

## SOLAR SECTOR UPDATE

The MAC Global Solar Energy Index (SUNIDX) is licensed as the tracking index for the Guggenheim Solar ETF\* (NYSE ARCA: TAN)

Note: Index performance does not reflect transaction costs, fees or expenses of TAN

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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), has sold off sharply this year and is currently down -41% year-to-date. The MAC index in 2015 closed -15% lower after the -2% decline seen in 2014 and the +127% gain seen in 2013.

Solar stocks have recently seen weakness due to (1) downward pressure on solar pricing and panel oversupply caused largely by a hangover from solar install spikes seen in 1H-2016 in China and the U.S., (2) uncertainty about U.S. clean energy policy and global climate change initiatives with the incoming Trump administration, (3) uncertainty for the U.S. residential solar market amidst a shift to purchase/loans from leases and cutbacks in net metering in some states, and (4) ongoing trade disputes that have resulted in tariffs and various market dislocations.

Recent bullish factors for solar stocks include (1) strong overall world demand for solar with the sector set to grow by at least 20% this year (see page 6 for the world solar growth outlook), (2) strong demand for solar power worldwide due to the increasingly competitive price of solar versus alternatives and due to the need for countries to meet their carbon-reduction targets under

last December's Paris COP21 global climate agreement, and (3) low valuation levels that indicate that solar stocks are very conservatively priced.

Solar stocks are currently trading at very low valuation levels compared with the broad market. The median forward P/E of companies in the MAC Solar Index is currently 8.7, which is far below the forward P/E of 19.0 for the S&P 500 index. In addition, the median price-to-book ratio of 0.84 for the companies in the MAC Solar Index is well below the 2.92 ratio for the S&P 500 and the median price-to-sales ratio of 0.76 for the MAC Solar Index is well below the 2.00 ratio for the S&P 500.

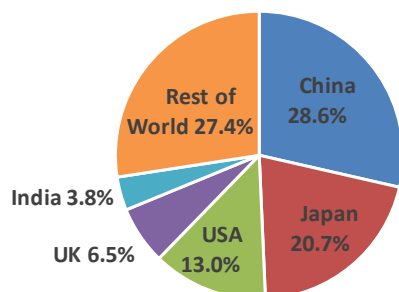
### Trump victory will be only a temporary obstacle for global solar

Solar stocks have been weak in recent months mainly because of concern about module oversupply and falling solar prices, which has pressured the profit margins of polysilicon, cell, and module producers. So far this year, average polysilicon solar module prices have fallen by -29% to a record low of 39.3 cents/watt (according to PV Insights) and solar cell prices have fallen by -27% to 25 cents/watt (according to Bloomberg New Energy Finance). Polysilicon prices posted a record low of \$12.76/kg in mid-October but then recovered slightly to \$12.88. Polysilicon prices are down -5.5% on a year-to-date basis (see pricing commentary and charts on page 10).

Solar stocks then saw some additional downward pressure after the November 8 U.S. election in which Donald Trump won the presidential contest and Republicans maintained control of both the House and the Senate. The Democrats will still have filibuster power in the Senate but their power will be very limited with Mr. Trump winning the White House and gaining control over the executive branch of the government.

Mr. Trump's victory was clearly negative for solar and the clean energy industry in general. However, there are several caveats to consider: (1) the U.S. solar market accounts for only about 13% of the overall global solar market, which means that the global solar market can still do well even if the U.S. solar market slows due to Trump administration policies, (2) there is still strong support for solar in many U.S. states where electricity is mostly

2015 Annual Solar Installs - Country Shares



regulated, and (3) solar pricing has fallen dramatically in the past several years and solar increasingly competes on its own merits regardless of government support.

The first thing to remember regarding the impact of the Trump administration is that U.S. solar demand is only a limited component of the global solar industry. The U.S. accounted for only 13.0% of world solar installations in 2015, third behind China at 28.6% and Japan at 20.7%, as seen in the graph above.

If U.S. solar completely disappeared, the global solar industry would see a one-time growth drop of only 13.0% and then growth would resume from there. Moreover, the importance of U.S. solar on the global stage is fading on a relative basis given how quickly solar is spreading to other countries across the world.

## Trump administration seems likely to cancel Clean Power Plan

There seems to be little doubt that the Trump administration will cancel President Obama's Clean Power Plan (CPP), which was designed to reduce carbon output from utilities and help the U.S. meet its overall carbon reduction targets. The likely cancellation of the CPP would be disappointing for the solar market, although it was never guaranteed that the CPP would survive its court challenges anyway.

The Court of Appeals for the DC Circuit in late September held oral arguments on the CPP and a decision is still expected by late 2016 or early 2017. The U.S. Supreme Court was then expected to hear the case on appeal by spring or fall 2017. However, if the Trump administration cancels the CPP as expected, then the court cases will be moot and the litigation will be dropped.

The likelihood increased that the Clean Power Plan will be canceled after President-elect Trump nominated Oklahoma Attorney General Scott Pruitt to be the new EPA chief. Mr. Pruitt has been a leader among state attorney generals in challenging nearly all of President Obama's regulatory initiatives, including the Clean Power Plan (CPP). Of the CPP, Mr. Pruitt said: "This is an effort that I think is extraordinary in cost, extraordinary in scope, and I think extraordinary as it relates to the intrusion into the sovereignty of the states." Mr. Pruitt has made comments

suggesting that he is a climate denier and a big supporter of the fossil fuel industry.

If the CPP is in fact canceled, then states will no longer be under a federal EPA requirement to reduce carbon emissions from their electricity utility sector. This will be a relief for states that are heavily dependent on fossil-fuel-driven electricity plants and that opposed the CPP in the first place.

However, there are still many states that will voluntarily continue their carbon-reduction plans because they believe it is the right thing to do. Indeed, three-quarters of the states that are suing to block the CPP are already on track to meet their 2024 targets, according to the Environmental Defense Fund. In addition, the nine states in the Regional Greenhouse Gas Initiative ([www.rggi.org](http://www.rggi.org)) could easily hit their 2030 targets without any significant changes, according to the Natural Resources Defense Council. Indeed, significant progress has already been made considering that carbon emissions from the U.S. power sector have already fallen to levels last seen back in the early 1990's.

## Other U.S. solar drivers will shine regardless of CPP's fate

Even if there is no extra utility demand for solar sparked by the CPP in coming years, utilities will still be installing solar to meet state-level Renewable Portfolio Standards (RPS). State-level RPS rules require utilities to derive certain percentages of their electricity generation from renewable sources. The RPS mandates that already exist in 38 states require that 7.2% of U.S. electricity demand in 2016 must come from renewable energy and that the requirement will grow to 10.2% by 2020 and 12.9% by 2030, according to Bloomberg New Energy Finance (BNEF). In addition, California and New York have very aggressive goals to source 50% of their electricity from clean energy by 2030.

Aside from regulatory mandates, solar is increasingly being driven by favorable economics. Bloomberg News reports that solar projects in the Arizona and Nevada deserts can be built for less than 4 cents per kWh versus the higher average lifetime cost for natural gas plants of 5.2 cents and 6.5 cents for coal. There are many solar power plants across the world that now cost as little as 4-5 cents per kWh on an unsubsidized basis, illustrating how many utilities often choose solar in part because of its low cost.

In fact, about one-third of the U.S. utility solar pipeline consists of voluntary projects rather than those driven by RPS requirements, according to GTM Research. A spokesman for Duke Energy, the second largest U.S. utility owner, said that "We said before the election that whoever is elected president, we would be continuing our efforts to go to a low-carbon fleet and also pursue renewables."

Corporations will also continue to be big drivers of solar regardless of whether or not the federal government supports solar. Many large U.S. corporations believe in the need to address global warming and have aggressive sustainability goals. Large U.S. corporations such as Apple, Google, Wal-Mart, Amazon.com and many others signed 2.3 GW of power purchase agreements

(PPAs) for clean energy in 2015 alone, according to BNEF. U.S. companies will buy another 17.4 GW of clean energy PPAs over the next nine years, according to BNEF.

## Trump's approach to COP21 Paris agreement remains uncertain

Mr. Trump's victory will almost certainly have negative implications for the Paris COP21 global climate agreement, which has already gone into effect with the U.S. as a signatory. Under the COP21 agreement, the U.S. agreed to meet a voluntary goal of reducing carbon emissions by 17% by 2020, by 26-28% by 2025, and an intent to reduce emissions by 80% by 2050.

Mr. Trump during his campaign said he would "cancel" U.S. participation in the Paris COP21 agreement and stop paying any money into UN climate programs. If the U.S. refuses to pay its share of climate change programs, then those programs could collapse since there would not be enough cash to meet their commitments and since other developed countries might refuse to make their payments as well. A linchpin of the Paris agreement is that developed nations agreed to contribute to a fund to help less-developed countries meet their climate goals. Without that funding, the less-developed countries may simply stop working on meeting their carbon reduction commitments.

Even though Mr. Trump said during the campaign that he would cancel U.S. participation in the Paris agreement, he said after the election that he has an "open mind" about the Paris agreement. No less a personality that Bill O'Reilly from Fox News said, "President-elect Trump should accept the Paris treaty on climate to buy some goodwill overseas. It doesn't amount to much anyway. Let it go."

There are 195 nations that have agreed to the Paris climate agreement after decades of climate negotiations. If Mr. Trump were to pull the U.S. out of the COP21 agreement, he would be isolated as virtually the only world leader to reject the need to address climate change. The U.S. would suffer diplomatic damage from withdrawing from the COP21 agreement and might find that the rest of the world would be less willing to cooperate with the U.S. on other issues of geopolitical importance to Mr. Trump.

The Trump administration would also face opposition from the corporate world if he were to withdraw from COP21. For example, more than 300 U.S. companies recently signed a letter supporting global climate initiatives and saying that a withdrawal from the Paris agreement would put "American prosperity at risk" (see [www.lowcarbonusa.org](http://www.lowcarbonusa.org)).

The Trump administration in any case will find that it is not easy to withdraw from the Paris agreement. The agreement is binding for the next three years and the agreement after that requires a 1-year notice to withdraw, meaning that the U.S. could not fully withdraw from the COP21 agreement until Mr. Trump's 4-year term is essentially over.

However, there is a way that Mr. Trump could withdraw faster if he takes the so-called "nuclear option" of withdrawing altogether from United Nations Framework Convention on Climate Change. That treaty established the overall UN climate process and was unanimously adopted by the Senate in 1992 and signed into law by President H.W. Bush. The U.S. could withdraw from that treaty on one year's notice, i.e., by 2018. That withdrawal would also effectively cancel U.S. participation in the COP21 Paris agreement.

Instead of announcing an official withdrawal from the COP21 agreement, Mr. Trump could also simply refuse to participate in ongoing talks and refuse to make any serious attempt to meet the U.S. carbon reduction targets. The carbon reduction targets are voluntary and there are no penalties if the U.S. fails to meet its targets. Alternatively, as a "delay-and-defer" tactic, Mr. Trump could also send the Paris agreement to Congress to be approved, which is not likely to happen in the Republican-dominated Senate. He could then blame Congress for killing the agreement.

In any case, there seems to be little chance of the U.S. meeting its COP21 carbon reduction targets if the Trump administration cancels the Clean Power Plan as expected. The Obama administration was relying on the CPP as the primary driver for meeting the COP21 carbon reduction targets.

Regardless of whether Mr. Trump officially withdraws from the Paris climate agreement, the U.S. will certainly no longer be considered a world leader on addressing climate change when Mr. Trump is inaugurated in January, at least based on Mr. Trump's stance on climate change thus far.

Other countries will need to take over the mantle of climate leadership if the world wants to meet the Paris goal of limiting global warming to 2 degrees Celsius by 2030. World leaders may simply decide to stick to their voluntary COP21 carbon reduction goals and hope that the Trump phenomenon blows over in four years, at which time the world can rededicate itself to tackling climate change.

If the U.S. withdraws from the COP21 agreement or simply ignores its obligations, there has been some speculation about whether China might also withdraw from COP21, possibly then causing the overall agreement to collapse. However, Bloomberg New Energy Finance says that its China research team believes that there is essentially a zero chance that China will abandon the climate process.

BNEF points out that China has already enshrined its Paris COP21 commitment into its domestic Five-Year plan. China's Vice Foreign Minister after Mr. Trump's election said on Nov 16 that China plans to continue addressing climate change "whatever the circumstances." BNEF also says that if U.S. cedes its leadership on climate, then China will gladly step into the breach and take one of the greatest economic opportunities of the 21st century "straight to the bank."

There are currently reports that Mr. Trump wants to appoint ExxonMobil CEO Rex Tillerson as his Secretary of State. If true, Mr. Tillerson's appointment would be another negative factor for clean energy since a fossil fuel CEO would then oversee U.S. climate negotiations. Mr. Tillerson appears to believe that climate change is real but there are doubts about whether he would make any serious effort to address the problem.

On energy in general, Mr. Trump seems to be mainly interested in supporting the fossil fuel industry rather than damaging the advanced energy industry. It wouldn't make much sense to purposely damage the U.S. advanced energy market ((i.e., renewable energy, building efficiency, and energy storage), which is now worth \$200 billion, more than the pharmaceutical industry and almost as much as the consumer electronics industry, according to the Advanced Energy Economy.

Mr. Trump says he will reduce regulation on coal plants and open up more mining leases, but the reality is that Mr. Trump can do little to save the coal industry which is dying of its own accord due to high extraction costs and competition from natural gas. Moreover, even with Mr. Trump in charge of U.S. energy policy, utilities will not be particularly interested in building dirty and expensive coal plants, which might be under renewed environment attack in four years depending on the outcome of the 2020 presidential election. Utilities already generally understand that coal has a limited future.

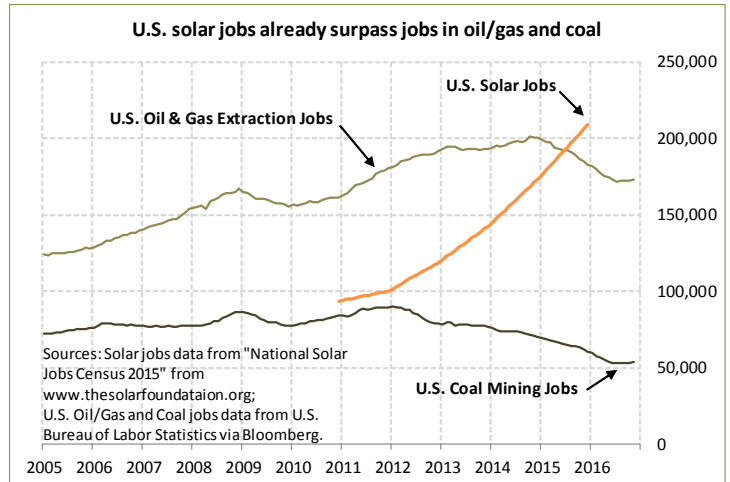
On natural gas, Trump administration support will not make much difference since oil and gas companies already have a glut of wells and drilling opportunities. Fracking is currently only lightly regulated at the federal level due to legislation passed during the Bush era. Any push by the Trump administration for more natural gas extraction will simply push natural gas prices lower, helping utilities but hurting revenues at oil/gas companies and hurting the coal industry with even tougher competition from natural gas. Lower natural gas prices, however, would make natural gas a tougher competitor for solar in the electricity generation space.

The Trump administration's promotion of the oil industry, by contrast, won't have much effect on the solar industry since solar does not directly compete with oil. Oil is mainly used as fuel in the transportation sector and virtually no oil is used to generate electricity in the U.S. The oil and solar industries operate largely independently of each other.

## U.S. solar ITC likely to remain in place

The most immediate issue for the U.S. solar market is whether there will be any change in the already-existing solar investment tax credit (ITC), which provides a 30% tax credit on solar installs. Congress just a year ago, extended the solar federal ITC for 5 years at 30% through 2019 with a step down to 26% in 2020 and 22% in 2021. The ITC in 2022 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.

Mr. Trump has so far made no mention of a desire to repeal the solar ITC. Even if there is a move in Congress to repeal the solar



ITC, Senate Democrats could filibuster that attempt. Nevertheless, a repeal of the solar ITC could be wrapped up in a big tax reform package that bypasses a filibuster through reconciliation. There is also the possibility that the Senate might change its rules and no longer allow the minority party to have a filibuster right for legislation. Therefore, there is still a risk of a solar ITC repeal, which would put a big dent in U.S. solar demand over the next few years. Greentech Media estimates that solar installs in the U.S. could be cut in half if Congress were to repeal the solar ITC.

Despite these risks, there are reasons to suspect that Mr. Trump and the Republican Congress will not repeal solar ITC legislation. First, there is a growing number of self-identified Republicans who believe that climate change is real and who are in favor of clean energy. In fact, a recent Pew Research poll found that 84% of Trump supporters favor expanding solar panel farms and 77% support expanding wind turbine farms.

Second, Washington already has a built-in jobs program with solar since the number of jobs in solar has already exceeded the number of jobs in the U.S. oil/gas extraction sector and in the U.S. coal mining sector, as seen in the above chart. Moreover, many of those solar jobs are in Republican-dominated states.

U.S. solar jobs have soared by an annual rate of 20% over the last four years to 208,859 jobs at the end of 2015, according to the "National Solar Jobs Census 2015" published by The Solar Foundation ([link](#)). That shows that solar jobs now exceed the latest figures of 173,400 jobs in the oil/gas extraction industry and 53,700 jobs in the coal mining industry, according to figures from the U.S. Bureau of Labor Statistics."

Globally, solar is an even bigger employer with 2.8 million solar jobs worldwide in 2015, up 11% from 2014, according to the "Renewable Energy and Jobs - Annual Review 2016" from the International Renewable Energy Agency (IRENA) ([link](#)). China is way ahead of the U.S. in solar jobs with 1.7 million jobs in 2015 due to larger installation and manufacturing solar operations, according to the IRENA report. Japan also has more solar jobs than the U.S. at 377,100, according to IRENA.

It would not make much sense to repeal the solar ITC and cause job layoffs in the solar sector while trying to stimulate new jobs elsewhere with an infrastructure spending program. Indeed, since solar energy projects qualify as energy infrastructure, Republican leaders should perhaps consider putting solar into the mix for their infrastructure stimulus program.

## The global solar opportunity is much larger than the U.S. federal government

Mr. Trump's presidential victory clearly represented a setback for the clean energy industry and was a big victory for the fossil fuel industry. However, it is important to keep an eye on the sweep of history rather than on temporary deviations. Mr. Trump can choose to play the role of climate denier and fossil-fuel supporter, but he cannot change the scientific facts on the ground. All he can do is slow down progress on addressing climate change and create the need to play catch-up once his presidency is over.

Moreover, as outlined earlier, there are many drivers for the global solar industry other than the U.S. federal government, including (1) increasingly favorable solar economics, (2) U.S. support for solar at the state, city, community and corporate level, and (3) support across much of the rest of the world for solar and the need to address climate change. Global solar is much bigger than the U.S. federal government and will prevail regardless of the Trump administration.

## Florida voters again show support for solar by voting down Amendment 1

Florida voters in the November 8 election again showed support for solar by voting down Amendment 1, which would have outlawed third-party ownership of solar in Florida. The measure would have significantly damaged solar potential in Florida by outlawing the leasing of solar equipment to homeowners, businesses, or government entities.

Florida voters voted down the measure even though utility interests spent more than \$20 million to promote the measure and despite the deceptive wording of the amendment. The Amendment 1 measure was formally called "Rights of Electricity Consumers Regarding Solar Energy Choice," which on its face sounds like a good thing for solar, when in fact the opposite was true.

The fact that anti-solar utility interests needed to use a deceptive title for their anti-solar measure showed that they knew they were on the wrong side of the public on solar. Moreover, it was encouraging that Florida voters saw through the deceptive advertising technique and voted to support solar.

Florida has been one of the very few states in the country that makes third-party leasing effectively impossible because the solar owner/lessor would need to register as a utility. Florida has been a tough place for solar to flourish due to anti-solar regulation and the lack of a renewable portfolio standard (RPS) for utilities. Florida ranks only 14th in installed solar capacity among U.S. states despite having the 3rd best solar potential in the nation, according to the Solar Energy Industries Association (SEIA).

## SOLAR PV GROWTH OUTLOOK

Over the last five years, global PV annual solar installs have tripled to 56.0 GW in 2015 from only 18.2 GW in 2010, producing a very strong +25% compounded annual growth rate, according to Bloomberg New Energy Finance (BNEF). Looking ahead, BNEF is forecasting solar growth at +20% (to 67 GW) in 2016, +25% in 2017, and +23% in 2018.

Solar growth rates are notoriously difficult to predict, sometimes leading to widely varying forecasts among various research groups. GTM Research, for example, is much more optimistic than BNEF for 2016. GTM is predicting that global solar installs in 2016 will surge by +43% to 73 GW due to the temporary growth spikes caused by the Chinese FIT step-down and the former end-of-year-2016 ITC expiration in the U.S. Since GTM is expecting such a big spike in 2016, GTM is then forecasting that growth will reset to more normal levels in 2017-18 with the growth rate in 2017 falling by -10% to 65.7 GW.

Regardless of the near-term volatility in solar growth, the long-term demand outlook for solar remains very strong since solar will account for 35% (3,439 GW) of all electricity capacity additions and a massive \$3.4 trillion of solar spending through 2040 (averaging about \$135 billion per year), according to BNEF. BNEF forecasts that solar PV will account for 15% of world electricity capacity by 2040, up from only about 1% today.

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. 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 1H-2016 installs surged on June FIT step-down

China is expected to install more than 20 GW of solar in 2016, which means growth in 2016 will be more than 25% from 16 GW in 2015. The 2016 install level will be well above the Chinese government's official target figure of 18.1 GW.

A race among developers to beat a June 30 step-down in China's feed-in tariff (FIT) caused a first-half install rush that was as high as 20 GW by some estimates. BNEF is predicting another 8 GW of installs in the second half of 2016 for a total annual install amount of 28 GW. In 2017, however, the Chinese government is likely to renew its solar target near the 2016 level of 18.1 GW, suggesting that solar installs in 2017 will fall back to the 18-22 GW area.

It should be noted that China is seeing problems with solar power curtailment in a few isolated areas that is hurting the overall national solar growth rate. Specifically, electricity usage

from existing solar plants is being curtailed by utilities in some northwestern provinces such as Inner Mongolia and Gansu. The curtailment is being caused mainly by electricity overcapacity due to coal plants being overbuilt in these areas, leading to the curtailment of solar power even though solar power in theory has a regulatory preference over coal. The Chinese government is trying to remedy the situation by halting new coal plant construction in those regions and by requiring grid operators to boost their use of renewable electricity.

### U.S. faces 2017 slowdown after 2016 utility solar surge

U.S. solar installs in 2016 will soar by 85% to 13.9 GW, according to GTM Research ([link](#)). In the latest figures, GTM says that the U.S. in Q2-2016 installed 2.051 GW of solar (+43% yr/yr). Solar accounted for 26% of overall new U.S. electricity generation capacity in the first half of 2016.

The surge in 2016 solar growth is mainly due to a spike in utility PV that will account for about 70% of all U.S. solar installs in 2016. Utility PV is seeing a big surge in 2016 because many solar projects were hurried into 2016 to take advantage of the Investment Tax Credit (ITC) that was previously scheduled to expire at the end of 2016. Congress in December 2015 extended the ITC by 5 years, but most of the projects that were already planned moved ahead in 2016, thus causing the 2016 bulge. That means that utility PV will drop sharply in 2017 from the artificially high level seen in 2016.

The drop in utility PV growth to more normal levels starting in 2017 is expected to cause the overall U.S. solar growth rate to fall by about -17% in 2017 and by about -7% in 2018, according to GTM. However, GTM then expects the U.S. solar install rate to return to a strong annual growth rate averaging about +20% in the 2019-2021 period. Smoothing out the ITC effects results in an expected 6-year compounded annual growth rate of +19% from 7.5 GW of installs 2015 to 21.5 GW of installs in 2021, according to GTM.

In the U.S. residential sector, solar growth in H1-2016 slowed to +3% yr/yr from +11% in the year-earlier period (according to GTM) because the residential sector is transitioning away from a lease model to a purchase/loan model and because some states are cutting back on their net metering incentives. Non-residential (commercial & industrial) solar in Q2-2016 was up +5% q/q and +49% y/y with weakness in northeast markets offset by strength in California, according to GTM.

U.S. solar in the next five years will benefit from the federal ITC, which stays at 30% through 2019 and will then step down to 26% in 2020 and 22% in 2021. The ITC in 2022 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 only need to commence construction by

## SOLAR PV GROWTH OUTLOOK (CONTINUED)

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.

When the ITC largely expires in 2022, the solar market was hoping for a dovetail boost from the EPA's Clean Power Plan (CPP), although that now seems unlikely with the incoming Trump administration. The goal of the EPA's CPP is to reduce national greenhouse gas emissions by 32% from 2005 through 2030 and for the U.S. to get 28% of its electricity from renewable energy sources by 2030, more than double the 2014 level of 13%. The CPP was the centerpiece of the Obama administration's plan on how to comply with the Paris COP21 global climate agreement.

### Japan is coming off its Fukushima solar boom

In Japan, solar surged after the Fukushima nuclear disaster in 2011 due to a generous government feed-in-tariff (FIT). Japan solar installs soared by +64% on an annual compounded basis in the five years through 2015. However, Japan is in the process of bringing nuclear capacity back on line and has cut its solar FIT, leading to expectations for substantially smaller Japanese solar installs over the next few years. GTM is forecasting that Japan's solar installs in 2016 will fall by -12% to 10.2 GW from the peak of 11.644 GW in 2015 and in 2017 will fall by another -14% to 8.8 GW.

### India solar boom in progress

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, including 40 GW of rooftop solar. The 100 GW target would be 20 times Indian's cumulative installed solar capacity of just over 5 GW at the end of 2015. India will install 5.4 GW of solar in 2016, according to Mercom Capital Group, which would represent a big 157% growth rate for 2016.

### European solar remains weak on reduced FIT support

The UK is coming off a solar boom with the government cutting its FIT by 65%. GTM Research is forecasting that UK solar growth in 2016 will fall sharply by -45%. Meanwhile, solar installs in continental Europe remain weak in the wake of FIT cuts in recent years. Europe is progressively moving towards competitive auction bidding for solar and is slowly moving away from FIT support.

### Rest-of-world is coming on strong

In 2016, the top five countries of China, U.S., Japan, India and UK will account for 80% of all solar installs. However, solar growth in coming years will diversify as a wide range of other countries ramp up installations. The geographical diversification of solar will be very helpful in reducing the boom-bust events in various developed countries that have buffeted the solar industry in recent years.

By 2020, GTM is forecasting that 26 GW of solar power growth will come from Latin America, 19 GW from the Middle East and Turkey, and 23 GW from Asia (apart from China, India, Japan and Australia).

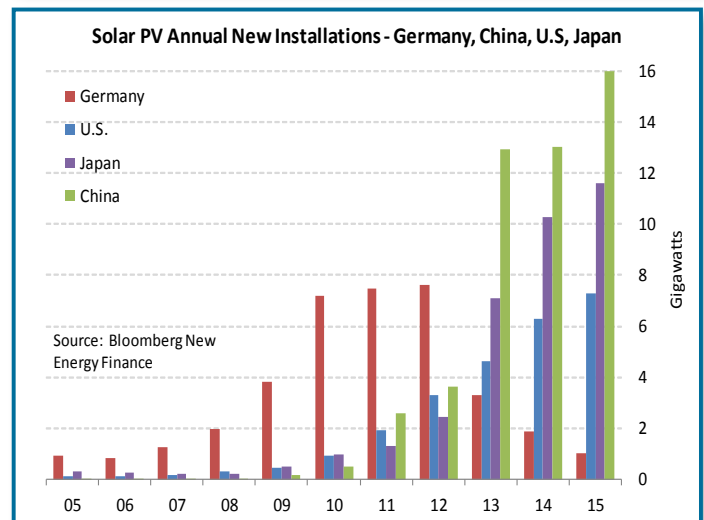
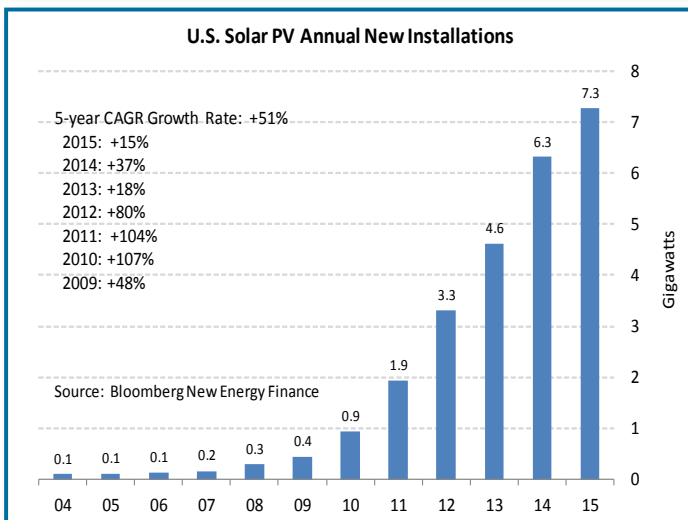
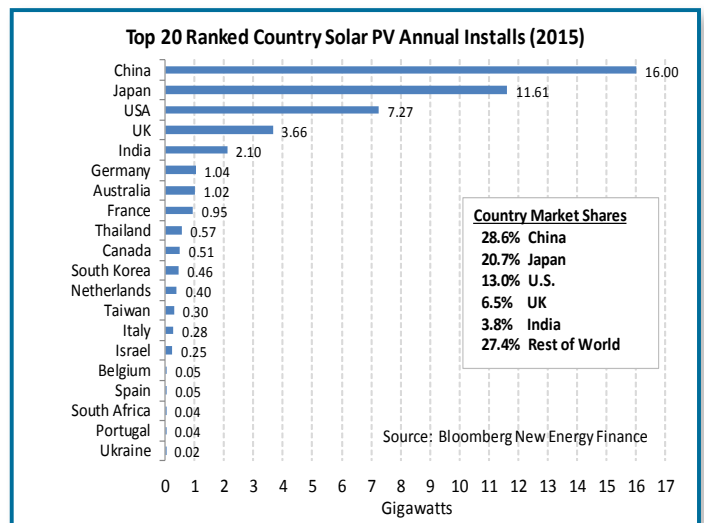
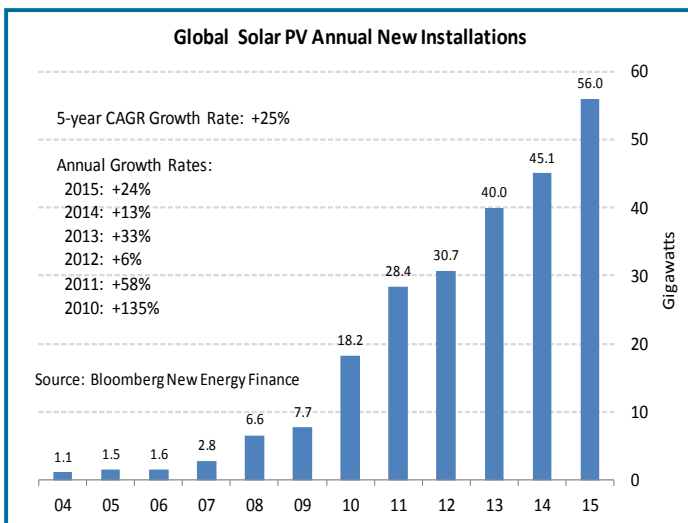
## SOLAR PV ANNUAL NEW INSTALLATIONS THROUGH 2015

New global solar PV installations in 2015 grew by +24% y/y to a record 56.0 gigawatts (GW), according to Bloomberg New Energy Finance (BNEF). The 2015 growth rate of +24% followed growth rates of +13% in 2014 and +30% in 2013. Global solar PV installations have grown at a compounded annual rate of +25% over the last 5 years and have risen by eight-fold from 2008.

In 2015, China was the top country in the world for new annual PV installs for the third straight year with 16.0 GW of installs, up +23% from the 13 GW of installs seen in 2013 and 2014. Japan remained in second place for the third straight year with 11.6 GW of new installs in 2015, up by +13% from 10.2 GW in 2014. The U.S. stood third in new installs in 2015 for the third straight year at 7.3 GW, up by +15% y/y. The UK was in fourth place for the second straight year with 3.7 GW of new installs in 2015, up +69% from 2.2 GW in 2014.

The sharp increase in installs in China, Japan and the U.S. more than offset the declines in continental Europe where installs continued to be undercut by reduced subsidy support. German solar installs in 2015 fell by -46% to 1.0 GW and were far below the 2013 peak of 7.6 GW. Italian installs in 2015 fell by -34% to 280 MW, sharply below the 2011 peak of 7.9 GW. French installs in 2015 fell by -10% to 950 MW, about half the 2011 peak of 1.8 GW.

U.S. solar PV installations in 2015 grew by +15% to a record high of 7.3 GW from 6.3 GW in 2014, according to BNEF. U.S. PV installations over the last 5 years have grown by a compounded annual growth rate of +51%. U.S. The states with the largest amount of new PV solar installations in 2015 were California (-8% yr/yr to 3.3 GW), North Carolina (+186% to 1.1 GW), Nevada (-12% to 307 MW), Massachusetts (-10% to 286 MW), and New York (+64% to 241 MW), according to GTM Research.





## SOLAR PV CUMULATIVE INSTALLATIONS THROUGH 2015

The amount of cumulative PV electricity generation capacity across the world grew sharply by +30% y/y to 248 GW in 2015, according to Bloomberg New Energy Finance (BNEF). In just five years, global cumulative solar PV electricity generation capacity increased nearly six-fold from 44 GW in 2010 to 248 GW in 2015, representing a compounded annual growth rate of +42%.

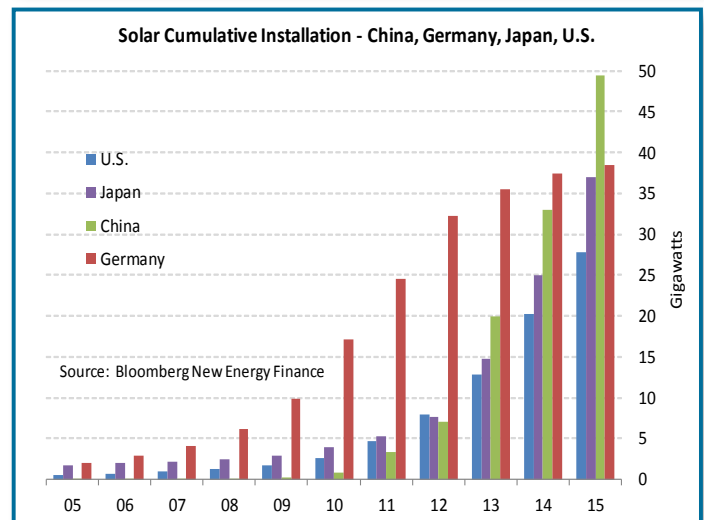
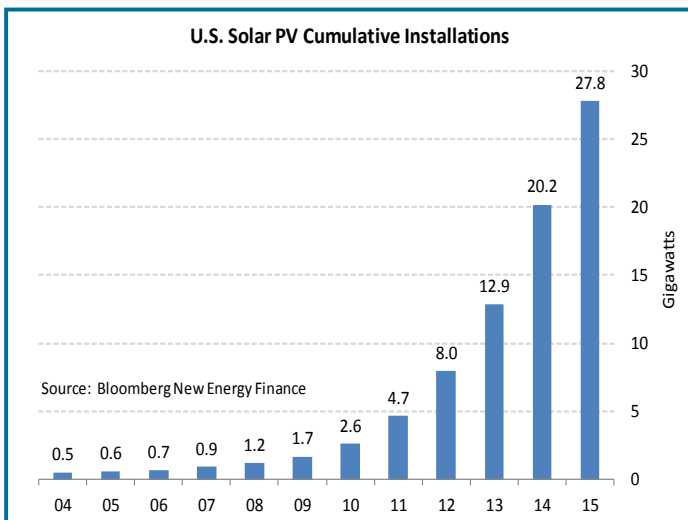
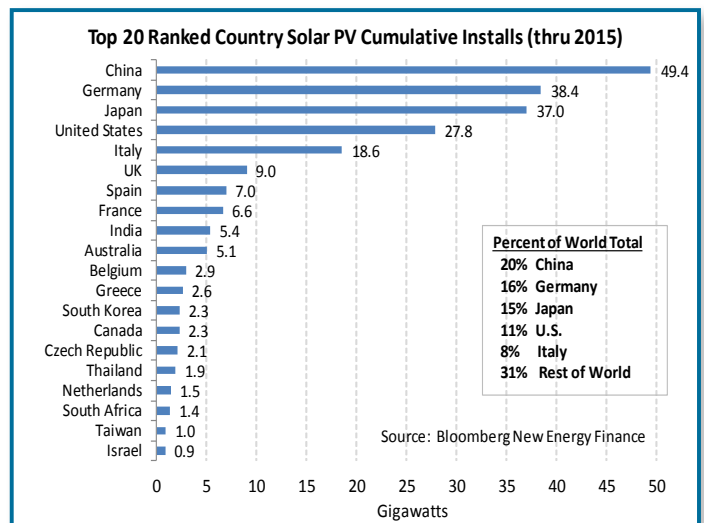
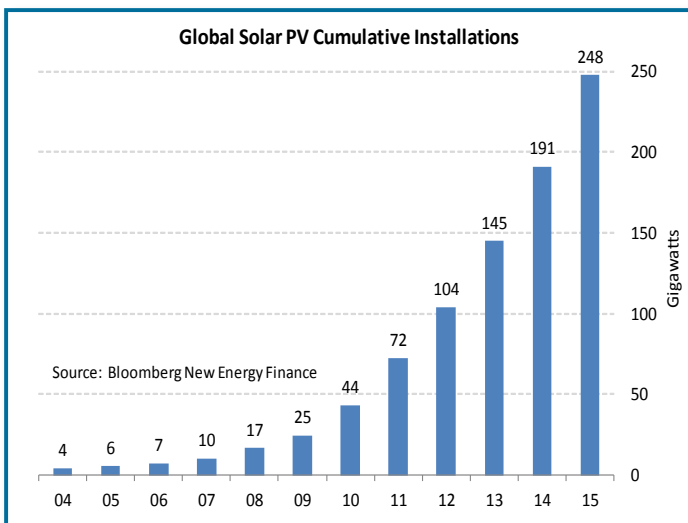
China leapt ahead of Germany in 2015 to take the top spot in the world for cumulative solar capacity at 49 GW, according to BNEF. China at the end of 2015 accounted for 20.0% of world solar PV capacity. In the past five years, China's cumulative solar capacity has soared 62-fold from only 789 MW in 2010 to the 2015 level of 49 GW, representing a 5-year compounded annual growth rate of 129%.

Germany fell into second place with 38 GW of cumulative solar PV capacity, up by only +2.8% from 2014. Germany's cumulative

solar electricity capacity in the past 5 years has more than doubled from 17.1 GW in 2010 to 38.4 GW in 2015. Germany at the end of 2015 accounted for 15.5% of the world's total solar PV capacity.

Japan remained in third place for the third straight year. Japan's cumulative solar capacity in 2015 rose by +48% to 37 GW, representing 14.9% of world capacity. Japan's cumulative solar capacity in the past 5 years has risen by nine-fold to 37.0 GW from only 3.9 GW in 2010, representing a 5-year compounded annual growth rate of 57%.

The U.S. remained in fourth place for the third straight year. U.S. solar capacity in 2015 rose by +38% to 27.8 GW, representing 11.2% of world capacity. U.S. cumulative solar electricity capacity over the past five years rose by ten-fold to 27.8 GW from 2.6 GW in 2010 and showed a compounded annual growth rate of +61%.



## SOLAR PRICING

Prices for solar cells and modules have fallen sharply this year and have hit record lows. Specifically, the price of multicrystalline solar cells fell to a record low of 21 cents per watt in Sep 2016, but then rebounded mildly to 25 cents by October, according to Bloomberg New Energy Finance (BNEF). Solar cell prices have fallen by -27% on a year-to-date basis and have plunged by a total of -69% in the past five years from the 81-cent level seen in mid-2011.

The average price of silicon solar modules has moved lower since late 2015 and fell to a new record low of 39.3 cents per watt in Nov 2016, according to PV Insights. Solar module prices have fallen by -29% on a year-to-date basis and by -68% in the past 5 years from the \$1.25 level seen in mid-2011.

Spot polysilicon prices fell to a new record low of \$12.76 per kg in mid-Oct 2016, but then rebounded slightly higher to \$12.88 in the week of Oct 24, according to data from BNEF. Polysilicon prices in the past 5 years have plunged by a total of -75% from the

\$51.37 level seen in 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 others fell to a record low of 40.6 cents per watt in Nov 2016, according to PV Insights. Thin-film module prices have fallen by -31% on a year-to-date basis and by -58% from the mid-2011 level of 95.5 cents.

Solar prices have fallen sharply in 2016 due to (1) reduced demand in 2H-2016 after the 1H-2016 China spike, (2) ample supplies, and (3) circumvented trade tariffs that had previously boosted solar prices. There is overcapacity in the Chinese market due a sharp drop in Chinese solar installs in 2H-2016 after the spike in 1H-2016 to beat the June 2016 FIT step-down. Solar prices typically decline slowly over time due to improved technology, scale manufacturing, and lower production costs.

