State Policy and Its Effect on Growth in the Solar and Energy Storage Industries

Brought to you by:

inter solar
connecting solar business | NORTH AMERICA

Produced by: diversified COMMUNICATIONS

INTRODUCTION

Over the last decade, the US solar industry has enjoyed explosive growth, pushed forward by falling technology prices and a wide variety of state-level policies and incentive mechanisms designed to encourage solar and renewable adoption. Each state has its own specific goals, but most desire a stronger solar market to help reduce emissions, build out a new local industry, and increase energy security and independence.

As local solar markets mature, many of these policies and incentives are either phasing out or being updated with more stringent requirements that seek to further increase solar and renewable penetration.

Over the next decade, as costs continue to fall and Renewable Portfolio Standards (RPS) and clean energy goals continue to increase, solar—along with energy storage—will make up an ever-larger portion of US electricity generation.

Though more nascent technologies than solar, energy storage and electric vehicles (EV) are also on the rise nationwide. Both offer benefits to homeowners and businesses (such as lower operating expenses), but utilities can also utilize the technologies as key components in tomorrow's modern, more flexible grid built

around distributed and sustainable resources. States like New York and California see these benefits and are already incentivizing both technologies and planning for more energy storage and EVs.

Solar and Energy Storage Growth Nationwide

Solar generation has been on the rise since the mid-2000s, as technology costs fell and states adopted RPS. At the same time, federal, state, and local governments began introducing a wide array of incentive programs designed to encourage homeowners and businesses to install solar by lowering the technology's then-high financial hurdle.

Since that time, solar penetration has continued to grow. In July 2014, the US generated 2,673 GWh of solar electricity. By July 2019, generation had jumped to 11,655 GWh—an increase of 336%. Figure 1 shows how utility-scale solar has grown faster and larger than commercial and residential solar in the years since 2014, though small-scale solar continued to show steady growth in that same period.

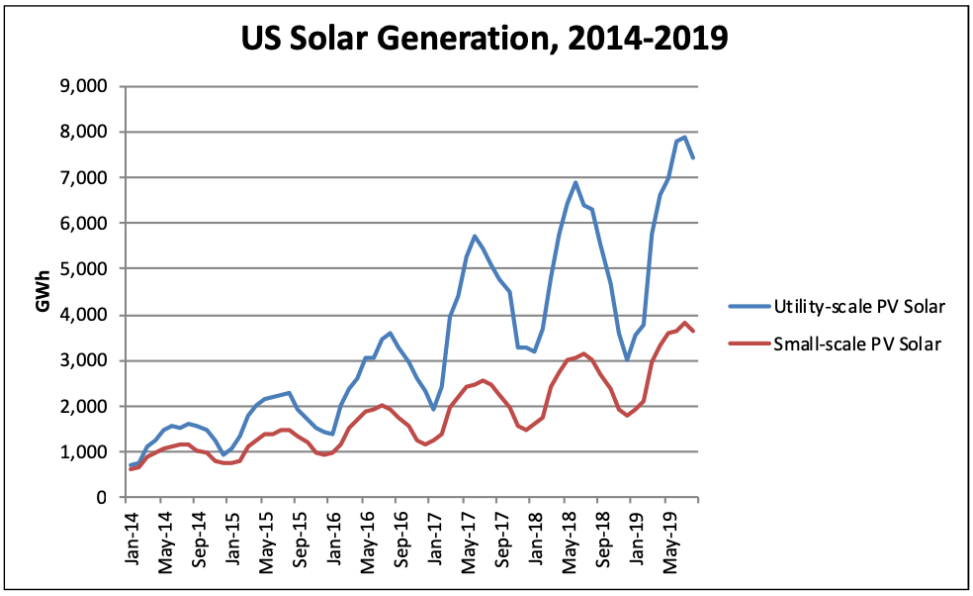

Figure 1: US Solar Generation, 2014-2019[1]

[1] *eia.gov*

Growth in solar electricity is largely centered around the West and Northeast, though some of the heaviest solar states (such as North Carolina, Florida, and Texas) fall outside these areas.

According to data from the Energy Information Association (EIA), the Pacific Contiguous region (California, Oregon, and Washington) has seen the fastest growth, driven almost exclusively by California. The Mountain region (which includes solar heavyweights Arizona, Nevada, Utah, and Colorado) has also seen explosive growth, while the South Atlantic (which includes North Carolina and Georgia) follows up in a strong third.

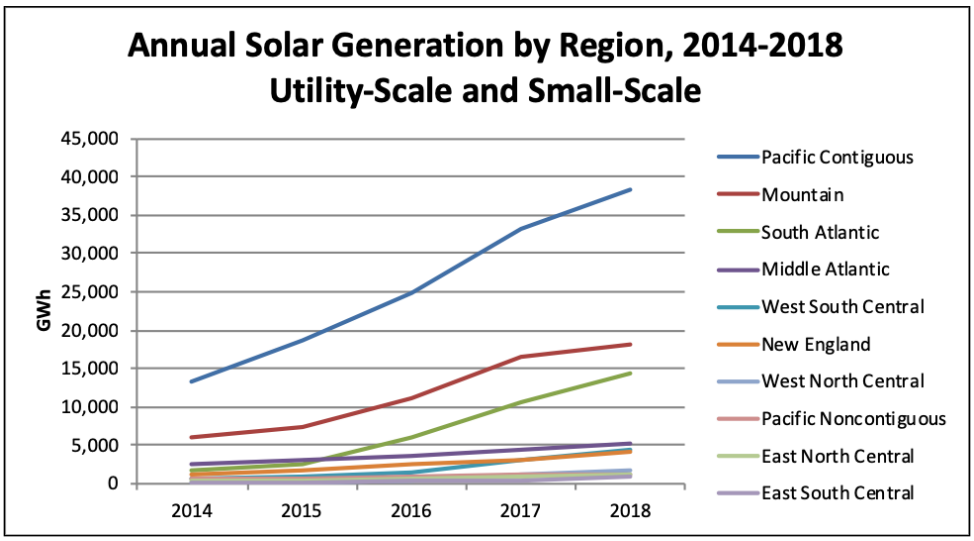

Figure 2: Annual Solar Generation by Region, 2014-2018[2]

In each region, one or two states generally produce the majority of solar energy. In the Pacific Contiguous area, both Oregon and Washington produce little solar electricity, so the trend line for the Pacific Contiguous region in Figure 2 and the trend line for California in Figure 3 are strikingly similar.

No individual state or region comes close to California. The Mountain region (led by Arizona and Nevada) and South Atlantic area (led largely by North Carolina) come closest, but both still see half the solar generation that California alone produces.

[2] *eia.gov*

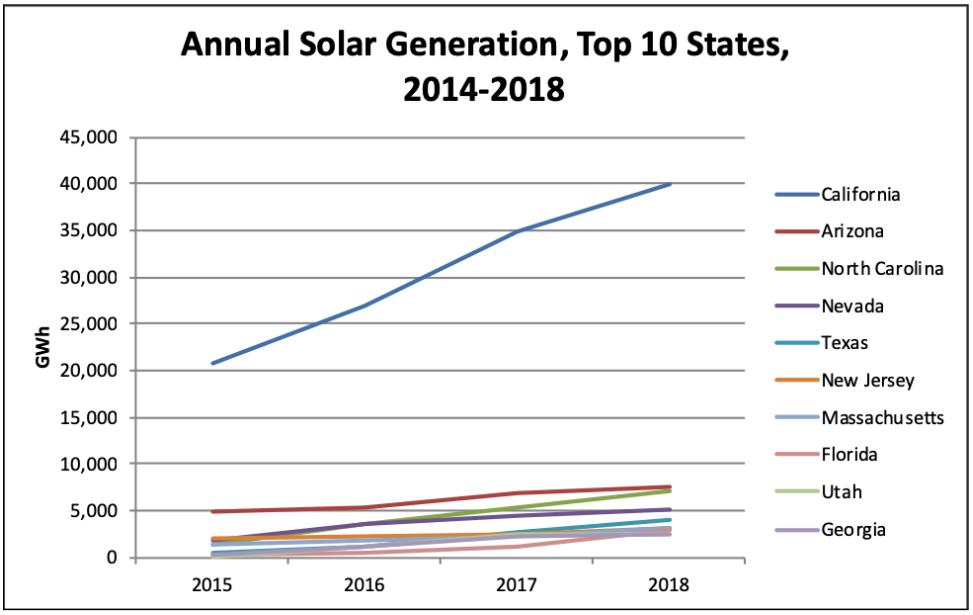

Figure 3: Annual Solar Generation in Top 10 States, 2014-2018[3]

While nationwide solar generation has grown quickly over the last 10 years, the US has only just begun its solar ramp-up. Driven by tax credits and falling installation costs, the EIA expects the solar market to continue its upward trajectory, with capacity jumping from 25 GW in 2017 to over 200 GW by 2050. Renewable capacity is expected to surpass coal around 2030 and, among renewable resources, solar is expected to surpass wind (which currently sees over double the capacity of solar) around 2035. Wind-generated energy capacity is projected to remain relatively flat during this same period.

Utility-scale solar is expected to continue growing at a faster rate than residential or commercial solar; over the next three decades, utility projects are expected to make up two-thirds of the growth in PV generation[4].

In comparison, the EIA expects zero capacity additions to solar thermal plants, also known as concentrating solar power (CSP); these create electricity by using mirrors to concentrate sunlight, which then heats a fluid to spin turbines. While PV costs have continually fallen, solar thermal's costs remain high, which have limited its deployment in the electricity industry.

[3] *eia.gov*
[4] *Annual Energy Outlook 2019, p 104*

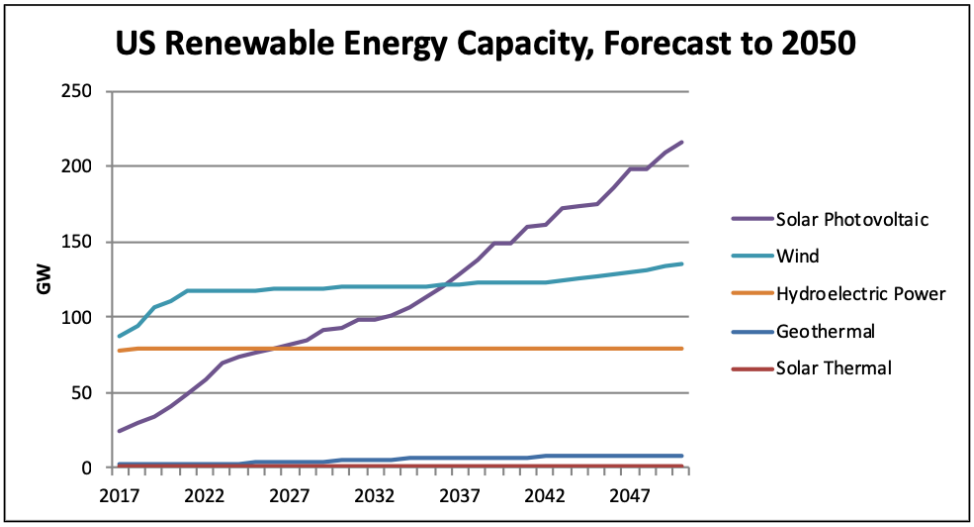

Figure 4: US Renewable Energy Capacity, Forecast to 2050[5]

As more utilities continue to add batteries to existing or new solar plants, utility-scale energy storage is also expected to grow over the next four years.

In 2014, US utilities installed a cumulative 214 MW of energy storage capacity. By 2019, that capacity had jumped to 1,000 MW. By 2023, energy storage capacity is expected to exceed 2,000 MW[6].

While US battery capacity is far lower than solar capacity, the energy storage market is expected to command a much steeper trend line over the next five years, with an average annual growth rate in cumulative capacity of 33.7% compared to solar's 19%.

[5] *EIA Annual Energy Outlook 2019*

[6] *eia.gov*

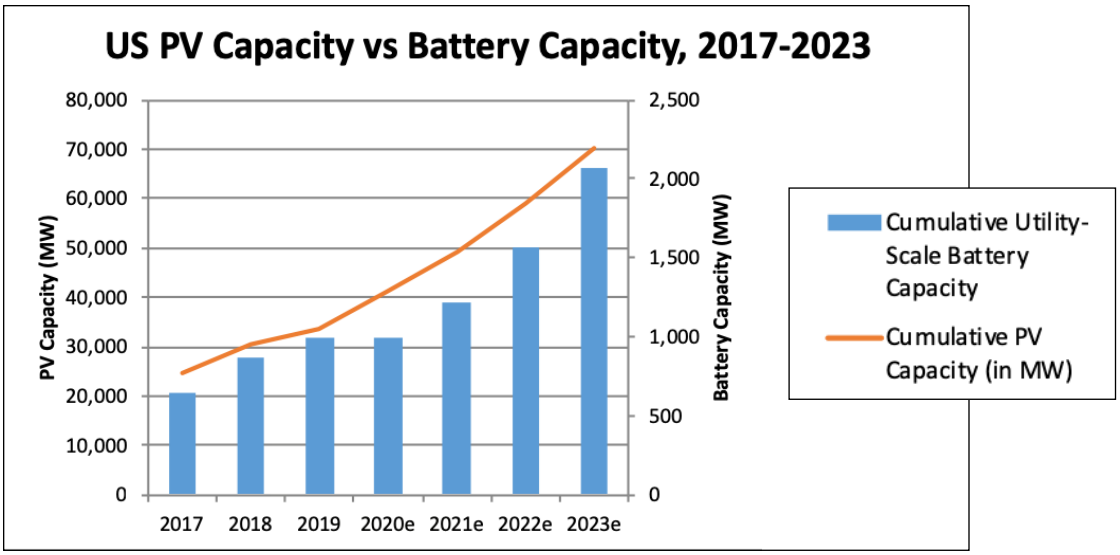

Figure 5: US PV Capacity vs Battery Capacity, 2017-2023[78]

Like the solar market, California is the leader in energy storage, with 230 MW installed as of 2019. Illinois and Texas follow, with 110 MW and 95 MW respectively. However, several large-scale projects already announced in other states could reorganize this list over the next five to ten years. In early 2019, Florida utility FPL announced a 409 MW battery project to replace two aging gas plants, which when complete will be the largest solar-battery system in the world. In September 2019, developer Ravenswood sought approval from the NY Public Utilities Commission (PUC) for a 316 MW facility in Queens, New York, to replace pre-existing peaker plants. These power plants are designed to quickly ramp up electricity generation at times of high demand, a task for which batteries—thanks to their instantaneous power—are well-suited.

Policies that Affect Growth of Solar and Energy Storage

The single most important factor in a healthy, growing local solar industry is simple market economics. If homeowners and businesses can financially benefit from installing solar, the ground is fertile for growth of a local solar industry.

In the late 1990s and throughout the 2000s, federal, state, and local governments introduced numerous policies to 'aid' the economics of photovoltaic solar. New York introduced a 25% residential tax credit for solar installations in 1997. Oregon launched an incentive program in 2003 for commercial and residential solar

[7] *EIA Monthly Electric Generator Inventory*

[8] *EIA Annual Energy Outlook 2019*

installations. The federal Energy Policy Act of 2005 set up the 30% tax credit for residential and commercial solar installations, which Congress extended in 2007, 2009, and 2016.

In 2006, when residential solar cost $9 to $10 per watt, California set up the California Solar Initiative and started offering rebates of $1.50 to $2.50 per watt to households installing solar.

As technology costs continued to fall and local solar markets matured, most of these tax credits and other incentives were designed to phase themselves out. By 2013, California's solar rebates had dropped to just $0.20 per watt[9], after spending $1.68 billion on rebates for over 100,000 installations. While many incentives have fallen away, long-term state initiatives like RPSs and Solar Renewable Energy Credit (SREC) markets create a demand for more solar and energy storage projects.

The following is a brief rundown of the federal and local policies that can affect solar industry—and job—growth.

Federal Policies

While the federal Investment Tax Credit (ITC) has been instrumental in the growth of solar nationwide, the federal government has only introduced a handful of policies to bolster the solar and energy storage markets.

Investment Tax Credit

Along with the falling costs of solar technology, the residential and commercial federal tax credit has been a major driver to the US' nationwide growth in renewables.

With so many policies and incentives at play in the solar industry, it's difficult to distinguish a single policy's effect on the market, but since the formation of the federal ITC in 2006, the national solar industry has grown an average of 50% each year.

The residential ITC is currently set to fully expire at the end of 2022, while the commercial side will permanently drop to 10%. The EIA forecasts that the phase-out will have little to no negative effect on the solar industry at large. Solar generation is expected to ramp up throughout 2022 as projects are brought online before the deadline. Afterwards, generation will resume a more gradual pace over the long term.

[9] *californiasolarstatistics.ca.gov*

Federal Energy Storage Policies

Currently, the federal government offers limited aid for battery projects. Energy storage is only eligible for the existing federal tax credit if it is paired with a solar installation, so stand-alone batteries are not eligible. In April 2019, US Congressman Mike Doyle introduced a bill to establish a federal tax credit (ITC) for utility-scale, commercial, and residential energy storage, but no further action has been taken and the bill languishes in the House as of November 2019[10].

However, steps have been taken on the federal level to better integrate energy storage into the electricity industry. In February 2018, the Federal Energy Regulatory Commission (FERC), which regulates wholesale electricity prices as well as inter-state electricity transmission, issued Order 841, which lifted restrictions on energy storage facilities participating in wholesale electricity markets[11]. Currently, energy storage projects are limited to installation by vertically-integrated utilities; once the new regulations are finalized, independent power producers (private companies that generate and sell electricity to utilities) will be able to integrate large-scale batteries into the grid and sell the electricity in the wholesale market.

State Policies

In the absence of holistic renewable energy policies from the federal government, state-level policies have been most instrumental in aiding growth of local solar industries. There's no one-size-fits-all approach to policy. States have a wide variety of tools in their tool belts, including RPSs, SREC markets, tax credits and other incentives, as well as net metering.

Rate design, grid modernization, and solar access rights can and do also play a strong role in solar growth, but are outside the scope of this white paper.

Renewable Portfolio Standards

Renewable Portfolio Standards (RPS) are state-mandated goals that a certain percentage of all electricity sold in the state must come from renewable resources by a certain date. The onus to comply with these goals falls onto utilities, which can produce or purchase renewably-sourced electricity, purchase RECs, or pay typically hefty fines for non-compliance. As such, RPSs are the most powerful mechanism that states have to drive the adoption of renewables. The Lawrence Berkeley National Lab estimates that from 2000 to 2017, RPSs were responsible for 50% of all growth in renewable energy[12].

---

[10] *congress.gov*

[11] *ferc.gov*

[12] *eta-publications.lbl.gov*

Of the twenty states in which solar accounts for the highest percentage of total generation, eighteen have passed RPSs. Figure 6 shows that all of the top five states—where solar generation accounts for between 11% and 20% of total generation—have adopted RPSs.

State RPS and Solar Share of Total Electricity Generation, Top 10 States							
Ranking	**State**	**RPS?**	**2014**	**2015**	**2016**	**2017**	**2018**
1	California	Yes	7.35%	10.59%	13.73%	16.96%	20.28%
2	Nevada	Yes	3.10%	4.72%	8.79%	11.93%	12.88%
3	Hawaii	Yes	5.78%	6.79%	8.52%	11.67%	12.39%
4	Vermont	Yes	0.81%	5.15%	7.06%	9.81%	11.58%
5	Massachusetts	Yes	2.99%	4.10%	5.83%	7.15%	11.42%
6	Arizona	Yes	3.78%	4.27%	4.94%	6.46%	6.66%
7	Utah	Voluntary	0.09%	0.24%	3.15%	6.68%	6.46%
8	North Carolina	Yes	0.63%	1.14%	2.74%	4.13%	5.38%
9	New Mexico	Yes	1.97%	2.31%	2.76%	4.16%	4.76%
10	New Jersey	Yes	2.77%	2.76%	2.86%	3.42%	4.28%

Figure 6: State RPS and Solar Share of Total Electricity Generation, Top 10 States[13]

Of course, simply adopting an RPS isn't enough to spur growth in the local solar industry. Some states, like South Carolina, adopt voluntary goals (known as Renewable Portfolio Goals) with no financial penalty for non-compliant utilities. In addition, some RPSs don't specify technology-specific goals, so utilities can decide on which technology to focus. Texas, for example, flew by its own RPS mandates largely driven by wind power.

As a component of their RPSs, twenty-two states have created solar or distributed carve-outs, which require utilities to source a certain percentage of electricity from the specified technology. Arizona, for example, requires 4.5% of sales to come from distributed sources by 2025. Minnesota mandates that 1.5% must be sourced from solar—and 0.15% from distributed PV specifically—by 2020.

Most of these solar carve-outs are small, typically accounting for between 0.15% and 3.5% of total electricity sales in the state. Of the seven states in Figure 6 that adopted carve-outs for solar or distributed generation (which generally includes residential and commercial solar), most have met these targets earlier than the mandatory date. Nevada utilities, for example, met the state's 2025 solar carve-out

[13] *eia.gov*

in 2018. Market forces are becoming an ever-stronger impetus to solar adoption, as costs continue to decrease and new solar generation becomes more cost-competitive.

Solar Carve-out Compliance, Top 10 States				
Ranking	**State**	**RPS?**	**Solar Carve-out?**	**Met Most Recent Solar Carve-out Obligations?**
1	California	Yes	No	N/A
2	Nevada	Yes	6% of RPS requirement x 2025 (1.5% of total sales)	100% Met (2018)
3	Vermont	Yes	1% of total renewable generation from distributed sources x 2017, 10% x 2032 (DG)	100% Met (2018)
4	Hawaii	Yes	No	N/A
5	Massachusetts	Yes	1600 MW x 2020 (PV Only)	100%+ Met (2019)
6	Arizona	Yes	4.5% of total sales X 2025 (DG), half from residential, half from commercial	95% Met (2018)
7	Utah	Voluntary	No	N/A
8	North Carolina	Yes	0.2% of RPS requirement x 2018	100% Met (2017)
9	New Mexico	Yes	4% of total sales x 2020, 0.6% x 2020 (DG)	75% Met (2017)
10	New Jersey	Yes	5.1% of total sales x 2021	100% Met (2018)

Figure 7: Solar Carve-out Compliance, Top 10 States[14]

To meet RPS mandates, utilities can build renewable generation themselves, purchase electricity from an independent power producer, or purchase Renewable Energy Credits (RECs) directly from customers or within a REC marketplace.

Depending on the state, solar homeowners must forfeit Solar RECs (also known as SRECs) when they enroll in net metering, can sell their SRECs to the utility through a performance-incentive program, or—in certain states—sell them in a marketplace. RPSs can jumpstart local solar industries, as utilities either purchase or provide incentives for RECs from local homeowners and businesses. These incentives can drive down investment costs for local homeowners and businesses, leading to a better cost-benefit.

[14] *Lawrence Berkeley National Lab US Renewables Portfolio Standards: 2019 Annual Status Update*

Tax Incentives

Many states have adopted tax credits for solar installations similar to the federal tax credit. Paired with other initiatives, tax credits can be a strong tool in a state's arsenal. But if the credit doesn't offer enough benefit to homeowners or businesses, they can have little effect on the industry.

Since 2012, for example, Iowa has offered a residential and commercial tax credit for solar installation, valued at 50% of the federal tax credit. But with a low RPS that's already met with wind power and electricity prices that are about 10% below the national average, there's not great demand for solar and the industry has grown little over the last five years. Solar's share of total generation grew from 0.04% in 2014 to just 0.23% in 2018—admittedly a large jump, but still one of the lowest in the country.

Net Metering

While net metering is probably the most controversial of all the solar incentives, its positive effect on the solar industry can't be ignored. Of the ten states with the highest concentrations of solar, all either currently require utilities to offer full, retail-rate net metering or have required it in the past.

Net Metering and Solar Share of Electricity Generation

Ranking	State	Retail Rate Net Metering	% Gen from Solar, 2018
1	California	Yes	20.28%
2	Nevada	No	12.88%
3	Hawaii	No	12.39%
4	Vermont	Yes	11.58%
5	Massachusetts	Yes	11.42%
6	Arizona	No	6.66%
7	Utah	Yes	6.46%
8	North Carolina	Yes	5.38%
9	New Mexico	No	4.76%
10	New Jersey	Yes	4.28%

Figure 8: Net Metering and Solar Share of Electricity Generation among Top 10 States[15]

Nevada, Hawaii, and Arizona all previously offered retail-rate net metering for customers, but have since moved to lower credits due to what utilities say is an unbalanced cost share for non-solar customers. While New Mexico doesn't require utilities to offer retail-rate credits, utilities can choose to do so.

[15] *eia.gov*

The effects of Nevada's net metering changes in 2015 can be seen in its residential solar generation. In December 2015, the Nevada PUC adopted a new solar tariff structure that phased out retail-rate credits and replaced them with credits based on utility-avoided costs over the course of four years.

As a result of these changes, national installers SolarCity (now Tesla) and Sunrun pulled out of the state and installations stagnated. Fewer homeowners installed solar in 2016 and therefore 2017 saw a negligible rise in solar generation: year-over-year growth in solar generation was just 13% in 2017, compared to 156% the previous year. In August 2017, the PUC decided to reinstate net metering at rates much closer to retail-rate however, and consequently solar generation increased 57% from summer 2018 to summer 2019 as more homeowners began installing solar.

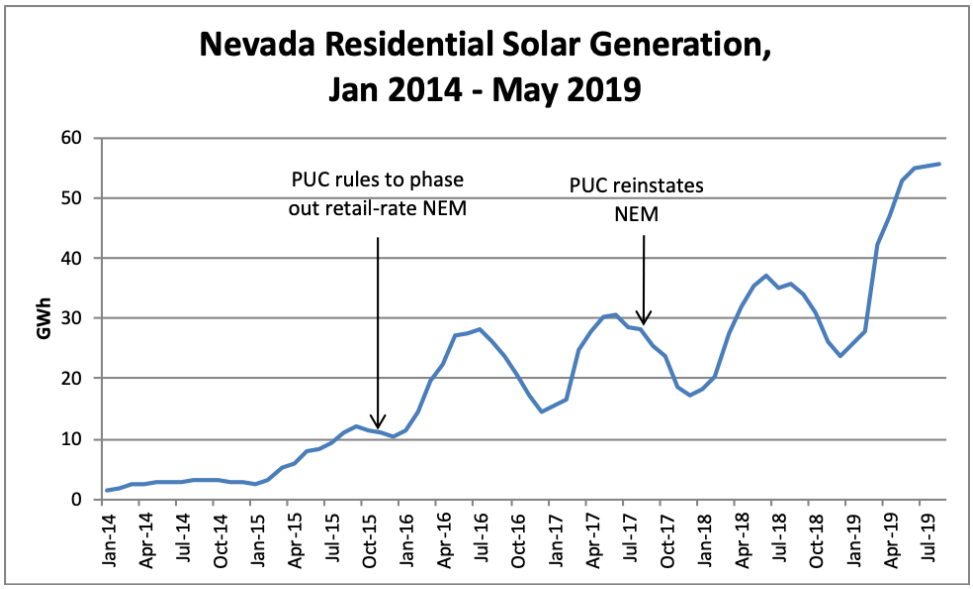

Figure 9: Nevada Residential Solar Generation, Jan 2014-May 2019[16]

How Do Policy and Costs Affect Growth?

For businesses, homeowners, and utilities, simple economics are the single biggest driver to solar adoption. If a business or homeowner can save money, solar is then a worthwhile investment.

Incentives and rebates can help lower the financial hurdle for homeowners and businesses that are interested in installing solar, but market and geographic factors like local installation costs and energy production determine the long-term

[16] *eia.gov*

cost-effectiveness of solar installations to a large extent. Technology prices are fairly standard across state lines, but supply chain costs, labor, permitting, and overhead vary by location and can add expense to a solar installation—especially in the residential market. While the cost-effectiveness of solar is naturally higher in areas with high irradiance (like the desert southwest where solar panels are more productive) states in areas with low irradiance can balance lower production through financial incentives.

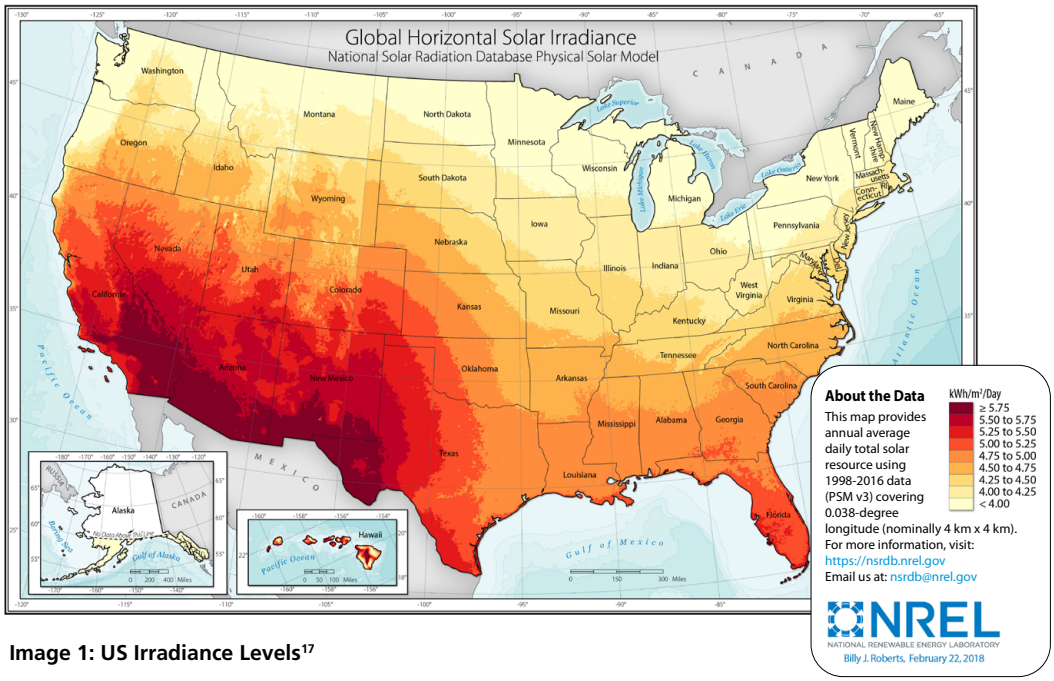

Image 1: US Irradiance Levels[17]

North Carolina, for example, boasts the second most solar generation in the country as of 2019, even though its irradiance levels are far below any state in the southwest. Through a mildly-aggressive RPS (12.5% by 2021) and a residential and commercial tax credit (which expired in 2015), as well as a unique implementation of the federal Public Utility Regulatory Policies Act[18] (PURPA) that has allowed utility-scale projects to flourish, the state has seen huge growth in solar over the last few years.

New York also enjoys high solar penetration, even though its irradiance levels are some of the lowest in the continental US. But high utility rates (39% higher than the national average[19]), an aggressive RPS (50% by 2030), retail-rate net metering, a 25% residential tax credit, and a rebate program for residential and small

[17] *Public domain via NREL, October 2019*
[18] *EIA Today in Energy*
[19] *EIA Electric Power Monthly*

commercial have all contributed to a thriving solar industry (with solar generation growing an average of 46% annually between 2015 and 2018, mostly from commercial and residential installations).

Policy and Growth in Seven Solar States

As mentioned previously, over the last decade states have assembled a variety of strategies—from RPSs to tax credits to SREC markets—in an effort to jumpstart local solar and renewable energy markets.

Energy storage policies are still nascent, though some states—California and New York in particular—have already introduced policies, incentives, and projects to spur the local battery market.

Other states, like Florida, have passed few if any battery-related policies or incentives; however, utilities are still moving towards batteries (typically paired with solar) as a cost-effective replacement for aging coal and natural gas plants.

Below is a brief discussion of solar policy and industry growth in seven states with high solar penetration.

California

Compared to other states, California is far ahead of the pack in both solar-related policy and results. The state has adopted a shockingly wide range of incentives and programs to bolster the renewables, storage, and Electric Vehicle (EV) industries far beyond any other state. As a result, California enjoys the highest number of solar installations in place, energy storage systems on the grid, and EVs on the road.

The state leads the US in annual solar production, and solar makes up a far larger percentage of total electricity generation than in any other states. In 2018, solar accounted for just over 20% of all generation in 2018—53% higher than runner-up Nevada's 13%. Because California's solar industry is more mature than any other state, it has seen slower growth than the national average in the last five years. However, it has still enjoyed an annual growth rate of 29% since 2014. With a further 58% growth over the next five years, equal to 15 GW in additional capacity, California is expected to remain the United States' biggest producer of solar energy[20].

[20] *seia.org*

The state has also adopted net metering, solar access laws, and strong RPS mandates to drive solar adoption. Residential solar has seen strong growth thanks to state-wide rebate programs (although most of these have already expired).

In 2016, the California PUC introduced NEM 2.0, a new net metering program that it hoped would balance the needs of the utility without stifling solar industry growth. The new structure places all NEM customers on a time-of-use rate and bases NEM credits around these varying rates. The state has also introduced solar and renewable energy into their building codes and will require all new residential construction to include solar modules by 2020.

California also leads the way in energy storage, home to 261 of the US' 1,000 MW of utility-scale storage capacity. In 2010, the state passed legislation (AB 2514) mandating that California's three investor-owned utilities—Pacific Gas & Electric, SCE, and SDG&E—add energy storage to the grid. Following the legislation, in 2013 the California PUC set a goal of 1.3 GW of storage by 2020, divided out among the three utilities and with specific goals for systems connected on the transmission-, distribution-, and customer-side. With such a large goal, the California PUC has earmarked almost $380 million in rebates for residential and commercial energy storage systems via the Self-Generation Incentive Program (SGIP)[21].

The state has also taken steps to encourage growth in the electric vehicle market. It offers a $2,500 rebate for electric vehicles through the Clean Vehicle Rebate Project. Palo Alto and San Francisco require new construction (with varying requirements for residential, commercial, and multi-family properties) to include 'EV ready' parking spaces that may include wiring, chargers, or outlets. In 2015, the Governor signed SB 350 into law, which raised the state's RPS, and called utilities to begin programs

[21] *cpuc.ca.gov*

to encourage EV adoption. All this has led to a large EV market, with 153,000 EVs sold in 2018—about half the US' total EV sales[22].

California also set a goal of 100% clean energy by 2050. This is an enormous undertaking considering it is the world's fifth largest economy, falling between India and Germany. As a clean energy goal, non-renewable technologies (like nuclear energy and even coal or natural gas plants with carbon capture) could be allowed, though market forces will likely move developers toward lower-cost renewable resources.

Florida

Florida is somewhat of an anomaly in the solar world. The state has done little historically to encourage growth of the solar industry, yet it ranked ninth nationally in total solar generation in 2018. It has adopted no RPS, offers no tax credits for renewable systems, and until mid-2018 disallowed solar leases (which were instrumental in building up the residential market in other states).

Florida has seen a huge jump in utility-scale projects since 2016, driven largely by economic factors, though policy does play a hand as well. The state allows utilities to recover costs associated with building solar plants through its customer rates in what's known as rate-basing. While the policy has allowed solar to flourish (utility-scale solar accounts for almost 90% of the Florida solar market[23]) some in the industry worry it stifles smaller commercial and residential projects.

As technology costs fall, Florida utilities are looking toward solar and energy storage to meet rising energy needs and to replace retiring plants. In January 2019, FPL (one of the largest utilities in the US), announced a plan to install 30 million solar panels by 2030—about 8 GW of solar, and five times the solar capacity Florida currently boasts. FPL also plans to build the world's largest battery storage bank, the Manatee Energy Storage Center, a 409 MW battery system that it will co-locate with an existing solar farm. This battery system is part of FPL's modernization plan to replace two 70s-era natural gas plants.

Duke Energy Florida also has plans to add 700 MW of solar between 2018 and 2022[24], and TECO (Tampa Electric) plans to add 600 MW by 2021[25]. All this adds up to over 8.5 GW in additional solar capacity by 2030. As such, the state will be one of the US' biggest hotbeds for solar over the next decade.

---

[22] *EVAdoption*
[23] *utilitydive.com*
[24] *duke-energy.com*
[25] *tampaelectric.com*

Massachusetts

While Massachusetts' smaller population naturally entails a smaller solar market than those in Florida or California, the state actually covered 11.4% of its energy needs with solar in 2018—the fifth highest in the country.

Massachusetts is one of only seven states (including New Jersey) that has adopted a Solar Renewable Energy Credit (SREC) market in which utilities can purchase SRECs to comply with the state's solar carve-out.

In 2010, the Massachusetts Department of Energy Resources (DOER) launched the original SREC program, known as SREC-I, with a goal of 400 MW. Extremely successful, the state reached this goal just three years later and launched a replacement initiative called SREC-II that same year.

The SREC-II program included a much larger goal of 1,600 MW by 2020. During this time, commercial–and to a lesser extent, residential—solar flourished as utilities purchased SRECs and worked toward meeting the solar carve-out. From 2014 to 2017, PV generation grew 36% even while commercial solar stagnated elsewhere in the US[26].

Under the SREC-II program, SRECs continue until 2023. At that point, they'll transition to Class I RECs (which denote new, regional renewable generation and enjoy the highest market value) that can be used to meet the state's RPS of 35% by 2030.

In 2018, the state met its 1600-MW SREC-II goal and closed the program. That same year, in an effort to continue growing the local solar market, the DOER began a replacement initiative called the Solar Massachusetts Renewable Target (SMART)

[26] *NREL Midmarket Solar Policies in the United States*

program. This is a long-term utility partnership that sets up fixed performance-based incentives with a goal of another 1,600 MW of additional PV capacity.

Under the SMART program, the state's three Investor-Owned Utilities (IOUs)—National Grid, Eversource, and Unitil—compensate customers through a declining block structure. Unlike the SREC market, where values fluctuate with supply and demand, the SMART program uses a fixed incentive model with varying incentives and terms depending on the utility and installation size[27]. System sizes are capped at 5 MW and all RECs go to the generator's utility, which can use the RECs or sell them in the marketplace.

With the new SMART program in place and the state's long-term RPS mandate, commercial and residential solar in Massachusetts is expected to continue growing over the next ten years.

New Jersey

Like Massachusetts, New Jersey has adopted an aggressive RPS (50% by 2030) and solar carve-out, mandating that 4.1% of total electricity sales must come from solar electric sources by 2028. And like Massachusetts, New Jersey has also adopted an active SREC market. However, unlike Massachusetts, New Jersey's solar generation is more equally distributed across residential, commercial, and (to a lesser degree) utility-scale projects.

Thanks to the largest SREC market in the country, New Jersey's solar market matured more quickly than in other areas. In 2014, it produced almost two gigawatt-hours of solar electricity, the third highest in the country after California and Arizona. Since then, however, the state's solar market has seen slower growth than the rest of the country; this could be linked to a decreasing SREC value due to oversupply. By 2018, the state had fallen from third to seventh in the US in total annual solar generation.

Still, New Jersey is a leader in solar energy driven by its RPS, solar carve-out, and SREC market, as well as retail-rate net metering that allows customers to keep all SRECs produced. In 2018, the state updated the RPS and SREC program, increasing the RPS to 50% by 2030 and the solar carve-out to 5.1% by 2021. After 2021, the carve-out then gradually reduces to 1.1% by 2033 to account for solar installations that reach the end of their 15-year SREC production eligibility. After reaching 5.1%, the SREC program will be closed with a new program likely to takes its place.

Along with California and Texas, New Jersey is already a leader in energy storage, with about 40 MW of utility-scale battery storage as of early 2019—the seventh

[27] *masmartsolar.com*

highest in the country[28]. In 2018, the state mandated the New Jersey Board of Public Utilities to conduct an analysis of energy storage in the state and set a goal of 600 MW of storage by 2021 and 2,000 MW by 2030.

New York

Like California, New York has adopted various incentives and policies to encourage solar adoption, including an aggressive RPS, homeowner tax credits, and rebates for both residential and commercial solar. Since 2014, solar capacity has grown an average of 46% YOY, almost equally divided between commercial and residential solar, with little activity on utility-scale projects.

After Hurricane Sandy destroyed much of the east coast in 2014, Governor Andrew Cuomo launched Reforming the Energy Vision (REV), a long-term initiative that seeks to modernize and strengthen New York's energy system by incorporating a wide variety of efficiency upgrades, renewables, and distributed projects into the grid.

REV is one of the biggest upheavals to the energy industry in the US. In REV's future, utilities will gradually move from vertical integration (controlling all aspects of electricity sales and supply) to the management of distribution and a decentralized energy market. In 2016, the utility industry began moving in this direction when the NY Public Service Commission issued a new order (Case 14-M-010) calling for utilities to replace traditional earning mechanisms with new structures that encourage distributed resources[29]. Traditionally, utilities earn revenue from building new infrastructure. But under the new system, known as Earning Adjustment

[28] *EIA Today in Energy*
[29] *nyrevconnect.com*

Mechanisms, New York utilities will earn revenue by meeting REV goals like supporting increased distributed resources, improving grid efficiency, transitioning to market-based energy efficiency, and supporting electrification of the transportation industry.

Utilities will also earn returns through a new form of revenue, Platform Service Revenues (PSR), for the sale of products and services. Utilities are already working with private companies on projects and demonstrations that could aid in incorporating distributed solar, energy storage, microgrids, and EVs; many of the projects could qualify as a PSR. Below are just a few of the incredibly diverse on-going projects and initiatives in New York as of 2019:

- CenHub Marketplace, with Simple Energy, is an online tool that connects residential customers with third-party, distributed energy generators
- A neighborhood-based microgrid that utilizes the existing grid and blockchains, led by LO3 Energy in Brooklyn
- Clean Virtual Power Plant, with Sunpower and Sunverge, which offers solar and energy storage to residential customers that the utility can then use as a virtual power plant to meet local energy needs
- Clean Fleets, a program that provides free assistance to municipalities looking to move toward electric fleet vehicles

New York sees a healthy, strong energy system as one that incorporates diverse, distributed resources. As such, solar growth over the last five years has focused on residential and commercial installations. While the state only has 33 MW of battery capacity installed as of 2019, both storage and solar are expected to increase as REV continues and the state moves to meet its goal of 50% renewable energy by 2030.

North Carolina

After a slow early start, North Carolina has come out as a major player in the solar market. As of late 2019, the state has installed 5.6 GW of solar—the second most of any state in the US—with another 4 GW expected over the next five years[30].

North Carolina has driven investment in solar largely through its RPS (12.5% by 2021 for IOUs, 10% by 2018 for municipal utilities and coops), which included a solar carve-out of 0.2% by 2018. Virtually all of the state's solar capacity is from large, utility-scale projects that take advantage of North Carolina's unique interpretation of the federal PURPA regulations.

[30] *seia.org*

The federal government passed PURPA in 1978 in a bid to encourage renewable energy and energy efficiency. PURPA requires utilities to purchase electricity from any qualifying facility at the utility's avoided cost. PURPA played a major role in the utility industry's adoption of renewable energy throughout the 1980s and early 1990s, but waned in effectiveness as fuel prices dropped in the late 1990s.

Today, North Carolina sees more PURPA-qualified solar than any other state, with 92% of all utility-scale solar projects in the state considered a qualifying facility. North Carolina's implementation of PURPA requires 15-year contracts between the utility and the renewable generator, with a fixed avoided cost and a capacity up to 5 MW. The long contract length (compared to other states) allows solar developers to more easily secure financing for renewable projects.

Texas

Texas is best known for its huge wind capacity, but solar has exploded over the last five years. From 2014 to 2018, solar generation grew from 446 MWh to 4,063 MWh, a 77% average annual increase—far above the national average.

In 1999, Texas adopted an RPS with a target of 10,000 MW by 2025 for IOUs and retail electricity suppliers, and a voluntary target of 500 MW for non-wind generation. By 2009, utilities in the state had already met the target. By 2017, the state had installed 26,000 MW of renewables, the vast majority of which were wind resources.

As of late 2019, utilities and electricity suppliers have surpassed the non-wind target as well, having installed 3,020 MW of solar (most of which is utility-scale projects).

While utility-scale projects have flourished, the residential and commercial solar industry remains small. As a deregulated market, homeowners and businesses must find electricity providers that voluntarily offer net metering, of which there are very few. Even still, with the state's huge residential electricity market, residential solar still accounted for 528 GWh of electricity in 2018—about 13% of the state's solar production.

While the RPS was instrumental in jumpstarting the renewable energy industry, simple economics play a major role in its success in Texas, much like Florida. The state offers few incentives for solar and doesn't require utilities to offer net metering. But wind energy's low cost allowed the technology to reach grid parity in the 2000s and solar technology reached that same point in the 2010s. Texas electricity generators are meeting growing electricity needs and replacing aging coal plants with more cost-effective renewable energy. At the same time, energy storage is also becoming an important component of the system.

The state is already one of the US' leaders in energy storage, with 89 MW of utility-scale batteries already on the grid. As of early 2019, an additional 2,300 MW of capacity has been submitted for approval to the Electric Reliability Council of Texas (ERCOT), an organization in charge of managing 90% of the state's electricity grid[31]. While many of these projects will likely go undeveloped, it does show that Texas is ready for energy storage. ERCOT and the Texas PUC are currently preparing for greater penetration of storage on the grid, and the organizations are researching how to improve the market design to incorporate batteries.

Texas has one of the fastest growing economies in the country[32], and it is installing solar, renewables, and energy storage to keep up. Over the next five years, the state is set to see fast growth in the solar industry, driven by ever-falling prices and its growing economy.

[31] *ercot.com*
[32] *bea.gov*

Key Takeaways

Over the last ten years, state-level policies have aided in the growth of healthy solar markets. States have used a variety of mechanisms to encourage this growth, including RPSs, tax credits and other incentives, net metering, SREC markets, and building codes. More often than not, states use a variety of these methods in tandem to achieve goals.

However, as installation costs continue to fall, market forces are changing. This informs three key takeaways on policy and market growth among solar, energy storage, and electric vehicles:

1. **Falling technology costs will allow solar and energy storage to grow in states with few pro-solar incentives or policy.** As costs continue to fall, solar and energy storage penetration will continue to grow throughout the US, even in areas without incentives or key policies like net metering. In a sentence: If the economics exist for a business or homeowner to save money with solar, the local solar market can thrive. Texas electricity generators, for example, are now adopting solar as the most cost-effective option. While energy storage capacity is currently far below solar, it is expected to grow at a faster rate over the next five years even in states with few policies to help the storage market. Florida utility FPL, for example, is adding the world's largest battery storage system to an existing solar farm to replace aging natural gas plants.

2. **State-level policy will continue to play a major role in certain markets.** With states like New Jersey, New York, and California extending RPS goals out to 2050, policy continues to drive growth in the solar industry. State-level initiatives like Massachusetts' SMART program will also continue to incentivize solar installations, leading to greater solar generation. The specifics of the policy dictate where the solar market will grow. In North Carolina, where solar developers have taken advantage of the state's unique implementation of PURPA, large utility-scale projects reign. Other states, like New Jersey with its thriving SREC market, see higher penetration of residential or commercial solar. While the energy storage industry is still nascent compared to the solar industry, forward-looking states like California and New York are already preparing for increased penetration. New Jersey has set a goal of 2,000 MW of energy storage capacity by 2030. California adopted a similar goal of 1.3 GW by 2020. In New York, after adopting the REV initiative, utilities have begun demonstration projects to study how distributed storage can be successfully integrated into the grid.

3. **State-level policy is necessary for greater EV adoption.** Nationwide sales of EVs and hybrids have remained around 3% of total car sales since 2012, with sales actually falling in 2015 and 2016. Automakers have introduced new EVs in recent years with greater range and lower prices, but the purchase price for EVs still remains higher than conventional vehicles, even with tax incentives. On top of the high cost, limited charging infrastructure has contributed to EVs' slow nationwide growth[33].

   California, however, provides a model for policy to encourage EV adoption. The state is home to almost 50% of the nation's EVs. In contrast to the national trend, EV sales' share of total car sales in California has grown from 1.3% in 2013 to 7.8% in 2018[34]. California has adopted numerous policies to overcome the challenges to EV adoption, including a rebate program to drive down purchase prices and local policies to increase the number of publicly-available chargers. Similar to solar technology, until EV expenses meet cost parity with conventional vehicles, government incentives and supportive policies will play a key role in increasing adoption of electric vehicles. ■

AUTHOR BIO

Ryan Austin is a writer and analyst in the renewable energy and utility industries, with a focus on solar energy, DSM, and electric vehicles. He works with utilities, consultants, industry organizations, and installers, preparing market analyses, white papers, and industry reports. He is based in Denver, CO.

[33] *EIA Today in Energy*
[34] *EVAdoption*