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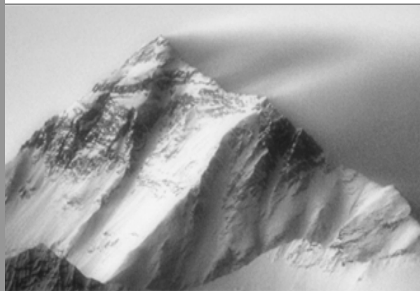

Solar Industry Growth ... You Ain't Seen Nothin' Yet

The Grid Parity Decade

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- **Solar industry likely to grow at 32% CAGR over next decade.** We estimate that over the last decade the PV industry grew at a 53% CAGR – 62% over just the last five years. Cumulative global installed capacity reached 36GW by YE2010; however, over the next decade, we estimate the PV industry will likely install 20x that number to reach cumulative installed capacity of 800GW+. It's hard to be bearish about such growth. Whereas the last decade was driven by subsides and cost reductions, the next decade will be driven by grid parity and potential consensus on the environment. We view near term concerns about industry oversupply akin to missing the forest for the trees.
- **New markets likely continue to emerge as industry nears grid parity.** In 2012 we expect 3 markets to reach grid parity with residential retail electricity rates: Italy, Spain and Hawaii. In the two years beyond that, we estimate an additional 10 markets reaching grid parity on either the residential or industrial pricing level. We note that globally 2015 appears to be the inflection point for grid parity for most countries, and we estimate demand likely grows at an accelerated CAGR of 40% over the 2015-2020 period.
- **System prices likely need to approach sub $2/watt levels to enable parity markets.** Based on our Levelized Cost of Electricity Model, we estimate a system price per watt of $1.50 in a region with 2000 kWh/yr of solar irradiance yields a price per kilowatt hour of $0.11, enabling grid parity in most residential and commercial markets around the world. We assume a module price of $0.75/watt and BOS of $0.75/watt which includes installer margins of $0.23, or 15%. We estimate module costs of $0.60/watt, enabling module margins of 20%. To reach $0.60/watt module cost would imply polysilicon at $35/kg and utilization at 4 grams per watt, wafering at $0.15, cell conversion at $0.16, and module conversion at $0.15/watt. Inverter price is estimated at $0.16/watt.
- **2011 top picks: SOLR, FSLR, PWER, and TSL.** We prefer SOLR for its leading share in upstream polysilicon and ingot growth equipment as the industry likely continues to build capacity to meet grid parity driven demand in the next five years. We prefer FSLR as its systems are likely the first to reach grid parity with module costs at $0.77/watt today declining to an estimated $0.70 in 2011. We prefer PWER given its growing market share globally in 2011 and believe inverters will increase overall volumes as grid parity approaches. We prefer TSL given its lowest cost vertically integrated manufacturing model which likely is the first to reach $1/watt module cost in 2011.

Risks:

1) Accelerated subsidy reductions; 2) Fall-off in solar demand; 3) Poly prices

TOP SOLAR PICKS FOR 2011

Company	Ticker	Rating	Target
First Solar	FSLR	OW	$200.00
GT Solar	SOLR	OW	$12.00
Trina Solar	TSL	OW	$36.00
Power-One	PWER	OW	$14.00

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Exhibit 1

PIPER JAFFRAY GLOBAL SOLAR COVERAGE UNIVERSE

Company	Price	Rating	PT	Upside/Downside Potential from PT
ReneSola	$8.74	OW	$26	197%
LDK Solar	$10.12	OW	$25	147%
JA Solar	$6.92	OW	$14	102%
Daqo New Energy	$10.16	OW	$20	97%
SunPower	$12.83	OW	$20	56%
Trina Solar	$23.42	OW	$36	54%
First Solar	$130.14	OW	$200	54%
Satcon	$4.50	OW	$6.75	50%
Yingli Green Energy	$9.88	OW	$14	42%
Power One	$10.20	OW	$14	37%
GT Solar	$9.12	OW	$12	32%
Canadian Solar	$12.39	N	$14	13%
Suntech Power	$8.01	N	$9	12%

Source: Piper Jaffray Research; prices as of December 31, 2010.

EXECUTIVE SUMMARY

Recently, solar investors have been focused on near term concerns about subsidy cuts and oversupply causing increased volatility in solar stocks. Such a view misses the bigger picture of long-term solar PV growth to come. In the medium term, the industry will transition from subsidy driven growth to grid parity driven growth. Our analysis of system price trends, electricity rates, and other historical growth rates leads us to estimate long-term solar growth at a 32% CAGR over the next ten years as solar electricity prices decline toward grid parity spurring demand.

The solar electricity price per kilowatt hour ($/kWh) is a function of the install cost of a solar system and the amount of electricity that system can produce. Grid parity also depends on the growth in electricity prices for a given market. We assume a very conservative 2% annual increase in grid electricity rates in our analysis. The amount of sun hours that a solar system can harvest is dependent on location as some areas of the world, such as market leader, Germany, can harvest ~900 hours on average whereas Spain or Arizona can harvest 2,000. Module costs, which comprise around 50% of the total system cost, have steadily decreased since 2007 at a CAGR of -20%, steadily lowering the system install cost. We look for system install costs to continue dropping at a more conservative CAGR of 12% through 2020 for both module and balance of system costs. As Exhibit 2 shows, as sun hours increase and install costs drop, the solar electricity price will begin approaching widescale grid parity at around the $0.16 mark in many markets, reaching an inflection point by 2015, according to our estimates.

Exhibit 2

SOLAR ELECTRICITY PRICE SENSITIVITY BASED ON INSTALL COST ($/KWH)

		Annual Sun hours								
	$0.28	**600**	**800**	**1,000**	**1,200**	**1,400**	**1,600**	**1,800**	**2,000**	**2,200**
	$0.50	$0.19	$0.14	$0.11	$0.09	$0.08	$0.07	$0.06	$0.06	$0.05
	$1.00	$0.28	$0.21	$0.17	$0.14	$0.12	$0.10	$0.09	$0.08	$0.08
	$1.50	$0.37	$0.28	$0.22	$0.19	$0.16	$0.14	$0.12	$0.11	$0.10
	$2.00	$0.47	$0.35	$0.28	$0.23	$0.20	$0.17	$0.16	$0.14	$0.13
Total	**$2.50**	$0.56	$0.42	$0.34	$0.28	$0.24	$0.21	$0.19	$0.17	$0.15
Install Cost	**$3.00**	$0.65	$0.49	$0.39	$0.33	$0.28	$0.24	$0.22	$0.20	$0.18
$/watt	**$3.50**	$0.74	$0.56	$0.45	$0.37	$0.32	$0.28	$0.25	$0.22	$0.20
	$4.00	$0.84	$0.63	$0.50	$0.42	$0.36	$0.31	$0.28	$0.25	$0.23
	$4.50	$0.93	$0.70	$0.56	$0.47	$0.40	$0.35	$0.31	$0.28	$0.25
	$5.00	$1.02	$0.77	$0.61	$0.51	$0.44	$0.38	$0.34	$0.31	$0.28
	$5.50	$1.12	$0.84	$0.67	$0.56	$0.48	$0.42	$0.37	$0.34	$0.30
	$6.00	$1.21	$0.91	$0.73	$0.61	$0.52	$0.45	$0.40	$0.36	$0.33
	$6.50	$1.30	$0.98	$0.78	$0.65	$0.56	$0.49	$0.43	$0.39	$0.36
	$7.00	$1.40	$1.05	$0.84	$0.70	$0.60	$0.52	$0.47	$0.42	$0.38

Source: Piper Jaffray Research

Exhibit 3 outlines our forecasts for when select markets will reach grid parity. Some already are approaching grid parity and we believe that early entrants are likely Hawaii, Italy and Spain by 2012. Electricity prices for residential customers are some of the highest globally and abundant sun hours make these markets the early winners in the grid parity race. By

2015, Germany, Brazil, Chile and industrial customers in India should reach grid parity, spurring demand. By 2017, most of these countries should be at grid parity and demand growth will accelerate in our view.

Exhibit 3

SELECT COUNTRIES ACHIEVING GRID PARITY BY 2020(PJ ESTS)

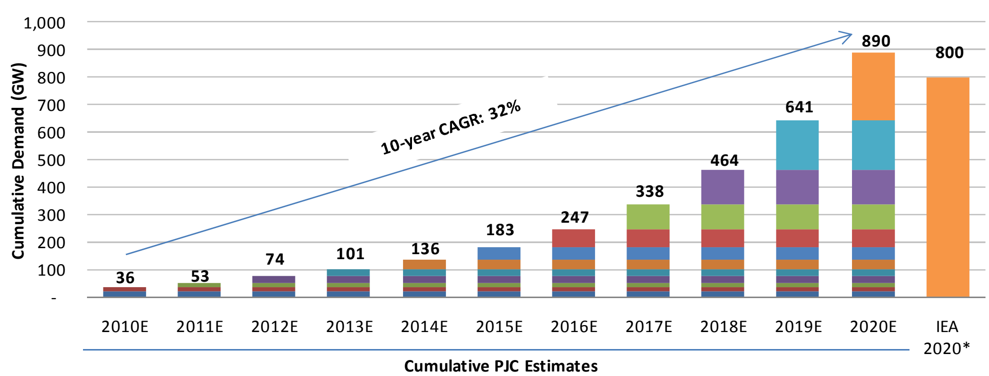
2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
	Hawaii	Ireland (Res.)	Connecticut	Germany (Ind.)	Spain (Ind.)	Ireland (Ind.)	China (Ind.)	Belgium (Ind.)	Hungary (Ind.)
	Italy (Res.)	Italy (Ind.)	Denmark (Res.)	Alaska	California	Netherlands (Ind.)	Hungary (Res.)	Luxembourg (Ind.)	UK (Ind.)
	Spain (Res.)	Chile (Ind.)	Germany (Res.)	New Jersey	Belgium (Res.)	Netherlands (Res.)	Mexico (Ind.)		
		Brazil (Res.)	Costa Rica (Ind.)	Brazil (Ind.)		Luxembourg (Res.)	Mexico (Res.)		
			India (Ind.)			UK (Res.)	South Africa (Res.)		
			Costa Rica (Res.)			India (Res.)			
						Chile (Res.)			
						Australia (Res.)			

Ind.= Industrial; Res.= Residential
Source: Piper Jaffray Research.

As the number of countries at grid parity grows, our estimate of solar installations grows. Our estimates shown in Exhibit 4 assume a 23% CAGR from 2010-2015 as markets transition from subsidy driven demand to grid parity driven demand. Starting in 2016 as grid parity numbers increase, we see demand for solar growing at a 40% CAGR through 2020. We estimate the solar industry will reach 890MW of cumulative installed capacity by 2020, representing 4% of global energy supply. We compare this to IEA projections that forecast 20,000GW of total energy supply in 2020, with ~10%, or 2,000GW, of that being non-hydro renewables. Assuming that 40% of that number is solar and primarily used for electricity generation, we estimate that 800 GW of the IEA estimate belongs to solar. Our outlook points to a 10-year CAGR of 32% until 2020.

Exhibit 4

PJC DEMAND PROJECTIONS THROUGH 2020



*Based on PJC assumption that 40% of IEA energy supply forecast for renewables (excl. hydro) is solar.
Source: IEA, Piper Jaffray Estimates.

Given the projected growth over the next few years, we introduce our top picks for 2011 as well as our CY12 EPS estimates for our solar coverage universe (see Exhibit 28). Our top picks benefit the most from grid parity driven growth in capacity, being the lowest cost module suppliers in the industry, and also benefit from volume growth projected over the next 5-10 years.

- First Solar (OW-$200 PT)—Industry leading low costs, superb balance sheet and growing project pipeline have positioned FSLR well to continue as a market leader. The company guides for 2GW of production with 1.1GW under framework agreements, 400MW allocated for EPC with 500MW unallocated. We look for 620MW of project business in 2011. FSLR currently trades at 11.3x our 2012 EPS estimate of $11.50, much too cheap in our view.
- GT Solar (OW-$12 PT)—Demand growth will fuel capacity growth and SOLR is a leading equipment supplier to the solar industry. A growing sapphire business is also a plus. SOLR is currently trading at a 6.3x multiple to our 2012 estimate of $1.44, well below the group average of 10x, pointing to attractive potential upside in the stock.
- Trina Solar (OW-$36 PT)—We like the vertically integrated players such as TSL, the leading low cost crystalline silicon module manufacturer. The company is on track to be the first to reach the $1/watt cost level in 2H11 and is experiencing demand that is 2x its supply capability. The company is currently trading at 6x our 2012 estimate of $4.00, below the historical norm for the group of 10x.
- Power-One (OW-$14 PT)—PWER will likely continue to grab share of the inverter market in 2011, reaching 26% by our estimates, up from 11% at 3Q10. Cash generation ($59m in FCF in 3Q10) and improving margins in the power business lead us to recommend the stock. Valuation points to upside also, as the stock currently trades at 6.4x our 2012 estimate of $1.60, well below competitor SMA at 9x.

WHAT IS GRID PARITY

The solar industry has seen rapid changes over the last four years. The price per watt of a solar PV system has declined from $8-$10/watt in 2007 to around $3-$4/watt in 2010. Solar electricity prices on a $/kWh basis have dropped from $0.53 to $0.28, in an 1,800 sun hour market. This has contributed to industry demand growing at a 63% CAGR over the same period, despite the annual ritual of bearish sentiment surrounding subsidy cuts, forex rates, and the like. In fact, Germany, the Achilles heel of solar stock sentiment these days, has managed to grow at 49% CAGR since 2007 (when the Feed In Tariffs were established) despite cuts to those same FITs. Subsidies are not infinite, and are designed to decline and drive costs down with them towards grid parity. We believe the next five-year period will be driven by the emergence of grid parity in numerous markets as subsidies wind down over the same period. In this report, we look past the near term volatility around subsidized markets, towards what we believe will characterize the next growth cycle for the solar industry, Grid Parity.

Grid parity is the point at which the price most consumers pay for solar electricity is equal to or less than the costs of traditional fossil fuel electricity generation (coal, natural gas, oil). Our analysis looks at how the market for solar electricity evolves as pricing for solar systems declines toward grid parity. Grid parity depends on the location, sunshine, and grid electricity prices. Parts of the U.S. (Hawaii) and Europe are already approaching grid parity at the retail level today.

Levelized Cost of Electricity (LCOE)

For our base case analysis, we plug relatively conservative estimates into our Levelized Cost of Electricity (LCOE) model (see Exhibit 5) to project solar electricity costs in terms of $/kWh. Assumptions that underlie our base case model include: 1,800 annual sun hours/year, 90% system yield, module and balance of system costs (BOS) are equal, installation margin of 15% and a 9% discount rate over a 25-year system life. The LCOE model shows the highest degree of variability based on the module and balance of system costs (BOS). Based on this model and using historic averages of module ASPs among major solar module manufacturers, the average solar electricity price has steadily declined to an estimated $0.28/kwh in 2010 from $0.53/kWh in 2007(see Exhibit 6).

Exhibit 5

LCOE MODEL

LCOE Assumptions	
Irradiance (KWh/KW)	1800
Annual degradation	0.5%
System yield	90%
Discount rate	9.0%
Module Cost ($/W)	$1.76
BOS Cost ($/W)	$1.76
Installation Margin	15%
Total Installation Cost ($/W)	$4.05
Maintenance Cost ($/W)	$0.05
Depreciation Base	$4.05
Depreciation Period (yr)	25

LCOE	($/KW)	($/kWh)
Installed cost	$4,048	$0.28
Maintenance cost	$445	$0.03
Depreciation tax benefit	$433	$0.03
Total life cycle cost	**$4,061**	**$0.28**
Total lifetime energy production (kWh/KW)	14,387	

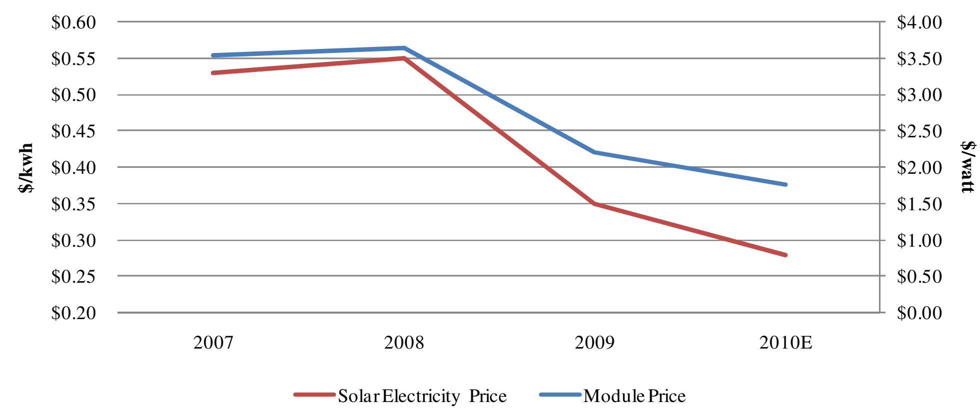
Source: Piper Jaffray Research.

Impact of Module Price Declines

This decline in solar electricity costs is due mainly to the significant 50% drop in solar module prices since 2007. As Exhibit 6 illustrates, as module pricing declines, solar electricity prices move with it. Key drivers of module pricing today include system owners' internal rates of return, which are tied to feed in tariff rates; however, as the industry approaches grid parity, and subsidies are phased out, pricing will be dependant on input costs and module efficiencies. Polysilicon and module processing costs are critical factors as well. Polysilicon prices peaked in 2008 at around $500/kg, due to poly shortages, but have since declined to the $60/kg level, and can comprise ~30-35% of the module manufacturing cost. Supply for polysilicon remains tight in 2011, but we expect poly pricing to pull back to the $50 level in 2011 and steadily decline in the coming years as more capacity comes online. Module processing costs comprise the remaining 65-70% of manufacturing costs and include expenses related to each part of the value chain, wafer, cell and module assembly. As companies improve their manufacturing efficiencies these costs have slowly declined and are expected to continue declining as module manufacturers bring more capacity online and continue improving manufacturing processes.

Exhibit 6

SOLAR ELECTRICITY PRICES VS. MODULE PRICE



Source: EIA, Piper Jaffray Research.

Solar Irradiance

Another important factor in understanding solar electricity costs is the output, or sun hours, of a solar system. Sun hours are a measurement of insolation, the amount of solar radiation at the earth's surface. It is measured as kilowatt hours per square meter (kwh/m^2). For example, if a particular location receives 5 kwh/m^2 per day, then there are 1,825 sun hours in a year (5 × 365). As exhibit 7 illustrates the more sun hours there are to harvest, the better the return. Using our LCOE model and assuming a $3.00 install cost, an 1,800 sun hour location provides electricity at $0.22/kwh vs. $0.28/kwh at a 1,400 sun hour location.

Exhibit 7

SOLAR ELECTRICITY PRICE SENSITIVITY BASED ON INSTALL COST ($/KWH)

		Annual Sun hours								
	$0.28	600	800	1,000	1,200	1,400	1,600	1,800	2,000	2,200
	$0.50	$0.19	$0.14	$0.11	$0.09	$0.08	$0.07	$0.06	$0.06	$0.05
	$1.00	$0.28	$0.21	$0.17	$0.14	$0.12	$0.10	$0.09	$0.08	$0.08
	$1.50	$0.37	$0.28	$0.22	$0.19	$0.16	$0.14	$0.12	$0.11	$0.10
	$2.00	$0.47	$0.35	$0.28	$0.23	$0.20	$0.17	$0.16	$0.14	$0.13
Total	$2.50	$0.56	$0.42	$0.34	$0.28	$0.24	$0.21	$0.19	$0.17	$0.15
Install Cost	$3.00	$0.65	$0.49	$0.39	$0.33	$0.28	$0.24	$0.22	$0.20	$0.18
$/w att	$3.50	$0.74	$0.56	$0.45	$0.37	$0.32	$0.28	$0.25	$0.22	$0.20
	$4.00	$0.84	$0.63	$0.50	$0.42	$0.36	$0.31	$0.28	$0.25	$0.23
	$4.50	$0.93	$0.70	$0.56	$0.47	$0.40	$0.35	$0.31	$0.28	$0.25
	$5.00	$1.02	$0.77	$0.61	$0.51	$0.44	$0.38	$0.34	$0.31	$0.28
	$5.50	$1.12	$0.84	$0.67	$0.56	$0.48	$0.42	$0.37	$0.34	$0.30
	$6.00	$1.21	$0.91	$0.73	$0.61	$0.52	$0.45	$0.40	$0.36	$0.33
	$6.50	$1.30	$0.98	$0.78	$0.65	$0.56	$0.49	$0.43	$0.39	$0.36
	$7.00	$1.40	$1.05	$0.84	$0.70	$0.60	$0.52	$0.47	$0.42	$0.38

Source: Piper Jaffray Research.

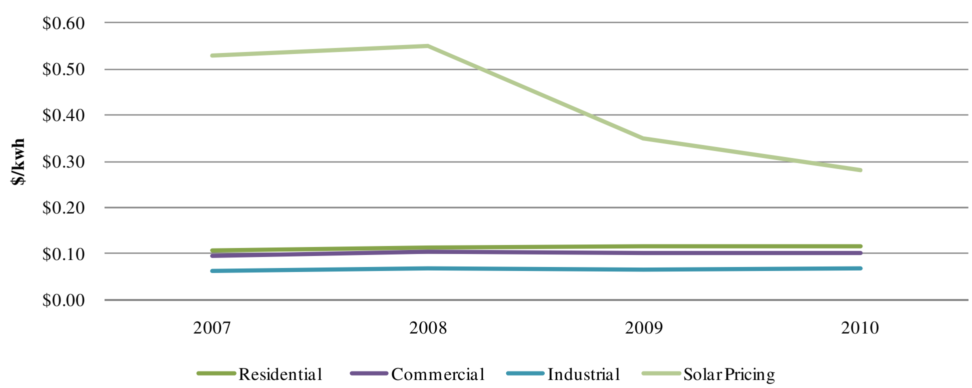
GRID ELECTRICITY PRICES

U.S. Electricity Prices

Exactly when grid parity is achieved is relative to a specific solar market. As Exhibit 8 illustrates, on a national level, solar electricity prices of $0.28/kwh are still almost 3x the average grid electricity price in the US. However, states such as Hawaii (see Exhibit 9) are much closer as their cost of grid electricity was $0.21/kwh in 2009 with Connecticut placing second at $0.18/kwh. Leading solar markets such as California and New Jersey are among the top ten as well in terms of high grid electricity prices.

Exhibit 8

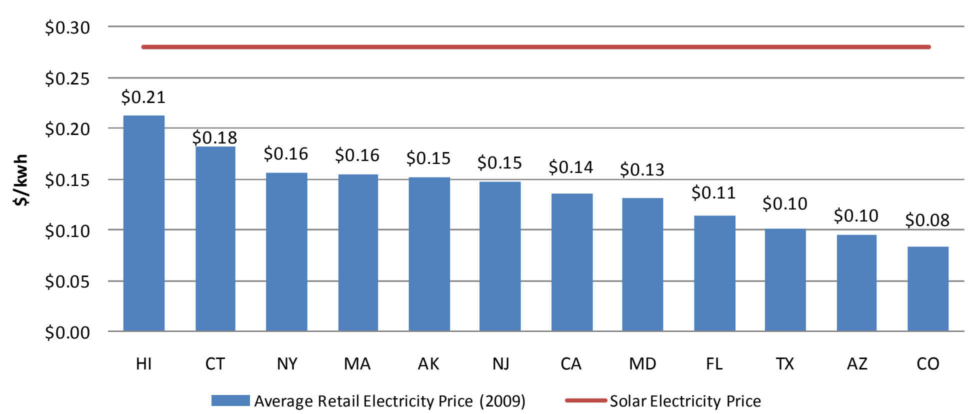
U.S. ELECTRICITY PRICES VS. LCOE SOLAR ELECTRICITY PRICES



Source: EIA, Piper Jaffray Research.

Exhibit 9

RETAIL ELECTRICITY PRICES BY STATE (2009)



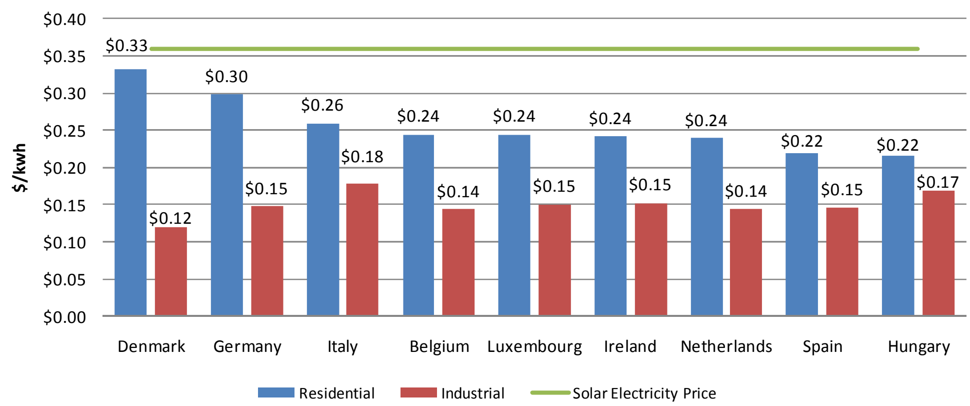
Source: EIA, Piper Jaffray Research.

EU Electricity Prices

EU markets are likely to be the first to reach grid parity. Higher priced residential electricity markets in Europe are also approaching grid parity (see Exhibit 10). The world's largest solar market, Germany, has some of the highest prices on the residential level at $0.30/kwh, which is nearing the estimated solar electricity price of $0.36/kWh. However, Europe's second largest solar market Italy at $0.26/kwh is approaching grid parity due to its higher solar irradiance. Industrial electricity pricing in Europe is as much as one-half residential pricing in most countries, indicating a longer path to grid parity. The key difference here is the amount of sun hours each country can harvest. Sun hours in Europe generally range from 900-1,800, so the solar electricity price can vary. For our analysis here, we assume the midpoint of this range at 1,400 sun hours, giving us a $0.36/watt electricity price. If sun hours are lower, then the price will be higher and conversely if sun hours are higher, then the price will be lower.

Exhibit 10

EU RETAIL ELECTRICITY PRICES (2009)*



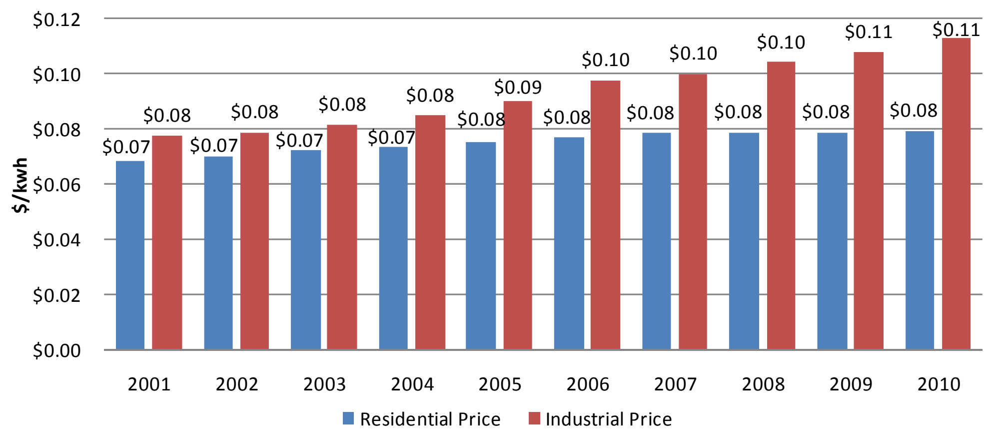
* Assumes a $1.30 euro exchange rate.
Source: Eurostat, Piper Jaffray Research.

China Electricity Prices

Electricity prices in China have been relatively stable since 2001. Residential pricing has increased at a CAGR of 1.7% over that time, while industrial pricing has grown at a 4.3% CAGR. However, the risk of higher inflation in coming years may cause electricity prices to increase faster.

Exhibit 11

CHINA HISTORICAL RETAIL ELECTRICITY PRICES*



* Assumes a 6.6RMB/USD exchange rate.
Source: NDRC, Piper Jaffray Research.

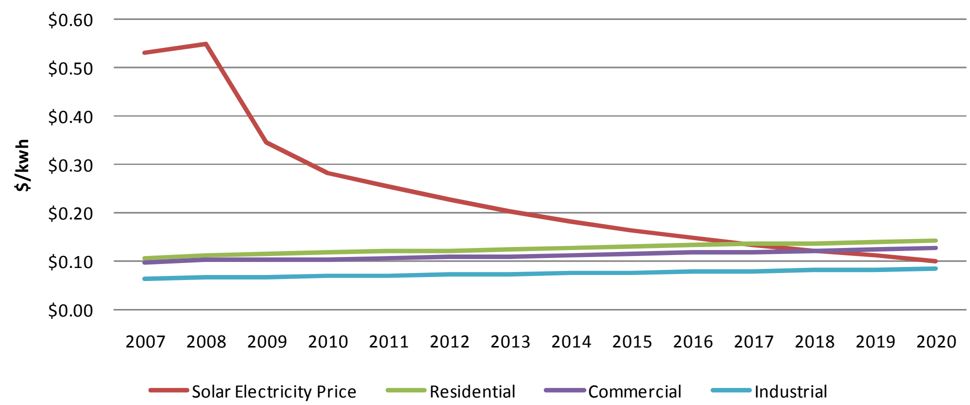
GRID PARITY PROJECTIONS

United States – National Level

Our U.S. grid parity outlook on the national level is separated into three categories based on available data for residential, commercial and industrial pricing. We use our LCOE model assumptions of 1,800 annual sun hours/year, 90% system yield, system price declines of 12% annually, installation margin of 15% and a 9% discount rate over a 25-year system life. Our projections for grid electricity pricing start with 2009 price levels increased annually at a conservative inflation rate of 2% (historically ranged from 2% to 4%) per year. Based on these assumptions we look for U.S. grid parity at the residential level in 2017. Commercial level grid parity is estimated to come in 2018 with Industrial level grid parity closer to 2020. Of course if grid electricity prices increase at a higher rate or if system prices fall at a higher rate annually, then grid parity will come sooner.

Exhibit 12

US GRID PARITY PROJECTION



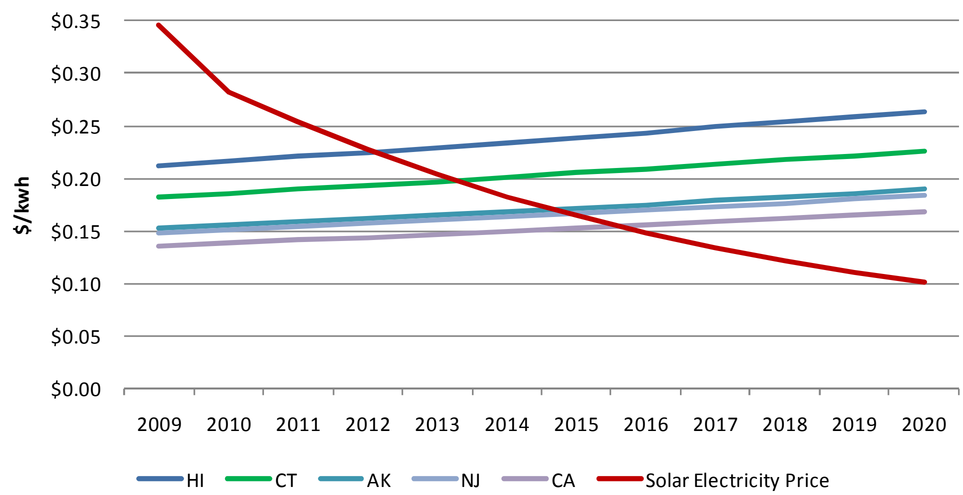
Source: EIA, Piper Jaffray Research.

United States – States

Grid parity will come sooner for several key states where grid electricity pricing is among the highest in the U.S. Again, using the same assumption of a 2% annual inflation rate on electricity prices for each state, Hawaii is the closest to solar grid parity, reaching it in 2012, by our estimates. States with the largest solar installation levels such as New Jersey and California should hit grid parity around 2013 and 2014, respectively. We note that our LCOE base model assumption of 1,800 sun hours is aggressive for a state such as Alaska which has closer to 1,200 sun hours a year. Thus, grid parity there could be pushed out beyond the 2014 timeframe indicated in Exhibit 13 to closer to 2016. Conversely, for regions which would have sun hour exposure greater than the 1,800 hours assumed in our base case LCOE model, grid parity could come sooner.

Exhibit 13

US GRID PARITY PROJECTION FOR KEY STATES



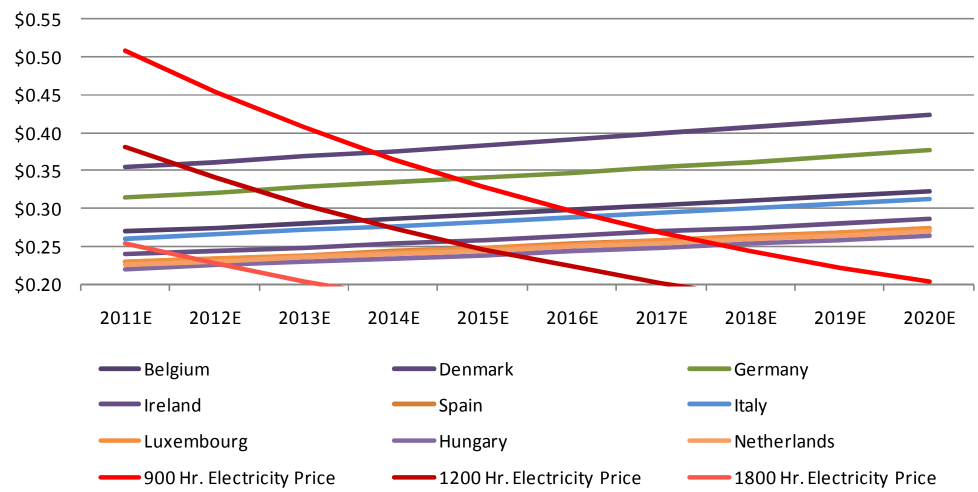
Source: EIA, Piper Jaffray Research.

European Union

Grid parity for EU residential pricing is closer to being achieved in nine of the highest price markets. We note that estimates for the solar electricity price can vary based on insolation levels. Parts of northern Europe can receive as little as 1,000 sun hours while parts of southern Italy and Spain can approach 2,000 sun hours. Our estimate of the solar electricity price is based on the midpoint of this range at 1,500 sun hours while assuming a more modest -12% CAGR from 2012 than the -20% CAGR for module pricing that has been the norm for the past three years. As Exhibit 14 shows, countries such as Italy could approach residential grid parity by 2012. The 1,500 sun hour assumption used here is aggressive for Germany, where sun hours average levels closer to 900 sun hours. This makes the solar electricity price higher there, making grid parity more likely to be achieved around 2015.

Exhibit 14

EU GRID PARITY PROJECTION FOR RESIDENTIAL PRICING

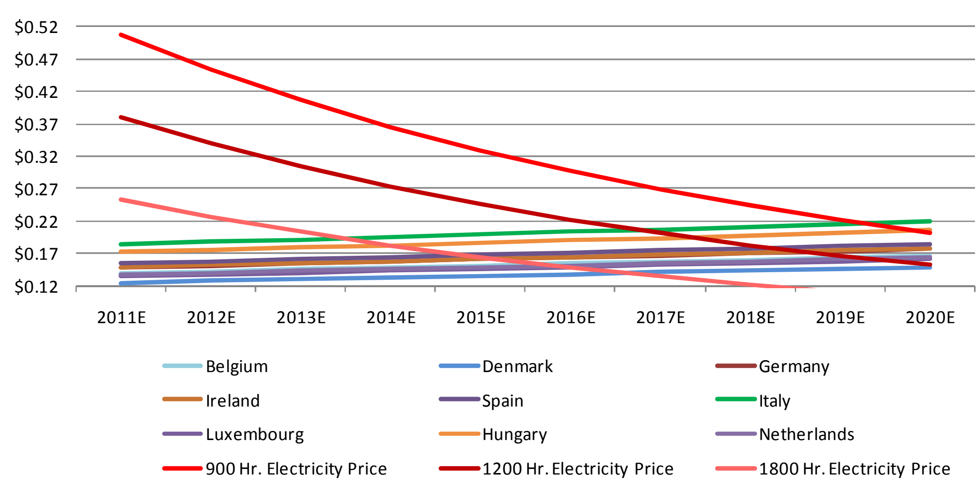


Source: Eurostat, Piper Jaffray Research.

Grid parity for industrial pricing is further away due to the significant discount in industrial pricing vs. residential pricing. Again using the same 1,500 sun hour assumption and -12% CAGR for module pricing, grid parity is pushed out 2-3 years for industrial pricing vs. residential. This analysis shows that nine of the top priced markets in the EU should hit grid parity by 2016 for industrial pricing. Again a key variable to our analysis is insolation levels that can extend when grid parity is achieved.

Exhibit 15

EU GRID PARITY PROJECTION FOR INDUSTRIAL PRICING



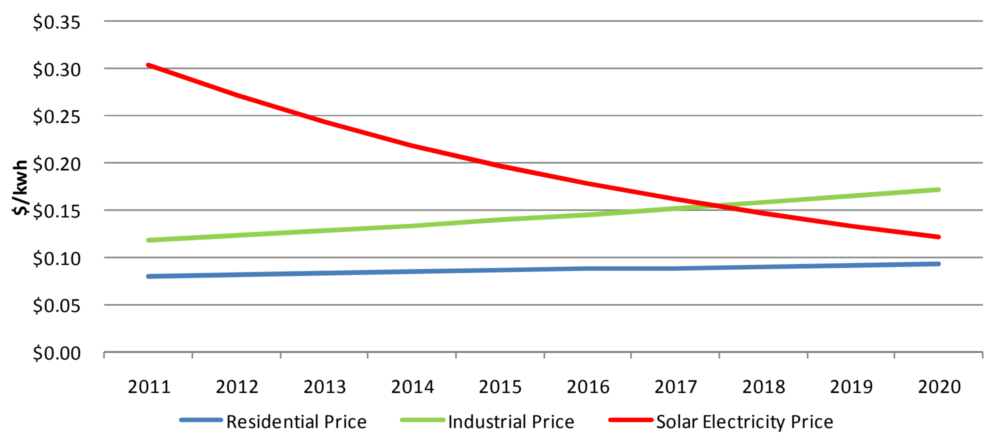
Source: Eurostat, Piper Jaffray Research.

China

China's path to grid parity is further away than either the U.S. or Europe due to relatively low electricity pricing for both residential and industrial use given its dependence on coal generation. The government has kept tight control on electricity pricing as a means of controlling inflation. Consequently, we project China's electricity pricing using a CAGR based on pricing since 2001 (1.7%-Residential; 4.3%-Industrial). China's most likely areas for solar installations, found mostly in the western half of the country, have insolation levels that range mostly from 1,200 to 1,800 sun hours a day. We use the midpoint of this range, 1,500 in our analysis. As Exhibit 16 shows, using these assumptions in our LCOE model, we see China reaching industrial grid parity around 2016 with residential grid parity in 2019. The key variable here is how tight the government keeps the reins on electricity pricing.

Exhibit 16

CHINA GRID PARITY PROJECTIONS*



*Assumes a 6.6 RMB/USD exchange rate.
Source: NDRC, Piper Jaffray Research.

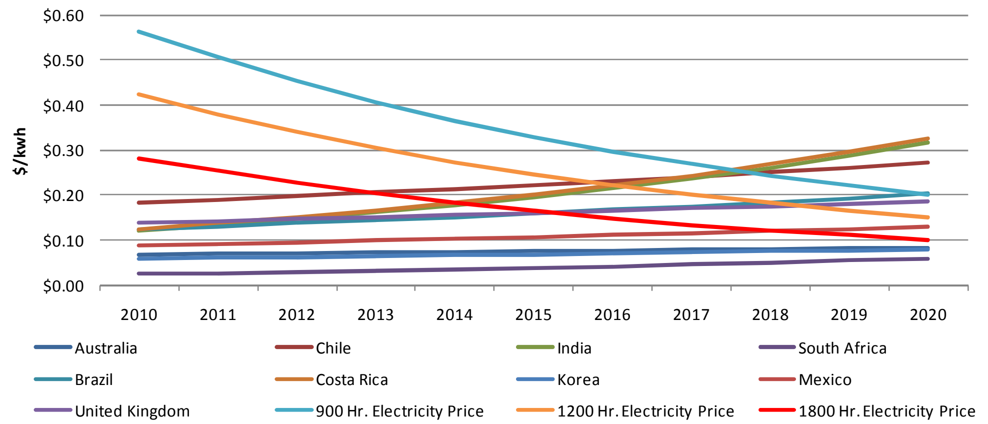
Rest of World

A look at grid parity in emerging solar markets could point the way toward how the global market will evolve. Currently, Europe dominates the solar electricity universe due mostly to Germany and Italy. Changes in these markets can significantly alter the outlook of the solar industry in general. Outside of Europe, growing focus on the United States and China is helping diversify solar markets. However, beyond those major regions, other countries will begin to approach solar grid parity as well, making them important drivers of future demand. These span areas of the globe including Australia, India, Mexico and South America.

In our analysis of industrial grid parity, we again use our base case LCOE model assumptions based on 1,800 sun hours. We forecast electricity pricing for each country using historical inflation rates for each country. As Exhibit 17 shows, Chile is expected to reach industrial grid parity first among our select group in 2013 followed by Brazil (2015) and Costa Rica (2015). India looks to hit grid parity in 2016 while South Africa will stay below grid parity beyond 2020.

Exhibit 17

KEY ROW COUNTRY INDUSTRIAL GRID PARITY PROJECTIONS

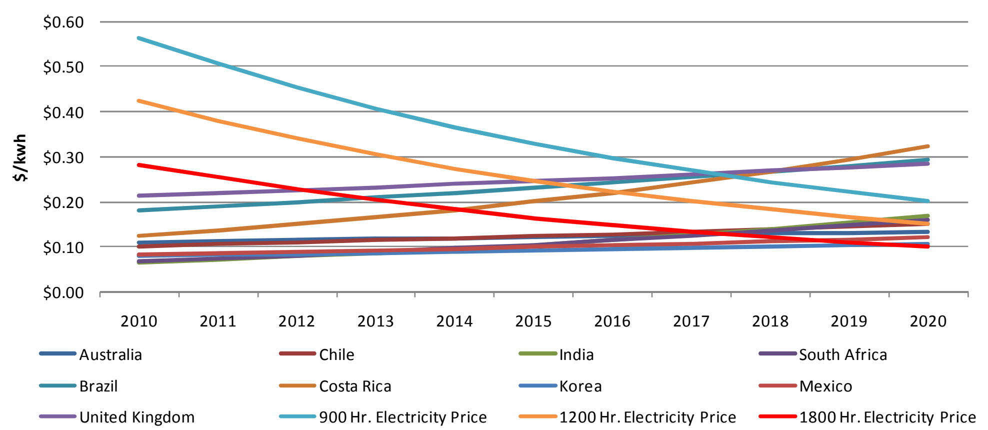


Source: IEA, Piper Jaffray Estimates.

On the residential side (Exhibit 18), Brazil will be the first, hitting grid parity in 2013. Costa Rica and Australia are at parity in 2015-2016, with South Africa waiting until 2019. The United Kingdom will approach grid parity probably closer to 2016 as sun hours (~1,200) are lower than our assumptions for the rest of the group. Potential solar giant India would not hit residential grid parity until 2020.

Exhibit 18

KEY ROW COUNTRY RESIDENTIAL GRID PARITY PROJECTIONS



Source: IEA, Piper Jaffray Estimates.

Out of this group, countries such as Chile and Brazil emerge as promising markets based on their path to grid parity, pointing toward largely untapped potential from South America. Australia and India are commonly identified as having enormous possibilities due to abundant sun hours, plentiful land and incentive programs. Industrial grid parity expected in 2016 for India and residential grid parity for Australia around the same time point to additional growth opportunities in these markets. Costa Rica and Mexico look to be the earliest opportunities from Latin America. One exception to our chart again is the United Kingdom which due to lower sun hours (~900) than we assume in our LCOE model here will likely hit industrial grid parity closer to 2017.

INDUSTRY COST STRUCTURE AT GRID PARITY

The decline in module costs will be a key determinant of when grid parity is achieved since we conservatively assume modules will comprise 50% of the future costs of a system. We project that module manufacturing costs will approach the $1.00/watt level for some of the lowest cost vertically integrated crystalline silicon (c-Si) manufacturers in China such as Trina Solar ($1.01/watt 2011E) and Jingle Green Energy ($1.07/watt 2011E). We note that Thin-Film module maker First Solar is already at $0.77/watt, and estimated to reach $0.70/watt cost in 2011. Other manufacturers currently have costs as high as $1.50 (Canadian Solar and Suntech) to $1.70 (Sun Power). This produces gross margins that can range from ~11% to ~37%. Looking ahead, the overall impact of module pricing on system costs will depend on poly pricing, processing costs, cell efficiencies, and the module manufacturer margin.

Exhibit 19 shows the cost structure of the solar PV industry to enable grid parity with a system priced at $1.50/watt by 2015. We assume that the module price continues to represent 50% of the system ASP, leading us to $0.75/watt per module which implies another 50% decline from our average 2011 module ASP of $1.56/watt. To enable manufacturers to earn a 20% margin on the module then module manufacturing costs have to be $0.60/watt. We assume that poly utilization improves over the next five years to 4 grams/watt from the current 5.5-6.0 grams given thinner wafers and higher efficiencies. We think it likely that polysilicon will move closer to the long-term historical norm of $35/kg over the same period, lowering poly costs to as low as $0.14. Module manufacturers with in-house poly will be able to achieve even lower poly costs. Wafering costs of $0.15/watt are achievable as new technologies such as continuous growth process are developed to lower wafer costs, as well as more efficient ingot growth furnaces and diamond wire saws. Cell costs should reach the $0.15/watt level due to improved efficiencies through the use of new materials (silicon ink), and processes (ion implant). Finally, automation and scale should make module costs of $0.15/watt achievable by 2015. Ultimately, we believe that vertical integration and scale are very important to achieving these cost levels.

As for the Balance of Systems (BOS) cost, with installer margin assumed at 15% or $0.23/watt on a system ASP of $1.50/watt, we estimate inverter cost of $0.16/watt which implies a 10% annual inverter price decline through 2015. We believe that improvements in power management technology will improve the power density of an inverter, essentially allowing manufacturers to do more in the same size box. This leaves $0.36/watt for other parts and labor.

Exhibit 19

2015 COMPONENTS OF A SOLAR SYSTEM $/WATT

	2010	2015	5-Yr CAGR
Total System Price	$3.50	$1.50	-16%
BOS	$1.75	$0.75	-16%
Module	$1.75	$0.75	-16%
Module Margin	36%	20%	
Module Manuf. Cost	$1.12	$0.60	-12%
Grams/watt	6	4	-8%
Poly Price ($/kg)	$55.00	$35.00	-9%
Cost/watt			
Poly	$0.33	$0.14	-16%
Wafer	$0.28	$0.15	-12%
Cell	$0.21	$0.15	-7%
Module	$0.30	$0.15	-13%
Module Manuf. Cost	$1.12	$0.59	-12%
Inverter	$0.27	$0.16	-10%
Materials	$0.40	$0.16	-17%
Labor	$0.55	$0.20	-18%
Installer Margin	$0.53	$0.23	
BOS cost	$1.75	$0.75	-16%

Source: Piper Jaffray Research.

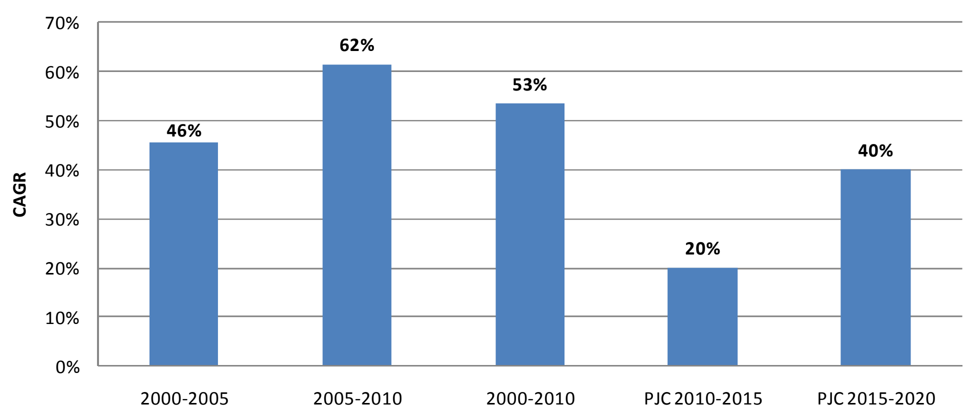
DEMAND PROJECTIONS TO 2020

Impact on demand at grid parity

Over the last ten years, solar installations have grown at a 53% CAGR, to an estimated cumulative installed capacity of 36GW at YE2010. The vast majority of that growth has come in the last five years at a CAGR of 62%. Markets have been driven primarily by subsidies. Furthermore, the rapid subsidy driven growth has enabled the PV industry to come down the cost curve, with system prices declining over 60% over the past 5 years. Solar electricity is now much closer to grid parity. Over the next 5 years, we expect the industry to approach grid parity with 2015 as a key inflection point for grid parity driven demand. We expect solar subsidies to be phased out and demand to pick up as solar becomes competitive with other forms of energy generation. Thus we look for a CAGR of 23% (see Exhibit 20), from 2010-2015, well below the 62% CAGR clocked over 2005-2010 as the industry moved through a transition phase. We estimate that the industry is still projected to install around 177GW over this transition period. After large-scale grid parity is reached in 2015, we estimate the growth rate to double to a 40% CAGR through 2020, installing a cumulative total of 890MW by 2020 representing 4% of total projected energy supply by 2020.

Exhibit 20

SOLAR DEMAND ESTIMATED CAGR TO 2020

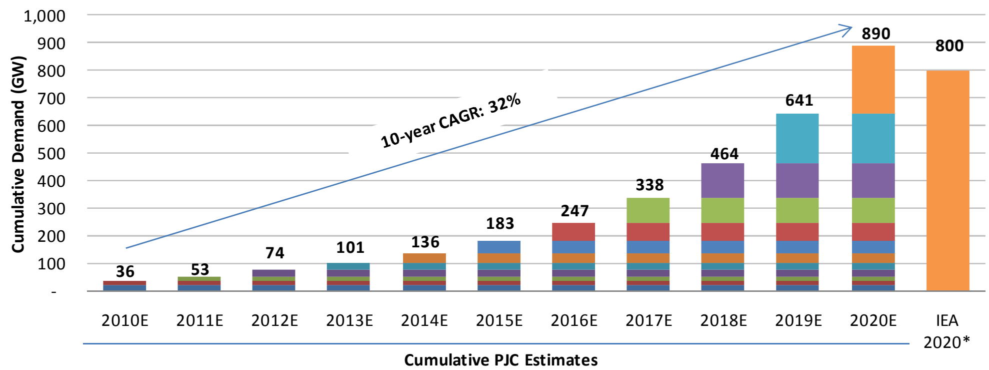


Source: Piper Jaffray Estimates.

As a reference point for our 2020 cumulative install capacity estimate, we reference the International Energy Agency's (IEA) estimates for 2020. The IEA currently projects 20,000 GW of total energy supply by 2020 with ~10% of that being renewables excluding hydro. We assume that these 2,000GW will be primarily used for electricity generation and that 40% of those will be solar with wind comprising the vast majority of the remaining 60%. This gives us an estimate of 800GW using the IEA's forecast. Solar would represent approximately 4% of energy supply by 2020.

Exhibit 21

PJC DEMAND PROJECTIONS THROUGH 2020



*Based on PJC assumption that 40% of IEA energy supply forecast for renewables (excl. hydro) is solar.
Source: IEA, Piper Jaffray Estimates.

Our projections assume that today's key markets will continue to be important over the next 10 years while a number of emerging markets help drive our 32% CAGR estimate. We see Germany continuing to add capacity at 4GW per annum, albeit at a lesser rate than in recent years, but not at an insignificant level. Other markets such as the US, China and India will continue to lead growth with new markets emerging as solar costs come down and grid parity nears. These markets include regions such as Africa, South America and the Middle East, where sun hours are abundant and electricity demand over the next decade is projected among the highest globally. There is also demand for rural electrification in these markets for which solar PV is well suited.

Exhibit 22

SOLAR DEMAND FORECAST

Annual PV installations and production volumes							Bear	Base	Bull	
(MW)	2005	2006	2007	2008	2009	2010E	2011E	2011E	2011E	2012E
Germany	906	832	1,107	2,002	3,800	8,000	4,000	6,500	7,000	4,000
Japan	290	287	210	230	484	1,000	1,500	1,500	1,500	2,000
USA	103	145	207	342	477	1,100	1,000	2,000	2,000	3,000
Spain	20	61	560	2,605	69	100	500	100	500	100
France	7	11	11	46	185	550	500	500	500	500
Italy	7	13	70	338	730	1,500	2,000	2,000	2,500	2,500
Belgium			18	50	292	180	200	250	200	200
Czech Republic			3	51	411	1,100	100	100	100	100
China			20	45	160	300	500	800	1,000	2,000
India					30	70	300	400	500	1,000
Australia					79	100	200	200	200	500
Canada					70	300	400	500	500	1,000
Rest of World	31	46	224	574	442	700	800	1,650	2,000	4,100
Demand (MW)	**1,364**	**1,394**	**2,430**	**6,283**	**7,229**	**15,000**	**12,000**	**16,500**	**18,500**	**21,000**
(% change)	30.9%	2.2%	74.4%	158.6%	15.1%	107.5%	-20.0%	10.0%	23.3%	27.3%

(MW)	2013E	2014E	2015E	2016E	2017E	2018E	2019E	2020E
Germany								
Japan								
USA								
Spain								
France								
Italy								
Belgium								
Czech Republic								
China								
India								
Australia								
Canada								
Rest of World								
Demand (MW)	**27,300**	**35,490**	**46,137**	**64,592**	**90,429**	**126,600**	**177,240**	**248,136**
(% change)	30.0%	30.0%	30.0%	40.0%	40.0%	40.0%	40.0%	40.0%

Source: Piper Jaffray

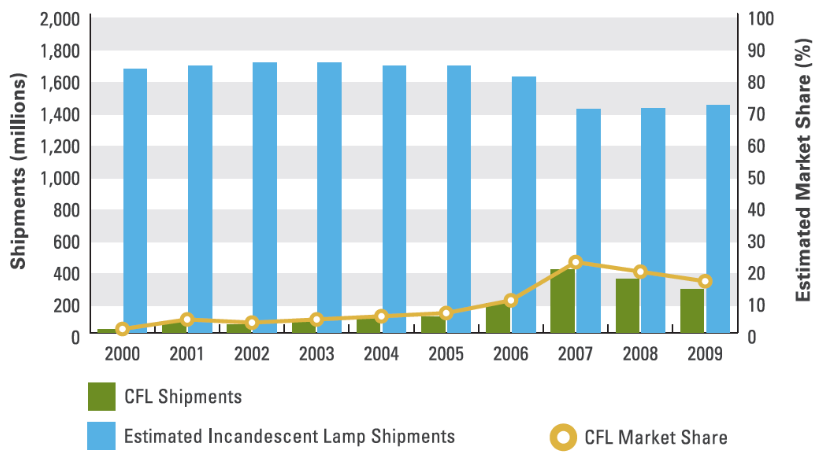
In light of this long-term forecast for the solar industry, we believe it is important to look beyond 2011 and near term concerns around subsidy cuts and oversupply. We encourage investors to see that an extraordinary 10 years lie ahead for solar and not to miss the forest for the trees. The market will move past subsidies and will continue to diversify beyond Germany, as we are already seeing for 2011 with more emphasis on China and North America. Concerns too of oversupply have also led to market caution recently, but our 10-year 32% CAGR estimate indicates that top suppliers across the solar value chain are only being prudent as they add capacity to prepare for very strong growth years ahead. Ultimately, we find it hard to be bearish with such promising years ahead for solar.

Compact Fluorescent Bulb and Parity

As a means of trying to understand further the potential spur in demand for solar at grid parity, we look at the evolution of the compact fluorescent light (CFL) bulb vs. the incandescent light bulb. For most of the 1990s the CFL struggled to gain significant market acceptance due primarily to high price, $10-$20 or greater per CFL, compared to the incandescent bulb priced at ~$1.00. Despite providing as much as 10x the hours of usage, consumers were reluctant to invest in a CFL. However, in the 2000s CFL prices began to drop and adoption increased. In 2005, CFL prices dropped to $3.50 and in the following two years, shipments grew from ~150m to ~400m units in 2007 (Exhibit 23), representing a 33% CAGR. While the $3.50 price point does not represent parity, it did trigger adoption as pricing reached an acceptable rate for consumers.

Exhibit 23

COMPACT FLUORESCENT ADOPTION HISTORY



Source: "CFL Market Profile and: Data Trends and Market Insights", DOE.

The CFL growth spurt is a good indicator of what grid parity will mean for solar adoption. As solar approaches grid parity, we believe that adoption rates will grow beyond our 23% CAGR estimated during widescale pre-parity years of 2010-2015, doubling to a 40% CAGR from 2015-2020 as pricing barriers disappear, similar to the performance of the CFL market over the previous five years.

OTHER FACTORS DRIVING DEMAND

While the achievement of grid parity will eliminate the need for incentive schemes such as feed-in tariffs (FiT), other programs designed to drive solar adoption will be important contributors to market growth. Grid parity will make electricity as cheap as other generation sources, but what will further motivate the purchase of solar electricity?

Renewable Portfolio Standards

The U.S. will continue to rely on state renewable portfolio standards (RPS) to drive solar adoption over the long-term. Currently, 29 states have an RPS in place, which, of course, can be satisfied by other renewable generation resources besides solar (wind, hydro, biomass). However, 16 of these states have provisions which mandate a minimum solar provision. California's 33% by 2020 requirement is the nation's most aggressive and is already a major market driver there. Our checks there indicate that utilities are primarily concerned with satisfying their RPS requirement and would see the attainment of grid parity as a means of helping satisfy that requirement while containing electricity costs for its customers. The U.S. has considered, but not implemented, a national RPS. While we would view this as a positive for the industry, we do not see it as essential for solar growth, nor would we see this as a negative for state RPS. Outside of the U.S., the European Union has a goal of 20% renewables by 2020 which promises to extend solar demand beyond the era of the FiT. China has a target of increasing its renewables to 15% of final energy consumption by 2020.

Rural Electrification

We look for the need for low-cost electricity in rural areas of emerging markets to be a growing source for solar demand. In countries such as India and Africa, vast areas are without reliable electricity generation as transmission lines are costly to implement at long distances for small communities. As solar costs decline, we look for rural electrification demand to increase as these remote areas will increasingly be able to afford reliable electricity supply from solar.

Climate Change Initiatives

Efforts have been made over the last 20 years to address climate change through various treaties. The United Nations Framework Convention on Climate Change (UNFCCC) was created in the early 1990s to address the effects of global warming. The UNFCCC is linked to the Kyoto protocol which established targets for 37 countries to reduce greenhouse gas emissions but expires in 2012. Efforts to draft a successor agreement at the Copenhagen accords in 2009 were not as successful as many had hoped as a non-legally binding agreement could not be reached. Modest progress was made toward a more definitive climate change framework agreement at the Cancun talks in December 2010, setting the stage for future efforts to lock in commitments from various countries. Ultimately, if a legally binding, timeframe committed agreement can be reached by UNFCCC countries, then renewable technologies such as solar stand to benefit.

2012 ESTIMATES

Our supply analysis for 2012 focuses on tier 1 suppliers across the value chain as they are likely the most cost effective and bankable sources. Tier 1 supply will likely remain tight across the value chain, pointing to top tier suppliers being sold out in 2011 and into 2012. Tier 2 and Tier 3 suppliers will likely be used as buffer capacity for the industry, and due to the lack of scale and technology, we believe many of the lower tier suppliers will likely fail. In our view, however, Tier 1 suppliers will be the go-to companies for the industry as manufacturers, distributors and installers look to grid parity markets over the next 5 years.

Exhibit 24

POLYSILICON SUPPLY FORECAST

Year-end capacity (tonnes)	2009	2010	2011	2012
Hemlock Semiconductor (Dow-Corning)	22,000	36,000	41,000	57,500
Wacker	18,000	30,000	33,000	40,000
REC	12,500	13,000	15,000	17,000
MEMC	11,700	20,000	24,000	24,000
Tokuyama	8,200	8,200	8,200	11,200
Mitsubishi Materials	3,300	3,300	4,300	4,300
Sumitomo	1,500	1,500	1,500	1,500
Total incumbent y/e capacity (polysilicon)	**77,200**	**112,000**	**127,000**	**155,500**
Total new entrant y/e capacity (standard process)	**68,455**	**94,730**	**114,630**	**125,130**
Total new entrant y/e capacity (umg silicon)	**11,500**	**22,500**	**32,500**	**32,500**
TOTAL YEAR END CAPACITY (MT)	**157,155**	**229,230**	**274,130**	**313,130**
Probability weighted production (90%/30%/2.5%) (MT)	**75,713**	**110,043**	**139,642**	**163,902**
Semi demand (tonnes of silicon)	22,813	29,657	34,106	37,516
Tonnes/MW	8.8	6.5	6.5	6.0
Theoretical crystalline solar production (MW)	6,046	12,367	16,236	21,064
Thin-film solar production (MW)	641	1,360	2,111	3,160
- % silicon based	1	89%	87%	85%
Total production possible based on available silicon capacity (MW)	**6,687**	**13,727**	**18,347**	**24,224**
Demand	7,216	15,000	16,500	20,850
Over-capacity/(shortage) (MW)	**-529**	**-1,273**	**1,847**	**3,374**

Source: Company reports, Piper Jaffray Research estimates

Exhibit 25

WAFER SUPPLY FORECAST

Top Wafer Suppliers (MW)

	Company	Domiciled	2009	2010E	2011E	2012E
1	LDK Solar	China	2,000	3,000	3,600	3,960
2	GCL Silicon	China	300	3,500	3,500	3,850
3	REC Wafer	Norway	1,463	1,925	2,400	2,640
4	Deutsche Solar (SolarWorld)	Germany	1,000	1,250	1,250	1,375
5	Glory Silicon Energy(STP)	China	375	500	1,200	1,320
6	ReneSola	China	825	1,200	1,800	1,980
7	Yingli	China	600	1,000	1,700	1,870
8	MEMC	US	888	900	1,500	1,650
9	Eversol	Taiwan	250	250	500	550
10	Solargiga Energy	China	210	420	630	693
11	Trina Solar	China	700	750	1,200	1,320
12	Canadian Solar	China	150	150	400	440
13	Solarfun	China	300	400	800	880
14	Sino American Silicon	Taiwan	380	800	1,100	1,210
15	Wafer Works	Taiwan	210	420	630	693
16	PV Crystalox	United Kingdom	-	400	630	800
17	Woongjin Energy	Korea	-	20	500	1,000
	Total Top Suppliers Year-End Capacity		9,651	16,885	23,340	26,231
	Others Year-End Capacity		6,036	6,842	7,527	8,279
	Total wafer capacity		15,687	23,727	30,867	34,510
	y/y increase		58%	51%	30%	12%
	Probability weighted production (90%/30%) (MW)			**13,873**	**20,257**	**24,678**
	y/y increase				46.0%	21.8%

Source: Company reports, Piper Jaffray Research estimates

Exhibit 26

CELL SUPPLY FORECAST

Top Crystalline silicon cell suppliers (MW)

	Company	Domicile	2009	2010E	2011E	2012E
1	JA Solar	China	800	1,900	2,000	2,200
2	Suntech Power	China	1,100	1,200	1,800	2,400
3	Yingli Green Energy	China	600	1,000	1,700	1,870
4	Trina Solar	China	600	1,100	1,700	1,870
5	Gintech	Taiwan	810	930	1,500	1,650
6	MoTech Industries	Taiwan	600	1,150	1,300	1,430
7	Canadian Solar	China	420	800	1,300	1,430
8	Solarfun	China	360	500	1,300	1,430
9	LDK Solar	China	-	120	1,260	1,386
10	Sharp (including thin-film)	Japan	710	800	1,200	1,320
11	Neo Solar Power	Taiwan	240	800	1,200	1,320
12	Q-Cells	Germany	800	1,100	1,100	1,210
13	Jinko Solar	China	300	600	800	880
14	SolarWorld Deutsche Cell	Germany	450	750	750	825
15	REC Solar	Sweden	180	730	730	803
16	Sunpower	US	574	654	700	770
17	E-Ton Solar	Thailand	320	560	650	715
18	Kyocera	Japan	400	400	600	800
	Total Top Suppliers Year-End Capacity		9,264	15,094	21,590	24,309
	Others		6,776	9,216	10,138	11,151
	Total crystalline cell capacity		16,040	24,310	31,728	35,460
	y/y increase			51.6%	30.5%	11.8%
	Probability weighted production (90%/30%) (MW)			**13,360**	**19,411**	**23,848**

Source: Company reports, Piper Jaffray Research estimates

Exhibit 27

MODULE SUPPLY FORECAST

Top Module Suppliers (MW)

			2009	2010	2011	2012
1	First Solar	US	1,100	1,400	2,200	2,420
2	Suntech Power	China	704	1,800	2,400	2,640
3	Sharp	Japan	595	870	1,000	1,100
5	Yingli Green Energy	China	525	1,000	1,700	1,870
6	JA Solar	China	520	500	500	550
7	Kyocera	Japan	400	600	800	880
8	Trina Solar	China	399	1,100	1,700	1,870
9	Sunpower	US	397	580	930	1,023
10	Ningbo Solar	China	260	338	439	483
11	Solarfun	China	550	900	1,500	1,650
12	Sanyo Electric	Japan	260	375	680	748
13	SolarWorld	Germany	500	1,000	1,250	1,375
14	Schott Solar (previously RWE-Schott, ASE)	Germany	228	300	500	550
15	Bosch Solar (was Ersol)	Germany	200	500	1,000	1,100
16	Canadian Solar	China	200	1,300	1,500	1,650
17	China Sunergy	China	-	480	1,200	1,320
21	REC Solar	Sweden	130	550	740	814
22	Renesola	China	135	375	600	660
23	LDK Solar	China	-	1,500	2,500	2,750
24	Jinko	China	-	600	1,000	1,100
	Total Top Supplier Year-End Capacity		7,103	16,068	24,139	26,553
	Other Year-End Capacity		1,000	1,000	3,000	3,300
	Total Module Supply		8,103	17,068	27,139	29,853
	y/y increase			110.6%	59.0%	10.0%

Source: Company reports, Piper Jaffray Research estimates

Piper Solar Coverage 2012 Estimates

In Exhibit 28, we introduce our 2012 estimates for our solar coverage companies. We discount our multiples from the industry norm of 10x to account for the risk associated with a longer term valuation shift in our valuations to our 2012 EPS estimates.

Exhibit 28

2012 COVERAGE ESTIMATES($M EXCEPT PER SHARE DATA)

			Revenue				EPS				
			2011E		2012E		2011E		2012E		
Ticker	Rating	PT	PJC	Consensus	PJC	Consensus	PJC	Consensus	PJC	Consensus	FY12 Multiple
FSLR	OW	$200	$3,937.3	$3,739.5	$4,492.3	$4,720.9	$9.94	$9.06	$11.50	$10.91	17x
TSL	OW	$36	$1,922.9	$1,997.6	$2,160.3	$2,263.1	$3.56	$3.60	$4.00	$3.73	9x
YGE	OW	$14	$1,881.2	$2,163.8	$2,045.2	$2,379.4	$1.41	$1.39	$1.70	$1.40	8x
SPWRA	OW	$20	$2,848.4	$2,781.5	$3,588.5	$3,498.1	$2.05	$1.86	$2.50	$2.19	8x
LDK	OW	$25	$2,908.7	$2,750.1	$3,097.9	$2,577.5	$2.50	$1.81	$2.84	$1.88	9x
SOL	OW	$26	$1,442.0	$1,372.5	$1,520.3	$1,554.1	$2.60	$2.05	$2.70	$1.85	10x
JASO	OW	$14	$1,900.4	$2,052.1	$1,972.4	$2,269.2	$1.40	$1.41	$1.50	$1.57	9x
SOLR	OW	$12	$805.7	$842.7	$1,017.5	NA	$1.21	$1.24	$1.44	NA	8x
CSIQ	N	$14	$1,914.7	$1,830.2	$2,030.0	$2,229.1	$1.57	$2.03	$1.69	$2.30	8x
STP	N	$9	$3,472.5	$3,371.8	$3,461.1	$3,403.5	$1.40	$1.24	$1.20	$1.18	8x
PWER	OW	$14	$1,409.6	$1,310.7	$1,606.3	$1,601.6	$1.40	$1.27	$1.60	$1.50	9x
SATC	OW	$6.75	$305.3	$308.7	$448.8	$401.9	$0.24	$0.25	$0.34	$0.38	10-yr DCF
DQ	OW	$20	$390.8	$350.6	$486.6	$479.3	$2.00	$2.01	$2.67	$2.44	7x

Source: Company reports, Piper Jaffray Research estimates

PIPER JAFFRAY SOLAR VALUATION COMPARABLES

(in millions, except per share data)

	Analyst	Rating	Price Target	Price	Mkt. Cap	EV	Sales 2011 Piper	Sales 2011 Consensus	Sales 2012 Piper	Sales 2012 Consensus	EBITDA 2011 Piper	EBITDA 2011 Consensus	EBITDA 2012 Piper	EBITDA 2012 Consensus	EPS 2011 Piper	EPS 2011 Consensus	EPS 2012 Piper	EPS 2012 Consensus	P/E 2011	P/E 2012	EV/EBITDA 2011	EV/EBITDA 2012	Price/Sales 2011	Price/Sales 2012	Price/BV
Poly																									
MEMC Electronic Materials Inc.				11.26	2,561	2,625	NA	2,660	NA	2,967	NA	472	NA	634	NA	1.05	NA	1.41	10.8	8.0	5.6	4.1	1.0	0.9	1.1
Renewable Energy Corp. ASA				17.79	17,711	26,743	NA	15,621	NA	15,635	NA	4,558	NA	4,862	NA	1.02	NA	1.32	17.5	13.5	5.9	5.5	1.1	1.1	0.8
Wacker Chemie AG				130.60	6,488	6,354	NA	5,014	NA	5,431	NA	1,309	NA	1,465	NA	11.35	NA	13.11	11.5	10.0	4.9	4.3	1.3	1.2	2.8
Tokuyama Corp.				414.00	144,062	215,061	NA	290,561	NA	288,122	NA	47,489	NA	47	NA	28.29	NA	27.59	14.6	15.0	4.5	NA	0.5	0.5	0.6
GCL-Poly Energy Holdings Ltd.				2.86	44,249	53,102	NA	18,711	NA	21,046	NA	6,603	NA	7,797	NA	0.23	NA	0.28	12.5	10.1	8.0	6.8	2.4	2.1	3.5
OCI Co. Ltd.				303,500.00	6,817,439	8,847,288	NA	3,482	NA	3,970	NA	1,293	NA	1,541	NA	30,688.4	NA	35,613.56	9.9	8.5	NM	NM	NM	NM	4.8
Daqo New Energy Corp. ADS	Zaman	OW	$20	10.16	203	640	390.8	351	486.6	479	127	133	127	174	2.00	2.01	2.67	2.44	5.1	3.8	4.8	5.0	0.6	0.4	2.3
Average																			**11.7**	**9.8**	**5.6**	**5.2**	**1.1**	**1.0**	**2.3**
Wafer																									
LDK Solar Co. Ltd. ADS	Zaman	OW	$25	10.12	1,330	2,398	2,909	2,750	3,097.9	2,578	677.6	539	677.6	501	2.50	1.81	$2.84	1.88	4.0	3.6	3.5	3.5	0.5	0.4	1.3
ReneSola Ltd (ADS)	Zaman	OW	$26	8.74	759	1,085	1,442	1,373	1,520.3	1,554	365.5	313	365.5	308	2.60	2.05	$2.70	1.85	3.4	3.2	3.0	3.0	0.5	0.5	1.5
MEMC Electronic Materials Inc.				11.26	2,561	2,625	NA	2,660	NA	2,967	NA	472	NA	634	NA	1.05	NA	1.41	10.8	8.0	5.6	4.1	1.0	0.9	1.1
Renewable Energy Corp. ASA				17.79	17,711	26,743	NA	15,621	NA	15,635	NA	4,558	NA	4,862	NA	1.02	NA	1.32	17.5	13.5	5.9	5.5	1.1	1.1	0.8
Comtec Solar Systems Group Ltd.	Wong	OW	HKD3.80	2.94	1,697	5,787	3,574	3,163	NA	4,426	NA	724	NA	1,225	0.41	0.42	NA	0.66	7.2	4.4	8.0	4.7	0.5	0.4	2.4
SOLARGIGA ENERGY HOLDINGS LTD				1.78	3,217	3,204	NA	3,133	NA	3,820	NA	483	NA	534	NA	0.17	NA	0.16	10.2	11.1	6.6	6.0	1.0	0.8	2.2
PV CRYSTALOX SOLAR PLC				0.52	210	153	NA	254	NA	250	NA	43	NA	41	NA	0.06	NA	0.06	8.8	8.6	3.5	3.7	0.8	0.8	0.8
SINO-AMERICAN SILICON PRODUCTS I				103.00	34,556	33,848	NA	25,777	NA	33,653	NA	5,551	NA	6,537	NA	9.36	NA	11.07	11.0	9.3	6.1	5.2	1.3	1.0	2.0
WAFER WORKS CORP				42.00	11,515	20,957	NA	20,196	NA	--	NA	3,041	NA	NA	NA	4.45	NA	--	9.4	NA	6.9	NA	0.6	NA	1.5
Average																			**9.1**	**7.7**	**5.2**	**4.4**	**0.8**	**0.8**	**1.5**
Cell																									
JA Solar Holdings Co. Ltd. ADS	Zaman	OW	$14	6.92	1,170	1,213	1,900.4	2,052	1,972.4	2,269	328.7	371	351.4	437	1.40	1.41	$1.50	1.57	4.9	4.6	3.7	2.8	0.6	0.6	0.2
Q-Cells SE				2.51	252	1,111	NA	1,404	NA	1,543	NA	184	NA	201	NA	0.20	NA	0.25	12.6	9.9	6.0	5.5	0.2	0.2	0.4
China Sunergy Co. Ltd. ADS				4.18	186	188	NA	755	NA	1,006	NA	63	NA	75	NA	0.80	NA	0.95	5.2	4.4	3.0	2.5	0.2	0.2	0.9
Motech Industries Inc.				112.50	42,491	38,154	NA	43,903	NA	54,678	NA	7,070	NA	8,240	NA	11.03	NA	11.46	10.2	9.8	5.4	4.6	1.0	0.8	1.9
E-Ton Solar Tech. Co. Ltd.				47.80	11,924	20,960	NA	21,991	NA	--	NA	--	NA	--	NA	4.30	NA	--	NA	NA	NM	NA	NA	NA	1.5
Gintech Energy Corp.				83.50	26,890	29,399	NA	20,788	NA	25,103	NA	3,483	NA	4,062	NA	9.26	NA	6.77	NA	12.3	8.4	NA	NA	1.1	1.6
Average																			**8.2**	**8.2**	**5.1**	**3.9**	**0.5**	**0.6**	**1.1**
Module																									
First Solar Inc.	Zaman	OW	$200	130.14	11,156	10,253	3,937	3,739	4,492.3	4,721	1136.9	1,104	1136.9	1,388	9.94	9.06	$11.50	10.91	13.1	11.3	9.0	4.3	2.8	2.5	3.4
SunPower Corp. (Cl A)	Zaman	OW	$20	12.83	1,256	1,808	2,839	2,782	3,588.5	3,498	399.0	366	399.0	371	2.03	1.86	$2.50	2.19	6.3	5.1	4.5	4.9	0.4	0.4	0.9
Suntech Power Holdings Co. Ltd. ADS	Zaman	N	$9	8.01	1,443	2,213	3,473	3,372	3,461.1	3,404	544.3	442	544.3	495	1.40	1.24	$1.20	1.18	5.7	6.7	4.1	4.5	0.4	0.4	1.0
Yingli Green Energy Holding Co. Ltd. ADS	Zaman	OW	$14	9.88	1,467	1,931	1,881	2,164	2,045.2	2,379	426.9	465	426.9	540	1.41	1.39	$1.70	1.40	7.0	5.8	4.5	3.6	0.8	0.7	0.2
Trina Solar Ltd. ADS	Zaman	OW	$36	23.42	1,633	1,575	1,923	1,998	2,160.3	2,263	411.8	426	411.8	444	3.60	3.60	$4.00	3.73	6.5	5.9	3.8	3.5	0.8	0.8	1.6
Canadian Solar Inc.	Zaman	N	$14	12.39	530	673	1,911	1,830	2,030.0	2,229	157.3	160	157.3	127	1.56	2.03	$1.69	2.30	7.9	7.3	4.3	5.3	0.3	0.3	1.1
SolarWorld AG				7.47	798	1,153	NA	1,533	NA	1,708	NA	253	NA	268	NA	0.67	NA	0.75	11.2	9.9	4.6	4.3	0.5	0.5	0.9
JinkoSolar Holding Co. Ltd. ADS				20.12	1,749	708	NA	895	NA	1,165	NA	192	NA	220	NA	4.68	NA	5.55	4.3	3.6	3.7	3.2	2.0	1.5	0.2
Average																			**7.8**	**7.0**	**4.8**	**4.2**	**1.0**	**0.9**	**1.2**
Inverters																									
Power-One Inc.	Zaman	OW	$14	10.20	1,088	1,017	1,410	1,311	1,606.3	1,602	391.8	340	391.8	440	1.40	1.27	1.60	1.50	7.3	6.4	2.6	2.3	0.8	0.7	4.5
Satcon Technology Corp.	Zaman	OW	$6.75	4.50	526	531	305	309	448.8	402	34.0	37	34.0	60	0.24	0.25	0.34	0.38	18.5	13.4	15.6	8.9	1.7	1.2	NA
Advanced Energy Industries Inc.				13.64	591	478	NA	576	NA	652	NA	95	NA	121	NA	1.54	NA	1.95	8.9	7.0	5.0	3.9	1.0	NA	1.7
SMA Solar Technology AG				69.50	2,412	1,936	NA	1,677	NA	1,728	NA	431	NA	421	NA	7.81	NA	7.64	8.9	9.1	4.5	4.6	1.4	1.4	3.7
Average																			**10.9**	**9.0**	**6.9**	**4.9**	**1.2**	**3.2**	**3.3**
Installers																									
Phoenix Solar AG				23.70	175	209	NA	726	NA	801	NA	37	NA	41	NA	3.52	NA	3.79	6.7	6.3	5.6	5.1	0.2	0.2	1.3
Centrosolar Group AG				5.07	103	152	NA	417	NA	458	NA	37	NA	41	NA	0.89	NA	1.04	5.7	4.9	4.1	3.7	0.2	0.2	1.1
Enel S.p.A.				3.74	35,169	101,439	NA	70,133	NA	71,955	NA	16,919	NA	17,494	NA	0.47	NA	0.49	8.0	7.6	6.0	5.8	0.5	0.5	1.0
Conergy AG				0.45	177	452	NA	1,045	NA	1,182	NA	57	NA	60	NA	0.02	NA	0.03	24.4	14.1	7.9	7.5	0.2	0.1	1.6
Kerself S.p.A.				3.60	62	242	NA	395	NA	347	NA	65	NA	--	NA	0.99	NA	--	3.7	NA	3.7	NA	0.2	0.2	3.7
Akeena Solar Inc.				0.47	19	20	NA	25	NA	--	NA	--	NA	--	NA	(0.12)	NA	--	NA	NA	NM	NA	0.8	NA	5.3
Premier Power Renewable Energy Inc.				1.10	32	30	NA	100	NA	--	NA	--	NA	--	NA	0.10	NA	--	NA	NA	NM	NA	NA	NA	3.0
Average																			**9.7**	**8.2**	**5.5**	**5.5**	**0.3**	**0.3**	**2.4**
Equipment																									
GT Solar International Inc.	Zaman	OW	$12	9.12	1,377	1,100	872	843	1,017.5	NA	239	219	239	165	1.21	1.24	$1.44	NA	7.6	6.3	4.6	6.7	1.6	1.4	4.9
Manz Automation AG				42.95	192	195	NA	231	NA	315	NA	29	NA	44	NA	2.75	NA	4.22	15.6	10.2	6.7	4.4	0.8	0.6	1.1
centrotherm photovoltaics AG				26.90	569	-	NA	650	NA	709	NA	97	NA	108	NA	2.43	NA	2.83	11.1	9.5	NA	0.0	0.9	0.8	1.5
Meyer Burger Technology AG				26.00	1,115	1,178	NA	816	NA	865	NA	135	NA	151	NA	1.63	NA	1.84	15.9	14.1	8.7	7.8	1.4	1.3	1.9
Average																			**12.5**	**10.0**	**6.7**	**4.7**	**1.2**	**1.0**	**2.4**
S&P 500																			**13.6**	**12.7**					

Prices as of 12/31/10.

Source: Piper Jaffray Research, Factset, Capital IQ and Thomson.

PIPER JAFFRAY SOLAR COST ANALYSIS

		Polysilicon			Wafer							Cells			Module									
		REC	DQ	GCL-Poly	GCL Wafer	SOL	LDK	REC	PVCS	Comtec	Solargiga	JASO	REC	QCE	FSLR	TSL	SOL	CSIQ	LDK	STP	YGE	REC	SPWRA	JASO
	1Q10	47.80	51.98	50.00	0.74	0.77	0.83	0.93	0.96	0.81	0.74	1.26	1.41	1.40	1.77	1.75	2.06	1.83	1.74	1.91	1.77	2.08	2.09	1.80
ASP	2Q10	57.65	52.45	50.00	0.80	0.82	0.85	0.85	0.96	0.83	0.78	1.34	1.36	1.33	1.73	1.66	1.67	1.82	1.77	1.83	1.73	1.97	1.92	1.73
	3Q10	59.00	56.73	54.00	0.83	0.84	0.87	0.88	0.88	0.95	0.82	1.39	1.33	1.33	1.64	1.73	1.85	1.79	1.88	1.80	1.69	1.93	1.93	1.75
	4Q10E	63.46	69.00	54.00	0.83	0.85	0.88	0.88	0.88	0.95	0.78	1.46	1.23	1.33	1.48	1.74	1.85	1.78	1.75	1.82	1.69	1.93	1.93	1.83
	2010E	56.00	57.54	52.00	0.80	0.82	0.86	0.87	0.88	0.90	0.78	1.36	1.32	1.35	1.64	1.72	1.86	1.81	1.79	1.84	1.72	1.98	1.96	1.78
	2011E	51.80	53.50	47.00	0.72	0.75	0.78	0.80	0.80	0.76	0.71	1.29	1.19	1.18	1.45	1.58	1.52	1.60	1.58	1.58	1.57	1.83	1.78	1.62
Conversion Cost	1Q10	-	-	-	0.28	0.28	0.31	-	0.37	0.34	0.34	0.21	-	0.55	0.81	0.76	1.15	0.64	1.21	0.56	0.74	-	1.46	0.53
($/watt)	2Q10	-	-	-	0.28	0.26	0.31	-	0.37	0.30	0.30	0.19	-	0.44	0.76	0.74	1.07	0.63	1.28	0.52	0.74	-	1.39	0.54
	3Q10	-	-	-	0.27	0.25	0.33	-	0.33	0.29	0.30	0.18	-	0.41	0.77	0.73	0.99	0.62	1.50	0.52	0.74	-	1.38	0.44
	4Q10	-	-	-	0.25	0.24	0.31	-	0.33	0.30	0.30	0.18	-	0.37	0.75	0.72	0.95	0.59	1.31	0.52	0.74	-	1.36	0.44
	2010E	-	-	-	0.25	0.26	0.32	0.40	0.35	0.30	0.30	0.19	0.41	0.42	0.78	0.74	1.04	0.62	1.33	0.53	0.74	0.76	1.38	0.49
	2011E	-	-	-	0.20	0.20	0.27	0.32	0.34	0.27	0.30	0.17	0.27	0.38	0.72	0.69	0.78	0.55	1.16	0.49	0.72	0.50	1.22	0.42
Poly/wafer Cost																								
($/kg; $/watt)	1Q10	-	26.86	35.00	35.00	60.00	64.37	-	-	55.00	60.00	0.79	-	-	0.00	0.39	0.36	0.95	0.38	0.98	0.43	-	0.30	0.79
	2Q10	-	24.42	31.50	31.50	55.00	60.84	-	-	50.00	55.00	0.85	-	-	0.00	0.36	0.33	0.94	0.35	0.98	0.40	-	0.29	0.85
	3Q10	-	22.80	28.00	28.00	51.00	59.81	-	-	57.00	51.00	0.90	-	-	0.00	0.35	0.31	0.90	0.29	0.99	0.37	-	0.34	0.90
	4Q10	-	25.00	25.00	25.00	57.50	53.93	-	-	60.60	57.50	0.98	-	-	0.00	0.36	0.35	0.89	0.29	1.09	0.41	-	0.34	0.98
	2010E	25.80	24.77	29.88	29.88	55.88	59.74	25.80	39.47	56.80	55.00	0.88	0.74	0.86	0.00	0.37	0.34	0.92	0.33	1.01	0.40	1.15	0.32	0.88
	2011E	23.90	23.59	23.00	23.00	53.63	46.28	23.90	31.52	57.00	53.63	0.85	0.65	0.76	0.00	0.33	0.32	0.81	0.29	0.91	0.34	0.92	0.33	0.85
Total Cost (6g/watt)																								
($/watt)	1Q10	-	-	-	0.63	0.64	0.69	-	0.88	0.67	0.70	1.00	-	-	0.81	1.15	1.51	1.59	1.59	1.54	1.17	-	1.77	1.32
	2Q10	-	-	-	0.57	0.59	0.66	-	0.88	0.60	0.63	1.04	-	-	0.76	1.10	1.40	1.58	1.64	1.50	1.15	-	1.68	1.39
	3Q10	-	-	-	0.56	0.56	0.62	-	0.75	0.63	0.61	1.08	-	-	0.77	1.08	1.30	1.52	1.79	1.51	1.11	-	1.72	1.34
	4Q10	-	-	-	0.53	0.59	0.60	-	0.75	0.66	0.65	1.16	-	-	0.75	1.08	1.29	1.48	1.61	1.61	1.15	-	1.70	1.42
	2010E	-	-	-	0.57	0.59	0.65	0.74	0.79	0.64	0.63	1.07	1.15	1.29	0.78	1.10	1.37	1.54	1.66	1.54	1.14	1.91	1.70	1.37
	2011E	-	-	-	0.49	0.51	0.56	0.65	0.70	0.61	0.62	1.02	0.92	1.14	0.72	1.01	1.10	1.36	1.44	1.40	1.07	1.42	1.55	1.27
Shipments (MW)	1Q10	3,322	814	2,584	31	227	257	287	78	36	63	175	67	165	322	193	15	185	31	279	200	43	135	15
	2Q10	2,854	896	2,810	198	207	378	329	78	41	74	199	84	221	344	223	51	181	74	312	226	80	138	31
	3Q10E	3,300	973	3,200	400	227	487	371	88	44	80	276	90	226	350	291	98	195	94	391	283	139	152	75
	4Q10E	3,499	840	3,200	600	220	484	417	88	75	85	261	100	234	357	300	100	200	125	450	321	111	192	90
	2010E	12,975	3,523	11,794	1,229	880	1,605	1,398	330	195	302	911	341	846	1,373	1,007	264	761	324	1,432	1,030	373	617	211
	2011E	14,025	3,156	15,000	2,500	1,200	2,003	1,583	383	700	500	917	435	927	2,024	1,225	400	965	565	2,205	1,170	432	809	500
Capacity (MW)	Current	17,000MT	3,300	21,000MT	1,200	1,200	2,600	1,925	400	200	210	1,900	730	950	1,430	950	240	1,000	760	1,600	600	740	580	300
	YE2010	17,000MT	3,300	21,000MT	3,000	1,200	2,800	1,925	400	600	420	1,900	730	1,100	1,430	1,100	375	1,300	1,500	1,800	1,000	740	580	500
	YE2011	17,000MT	4,300	21,000MT	3,000	1,800	3,600	2,295	450	1,000	630	1,900	550	1,370	2,124	1,700	600	1,500	2,500	2,400	1,700	590	930	500
Gross Margin	1Q10	-	48.3%	30.0%	14.9%	16.9%	17.1%	-	8.5%	17.3%	5.4%	20.5%	-	-	54.2%	33.9%	27.0%	13.3%	8.3%	19.4%	33.6%	-	15.4%	17.4%
	2Q10	-	53.4%	37.0%	28.8%	28.0%	21.8%	-	8.5%	27.7%	19.2%	22.4%	-	-	56.0%	33.7%	15.8%	13.6%	7.6%	18.2%	33.8%	-	12.4%	9.8%
	3Q10	-	59.8%	48.1%	32.5%	33.8%	28.2%	-	15.2%	33.8%	26.1%	22.4%	-	-	52.8%	37.6%	30.0%	15.0%	4.6%	16.0%	34.1%	-	10.6%	14.8%
	4Q10	-	63.8%	53.7%	36.1%	31.0%	31.2%	-	15.2%	30.9%	17.3%	20.6%	-	-	49.2%	37.7%	30.1%	16.8%	8.0%	11.8%	32.1%	-	11.5%	14.5%
	2010E	53.9%	57.0%	42.5%	28.4%	27.6%	24.7%	14.6%	10.3%	28.7%	19.2%	21.5%	12.8%	4.7%	52.8%	35.7%	26.1%	14.7%	7.1%	16.4%	33.6%	3.3%	13.3%	14.1%
	2011E	53.9%	55.9%	51.1%	31.9%	31.3%	28.2%	18.4%	12.0%	20.1%	12.4%	21.1%	22.6%	3.3%	49.9%	35.8%	27.4%	14.9%	8.6%	11.9%	32.3%	22.5%	12.7%	12.0%

NB. The European figures (REC, PVCS, QCE) reflect fully loaded costs, including personnel and other operating expenses as well as depreciation.
All Euro denominated forward cost estimates are based on a EUR:USD rate of 1.27.

Source: Piper Jaffray Research and Company Reports.

PIPER JAFFRAY SOLAR CATALYST CALENDAR

2011

January	February	March	April
U.S. Texas - Legislature to likely consider SB 541	U.S.	U.S.	U.S.
Europe *Czech Republic*- FIT Revisions *Germany*- FIT Revisions *Greece*- FIT Revisions *Italy* -FIT Revisions-1st Round	Europe	Europe *Germany* -Publication of 2010 solar installations	Europe *Italy* -Publication of 2010 solar installations
APAC *Australia*- FIT Revisions *Australia* -Implementation of Small-scale Renewable Energy Scheme (SRES) and Large-scale Renewable Energy Target (LRET)	APAC *China*- New Solar Energy Target--National People's Congress	APAC *China*- Revised long term renewable energy targets	APAC
May	**June**	**July**	**August**
U.S.	U.S.	U.S. Intersolar North America Conference	U.S.
Europe *Italy*- FIT Revisions-2nd Round	Europe *Germany*- Intersolar 2011	Europe	Europe
APAC *China* -Renewable energy development plan	APAC *China*- 3rd round bidding for national solar projects *Malaysia* -Implementation of FiT	APAC	APAC
September	**October**	**November**	**December**
U.S.	U.S. Solar Power Int'l Conference	U.S.	U.S. Solar Cash Grant Expires Dec. 31.
Europe *Italy*- FIT Revisions-3rd Round	Europe	Europe	Europe
APAC	APAC	APAC	APAC

Source: Piper Jaffray Research.

Important Research Disclosures

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Rating	Count	Percent	IB Serv./Past 12 Mos. Count	IB Serv./Past 12 Mos. Percent
BUY [OW]	320	51.20	71	22.19
HOLD [N]	260	41.60	29	11.15
SELL [UW]	45	7.20	2	4.44

Note: Distribution of Ratings/IB Services shows the number of companies currently in each rating category from which Piper Jaffray and its affiliates received compensation for investment banking services within the past 12 months. FINRA rules require disclosure of which ratings most closely correspond with "buy," "hold," and "sell" recommendations. Piper Jaffray ratings are not the equivalent of buy, hold or sell, but instead represent recommended relative weightings. Nevertheless, Overweight corresponds most closely with buy, Neutral with hold and Underweight with sell. See Stock Rating definitions below.

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