M	China
SolarFun Power Holdings	Silicon modules	~$150M	China
PowerFilm, Inc	Thin-film modules	$16M	US
First Solar, Inc.	Thin-film modules	~$420M	US
Akeena Solar, Inc.	Solar installation	Reverse merger	US

Source: Company reports and RBC Capital Markets estimates

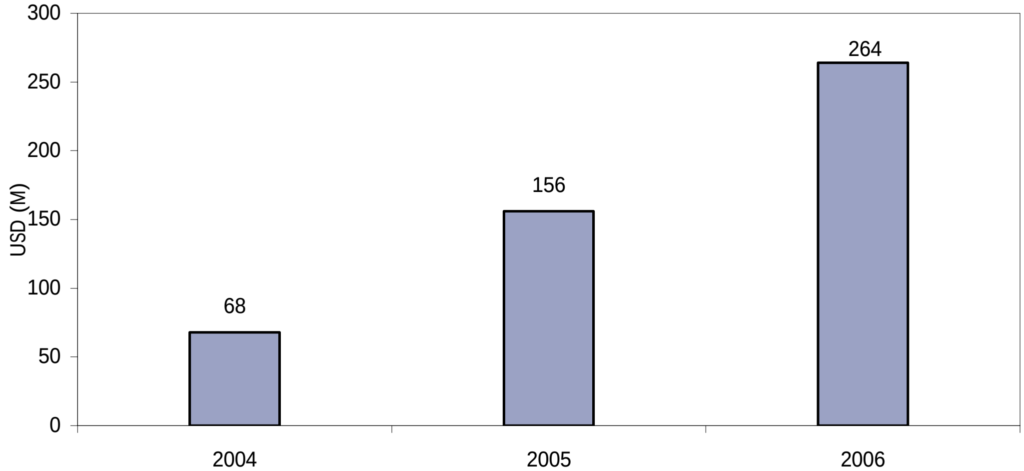
- **2007 Solar IPOs:** This year started out strong with China-based cell producer JA Solar raising ~$225 million in a deal that was priced in February 2007. Given some of the inherent operating advantages of Asian-based solar producers, there are three new Chinese companies eyeing the public markets for capital infusion. If the three deals below meet funding expectations, they will eclipse the capital raised by 2006 deal flow:
  - **LDK Solar Hi-Tech Co.:** Solar wafer manufacturer aims to raise ~$400 million this year.
  - **Tianwei Yingli New Energy Resources:** Integrated solar producer's goal is to raise ~$500 million.
  - **CEEG PV-Tech Co.:** Silicon-cell producer seeks to raise ~$200 million.
- **Solar Venture Capital Investment:** Over the next 10 years, total U.S. "clean energy" revenues are expected to grow at ~15% CAGR (~$55.4 billion in 2006 to ~$226.5 billion in 2016). Total solar revenues are expected to grow at ~16% CAGR over the same period from $15.6 billion in 2006 to $69.3 billion in 2016 (Clean Edge, Inc. 2007).
- We believe it is important to track solar VC investment because the recipients of such funding often hold the key to the commercialization of market-changing technologies. Per a 2007 report by Nth Power and Clean Edge, U.S.-based solar VC investment has increased from ~$68 million in 2004 to ~$264 million in 2006 (97% CAGR).

Exhibit 51: U.S. Energy Technology VC Investments



Source: Nth Power LLC and Clean Edge Inc and RBC Capital Markets estimates

Exhibit 52: U.S. Solar VC Investments



Source: Nth Power LLC and Clean Edge Inc and RBC Capital Markets estimates

Market Factors & Valuation

Consolidation Outlook

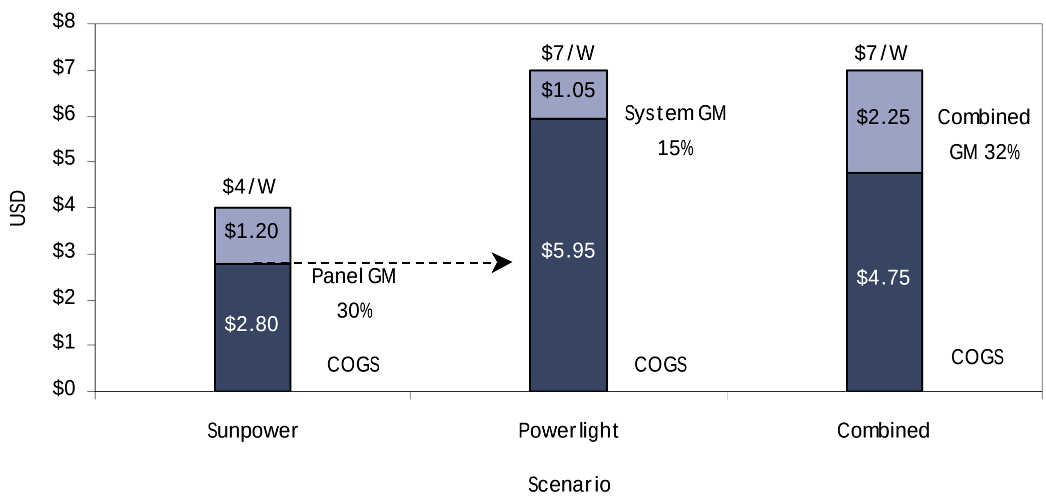
Given the rapid growth of the solar industry, companies in all aspects of the supply chain are vying to maximize both market share and profit margin. Of course, the growth strategy for each solar player varies by region, product and management inclination. While many companies remain steadfast in an organic growth strategy, others are actively combing the marketplace for an attractive acquisition or integration opportunity to find operational, sales channel or other technological synergies.

Downstream Integration

In 2006 we observed a game-changing downstream acquisition with the SunPower (SPWR - Sector Perform; Speculative Risk), acquisition of Powerlight. SunPower is a U.S.-based solar cell and module manufacturer with industry-leading efficiencies approaching 22%. Its new subsidiary, Powerlight, is a well-respected solar integrator and installer with industry-leading business relationships in both Europe and the United States. The deal combined two of the best companies in each of their respective businesses (cell/module production and installation) but also is projected to generate a combined margin profile that is higher combined than each company could achieve independently.

The margin projections communicated by SunPower are illustrated in Exhibit 53. By producing industry-leading modules for a leading installation company in one in-house step, Sunpower projects that through "margin stacking" it can incrementally increase its gross margins per unit of revenue. As importantly, the company also believes that by working in a broader part of the supply chain, it has better opportunities to drive down final system installed costs via enhanced supply-chain management and process integration. We are typically not in favor of a cell or module producer moving downstream into the installation game; however, given the unique technology and product differentiators possessed by each company (SunPower and Powerlight) we believe that they possess the unique ability to garner price premium on their total product offering.

Exhibit 53: Margin Stacking Example



Source: Company reports and RBC Capital Markets estimates

Semis Getting Into Solar

We have recently seen companies with experience in the semiconductor business applying their R&D and production prowess in the solar business. A great example is the recent activity by Applied Materials, Inc. Taking a page out of the semi book, Applied Materials is applying both scale (which played a leading role in semi cost reductions) and engineering expertise to gain a profitable foothold in the solar business. On July 7, 2006, Applied Materials announced the acquisition of Applied Films Corporation, a producer of thin-film deposition equipment used to make solar cells and other electronic materials. With the acquisition, the company made a statement that it was getting into the solar business. Applied believes that the thin-film marketplace is best suited to leverage its semi expertise in layer deposition and technology at extreme scale. We believe that the simplified module production process involved in the thin-film business can certainly benefit from the expertise of an established semi player like Applied with experience in semi manufacturing that involves higher quality and more processing steps.

Full Solar Integration

Probably the most recognized integrated solar company is REC of Norway. Not only is REC a leading silicon producer, but it also possesses substantial wafer, cell and module production capacities. Over the coming years, we believe that other solar companies will emulate REC's business model as their primary strategy to maintain a competitive cost structure. Moreover, we believe that more European solar companies will adopt a more structured, integrated business model as a way to combat some of the cost savings generated by Asian firms via their unique operating and production model.

With its recent announcement of silicon and thin-film module production, German-based Ersol Solar Energy AG will become yet another fully integrated solar company in Europe. With operations ranging from silicon production to module construction, as well as technology diversification via thin film, the company believes that significant module cost reductions can be achieved. Ersol now claims that ~40% module cost reductions can be achieved by 2010, with the bulk of the savings attributable to its integrated approach with economies of scale.

Over the past two years, Ersol has methodically taken steps towards becoming a fully integrated solar company:

- **Acquired Wafer Operations:** Ersol acquired wafer manufacturer ASi Industries and silicon recycler SRS, completing its backward integration into silicon production. With the former operations tucked in, the company claims that 80% of the silicon is now used for internal solar production.
- **Ersol Begins Crystalline Solar Module Production:** By the 2009-2010 timeframe, the company anticipates cell production should ramp beyond 200MW with new module production capacity between 50 and 100MW.

Beyond economies of scale, Ersol believes that direct access to the market via focused sales channels is a crucial step in the cost and brand management of its end product. The desire to control more downstream customer relationships was also observed with Sunpower and Powerlight. Additionally, the company believes that a "cost-controlled, technologically integrated module production system to the cell production stage" is critical for grid-parity production costs to be achieved. Overall, we believe any integrated solar company will seek to improve the fragmented, solar supply chain by migrating to more continuous (as opposed to batch-to-batch) processing, eliminating energy and material loss between and within current processing steps, and by re-engineering work flow to aid in cost decreases.

We believe that integrated solar companies have potential to make substantial production cost gains via economies of scale, enhanced supply chain and inventory management, and end-to-end production processing efficiency; however, operating scale/prowess (i.e. throughput) and continued technology improvement (i.e. cell efficiency) must still become an integral part of the business model theme.

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Outperform (O): Expected to materially outperform sector average over 12 months.
Sector Perform (SP): Returns expected to be in line with sector average over 12 months.
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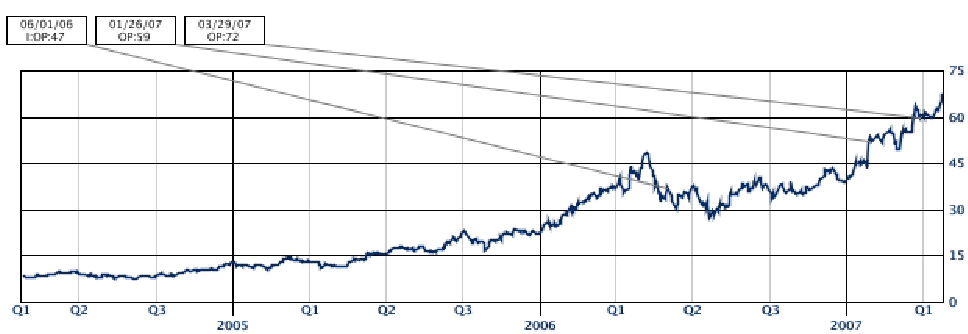
RBC Capital Markets			Investment Banking Serv./Past 12 Mos.	
Rating	Count	Percent	Count	Percent
BUY [TP/O]	442	42.66	187	42.31
HOLD [SP]	490	47.30	144	29.39
SELL [U]	104	10.04	20	19.23

Rating and Price Target History for: MEMC Electronic Materials, Inc. as of 04-26-2007 (in USD)



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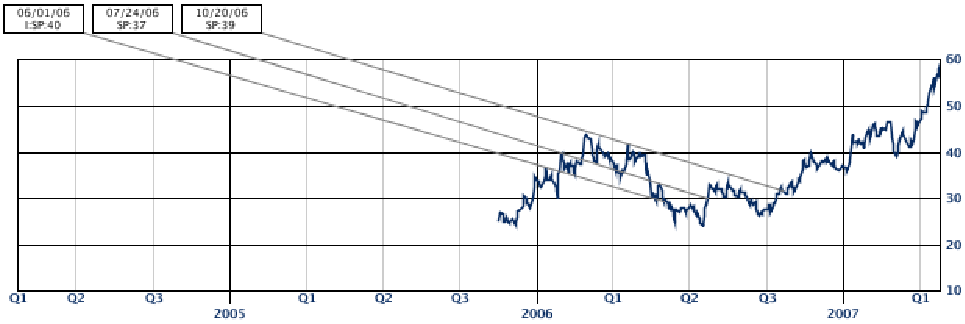
Rating and Price Target History for: SunPower Corporation as of 04-26-2007 (in USD)



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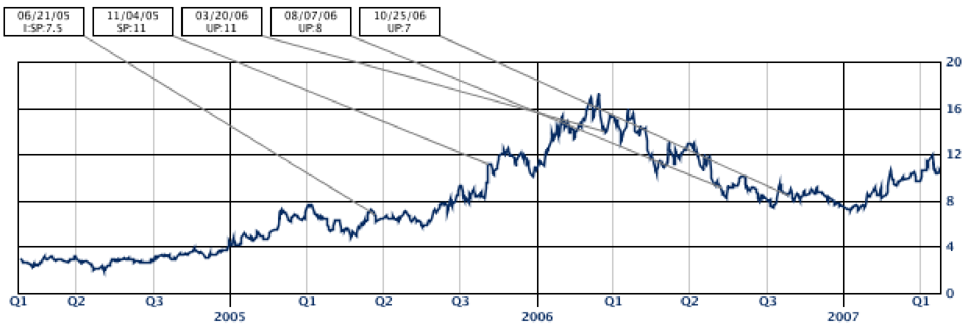

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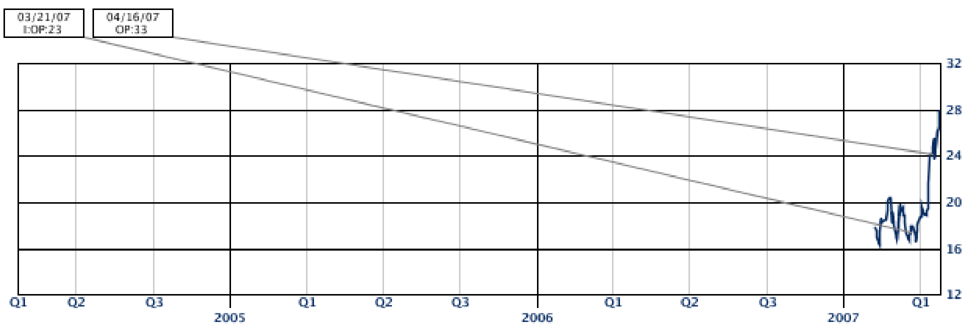
Rating and Price Target History for: JA Solar Holdings Co., Ltd. as of 04-26-2007 (in USD)



Legend:
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