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U.S. Solar Market Insight

Executive summary

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About the report

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U.S. Solar Market Insight® is a quarterly publication of Wood Mackenzie and the Solar Energy Industries Association (SEIA)®. 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® report, in which we identify and analyze trends in U.S. solar demand, manufacturing and pricing by state and market segment over the next five to ten years. All forecasts are from Wood Mackenzie, Limited; SEIA does not predict future pricing, bid terms, costs, deployment or supply. The report includes all 50 states and Washington, D.C. National totals reported also include Puerto Rico and other U.S. territories. Detailed data and forecasts for 50 states and Washington, D.C. are contained within the full version of the report.

References and Contact

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- Media inquiries should be directed to Wood Mackenzie’s PR team (WoodmacPR@woodmac.com) and Morgan Lyons (mlyons@seia.org) at SEIA.
- All figures are sourced from Wood Mackenzie. For more detail on methodology and sources, access the full report at www.woodmac.com/research/products/power-and-renewables/us-solar-market-insight/.

Note on U.S. Solar Market Insight report title: The report title is based on the quarter in which the report is released, not the most recent quarter of installation figures.

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1. Key figures

- In Q1 2021, the U.S. solar market installed just over 5 GW_{dc} of solar capacity, a 46% increase over the first quarter of 2020 and the largest Q1 on record.
- With Q1 additions, cumulative solar capacity in the U.S. has officially surpassed 100 GW_{dc} and is expected to pass 100 GW_{ac} next year.¹
- Solar accounted for 58% of all new electricity-generating capacity added in the U.S. in Q1 2021, with wind making up most of the remainder.
- Residential solar was down 8% from Q4 2020, but up 11% from Q1 2020 with 905 MW_{dc} installed, thanks to healthy sales pipelines that spilled over into the first quarter.
- Commercial solar and community solar volumes declined from Q4 2020, as is typical for these market segments. Commercial solar increased 19% over Q1 2020 and community solar declined 15% from Q1 2020.
- Utility-scale solar set a record for first-quarter installations at 3.6 GW_{dc}. Texas made up the largest share of this capacity, with more than 1.4 GW_{dc} of installations.
- A total of 6.2 GW_{dc} of new utility-scale solar power purchase agreements were announced in Q1 2021, on par with Q1 2020. The total utility-scale contracted pipeline has grown to nearly 77 GW_{dc}.
- Wood Mackenzie forecasts that the solar industry will continue to break annual installation records every year for the next three years before the investment tax credit (ITC) fully phases down under current law. Another 160 GW_{dc} of capacity will be installed between 2021 and 2026 to accompany today's current operational fleet of over 100 GW_{dc}. This will bring the total operating PV fleet to over 250 GW_{dc} by the end of 2026.

¹ Photovoltaic systems have a direct current (DC) rating based on the total DC capacity of all the panels and an alternating current (AC) rating based on the rated capacity of all inverters that convert DC to AC for use on the grid. This DC:AC ratio or inverter loading ratio (ILR) is a design choice made to optimize project economics and varies from system to system. This report series uses DC capacity to report on the volume of activity in the solar energy industry. All generating technologies connect to the grid with an AC interconnection.

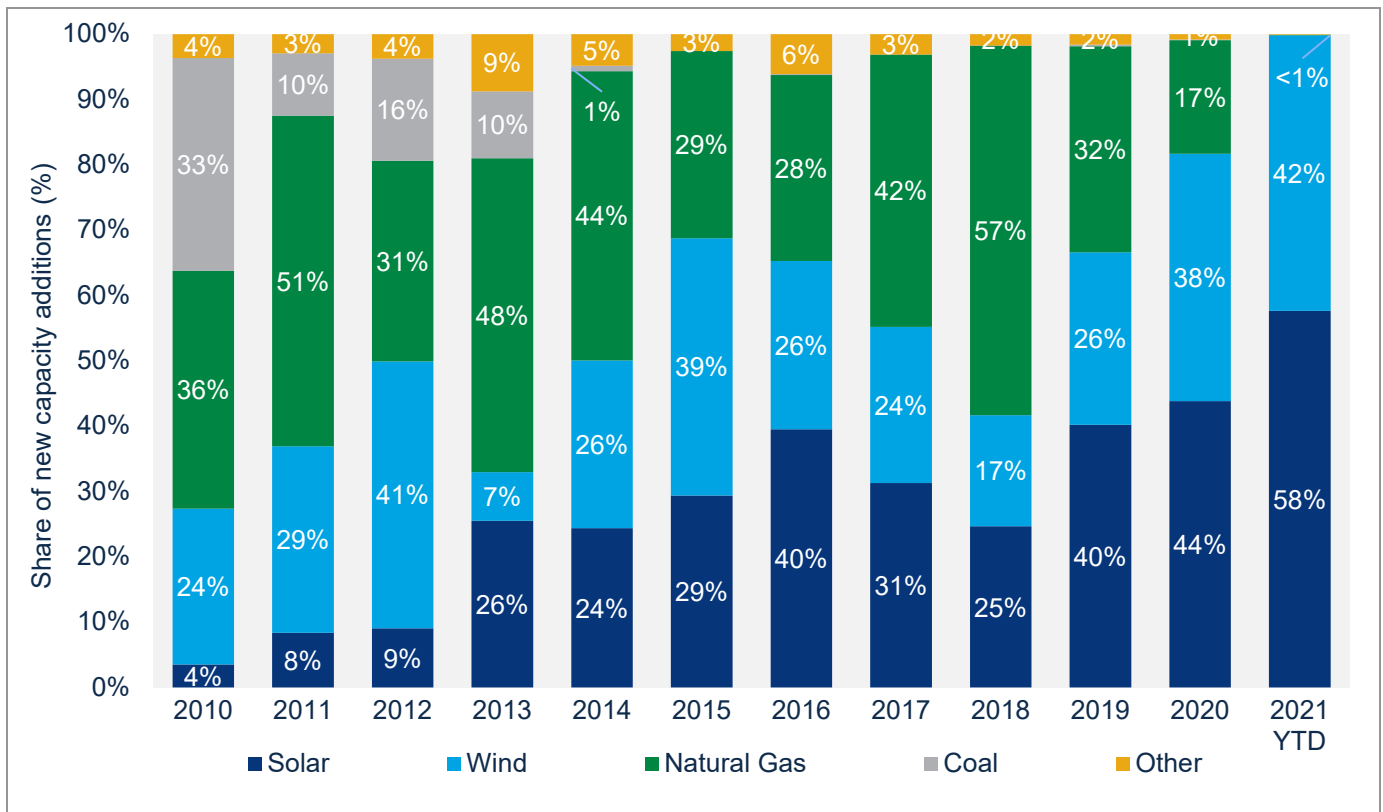
2. Introduction

Note on market segmentation: Beginning with the Q2 2021 report, Wood Mackenzie has modified how we cover specific market segments. The former “non-residential” segment has been split into “commercial solar” and “community solar.” See more specific definitions in the market segment outlook sections. We continue to use “non-residential” to refer to these two market segments combined.

In the first quarter of 2021, the U.S. solar industry installed just over 5 GW-direct current (GW_{dc}) of capacity, the largest first quarter on record. The first quarter of the year typically brings a slowdown in installations after the year-end push. While Q1 2021 followed this same pattern, all market segments except community solar grew compared with Q1 2020.

Residential solar volumes grew 11% over Q1 2020 but declined from a record Q4 2020. Commercial solar grew 19% over Q1 2020, while utility solar set a record for the largest first quarter in history. And while community solar declined year-over-year, that market segment is still expected to reach record-setting installations this year. Finally, solar PV accounted for 58% of all new electricity-generating capacity additions in Q1 2021.

New U.S. electricity-generating capacity additions, 2010-2021YTD



Source: Wood Mackenzie, Federal Energy Regulatory Commission (for all other technologies)

Supply chain constraints start to hit the solar industry

Over the last several quarters, critical components for solar equipment – polysilicon, steel, aluminum, semiconductor chips, copper and other metals – have become increasingly supply-constrained. The dynamics around each commodity are nuanced. But increasing demand for solar, combined with pandemic-related macroeconomic realities (such as increased shipping costs, microchip availability, and a residential home renovation boom) have led to increased commodity prices and delivery delays.

The impacts of these constraints on the solar industry vary. The price of steel has more than doubled since the pandemic began, which has led to increased prices and lowered availability of solar racking equipment and trackers. To date, this has mostly affected utility-scale solar projects but has also impacted carport installations, which require more steel support structures than other solar projects. Polysilicon supply and demand are barely balanced, so small production errors can make an outsized difference. This has led to stagnant or increasing module costs (depending on the manufacturer), reversing a decades-old trend of module cost declines.

Generally, there is a lag between changes to commodity prices and subsequent changes to solar system prices. The extent to which commodity price increases are passed onto customers can vary. But through Q1, the effects on installed solar system prices have been marginal.

This is not to say there haven't been impacts from commodity price increases and equipment delays, and those impacts vary by market segment. The effects on distributed solar, for instance, have been more muted. A few additional cents per watt in module costs represent a relatively small percent increase in total costs for residential and commercial installers. And many developers have work pipelines strong enough to accommodate a few weeks' delay in equipment deliveries. But compounding cost increases across all materials are just beginning to affect installers. Developers of distributed solar-plus-storage projects have started to report months-long installation delays stemming from constrained battery supplies.

The most significant impact of the current supply environment is on utility-scale projects that are under development. Developers are approaching offtakers to renegotiate their PPAs to increase prices or relax online dates. So far, efforts to increase PPA prices on existing contracts have not been very successful in a hyper-competitive market. This will be an important issue to watch throughout 2021 and beyond.

Biden's infrastructure plan is a big upside for solar – if it's passed

In late March, President Biden published The American Jobs Plan – a sweeping plan to upgrade the nation's infrastructure while creating jobs. The most important parts of the plan for the solar industry include extending the ITC and expanding the credit to include direct-pay, extending the production tax credit, incentives to build out the transmission grid, and a target to make the electric sector 100% carbon-free by 2035. These are big proposals, any of which would have significant implications for the solar industry. Which

policies Congress includes in upcoming legislation remains to be seen, and we will track potential impacts on the industry as this moves forward.

State solar PV installation rankings, Q1 2021

State	Rank			Installations (MW _{dc})		
	2019	2020	Q1 2021	2019	2020	Q1 2021
Texas	2	2	1	1,412	3,427	1,525
California	1	1	2	3,112	3,917	563
Florida	3	3	3	1,367	2,830	525
Indiana	24	32	4	Underlying data available in the full report		
Virginia	19	4	5			
Michigan	32	27	6			
Oregon	18	20	7			
Iowa	33	22	8			
Utah	20	10	9			
New York	8	8	10			
South Carolina	7	6	11			
Massachusetts	12	12	12			
North Carolina	4	5	13			
Illinois	21	14	14			
Maine	40	29	15			
Arizona	5	9	16			
New Jersey	9	11	17			
Colorado	14	13	18			
Maryland	16	26	19			
Nevada	10	15	20			
Minnesota	13	21	21			
Connecticut	15	24	22			
Ohio	27	18	23			
Pennsylvania	25	17	24			
Puerto Rico and Other U.S. Territories	38	33	25			
New Mexico	22	16	26			
Hawaii	11	28	27			

Source: Wood Mackenzie

State solar PV installation rankings, Q1 2021

State	Rank			Installations (MW _{dc})		
	2019	2020	Q1 2021	2019	2020	Q1 2021
Missouri	26	37	28	Underlying data available in the full report		
Rhode Island	17	25	29			
Washington, D.C.	39	42	30			
Wisconsin	30	19	31			
Washington	31	34	32			
New Hampshire	34	39	33			
Arkansas	37	23	34			
Idaho	35	38	35			
Oklahoma	47	40	36			
Delaware	42	44	37			
Georgia	6	7	38			
Vermont	29	41	39			
Kansas	36	35	40			
Louisiana	43	30	41			
Kentucky	45	46	42			
Montana	28	45	43			
Wyoming	49	36	44			
West Virginia	48	48	45			
Alaska	46	47	46			
Mississippi	44	31	47			
Nebraska	41	43	48			
South Dakota	52	50	49			
Tennessee	23	49	50			
North Dakota	50	52	51			
Alabama	51	51	52			

Source: Wood Mackenzie

3. Market segment outlooks

3.1. Residential PV

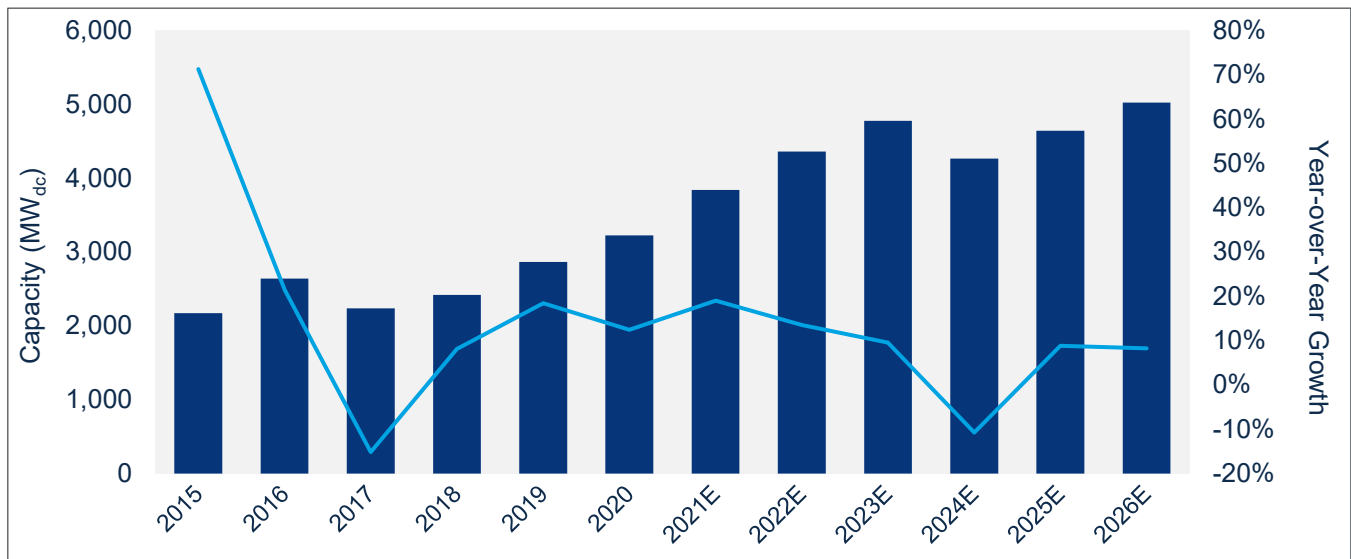
- 905 MW_{dc} installed in Q1 2021, the largest first quarter on record
- Up 11% from Q1 2020
- Down 8% from Q4 2020

Residential solar had its largest-ever first quarter and second-largest quarter in history, setting up 2021 to be the biggest year yet for the market. Florida and Arizona had record-breaking quarters, while Texas set a new first-quarter record (despite losing a week of activity during the February winter storm).

Many installers reported that project backlogs stabilized throughout the quarter after having grown to borderline unsustainable levels during the latter half of 2020. Issues related to obtaining permits and gaining permission to operate have eased somewhat. Companies are now focused on scaling operations to keep up with growing sales activity. Early signs show that this spring's sales season is breaking records. But the market is not uniform – some installers have only just returned to pre-pandemic sales levels.

Consumer demand for residential solar remains stronger than ever. Wood Mackenzie forecasts the residential market will grow 19% year-over-year, resulting in more than 3.8 GW_{dc} of installed capacity in 2021. The two-year ITC extension will drive double-digit growth in 2022 and 2023, with improved economics for customer-owned systems during this period boosting solar loans. The market will take a couple of years to recover post-ITC-stepdown before eclipsing 5 GW_{dc} for the first time in 2026.

Residential installations and forecast, 2015-2026E



Source: Wood Mackenzie; note that Wood Mackenzie's forecasts do not assume any extension of the ITC

3.2. Commercial PV

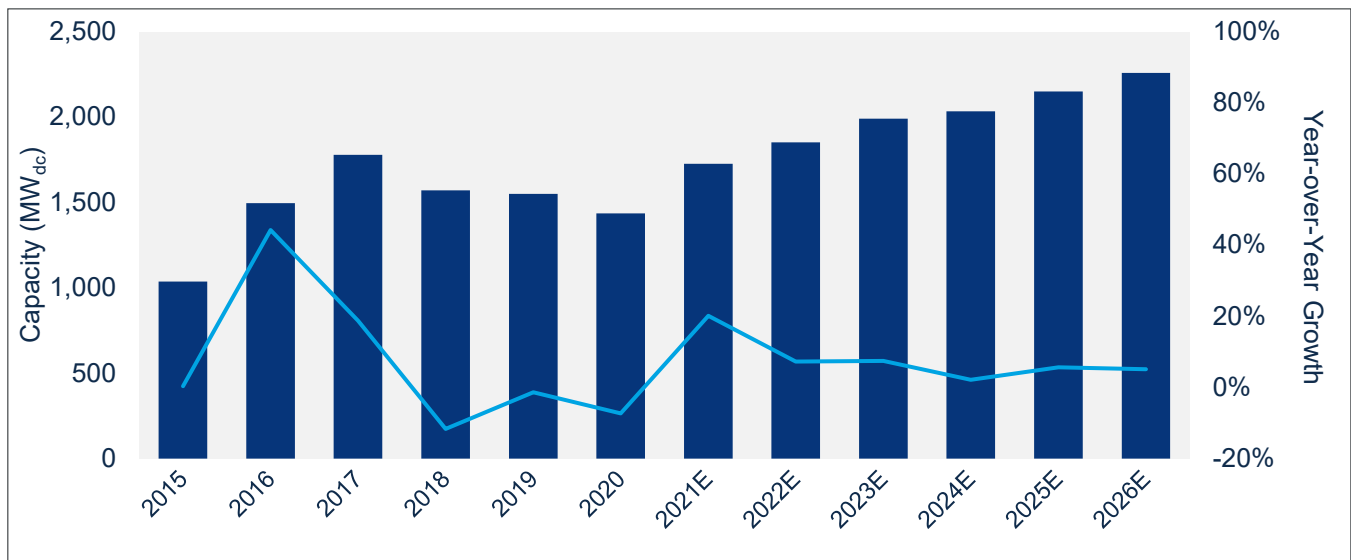
- 347 MW_{dc} installed in Q1 2021
- Up 19% from Q1 2020
- Down 35% from Q4 2020

Note on market segmentation: Beginning with the Q2 2021 report, Wood Mackenzie has modified how we cover specific market segments. The former “non-residential” segment has been split into “commercial solar” and “community solar.” Commercial solar encompasses distributed solar projects with commercial, industrial, agricultural, school, government or nonprofit offtakers, including remotely net-metered projects.

Commercial solar had a decent start to the year with first-quarter installations at their highest level since 2018. States with healthy capacity additions included California, Illinois, and New York. There are still certain customer segments that are in recovery mode, with insufficient credit for solar project financing. At the same time, there is a surge in interest in environment, social, and governance (ESG) investments. For some developers, this has helped increase lead generation.

Looking ahead, commercial solar is at an interesting juncture with 2021 installations expected to grow 20% over 2020. This is colossal growth for a market that has declined for three years in a row. The extended ITC certainly contributes to this forecast. But more important, multiple state-level incentive programs are culminating this year, resulting in record growth. These large pipelines have also led to the most significant challenge facing commercial solar (and community solar) today: interconnection costs and upgrades. Beyond 2021, growth averages 6% annually as pipelines are built out and incentives are used up.

Commercial solar installations and forecast, 2015-2026E



Source: Wood Mackenzie; note that Wood Mackenzie’s forecasts do not assume any extension of the ITC

3.3. Community solar PV

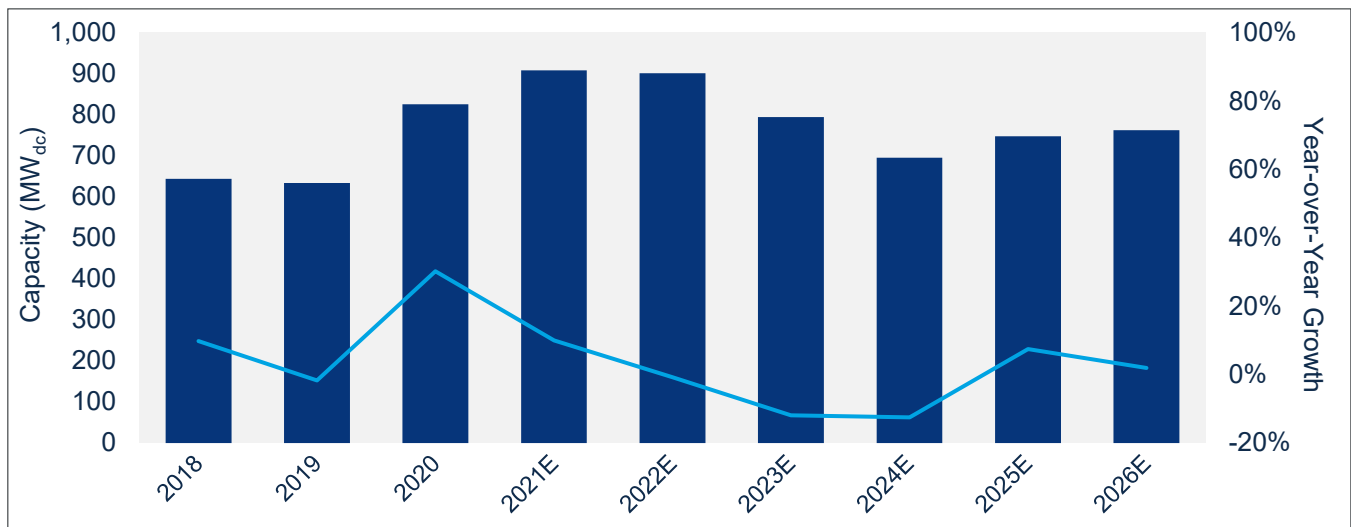
- 131 MW_{dc} installed in Q1 2021
- Down 15% from Q1 2020
- Down 68% from Q4 2020

Note on market segmentation: Beginning with the Q2 2021 report, Wood Mackenzie has modified how we cover specific market segments. The former “non-residential” segment has been split into “commercial solar” and “community solar.” Community solar projects are part of formal programs where multiple customers can subscribe to the power produced by a local solar project and receive credits on their utility bills.

Installation levels were modest across most community solar markets in Q1 2021. But lower first-quarter volumes are not necessarily indicative of a long-term trend. Rather, current interconnection and siting challenges, new and transitioning programs, and policy uncertainty are leading to delays in bringing projects online. This year is expected to set the record for annual community solar installations at 909 MW_{dc}. As current interconnection issues in states such as Maine and Massachusetts are disentangled, high volumes of pent-up capacity will come online. Meanwhile, much of New York’s allocated Community Adder capacity is expected to be interconnected this year. Finally, despite a slow start to the first year of New Jersey’s community solar pilot program, the state should begin bringing dozens of megawatts online in the coming months.

We have increased the five-year community solar outlook by 16% since last quarter’s forecast. Robust growth of interconnection queues as developers continue to add projects to their pipelines in states like New Jersey, Maine, and Illinois will lead to high volumes over the next few years.

Community solar installations and forecast, 2015-2026E



Source: Wood Mackenzie; note that Wood Mackenzie’s forecasts do not assume any extension of the ITC

3.4. Utility PV

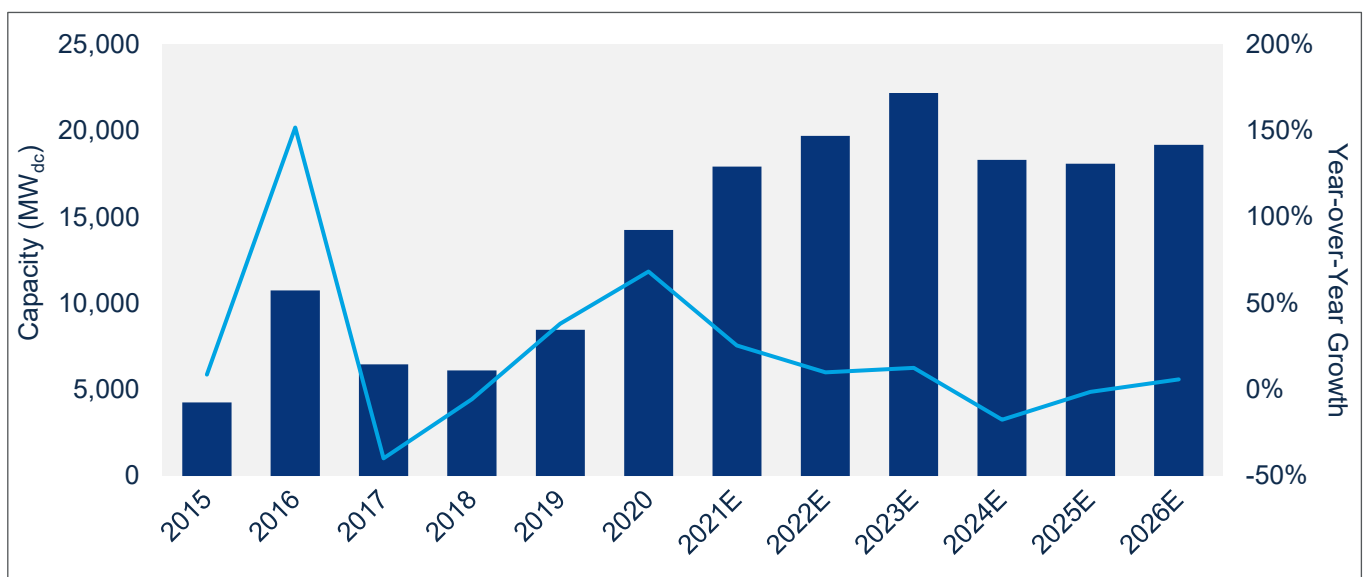
- 3.63 GW installed in Q1 2021, the largest first quarter on record
- 6.2 GW_{dc} of new utility-scale solar contracts were signed
- The contracted pipeline now totals nearly 77 GW_{dc}

The utility solar sector had the largest first quarter on record with 3.63 GW_{dc} installed. The momentum from a strong 2020 has carried into 2021. There are 17 GW_{dc} of projects under construction, 10.6 GW_{dc} of which are slated to come online this year, putting the market on pace to hit a record-breaking 17.9 GW_{dc} of annual capacity additions in 2021.

The ITC extension in late 2020 created tailwinds for the utility-scale solar market even as the segment was expected to break records in each of the next three years. In the first quarter of 2021, 6.2 GW_{dc} of new contracts were signed, adding to the already historic project pipeline. The sector will see double-digit year-over-year growth through 2023 as developers build out pipelines that accrued under earlier ITC deadlines. The market is still responding to the year-end ITC extension, which pushed out the safe harbor installation deadline to the end of 2025. As a result, annual installations are currently expected to decline in 2024 but remain at 18-19 GW_{dc} until 2026.

Multiple factors may create upside and downside pressure to this forecast. On the positive side, President Biden’s proposals to improve American infrastructure, if passed by Congress, will give a significant boost to the renewable energy industry, including solar. But the industry faces headwinds such as high component costs, global logistics challenges, tax equity supply shortages and EPC (engineering, procurement, and construction) capacity constraints that could be exacerbated by new labor requirements.

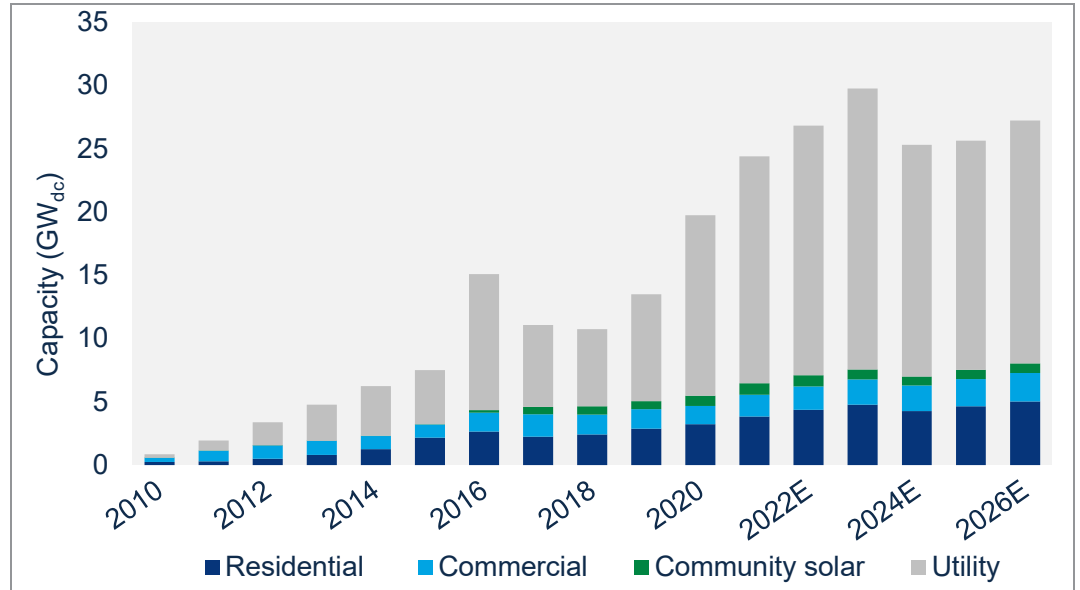
Utility PV installations and forecast, 2015-2026E



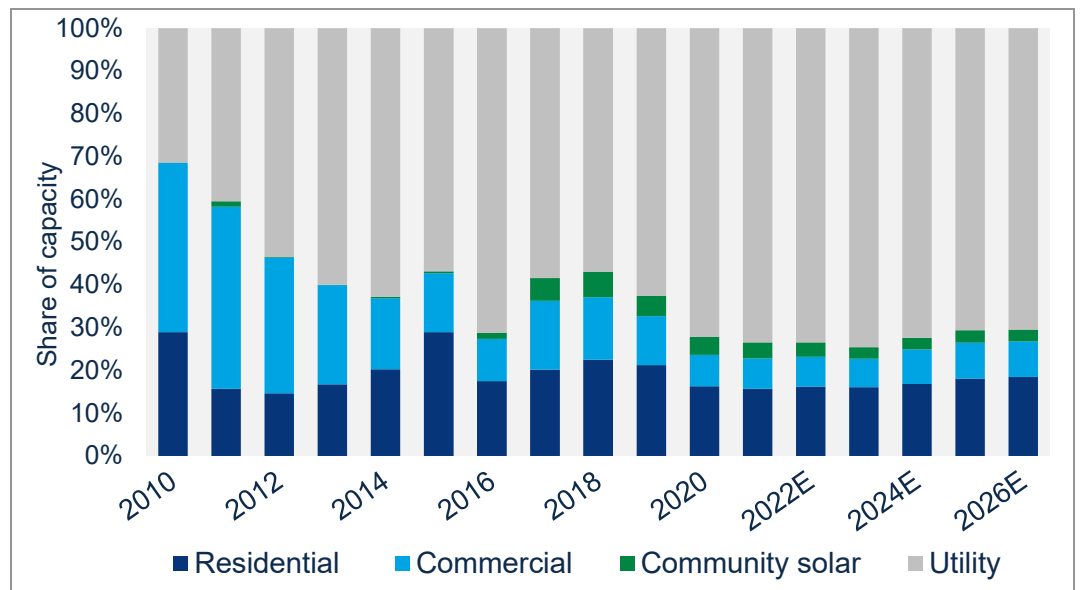
Source: Wood Mackenzie; note that Wood Mackenzie’s forecasts do not assume any extension of the ITC

4. U.S. solar PV forecasts

U.S. PV installation historical data and forecast, 2010-2026E



U.S. PV installations by share of capacity, 2010-2026E

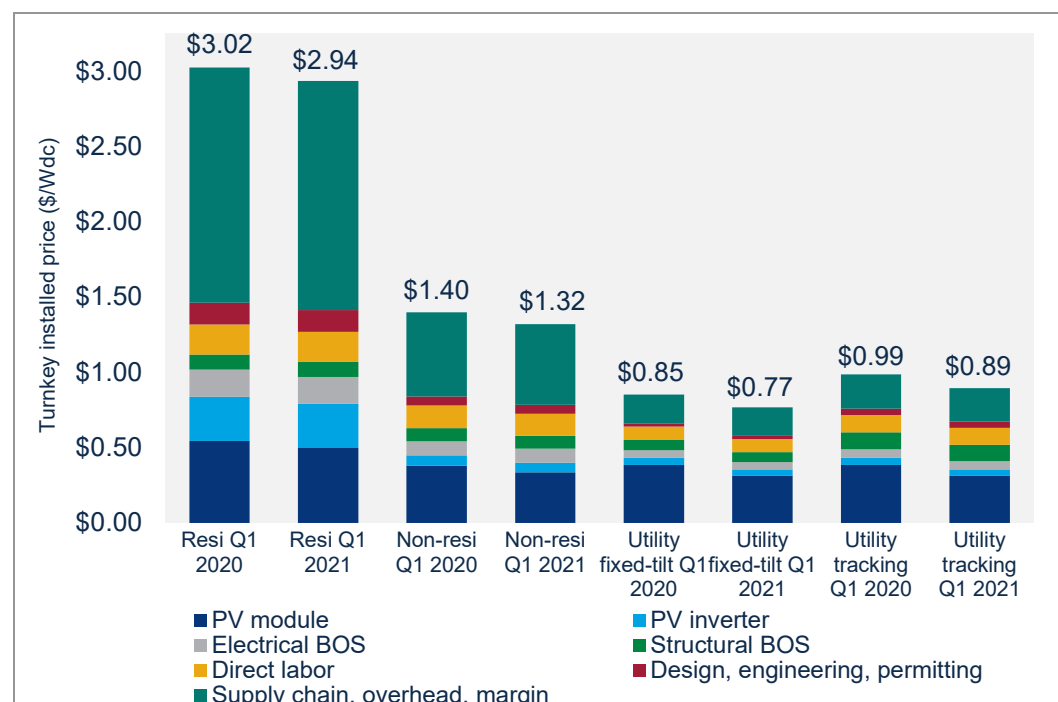


Source: Wood Mackenzie

5. National solar PV system pricing

We employ a bottom-up modeling methodology to capture, track and report national average PV system pricing by segment for systems installed each quarter. Our methodology is based on the tracked wholesale pricing of major solar components and data collected from industry interviews. We report a weighted average of multi-silicon and mono PERC solar modules for the non-residential and utility segments, and a weighted average of standard mono PERC and high-efficiency modules for the residential segment.

Modeled U.S. national average system prices by market segment, Q1 2020 and Q1 2021



Source: Wood Mackenzie

In Q1 2021, system pricing fell both year-over-year and quarter-over-quarter across all market segments. System pricing fell quarter-over-quarter by 1.1%, 2.9%, 3.7% and 3.6% in the residential, non-residential, utility fixed-tilt and utility single-axis tracking markets, respectively.

Average system prices remained relatively stable from Q4 2020 to Q1 2021, despite the supply chain and logistics constraints that the solar industry faces today. The impact from these bottlenecks had not yet fully manifested into system prices as of Q1. Important raw material inputs to the solar supply chain include steel, aluminum and copper. Price increases for manufacturers may not be felt immediately by customers due to time lags in procuring equipment and long-term supply agreements. Further, manufacturers may still be estimating how much of these price increases they want to pass along to the customer, and how much they decide to absorb.

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