

國際綠能低碳發展趨勢

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Agenda

- Green Energy
- Solar Energy
- Current Market Situation
- Market Forecast
- Key to Success
- Market Trend
- Conclusions

Green Energy

Green energy is referred to as the type of energy that is produced from energy sources that are environmentally friendly compared to fossil fuels like coal, oil and natural gas. It includes all the renewable energy sources like wind, solar, geothermal and hydropower.

Green Energy

Installation:

	<u>2010</u>	<u>2012</u>	<u>2013</u>	<u>AGR</u>
Wind Energy	35GW	45GW	52GW	14%
Solar Energy	20GW	31GW	35GW	20%
Geothermal	10GW	11GW	12GW	6%

Solar Energy

- 1839 Photovoltaic activity found by Edmond Becquerel, a French physicist
- 1905 Photoelectric effect discovered by Albert Einstein
- 1921 Einstein received Nobel Prize
- 1954 First solar battery invented from AT&T
- 1958 First long-term practical application of PV cells equipped in satellite Vanguard

Current Market Situation

European PV market has weakened further in Q3 2013. Installations in Europe are forecast to reach less than 11 GW in 2013, almost half the amount installed in 2011.

Strong growth of China, Japan and USA, is predicted to continue in the coming years and forecasts for future installations have been raised.

Non-Chinese suppliers that are widely exposed to the European market will temporarily benefit from the minimum price set by the European Commission for Chinese imports.

The uptick of global PV demand in Q2 2013, which was mainly driven by installations in China, was paralleled by a stabilization of prices across the PV value chain.

Leading module suppliers reported double-digit gross margins in Q3. Expect several manufacturers to return to net profitability in 2013.

c-Si Cell Market Share in Q3'13

Total Production (Q3'13)	8.9GW	100%
China	5.4GW	61%
Taiwan	2.0GW	22%
Japan	0.5GW	6%
SE Asia	0.5GW	6%
Korea	0.2GW	2%
Germany	0.2GW	2%

PV Solar Module Market Share in 2012

2011 Rank	2012 Rank		2011 Revenue (US\$M)	2012 Revenue (US\$M)	Percentage Change	2012 Share (%)
2	1	Yingli Green Energy	2,332	1,784	-23%	8%
6	2	Kyocera	1,519	1,506	-1%	6%
8	3	Panasonic	1,465	1,395	-5%	6%
7	4	Sharp	1,505	1,227	-18%	5%
4	5	Trina Solar	2,050	1,212	-41%	5%
3	6	First Solar	2,068	1,186	-43%	5%
5	7	Canadian Solar	1,671	1,180	-29%	5%
1	8	SunTech Power	2,990	1,160	-61%	5%
17	9	JA Solar	550	721	31%	3%
12	10	Jinko Solar	945	690	-27%	3%
9	11	SunPower	1,374	672	-51%	3%
10	12	Hanwha SolarOne	1,029	591	-43%	3%
		Others	11,298	9,859	-13%	43%
		Total Market	30,796	23,183	-25%	100%

Top Module Manufacturers in 2013

Company	Q3'12	Q4'12	Q1'13	Q2'13
Yingli	492MW	692	647	800MW
Trina Solar	380	415	393	647
Jinko Solar	280	252	282	460
Canadian Solar	384	404	340	455
Renesola	145	321	327	434
Sharp Solar	289	274	503	343
Hanwha	240	199	289	321
SunPower	210	225	173	277
Kyocera	155	209	303	260
JA Solar	247	322	248	254

Module Pricing Status

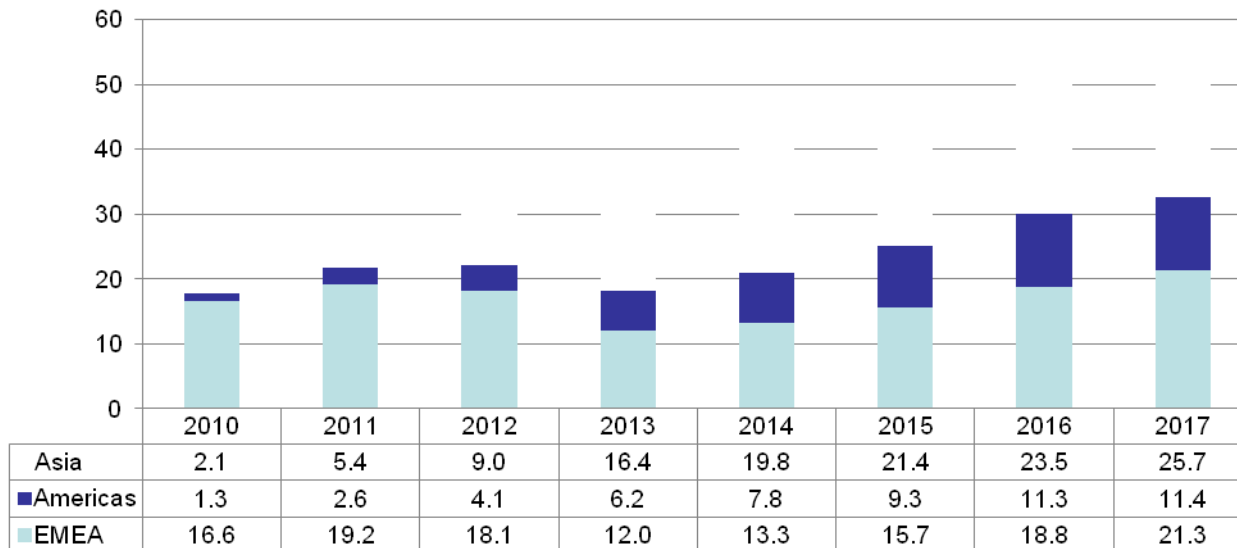
- PV module pricing fell in Q3'13; the pricing declines were moderate, falling only 1% Q/Q
- Stabilization in ASPs is being driven by a few factors including:
 - Increased shipments to the high ASP market of Japan
 - ASP stabilization in Europe due to lower downstream inventory levels
 - Increased demand and utilization for components from Tier 1 cell and module players.
 - Continuing demand for Taiwanese cells
- Downward pressure on module ASPs is anticipated until demand and supply move more into balance
- The full effects of the Europe/China trade case will become apparent in the next a few months

PV Market Forecast

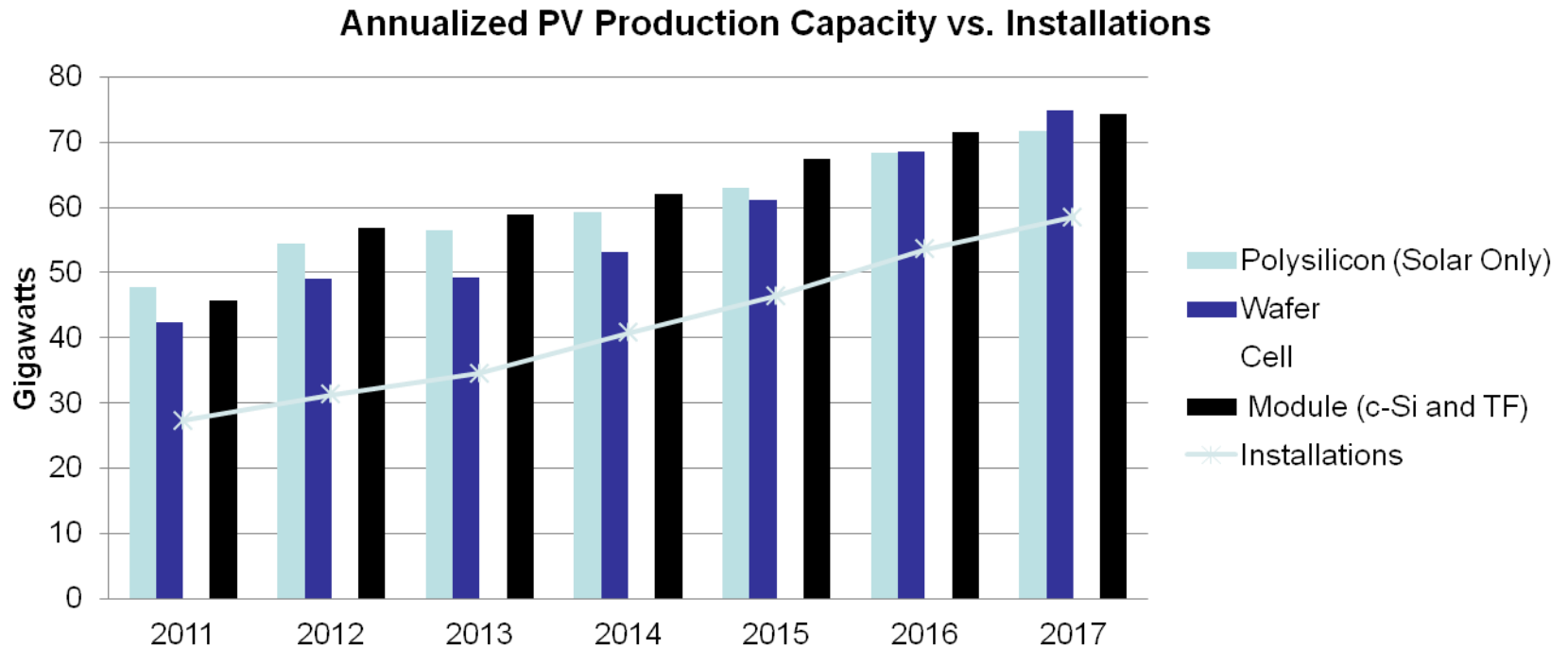
PV installations are forecast to grow by 10% in 2013 to reach 34.5 GW. The fastest growing region is projected to be Asia where annual installations are forecast to increase by over 80% in 2013, largely driven by China and Japan which will become the two largest markets in the world.

Despite limited long-term growth from EMEA, global growth is forecast to accelerate from 2014. Global market will reach 58 GW in 2017, with Asia contributing to nearly half of global demand.

PV Installations Forecast by Region (GW)



Long-term PV supply/demand balance



- In 2013, a total module production capacity of 58.9 GW, a cell production capacity of 46.8 GW, a wafer production capacity of 49.2 GW, and a polysilicon production capacity equivalent to 56.4 GW.
- Considering that the PV industry is still growing strongly, which necessarily involves a certain level of overcapacity, the supply/demand situation is forecast to be healthy again in 2014.

Key to Success - Energy Cost

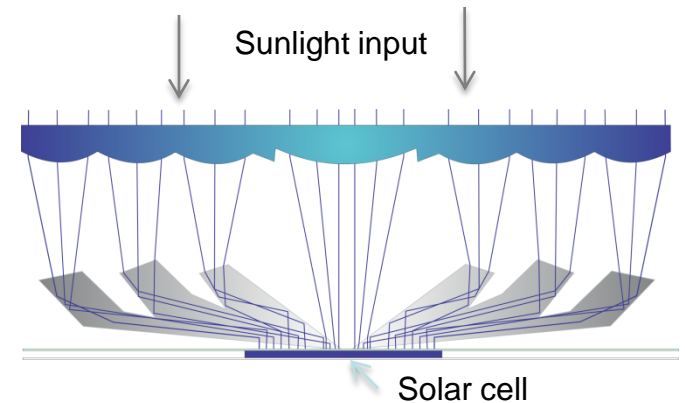
- Electrical energy is measured in kilowatt-hours (kWh)
- Power Purchase Agreements specify price in dollars/kWh
- Module cost in dollars/watt is very important, but not the only factor that determines the cost of electricity. Other key parameters are:
 - Energy harvest (total electrical energy generated over time)
 - Balance of system costs (inverter, mounting, wiring, labor, etc.)
 - Project finance terms (debt:equity, rate of return, etc.)
 - Amount of direct sun and total sun
 - System operating & maintenance costs
 - System life
- All of these are rolled into the Levelized Cost of Electricity (LCOE)

Breakthrough Optics = Low Cost Solar

Banyan OptiWave™ low concentration PV technology offers two critical advantages:

1. Reduce module cost to \$0.30/watt and lower LCOE* by up to 20%
2. Reduce wafer and cell manufacturing CapEx by 80% or more for integrated manufacturers.

The module has the same form factor as conventional modules, so it uses standard system components.



- ✓ Banyan is a leader in waveguide optics – Four US Patents granted with many additional US and international patents pending.
- ✓ 7X concentration is the economic “sweet spot,” reducing cost by eliminating over 85% of the solar cells while not causing any heat management problems.
- ✓ Superior for applications in solar photovoltaics and LED lighting for precise directional control of the light coupled with high efficiency.

Market Trend

- Revenue growth is stagnating even demand is growing
- LCOE will continue decline thru the area of:
 - Greater economies of scales
 - Manufacturing cost reduction
 - Advances in PV cell efficiency
 - Better financial support
- China and Japan are projected to account for over 40% of end-market demand, and China will lead the market demand
- US market will grow to be the 2nd largest market
- India market will grow rapidly, but challenges remain

Conclusions

- Taiwan is and will play a significant role in worldwide solar industry due to its high performance solar cells.
- Taiwan should build PV module and EPC/system finance infrastructure to target worldwide solar end-market.
- Taiwan should develop energy saving technology to steer the end-market