MAY 17, 2018

MAC Solar Index

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SOLAR SECTOR UPDATE

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MAC Global Solar Energy Index (SUNIDX)

SOLAR INDEX PERFORMANCE

The MAC Solar Index, the tracking index for the Guggenheim Solar ETF (NYSE ARCA: TAN), rallied to a new 2-1/4 year high in May, extending the rally seen in 2017. The index is currently up +6% on the year, adding to the annual gain of +52% seen in 2017.

Bullish factors for solar stocks include (1) broadening solar growth coming from India, Turkey, Latin America, the Middle East, and Southeast Asia (see page 4 for the world solar growth outlook), (2) stronger demand for solar power due to the increasingly competitive price of solar versus alternatives as countries seek to meet their carbon-reduction targets under the Paris COP21 global climate agreement, and (3) modest valuation levels that indicate that solar stocks are conservatively priced.

Bearish factors for solar stocks include (1) reduced subsidy support as countries move more towards using competitive auctions to acquire solar power now that solar has become grid-competitive in many areas, (2) the Trump administration's 4-year 30% tariff on imported cells and tariffs that will dampen U.S. solar install growth, and (3) ongoing solar trade disputes that have resulted in tariffs and various market dislocations.

Solar stocks are trading at modest valuation levels compared with the broad market. The median trailing P/E for the companies in the MAC Solar Index is currently 17.0, which is below the comparable figure of 20.9 for the S&P 500 index. Meanwhile, the median forecasted 2018 P/E of 17.1 for the companies in the MAC Solar Index is slightly below the comparable figure of 17.2 for the S&P 500 index. The median price-to-book ratio of 1.48 for the companies in the MAC Solar Index is well below the 3.27 ratio for the S&P 500. The median price-to-sales ratio of 1.93 for the MAC Solar Index is below the 2.19 ratio for the S&P 500.

Solar stocks rally to 2-1/4 year high

Solar stocks in mid-May rallied to a 2-1/4 year high due to improved company fundamentals and reduced policy uncertainty. The solar market is also encouraged about the strong growth of solar demand in the emerging world, which is reducing the industry's reliance on a few key areas such as China, the U.S., Japan and Europe. Solar stocks have also been boosted by the stabilization of solar cell and panel prices, which has helped profits for solar manufacturers.

Solar stocks also received a boost in early May after California announced that all new homes and low-rise multi-family units built after January 1, 2020, will be required to have solar systems installed. That announcement illustrated how solar is becoming a mainstream solution for the world's energy problems.

The U.S. solar market is still adjusting after recent government policy moves on tariffs and taxes. The markets now have clarity on the Trump administration's 30% tariff on imported solar cells and panels, with some possible good news if the administration happens to grant exemptions to the tariff for particular companies or products such as 72-cell solar panels for utility solar plants.

Solar continues to receive generally favorable treatment from U.S. grid regulators. In addition, the Trump administration has made little progress thus far on trying to provide artificial support for coal-fired plants, which could dampen solar adoption.

Solar-plus-battery is quickly gaining momentum

The main knock on solar, of course, is that it produces electricity only during the day. However, that situation is quickly changing as battery costs drop sharply and allow developers to offer price-competitive solar-plus-battery systems. The result is a plant that can provide 24/7 base load electricity such as that provided by nuclear, coal, and natural gas plants. Solar has the added advantage of having zero safety risk (vs nuclear) and zero emissions and zero fuel-cost risk (vs natural gas and coal).

The solar-plus-battery combination also solves the so-called "duck curve" pricing problem whereby wholesale power prices in areas with heavy solar resources experience depressed prices during mid-day due to the large amount of solar power on the grid. Adding a battery storage system allows a solar-plus-battery plant to produce a smoother flow of electricity over a 24-hour period, thus avoiding a disruption of wholesale electricity pricing.

The sharp drop in battery prices has made the solar-plus-battery combination more economically attractive. The price of lithium-ion battery packs last year fell sharply by -24%, according to Bloomberg New Energy Finance (BNEF). In fact, battery storage has become cheap enough that California is starting to require utilities to use battery storage as a substitute for natural gas peaker plants.

The solar-plus-battery solution is quickly becoming more popular among utilities. Lightsource, a solar developer backed by BP, recently said that it is not submitting any utility-scale solar proposals without battery storage to any utilities west of Colorado where sun resources are high.

The reduced cost of a solar-plus-battery system was recently seen in an electricity plant solicitation by Minnesota-headquartered Xcel Energy. The solicitation received a median bid for solar-plus-battery plants of only 3.6 cents/kWh for facilities scheduled to go online in 2023.

Battery and solar costs have fallen to the extent that a "solar peaker plant" has become a reality. A "peaker plant," which in the past has typically been driven by natural gas turbines, is a plant that can be quickly fired up to temporarily provide electricity to a utility during times of peak demand.

In fact, First Solar (FSLR) recently won a 15-year power-purchase agreement (PPA) to provide NextEra Energy, Arizona's largest utility, with electricity during its peak demand period of 3-8 p.m. The plant includes a 65 MW solar panel system that will charge a 50 MW battery system, allowing the battery system to provide the electricity during the needed period of 3-8 p.m.

The solar-plus-battery peaker plant was less expensive than competing natural gas peakers and thereby won the contract. The solar-battery peaker plant is due to begin running in 2021. Pricing on the contract was not made public.

California mandates solar on newly-built homes

California in early May announced that most new homes built after January 1, 2020, will be required to have solar power systems. The mandate applies to all single-family homes and multi-family units of three stories or less. There is an exception for homes built on a shady plot.

The announcement was important as a sign of how solar is quickly becoming a mainstream solution for clean and cost-effective electricity generation.

The solar system will add an average of about $9,500 to the up-front cost of a home but will save the homeowner about $19,000 in energy savings over 30 years, leading to a net benefit of about $9,500 for the homeowner, according to the California Energy Commission.

The new mandate means that residential solar installs in California in 2020 will receive an extra boost of 200-300 MW (23-34%), adding to the already expected growth rate of 9%, according to BNEF.

U.S. homebuilders should have no problem adding solar systems to newly-built homes since many large homebuilders already offer solar power as an option. Most solar systems are likely to include batteries, which will further reduce the homeowner's need to pay for grid electricity and reduce the homeowner's exposure to any change in state net metering policies.

U.S. solar industry adjusts to Section 201 tariff

The U.S. solar industry is adjusting to the 30% tariff on imported solar cells and modules that the Trump administration announced on January 22. The 4-year tariff was less severe than feared but will nevertheless dampen U.S. solar growth over the next several years due to the increased cost of imported solar cells and panels.

The 30% tariff on imported crystalline solar cells and panels took effect on February 7. The tariff starts at 30% in 2018 and then steps down by 5 percentage points per year to 25% in 2019, 20% in 2020, and 15% in 2021, expiring in 2022. The first 2.5 GW of solar imports are exempt from the tariff. Thin-film solar panels, such as those produced by First Solar, are exempt from the tariff even if those panels are imported from overseas factories.

The tariff applies to imports from all major countries in which solar cells and panels are produced, including U.S. free-trade partners Canada and Mexico. There are a number of countries that are exempt from the tariffs, including India, Turkey, Brazil, and South Africa. However, imports from those exempted nations are capped at 300 MW each and at 900 MW as a group.

The Trump administration's tariff decision was a response to the Section 201 safeguard trade case brought by foreign-owned manufacturers Suniva and SolarWorld, which had U.S. solar manufacturing plants that went bankrupt because they could not compete with non-U.S. factories.

The tariff is a net negative for the U.S. solar industry, which is dominated by installation companies and has very few American-based solar factories. In fact, the U.S. has so few manufacturers that it needs to import more than 80% of the solar panels that are installed in the U.S. The tariff will raise the average cost of solar installs, thus undercutting solar project economics and reducing the amount of solar installs.

The tariff will raise the cost of solar panels by 10 cents/watt to an average of 42 cents/watt in 2018, according to BNEF. That cost will fall over the next four years as the tariff steps down. Since the cost of a panel is only one part of an overall solar installation, BNEF expects the tariff to raise the total system cost by 8-10% for utility scale plants and by about 4% for residential rooftop systems.

Because of the tariff, BNEF reduced its forecast by an average of 16 percentage points per year during 2018-2021 for U.S. utility-scale solar installs. BNEF forecasts a smaller negative effect of 7 percentage points for the residential market during 2018-2021 because the panel cost is a smaller percentage of the overall system cost in residential solar systems.

The tariff will result in a net loss of about 23,000 U.S. solar jobs from the current total of about 250,000 solar jobs, according to Solar Energy Industry Association (SEIA). The SEIA points out that about 85% of the solar jobs in the U.S. are involved with installing solar installation systems. SEIA expects the tariff to reduce the number of solar installations and by extension the number of jobs involved with installations.

The tariff should marginally increase the number of solar manufacturing jobs, but not by nearly enough to offset the number of lost installation jobs. The SEIA estimates that there are about 38,000 solar manufacturing jobs in the U.S. but that only 2,000 of those jobs are involved with manufacturing solar cells and modules. The other 36,000 jobs are involved with manufacturing other solar products such as metal racking systems, tracking systems, and inverters.

The tariff is not expected to produce any big increase in the number of U.S. solar factories because the tariff provides only modest protection from foreign competition and lasts for only four years. The tariff does not provide enough protection for a company to justify sinking millions of dollars into a new U.S. solar manufacturing plant that over the long-term may have higher operating costs than overseas plants.

While the Section 201 tariff is a negative factor for the U.S. solar industry, the industry will nevertheless survive the latest of the many instances across the world of governmental trade interference in the solar industry. The tariff will reduce the U.S. solar growth rate from what it otherwise would have been. However, most U.S. solar projects will still have attractive economics and the U.S. solar industry will continue to grow at a solid clip.

Moreover, it is possible that the tariff could eventually be eliminated as part of a trade deal or by Congressional legislation. It is also possible that certain companies, or categories of solar imports, could be exempted from the tariff. For example, a group of eight Republican Senators from five solar-heavy states recently asked the Trump administration to provide a tariff exemption for the 72-cell, 1,500-volt panels that are typically used in large utility-scale solar farms.

From a global perspective, it is important to note that the U.S. solar tariff will have only a minor effect on the overall global solar growth rate. The U.S. accounted for only 11% of global solar installs in 2017, according to BNEF. That means that slower U.S. solar installs will have only a modest effect on the overall global solar growth rate. For example, if overall U.S. solar installs in 2018 suffer by an average of 15 percentage points from the Section 201 tariff, that would translate to a decline of only about 2% in worldwide installs (i.e., the 15 point U.S. decline multiplied by the 11% U.S. market share).

SOLAR PV GROWTH OUTLOOK

Global annual solar PV installs grew by a strong compounded annual rate of +27% in the five years through 2017. Solar installs in 2017 reached a new record high of 98 GW, up by +31% yr/yr from 75 GW in 2016 and more than tripling from 30 GW in 2012, according to Bloomberg New Energy Finance (BNEF).

The global solar industry showed very strong growth in 2017 mainly because of a +76% surge in Chinese installs and a +94% surge in India installs. European installs showed mild growth while U.S. installs fell on a hang-over from the growth spike seen in 2016.

For 2018, BNEF is currently forecasting world solar install growth at about +10% to 109 GW. The solar industry in 2018 is expected to consolidate after the extraordinary growth seen in the past two years of +34% in 2016 and +31% in 2017.

The slower growth rate in 2018 is expected to stem from slower growth in China and only mild growth in the U.S. Picking up the slack will be much stronger growth in Middle East, Latin America, and Southeast Asia.

Regarding a long-run solar growth rate, the International Renewable Energy Agency (IRENA) is forecasting 15% annual solar industry growth through 2030 with PV capacity up six-fold at 1,760 GW by 2030. IRENA expects solar PV to account for about 7% of worldwide electricity generation by 2030 versus the current level of less than 2%.

The long-term demand outlook for solar remains very strong since solar will account for some 35% (3,439 GW) of all electricity capacity additions and a massive $3.4 trillion of solar spending through 2040, according to BNEF. BNEF forecasts that solar PV will account for 15% of world electricity capacity by 2040, up from the current level of less than 2%.

Demand for solar should continue to surge in coming years as unsubsidized solar pricing falls farther and increasingly beats other sources of electricity generation. Solar costs have already fallen by some 50% over the past several years due to technological advances and economies of scale. Looking ahead, the International Renewable Energy Agency predicts that the average solar electricity cost will plunge by another -59% by 2025, making solar the cheapest form of power generation in "an increasing number of cases."

China's 2017 solar installs surge

China's solar installs in 2017 soared by +76% to 53 GW from 30 GW in 2016, according to BNEF. China accounted for 54% of world installs in 2017, which was more than the rest of the world combined.

China's cumulative installed solar capacity reached 130 GW in 2017, representing about 7.3% of the nation's total electricity generation capacity, according to the Asia Europe Clean Energy (Solar) Advisory Co. Ltd (AECEA).

Chinese solar continued to surge in 2017 as developers raced to meet step-downs in the government's feed-in-tariff, which guarantees an electricity price for solar electricity producers.

The bulk of 2017 installs involved utility-scale solar. However, there was a surge in distributed solar projects (i.e., solar panels on commercial and industrial buildings, malls, and schools), which were not subject to quotas and accounted for about a third of total Chinese installs in 2017.

Chinese solar installs in 2018 will grow by +23% to 65 GW, according to a forecast by BNEF. Growth is expected to come mainly from utility solar but there should be a growing contribution from distributed solar and special government programs such as the Top Runner and Poverty Alleviation programs.

While the future for Chinese solar is bright, the Chinese solar industry continues to see growing pains from curtailment of solar power usage in some regions and from delays in government subsidy payments to developers.

U.S. faces flat year in 2018 after volatile 2016/17

U.S. solar installs in 2017 fell by -22% to 10.7 GW, according to BNEF. Despite that decline, U.S. solar in the past five years through 2017 surged by a compounded annual rate of +26%.

Solar accounted for 30% of all new U.S. electricity generation capacity in 2017, representing the second largest source of new electricity generation behind natural gas.

U.S. solar installs in 2017 dropped to a more sustainable level after the +93% growth spike seen in 2016. The growth spike in 2016 was caused mainly by the fact that many utility solar projects were accelerated into 2016 to take advantage of the Investment Tax Credit (ITC), which had previously been scheduled to expire at the end of 2016. It turned out that Congress in December 2015 extended the ITC by 5 years. However, many accelerated solar projects were still completed during 2016, thus causing the 2016 growth spike and then causing the relative dearth of projects in 2017.

SOLAR PV GROWTH OUTLOOK (CONTINUED)

U.S. solar installs in 2017 were also undercut by uncertainty about the Section 201 trade case, which pushed solar panel prices higher on hoarding and also caused a delay in project planning to await the outcome of the case. The Trump administration announced its tariff decision on January 22, 2018, which involved a tariff on imported cells and modules during 2018-2021. The tariff was set at 30% in 2018, stepping down to 25% in 2019, 20% in 2020, 15% in 2021, and expiring in 2022. Because of the tariff, GTM Research reduced its estimated overall U.S. solar annual growth rate by 13% annually for 2018/2022.

Despite the tariff headwind, GTM Research is still forecasting that U.S. solar installed cumulative capacity will more than double over the next 5 years and that annual installs will be more than 15 GW by 2023, representing +6% compounded annual growth.

While U.S. solar growth will be dampened by the Section 201 tariff over the next few years, solar will still receive a big boost from the federal investment tax credit (ITC) through 2021. It is worth noting that the ITC gives a tax break on the total project cost whereas the tariff is only on the smaller cost for solar modules.

The ITC will remain at 30% in 2018-2019 and then step down to 26% in 2020 and 22% in 2021. In 2022, the ITC will expire entirely for direct-owned residential but will remain at 10% indefinitely for utility PV projects, non-residential, and third-party-owned residential solar. Projects need only commence construction by the end of the year in question to qualify for the ITC, as opposed to the previous requirement that the project had to be completed and grid-connected by year-end.

The solar ITC extension was approved by Congress in late 2015 as part of a bipartisan energy bargain that involved trading the solar ITC extension in return for dropping the ban on exporting U.S. crude oil. The solar ITC was left intact by the tax-cut bill that Congress passed in November 2017. The cut in the top corporate tax rate to 21% from 35% reduced the benefit from the ITC, but the tax bill was still helpful in eliminating the alternative minimum corporate tax.

Japan solar growth stabilizes following the post-Fukushima solar boom

Solar power surged in Japan after the Fukushima nuclear disaster in 2011 due to encouragement from a generous government feed-in-tariff (FIT). Japan solar installs during the post-Fukushima solar boom soared by +77% in 2012, +227% in 2013, +46 in 2014, and +16% in 2015.

However, the Japanese government then started cutting the feed-in-tariff to reduce subsidy costs, which caused solar growth to fall back to more sustainable levels. Solar installs fell by -28% in 2016 and by -7% in 2017 to 7.5 GW, which was well below the peak of 11.5 GW seen in 2015, according to BNEF.

For 2018, BNEF is expecting Japan solar installs of 7.3 GW, which would represent a small -3% yr/yr decline. BNEF is expecting slower growth in large-sized solar project in 2018, offset by stronger growth in smaller-sized (sub-500 kW) distributed and rooftop solar projects.

India solar boom runs into some obstacles

The Indian government is pushing solar very hard as part of its goal of modernizing India's infrastructure and boosting its global business competitiveness. The government has set a goal of installing a cumulative 100 GW of solar by 2022, consisting of 60 GW of large-scale solar and 40 GW of rooftop solar.

The 100 GW target is about five times India's cumulative installed solar capacity of 21 GW as of the end of 2017. To meet that target, India would need to install an average of 16 GW of solar per year for the next five years.

India's solar installs in 2017 nearly doubled to 10.3 GW from 5.3 GW in 2016, according to BNEF. That put India in third place for global installs in 2017 behind China (53.0 GW) and the U.S. (10.7 GW).

Solar accounted for about 45% of new Indian electricity generation installed in 2017, easily taking first place as the most popular new electricity generation source, according to Mercom Capital. Wind was a distant second at about 20% of new capacity.

Solar growth in India may slow in 2018 to about 7.5 GW after the torrid 2017 pace, according to Mercom Capital. Mercom then expects Indian solar growth to revive to the 10.5-11.0 GW area during 2019-2022.

Slower growth in 2018 would be due to (1) uncertainty about an impending Indian tariff on imported solar panels, (2) increased solar panel costs due to the tariff uncertainty, (3) slow payment of subsidies for developers installing rooftop solar, and (4) delays in grid connections.

The Indian government is currently considering imposing safeguard and anti-dumping tariffs on imported panels. India's Directorate General recommended a 70% safe-guard tariff on panels shipped from China and Malaysia due to the "threat of serious injury" to domestic solar panel producers from import competition. India is also embroiled in WTO challenges from the U.S. and others to its domestic content requirements for solar installations.

SOLAR PV GROWTH OUTLOOK (CONTINUED)

European solar growth expected to improve

Solar installs in the European Union grew by +6% to 6.03 GW in 2017 from 5.69 GW in 2016, according to SolarPower Europe. Solar power in Europe is starting to recover after having fallen sharply in recent years due to reduced subsidies. European governments are now using more auctions to buy solar rather than relying solely on feed-in-tariff schemes that can get expensive and that are difficult to properly calibrate.

Germany continued to be the largest solar player in Europe by far with 1.56 GW of installs in 2017, up by +33% from 1.51 GW in 2016. German 2017 installs were only about a fifth of Germany's 2012 record high of 7.6 GW. Germany's 2017 install level of 1.56 GW was also far below the German government's 2017 target of 2.5 GW.

In Q1-2018, German solar installs picked up substantially to 580 MW, which could put solar on track to meet the government's 2018 target of 2.5 GW. The German government has a target of deriving 65% of its power generation from renewables by 2030, which will require an additional 11 GW of wind and solar power, according to BNEF.

The UK had the second largest amount of European solar installs in 2017 at 990 MW, which was down by -52% from 2016 due to reduced subsidy support and was far below the peak of 4.3 GW seen in 2015, according to BNEF. The Netherlands had the third largest installs in 2017 at 720 MW, which was up by +37% yr/yr and a record high.

France had the fourth largest European installs in 2017 at 636 MW, which was up by +14% from 2016 but still well below the peak of 1.76 GW seen in 2011, according to BNEF. Italy was fifth with installs of 409 MW in 2017, up by +11% from 2016. Spain trailed with 135 MW of solar installs in 2017, up +146% from 2016 but still far below the peak of 546 MW seen in 2007.

Turkey came on very strong in 2018 and installed 1.79 GW of solar in 2017, beating Germany and representing growth of +213% yr/yr, according to SolarPower Europe. Turkey is not a member of the EU but SolarPower Europe nevertheless includes Turkey in its European category.

European solar growth is expected to show solid growth in coming years due to the need to meet renewable energy targets. A SolarPower Europe official recently said, "We are expecting strong growth in the coming years as several EU member-states are choosing solar to meet their national binding 2020 renewable targets."

Middle East is coming on strong

A core group of Middle East countries will install an impressive 8 GW of solar in 2018 and will reach 22.4 GW of cumulative capacity by 2023, according to GTM Research. The countries in that group include Saudi Arabia, Bahrain, Jordan, Oman, and UAE.

Those Middle East countries as a group would take third place in the global rankings behind China and the U.S. if they can install 8 GW of solar in 2018.

Saudi Arabia will tender 3.3 GW of solar capacity during 2018, according to Saudi Arabia's Renewable Energy Project Development Office. An install rate of 3.3 GW in 2018 would launch Saudi Arabia into fifth place in the all-country rankings in 2018 behind China, the U.S., India and Japan.

Saudi Arabia is seeking to produce a large amount of its electricity from solar as a means of reducing its reliance on electricity produced by burning oil, thus conserving its oil reserves and boosting the amount of revenue it can earn by selling its oil to overseas buyers.

SOLAR JOBS

U.S. solar jobs in 2017 fell by -3.8% to 250,271 jobs from the record high of 260,077 jobs in 2016, according to the "National Solar Jobs Census 2017" published by The Solar Foundation (link).

However, even with the 2017 decline, the U.S. solar industry during the 5-year period of 2012-2017 added a net total of 131,000 jobs to the U.S. economy, rising by +110% overall and by 16% annually.

Solar employment over the last five years grew nine times faster than the 1.8% annual growth rate of the U.S. economy, according to the Solar Foundation, illustrating how the solar industry has made a substantial contribution to the U.S. labor market.

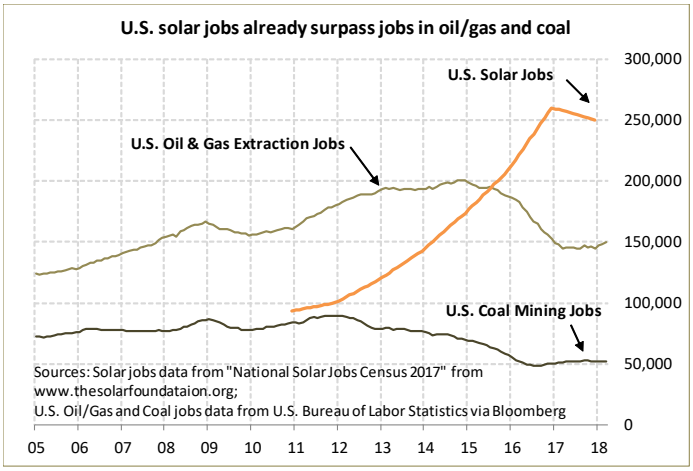
About 78% of U.S. solar jobs are in the demand-side sectors such as installation, sales & distribution and project development. Meanwhile, manufacturing accounts for only 15% of total solar jobs, according to the Solar Foundation.

The decline in solar jobs in 2017 was due to slower solar installs after the growth spike seen in 2016. In addition, solar jobs retrenched in 2017 on uncertainty ahead of the Trump administration's 30% solar tariff on imported cells/modules, which raised the cost of solar projects and reduced project installs.

Despite the 2017 job decline, solar jobs in the U.S. still substantially exceed those in the fossil fuel industries. Specifically, the 250,271 jobs in the solar sector far exceed the 150,200 direct jobs in the oil/gas extraction industry and 52,100 direct jobs in the coal mining industry, according to figures from the U.S. Bureau of Labor Statistics (see chart on the right).

Globally, solar is a huge employer with 3.1 million solar jobs worldwide in 2016, up 12% from 2015, according to the "Renewable Energy and Jobs--Annual Review 2017" from the International Renewable Energy Agency (IRENA) (link).

China is way ahead of the U.S. in solar jobs with a total of 1.9 million jobs in 2016 due to a much larger installation and manufacturing solar sector, according to the IRENA report. Japan also has more solar jobs than the U.S. at 302,000, according to IRENA.



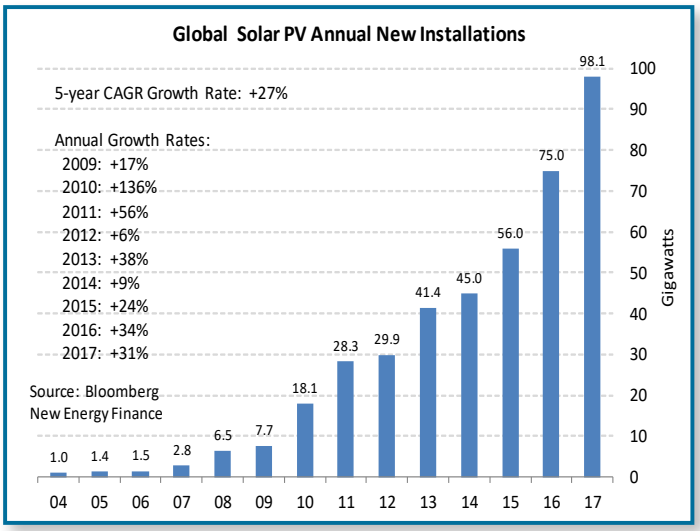
SOLAR PV ANNUAL NEW INSTALLATIONS -- 2017

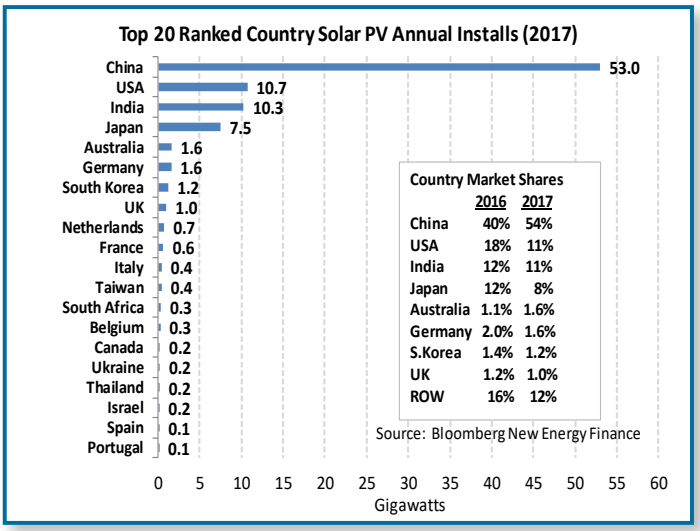
New global solar PV installations in 2017 grew by +31% yr/yr to a record 98.1 gigawatts (GW), according to Bloomberg New Energy Finance (BNEF). The 2017 growth rate of +31% followed growth rates of +34% in 2016 and +24% in 2015. Global solar PV installations have grown at a compounded annual rate of +27% over the last 5 years and have risen by 15-fold from 2008.

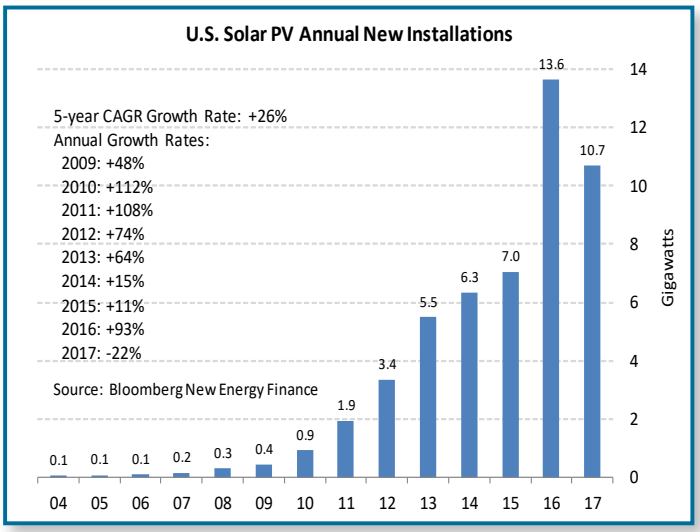
In 2017, China led the world for annual solar PV installs for the fifth straight year with 53.0 GW of installs, up by +76% from the 30.0 GW of installs seen in 2016. The U.S. took second place for the second straight year with 10.7 GW of installs, which was down by -22% from 2016. India passed up Japan for third place with 10.3 GW of installs, up by +94% from 2016. Japan fell into fourth place with 7.5 GW of installs, down by -6% from 2016. Other countries trailed the top-four leaders with less than 2 GW of installs each.

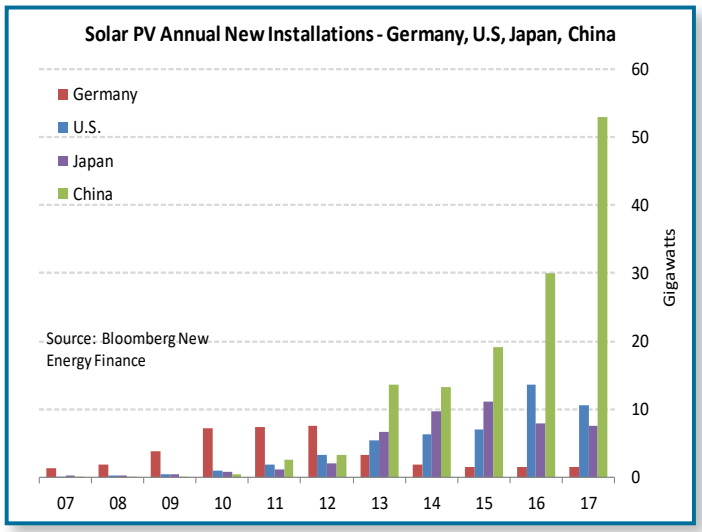
Solar installs in Europe showed modest growth in 2017 as Europe deemphasized subsidies in favor of holding auctions to buy solar power. German solar installs in 2017 rose slightly by +3% to 1.6 GW but remained far below the 2013 peak of 7.6 GW. French installs in 2017 rose by +14% to 636 MW, far below the 2011 peak of 1.8 GW. Italian installs in 2017 rose by +11% to 409 MW but remained far below the 2011 peak of 7.9 GW. UK installs fell by -52% to 990 MW as the government curbed feed-in tariffs.

U.S. solar PV installations in the five years through 2017 grew by a compounded annual rate of +26% and were up by three-fold from 3.4 GW in 2012, according to BNEF. The states with the largest amount of new PV solar installations in 2017 were California (-50% to 2.6 GW), North Carolina (+18% to 1.2 GW), and Florida (+85% to 749 MW), according to GTM Research. After those top three, the states with the largest 2017 installs were Texas, Massachusetts, Minnesota, Arizona, South Carolina, and Nevada. The states with the largest installed cumulative base of solar power are now California, North Carolina, Arizona, Nevada, New Jersey, Massachusetts, Texas, Utah, Georgia, and Florida.









SOLAR PV CUMULATIVE INSTALLATIONS THROUGH 2017

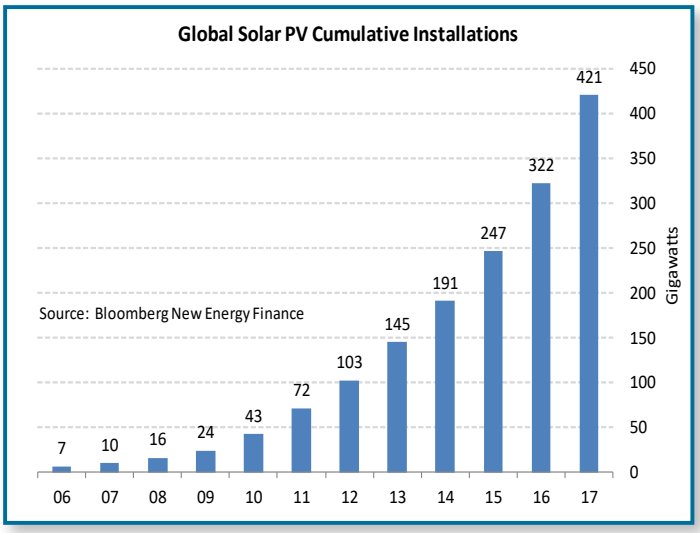
The amount of cumulative PV electricity generation capacity across the world grew sharply by +30% yr/yr to 421 GW in 2017, according to Bloomberg New Energy Finance (BNEF). In the last five years, global cumulative solar PV electricity generation capacity increased by more than four-fold from 103 GW in 2012 to 421 GW in 2017, representing a compounded annual growth rate of +33%.

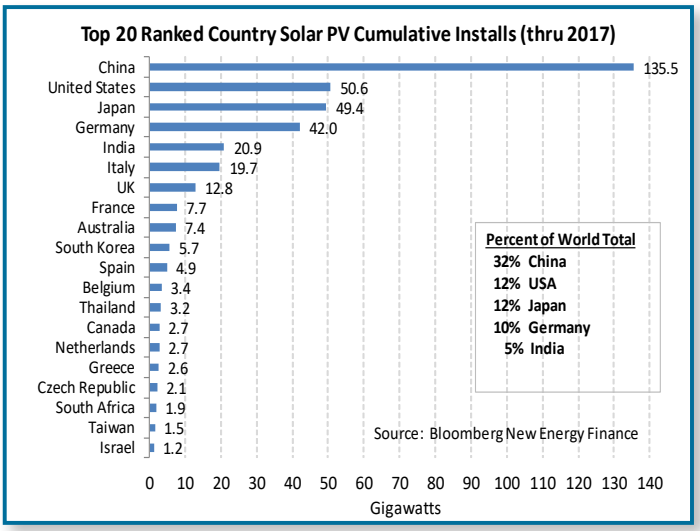
China remained the world's leader for cumulative solar capacity at 135 GW, according to BNEF. China at the end of 2017 accounted for 32% of the world's solar PV capacity. In the past five years, China's cumulative installed solar capacity has soared by 21-fold from 6.4 GW in 2012 to the 2017 level of 135 GW, representing a 5-year compounded annual growth rate of 84%.

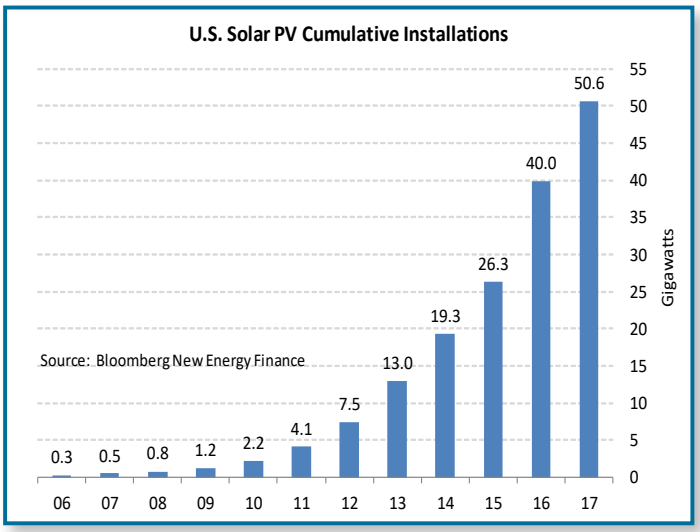
The U.S. in 2017 jumped into second place from fourth place in 2016 for cumulative solar installs. U.S. solar electricity capacity in 2017 rose by +27% to 51 GW, representing 12% of world capacity. U.S. cumulative solar electricity capacity over the past five years rose by nearly seven-fold to 51 GW from 7.5 GW in 2012 and showed a compounded annual growth rate of +47%.

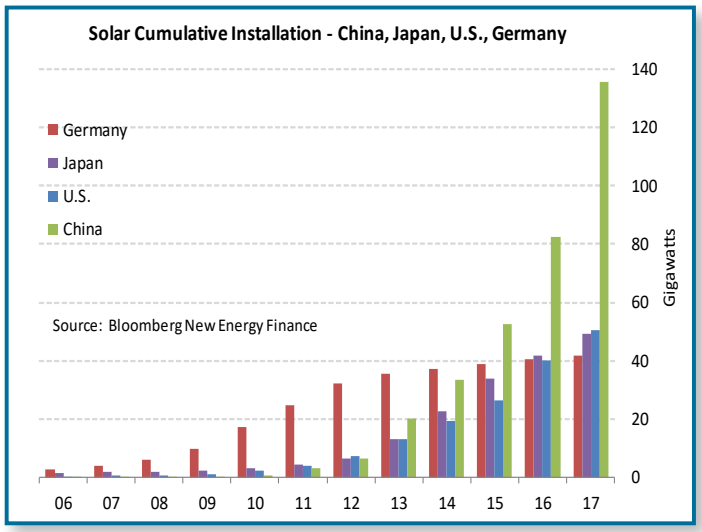
Japan remained in third place for the fourth straight year. Japan's cumulative solar capacity in 2017 rose by +18% to 49 GW, representing 12% of world capacity. Japan's cumulative solar capacity in the past 5 years has risen nearly eight-fold to 49 GW from only 6.4 GW in 2012, representing a 5-year compounded annual growth rate of 50%.

Germany in 2017 fell into fourth place from second place in 2016 with 42 GW of cumulative solar PV capacity, up by +4% from 2016. Germany's cumulative solar capacity in the past 5 years has risen 1.3-fold to 42.0 GW from 32.2 GW in 2012. Germany at the end of 2017 accounted for 10% of the world's total solar PV capacity.









SOLAR PRICING

Prices for solar cells and modules during 2017 and early 2018 stabilized after falling fairly sharply during 2016. The price of multicrystalline solar cells fell to a record low of 20 cents per watt in March 2018 but is currently slightly above that level at 22 cents per watt, according to Bloomberg New Energy Finance (BNEF). Solar cell prices have plunged by a total of -73% since mid-2011.

The average price of silicon solar modules has slowly moved lower since late 2016 and is currently at a record low of 29.7 cents per watt, according to PV Insights. Solar module prices have fallen by -12% on a year-on-year basis and by -76% from mid-2011.

Spot polysilicon prices fell to a new record low of $12.76 per kg in mid-Oct 2016, but then rebounded mildly higher and are currently at $15.88, according to BNEF. Polysilicon prices are up by +24% year-on-year but have plunged by -69% since mid-2011. The decline in polysilicon prices is a key factor in allowing solar cell and solar panel prices to decline since polysilicon is the key raw material for most solar cells.

The price of thin-film modules made by First Solar and other companies has fallen to a record low of 31.7 cents per watt, according to PV Insights. Thin-film module prices have fallen by -9% on a year-on-year basis and by -67% since mid-2011.

Solar prices in the second half of 2016 fell sharply mainly because of panel oversupply after the solar install spikes seen in China and the U.S., which were caused by developers trying to beat respective subsidy reduction deadlines. Solar pricing during 2017 and early 2018, by contrast, has moved only mildly lower in line with its natural long-term downward trend that is the result of lower production costs stemming from technology advances and economies of scale in manufacturing.