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# U.S. SOLAR MARKET INSIGHT

REPORT | 2014 YEAR IN REVIEW | EXECUTIVE SUMMARY



# About the Report

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**U.S. Solar Market Insight**<sup>®</sup> is a quarterly publication of GTM Research and the Solar Energy Industries Association (SEIA)<sup>®</sup>. Each quarter, we collect granular data on the U.S. solar market from nearly 200 utilities, state agencies, installers and manufacturers. This data provides the backbone of this U.S. Solar Market Insight<sup>®</sup> report, in which we identify and analyze trends in U.S. solar demand, manufacturing and pricing by state and market segment. We also use this analysis to look forward and forecast demand over the next five years. All forecasts are from GTM Research; SEIA does not predict future pricing, bid terms, costs, deployment or supply.

\* References, data, charts and analysis from this executive summary should be attributed to “GTM Research/SEIA U.S. Solar Market Insight<sup>®</sup>.”

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\* All figures are sourced from GTM Research. For more detail on methodology and sources, visit [www.gtmresearch.com/solarinsight](http://www.gtmresearch.com/solarinsight).

Our coverage in the U.S. Solar Market Insight reports includes 32 individual states and Washington, D.C. However, the national totals reported include all 50 states, Washington, D.C., and Puerto Rico.

Detailed data and forecasts for all 32 states are contained within the full version of this report, available at [www.greentechmedia.com/research/ussmi](http://www.greentechmedia.com/research/ussmi).

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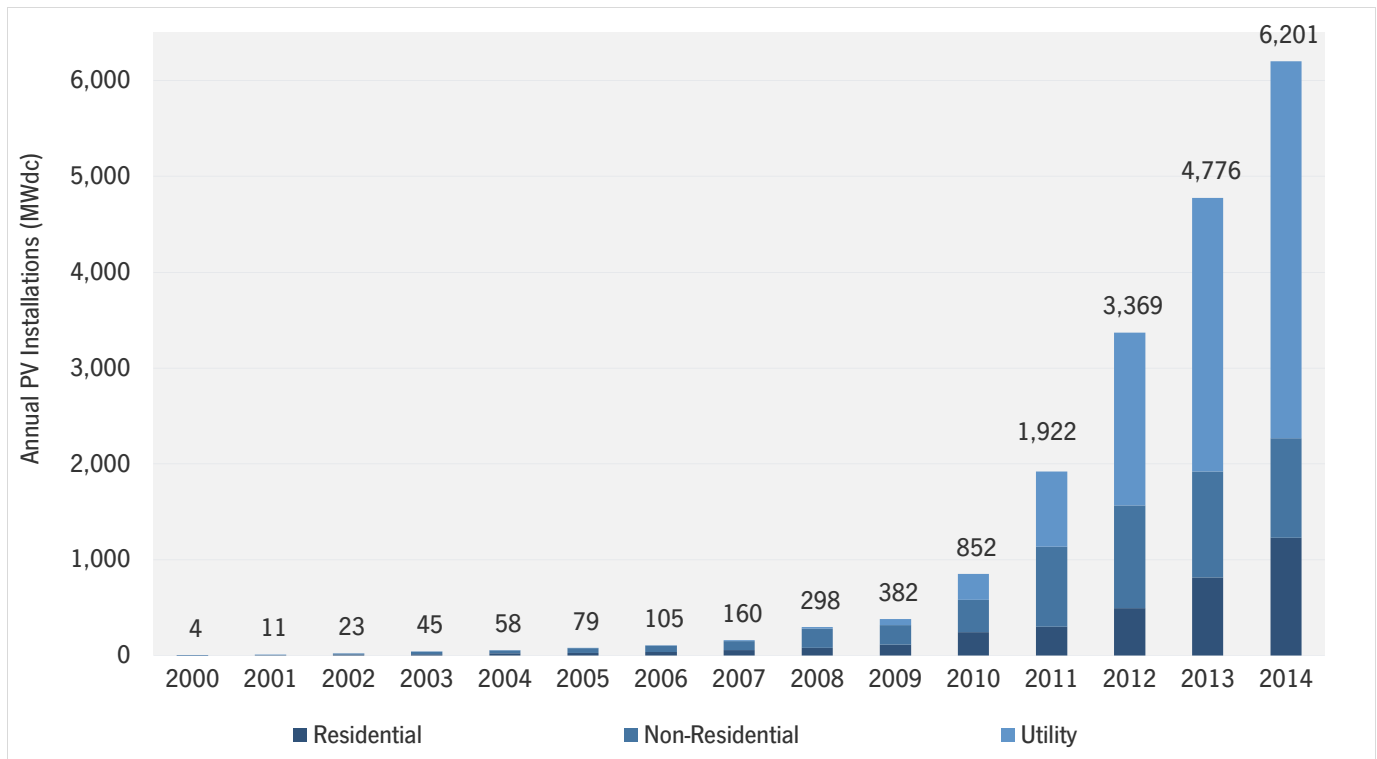
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# 1. Introduction

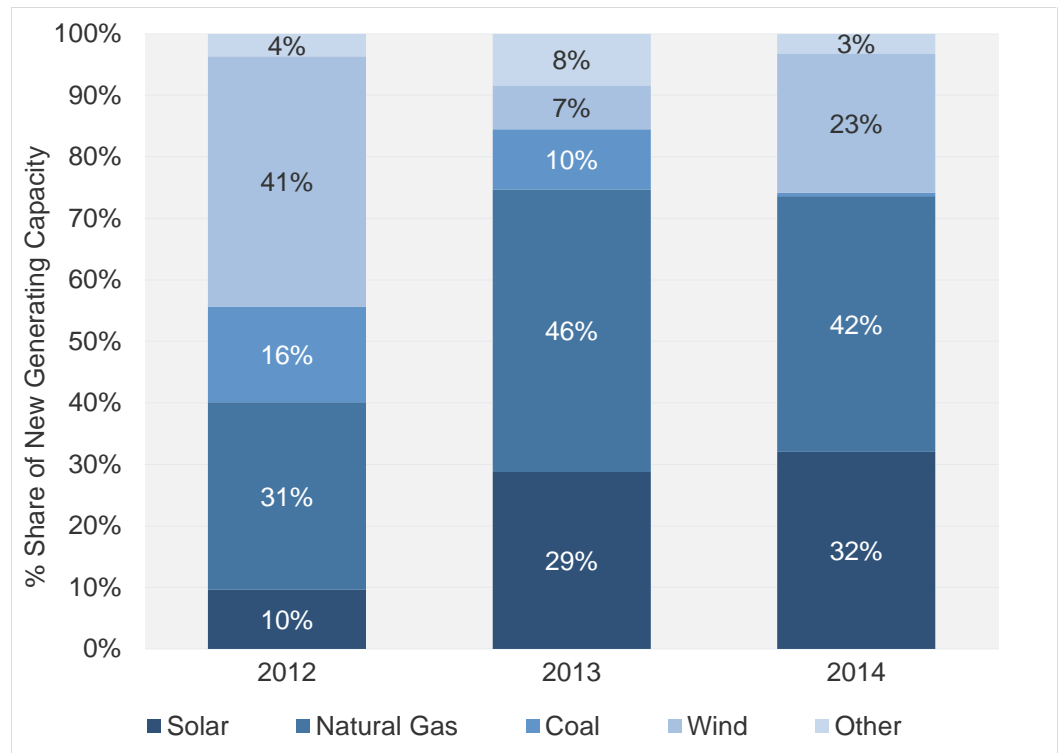
Solar energy posted another banner year in the U.S. in 2014. Photovoltaic (PV) installations reached 6,201 MW<sub>dc</sub>, up 30% over 2013 and more than 12 times the amount installed five years earlier. By the end of the year, a cumulative total of 18.3 GW<sub>dc</sub> of solar PV and another 2.2 GW<sub>ac</sub> of concentrating solar power (CSP) were operating in the U.S. Over 600,000 homes and businesses now have on-site solar (nearly 200,000 of these installations were completed in 2014), and six states are home to more than 500 MW<sub>dc</sub> each of operating solar capacity.

Figure 1.1 Annual U.S. Solar PV Installations, 2000-2014



As solar has grown in the U.S. over the past few years, so has its share of total new electricity generation capacity. In 2014, solar accounted for 32% of new generating capacity in the U.S., second only to natural gas.

**Figure 1.2 New U.S. Electric Generating Capacity Additions, 2012-2014**



Source: GTM Research, FERC

Note: SMI data used for solar and PV installation figures converted from DC to AC for apples-to-apples comparison. FERC data used for all other technologies.

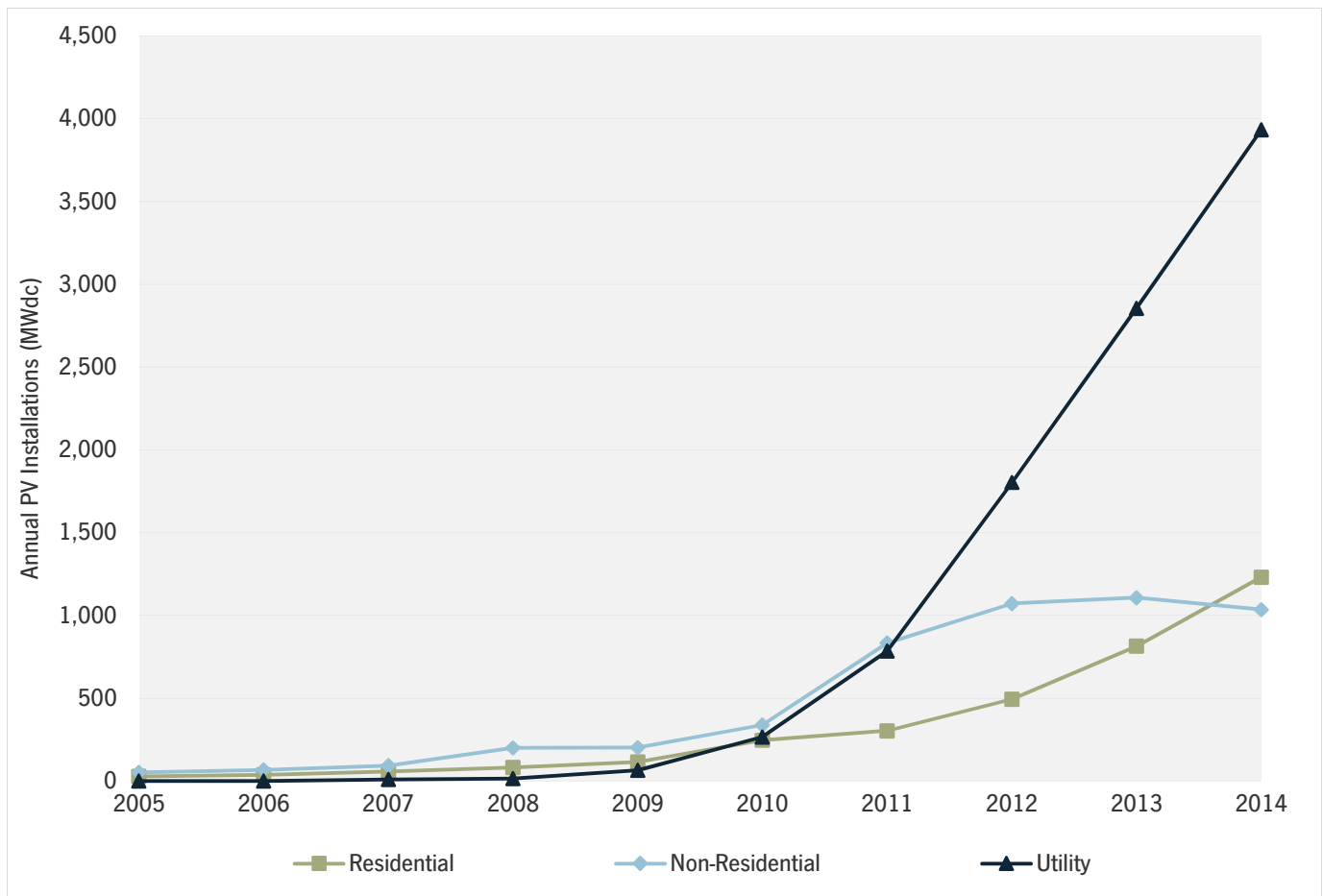
Three fundamental drivers have contributed to solar's continued growth in the U.S.

1. **Falling costs:** The cost of solar continues to fall across segments and states. While PV module prices remained relatively flat in 2014, balance-of-systems (BOS) prices fell precipitously, leading to an average 10% annual decline in system prices, depending on the market segment. In many states, solar is on the cusp of economic feasibility, so each incremental decline in prices opens up the market to new potential customers and makes solar more competitive with the alternative, whether that's retail electricity or new combined-cycle natural gas plants.
2. **Downstream innovation and expansion:** As the cost of solar has fallen, solar companies have created new and better ways to make solar available and attractive to more customers. In the residential market, the advent of financial solutions including power-purchase agreements (PPAs), leases and increasingly solar-optimized loans has opened up a wide swath of demand that previously did not exist. In the commercial market, developers sell multi-site portfolios to retailers, standardize their contracts to streamline financing, and now offer energy storage as an add-on to maximize solar's benefits by reducing demand charges. And in the utility-scale market, developers have sought procurement mechanisms

outside utility regulatory or legislative requirements, resulting in over 4 GW<sub>dc</sub> of new PPAs signed through non-traditional means over the past 12 months.

3. **Stable policy and regulation:** Despite an increasing number of proceedings regarding solar and electricity rate structures, the regulatory and policy environment for solar in the U.S. has generally been stable for the past few years. At the federal level, the industry has benefitted from the federal 30% Investment Tax Credit (more on that to follow), and most state policies have been reasonably clear and visible. As a result, businesses have been able to plan strategically and chart a clear course for expansion.

Figure 1.3 U.S. PV Installations by Segment, 2005-2014



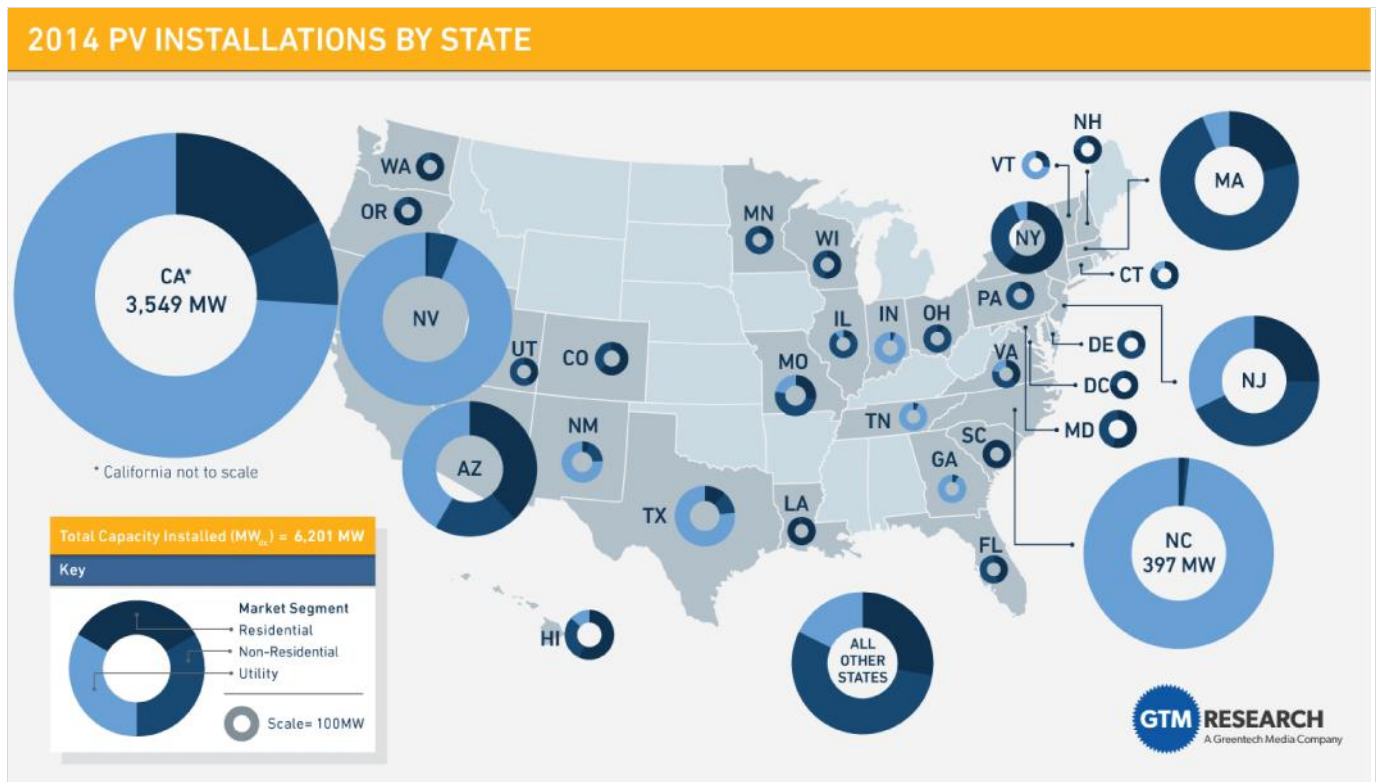
Without question, 2015 will be another growth year for U.S. solar. But a number of factors will dictate the course and trajectory of growth. Some key themes to watch in 2015:

- **The residential solar boom continues, but rate structure revisions threaten growth.** Home solar has been a consistent growth story over the past three years, posting annual growth rates over 50% in 2012, 2013 and 2014. But as we detail in this report, there are more than 20 ongoing proceedings that could impact residential solar’s value proposition through either changes to net energy metering or electricity

rate structures. 2015 will be the year in which some of the most prominent proceedings (most notably California’s AB 327) start to see resolution, while new debates will undoubtedly emerge.

- **Commercial solar is seeking a comeback.** While residential solar has soared in the U.S., commercial solar has stagnated. In 2014, just over 1,000 MW<sub>dc</sub> of commercial solar capacity was installed, down 6% from 2013 and even down 3% from 2012. Many factors have contributed to this trend, ranging from tight economics to difficulty financing small commercial installations. But 2015 will be a telling year for the commercial market. Many participants expect a pickup in demand in key states including California, New Jersey and New York, which, if proven true, could reignite the sector and bring it back on pace with the residential market.
- **The enormous utility-scale solar pipeline comes to fruition.** There are just over 14 GW<sub>dc</sub> of utility-scale solar projects in the U.S. with power-purchase agreements in place and expected completion dates of 2015 or 2016. The next two years will see a flurry of project completion announcements and unprecedented installation figures from the utility solar sector. There is no question that this segment will remain by far the largest in terms of annual capacity additions through 2016, but its fate after the 2017 ITC expiration remains in doubt.

Figure 1.4 U.S. PV Installations by State and Market Segment, 2014



Complete dataset available in the full report

Figure 1.5 State Solar PV Installation Rankings, 2012-2014

State	Rank			Installations (MWdc)		
	2012	2013	2014	2012	2013	2014
California	1	1	1	1,046	2,621	3,549
North Carolina	6	3	2	124	335	397
Nevada	4	12	3	198	47	339
Massachusetts	5	4	4	134	240	308
Arizona	2	2	5	719	421	247
New Jersey	3	5	6	419	236	240
New York	10	9	7	63	72	147
Texas	12	8	8	51	75	129
Hawaii	7	6	9	109	144	107
New Mexico	18	13	10	24	45	88
Missouri	23	17	11			
Maryland	8	16	12			
Colorado	9	10	13			
Indiana	31	11	14			
Tennessee	14	19	15			
Georgia	22	7	16			
Connecticut	21	15	17			
Vermont	20	21	18			
Florida	17	18	19			
Ohio	16	20	20			
Washington	25	23	21			
Utah	29	29	22			
Pennsylvania	11	14	23			
Oregon	15	24	24			
Delaware	19	22	25			
Illinois	13	32	26			
Minnesota	24	25	27			
Virginia	31	26	28			
New Hampshire	26	31	29			
Washington, D.C.	27	30	30			
Wisconsin	28	28	31			
South Carolina	30	27	32			

**Underlying Data Available in the Full Report**

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## Key Figures

- The U.S. installed 6,201 MW<sub>dc</sub> of solar PV in 2014, up 30% over 2013, making 2014 the largest year ever in terms of PV installations.
  - More than one-third of all cumulative operating PV capacity in the U.S. came on-line in 2014.
  - By the end of 2014, 20 states eclipsed the 100 MW<sub>dc</sub> mark for cumulative operating solar PV installations, and California's market alone is home to 8.7 GW<sub>dc</sub>.
  - For the first time ever, more than half a gigawatt of residential solar installations came on-line without any state incentive in 2014.
  - 32% of all new electric generating capacity in the U.S. came from solar in 2014.
  - Growth remains driven primarily by the utility solar PV market, which installed 1.5 GW<sub>ac</sub> in Q4 2014, the largest quarterly total ever for any market segment.
  - We forecast that PV installations will reach 8.1 GW<sub>dc</sub> in 2015, up 59% over 2014. Growth will occur in all segments, but will be most rapid in the residential market.
  - 2014 was the largest year ever for concentrating solar power, with 767 MW<sub>ac</sub> brought on-line. Notable project completions include the 392 MW<sub>ac</sub> Ivanpah project. Genesis Solar project's second phase of 125 MW<sub>ac</sub>, and Abengoa's Mojave Solar (250 MW<sub>ac</sub>), which achieved commercial operation in December 2014.
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## 2. Photovoltaics

### 2.1.1. Market Segment Trends

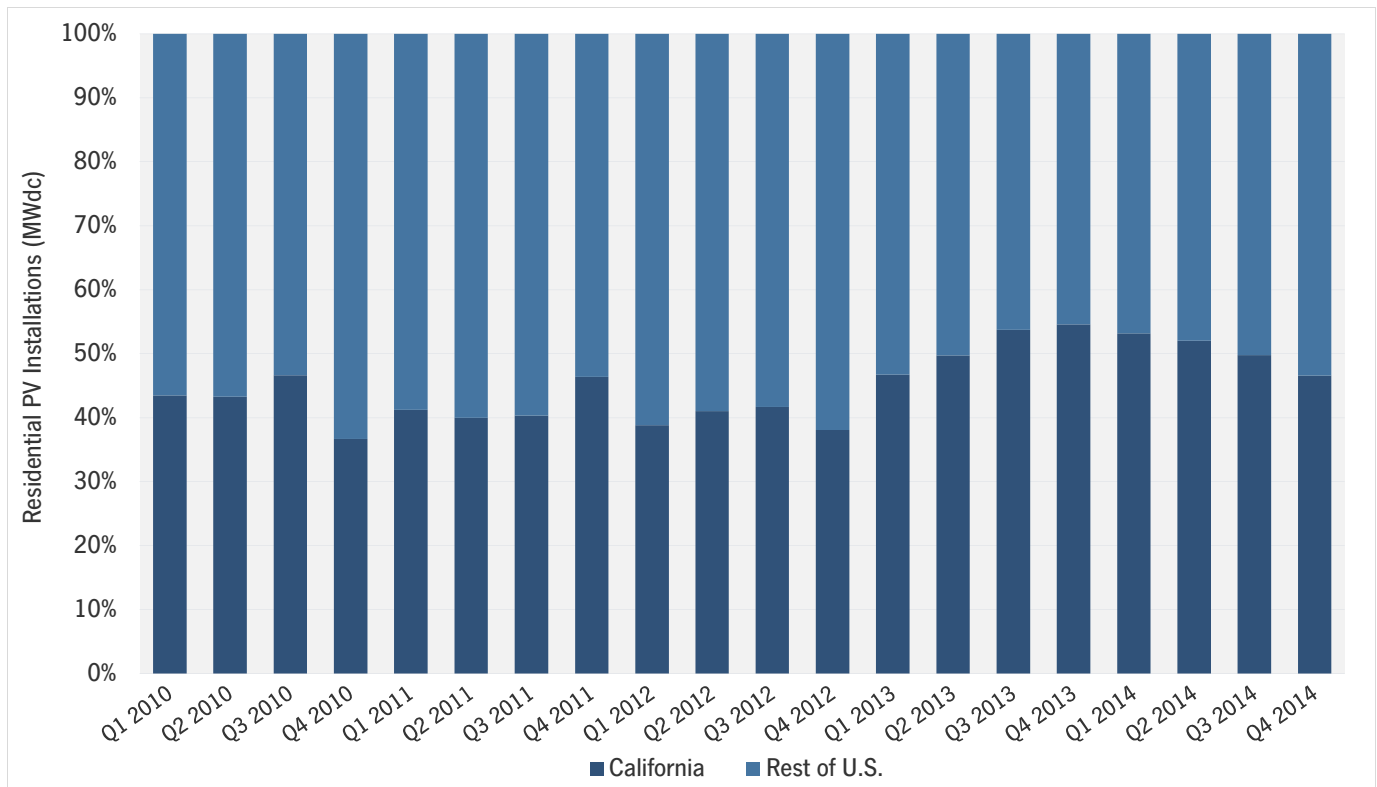
#### Residential PV

1,231 MW<sub>dc</sub> installed in 2014, representing 51% annual growth over 2013

2014 marked the third consecutive year of greater than 50% annual growth in the residential solar market, with over 186,000 individual installations completed during the year.

While California remains by far the dominant source of residential solar demand, Q4 2014 was the first quarter since early 2013 during which more than half of all residential solar in the U.S. came from other states. This has been a slow but consistent trend throughout 2014, with states such as Massachusetts, New York, Maryland and others growing even faster than California.

Figure 2.1 Share of Residential PV Installations, California vs. Rest of U.S.



### Non-Residential PV

**1,036 MW<sub>dc</sub> installed overall in 2014, down 6% from 2013**

The non-residential market jumped 28% in Q4 2014 versus the previous quarter, but this number was insufficient to keep the market from having its first down year in recent history. As we discuss further in the full report, the non-residential market has proven much harder to scale, and has been much more sensitive to incentive reduction, than the residential market. And while a few major state markets (Massachusetts, New York, California and Maryland) did grow in 2014, this expansion was offset by significant downturns in New Jersey, Arizona and Hawaii.

We remain confident that the non-residential market will see a resumption of growth in 2015. A wide range of states are poised to have a stronger year, while some of the incumbent markets (most notably New Jersey) appear to have hit their nadir.

### Utility PV

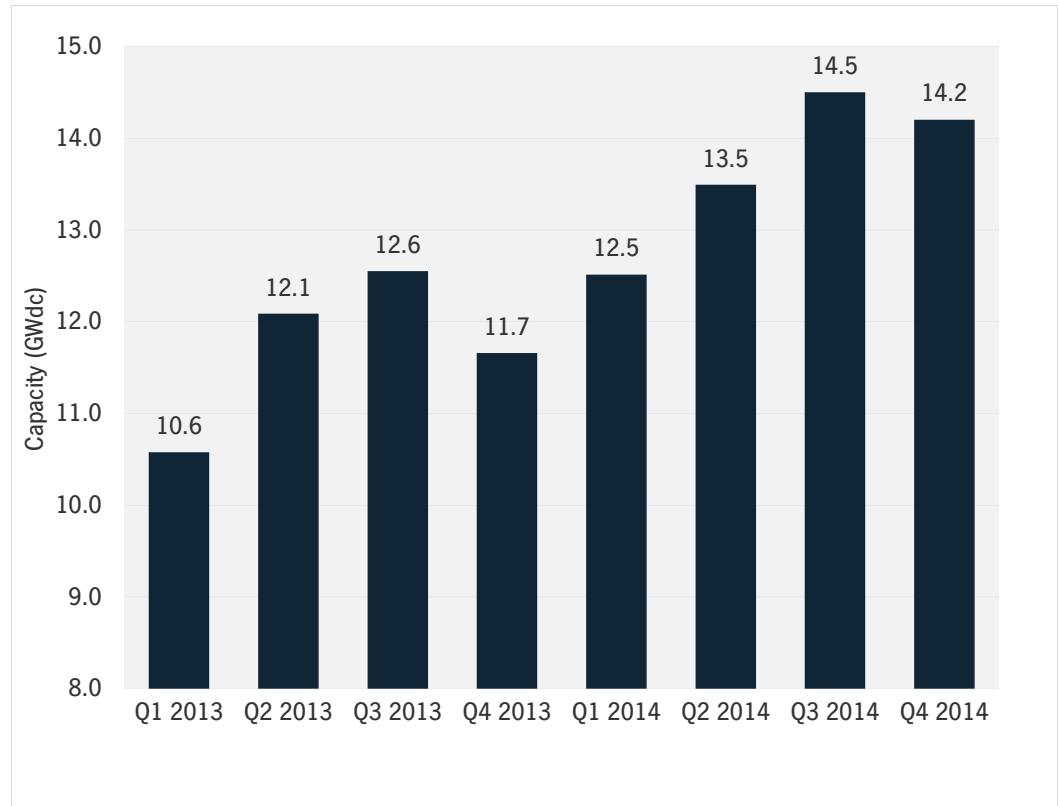
**3,934 MW<sub>dc</sub> installed overall in 2014, up 38% from 2013**

The utility PV sector continues to remain the bedrock of demand within the U.S. solar market, accounting for 63% of all PV capacity brought on-line in 2014. Most notably, First Solar's Topaz Solar and Desert Sunlight projects, each 550 MW<sub>ac</sub>, achieved full commercial operation at the end of 2014, ranking as the largest solar projects currently on-line in the world.

In addition to being a record year in terms of installation growth, 2014 was a busy period for project developers as utilities ramped up procurement opportunities to optimize the number of projects eligible to come on-line before the federal ITC is scheduled to drop at the end of 2016.

This rush was not only born out of the necessity of meeting RPS obligations, but also due to utility PV's growing economic competitiveness in the broader electricity market. As mentioned, by year's end, more than 4 GW<sub>dc</sub> of centralized PV capacity had been procured by utilities based on solar's competitiveness with natural-gas alternatives. Looking ahead to the rest of 2015, we expect utility procurement efforts to slow down, as developers double down on efforts to complete ambitious project pipelines before the end of 2016.

Figure 2.2 Utility PV Contracted Pipeline, Q1 2013-Q4 2014



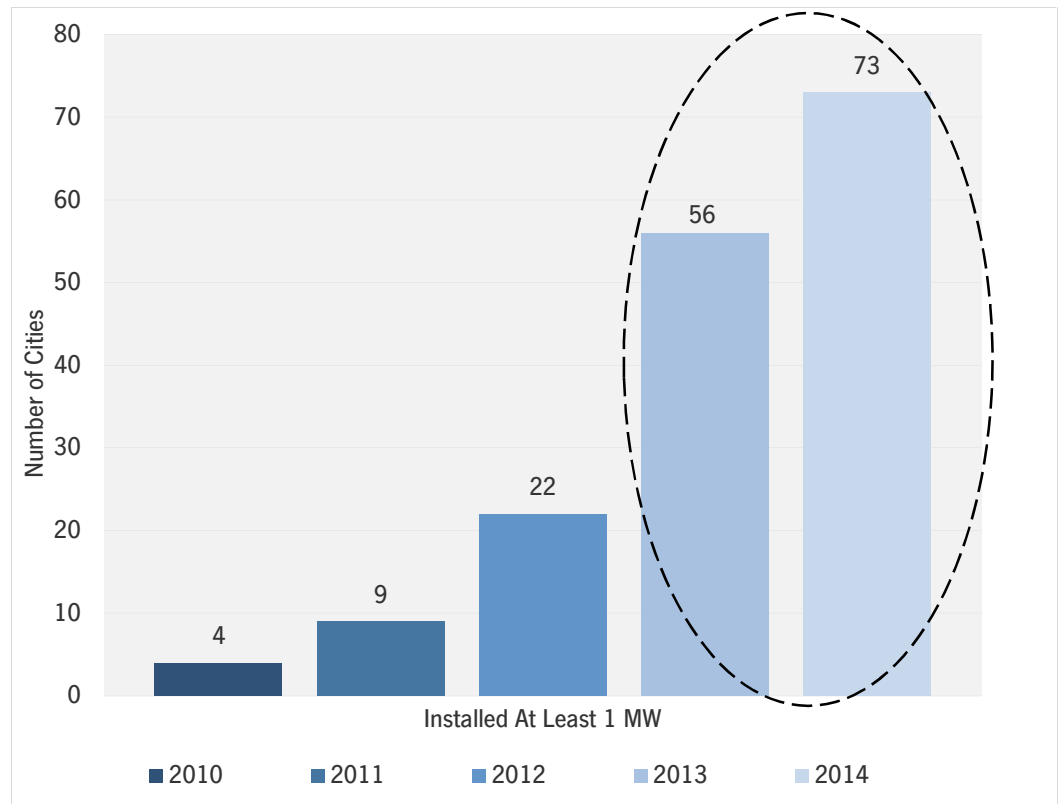
Source: GTM Research, U.S. Utility PV Tracker

### 2.1.2. Full Report Excerpt | California Residential PV: The Epicenter of Market Maturity

In 2014, California once again reigned supreme as the largest residential state market in the U.S. – adding well over half a gigawatt for the first time on an annual basis. As analyzed further in the full report, rebate funding offered by the California Solar Initiative has fully depleted for residential installations. Given that, three key factors fueled California’s continued momentum in 2014.

- Scale via geographic diversification:** This past year saw numerous in-state and national installers ramp up sales footprints from one to two utility service territories, especially those with a longstanding, exclusive presence in either SDG&E or SCE’s markets. As Figure 2.3 illustrates, installers have undertaken unprecedented geographic diversification over the last 24 months. More than 70 towns and cities in Southern California added at least 1 MW of residential solar in 2014, a milestone that only 22 cities had achieved two years prior.

Figure 2.3 Cities in Southern California That Installed 1 MW or More of Residential PV Annually, 2010-2014



Based on residential PV installation figures for SDG&E, SCE, and LADWP territories

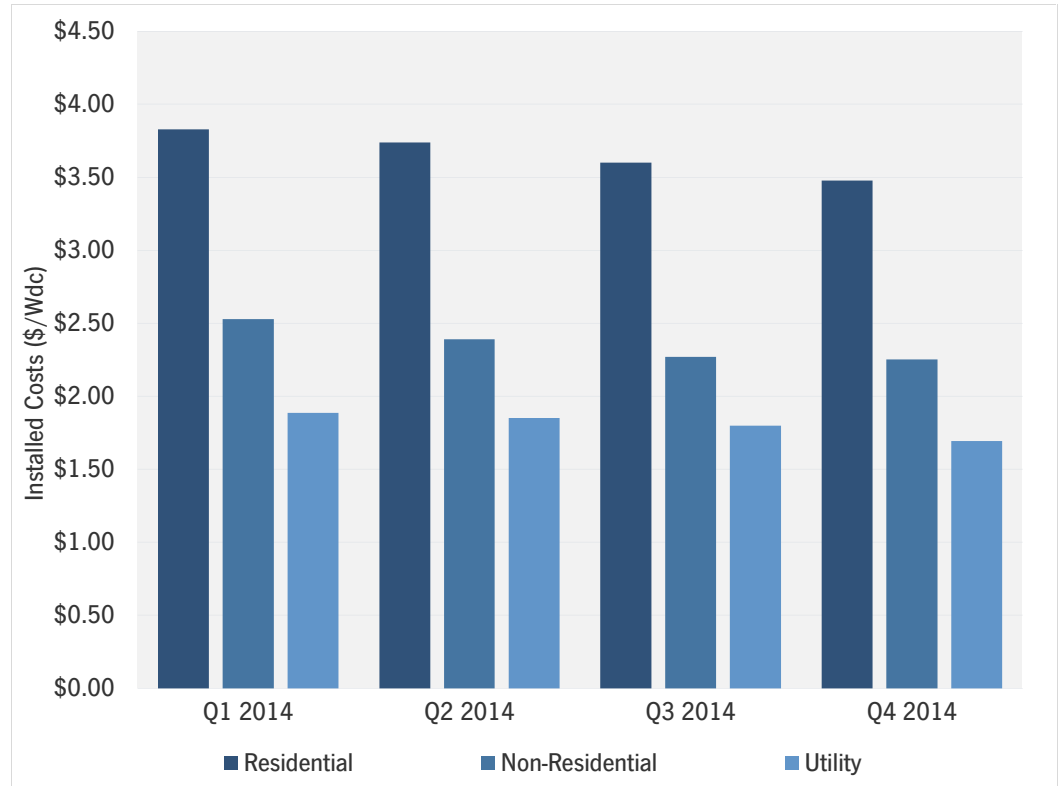
- Above-average electricity bill hikes spurred higher sales:** In the summer of 2014, the CPUC approved retail rate hikes for customers of IOU utilities who use less energy, which in turn expanded the pool of customers willing to install solar in California, an option offering savings of 10% to 20% on their monthly bills.
- Standardizing financing and installation solutions:** The diversification of homeowner financing solutions, including PACE and solar loans, has scaled up closing rates for customers eager to own rooftop solar rather than signing a lease or PPA. On top of that, installers are speeding up sales-to-installation timelines by tapping into communities with over-the-counter permitting processes.

In 2015, California will be the first state to add more than 200 MW<sub>dc</sub> of residential installations in a given quarter. Based on the continued availability of third-party financing solutions, along with the increasing penetration of PACE and other loan products, California's market remains well positioned to sustain its rank as the top residential state market. But amidst this continued growth, for the first time since its passage, AB 327 (which will create a net energy metering successor program, among other things) is already having a material impact on demand for residential solar within the state. In particular, certain installers are pushing to expedite sales through the first half of 2015, due to concerns that the aggregate NEM capacity limit could be reached by Q4 2015 or early 2016. Once the cap is reached, the next version of NEM is scheduled to take effect, although decisions regarding NEM rule revisions could be announced by the CPUC as late as December 2015.

## 2.2. National Solar PV System Pricing

Our bottom-up system-price estimation methodology is based on tracked wholesale pricing of major solar components and data collected from major installers, with national average pricing supplemented by data collected from utility and state programs. The full report contains cost buildup, as well as reported system pricing from state and utility incentive programs.

**Figure 2.4 U.S. National Average System Costs by Market Segment**



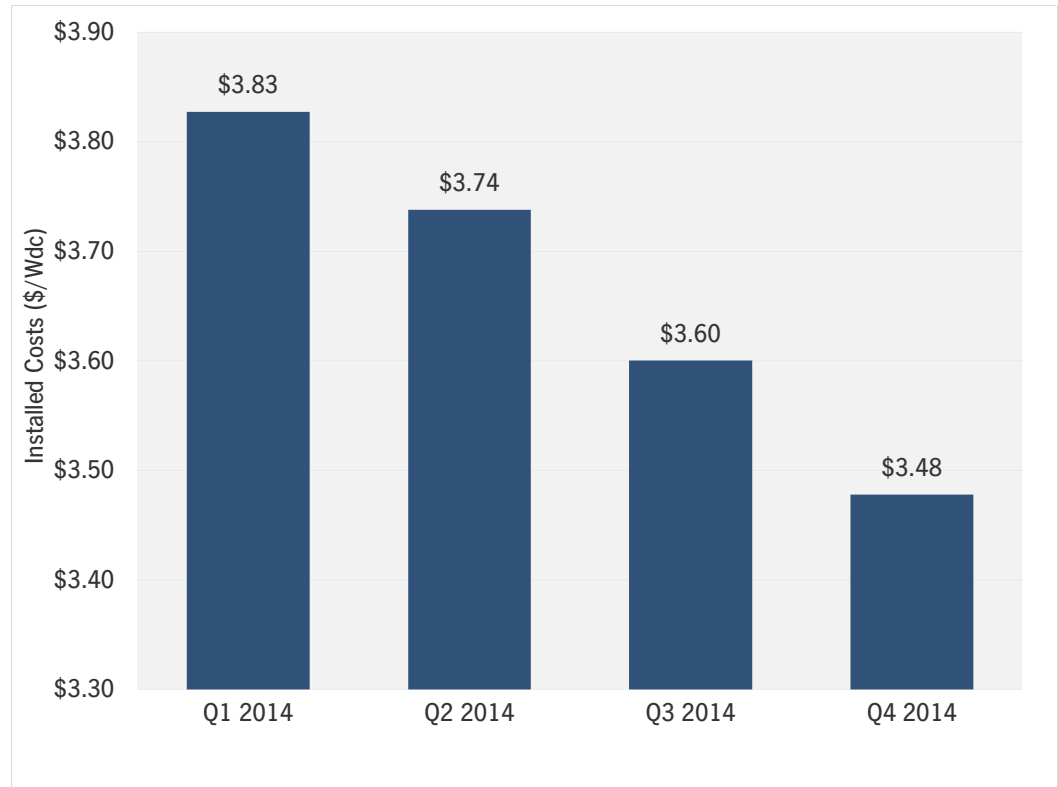
Note: Detailed information about national system prices by market segment and component is available in the full report.

System costs dropped by 9% to 12% over the course of 2014, depending on the market segment. While specific cost reduction areas vary depending on market segment, competition amongst hardware suppliers, more efficient installation and operations, industry scale and more aggressive bidding have driven costs down across the board – even as PV module costs remained relatively stable. Total installation costs for utility and large commercial systems have fallen below \$2.00/W<sub>dc</sub> and are now below 2011 module costs, underscoring the magnitude of the impact of falling module prices and incremental balance-of-system reductions.

### 2.2.1. National Residential System Pricing

Note: Detailed breakdowns of national residential system prices by market segment and component are available in the full report.

Figure 2.5 Residential Turnkey Rooftop PV System Installed Costs, Q1 2014-Q4 2014



Note: Assumes a 5-10 kW<sub>ac</sub> rooftop system, standard crystalline silicon modules, blended string and microinverters

Our model shows weighted national residential system costs at \$3.48/W<sub>dc</sub> in the fourth quarter, representing a 3.3% decrease quarter-over-quarter. Best-in-class installers are achieving lower costs by leaning on high installation volumes that allow the purchase of hardware directly from manufacturers, as well as by amortizing overhead costs over a larger installation base.

On an absolute basis, the residential PV market has seen the sharpest cost declines of the three market segments. Weighted average pricing in the segment fell by \$0.40/W<sub>dc</sub> from 2013, despite increases in both module pricing and average inverter pricing (from a larger proportion of residential systems using module-level power electronics).

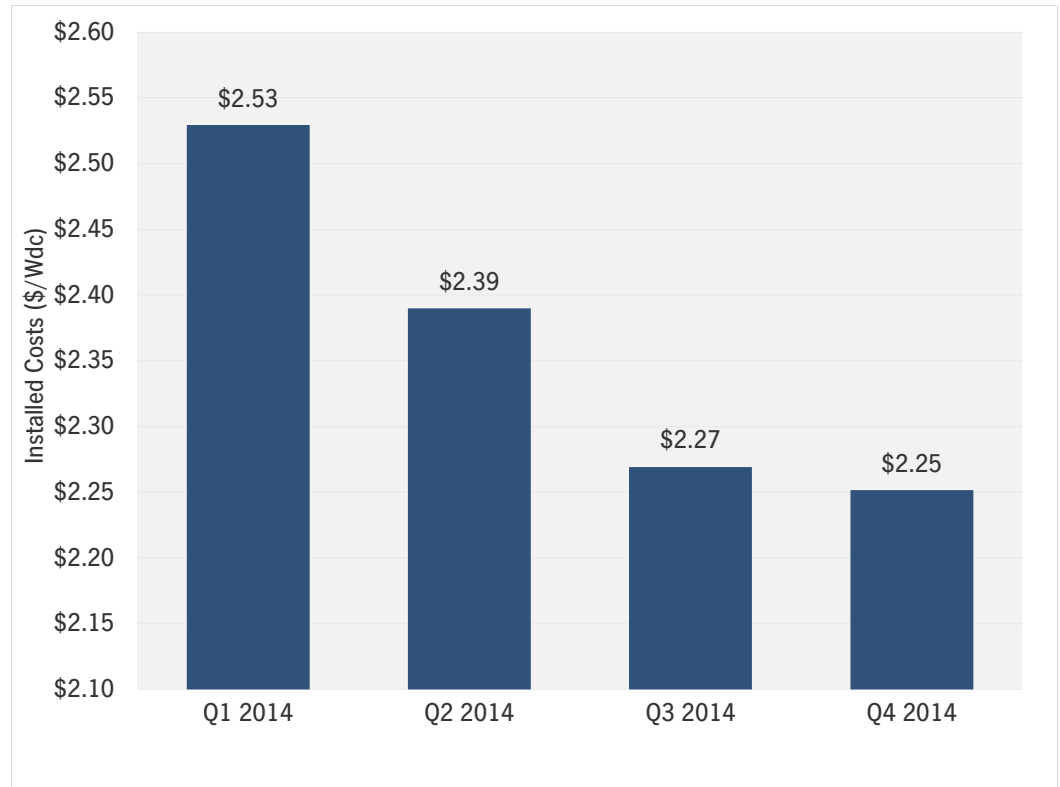
While soft costs still make up 60% of system costs, tremendous cost-reduction efforts resulted in more efficient installations and operations throughout 2014. In fact, hardware component manufacturers are focusing on the effect of hardware on logistical effort and installation times as much as they are on manufacturing efficiencies. Still, significant opportunities to reduce costs remain; we have found that the share of customer acquisition costs have fallen by only 0.4% in the past year (from 12% of total system costs to 11.6% of total systems costs).

Furthermore, we have not seen a strong correlation between customer acquisition cost reduction and the size of the solar company, suggesting that customer acquisition is an industry-wide challenge.

### 2.3. National Non-Residential System Pricing

Note: Detailed breakdowns of national residential system prices by market segment are available in the full report.

Figure 2.6 Non-Residential Turnkey Rooftop PV System Installed Costs, Q1 2014-Q4 2014



Note: Assumes a 5 kW rooftop system, standard crystalline silicon modules, blended string and microinverters

Our modeled cost for a medium-scale commercial system is \$2.25/W<sub>dc</sub> for the fourth quarter of 2014, with a full-year blended average of \$2.36/W<sub>dc</sub>. This represents a 20% decrease year-over-year, with significant reductions in the structural balance-of-system costs, as well as more competitive pressure on margins throughout the value chain. Similar to residential systems, these overhead and soft costs represent a significant share of the overall project cost structure and could be reduced if the market scales up.

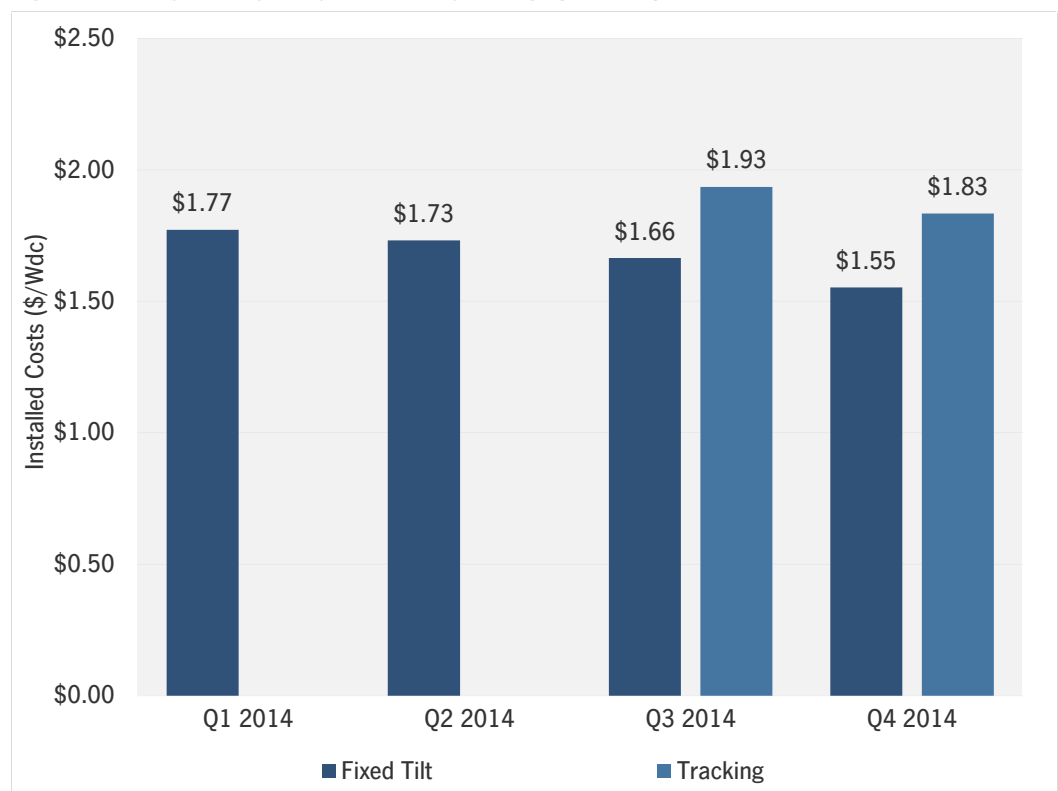
## 2.4. National Utility System Pricing

Note: Detailed breakdowns of national residential system prices by market segment are available in the full report.

Modeled costs of a fixed-tilt utility system land at \$1.55/W<sub>dc</sub> in the fourth quarter of 2014, reflecting a significant drop from last quarter's \$1.66/W<sub>dc</sub> pricing. In particular, we have witnessed strong pressure on racking pricing, with the lowest costs under \$0.10/W<sub>dc</sub>.

We also find that costs for systems installed in Q4 2014 came in as low as \$1.40/W<sub>dc</sub> and as high as \$2.10/W<sub>dc</sub>. Low pricing reflects strong competition in new markets with low labor pricing, such as those in the Southeast U.S. High pricing reflects systems with legacy PPAs and higher-cost labor and components.

Figure 2.7 Utility Turnkey PV System Turnkey Pricing, Q1 2014-Q4 2014



Note: Assumes a 10 MW<sub>dc</sub> fixed-tilt or horizontal single-axis ground-mount system with standard crystalline silicon

## 2.5. Component Pricing

### 2.5.1. Polysilicon, Wafers, Cells and Modules

Blended pricing for polysilicon was up year-over-year, increasing 21% to \$21.5/kg in Q4 2014. This increase was driven by both polysilicon demand recovery in 2014 and favorable supply-demand dynamics. In contrast to dramatic polysilicon price growth, end-of-year multi wafer prices were even with 2013 year-end levels, at \$0.22/W. Multi cells were the one component in which prices fell, down 25% Y/Y to \$0.32/W.



It should be noted that following the U.S. imposition of antidumping duties on Taiwanese cells and modules, Chinese producers largely switched from using Taiwanese cells in U.S.-bound modules to using Chinese cells. Previously, prices for Taiwanese-produced cells were relevant to determining the price for a U.S.-bound Chinese-produced module (Q2 2012-Q3 2014), whereas prices and tariffs on Chinese-produced cells now drive module prices.

Module pricing in the U.S. differs widely based on order volume, producer region and individual firm. During the fourth quarter, delivered prices for Chinese modules ranged from \$0.69/W on the low side (corresponding to order volumes greater than 10 MW) to \$0.73/W on the high side (order volumes of less than 1 MW). The blended delivered price for Chinese-produced multi modules is estimated to have risen 1% Y/Y to \$0.73/W in Q4 2014. This upward trend contrasts with the downward global module price trend and was driven by the United States' unique price driver: the imposition of new tariffs on Chinese and Taiwanese produced modules. Pricing for delivered American modules, as well as modules from the other Asian countries (Korea, Malaysia, Singapore) selling into the residential and commercial sector were in the low- to mid- \$0.80/W range, largely in sync with price levels throughout the year.

**Figure 2.8 U.S. Polysilicon, Wafer, Cell, and Module Prices, Q4 2013-Q4 2014**

	Q4 2013	Q1 2014	Q2 2014	Q3 2014	Q4 2014
Polysilicon (\$/kg)	\$17.72	\$21.70	\$22.13	\$21.69	\$21.47
Wafer (\$/W)	\$0.22	\$0.24	\$0.23	\$0.22	\$0.22
Cell (\$/W)	\$0.43	\$0.44	\$0.42	\$0.32	\$0.32
Module (\$/W)	\$0.72	\$0.73	\$0.73	\$0.75	\$0.73

Source: GTM Research

## 2.6. Market Outlook

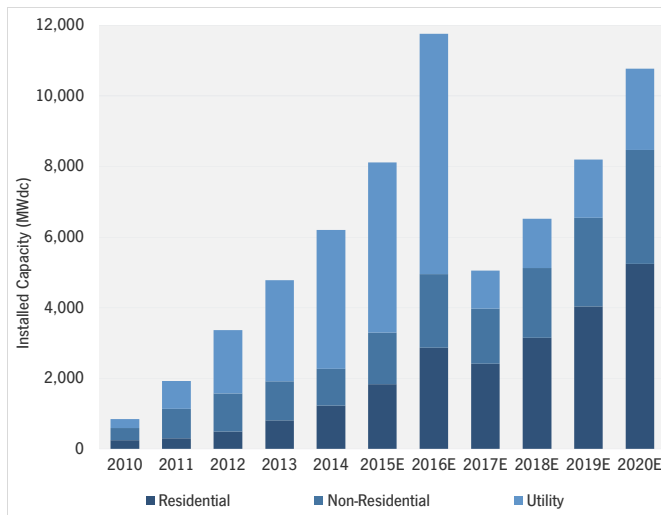
We expect another strong year for the U.S. PV market in 2015, with installations reaching 8.1 GW<sub>dc</sub>, a 31% increase over 2014. The fastest growth will come from the residential segment, followed by the non-residential segment. Utility PV will grow the slowest compared to 2014, but will still account for 59% of all installations brought on-line.

On January 1, 2017, the 30% federal investment tax credit (ITC) is scheduled to drop to 10% for commercial projects under section 48 of the tax code, while the credit for individuals under section 25d is scheduled to expire entirely. Businesses across the solar energy industry have begun preparing for the worst while hoping for the best. In general, solar businesses will try to bring as much capacity online as possible before the scheduled stepdown. Solar development will continue, but some markets will fare better than others and resumption of growth after 2017 will look different from the growth seen over the past eight years. For all market segments, the total addressable market will shrink post-2016, some states will fall off the solar map entirely, and resumption of growth at a national level will be due to several states with strong economics.

The utility-scale market shows the most dramatic drop in 2017 not only because of the challenges posed by the lower ITC, but also because project developers have largely turned their attention to bringing their contracted projects online before the end of 2016 in order to capture the full 30% credit. Many of these projects have long-term PPAs that begin in 2017 or later but will sell electricity either through short-term PPAs or on the spot market to bridge the gap between their commercial operation date and the beginning of their long-term PPAs. This pull-in of the utility solar pipeline will make the ITC cliff dramatic. Overall, installations are expected to drop 57% in 2017.

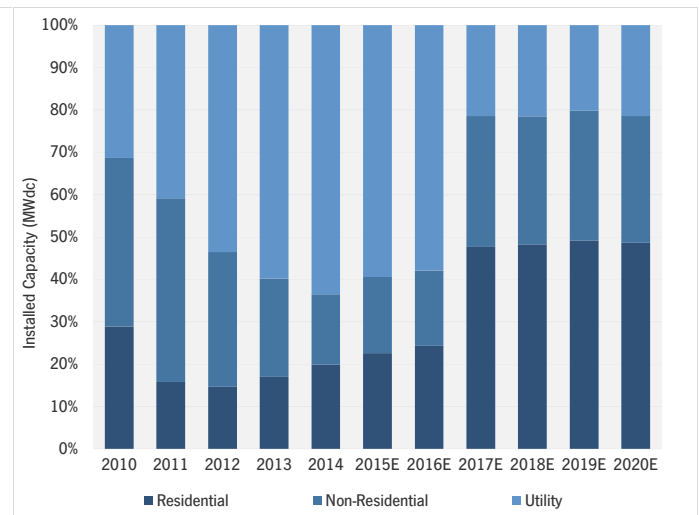
Forecast details by state (32 states) and market segment through 2020 are available in the [full report](#).

Figure 2.9 U.S. PV Installation Forecast, 2010-2020E



Source: GTM Research

Figure 2.10 U.S. PV Installation Forecast by Segment, 2010-2020E



Note: Complete forecast by state and market segment available in the full report

### 3. Concentrating Solar Power

The final quarter of 2013 kicked off the first wave of mega-scale CSP projects to be completed over the next few years, and Q1 2014 built on that momentum with 517 MW<sub>ac</sub> brought on-line. This included BrightSource Energy's 392 MW<sub>ac</sub> Ivanpah project and the second and final 125 MW<sub>ac</sub> phase of NextEra's Genesis solar project. While Q2 2014 and Q3 2014 were dormant for CSP, Abengoa finished commissioning its 250 MW<sub>ac</sub> Mojave Solar project in December 2014. As a result, 2014 ranks as the largest year ever for CSP, with 767 MW<sub>ac</sub> brought on-line. The next notable project slated for completion is SolarReserve's 110 MW<sub>ac</sub> Crescent Dunes project, which entered the commissioning phase in February 2014 and is now expected to become fully operational before the end of March 2015.

In 2016, growth prospects for the CSP market in the U.S. are bleak. On one hand, CSP when paired with storage represents an attractive generation resource for utilities, offering a number of ancillary and resource adequacy benefits. However, due to extensive permitting hurdles that have confronted CSP projects, developers are putting their CSP pipelines on hold given the short window to bring projects online before the federal ITC is scheduled to expire at the end of 2016. Most notably, Abengoa's Palen Solar project, BrightSource's Hidden Hills project, and SolarReserve's Rice Solar project are all delayed indefinitely.

Beyond 2016, the outlook for the CSP market will depend on further progress made towards mitigating early stage development hurdles, lowering hardware costs, and strengthening the ancillary and capacity benefits provided by CSP paired with storage.



# U.S. SOLAR MARKET INSIGHT

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### FULL REPORT

- Installations by market segment for the top 32 states and Washington DC
- Installed cost by market segment for each state
- State-by-state market analysis
- Component pricing across the value chain
- Manufacturing capacity & production by component
- Demand projections out to 2020 by technology, market segment & state



### EXECUTIVE SUMMARY - FREE

- National aggregate capacity additions
- National aggregate number of installations
- National weighted average installed price
- National aggregate manufacturing production



# U.S. SOLAR MARKET INSIGHT

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## WHO BUYS US SOLAR MARKET INSIGHT?

Subscribers to U.S. Solar Market Insight include:



Technology Firms



Component Manufacturers



BOS Providers



System Integrators



Residential Third-Party Financiers



Project Developers



Utilities & IPPs



Investors

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