Lighting the Way 4

The Top States that Helped Drive America's Solar Energy Boom in 2015

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Executive Summary

American solar energy is booming. Hundreds of thousands more Americans each year are experiencing the environmental and consumer benefits of clean energy from the sun, often generated right on the rooftops of their homes or places of business.

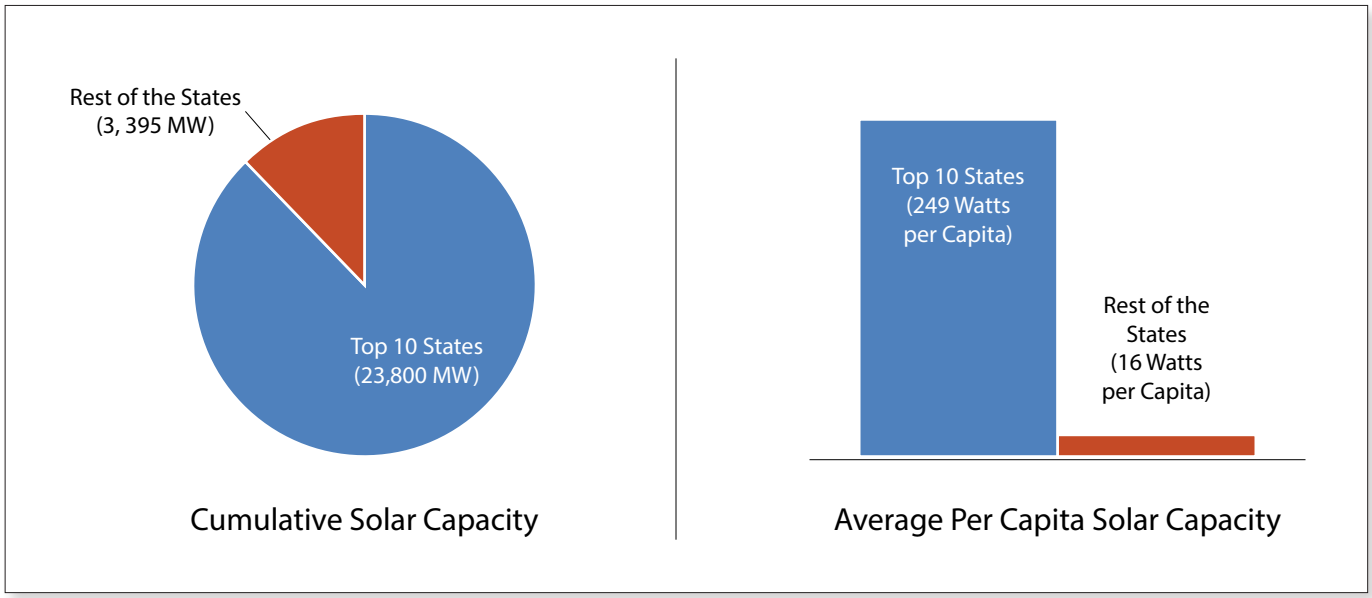
A growing number of states are leading America's ongoing solar boom. Those states are not necessarily the ones with the most sunshine, but rather the ones that have opened the door for solar energy through the adoption of strong public policies. The 10 states with the most solar capacity per capita – Nevada, Hawaii, California, Arizona, North Carolina, New Jersey, Vermont, New Mexico, Massachusetts and Colorado – have a track record of strong public policies that are enabling increasing numbers of homeowners, businesses, communities and utilities to "go solar."

Yet while strong policies have helped to grow solar energy in the U.S., some utilities and fossil fuel companies are now working to limit the growth of distributed solar energy. Within the last year, for example, two of the top 10 states in this year's rankings – Nevada and Hawaii – eliminated retail net metering,

Table ES-1. Solar Electric Capacity in the Top 10 Solar States (ranked by cumulative capacity per resident; data from Solar Energy Industries Association/GTM Research's *U.S. Solar Market Insight*)

State	Cumulative Solar Electric Capacity per Capita 2015 (watts/person)	2015 Rank	2014 Rank
Nevada	421	1	3
Hawaii	394	2	1
California	338	3	4
Arizona	337	4	2
North Carolina	208	5	9
New Jersey	182	6	5
Vermont	181	7	7
New Mexico	175	8	6
Massachusetts	153	9	8
Colorado	99	10	10

Figure ES-1. Solar Energy in the Top 10 Solar States versus the Rest of the U.S.



which makes solar energy affordable for many homes and businesses; while North Carolina's General Assembly allowed one of the best solar tax credits in the nation to expire at the end of 2015.

By following the actions of leading states, and avoiding missteps, the United States can continue to experience dramatic growth in solar energy – resulting in cleaner air, more local jobs and reduced emissions of pollutants that cause global warming, and putting America on track to a future in which our economy is powered by 100 percent clean, renewable energy.

The top 10 solar states account for 88 percent of American solar energy capacity, but only 26 percent of America's population. Of the 10 states with the most solar capacity per person:

- Nine had strong net metering policies at the beginning of 2015, though only seven retain strong net metering policies today following the elimination of retail net metering in Nevada and Hawaii during 2015;
- Nine have strong interconnection policies;
- Nine have policies that allow critical financing options like third-party power purchase agreements; and
- All have renewable electricity standards, while eight have specific requirements for solar energy or distributed generation.

Driven forward by the top 10 states, solar energy in the U.S. is reaching new heights of adoption:

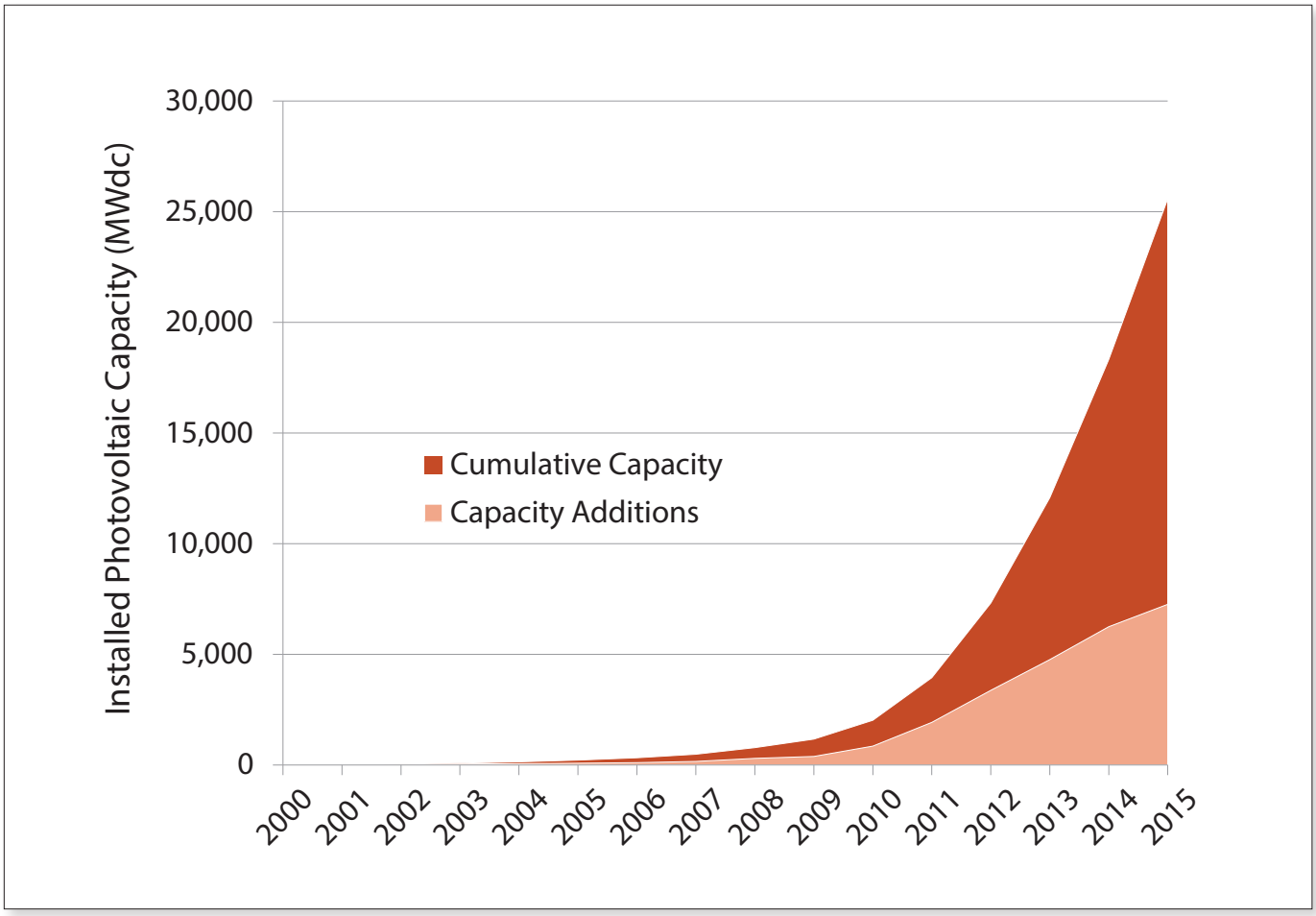
- In February 2016 America saw its one millionth solar installation, compared to just 10,000 installations in 2003. While it took 40 years for America to reach one million solar installations, forecasts predict an additional one million solar installations in the next two years.
- American solar energy capacity doubled from 2013 to 2015.
- California now generates the equivalent of nearly 8 percent of the electricity it uses each year with solar energy.
- Solar energy is expected to be the leading source of new utility-scale electric generating capacity in the U.S. in 2016.

Despite the rapid increase in solar energy capacity, some states and utilities are exploring and adopting policies that could slow future growth in solar energy:

- Nevada, which now holds the number one ranking for solar capacity per capita, eliminated retail net metering in 2015 and imposed higher charges on solar customers.
- Rooftop solar installations have slowed in parts of Arizona due to new demand charges imposed by the Salt River Project utility on its solar customers, while similar charges are pending before state regulators by utilities Arizona Public Service and UniSource Energy as of June 2016.
- In 2015, at least 13 utilities proposed the imposition of demand charges on their customers, which can reduce the economic viability of rooftop solar installations.

Strong public policies at every level of government can help unlock America's potential for solar energy and pave the way toward powering America with 100 percent clean, renewable energy. State governments should encourage adoption of solar energy through policies including net metering, statewide interconnection standards, and ambitious renewable electricity standards with solar carve-outs. By encouraging solar power, states can bring about environmental and consumer benefits to their residents, while driving forward America's transition to a clean energy economy.

Figure ES-2. Cumulative U.S. Grid-Connected Solar Photovoltaic Capacity



Introduction

In February 2016 solar energy hit a new milestone: America's millionth solar energy installation.[1]

Until recently, reaching this milestone so quickly seemed impossible. In 2003, with only 10,000 installations nationwide, solar energy was regarded as a novelty for the wealthy or a display for science museums.[2] But today, solar energy is booming. Since 2010, America's solar energy capacity has grown more than thirteen-fold.[3] And while solar energy has barely begun to tap into its almost endless potential, it is already bringing transformative changes to our economy, along with cleaner air, a growing job market, and benefits for consumers.

These benefits are adding up quickly. In 2015, American solar energy:

- Offset nearly 34 million metric tons of carbon dioxide pollution, equivalent to taking more than 7 million vehicles off the road for a year, by reducing the need for electricity generated by burning fossil fuels.[4] In addition to reducing carbon dioxide emissions, the leading cause of global warming, solar energy also helped reduce emissions of toxic mercury and smog-forming nitrogen oxides.[5]
- Supported an industry that employed more than 200,000 Americans, and accounted for more than 1 percent of all jobs created in the U.S. in 2015.[6] There are now more solar jobs in America than jobs in coal mining or oil and gas extraction.[7]
- Benefitted electricity consumers by reducing dependence on fossil fuels such as natural gas, which are often volatile in price, and in the case of rooftop solar power, reducing the need for expensive electric grid infrastructure.[8]

The states reaping the largest benefits from the growth of solar energy are not necessarily those with the most sunshine. Rather, they are the states that have laid the policy groundwork to encourage solar energy adoption. States with these policies – such as net metering policies that provide solar homeowners a fair return for the energy they supply to the grid, policies that make installing solar panels easy and hassle-free, and policies that provide attractive options for solar financing – have seen solar energy take hold and thrive.

This report is our fourth annual analysis of solar energy adoption in the states and the links between solar energy growth and public policy. The benefits of solar energy for America's environment, economy, and consumers are now clear. By understanding the keys to the growth of solar energy, other states will have the tools to follow the path set by America's solar energy leaders, creating a cleaner environment and a more vigorous economy.

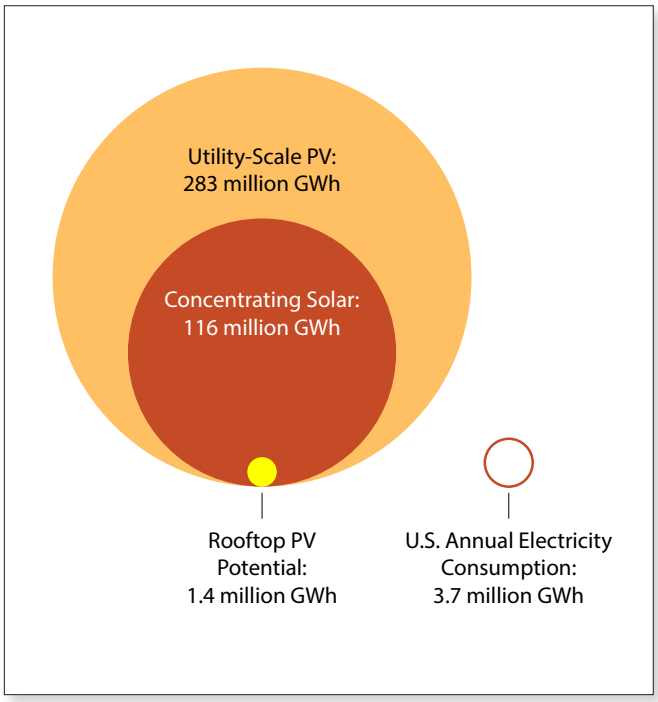
Solar Power Is on the Rise

With endless potential for growth, plummeting prices, and improving technology, the amount of solar energy in the United States is rising rapidly, reducing America's dependence on dirty sources of energy.

America's Solar Energy Potential Is Virtually Endless

America has enough solar energy potential to power the nation many times over. An analysis by researchers with the National Renewable Energy Laboratory (NREL) estimated that the U.S. has the potential to use photovoltaic panels to generate 76 times as much as electricity as is used in the United States each year. (See Figure 1.)

Figure 1. Comparison of Solar Energy Technical Potential and Current Consumption[9]



Solar energy potential is not distributed evenly across the United States, but every one of the 50 states has the technical potential to generate more electricity from the sun than it uses in an average year. In 19 states, the technical potential for electricity generation from solar photovoltaics exceeds annual electricity consumption by a factor of 100 or more. (See Figure 2.) Thirty-three U.S. states could generate more than a third of their annual electricity consumption using rooftop solar installations alone.[10]

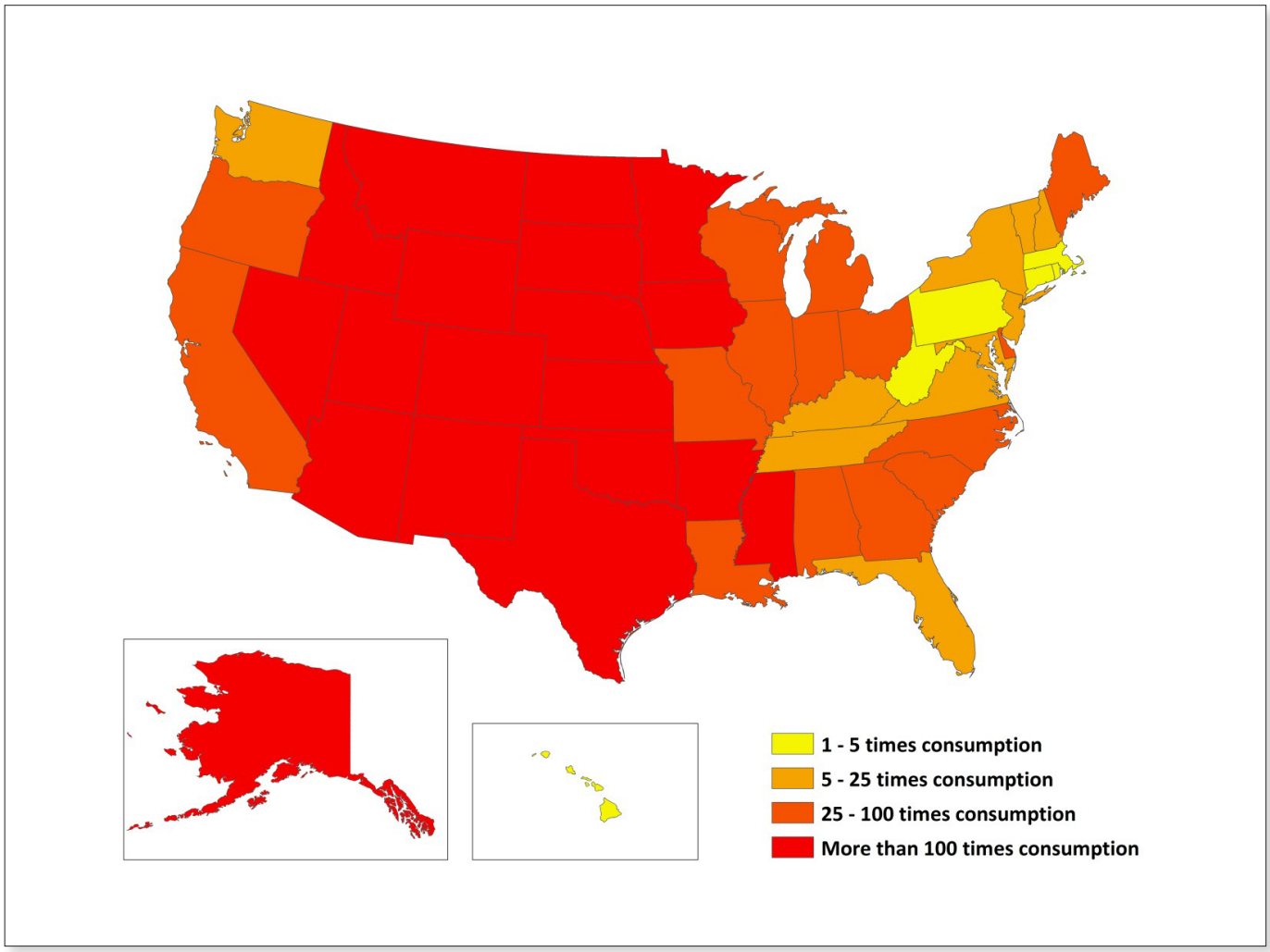
The high potential for solar photovoltaic power in the Western states is a factor of their strong sunlight and vast open landscapes. America neither can – nor should – convert all of those areas to solar farms. But the existence of this vast technical potential for solar energy shows that the availability of sunshine is not the limiting factor in the development of solar energy.

Solar Power Is Cheaper and More Efficient than Ever

Over the past decade, technological innovation and economies of scale have helped solar power evolve from a novelty into a mainstream and price-competitive source of energy.

From 2008 to 2014, the price of residential solar installations dropped by more than half, while the price of large non-residential solar installations dropped by more than 60 percent.[12] The price of utility-scale solar PV installations fell by more than 50 percent from 2007-2009 to 2014, and in many cases electricity from new utility-scale solar plants is now cheaper than from new natural gas plants.[13] Evidence suggests that costs

Figure 2. Solar PV Technical Potential versus Annual Electricity Consumption by State[11]

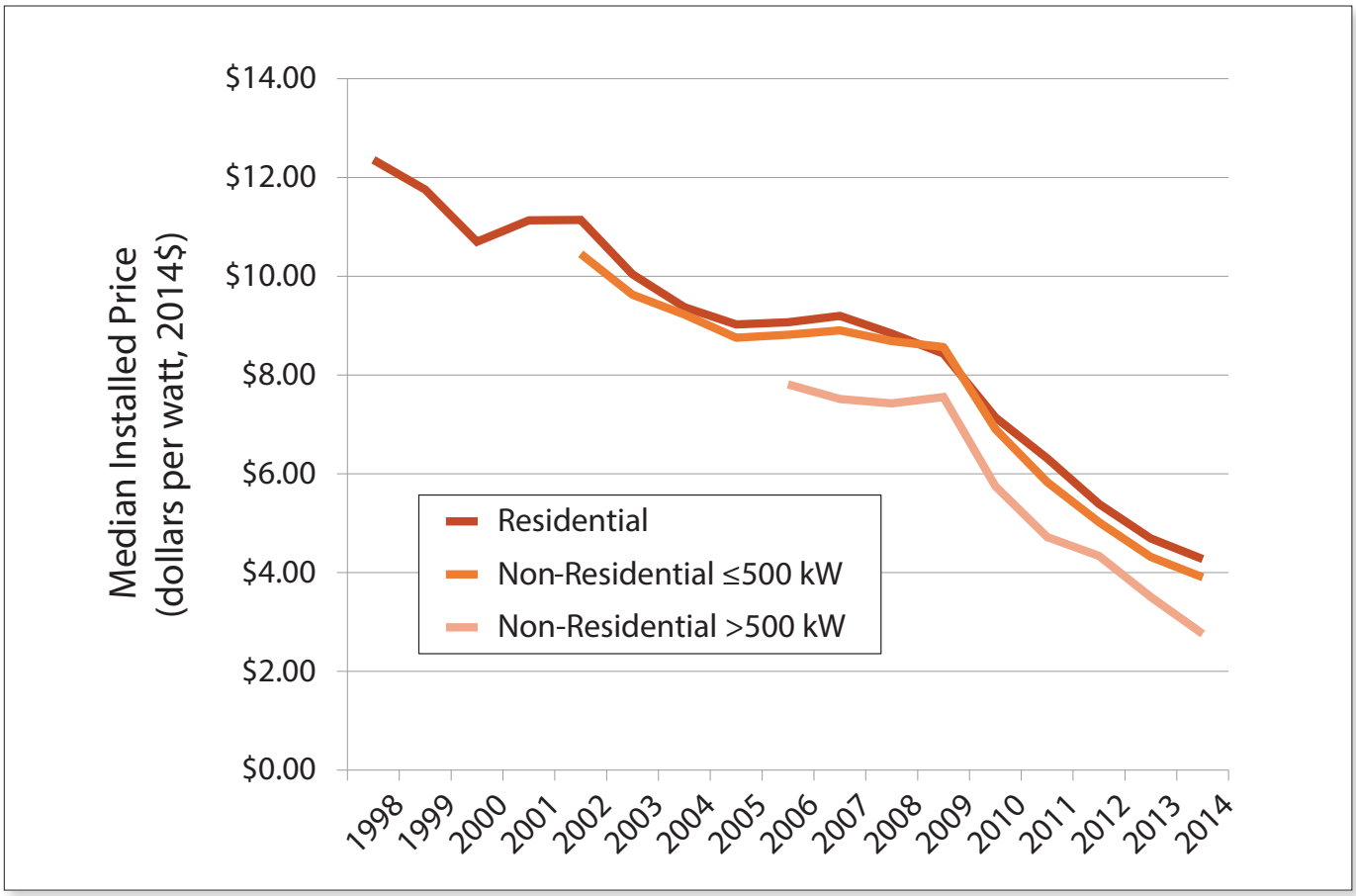


for all types of solar installations have continued to fall quickly since the end of 2014, including for residential solar power, for which system costs fell by 8 percent from fourth quarter 2015 to first quarter 2016.[14]

Price drops of recent years have been driven in part by falling costs of solar panels, but also by the falling costs of other components, including inverters and racking equipment, and by falling "soft costs," which include the costs of labor, design and permitting.[15] The U.S. Department of Energy has initiatives to bring down soft costs: the SunShot Initiative is working to reduce soft costs as part of its goal to bring solar energy's cost down to $0.06 per kWh by 2020, while the SolSmart designation program recognizes communities that have taken action to reduce soft costs.[16]

Solar energy systems are also becoming increasingly efficient, allowing businesses and homeowners to generate more energy in smaller spaces. From 2010 to 2014, the median efficiency of panels installed in non-utility systems increased by 13 percent.[17] More efficient solar energy systems can drive down overall project costs by reducing costs of components that scale with the size of the system, including mounting equipment and labor.[18]

Figure 3. Median Installed Price of Residential and Commercial Solar Photovoltaic Systems by Size[19]



Solar Capacity in America Doubled from 2013 to 2015

Solar energy in America is skyrocketing. America's cumulative installed solar power capacity of 25.5 gigawatts at the end of 2015 was more than double its capacity at the end of 2013. From 2005 to 2015, America's cumulative solar capacity grew by an average of 60 percent every year. (See Figure 4.) And while it took 40 years for America to reach one million solar installations, forecasts predict an additional one million solar installations in the next two years.[20]

Solar power now accounts for a sizable share of the American energy market. In four states – California, Hawaii, Arizona and Nevada– solar power generates more than 5 percent of total state electricity consumption.[21] In 2015, solar energy (including from concentrated solar power) accounted for 30 percent of the United States' newly installed electric generating capacity.[22] (See Figure 5.)

America's solar energy growth is projected to continue in 2016. The Energy Information Administration (EIA) estimates that solar energy will be the leading source of new utility-scale electric generating capacity in the U.S. in 2016.[25] The EIA anticipates a total of 9.5 GW of utility-scale solar power to come online in 2016, which would exceed the amount of utility-scale solar capacity added to the grid over the previous three years combined. In terms of total PV capacity, GTM Research forecasts that 14.5 GW of solar power will come online in 2016, nearly doubling 2015's solar energy additions.[26] Through the first quarter of 2016, solar energy made up 64 percent of new electric generating capacity in the U.S.[27]

Figure 4. Annual and Cumulative Installed Photovoltaic Capacity, United States[23]

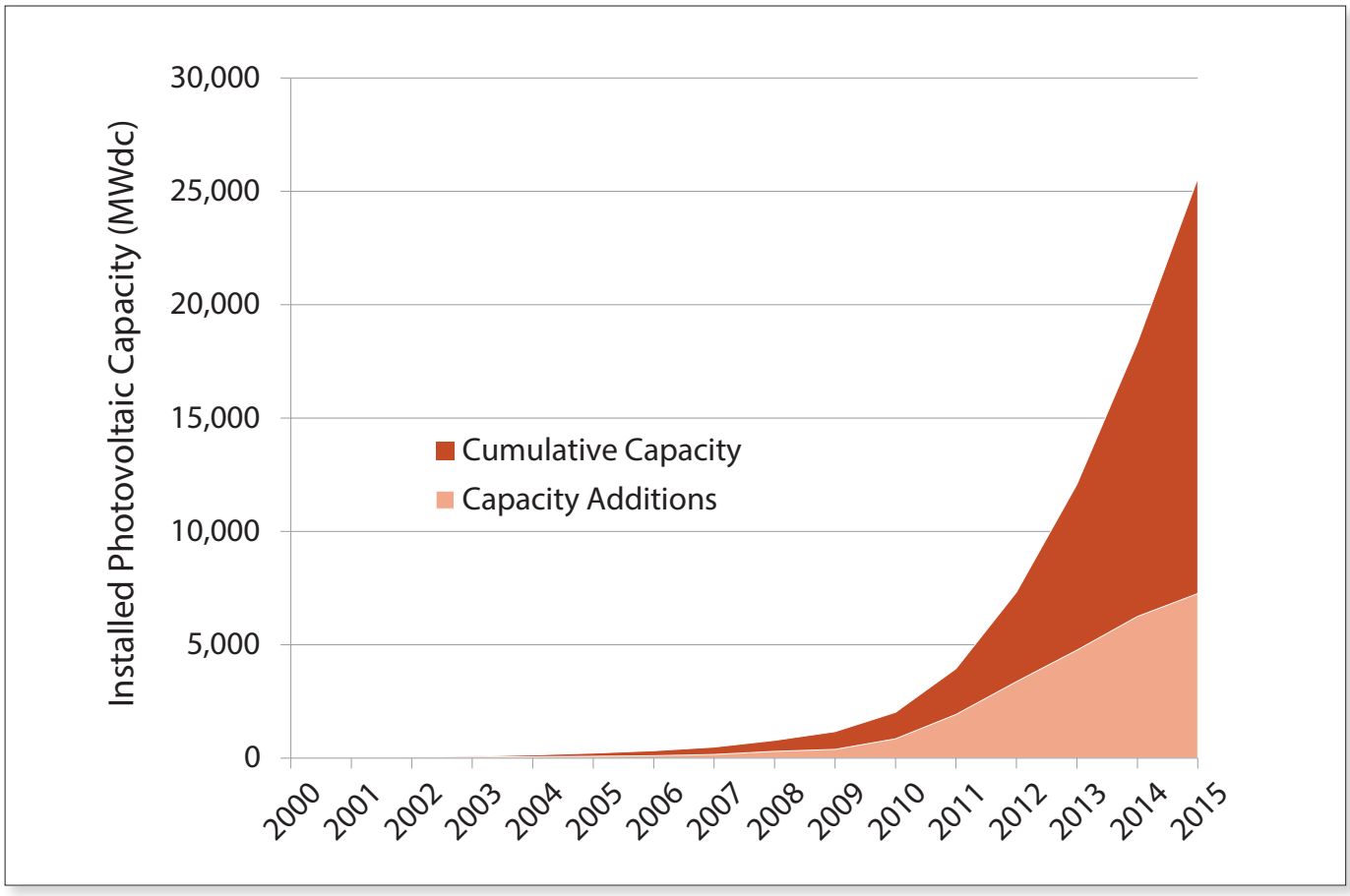


Figure 5. Solar Energy Accounted for Nearly One-Third of New U.S. Electric Capacity in 2015[24]

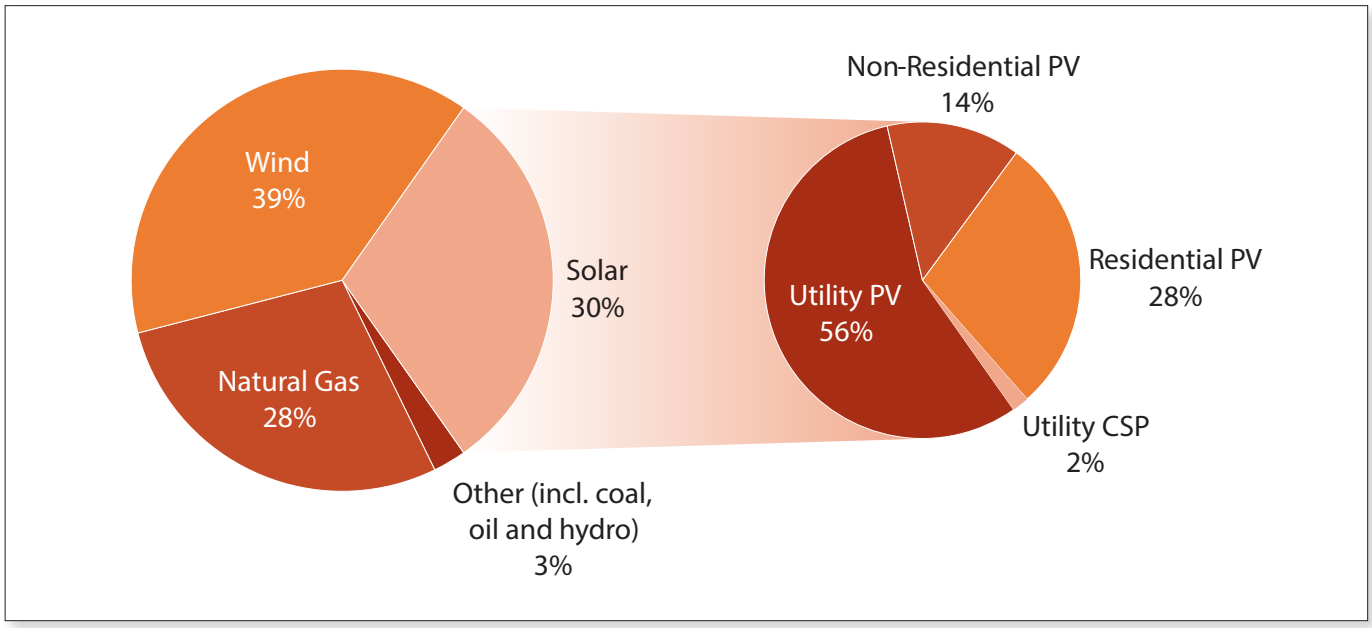
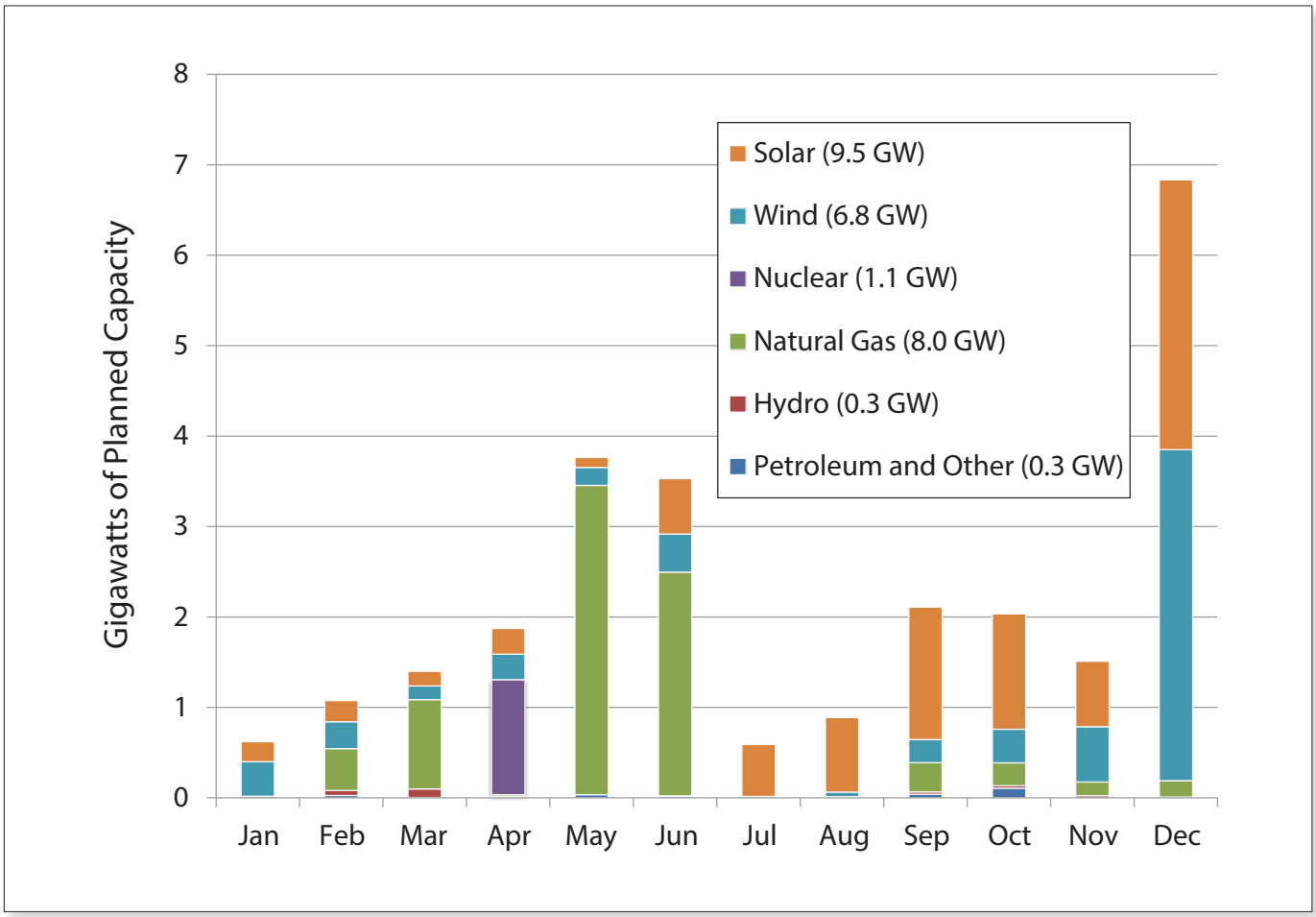


Figure 6. Scheduled Utility-Scale Electric Generating Capacity Additions in 2016[28]



The Top 10 Solar States Lead the Way

America's leading solar states are not necessarily those with the most sunshine. Rather, they are those that have opened the door for solar energy with the adoption of strong public policies.

Solar energy is seeing tremendous growth in many states across the country. But, the vast majority of America's solar power capacity is located in 10 states that have seen high rates of per-capita adoption of solar energy. Many of these states, not coincidentally, have also demonstrated foresight in developing public policies that pave the way for solar power.

America's Top 10 Solar States

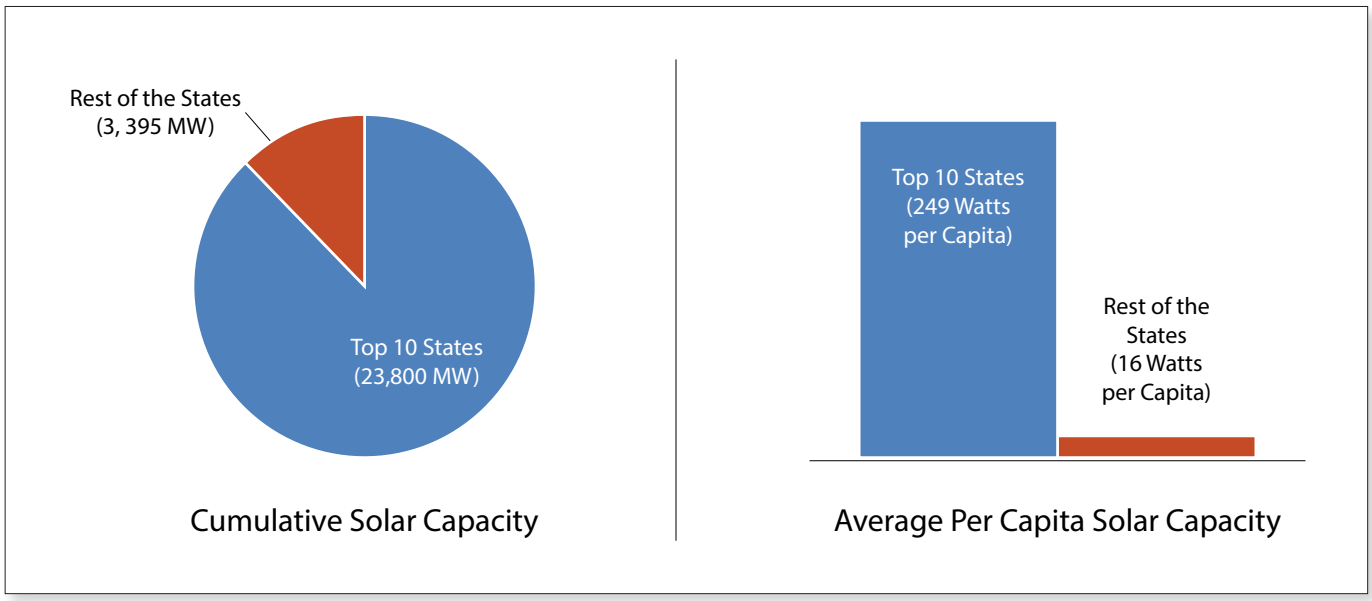
Ten U.S. states lead the nation in the amount of installed solar electricity capacity per capita. Most of these states also led the nation in new capacity additions in 2015, indicating their sustained commitment to solar energy.

These 10 states account for:

- 26 percent of the U.S. population,
- 19 percent of U.S. electricity consumption,
- 88 percent of total U.S. solar electric capacity, and
- 88 percent of U.S. solar electric capacity installed in 2015.

The top 10 states average 249 watts per capita of solar capacity, more than 15 times the average of 16 watts per capita of solar capacity in the rest of the states.

Figure 7. Solar Energy in the Top 10 Solar States versus the Rest of the U.S.



Solar Electric Capacity per Capita

Nevada leads the nation in solar electric capacity per capita, with 421 watts of solar electric capacity per resident. That is nearly seven times as much solar electric capacity per person as the national average. Nevada's new number one ranking, a jump from third in 2014, is a reflection of large additions of utility-scale solar power. In 2015, Nevada saw the completion of three of the highest-capacity solar plants in the world: the 110 MW Crescent Dunes Solar Energy Project (which uses concentrating solar power), the 150 MW Copper Mountain Solar 2 plant (of which 58 MW came online in 2015) and the 250 MW Copper Mountain Solar 3 plant.[29] Nevada's fast solar energy growth has brought economic benefits: In 2015, more than $800 million was invested in solar energy installations in Nevada, and today Nevada has more solar jobs per capita than any other state.[30] (Nevada's rooftop solar industry however, appears set to take a step backwards – see "Nevada Jumps to Number One, But Cripples Rooftop Solar," page 13.)

Arizona's fall from its perch as the nation's leading state for per-capita solar energy in 2013 to fourth in 2015 came after years of attacks on distributed solar energy by state utilities, the creation of new fees for some Arizona solar customers, and slowing growth of utility-scale solar. (See Table 1.)

Hawaii, which ranked number one in 2014 and second in 2015, continued to add solar capacity at a fast clip in 2015. However, in late 2015 state regulators ended Hawaii's retail net metering program, replacing it with a new "grid-supply" tariff, under which solar customers will receive about half the compensation for solar energy fed into the grid that they received through net metering.[31] Since the decision to end net metering, some of Hawaii's solar companies have announced plans to downsize or slow operations.[32]

Table 1. Cumulative Solar Capacity per Capita (data from the Solar Energy Industries Association/GTM Research *U.S. Solar Market Insight*)

State	Cumulative Solar Electric Capacity per Capita 2015 (watts/person)	2015 Rank	2014 Rank
Nevada	421	1	3
Hawaii	394	2	1
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New Jersey	182	6	5
Vermont	181	7	7
New Mexico	175	8	6
Massachusetts	153	9	8
Colorado	99	10	10

While several Western states with excellent solar resources are on the list of solar energy leaders, so too are New Jersey, Massachusetts and Vermont – small northeastern states where sunlight is relatively less abundant but grid electricity prices are high and public concern about pollution has led to strong support for clean local energy. (See Table 1.) Vermont first joined the Top 10 for solar capacity per capita in 2014 after 100 percent of the state's new electric capacity came from solar energy in that year.[33]

Nevada led the list for solar capacity added per capita in 2015 for the second year in a row, with more than 144 watts per person installed during 2015. (See Table 2.)

North Carolina ranked second for per capita solar capacity added in 2015, a jump from seventh in 2014. The jump resulted from strong state support for utility-scale solar power, in particular North Carolina's renewable electricity standard (RES), which requires state utilities to generate 12.5 percent of electricity using renewables by 2021; the state's now-expired 35 percent renewable energy tax credit; and the state's utility-scale power purchase agreement (PPA) standard. North Carolina's PPA standard encourages the development of small-scale utility-scale solar by requiring that utilities enter 15-year PPAs with companies for renewable energy systems of up to 5 megawatts.[34] As a result, North Carolina's 1,043 MW of 5-MW-and-under utility-scale solar leads the nation, and accounts for half of all North Carolina solar capacity.[35] The expiration of North Carolina's renewable energy tax credit, which provided a 35 percent state tax credit for solar installations, is expected to slow future state solar growth.[36]

North Carolina's support for rooftop solar energy is far weaker, as the state does not allow third-party ownership of solar energy systems and has a very limited net metering program. In 2015, only 5 percent of the state's solar energy generation was from distributed solar.[37] The utility Duke Energy has made repeated efforts to continue North Carolina's prohibition of third-party ownership.[38] Furthermore, renewable energy has been under attack at the General Assembly, where state lawmakers have repeatedly tried to repeal the state's renewable energy requirement. In 2016, a bill was introduced that would essentially ban new solar and wind systems in North Carolina through new financial hurdles and safety restrictions for renewable energy that are in some cases more restrictive than the state's standards for coal and nuclear plants.[39]

Table 2. Solar Electric Capacity Installed During 2015 per Capita (data from the Solar Energy Industries Association/GTM Research *U.S. Solar Market Insight*)

Rank	State	Solar Electric Capacity Installed During 2015 per Capita (watts/person)
1	Nevada	144
2	North Carolina	113
3	California	83
4	Hawaii	82
5	Utah	77
6	Vermont	69
7	Massachusetts	42
8	Arizona	34
9	Colorado	26
10	Connecticut	25

Nevada Cripples Rooftop Solar with New Fees, Elimination of Net Metering

With large additions of utility-scale solar capacity in 2015, Nevada jumped to number one in the country for solar capacity per capita. However, Nevada's rapid increase in utility-scale solar has come alongside the recent passage of policies that could cripple Nevada's residential solar market for the foreseeable future.

In December 2015, the Nevada Public Utilities Commission voted to put in place new electric rates that will, over the next five years, triple the monthly charge for solar customers to nearly $40, while cutting the credit for solar energy fed into the grid by three-quarters.[40] This dramatic reduction in compensation is at odds with a growing body of evidence that the benefits of adding solar energy to the grid well exceed the cost of retail net metering.[41] The new rates will also retroactively apply to the state's existing 17,000 solar owners, although that provision has been recommended for review by a state energy task force.[42] Following the passage of the new rates, solar developers SunRun and SolarCity ceased operations in the state.[43]

Solar advocates in Nevada are working to reverse the new solar rates, but those efforts are being opposed by NV Energy, Nevada's biggest utility.[44] In recent years, NV Energy has campaigned for other policies unfavorable to solar owners, including past attempts to reduce the net metering credit.[45] Meanwhile, as solar energy prices continue to fall and NV Energy erects new barriers to solar power, the utility is having increasing difficulty retaining some of its largest customers. In recent months, some of Las Vegas' huge and energy-intensive casinos have made plans to exit NV Energy's service in order to obtain their own electricity from the wholesale market and from their own rooftop panel and solar array installations.[46]

Even as residential and commercial solar markets in Nevada remain in disarray, Nevada's excellent solar resources will likely lead to continued growth in utility-scale projects. Those projects include FirstSolar's 250 MW Silver State South Solar Project, which will provide energy to Southern California Edison.[47] NV Energy is even making solar investments of its own – the 180 MW Switch Station 1, for example, will provide electricity for large data centers through NV Energy's program allowing commercial and industrial customers to source electricity from renewable sources.[48] But by turning its back on distributed solar energy, Nevada – one of the United States' best resources for solar energy – will be unable to reach its full potential for solar leadership.

Total Solar Electric Capacity

In terms of total solar electric capacity through 2015, California led the nation with more than 13 GW – equivalent to nearly half of the nation's total solar capacity, and more than double its year-end capacity from 2013. Arizona, North Carolina, New Jersey, and Nevada round out the top five. (See Table 3.)

Nearly all of the Top 10 states for total solar electric capacity are also those with the most per-capita solar capacity. The exceptions are New York and Texas; both appear in the Top 10 for total solar capacity, but fall out of the Top 10 for per-capita solar capacity because of their large populations. In contrast, Vermont and New Mexico appear in the Top 10 for per capita solar capacity, but do not crack the Top 10 for total solar electricity capacity.

Table 3. Top 10 States for Cumulative Solar Electric Capacity through 2015 (data from Solar Energy Industries Association/GTM Research's *U.S. Solar Market Insight*)

Rank	State	2015 Cumulative Solar Electric Capacity (MW)
1	California	13,243
2	Arizona	2,303
3	North Carolina	2,087
4	New Jersey	1,632
5	Nevada	1,216
6	Massachusetts	1,037
7	New York	638
8	Hawaii	565
9	Colorado	543
10	Texas	537

California led the way with the most solar capacity installed in 2015 by adding more than 3 gigawatts of solar electricity capacity – more than the cumulative solar capacity of any other state. North Carolina, Nevada, Massachusetts and New York rounded out the list of the top five states for new solar energy capacity. (See Table 4.)

At number seven with 231 MW of solar electric capacity added in 2015, Utah was a new addition to the top 10 for solar capacity additions. From 2014 to 2015, Utah's cumulative solar capacity grew fourteen-fold, from 18 MW to 246 MW, with 165 MW of its new solar capacity coming from 11 new utility-scale solar plants (compared to just one such facility in operation before 2015).

In past years, Utah's solar energy development has lagged in part because of its lack of an RES to require renewable energy investment; Colorado, with similar solar resources and an RES, had 12 times Utah's per-capita solar capacity in 2014. Yet as the price of solar energy has come down, with help from the federal investment tax credit and state incentives (of which Utah has two available for utility-scale solar plants), utility-scale solar in Utah has become financially viable without an RES requirement.[49] Low prices are driving both voluntary utility procurement of solar energy – for example, Rocky Mountain Power's 20-year power purchase agreement with the 104 MW Red Hills Renewable Park solar plant—and independent solar development, taking advantage of Utah's favorable standard terms for contracts under the Public Utility Regulatory Policies Act (PURPA).[50] (For more on PURPA see "State Policies Driving Utility-Scale Solar" on page 24.) Although utility-scale solar is leading the way in Utah, with both strong net metering and a strong interconnection standard, residential solar energy in Utah is on the rise too, with 78 percent more distributed solar generation in 2015 than in 2014.[51]

Table 4. Top 10 States for Solar Electric Capacity Installed during 2015 (data from Solar Energy Industries Association/GTM Research's *U.S. Solar Market Insight*)

Rank	State	2015 Solar Electric Capacity Additions
1	California	3,266
2	North Carolina	1,134
3	Nevada	417
4	Massachusetts	286
5	New York	241
6	Arizona	234
7	Utah	231
8	Georgia	209
9	Texas	207
10	New Jersey	181

California Commits to Net Metering

California is home to nearly half of the nation's solar capacity, and nearly one-third of that capacity is in the form of distributed solar energy on homes and businesses. California's solar success has been due, in large part, to smart policies designed to encourage solar energy growth; these include an RES that now calls for 50 percent renewable energy by 2030, the financial incentives historically offered through the California Solar Initiative – and strong net metering policies.

But in 2015, net metering's future in California was in question. A 2013 law required state regulators to come up with a successor to California's net metering rules, and as state regulators debated "net metering 2.0," California's biggest utilities – including Pacific Gas & Electric, Southern California Edison and San Diego Gas & Electric – asked for changes that would dramatically reduce the value of solar installations for California consumers.[52]

In its final decision, the California Public Utilities Commission (CPUC) decided to preserve net metering in California through 2019, finding that net metering provides for rates that are "just and reasonable" and "ensures that customer-sited renewable distributed generation (DG) continues to grow sustainably."[53] The CPUC's decision was broadly supported by the public, with approximately 130,000 Californians signing a petition to the CPUC asking for a continuation of net metering.[54]

By keeping strong net metering in place, California – which this year climbed to third in the rankings for solar per capita, and which now generates the equivalent of nearly 8 percent of the electricity it uses each year with solar energy – should see its rooftop solar generation continue to grow quickly for years to come.[55]

Solar Generation as a Share of State Electricity Consumption

The U.S. Department of Energy's Energy Information Administration now publishes comprehensive solar generation data for every state, for years starting in 2014. This data allows comparisons of each state's solar generation as a share of that state's total electricity consumption. The leading states are California, where solar generates 7.8% of electricity consumption, Hawaii (7.2%) and Arizona (6.0%).

Table 5. Top 10 States for Solar Generation as Percentage of Electricity Consumption in 2015[61]

Rank	State	Solar Generation as Share of State Electricity Consumption
1	California	7.8%
2	Hawaii	7.2%
3	Arizona	6.0%
4	Nevada	5.2%
5	New Mexico	3.4%
6	New Jersey	2.6%
7	Massachusetts	2.5%
8	Vermont	2.2%
9	North Carolina	1.4%
10	Colorado	1.3%

South Carolina Takes Three Steps Toward a Solar Future

South Carolina's solar industry is still in its infancy, with the state ranking 40th for solar energy capacity per capita. However, that may soon change, as over the last two years South Carolina adopted three new policies to encourage solar energy growth.

In 2014, South Carolina adopted Act 236, which created a voluntary Distributed Energy Resource Program allowing utilities to recover costs connected to meeting a 2 percent renewable energy target by 2021.[56] Unlike a true RES, the program is voluntary; its impact on solar energy adoption may also be tempered because a wide variety of renewable sources are eligible under the program. Nevertheless, the program is expected to increase South Carolina's solar power capacity to 300 MW by 2021 (from just over 11 MW today).[57]

The same legislation also allowed consumers in South Carolina to lease solar energy systems from third-party owners. Although the solar leasing arrangements allowed in South Carolina are more limited than third-party ownership agreements allowed in some other states, the new rule will allow many homeowners to "go solar" without upfront costs.[58]

Finally, in March 2015 (and also as a result of Act 236), the Public Service Commission approved a settlement agreement creating net metering in South Carolina. The agreement, which compensates solar owners for solar electricity at the full retail rate, earned a B grade from Freeing the Grid, which is a partnership of energy experts and solar advocates that grades states on best practices for net metering and interconnection standards.[59]

In June 2015, just after net metering took effect, the large rooftop solar company SunRun moved into South Carolina for the first time, and already offers customers the ability to either lease or purchase panels.[60] And while South Carolina's solar policy suite still lags behind solar leaders in some respects, including the lack of a true RES and the lack of strong interconnection policies, with new policy support, solar energy in South Carolina seems primed to take off.

America's Leading Solar States Have Strong Solar Policies

What separates the leading solar energy states from those that lag? It is not necessarily the availability of sunlight – leading states such as New Jersey and Vermont do not receive as much sunlight as states like Texas or Florida, but their solar energy markets are much more developed. High electricity prices are not always a determining factor, either – five of the Top 10 states have retail electricity rates that are below the national average.[62] Instead, the most important determinant of a successful solar energy market is the degree to which state and local governments have recognized the benefits of solar energy and created a fertile public policy atmosphere for the development of the solar industry.

The presence of strong solar policies has been consistently linked with the emergence of strong solar energy markets. Of the 10 states with the most solar energy capacity per person, nine had strong net metering policies at the beginning of 2015 (though by the end of 2015 Hawaii and Nevada had eliminated their retail net metering policies); nine have strong interconnection policies; nine have policies that allow creative financing options like power purchase agreements; and all have renewable electricity standards.

Below, states are surveyed on three categories of public policies that National Renewable Energy Laboratory (NREL) researchers have identified as helping to build strong markets for solar energy:[63]

Market preparation policies make it possible for homeowners and businesses to "go solar." Without these policies in place, it might be impractical – and in some cases, impossible – for even those residents who are most enthusiastic about solar energy to install solar panels.

Market creation policies are those that create the conditions for businesses to begin marketing solar energy to individuals and commercial facility owners. By ensuring the availability of a steady market for solar energy, these policies draw investment from solar energy companies and send a signal that a given state is truly committed to the development of solar energy.

Market expansion policies are those that bring solar energy within the reach of those who might not otherwise have access to the technology due to financial restrictions or other impediments.

Market Preparation Policies

Clear and solar-friendly interconnection policies, policies that ensure fair compensation for consumers who install solar panels, and solar rights policies are essential for preparing state markets for solar energy. States in this analysis are surveyed on the following market preparation policies:

Net metering, which guarantees owners of solar power systems a fair return for the excess electricity they supply to the grid by crediting them with the value of such electricity at the retail rate, has proven to be important for the development of a strong solar energy market among residential and small business consumers. Net metering essentially allows the

Investment Tax Credit Renewal Gives U.S. Solar Energy a Boost

Solar energy's rise over the last decade has been heavily driven by local, state and federal policies. At the federal level, the solar investment tax credit (ITC), which provides a 30 percent tax credit for residential and commercial installations, has provided key financial support for solar energy nationwide.

The ITC was set to expire at the end of 2016, resulting in predictions of a significant drop-off in solar installations in 2017. But in December 2015, federal lawmakers renewed the 30 percent ITC through the end of 2019 (at which time it will decline in value before dropping permanently at the end of 2023 to 0 percent for residential installations and 10 percent for commercial installations.)[64]

According to an analysis by Bloomberg New Energy Finance, the result of the extended tax credit will be an additional $38 billion in solar energy investment through 2021 and an extra 20 GW of solar capacity (roughly equivalent to total solar capacity in the United States at the end of 2014). The extension is also expected to add more than 200,000 new solar jobs by 2020.[65]

customer's power meter to "spin backwards" at times when solar power production exceeds on-site needs.

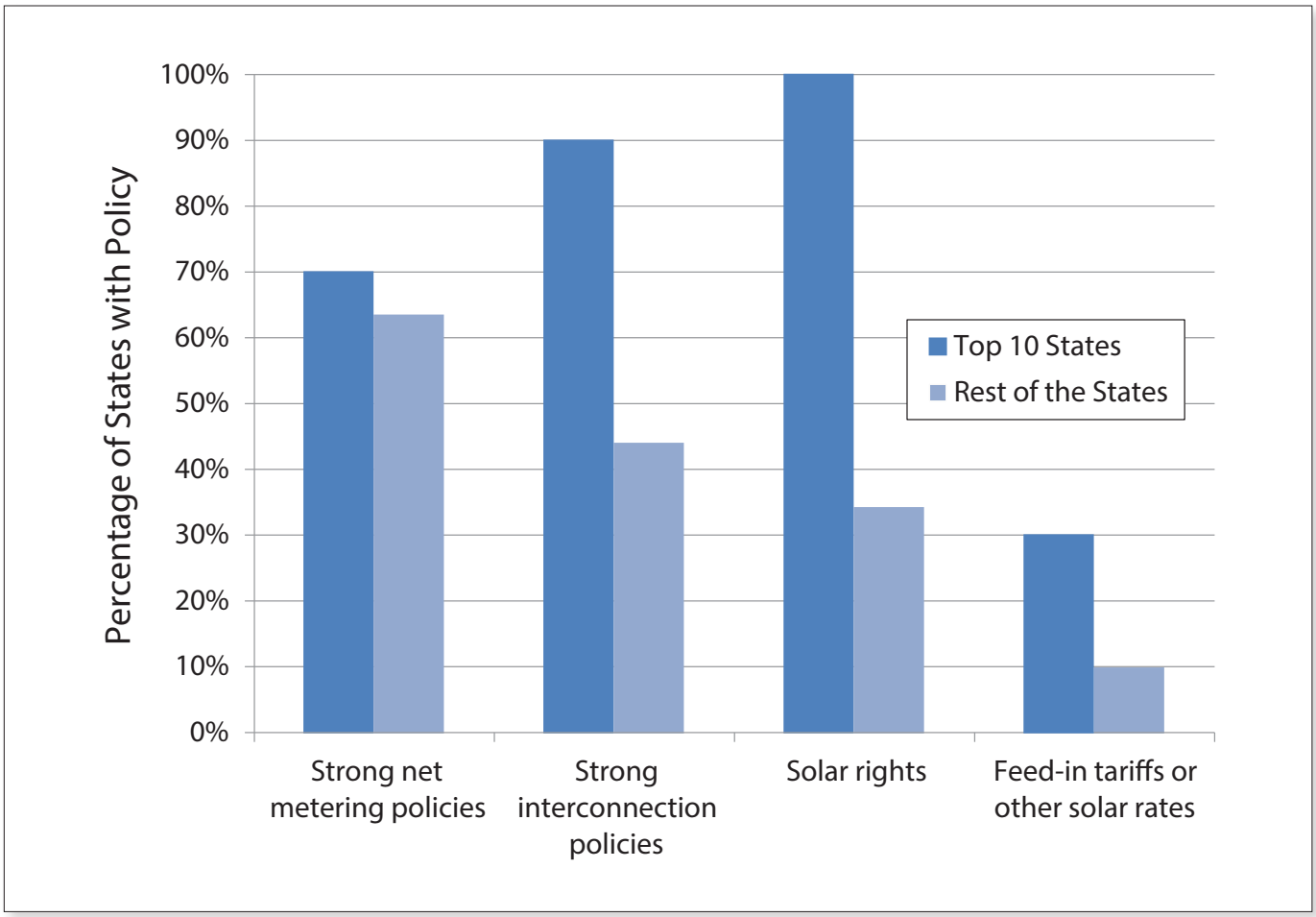
Nine of the top 10 states had strong net metering policies at the beginning of 2015, though only seven retain strong net metering policies today following the elimination of net metering at the retail rate in Nevada and Hawaii during 2015. Strong net metering policies are defined as those that received an "A" or "B" grade from Freeing the Grid, which is a partnership of energy experts and solar advocates that grades states on best practices for net metering and interconnection standards. Both Nevada and Hawaii now credit excess solar generation at far lower rates, and solar companies in both states have indicated that they will be forced to scale back operations as a result. North Carolina, the third top 10 state without strong net metering, received a lower grade ("C") because of certain weaknesses in its net metering policy, including denying customers ownership of renewable energy credits unless the customer takes service under a time-of-use rate schedule that includes an onerous demand charge, and subjecting customers with systems over 100 kW to standby charges (which are fees charged to compensate utilities for "standing by" at times when net metering customers generate their own electricity).[66]

Feed-in tariffs, including value-of-solar rates, can provide support for solar in states or localities where net metering policies are weak or do not exist, or can encourage wholesale distributed generation systems (small-scale solar energy systems connected directly to the distribution grid). Three of the top 10 states have a feed-in tariff. One example is California's ReMAT feed-in-tariff program for wholesale distributed generation systems less than 3 MW; that program is expected to help bring online 200 MW of solar capacity by 2020.[67]

Interconnection standards clarify how and under what conditions utilities must connect solar panels to the grid while preserving the reliability and safety of the electricity system. Nine of the Top 10 states had interconnection policies that merited an "A" or "B" grade in *Freeing the Grid*. Arizona does not yet have a statewide interconnection standard, leaving individual utilities to develop their own, and therefore received an "F."[68] Arizona's solar customers often are faced with delays in connecting to the grid, and in 2016 Arizona adopted a policy to let utilities make homeowners wait 60 days before connecting solar panels.[69]

Solar rights policies override local ordinances or homeowners' association policies that bar or limit citizens from installing solar energy equipment on

Figure 8. Prevalence of Market Preparation Policies, Top 10 States versus Others



their properties. All of the Top 10 states have solar rights laws that protect the individual homeowner's right to "go solar."

Important market preparation policies not surveyed include:

Utility rate structures, which can have a major impact on the financial desirability of solar energy. For example, rate structures that have a higher ratio of per-kilowatt-hour to per-customer charges will tend to encourage solar energy by ensuring that customers receive the maximum benefit for reducing their consumption of electricity from the grid, especially during peak times. High residential demand charges, on the other hand, can limit savings from reduced overall energy use. (See "Residential Demand Charges Could Slow Growth of Rooftop Solar," page 20.)

Smart permitting and zoning rules can help state and local governments reduce the costs and obstacles of solar development. A 2014 study by the Lawrence Berkeley National Laboratory found that variations in local permitting and regulatory procedures can add costs of more than $2,500 for a typical 5 kilowatt solar installation.[70] A separate study found that the cost of permitting, interconnection and inspection of solar energy systems represents about 4 percent of the cost of a residential solar energy system.[71] States can set reasonable limits on the permitting practices of local governments – California and Colorado, for

instance, limit the permitting fees that local governments can charge for solar installations.[72]

Building codes – either local or statewide – can require new homes and commercial establishments to be built "solar ready" or to meet standards for energy consumption (such as "zero net energy" standards) that encourage the use of solar or other renewable energy technologies. In 2016, San Francisco adopted a policy requiring solar photovoltaic or thermal systems on all new buildings under 10 stories, the most ambitious solar building code yet adopted by a large U.S. city.[73] San Francisco's solar requirement follows the lead of California cities Lancaster and Sebastopol, which became the nation's first cities to require solar energy on new developments in 2013.

High Residential Demand Charges Could Slow Growth of Rooftop Solar

Rooftop solar energy is changing how consumers obtain power and how utilities manage the grid. Some utilities have started to embrace these changes by envisioning new business models appropriate for the energy system of the 21st century. Others, however, have reacted by trying to slow the growth of rooftop solar power, including by adding extra monthly charges on solar energy owners, increasing the fixed charge component of residential customer energy bills, reducing credits for solar energy under net metering policies, and restricting financing options like third-party solar ownership.[74] In recent months, utilities have worked to put in place another policy that could slow the growth of rooftop solar: high residential demand charges.

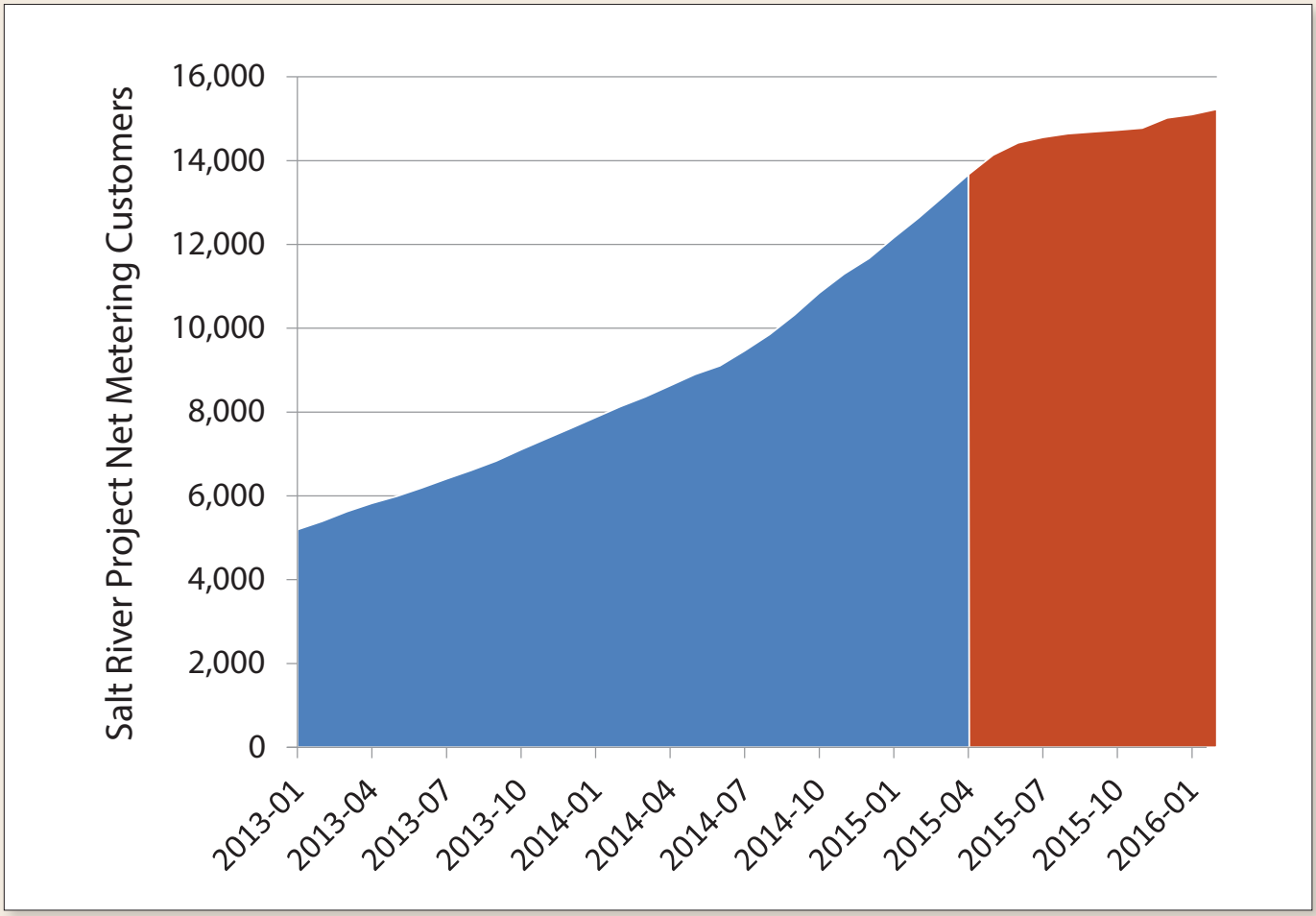
One of the main benefits of rooftop solar energy is that it lets consumers use less electricity from the grid, resulting in a lower electric bill that offsets the cost of solar panels. Demand charges change this calculus, as they are based not on electricity use, but on peak electricity demand for a short (typically 15 to 60 minutes) period over the course of a month. An electric bill with a large demand charge can limit the cost savings of solar energy because just one interval of high peak demand – at night or on a cloudy day – can result in charges that undercut the financial benefits of generating solar power over the course of an entire month. Furthermore, increases in demand charges can lead to reductions in net metering benefits for solar customers. Because new demand charges are often accompanied by reductions in the retail volumetric rate of electricity, and net metering compensation is typically based on this retail rate of electricity, demand charges can indirectly reduce the benefits received by solar customers for the excess electricity they feed into the grid.

Solar panel owners faced with demand charges can take steps to reduce their overall demand, including through energy efficiency or by installing energy storage. These steps have been used by large commercial and industrial electric customers, who long have been subject to demand charges reflecting their higher energy demand and thus the greater investments that must be made in the grid to serve them.

Nevertheless, in territories where large residential demand charges have been implemented, solar energy growth has stagnated. In April 2015, the Salt River Project instituted a demand charge equaling approximately $29 per month on its net metering customers.[75] In the 11 months before the demand charge took effect, the number of net metering customers grew by 4,500; in the 11 months afterwards, the number grew by barely a third of that, despite the continued rapid fall in the cost of solar energy systems.[76]

Now, other utilities are looking to implement similar demand charges. In 2015, at least 13 utilities proposed new demand charges.[78] Two Arizona utilities, Arizona Public Service and Unisource Energy, are requesting demand charges that would affect

Figure 9. After the Salt River Project Utility Implemented Demand Charges, Rooftop Solar Growth Stagnated (red shading indicates period since demand charges took effect)[77]



solar customers as of June 2016.[79] As of April 2016, regulatory approvals for demand charges were also pending in Oklahoma and Texas.[80] And in Illinois, Commonwealth Edison (ComEd) supported state legislation that would have introduced a mandatory residential demand charge.[81]

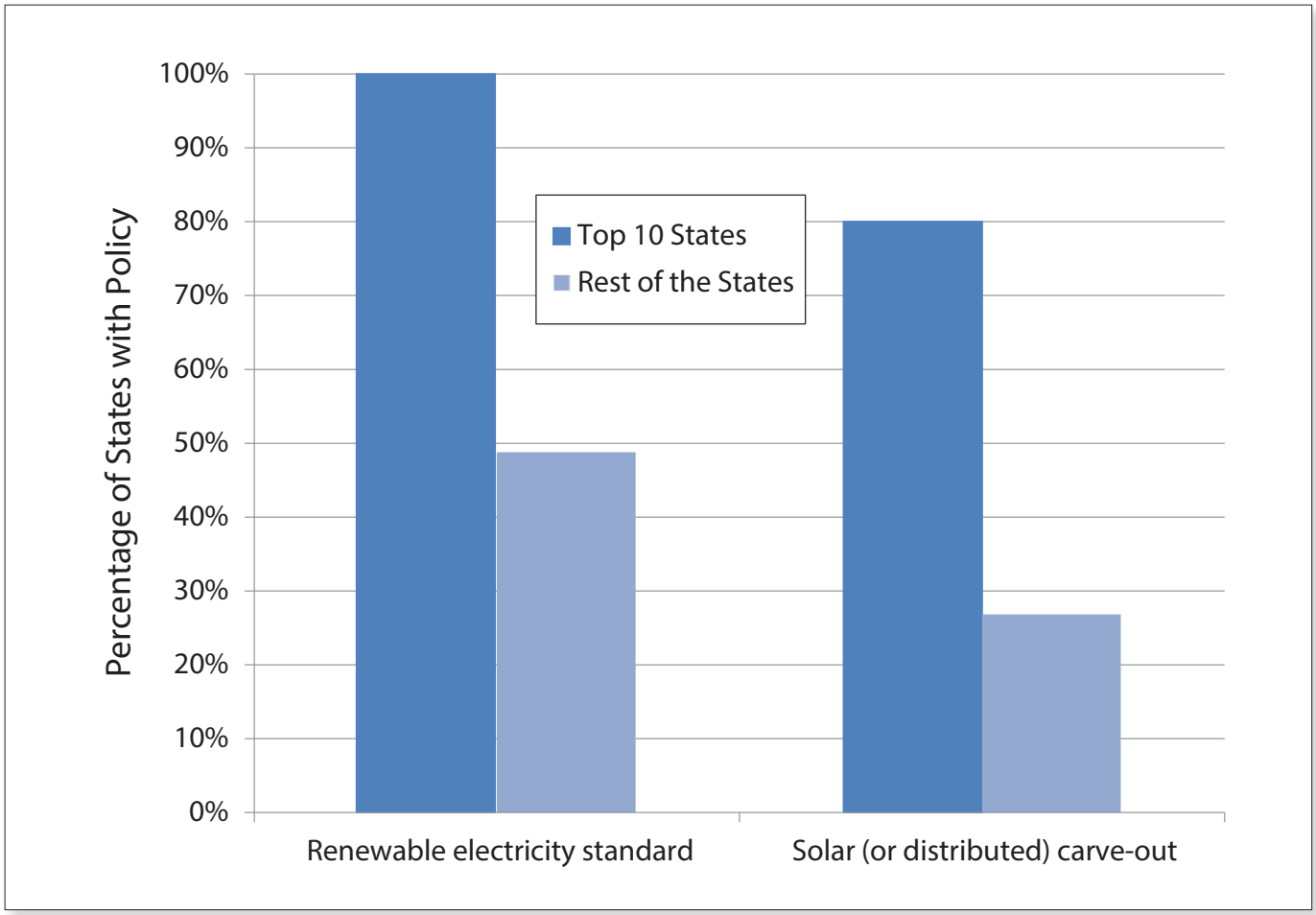
Market Creation Policies

Market creation policies ensure the availability of a steady market for solar energy, draw investment from solar energy companies, and send a signal that a given state is truly committed to the development of solar energy.

States in this analysis are surveyed on two market creation policies: *renewable electricity standards (RESs)*, also known as renewable portfolio standards, which set minimum renewable energy requirements for utilities; and *RESs with a solar carve-out*, which create a specific minimum requirement for solar energy.

All of the Top 10 states have RESs, and eight (all but Hawaii and California) have an RES with a carve-out for solar electricity or for customer-sited distributed renewable electricity technologies, of which solar power is the most common. Although Hawaii and California do not have carve-outs, they have two of the highest

Figure 10. Percentage of Top 10 versus Other States with Key Market Creation Policies



RES standards in the country: Hawaii's RES requires 100 percent renewable electricity by 2045, and California's requires 50 percent renewable electricity by 2030. Top 10 states with strong solar carve-outs include Vermont, with a carve-out requiring 10 percent distributed generation by 2032, and New Jersey, with a carve-out requiring 4.1 percent solar electricity by 2028.[82]

Market Expansion Policies

Market expansion policies enable a wide range of individuals, businesses and organizations to "go solar" by removing barriers to solar energy.

States in this analysis are surveyed on the following market expansion policies:

Grants and rebates that provide direct cash assistance for individuals or businesses seeking to install solar energy systems, and *tax credits* that reduce the tax burden of an individual or business choosing to "go solar" provide important financial incentives for prospective solar owners. Four of the top 10 states have grant or rebate programs, and six offer tax credits. Some programs are designed to ramp down in scale as solar comes down in price and no longer needs as much financial support; this has been the case with state programs including the California Solar Initiative.

Policies that allow *third-party ownership* of solar panels let solar owners avoid the up-front cost associated

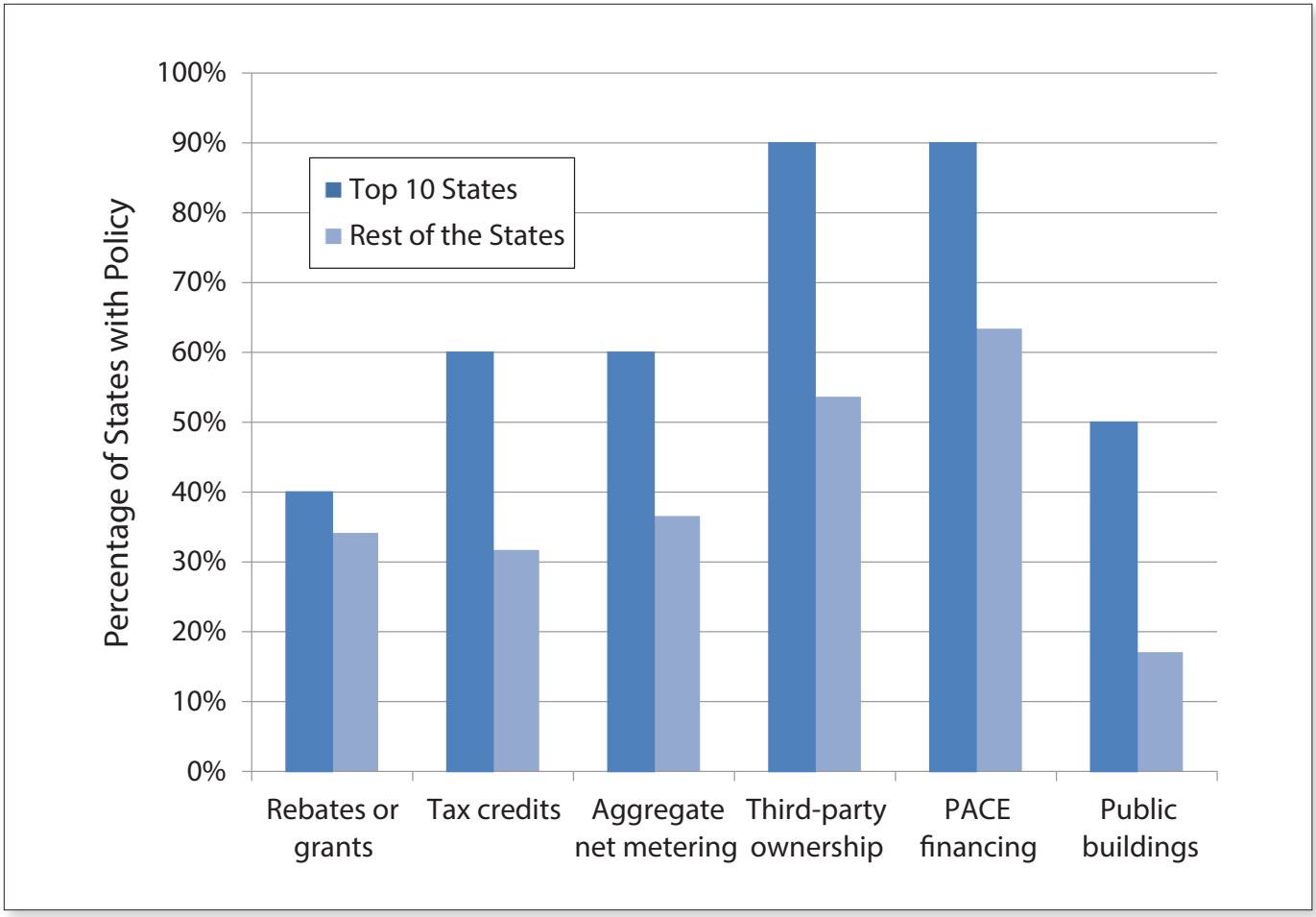
with purchasing a solar energy system outright. For many homeowners and small businesses, the prospect of buying 20 years' worth of electricity upfront is daunting – particularly if there is a chance that one might move during that time. Nine of the top 10 states allow third-party ownership; North Carolina, where the vast majority of solar energy installed is non-residential, is the only exception.

Property Assessed Clean Energy (PACE) financing is another mechanism for reducing the upfront cost of solar energy. PACE financing enables consumers to pay back the cost of solar energy systems over time on their property tax bills. PACE financing not only spreads the cost of solar energy over time, but by tying responsibility for repayment to the property – not the owner of the property – it ensures that a consumer will receive savings even if he or she must move in a few years.

Nine of the top 10 states allow PACE financing. Although residential PACE financing was made largely unavailable in 2010 when the Federal Housing Administration (FHA) raised objections, in August 2015 the FHA announced that it was creating guidelines that should make PACE loans available for single-family homes in states with PACE programs.[83]

Aggregate net metering policies – including virtual net metering and community net metering – open the door for more individuals and businesses to reap the benefits of net metering and to "go solar." Virtual net metering is the most flexible of these rules, as it allows individuals to receive net metering credits even if they

Figure 11. Percentage of Top 10 versus Other States with Key Market Expansion Policies



are not physically connected to a solar installation. Community net metering allows "community solar gardens," where neighbors can all receive net metering credits from a connected solar energy system; and *meter aggregation* allows a single utility customer (usually commercial, agricultural or government) to apply net metering credits to multiple meters.

Six of the top 10 states allow aggregate net metering in some form. One of the newest such policies is in New York, which introduced community net metering in July 2015. New York's policy allows multiple customers to subscribe to and receive benefits from a single system; this policy should provide increased access to solar energy for the millions of residents in New York City apartment buildings without ready access to their own rooftop.

Policies to require solar energy on *public buildings* let state governments provide support for their local solar industries and to lead by example. The state of Massachusetts, for example, has set a goal of procuring 30 percent of state agency electricity from renewable sources by 2030.[84] Five of the top 10 states have policies that require either evaluation or implementation of solar energy on public buildings.

State Policies Driving Utility-Scale Solar Energy

During 2015 4,150 MW of utility-scale solar energy was installed in the United States, accounting for nearly 60 percent of solar capacity additions.[85] In 2016, this number is expected to more than double. Just like rooftop solar, growth in utility-scale solar energy has been aided by support from state policymakers.

The most important policy drivers of utility-scale solar power through 2016 have been renewable electricity standards (RESs). As of March 2016, 80 percent of utility-scale solar was procured by utilities to fulfill state RESs, and the five states with the most utility-scale solar – California, North Carolina, Arizona, Nevada and New Jersey – all have an RES.[86]

State financial incentives, including tax credits, can also drive utility-scale solar growth. North Carolina's now-expired 35 percent renewable investment tax credit, which was the nation's most generous state tax credit, helped North Carolina become the state with the second most utility-scale solar capacity in the U.S.[87]

With utility-scale solar PV prices falling by more than 50 percent from 2007-2009 to 2014, new factors are beginning to affect the growth of utility-scale solar.[88] In some states, utility solar plants are now financially viable even without an RES. In 2016, analysts anticipate that more than half of utility PV capacity will not be built to fulfill a state RES.[89]

The new cost-competitiveness of utility-scale solar power has increased the importance of state implementation of the 1978 Public Utility Regulatory Policy Act (PURPA). PURPA requires utilities to purchase electricity from small utility solar plants at the "avoided cost" of electricity – a rate based on the marginal cost of producing electricity for utilities, and which until recently was too low to support solar energy. Some details of PURPA contracts are up to state policymakers, including standard contract lengths and eligible system sizes, and these decisions can affect the financial viability of utility solar plants. In Utah, which has 15-year standard PURPA contracts but no RES, PURPA has become a primary driver of utility-scale solar growth.[90] A substantial portion of solar growth in North Carolina in the past several years has been driven by its favorable standard contract terms, which apply to systems up to 5 MW in size and last for a 15-year period. As these contracts have become more important, utilities in states including Utah, Idaho and North Carolina have undertaken lobbying efforts to shorten standard PURPA contracts and reduce eligible system sizes.[91]

Conclusion and Recommendations

The Top 10 solar states did not come to be America's solar energy leaders by accident. Their leadership is the result of strong public policies that eliminate barriers that often keep consumers from "going solar" and provide financial assistance to expand access to solar energy to every individual, business, non-profit and government agency that wishes to pursue it.

The path to a clean energy future powered increasingly by solar energy is open to every city and state. All it takes is a commitment by decision-makers and key stakeholders to make it happen. By adopting strong policies to remove barriers to solar energy, ensure a minimum level of demand for solar energy, and provide individuals and businesses with incentives and financing tools, every state in the country can achieve or surpass the solar success of the Top 10.

Every state should adopt aggressive targets for the development of solar energy consistent with achieving a rapid transition to 100% renewable energy. Leading states should build on their successful programs and set even bigger goals for solar deployment. Other states should set ambitious goals and follow the policy lead of the Top 10 states in getting their own solar energy industries off the ground.

Local Government

Local governments should ensure that every homeowner and business with access to sunlight can exercise the option of generating electricity from the sun. Solar access ordinances – which protect homeowners' right to generate electricity from the sunlight that hits their property, regardless of the actions of neighbors or homeowners' associations – are essential protections.

Local governments can also eliminate red tape and help residents to go solar by reforming their permitting process – reducing fees, making permitting rules clear and readily available, speeding up the permitting process, and making inspections convenient for property owners. The Vote Solar Initiative and the Interstate Renewable Energy Council have laid out a series of best practices that local governments can follow in ensuring that their permitting process is solar-friendly.[92] And the Department of Energy's SolSmart program offers no-cost technical assistance to local governments looking to improve solar policies and provides national recognition to those that have taken steps to facilitate the growth of a more robust local solar market.[93]

Local governments can also ensure that their zoning regulations are clear and unambiguous in allowing solar energy installations on residential and commercial rooftops. The North Carolina Clean Energy Technology Center and the North Carolina Sustainable Energy Association have released a model solar energy zoning ordinance for local governments to use as a template to develop their own ordinances for solar energy development, which will help unlock new solar markets in communities where a poor understanding of how to regulate solar development might otherwise create barriers to entry.[94] Model solar zoning ordinances are also available from the state of Massachusetts and the Delaware Valley Regional Planning Commission.[95]

Cities in states where Property Assessed Clean Energy (PACE) financing is an option for commercial establishments can allow for property tax bills to be used for the collection of payments toward a solar energy system. Bulk purchasing ("solarize") programs, in which cities facilitate bulk purchases of solar PV for homes and businesses, can also help reduce the cost of going solar.[96] Cities can also provide financial or zoning incentives to encourage the construction of green buildings that incorporate small-scale renewable energy technologies such as solar power. Building codes can also help spark the widespread adoption of solar energy, either by requiring new homes and businesses to be "solar-ready" or by requiring the use of small-scale renewable energy in new or renovated buildings. California cities including San Francisco, Lancaster and Sebastopol have adopted requirements that newly built and renovated homes and commercial buildings incorporate solar panels or solar hot water; and Tucson, Arizona, requires all new homes to be built "solar ready" for easy installation of either solar photovoltaic panels or solar water heating.[97]

Cities with municipal utilities have even greater potential to encourage solar energy, through the establishment of local renewable electricity standards, strong net metering and interconnection policies, and other pro-solar policies. Municipal utilities can also encourage solar energy through rate structures, including rate structures with a higher ratio of per-kilowatt-hour to per-customer charges.

State Government

State governments should set ambitious targets for the growth of solar energy consistent with a rapid transition to 100 percent renewable energy. To help achieve that vision, states should adopt renewable electricity standards with solar carve-outs that require a significant and growing share of that state's electricity to come from the sun. States with existing ambitious targets include Hawaii, with a target of 100 percent renewable electricity by 2045, and Vermont, with a target of 75 percent renewable electricity by 2032 and a carve-out for 10 percent distributed generation.

States should also adopt strong statewide interconnection and net metering policies, along with community solar policies and virtual net metering, to ensure that individuals and businesses are able to receive fair compensation for any excess power sent back to the electric grid. In states without strong net metering programs, feed-in tariffs (sometimes known as CLEAN contracts) and value-of-solar bill credits can play an important role in ensuring that consumers receive fair compensation for solar energy, so long as the compensation they receive fully accounts for the benefits of distributed solar energy and is sufficient to spur participation in the market. Multiple analyses have shown that even when credited at the retail electricity rate, rooftop solar energy provides a net benefit to the grid and to other electric customers.[98] States should also allow third-party ownership agreements as a means to reduce the upfront costs associated with "going solar."

As the nation's primary regulators of electric utilities, state governments have a critical role to play in ensuring that interconnection rules and net metering policies are clear and fair and that utilities are considering investing in solar energy. State utility regulatory agencies should respect overwhelming public support for solar energy and the overwhelming evidence demonstrating its positive value to the economy, electric grid, and environment and set policy accordingly.

In addition, as solar power comes to supply an increasing share of the nation's energy, state governments will need to be at the forefront of designing policies that transition the nation from a power grid reliant on large, centralized power plants to a "smart" grid where electricity is produced at thousands of locations and shared across an increasingly nimble and sophisticated infrastructure. In order to begin planning for that future, states should develop policies that support the expansion of energy storage

technologies and microgrids, including microgrids owned by third parties and non-utility entities.[99] For example, New York State's Reforming the Energy Vision (REV) strategy aims to create a more modern grid, in part by changing utility business models to encourage them to achieve higher levels of distributed renewable resources, greater efficiency, expanded microgrids and energy storage.[100]

States are also powerful engines of policy innovation. Each of the policies described here was originally adopted by a single state that identified a barrier to solar energy development and put in place a creative solution to surmount that barrier. State policies also have the potential to raise the bar for federal policies and demonstrate to federal decision-makers the strong interest in solar energy that exists in the states.

Federal Government

The federal government is also responsible for developing the nation's solar energy potential. Strong and thoughtful federal policies lay an important foundation on which state policy initiatives are built. Among the key policy approaches that the federal government should take are the following:

Use regulatory powers wisely – The federal government has a great deal of influence over the development of solar energy, including through its regulatory authority to protect the environment via the promotion of clean energy (e.g., the Clean Power Plan), its control of millions of acres of land with strong solar resources in the American West, and as the primary regulator of the interstate system of electricity transmission. The federal government should continue to work for environmentally responsible expansion of solar energy on federal lands. Energy regulators should adopt rules recognizing the benefits that fuel-free distributed energy sources provide by lowering peak demand and making the electric grid more resilient. They should ensure that solar energy can be delivered to electricity consumers in ways that are efficient and fair. And they should continue to uphold the requirements of PURPA, which if implemented in a smart way by states, can allow solar developers to get fair terms on solar power they sell to the grid.

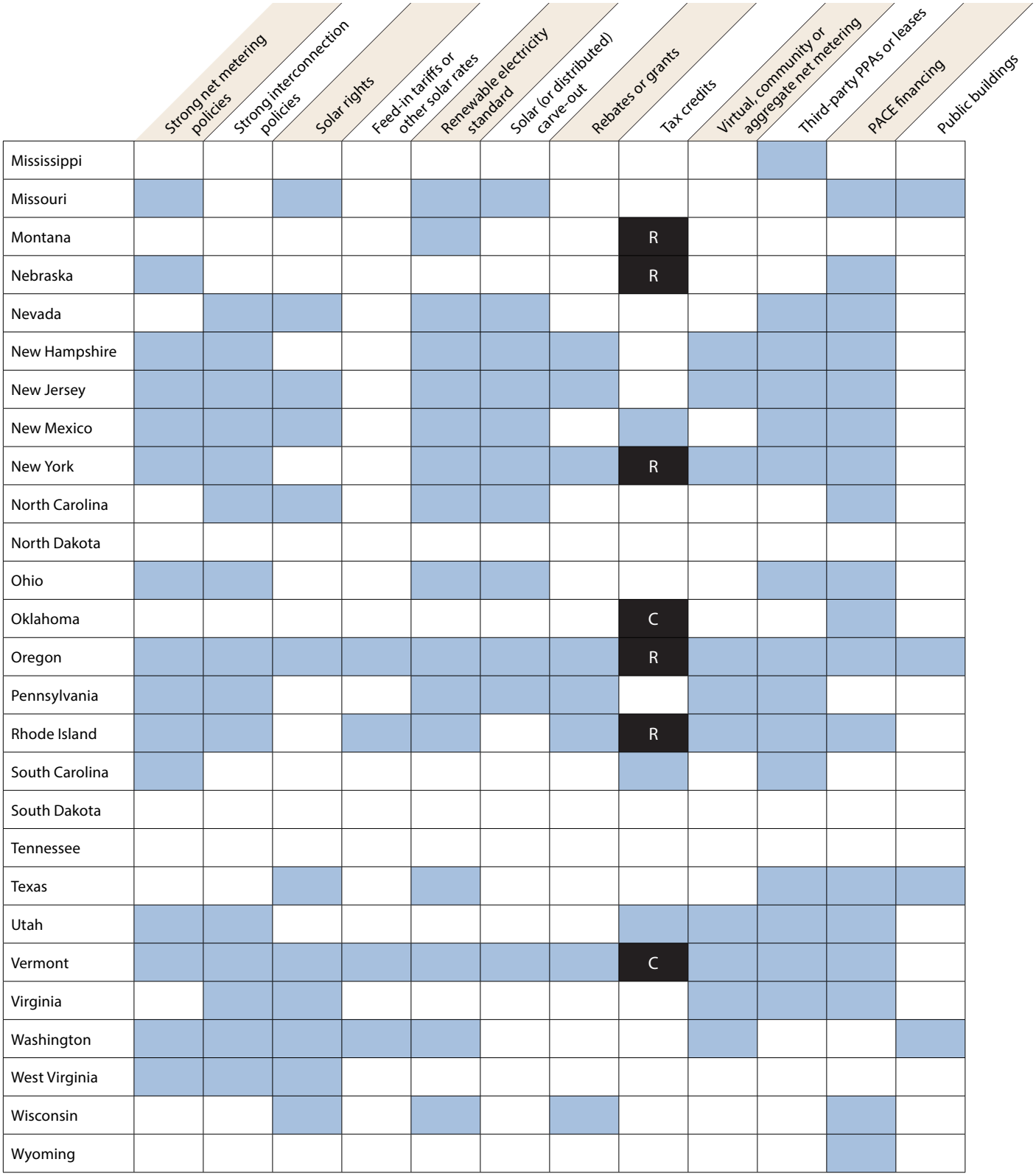
Continue to set high standards and goals for solar energy – The U.S. Department of Energy's SunShot Initiative has served as a rallying point for federal efforts to bring the cost of solar energy down to compete with electricity from fossil fuels. The SunShot Initiative recognizes that while traditional research and development efforts for solar energy remain important, a new set of challenges is emerging around the question of how to bring solar energy to large-scale adoption. By investigating and funding research into how best to integrate solar energy into the grid, how to deliver solar energy more efficiently and cost-effectively, and how to lower market barriers to solar energy, the SunShot Initiative and other efforts play a key supporting role in the nation's drive to embrace the promise of solar energy.[101]

Lead-by-example – In his June 2013 speech on global warming, President Obama committed to obtaining 20 percent of the federal government's electricity from renewable sources by 2020.[102] Solar energy will likely be a major contributor to reaching that goal. The U.S. military has been particularly aggressive in developing its renewable energy capacity, committing to getting one-quarter of its energy from renewable sources by 2025.[103] As of May 2013, the military had already installed more than 130 megawatts of solar energy capacity and has plans to install more than a gigawatt of solar energy by 2017.[104] Federal agencies should continue to invest in solar energy. In addition, agencies such as the Department of Housing and Urban Development and Department of Education should work to encourage the expanded use of solar energy in schools and in subsidized housing.

Appendix A: Solar Energy Policies

See Appendix B for details on criteria and sourcing for solar energy policies table.

State	Strong net metering policies	Strong interconnection policies	Solar rights	Feed-in tariffs or other solar rates	Renewable electricity standard	Solar (or distributed) carve-out	Rebates or grants	Tax credits	Virtual, community or aggregate net metering	Third-party PPAs or leases	PACE financing	Public buildings
Alabama											■	
Alaska							■					
Arizona	■		■		■	■		R		■		■
Arkansas	■								■		■	
California	■	■	■	■	■		■		■	■	■	■
Colorado	■	■	■		■	■		C	■	■	■	■
Connecticut	■	■			■		■		■	■	■	
Delaware	■	■	■		■	■	■		■	■		■
D.C.	■	■			■	■	■		■	■	■	
Florida	■		■					C			■	■
Georgia										■	■	
Hawaii		■	■	■	■			■	■	■	■	■
Idaho												
Illinois	■	■	■		■	■	■			■	■	
Indiana	■	■	■				■					
Iowa	■	■			■			■		■		
Kansas										■		
Kentucky	■							R			■	
Louisiana	■		■					■		■	■	
Maine	■	■	■		■				■	■	■	
Maryland	■	■	■		■	■	■	■	■	■	■	
Massachusetts	■	■	■		■	■	■	R	■	■	■	■
Michigan	■				■		■			■	■	
Minnesota	■			■	■	■			■		■	■


Strong net metering policies
Strong interconnection policies
Solar rights
Feed-in tariffs or other solar rates
Renewable electricity standard
Solar (or distributed) carve-out
Rebates or grants
Tax credits
Virtual, community or aggregate net metering
Third-party PPAs or leases
PACE financing
Public buildings
Mississippi
Missouri
Montana
Nebraska
Nevada
New Hampshire
New Jersey
New Mexico
New York
North Carolina
North Dakota
Ohio
Oklahoma
Oregon
Pennsylvania
Rhode Island
South Carolina
South Dakota
Tennessee
Texas
Utah
Vermont
Virginia
Washington
West Virginia
Wisconsin
Wyoming
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Appendix B: Criteria and Sourcing for Solar Policies

States are credited with having the following key solar energy policies if they meet the following criteria.

Strong net metering policies: Received a net metering grade of an "A" or a "B" in *Freeing the Grid*. (Freeing the Grid 2015, accessed at freeingthegrid.org on 2 May 2016.)

Strong interconnection policies: Received an interconnection grade of an "A" or a "B" in *Freeing the Grid*. (Freeing the Grid 2015, accessed at freeingthegrid.org on 2 May 2016.)

Solar rights: Presence of a solar rights policy based on review of program listings in DSIRE. (NC Clean Energy Technology Center, *DSIRE*, 2 May 2016.)

Feed-in tariffs or other solar rates: Presence of a feed-in tariff or value-of-solar policy, based on review of program listings in DSIRE. (NC Clean Energy Technology Center, *DSIRE*, 2 May 2016.)

Renewable electricity standard: Presence of a mandatory RES, based on review of program listings in DSIRE. (NC Clean Energy Technology Center, *DSIRE*, 2 May 2016.)

Solar carve-out: Presence of a requirement for solar energy or distributed generation in the state renewable electricity standard. States were not included if they only had solar or distributed generation multipliers in their RES, but no requirement. Based on review of DSIRE detailed summary map. (NC Clean Energy Technology Center, *DSIRE: Renewable Portfolio Standards (RPS) with Solar or Distributed Generation Provisions*, available at ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2015/01/RPS-carveout-map2.pdf, updated August 2015.)

Rebates or grants: Presence of a statewide rebate or grant program directed toward solar PV, based on review of program listings in DSIRE. (NC Clean Energy Technology Center, *DSIRE*, 2 May 2016.)

Tax credits: Presence of a residential or commercial tax credit policy, based on review of program listings in DSIRE. Blue shading indicates the presence of both residential and commercial tax credits; states with one tax credit are indicated in black shading with an "R" or "C." (NC Clean Energy Technology Center, *DSIRE*, 2 May 2016.)

Virtual, community or aggregate net metering: Allowance of any type of meter aggregation under state net metering law, based on review of program listings in DSIRE. (NC Clean Energy Technology Center, *DSIRE*, 2 May 2016.)

Third-party PPAs or leases: States in which third-party power purchase agreements or leases are legal. Based on review of DSIRE detailed summary map. (NC Clean Energy Technology Center, *DSIRE: 3rd Party Solar PV Power Purchase Agreement (PPA)*, available at ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2016/05/3rd-Party-PPA.pdf, updated April 2016.)

PACE financing: Presence of PACE financing policy based on review of program listings in DSIRE. Because local PACE programs can only exist with enabling state action, states were considered to allow PACE financing if any local PACE programs were listed for that state, even if no program listing existed for statewide PACE.[105] (NC Clean Energy Technology Center, *DSIRE*, 2 May 2016.)

Public buildings: States were included that had efficiency or green building standards for public buildings according to DSIRE. This category includes only those states where agencies are required to evaluate or implement renewable energy technologies if they are cost-effective, as well as states with zero net energy building requirements or renewable energy procurement requirements. This category includes programs designed specifically to promote solar water heating. Based on review of program listings in DSIRE. (NC Clean Energy Technology Center, *DSIRE*, 2 May 2016.)

Appendix C: Solar Electric Capacity in the States

Year-end 2015 data courtesy of SEIA/GTM Research *U.S. Solar Market Insight*.

	2015						2012	
State	Cumulative Solar Capacity per Capita 2015 (watts/person)	Rank	Solar Capacity Installed During 2015 per Capita (watts/person)	Rank	Cumulative Solar Capacity (MW)	Rank	Cumulative Solar Capacity per Capita 2012 (watts/person)	Cumulative Solar Capacity 2012 (MW)
Alabama	0.4	48	0.0	49	2.0	45	0.2	1.1
Alaska	0.9	46	0.4	45	0.7	49	0.0	0.0
Arizona	337.3	4	34.3	8	2,303.2	2	171.2	1,121.7
Arkansas	6.7	32	5.5	22	20.1	33	0.5	1.6
California	338.3	3	83.4	3	13,242.8	1	76.6	2,914.9
Colorado	99.4	10	26.4	9	542.5	9	53.4	277.3
Connecticut	61.4	13	25.4	10	220.6	17	10.1	36.4
Delaware	74.4	12	10.3	18	70.4	25	47.8	43.8
D.C.	24.5	18	10.7	17	16.5	37	7.1	4.5
Florida	13.6	28	2.0	30	275.1	14	9.6	186.3
Georgia	36.2	15	20.5	12	370.2	11	2.5	24.8
Hawaii	394.3	2	81.7	4	564.5	8	137.9	192.0
Idaho	2.8	37	1.2	32	4.6	42	0.6	1.0
Illinois	5.1	34	0.9	37	65.1	26	3.6	46.2
Indiana	20.5	20	3.6	26	136.0	18	0.0	0.1
Iowa	8.7	31	2.0	29	27.2	29	0.6	1.7
Kansas	1.6	44	0.8	38	4.7	41	0.2	0.5
Kentucky	2.1	41	0.2	46	9.5	39	1.1	4.7
Louisiana	17.9	24	6.7	21	83.8	24	0.0	0.0
Maine	14.6	27	5.0	23	19.4	34	4.4	5.8
Maryland	61.0	14	24.0	11	366.5	12	19.3	113.6
Massachusetts	152.7	9	42.1	7	1,037.2	6	30.5	203.2
Michigan	1.9	42	0.4	43	18.8	35	0.9	9.2

State	2015						2012	
	Cumulative Solar Capacity per Capita 2015 (watts/person)	Rank	Solar Capacity Installed During 2015 per Capita (watts/person)	Rank	Cumulative Solar Capacity (MW)	Rank	Cumulative Solar Capacity per Capita 2012 (watts/person)	Cumulative Solar Capacity 2012 (MW)
Minnesota	6.0	33	2.3	28	32.7	28	1.5	8.0
Mississippi	0.4	49	0.0	48	1.1	47	0.2	0.7
Missouri	21.6	19	3.3	27	131.4	19	1.7	10.3
Montana	4.4	35	0.5	42	4.5	43	2.0	2.0
Nebraska	0.6	47	0.2	47	1.1	47	0.2	0.4
Nevada	420.5	1	144.4	1	1,215.7	5	146.3	403.1
New Hampshire	17.3	25	11.6	16	23.0	31	1.8	2.4
New Jersey	182.2	6	20.2	13	1,631.8	4	110.0	975.8
New Mexico	175.2	8	19.6	14	365.4	13	91.7	191.2
New York	32.2	16	12.2	15	638.2	7	9.1	177.7
North Carolina	207.8	5	112.9	2	2,087.1	3	22.7	221.2
North Dakota	0.3	50	0.0	49	0.2	50	0.1	0.1
Ohio	9.7	29	0.9	36	112.6	23	5.8	66.9
Oklahoma	1.3	45	0.9	35	5.2	40	0.1	0.3
Oregon	28.3	17	7.4	20	114.2	21	17.7	69.1
Pennsylvania	20.1	21	1.0	34	257.6	15	15.4	196.3
Rhode Island	16.2	26	4.3	24	17.1	36	1.8	1.9
South Carolina	2.3	40	0.7	40	11.5	38	0.7	3.3
South Dakota	0.2	51	0.0	49	0.2	50	0.0	0.0
Tennessee	19.6	22	1.7	31	129.1	20	7.6	49.1
Texas	19.6	23	7.5	19	537.1	10	4.8	125.9
Utah	82.9	11	77.1	5	248.5	16	0.4	1.1
Vermont	181.1	7	69.5	6	113.4	22	26.7	16.7
Virginia	2.5	39	1.2	33	20.9	32	0.0	0.1
Washington	9.0	30	3.6	25	64.3	27	2.3	16.2
West Virginia	1.8	43	0.4	44	3.3	44	0.9	1.6
Wisconsin	4.2	36	0.8	39	24.5	30	2.5	14.2
Wyoming	2.6	38	0.5	41	1.5	46	1.0	0.6

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