

Q3/Q4 2017 Solar Industry Update

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Executive Summary

- The passage of the Tax Cuts and Jobs Act of 2017 had several provisions that will impact PV economics and change funding levels for various investors.
- The President issued a proclamation imposing safeguard tariffs on imported c-Si cells and modules to begin February 7.
- In 2017, 5 states issued successor net metering decisions, bringing the total to 10.
- China installed approximately 53 GW of PV systems in 2017, bringing its total PV installations to 130 GW—distributed PV systems represented a much larger percentage of installed capacity compared to previous years.
- In 2017, India grew its market ~125% y/y to around 9 GW.
- The United States installed 2.0 GW-DC of PV in Q3 2017, its lowest quarter since Q3 2015—cumulative capacity reached 47.5 GW.
- EIA estimates that 29% of all new U.S. electricity generating capacity came from solar installations in 2017—second to natural gas.
- In the first eleven months of 2017, 13 states produced more than 2.5% of total net generation from solar.
- In Q3 2017, large residential installers report continued declines in installation costs but face challenges reducing overhead costs.
- As of February 2018, there are 250,000 solar jobs in the United States—down 4% y/y.
- Global module ASP continues to decline to 30–35 cents/W, while many manufacturers report module costs at similar values.
- U.S. module pricing traded at a premium in late 2017 due to tariff concerns.
- In 2017, solar stocks, on average, performed much better than the broader market.

Agenda

1 State and Federal Updates

2 Global PV Deployment

3 U.S. PV Deployment

4 PV System Pricing

5 Global Manufacturing

6 Component Pricing

7 Market Activity

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1 State and Federal Updates

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- The Tax Cuts and Jobs Act of 2017 has several provisions that will impact PV economics and change funding levels for various investors.
- The President issued a proclamation imposing safeguard tariffs on imported c-Si cells and modules to begin February 7.
- In 2017, states and utilities took 249 separate policy actions regarding distributed PV systems, with 5 states issuing successor net metering decisions, bringing the total to 10.

Tax Changes

Lower Corporate Tax Rate

- Corporate tax rate reduced from 35% to 21%
 - Lowers the demand for tax credits by reducing the amount of taxes paid by corporations
 - » While the *effective* tax rate change may not be as substantial as the absolute values listed above, most estimates (e.g., CBO) project a decrease in tax receipts from corporations.¹
 - Reduces the benefits of depreciation expense
 - » Depreciation expense is a deduction that lowers a company's taxable income. Because income will be taxed at a lower rate, its “sheltering” effect is worth less.

¹The Penn Wharton Budget Model calculates that across all industries the tax bill will decrease the corporate tax rate from 21% to 9% in 2018, from 24% to 17% in 2023, and from 23% to 19% in 2027; however, this varies widely by industry.

Source: <http://budgetmodel.wharton.upenn.edu/issues/2017/12/15/effective-tax-rates-by-industry>.

Tax Changes

100% Immediate Expensing

- From 2018 to 2022, new and old capital equipment can be expensed immediately.
 - Capital equipment is typically expensed over its given depreciation schedule; the majority of renewable equipment is allowed to use an accelerated depreciation schedule (5-year MACRS) for tax purposes, while other technologies have longer depreciation schedules.
 - Over the past decade, a lot of new equipment received “bonus” depreciation, which allowed system owners to depreciate some or all of their capital costs in the first year.
 - 100% expensing for all technologies reduces the advantage that renewables have over other technologies by allowing all technologies to use an accelerated depreciation schedule.
 - Encourages the sale of old energy generation facilities which can now depreciate their full value in first year
 - Previously, many renewable energy investors did not use bonus depreciation because they preferred to spread tax capacity over more projects. Investors may also elect not to use 100% expensing for the same reasons.
- Starting in 2023, the percentage of capital equipment that can be expensed immediately drops 20% per year (e.g., 80% in 2023 and 60% in 2024) until the provision drops to 0% in 2027.
- The new law prohibits regulated utilities from immediately expensing their equipment, putting them back on a MACRS depreciation schedule.
 - An article from Utility Dive stated that many utilities did not elect bonus depreciation previously when they were eligible to do so.

Tax Changes

BEAT Provision

- The Base Erosion Anti-Abuse Tax (BEAT) provision aims to prevent multinational companies from reducing their U.S. taxes by making cross-border payments to foreign affiliates that can be deducted in the United States.
 - Under BEAT, two tax payments are calculated and a company must pay the higher amount:
 - Calculation #1: 10%¹ of taxable income (not including any cross-border deductions)
 - Calculation #2: Corporation's regular tax liability reduced by most tax credits
 - Excludes all R&D tax credits and 80% of energy and low-income tax credits until 2026
 - » Companies may only receive 80% of value of ITC; however, they may have to wait until the end of year to know for certain.
 - » Because wind tax credits are taken over 10 years, the 2025 end-date will effect these projects more than solar; some wind projects in lower-resource areas could consider taking the ITC in lieu of the PTC.
 - Analysts have thus far felt that BEAT will only effect a few banks; many developers and tax equity providers are still assuming 100% value of the tax credits.

¹ 11% for banks and securities dealers. Tax rate starts at 5% in 2018 (6% for banks and securities dealers) and goes up to 12.5% (13.5% for banks and securities) after 2025.

Tax Changes

30% Cap on Interest Deductions

- Starting in 2018, a company's net interest expense will be limited to 30% of its adjusted taxable income (not including interest expense, interest income, and net operating losses).
 - Through 2021, adjusted taxable income will not include interest deduction, depreciation, amortization, or depletion.
 - Any interest not deducted in a given year can be carried forward.
 - The limit on interest deductions does not apply to companies with average gross receipts of \$25MM or less or regulated public utilities.
- Congress has estimated that this provision will not effect 95% of businesses through 2021.
- Regulated utilities are exempt from this limitation because it is one of the most capital-intensive industries.
 - It is unclear whether “regulated utilities” include IPPs, unregulated subsidiaries of regulated utilities, or utility holding companies.

Tax Changes

Other Notable Provisions

- **Prepaid Power Contracts:** Providers of previous prepaid PPAs could receive advanced electricity payments but report the advanced payments over the period the electricity (or gas) was delivered. Providers must now report payments immediately making them less economical (as taxes on the income are owed sooner).
- **Partnership Termination:** Investors in renewable energy partnership transactions had gone to great lengths to avoid the termination of partnerships for tax purposes; after 2017, under the new law, transfer of partnership interests will not cause a termination of the partnership for tax purposes.
- **Government Grants:** Corporations must now report government grants as income.
- **Mandatory Repatriation:** U.S. companies have at least \$2.6 trillion in offshore holding companies. The new law subjects all untaxed earnings, post-1986, to a 15.5% tax, if they are cash, or an 8% rate otherwise. The back taxes can be paid over an eight-year period.

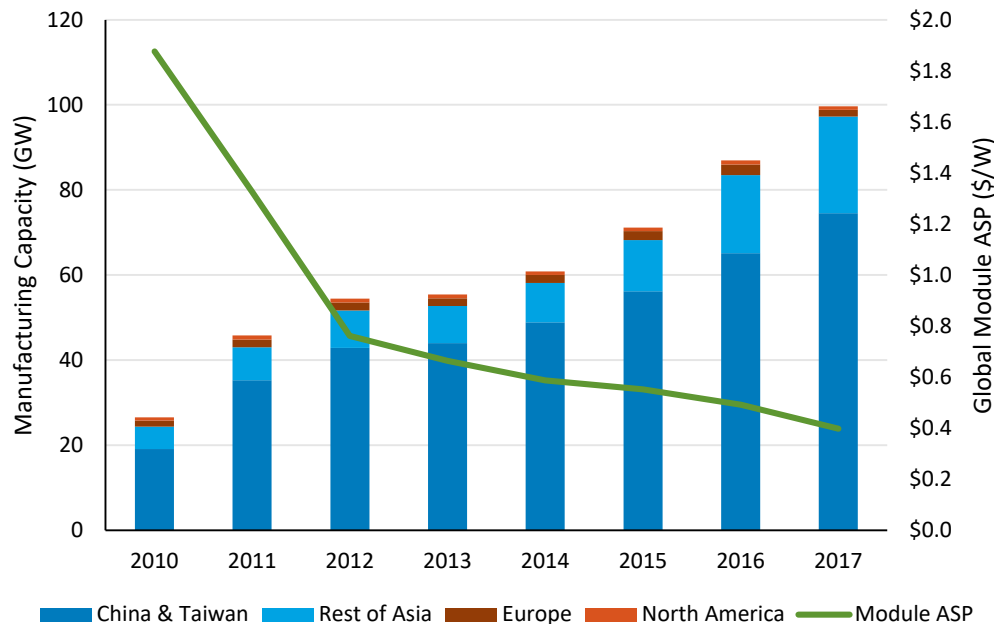
Tax Changes

Additional Utility Revenue

- Utilities have historically collected deferred money set asides from customers to pay for future years' taxes for capital equipment projects, such as transmission lines and power plants.
 - Due to normalization requirements, a utility must spread depreciation expenses over the useful life of a project for ratemaking (and “book accounting”) purposes even though most equipment benefits from an accelerated depreciation schedule for actual tax purposes (“tax accounting”). This benefit (accumulated deferred tax) builds up in the beginning of an asset’s life—as the accelerated depreciation allows them to pay fewer taxes than the utility calculated for ratemaking purposes—and is drawn down during the remainder of the assets’ useful life, as booking accounting catches up with tax accounting. In this way, the benefit is spread to all consumers over the life of the asset, not just those during the accelerated depreciation period. When the corporate tax rate changes, the drawdown of accumulated deferred taxes will be less, and it would never balance without an adjustment.
- With a lower corporate tax rate, utilities will likely pay less in future taxes and will be able to free up some of the deferred money set aside. Utilities may be able to use these funds to:
 - Reduce retail rates
 - Fund infrastructure projects, such as modernizing and strengthening the electric grid.
- Edison Electric Institute estimate that deferred tax balances across the power industry total \$165B.

Section 201 Trade Case

PV Manufacturing Capacity and Module Price



- Global PV production capacity grew by a factor of four between 2010 and 2017, while global module ASPs declined by roughly 80%.
- Despite this rapid global expansion, U.S. PV manufacturers have had challenges maintaining market share and profitability.
- By 2016, many Chinese companies had opened manufacturing in other parts of Asia, allowing them to sell into the United States and other markets with tariffs on Chinese goods, at prices near the global average
 - Well over half the modules produced in China are now going to the domestic market.

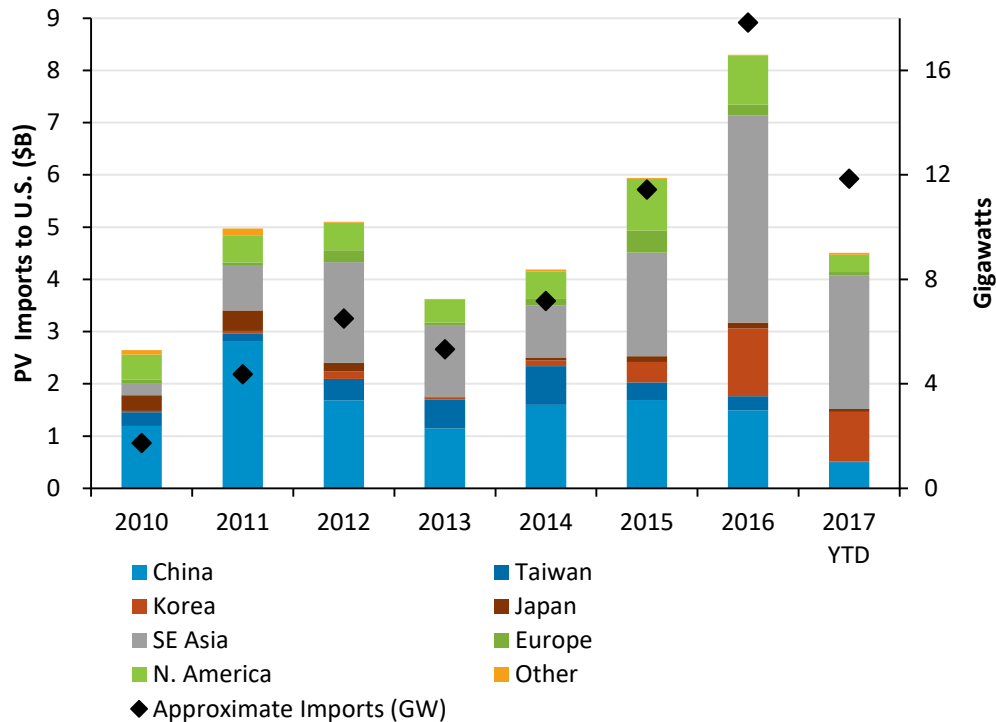
Section 201 Trade Case

U.S. PV Manufacturing Reaction to Global Capacity and Module Price

- U.S. PV manufacturers have attempted to curb the import of PV from expanded global manufacturing, filing trade cases with the U.S. Department of Commerce and the U.S. International Trade Commission (USITC) in 2012, 2014, and most recently in 2017.
 - The filing of the trade cases in the United States have followed a period of sustained and unexpected drops in module price.
- The 2012 U.S. tariffs focused on Chinese manufacturers that had expanded manufacturing capacity dramatically; these tariffs were circumvented in large part through the incorporation of Taiwanese cell manufacturing into the process (adding some costs to modules sold into the United States).
- The 2014 tariffs closed this loophole, providing more of a buffer between global module ASP and U.S. ASP.
- The requested tariffs filed in 2017 were focused on *all* imported PV modules and cells.

Section 201 Trade Case

PV Module and Cell Imports to U.S. by Country



Note: GW of imports are calculated by dividing the dollar value of imports by global module and cell ASP, plus 10% (to account for measures taken by companies to circumvent existing U.S. tariffs).

Sources: Imports, by value: U.S. International Trade Commission, 2018. Average module and cell price: IHS Markit, Technology Group, PV Integrated Market Tracker, October, 2017.

- Since 2016, Malaysia has replaced China as the country providing the most module and cell imports into the United States; however, many companies operating in Malaysia are Chinese-owned.
 - In the first 11 months of 2017, approximately 57% of module and cell value entering the United States came from South East Asia—Malaysia alone supplied the United States with 31% of imports of module and cell value.
- Despite potential tariffs on future foreign modules and cells, the USITC has not reported a dramatic increase in imports in the first 11 months of 2017, compared to previous years.
 - While the capacity of module and cell imports into the United States is likely greater than annual deployment, it does not appear to be enough to sustain a large inventory of supply of “pre-tariff” equipment.

What is a Section 201 case?

- The name comes from Section 201 of the Trade Act of 1974.
- In a Section 201 case, an industry asks for temporary protection from increased imports in order to give it time to become competitive.
- Safeguards can be initially imposed for up to four years, and they can be extended for another four years. The tariff rate has to decline over this period.
- Any import protections would apply to imports from all countries, except potentially those with whom the United States has special trade deals.

Section 201 trade cases are VERY different than other trade cases.

Section 201

- Tariffs are applied to imports from all countries.
- No “wrongdoing” by other countries is required—only harm to the domestic industry.
- Higher standard for harm caused to the domestic industry
- Tariffs decrease each year.
- Highly political process—if harm is found, the President has wide latitude to implement different safeguards

Anti-Dumping/Countervailing Duties

- Tariffs are only applied to imports from certain countries.
- Can only be implemented if other countries are found to be either subsidizing exports or selling them below cost to gain market
- Lower standard for harm caused to the domestic industry
- Tariffs may rise or fall over time.
- Relatively bureaucratic process—tariffs are set by the USITC

Section 201 Trade Case Timeline

April 26

Suniva requested the investigation after filing for bankruptcy in April 2017. SolarWorld joined the case in May. Suniva made an initial tariff request of **\$0.40/W on solar cells and a \$0.78/W floor price** on c-Si solar modules.

- Suniva later revised proposal to \$0.32/W.
- SolarWorld proposed an import quota instead of a price floor.

September 22

The USITC unanimously found that the domestic U.S. module and cell manufacturing industry had been **seriously harmed by c-Si imports**.

October 31

The commissioners released three proposed remedies in late October that are significantly below Suniva/SolarWorld proposals.

January 23

President Trump issued a proclamation imposing safeguard tariffs on imported c-Si cells and modules to begin February 7.

Imposed Tariffs versus the USITC Commissioner's Findings

Commissioner Findings

Commissioner Williamson and Johnson	Year 1	Year 2	Year 3	Year 4
Cell Quota Volume	1 GW	1.2 GW	1.4 GW	1.6 GW
Cell Tariffs below Quota	0%	0%	0%	0%
Cell Tariffs above Quota	30%	25%	20%	15%
Module Tariffs	30%	25%	20%	15%

Commissioner Schmidtlein	Year 1	Year 2	Year 3	Year 4
Cell Quota Volume	0.5 GW	0.6 GW	0.7 GW	0.8 GW
Cell Tariffs below Quota	10.0%	9.5%	9.0%	8.5%
Cell Tariffs above Quota	30%	29%	28%	27%
Module Tariffs	35%	34%	33%	32%

Commissioner Broadbent	Year 1	Year 2	Year 3	Year 4
Quota (Cells and Modules)	8.9 GW	10.3 GW	11.7 GW	13.1 GW
Quota (for Mexico)	0.72 GW	0.84 GW	0.95 GW	1.07 GW
Import License Fee	1 ¢/W	1 ¢/W	1 ¢/W	1 ¢/W
Estimated Import License Auction Proceeds	\$89MM	\$103MM	\$117MM	\$131MM

Imposed Tariffs

	Year 1	Year 2	Year 3	Year 4
Cell Quota Volume	2.5 GW	2.5 GW	2.5 GW	2.5 GW
Cell Tariffs below Quota	0%	0%	0%	0%
Cell Tariffs above Quota	30%	25%	20%	15%
Module Tariffs	30%	25%	20%	15%

The imposed tariffs are similar to three of the four commissioners' findings—however have a higher cell-import exemption:

- The 2.5-GW cell exemption will help the 14 U.S. module assembly manufacturers from having tariffs imposed on their products.
- Current U.S. module assembly capacity is well below 2.5 GW. Based on public data from the USITC, 250–300 MW of PV cells were imported in 2017.
- GTM Research estimates that in Q3 2017 the United States had 1.4 GW of c-Si module assembly capacity and 0.9 GW of cell manufacturing capacity.

Section 201 Trade Case

The WTO and Safeguards

- The WTO cannot force any sovereign country to change its trade policies. However, when countries violate its rules, it tells other nations that they are allowed to issue retaliatory tariffs.
- According to the WTO, countries that impose safeguards are supposed to give 'compensation' to affected countries.
- If this rule is followed, the country that puts tariffs in place negotiates with affected countries and comes to an agreement, usually one involving a reduction in other tariffs.
- If no agreement is reached, the WTO says that other countries can levy retaliatory tariffs, but only after three years.
- A broad range of countries have said they would use the WTO or trade agreements to fight the U.S. tariff.
- The USITC has left the option for their to be a global settlement; there is also a possibility for more country exclusions.

Section 201 Trade Case

Country-Specific Exclusions to Tariffs

Country-Specific Exclusions

- The United States has a variety of free trade agreements with countries.
- In its case, Suniva dedicates a significant amount of time to arguing that no countries, especially Mexico and Canada, should be excluded.
- All four USITC commissioners recommended remedies be applied to certain trade partners, including Mexico and South Korea, though notably not Singapore.
- The final proclamation excludes certain developing countries that are eligible for Generalized System of Preferences (GSP) treatment, with the exception of Thailand and the Philippines (the U.S. imports more than 3% of its solar panels from each of these countries). The exemption will be lifted if import volume from the country surges to more than 3% of total imports or if total GSP imports increases to more than 9% of total imports.

Section 201 Trade Case

Other Exclusions to Tariffs

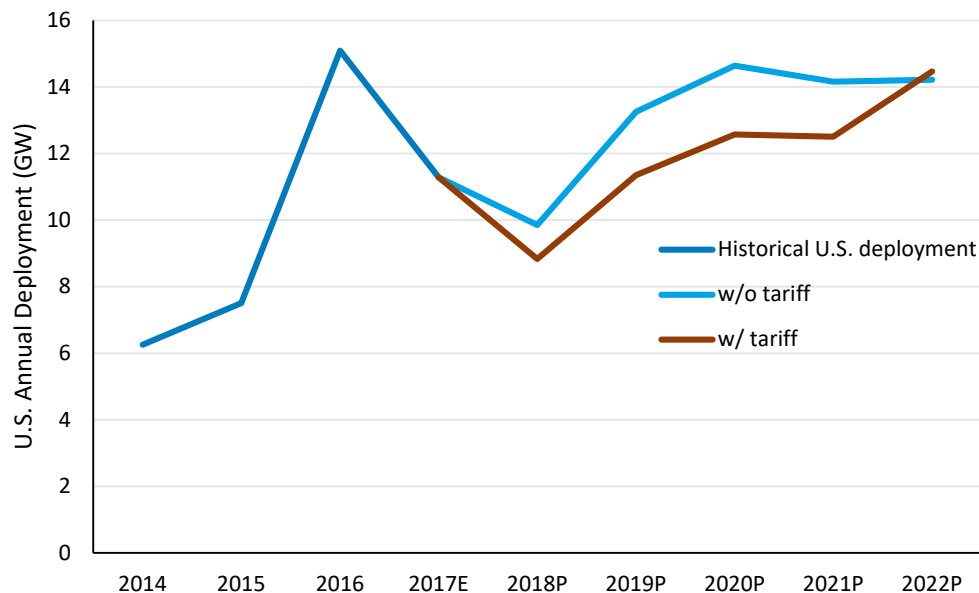
Thin-Film Modules: The largest thin-film manufacturer, First Solar, will have approximately 3 GW of Series 4 and Series 6 global manufacturing capacity in 2018, and it is planning to grow manufacturing capacity to approximately 5.7 GW by 2020.

2.5 GW of Imported Cells: Analysts believe the exclusions is “first come first served,” but further guidelines may codify the procedure. There is currently not 2.5 GW of U.S. module assembly capacity.

Product-Specific Exclusions: Exclusion can be requested for products. SunPower, which produces most of its panels in Asia, has requested an exclusion for its, “unique interdigitated back contact (IBC) solar cells.”

Section 201 Trade Case

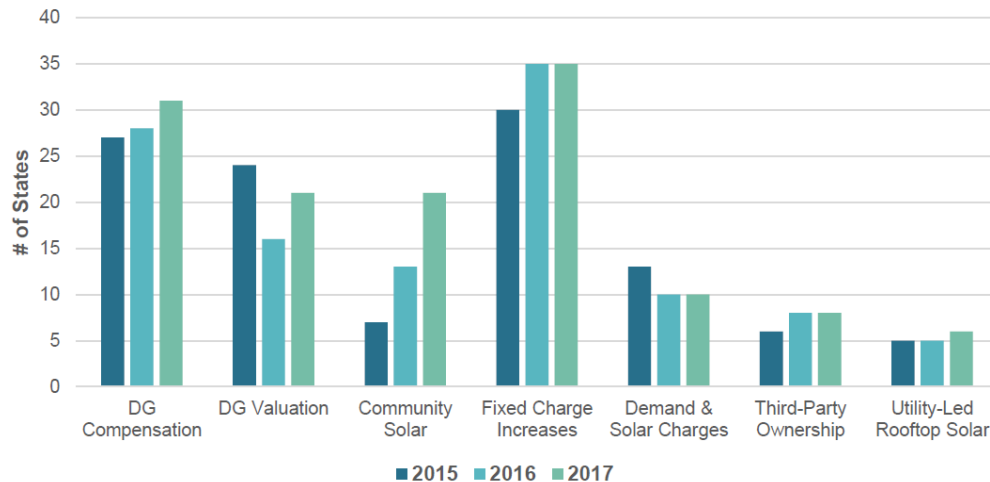
Outcomes on Price, Deployment, and Jobs



- A 30% tariff would add \$0.09–\$0.12/W to global module ASP. By the fourth year, the tariff could add as little as \$0.03/W to imported panel prices. Because the tariffs have been expected, analysts predict a minimal impact on U.S. module ASP, as pricing has already been approximately \$0.10/W–\$0.15/W above global averages.
 - The tariff will be additive to existing Chinese and Taiwanese tariffs.
- SEIA reports these tariffs will cost 23,000 U.S. jobs.
- GTM Research and BNEF estimate annual U.S. deployment will be 6% to 16% lower with the tariffs in place—compared to no tariff.
 - Analysts estimate utility-scale PV deployment will be most effected—in particular, in highly competitive states such as Idaho and Mississippi.

State Actions on Distributed Solar—2017

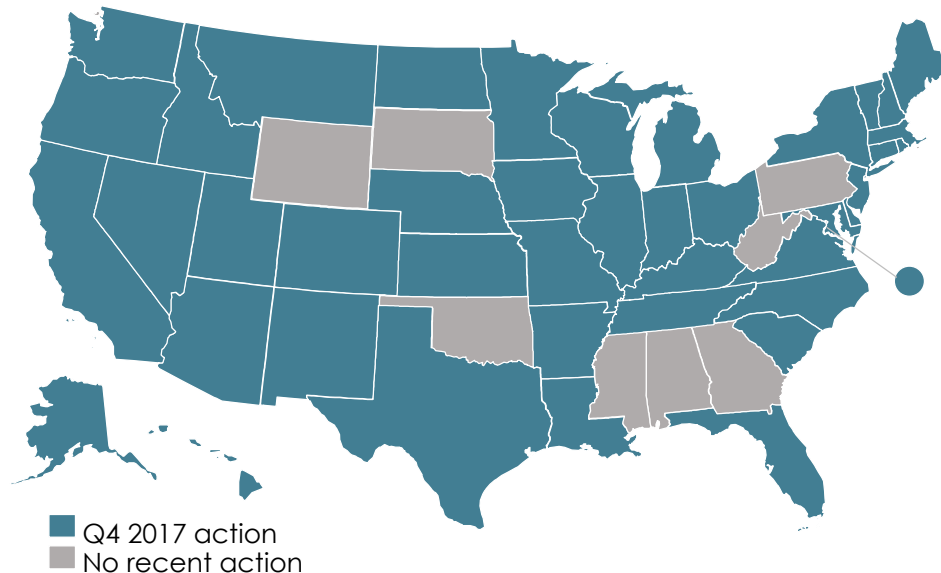
Figure 4. Number of States Taking Solar Policy Action 2015-2017



- Distributed solar policy action has increased over the past few years, with states and utilities taking approximately 175 actions in 2015, 212 actions in 2016, and 249 actions in 2017.
 - Community solar and fixed charge actions have shown steady increases in activity from 2015 to 2017.
- In 2017, 31 states and the District of Columbia (D.C.) considered or enacted changes to net metering policies.
 - Five states issued successor net metering decisions in 2017, bringing the total to 10.

State Actions on Distributed Solar—Q4 2017

- Forty-two states and D.C. took action on distributed solar policy and rate design during Q4 2017.



- Of those, Louisiana PSC filed its proposed modified net metering rules in November 2017. The rule credits excess generation at avoided cost calculated by the utilities. The proposal also allows community net metering.
- Jacksonville Electric Authority (Florida) approved a net metering successor program in October 2017, with excess generation for new customers credited at 3.25 cents/kWh.
- Nevada ordered a decrease in Nevada Power's residential fixed and volumetric charges following strong public pressure.
- Hawaii PUC established final rule for the state's community solar program. In its second phase, the program shifts to time-varying credits and allows utilities to develop, own, and operate systems that have at least 50% of subscribers from low to moderate income households.

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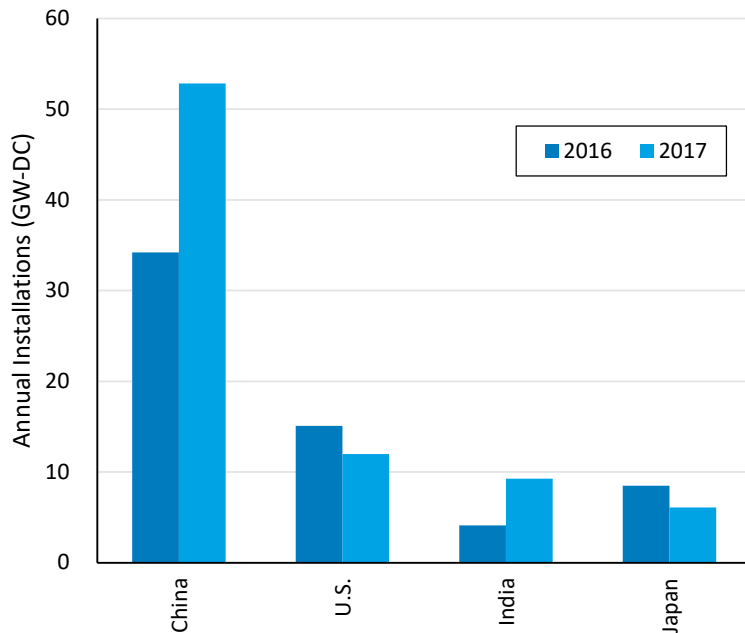
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6 Component Pricing

7 Market Activity

- **China installed approximately 53 GW of PV systems in 2017, bringing its total PV installations to 130 GW. Distributed PV systems represented a much larger percentage of installed capacity compared to previous years.**
- **In 2017, India grew its market ~125% y/y, to around 9 GW.**
- **The Japanese market continues to contract in annual PV installations from its high of 11 GW in 2015.**

Estimated 2017 PV Installations in Leading Global Markets



- In 2017, China installed approximately 53 GW of PV systems—an increase of around 54% y/y—bringing total Chinese PV installations to 130 GW.
 - Of the 53 GW of PV installs, approximately 19 GW were distributed PV—up from 4 GW in 2016.
 - In 2017, China for the first time installed more renewables in a year than traditional thermal plants.
- Despite contracting, the United States was still the second largest PV market in 2017.
- In 2017, India grew its market ~125% y/y to around 9 GW.
- The Japanese market continues to contract in annual PV installations from its high of 11 GW in 2015.

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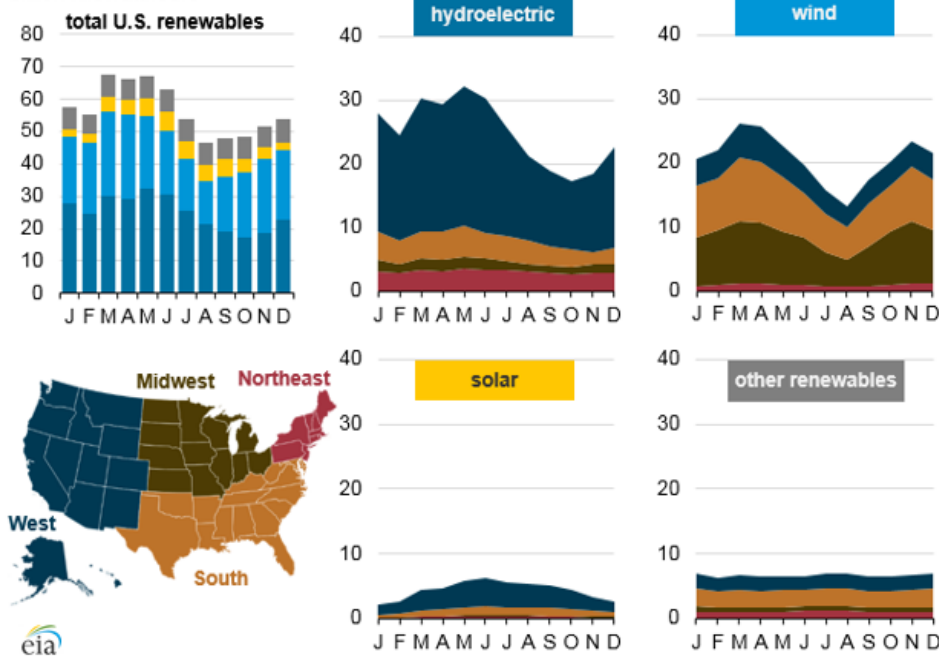
7 Market Activity

- The United States installed 2.0 GW-DC of PV in Q3 2017, its lowest quarter since Q3 2015—cumulative capacity reached 47.5 GW.
- As of February 2018, there are 250,000 solar jobs in the United States down 4% y/y.
- Utility-scale continued to be the primary driver of PV in 2017.
- EIA estimates that 29% of all new electricity generating capacity came from solar installations in 2017—second to natural gas.
- In the first eleven months of 2017, 13 states produced more than 2.5% of total net generation from solar.

Utility-Scale Renewable Electricity Generation by Census Region, 2017

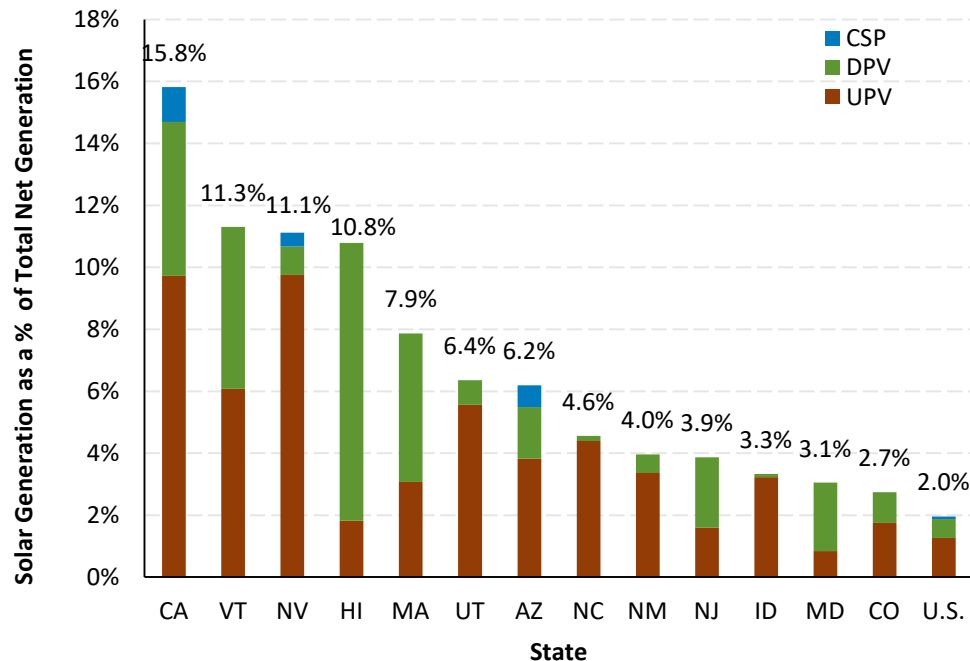
Monthly renewable electricity generation by census region, 2017

billion kilowatthours



- Monthly U.S. renewable electricity generation peaked in March at 67.5 billion kWh, or 21% of total utility-scale electricity generation.
- Most renewable generation in 2017 came from the West Census Division, which accounted for the majority of the hydroelectric (67%) and solar (69%) generation.

Solar Generation as a Percentage of Total Generation, January–November 2017



- Four states produced more than 10% of total net generation from solar in the first eleven months of 2017, and an additional nine states produced more than 2.5% of total net generation from solar.
- Solar technology contribution varied by state, with Hawaii generating most of its energy from distributed PV, while North Carolina generated the vast majority of its energy from utility-scale PV.
- During the same period, CSP generated more than 1% of California's electricity and more 0.7% of Arizona's.

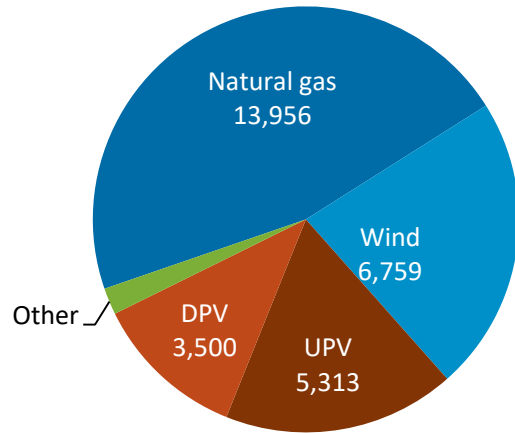
Note: EIA monthly data for 2017 are not final. Additionally, smaller utilities report information to EIA on a yearly basis, and therefore, a certain amount of solar data has not yet been reported. "Net Generation" includes DPV generation.

Sources: EIA, "Electric Power Monthly," forms EIA-023, EIA-826, and EIA-861 (January 2018).

U.S. Generation Capacity Additions by Source, 2016 and *Estimated* 2017

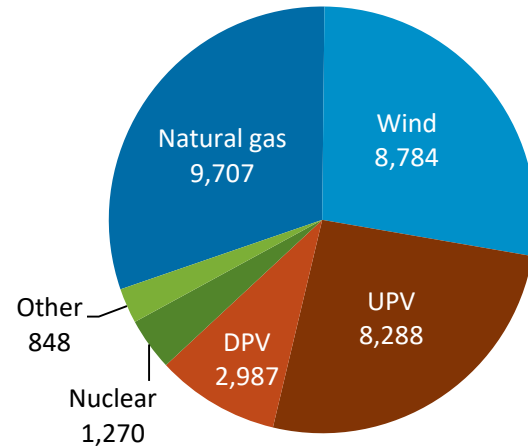
- EIA estimates that 29% of all new electricity generating capacity came from solar installations in 2017—second to natural gas.
- Despite a drop in UPV installations, EIA estimates that DPV grew in 2017 y/y.

***Estimated* 2017 U.S. Generation Capacity Additions**
(Total 30.1 GW-AC)



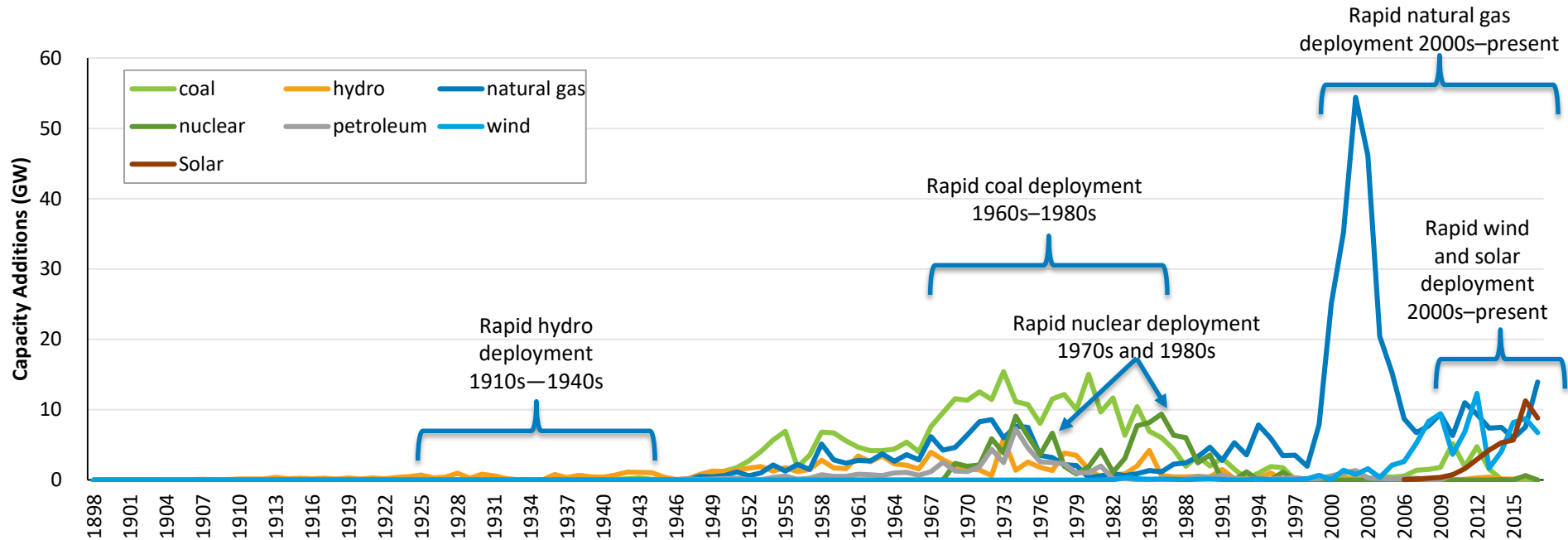
- Natural gas represented 46% of new generating capacity in 2017, up from 30% in 2016
- More than half of all new additions came on-line in the fourth quarter.
- Solar and wind represented approximately 52% of all new sources of generation in 2017, compared to 63% in 2016.

2016 U.S. Generation Capacity Additions
(Total 31.9 GW-AC)



Historically High Year for Solar in 2016

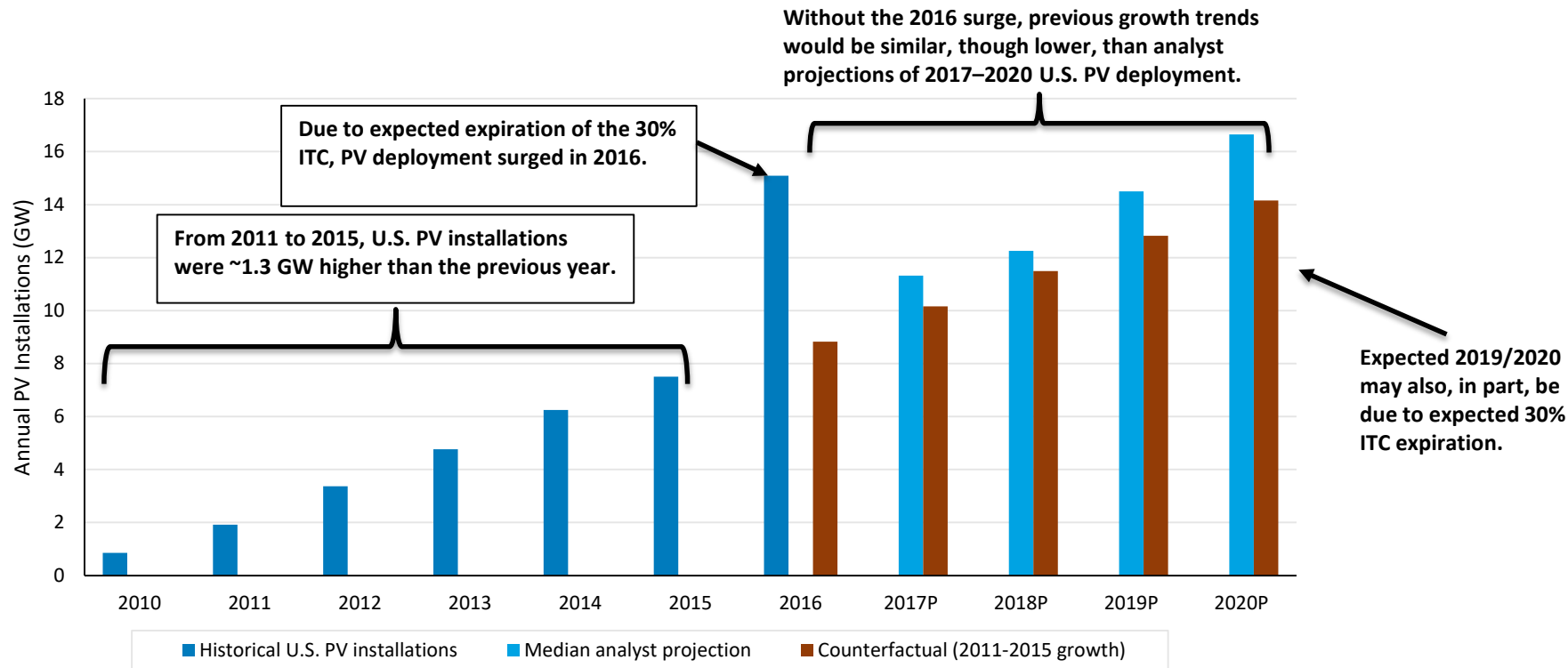
While solar PV annual deployment is estimated to have dropped between 2016 and 2017, solar is still experiencing a historically high level of deployment compared to other technologies in the United States.



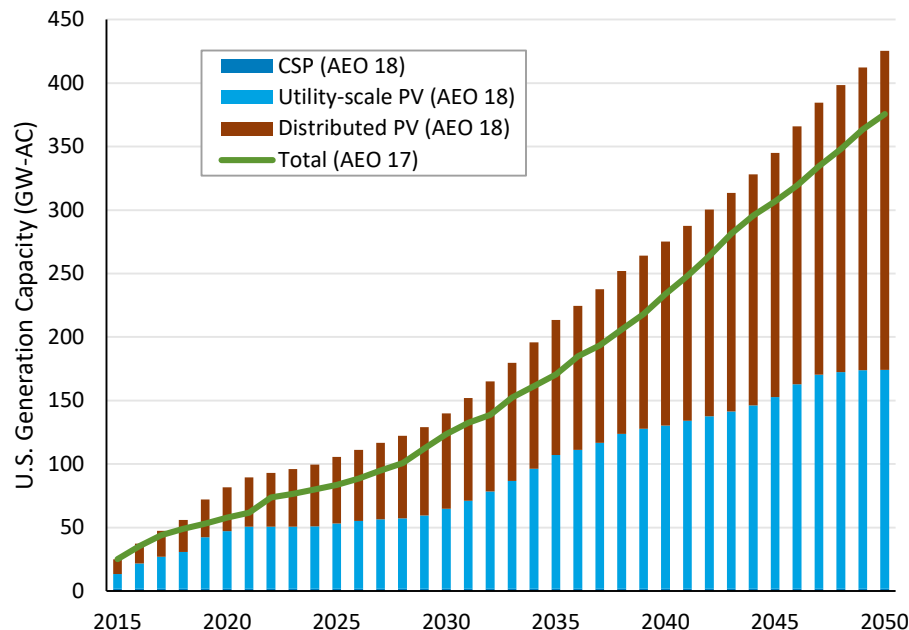
Sources: EIA, U.S. installed capacity, 1898–2010, EIA, “Today in Energy,” July 2011. Form 860. 2011–2013: FERC, “Office of Energy Projects Energy Infrastructure Update for December 2012/2013/2014/2015.” 2006–2013 Distribute Solar (DPV), GTM/SEIA, U.S. Solar Market Insight Q4 2014, using PV converted to AC using .8333 derate factor. 2014 DPV, SEPA “2014/2015 Solar Market Snapshot”. 2009–2016 Utility PV, and 2015–16 DPV, EIA “Electric Power Monthly” (February 2017).

Impact of Potential ITC Expiration on U.S. Deployment

Due to increased competitiveness, the U.S. PV market has grown substantially in the past decade and would likely continue to grow without regulatory interference.



EIA's Preliminary 2018 Annual Energy Outlook



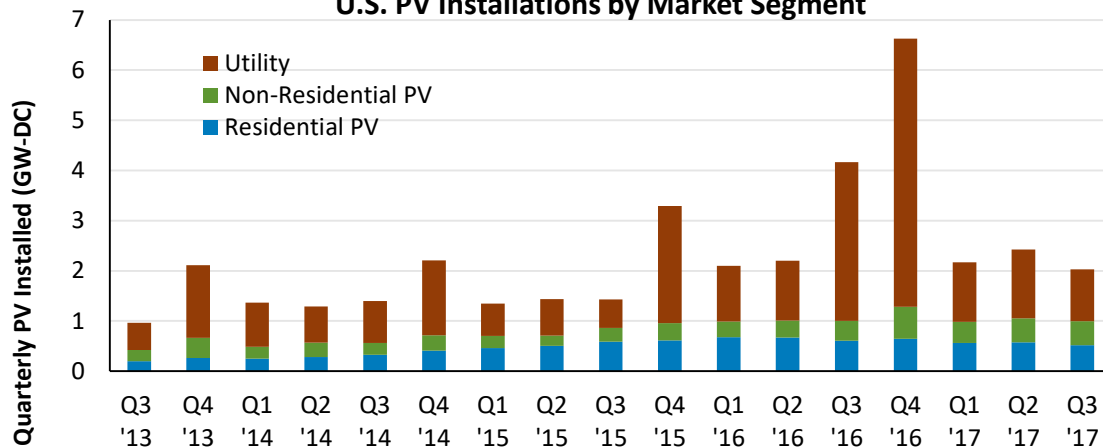
- EIA has released its Annual Energy Outlook (AEO) 2018, projecting that U.S. solar installed capacity will grow to 425 GW by 2050.
 - Of the total, 251 GW is projected to be distributed PV, 172 GW utility-scale PV, and 2 GW of CSP.
 - 425 GW of solar would represent approximately 24% of total U.S. installed capacity, supplying 16% of total U.S. electricity—all renewables are projected to supply 34%.
 - Distributed PV is projected to surpass utility-scale PV in installed capacity by 2026.
- 2050 capacity represents a growth of 17% above AEO 2017 capacity projections.

U.S. Installation Breakdown

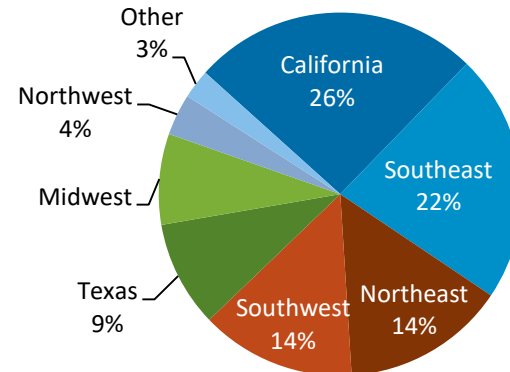
- The United States installed 2.0 GW-DC of PV in Q3 2017, its lowest quarter since Q3 2015—cumulative capacity reached 47.5 GW.
- The non-residential market is expected to be the only sector to grow in 2017, helped in part by a growing community solar market.
- Utility-scale continued to be the primary driver of PV in 2017. GTM Research reports that 57% of utility-scale PV PPAs signed in 2017 were through voluntary procurement based on economic competitiveness and a hedge against natural gas.

- A considerable amount of PV deployment is estimated to have occurred in Q4 2017.
- Distributed PV has been challenged in many states by a shift to a more “value-based” approach (e.g., AZ, CA, HI, MA, MN, and NH). Economics should improve with continued decreases in cost or, in a few areas, the incorporation of low-cost storage.
- Thus far in 2017, new PV installations have had a fair geographic mix across the United States, with the Southeast having the largest market-share outside California.

U.S. PV Installations by Market Segment



U.S. PV Installations by Region (MW-DC)
Q1—Q3 2017

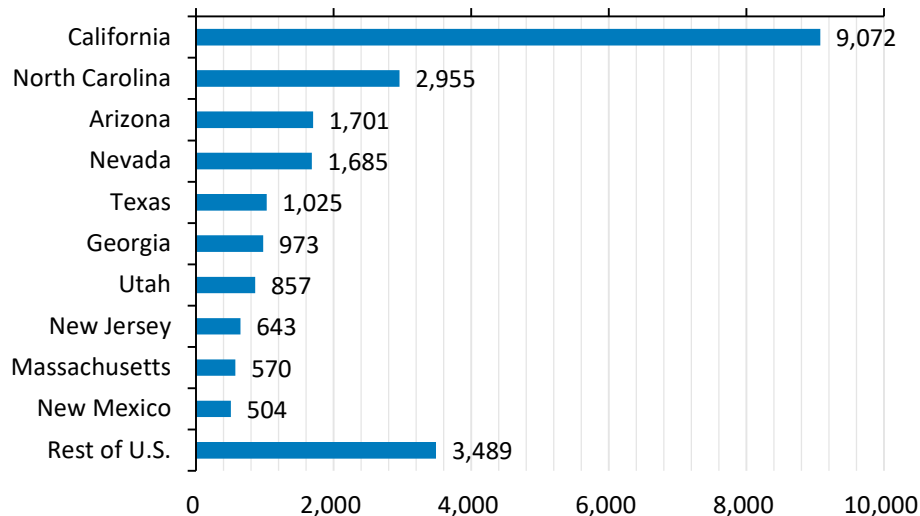


U.S. Installation Breakdown by State

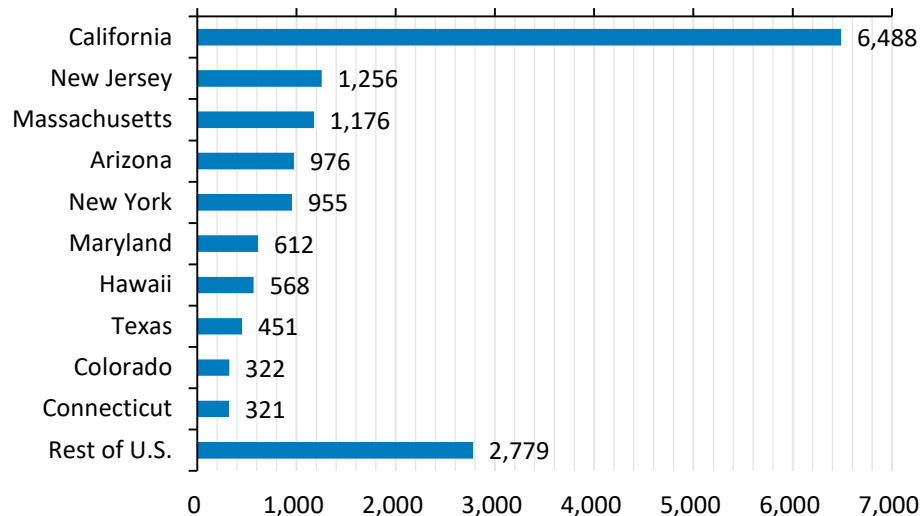
- At the end of November 2017, there were 39.4 GW-AC of solar systems in the United States.
- Of the 39.4 GW, 23.5 GW were utility-scale PV and 15.9 GW were distributed PV.

- Six of the top 10 states with utility-scale PV were in the Southwest while 5 of the top 10 states with distributed PV were in Northeast.
- Nine states had more than 1 GW-AC of PV and an additional six states had more than 500 MW.

UPV Installed Capacity, Top 10 States as of Nov. 2017
Megawatts (MW-AC)



DPV Installed Capacity, Top 10 States as of Nov. 2017
Megawatts (MW-AC)

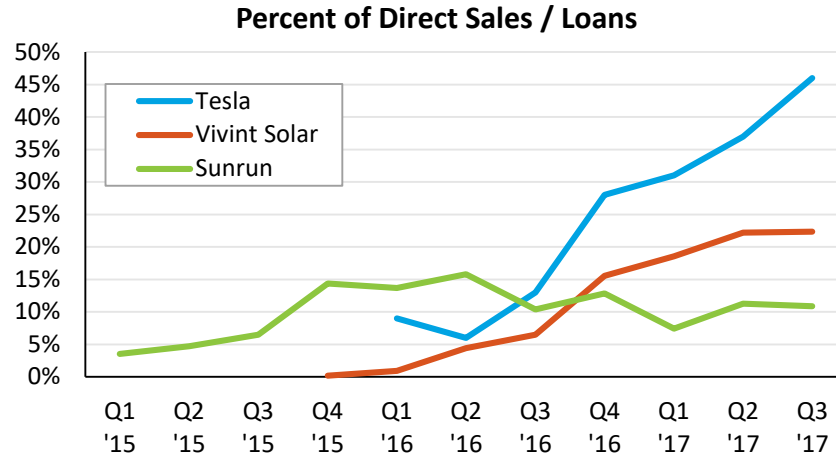
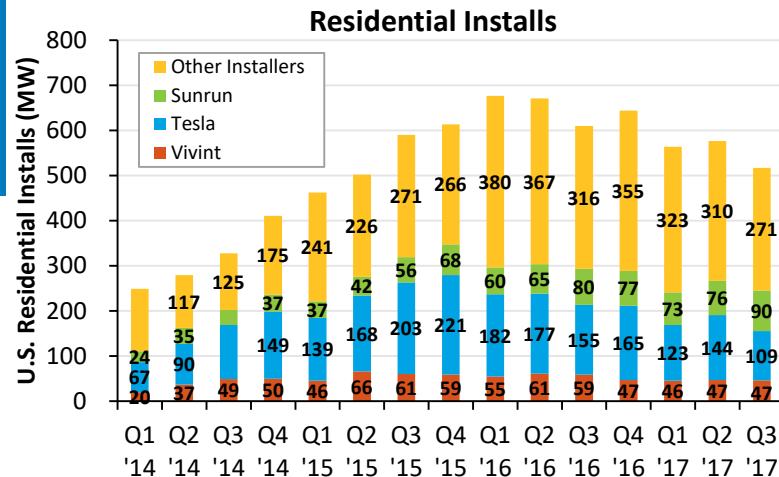


Note: EIA monthly data for 2017 are not final. Additionally, smaller utilities report information to EIA on a yearly basis, and therefore, a certain amount of solar data has not yet been reported. "Net Generation" includes DPV generation.

Sources: EIA, "Electric Power Monthly," forms EIA-023, EIA-826, and EIA-861 (January 2017).

Tesla, Vivint Solar, and Sunrun Residential Market Share

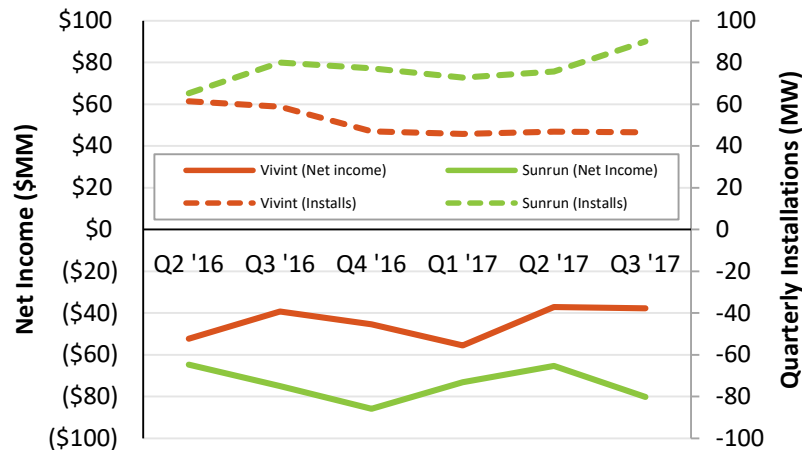
- The U.S. residential PV market continued to contract in Q3 2017, reaching its lowest level since Q2 2015.
 - Significant contractions in deployment by Tesla and Vivint Solar have been partially offset by increased deployment by Sunrun.
 - Conversely, while Sunrun direct sales have not grown, Tesla and Vivint Solar's direct sales are becoming a larger share of their total installs.
- Tesla and Sunrun are also expanding product offerings through PV+storage.
 - Tesla has installed 365 MWh of storage in the past year.
 - Ten percent of Sunrun's California customers opted for their solar+storage option; the company plans to launch a storage option in new states in the coming quarters.



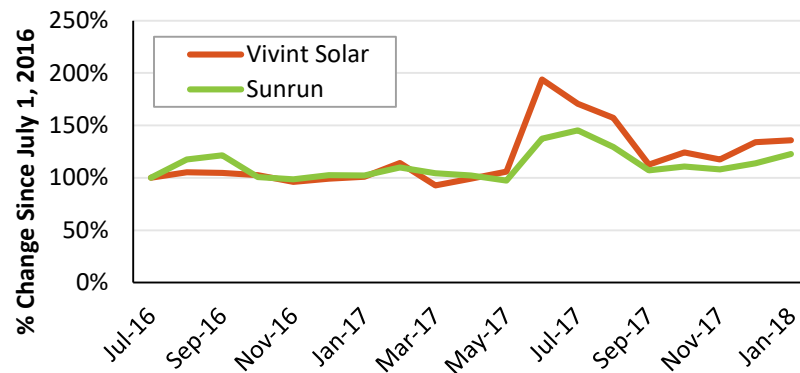
Vivint Solar and Sunrun Different Market Strategies

- Part of the contraction in solar deployment by Vivint (and Tesla) stems from a desire to prioritize profitability over market expansion.
- From Q2 2016 to Q3 2017, Vivint Solar reduced its quarterly installations by 24% but its net losses contracted by 28%.
- Sunrun, taking a different approach, has grown its quarterly installations over the same period but its net losses increased by 24%.
 - Sunrun is also different in that it relies more heavily on leases and contracting many of its residential installations to outside parties.
- Despite the different strategies, since Vivint Solar and Sunrun reported their Q2 2016 figures, their stocks have performed similarly.

Installs and Profitability

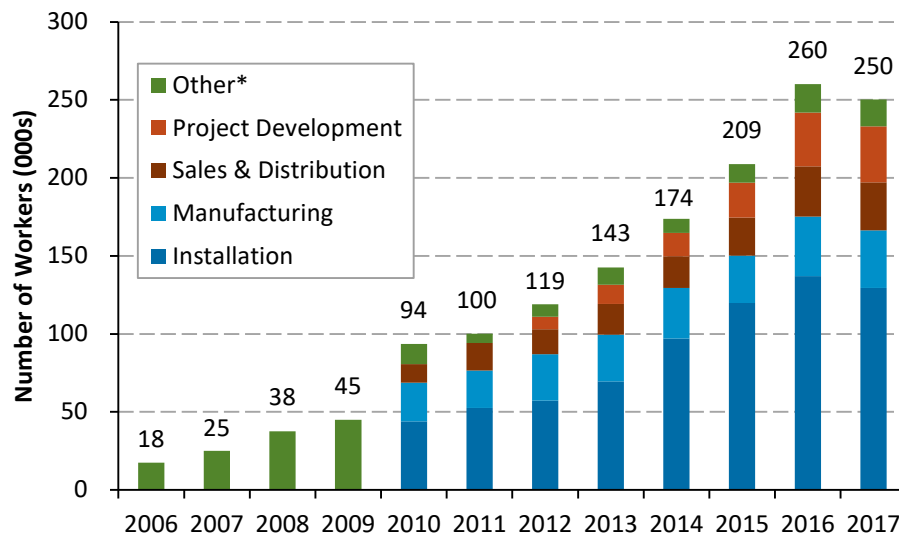


Stock Performance



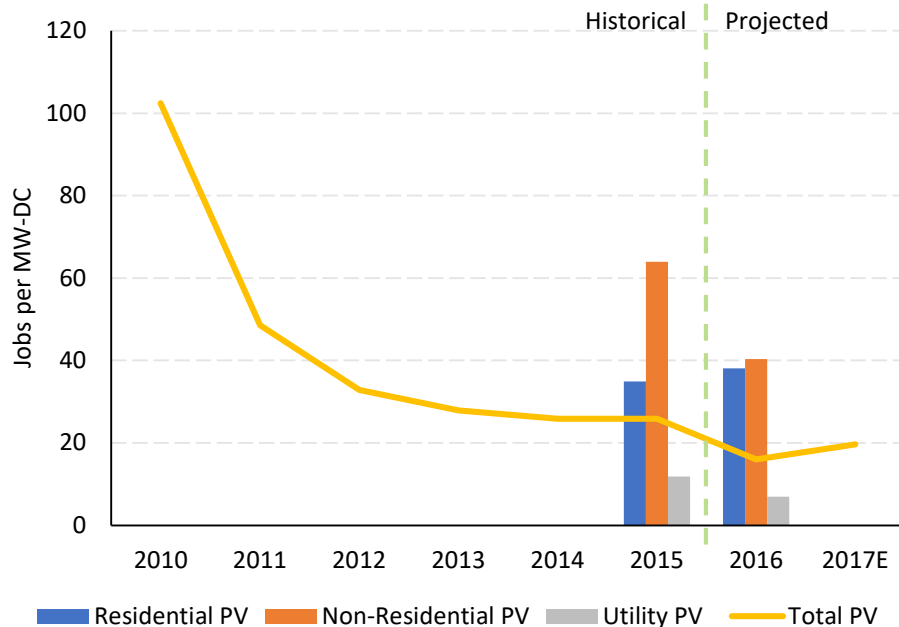
U.S. Solar Workforce

U.S. Solar Workforce



- As of February 2018, there are 250,000 solar jobs in the United States—down from 260,000 in the beginning of 2017—a loss of 4%.
 - Job cuts occurred in all sectors, except project development—installations jobs dropped by the most (6%).
 - Solar jobs are still up 168% since 2010.
- Solar employment decreased in established markets, such as CA, MA, and NV; however, solar jobs increased in 29 states, such as UT, MN, and TN.
 - Job growth and losses often correlated with annual deployment—however, not always (potentially owing to uneven job intensiveness per sector).
- Solar wages remain above national averages, with mid-level employees receiving approximately \$20/hour, and supervisors receiving \$30–\$38/hour, in the installation and manufacturing sectors.

PV Job Intensiveness by Market Sector

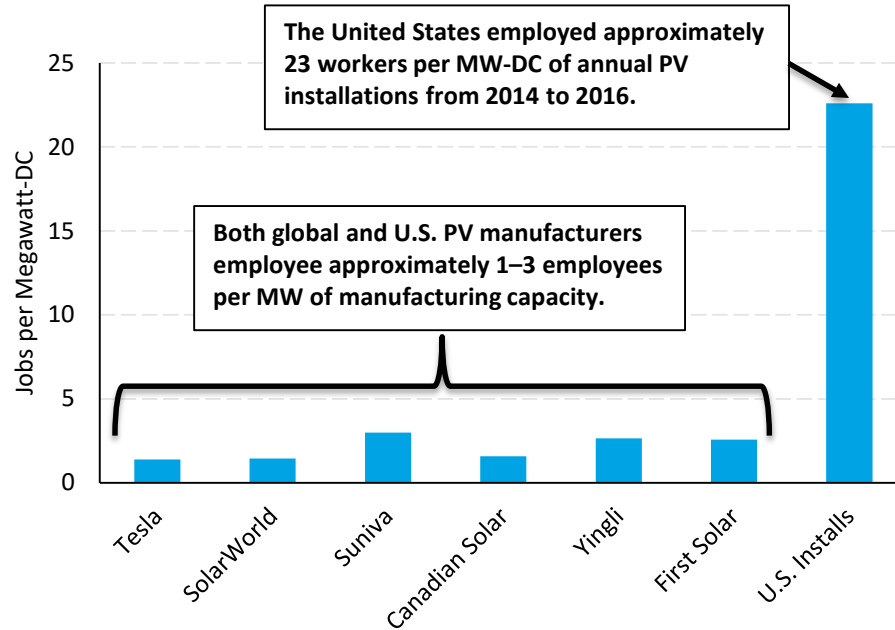


- PV job intensity, by the industry at large, has declined by approximately 5X since 2010; however, it has remained at around 25 jobs per MW of annual installations since 2013, falling approximately 5% per year.
 - This ratio dipped in 2016 to around 16; however, due to the spike in solar deployment, it is expected to return to the historical average in 2017.
- Job intensity varies widely by market sector within the PV industry. While industry data are not robust with regards to breakdown by sector, in 2015–2016, the distributed PV sector employed approximately 40 people per MW-DC of annual installations, versus approximately 10 people per MW-DC in the utility-scale sector.

Note: In 2015–2016, 93% of solar jobs were related to PV, with the remainder focused on concentrating solar power (CSP) and solar water heating (SWH)

Sources: The Solar Foundation, “The National Solar Jobs Census 2016;” January 2017; “The National Solar Jobs Census 2017;” February 2018; GTM Research & SEIA. “U.S. Solar Market Insight,” December 2017.

PV Job Intensiveness—Cell/Module Manufacturing vs. Installation



A loss of 1 MW of annual installations would effect U.S. employment approximately 6x–12x more than a loss of 1 MW of manufacturing capacity.

Note: U.S. manufacturing is included in the ratio of 23 total PV workers per MW-DC above. A drop in installations may also increase the number of jobs in domestic cell and module manufacturing; however, this sector represents a relatively small portion of total U.S. PV manufacturing. Jobs related to PV inverters, racking, steel, polysilicon, and other hardware and material would all likely go down. O&M jobs are also included in this metric; however, it should be noted that they are likely more effected by total cumulative PV installations than annual PV installations.

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4 PV System Pricing

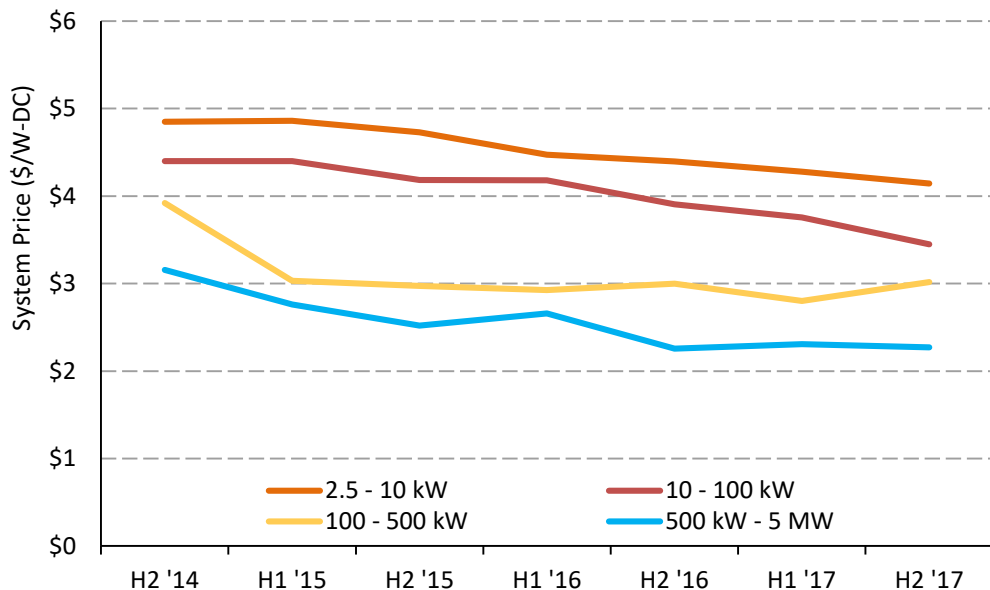
5 Global Manufacturing

6 Component Pricing

7 Market Activity

- From H2 2016 to H2 2017, the median reported PV system price in select major markets fell 6%–12% for small systems but increased 1% for larger systems.
- In Q3 2017, large residential installers report continued declines in installation costs; however, they face challenges reducing overhead costs.
- SolSystem reports a developer all-in asking price below \$1.5/W-DC in Q4 2017.

System Pricing from Select States



From H2 2016 to H2 2017, the median reported PV system price in the four states analyzed:

- Fell 6% to \$4.14/W, for systems 2.5 kW–10 kW
- Fell 12% to \$3.45/W, for systems 10 kW–100 kW
- Increased 1% to \$3.02/W, for systems 100 kW–500 kW
- Increased 1% to \$2.26/W, for systems 500 kW–5 MW.

H2 2017 MW: AZ (78), CA (320), MA (118), NY (90)

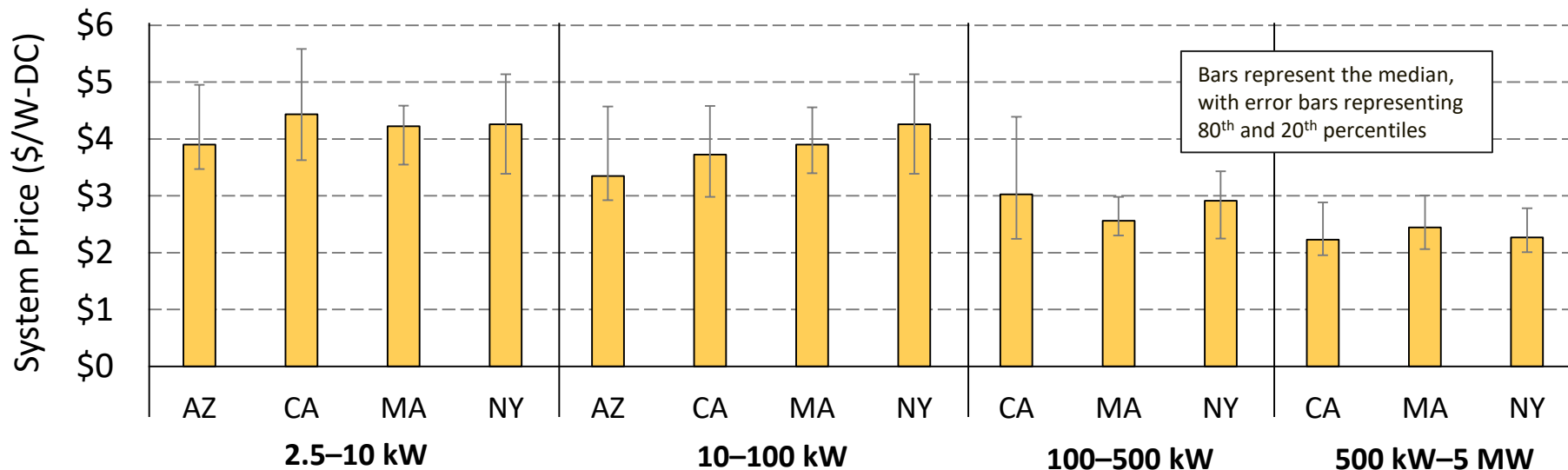
Note: California pricing data before 2015 are collected from the California Solar Initiative database. CA NEM data have only been reported through November 2017.

Sources: CA NEM database; MA SREC program; Arizona Public Services and Salt River Project; NY PV Incentive Program. All programs accessed 01/17/2018.

System Pricing from Select States, H2 2017

- In addition to price differences based on system size, there is also variation between states and within individual markets.

- In H2 2017, the median price of a small system in Arizona was about 12% less than the median price in California.
- In H2 2017, the 20th and 80th percentile prices in California for a system 100 kW–500 kW were \$4.39/W and \$2.24/W respectively.



H2 2017 MW: AZ (78), CA (320), MA (118), NY (90)

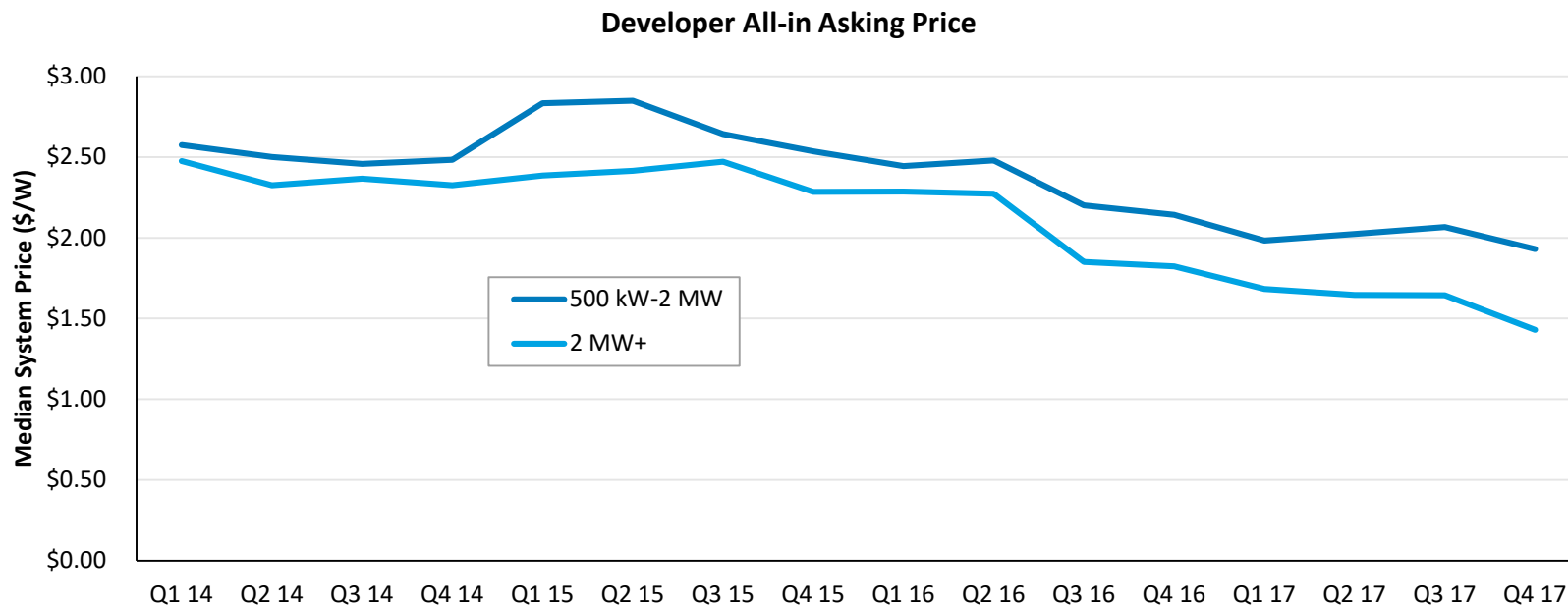
Note: California pricing data before 2015 are collected from the California Solar Initiative database. CA NEM data have only been reported through November 2017.

Sources: CA NEM database; MA SREC program; Arizona Public Services and Salt River Project; NY PV Incentive Program. All programs accessed 01/17/2018.

System Prices from Sol Systems

500 kW–2 MW and 2 MW+

Sol Systems reports that from Q4 2016 to Q4 2017 the median all-in asking price for systems 500 kW–2 MW fell approximately 10%, and the median all-in asking price for systems greater than 2 MW fell 22%.



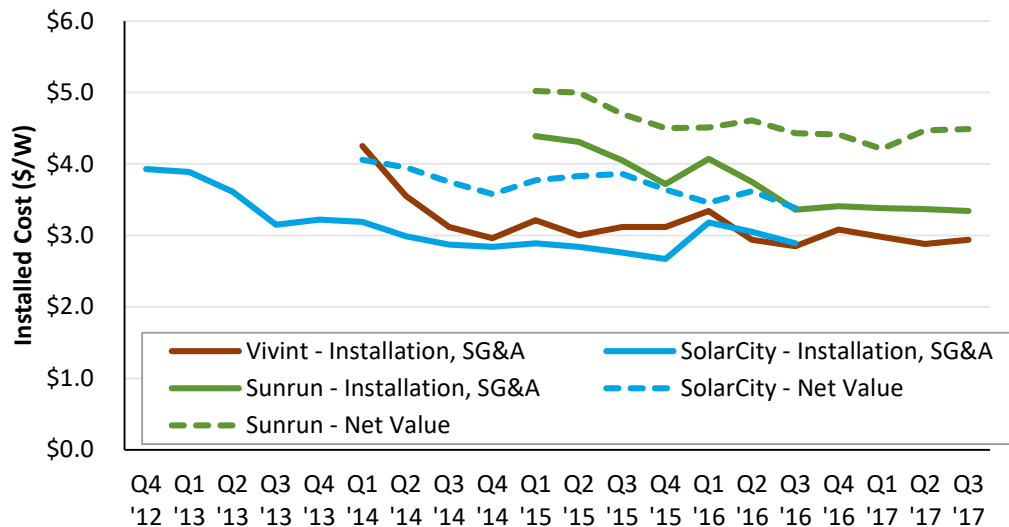
Note: Sol Systems reports values on a monthly basis. Values for each quarter from Q2 2016 to Q4 2017 represent the average of the three monthly medians reported each quarter. Prior to Q2 2016 Sol Systems only reported a high and low value for each market segment; values prior to Q2 2016 represent the midpoint between the reported high and low value.

Source: Sol Systems, "The Sol Source," March 2014—December 2017.

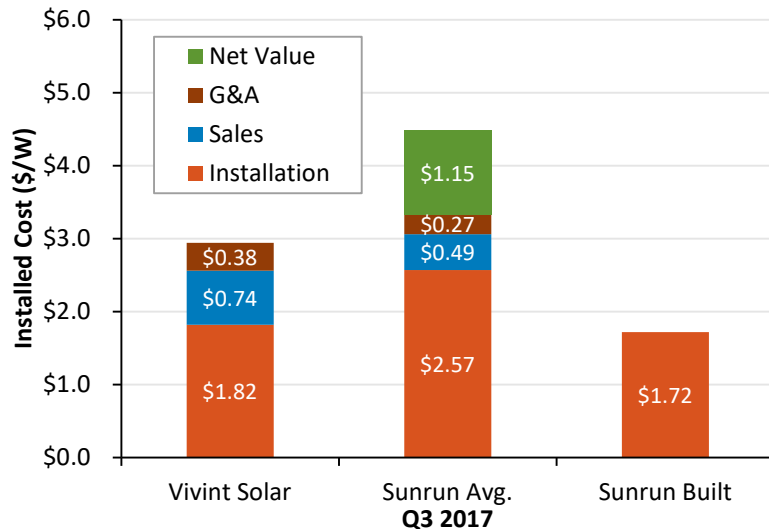
Vivint Solar, Sunrun, and SolarCity

Cost and Value

- From Q3 2016 to Q3 2017, Vivint Solar total system costs increased 3% and Sunrun total system costs decreased 1%.
 - Vivint Solar and Sunrun-built installation costs decreased 10% and 14% y/y respectively to between \$1.70/W and \$1.85/W.



- Vivint Solar's overhead costs increased from \$0.83/W to \$1.12/W over that time, while Sunrun's overhead costs decreased from \$0.88/W to \$0.76/W. Vivint Solar's quarterly installation levels have decreased while Sunrun's quarterly installation levels have increased.
- Sunrun reports much higher installation costs due to its large percentage of third-party-built systems.



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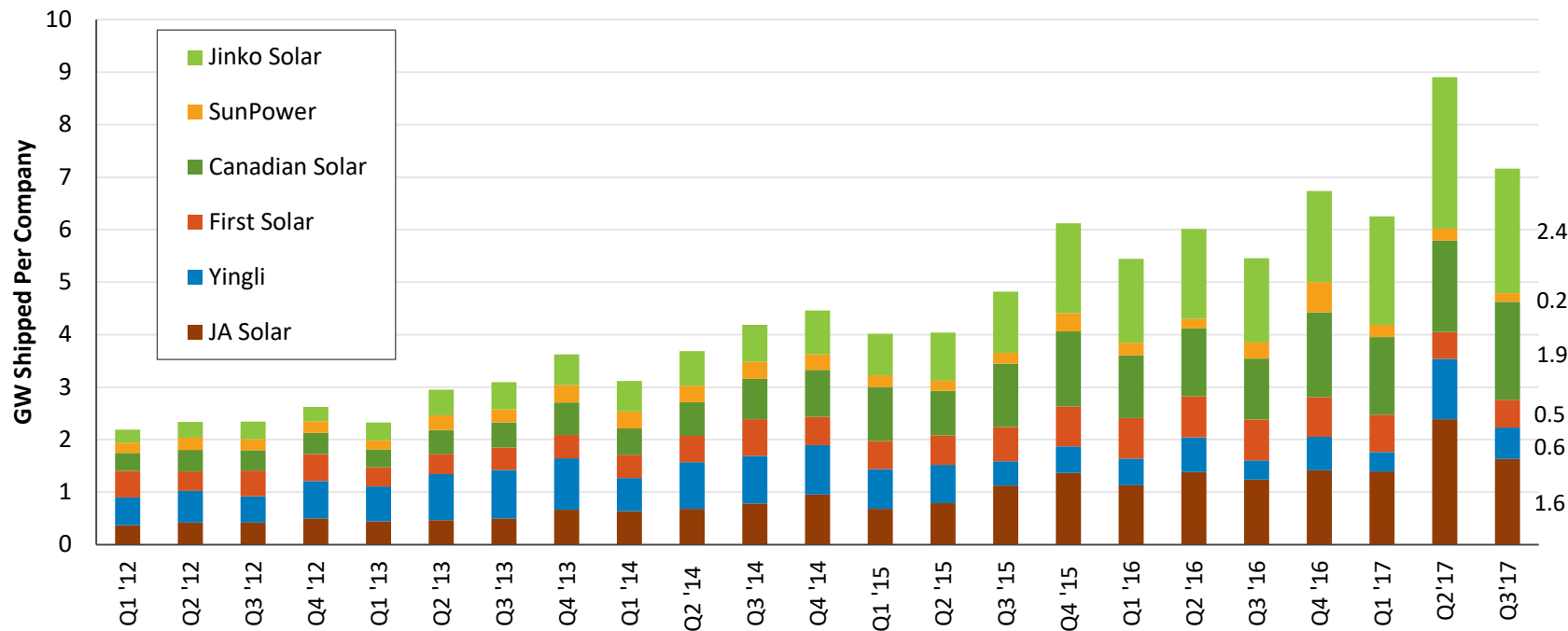
7 Market Activity

- In Q3 2017, PV shipments from companies we track fell 20% from the previous quarter, but they represented a 31% increase over Q3 2016.
- While gross margins continued to increase in Q3 2017, operating margins fell slightly.

Manufacturers' Shipments

Publically Traded Cell/Module Manufacturers

In Q3 2017, the tracked companies shipped 7.2 GW, a fall of 20% from the previous quarter but an increase of 31% over Q3 2016.

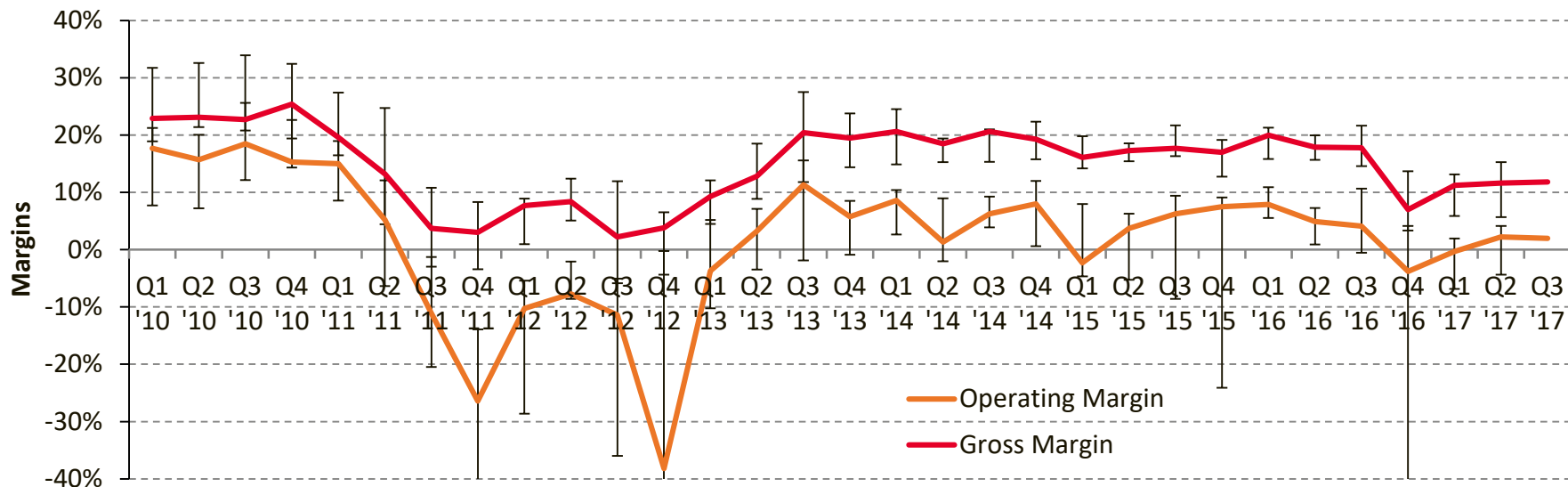


Note: First Solar reports production, not shipments.

Sources: Company figures based on Q3 2017 (and previous) SEC filings by the respective companies.

PV Manufacturers' Margins

While gross margins continued to increase in Q3 2017, operating margins fell slightly. The median gross margin was 12% and the median operating margin was 2% for the seven companies tracked.



Line represents the median, with error bars representing 80th and 20th percentiles for the following companies: Canadian Solar, First Solar, Hanwha Q Cells, JA Solar, Jinko Solar, SunPower, and Yingli Solar.

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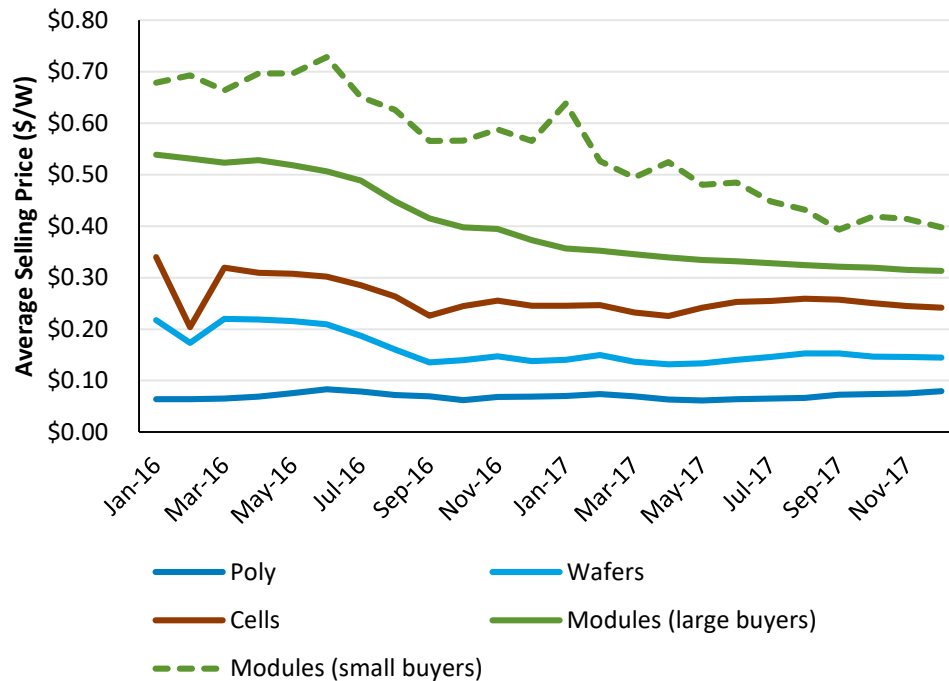
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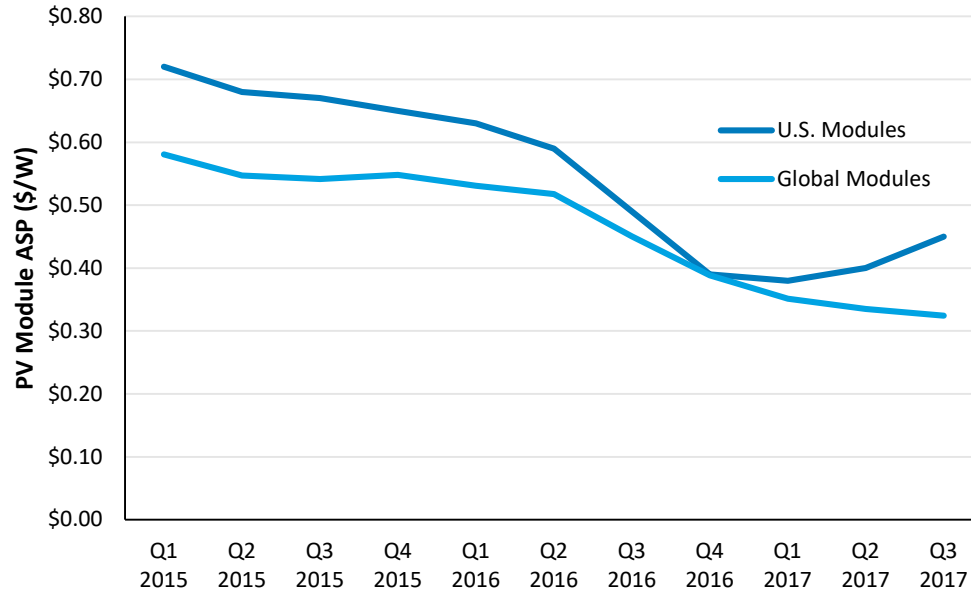
- **Global module ASP continues to decline to low-30 cents/W, while many manufacturers report module costs at similar values.**
- **U.S. module pricing traded at a premium in late 2017 due to tariff concerns.**
- **String and central inverter pricing were flat while MLPE price and costs continue to drop.**

Module Average Selling Price— Global vs. U.S.



- Module prices for larger and small buyers fell 12% and 38% in 2017, while over the same period, poly prices increased 13%—wafer and cell prices were flat in 2017.
- In 2017, poly pricing varied from \$13/kg to \$17/kg, making it harder for PV manufacturers to determine whether they can hit their cost-roadmap targets.
- BNEF and GTM Research report U.S. module prices have increased approximately \$0.10/W since the beginning of 2017, due to trade case fears.

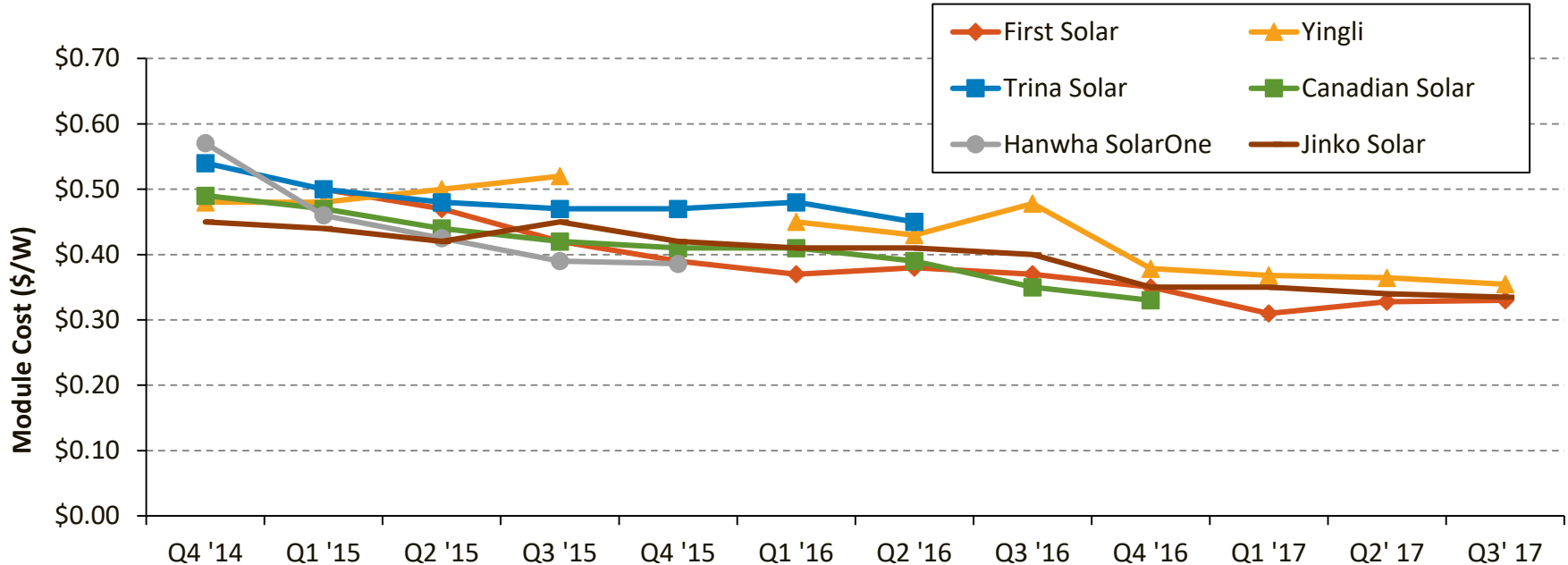
Module Average Selling Price— Global vs. U.S.



- Since tariffs were placed on Chinese modules in 2012, modules sold in the United States have sold at a premium to the global average; this trend was narrowing through 2016 due to increased manufacturing capacity in other parts of Asia.
- In 2017, the price gap widened again due to market fears of another tariff being placed on imported cells and modules.
 - Modules sold in the United States in Q3 2017 were 18% higher than modules sold in the United States in Q1 2017.

PV Manufacturers' Cost

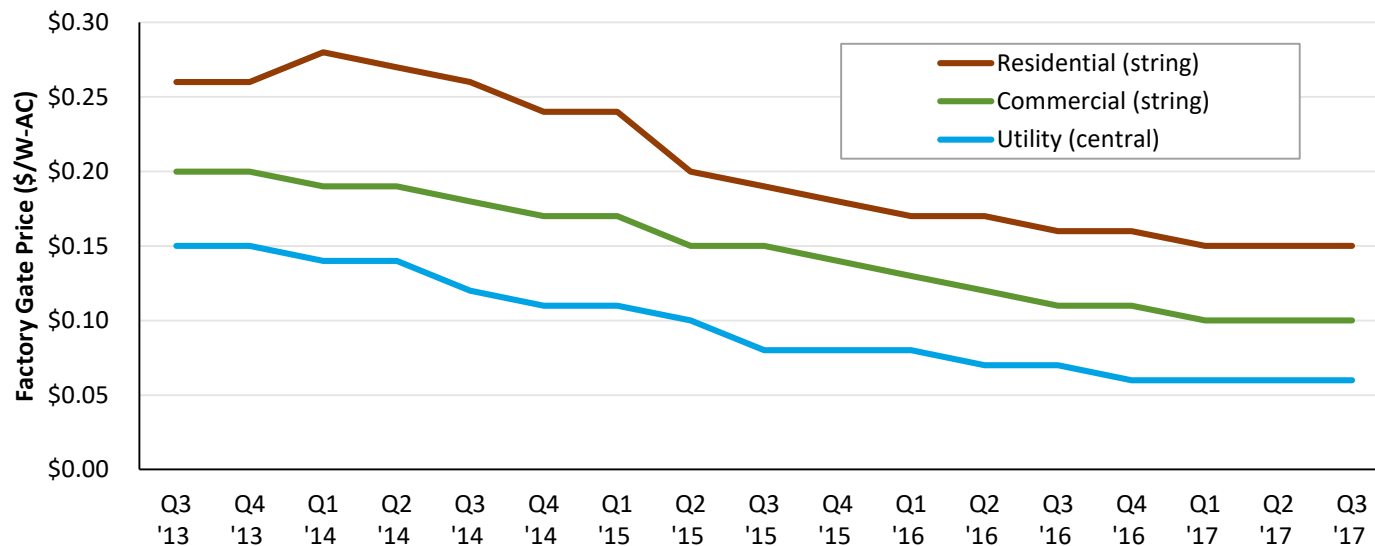
In Q3 2017 module costs were reported between \$0.33 and \$0.35. As prices have come down, fewer and fewer companies are reporting prices.



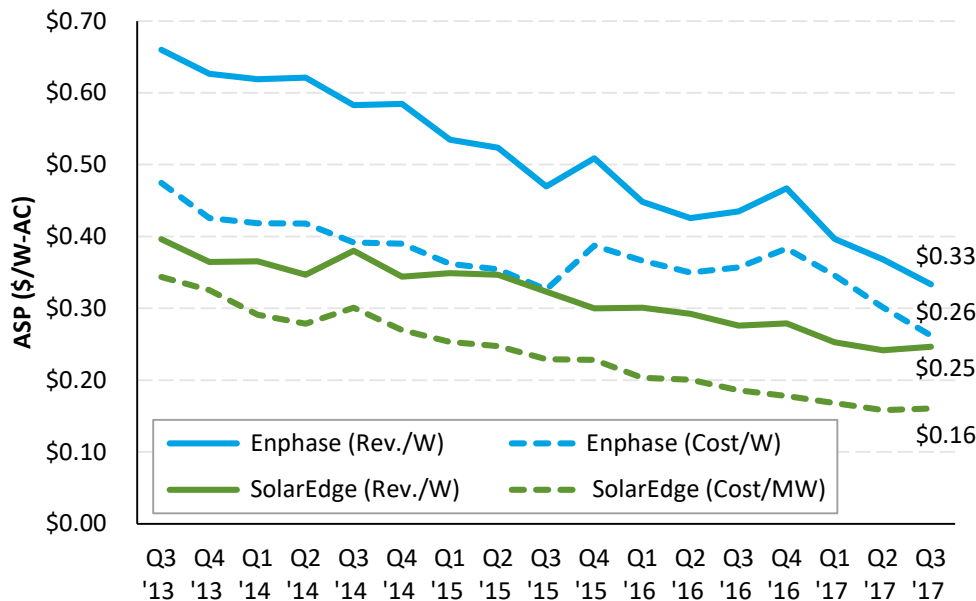
Inverter Pricing

Since Q3 2016, the decrease in inverter price has slowed.

- From Q1 2017 to Q3 2017, string and central inverters have been flat.



Enphase Microinverters and SolarEdge DC-Optimized Inverter Systems

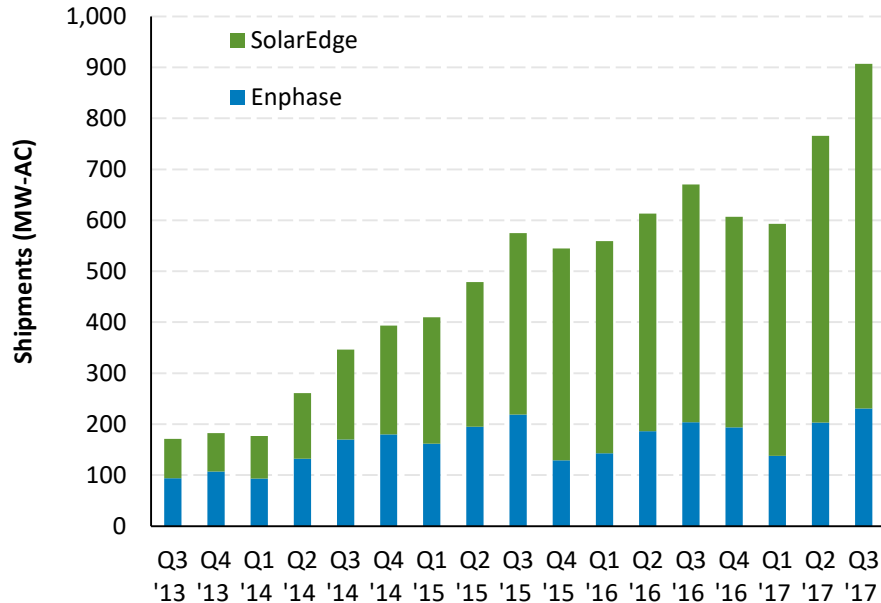


Module-level power electronics (MLPE) price and costs are at historical lows and shipments are at historical highs—companies are expanding into new markets, growing shipments but also growing competition.

- From Q3 2016 to Q3 2017, Enphase and SolarEdge MLPE prices fell 23% and 11% respectively.
- Enphase and SolarEdge MLPE costs also decreased by 27% and 14% respectively over the same period.
- These companies have also cut operating costs and are transitioning to more advanced technologies to better compete in this highly competitive marketplace.

Enphase Microinverters and SolarEdge DC-Optimized Inverter Systems

- In Q3 2017, Enphase and SolarEdge achieved record shipment levels, growing 13% and 45% y/y respectively.
- SolarEdge reported 51% of sales during Q3 2017 from end markets outside the United States. Management targets a long-term shift to an equal split of sales among North America, Europe, and Asia.
- Deutsche Bank reports that Huawei, the largest global inverter manufacturer, is readying its pre-UL shipments for its new MLPE product and plans to ship units to independent engineers for verification. This process, which most large distributed installers require, takes 3–6 months. They expect large volumes of orders in the United States by the summer of 2018.



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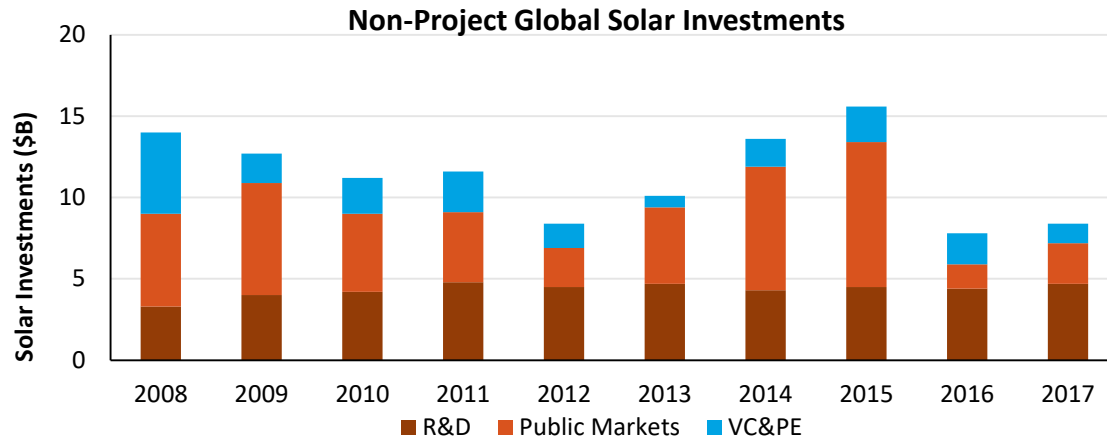
7 Market Activity

- Since 2011 global investments in solar energy has been approximately \$150B per year—the majority of global and U.S. investment in solar has historically gone to fund projects.
- Non-project global solar public market investments was significantly down in 2016–2017.
- In 2017, SREC pricing in most markets continued its downward trend, with some upward pricing trends in the later part of the year.
- In 2017, solar stocks, on average, performed much better than the broader market.

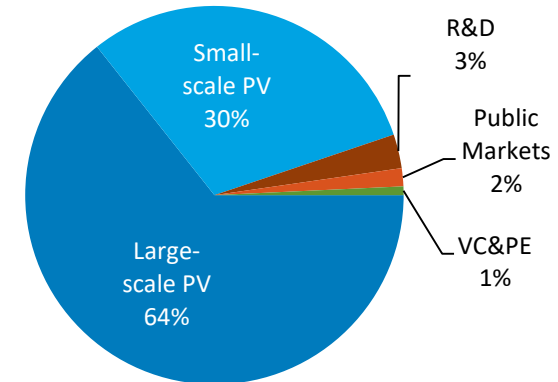
Global Solar Investments

- In 2017, non-project global solar public market investments grew 66% y/y, though still well below 2013–2015 levels.
- In 2017, VC&PE investments in solar were there second lowest in the past 10 years.
- The largest solar public market deal in 2017 was a \$465MM secondary capital raise by Risen Energy in China.

- Since 2011, global investments in solar energy have been approximately \$150B per year.
- The majority of global investment in solar has historically gone to fund projects—94% in 2017.
- Since 2009, governments and corporations have funded approximately \$4B per year in solar R&D.
- Public markets and VC&PE have varied significantly more over time, with a significant increase in public markets in 2013–2015 going toward yieldcos (e.g., Terraform and 8point3) and third-party residential companies (e.g., SolarCity and SunPower)—both of which were lower in 2016–2017.

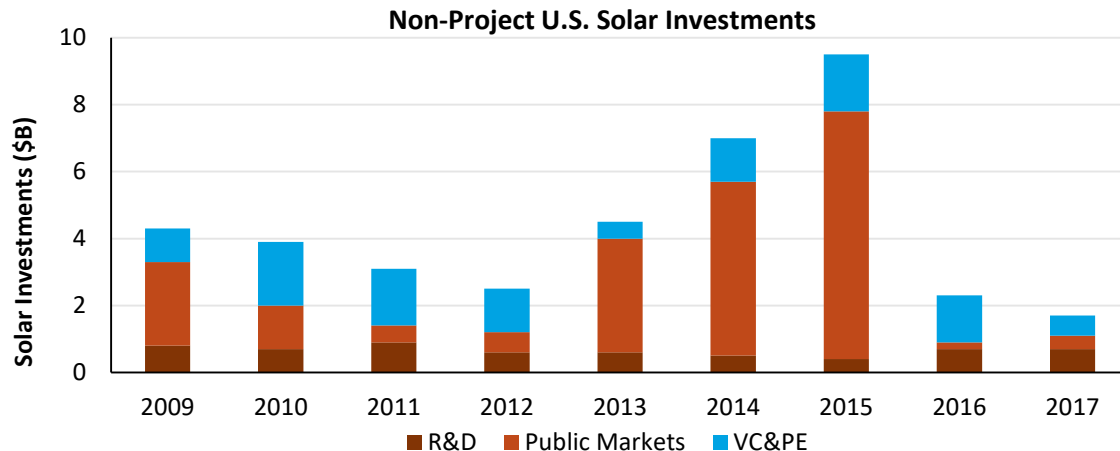


2017 Global Solar Investments (\$161B)



U.S. Solar Investments

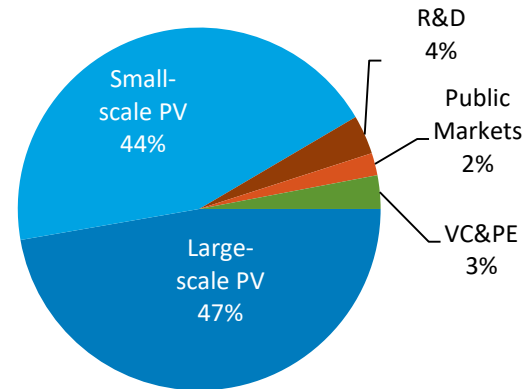
- Total U.S. investments in solar energy fell from \$31.8B in 2015 to \$19.8B in 2017.
- The majority of U.S. investment in solar has historically gone to fund projects—94% in 2017.
- U.S. public markets in 2013–2015 raised funds for yieldcos (e.g., Terraform and 8point3) and third-party residential companies (e.g., SolarCity, SunPower)—but dropped precipitously in 2016–2017.



Source: BNEF, "Clean Energy Investment Trends 2017"

- In 2017, Sunlight Financial, a New Jersey-based residential solar finance company, raised \$130MM of VC funding.
- Separate from the values reported below, in 2017, Canadian asset manager Brookfield purchased a majority share in both Terraform yieldcos from SunEdison, allowing SunEdison to emerge from bankruptcy.

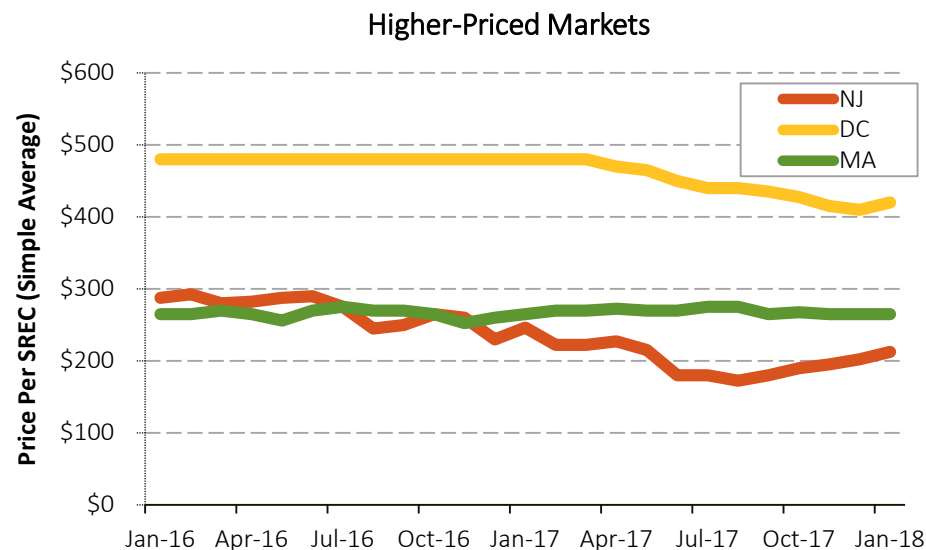
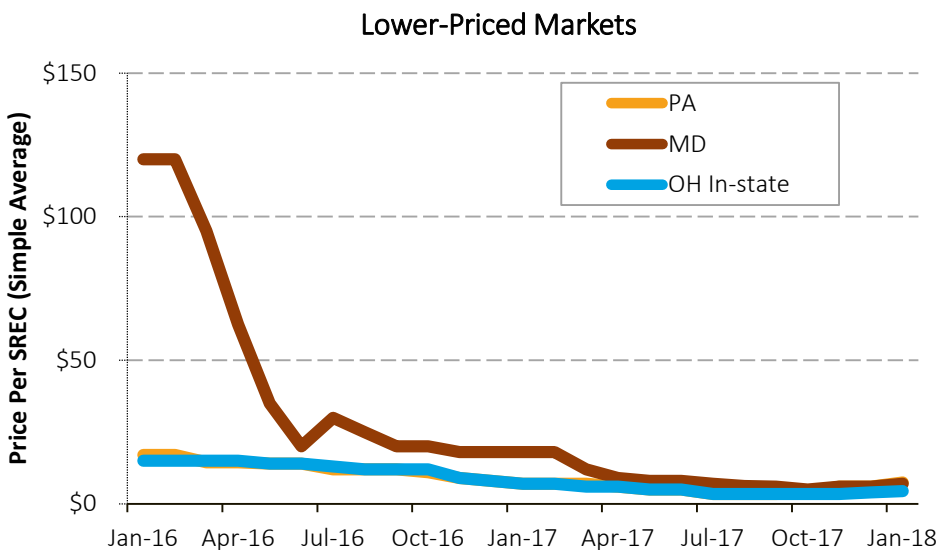
2017 U.S. Solar Investments (\$19.8B)



SREC Pricing

- In 2017, SREC pricing in most markets continued its downward trend, with some upward pricing trends in the later part of the year.

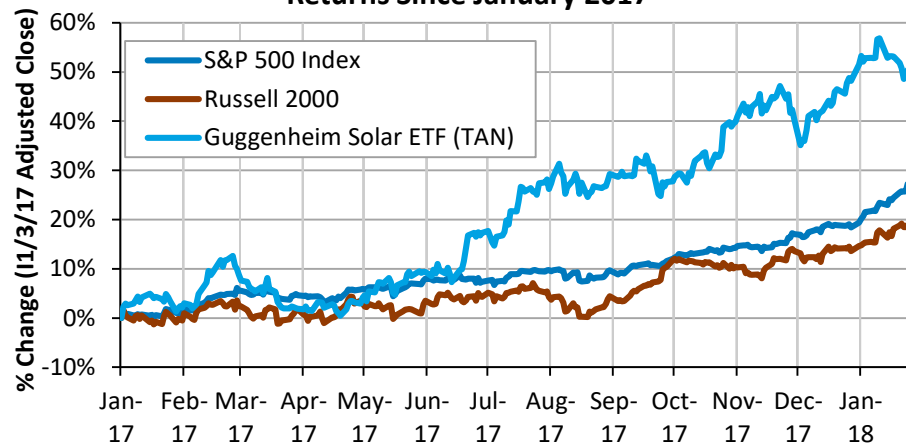
- Pennsylvania recently passed a law that prohibits future out-of-state facilities from registering in the PA SREC market—it is unclear what the decision will have on the market long-term. The spot market price of PA SRECs doubled between August 2017 and January 2018.
- New Jersey passed legislation to amend the state's RPS but it was pocket-vetoed by the outgoing governor. The bill was introduced again in 2018.



Stock Market Activity

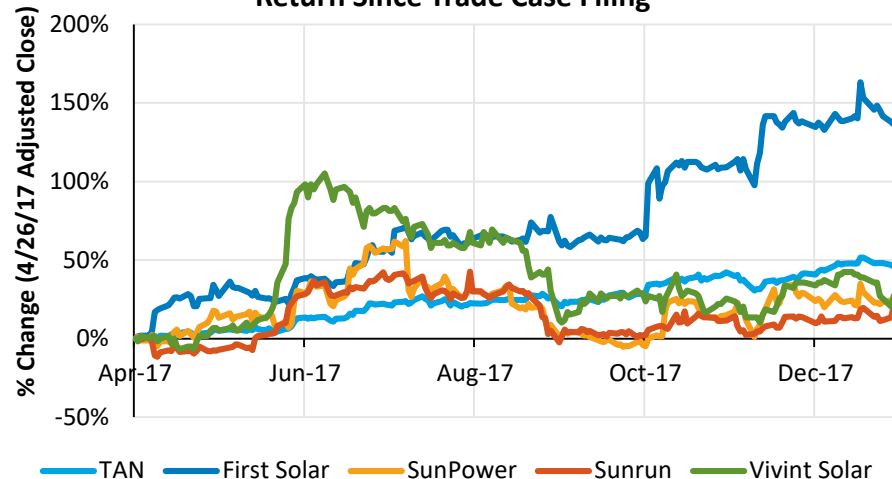
- In 2017, solar stocks, on average, performed much better than the broader market.
 - The Guggenheim Solar ETF (TAN) had its second-best yearly performance in 2017, at 52%, since its inception in 2008. TAN performance in 2013 was 134% and also followed a period of major module ASP decline.

Returns Since January 2017



- Since the Section 201 trade case filing, U.S. solar stocks have varied in performance, though all still report positive gains.
 - SunPower stock fell 5%–10% the week the final Section 201 proclamation was announced; however, it was still up over the trade-case period.

Return Since Trade Case Filing



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List of Acronyms and Abbreviations

• AC	alternating current	• MW	megawatt
• ASP	average selling price	• MWh	megawatt-hour
• B	billion	• NEM	net energy metering
• BEAT	base erosion anti-abuse tax	• O&M	operation and maintenance
• BNEF	Bloomberg New Energy Finance	• PE	private equity
• CBO	Congressional Budget Office	• PSC	public service commission
• C-Si	crystalline silicon	• PUC	public utility commission
• CSP	concentrating solar power	• PV	photovoltaic
• DC	direct current	• Q	quarter
• DPV	distributed photovoltaic system	• R&D	research and development
• EIA	Energy Information Administration	• SE	southeast
• ETF	exchange traded fund	• SEC	United States Securities Exchange Commission
• G&A	general and administrative expenses	• SG&A	selling, general and administrative expenses
• GSP	generalized system of preferences	• SREC	solar renewable energy certificate
• GW	gigawatt	• UPV	utility-scale photovoltaic system
• IBC	interdigitated back contact	• USITC	United States International Trade Commission
• IPP	independent power producer	• VC	venture capital
• ITC	Investment Tax Credit	• W	watt
• kW	kilowatt	• WTO	World Trade Organization
• kWh	kilowatt-hour	• y/y	year over year
• MACRS	modified accelerated cost recovery system		
• MLPE	module-level power electronics		