Lighting the Way

The Top Ten States that Helped Drive America's Solar Energy Boom in 2013

ENVIRONMENT RHODE ISLAND
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August 2014

Acknowledgments

Environment Rhode Island Research & Policy Center sincerely thanks the Solar Energy Industries Association for providing data on solar energy installations through 2013. Environment Rhode Island Research & Policy Center also thanks Kevin Armstrong and Nathan Phelps at Vote Solar; Pierre Bull and Jay Orfield at Natural Resources Defense Council; John Farrell at Institute for Local Self-Reliance; Steve Kalland at the North Carolina Solar Center at North Carolina State University; Emily Rochon at Boston Community Capital; and Warren Leon of the Clean Energy States Alliance for their review of drafts of this document, as well as their insights and suggestions. Thanks also to Tony Dutzik and Jeff Inglis of Frontier Group for editorial support.

Environment Rhode Island Research & Policy Center thanks the Tilia Fund, the John Merck Fund, the Scherman Foundation, the Energy Foundation, Fred and Alice Stanback, the Arntz Family Foundation, the Mitchell Foundation, the Town Creek Foundation, the Edna Wardlaw Charitable Trust, and the Carolyn Rauch Foundation for making this report possible.

The authors bear responsibility for any factual errors. The recommendations are those of Environment Rhode Island Research & Policy Center. The views expressed in this report are those of the authors and do not necessarily reflect the views of our funders or those who provided review.

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Layout: To the Point Publications, tothepoint@imagina.com

Cover photos courtesy of National Renewable Energy Laboratory. Main photo: Rooftop solar photovoltaic (PV) system in New York City, photographed by Aeon Solar. Bottom left: Solar PV system near Sedona, Arizona, photographed by ETA Engineering, Inc. Bottom right: House with solar PV panels on the roof, photographed by Puget Sound Solar.

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Executive Summary

Solar energy is on the rise. Over the course of the last decade, the amount of solar photovoltaic (PV) capacity in the United States has increased more than 120-fold, from 97 megawatts in 2003 to more than 12,000 megawatts at the end of 2013. In the first quarter of 2014, solar energy accounted for 74 percent of all the new electric generation capacity installed in the United States. The cost of solar energy is declining, and each year tens of thousands more Americans begin to reap the benefits of clean energy from the sun, including energy generated right on the rooftops of their homes or places of business.

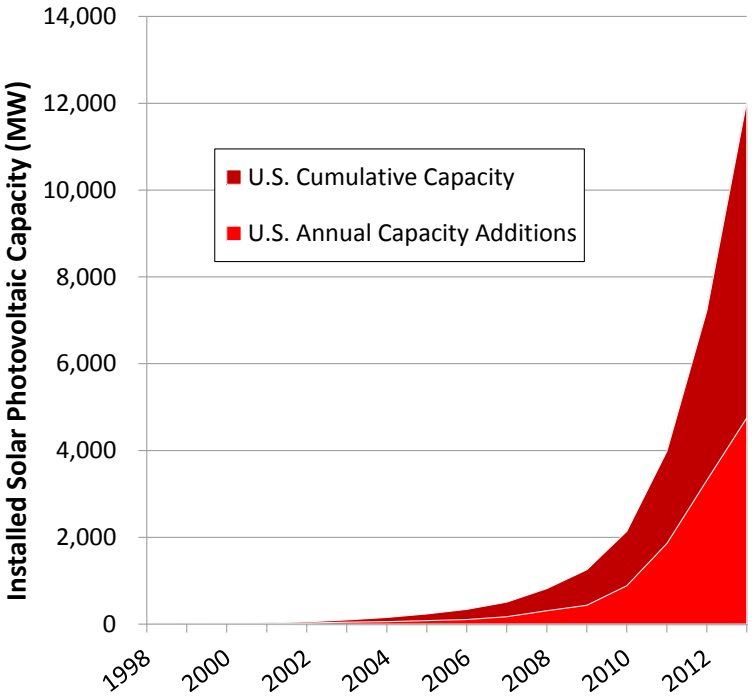
America's solar energy revolution has been led by 10 states that have the greatest amount of solar energy capacity installed per capita. These 10 states have opened the door for solar energy and are reaping the rewards as a result.

The Top 10 states with the most solar electricity installed per capita account for only 26 percent of the U.S. population but 87 percent of the nation's total installed solar electricity capacity.* These 10 states – Arizona, California, Colorado, Delaware, Hawaii, Massachusetts, Nevada, New Jersey, New Mexico and North Carolina – possess strong policies that are enabling increasing numbers of homeowners, businesses, communities and utilities to "go solar."

Other rising stars include New York, Vermont and Georgia, which have large or fast-growing solar energy markets and strong new solar policies or programs implemented since mid-2013.

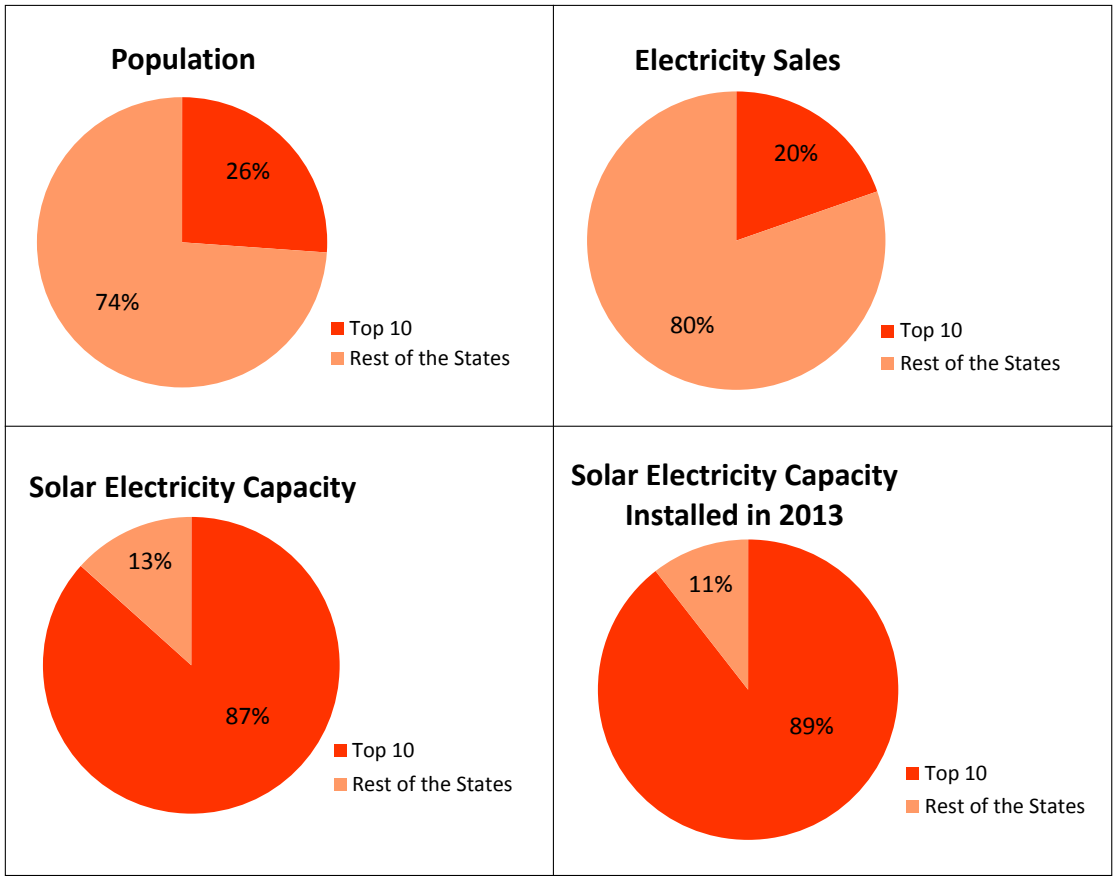
- Unfortunately, the success of solar power in these and other states has been threatened by recent attacks by fossil fuel interests and electric utilities on key solar policies, such as net metering. Despite those attacks, many states have reaffirmed and expanded their commitments to solar energy over the past year by increasing solar energy goals and implementing new policies to expand access to clean solar power.

Figure ES-1. Cumulative U.S. Grid-Connected Solar Photovoltaic Capacity



* In this report, "solar photovoltaic capacity" refers to installed solar photovoltaic systems, both distributed and utility-scale. "Solar electricity capacity" refers to all solar technologies that generate electricity, including concentrating solar power systems that use the sun's heat – rather than its light – to generate electricity. The figures in this report do not include other solar energy technologies, such as solar water heating.

Figure ES-2, a-d. Solar Energy in the Top 10 Solar States versus the Rest of the U.S.



- By following the lead of these states, the United States can work toward getting at least 10 percent of our energy from the sun by 2030, resulting in cleaner air, more local jobs and reduced emissions of pollutants that cause global warming.

Solar energy is good for the environment, consumers and the economy.

- Solar photovoltaics (PV) produce 96 percent less global warming pollution per unit of energy than coal-fired power plants over their entire life cycle, and 91 percent less global warming pollution than natural gas-fired power plants.
- Solar energy benefits consumers by reducing the need for expensive investments in long-distance transmission lines.
- Solar energy can lower electricity costs by providing power at times of peak local demand.
- The cost of installed solar energy systems has fallen by 60 percent since the beginning of 2011.
- Solar energy creates local clean energy jobs that can't be outsourced. More than 140,000 people currently work in America's solar energy industry, about half of them in jobs such as installation that are located in close proximity to the places where solar panels are installed.

Solar energy is on the rise – especially in states that have adopted strong public policies to encourage solar power.

- The amount of solar photovoltaic capacity* in the United States has tripled in the past two years. (See Figure ES-1.)
- America's solar energy revolution is being led by 10 states which have the highest per-capita solar electricity capacity* in the nation. These 10 states

– Arizona, California, Colorado, Delaware, Hawaii, Massachusetts, Nevada, New Jersey, New Mexico and North Carolina – account for 26 percent of the U.S. population and 20 percent of U.S. electricity consumption, but 87 percent of total U.S. solar electricity capacity and 89 percent of the solar electricity capacity installed in 2013. (See Figure ES-2 and Table ES-1.)

- From 2012 to 2013, Arizona maintained its first-place ranking as the state with the largest amount of solar energy capacity per capita, with 275 Watts/person at the end of 2013. California and Massachusetts both advanced two spots in the rankings to fourth place and eighth place, respectively, significantly increasing their per-capita installed solar energy capacity. North Carolina continued its aggressive build-out of utility-scale solar energy, growing its per-capita capacity by more than 140 percent since 2012.

America's leading solar states have adopted strong policies to encourage homeowners and businesses to "go solar." Among the Top 10 states:

- Nine have strong ***net metering policies***. In nearly all of the leading states, consumers are compensated at the full retail rate for the excess electricity they supply to the grid.
- Nine have strong statewide ***interconnection policies***. Good interconnection policies reduce the time and hassle required for individuals and companies to connect solar energy systems to the grid.
- All have ***renewable electricity standards*** that set minimum requirements for the share of a utility's electricity that must come from renewable sources, and eight of them have ***solar carve-outs*** that set specific targets for solar or other forms of clean, distributed electricity.

Table ES-1. Solar Electricity Capacity in the Top 10 Solar States (ranked by cumulative capacity per resident; data from the Solar Energy Industries Association)

State	Cumulative Solar Electric Capacity per Capita (Watts/person)	Rank	Solar Electric Capacity Installed During 2013 per Capita (Watts/person)	Rank	Cumulative Solar Electricity Capacity (MW)	Rank	Total Solar Electricity Capacity Installed During 2013 (MW)	Rank
Arizona	275	1	109	1	1,821	2	724	2
Hawaii	243	2	107	2	341	7	150	6
Nevada	161	3	17	9	450	5	47	12
California	148	4	72	3	5,661	1	2,760	1
New Jersey	136	5	27	6	1,211	3	240	5
New Mexico	113	6	22	7	236	10	46	13
Delaware	82	7	14	10	53	21	9	23
Massachusetts	66	8	37	4	442	6	244	4
Colorado	63	9	12	11	331	8	61	10
North Carolina	57	10	33	5	557	4	328	3

- Nine allow for ***creative financing options*** such as third-party power purchase agreements, and eight allow Property Assessed Clean Energy (PACE) financing.
- States in the Top 10 are far more likely to have each of these key solar policies in place than other states, reinforcing the conclusion of U.S. Department of Energy research linking the presence of key solar policies to increases in solar energy deployment.

Beyond the Top 10 states for per-capita solar energy capacity, there are several "advancing" states that have accelerated growth of their solar energy markets by embracing solar-friendly policies.

- With 250 MW of solar electricity capacity installed at the end of 2013, New York ranks ninth in the nation for cumulative solar energy capacity. New York recently expanded its commitment to solar energy by investing an additional $1 billion in its highly successful NY-Sun Initiative and extending the program through 2023. The state has also developed an innovative, market-based structure for solar energy incentives that will provide long-term funding certainty for solar energy developers.
- Vermont ranked eighth for per-capita solar energy capacity installed during 2013. Though Vermont is the only state in the Northeast not to have a renewable portfolio standard, it has many other strong policies that drive solar energy development. The state continued its track record of solar energy leadership in 2013 by raising its net metering cap from four percent of a utility's peak load to 15 percent.
- Georgia's per-capita solar energy capacity took a dramatic leap forward in 2013 after the state Public Service Commission voted to require the state's largest utility to construct or procure 525 MW of solar energy capacity by the end of 2016. The state added 9 W per person in 2013 – more than eight times as much as it added in 2012.

Strong public policies at every level of government can help unlock America's potential for clean solar energy. To achieve America's full solar potential:

- **Local governments** should adopt policies guaranteeing homeowners and businesses the right to use or sell power from the sunlight that strikes their properties. They should also implement financing programs, such as property-assessed clean energy (PACE) financing, adopt bulk purchasing programs for solar installations, and adopt solar-friendly zoning and permitting rules to make it easier and cheaper for residents and businesses to "go solar." Municipally-owned utilities should promote solar by providing net-metering, Value of Solar rates, and by making investments in community-scale and utility-scale solar projects.
- **State governments** should set ambitious goals for solar energy and adopt policies – including many of those described in this report – to meet them. State governments should also use their role as the primary regulators of electric utilities to encourage utility investments in solar energy, implement rate structures that maximize the benefits of solar energy to consumers, and support smart investments to move toward a more intelligent electric grid in which distributed sources of energy such as solar power play a larger role.
- **The federal government** should continue key tax credits for solar energy, encourage responsible development of prime solar resources on public lands in the American West, and support research, development and deployment efforts designed to reduce the cost of solar energy and smooth the incorporation of large amounts of solar energy into the electric grid.
- **All levels of government** should lead-by-example by installing solar energy technologies on all government buildings.

Introduction

The United States is closer to a clean energy future than would have seemed possible only a few years ago. States with well-established solar energy markets are ramping up their production of solar energy, while other states are beginning to open the door to solar power. U.S. distributed solar energy capacity (everything except utility-scale installations) is on track to reach 12,000 MW by the end of 2015 – nearly doubling from the end of 2013.[1] In August 2013, Jon Wellinghoff, then chair of the Federal Energy Regulatory Commission, said that with the continued decline of solar energy costs, and with the growing promise of cost-effective energy storage, solar electricity generation "is going to overtake everything."[2]

Some states have made dramatic leaps forward in their adoption of solar energy, and not necessarily because they are the states with the most sunshine or the highest electricity rates. Rather, these states have strong public policies that encourage the development of solar power, such as paying solar homeowners a fair price for the energy they supply to the grid, ensuring that installing solar panels is easy and hassle-free, and offering attractive options for solar financing. These policies are helping make solar power a mainstream energy source with powerful environmental benefits, particularly as states work to curb global warming pollution from their electricity sectors to comply with new federal limits on emissions from dirty power plants.

This report is a follow-up analysis of our 2013 report, *Lighting the Way*, in which we compared the solar energy policies of the top 12 states with the nation's most well-developed solar energy markets. We highlighted 12 states in our 2013 report because the top 12 states for solar energy capacity per-capita were also the top 12 states for per-capita capacity added during the previous year – indicating that these states led the nation in solar energy adoption. In 2014, however, annual per-capita capacity additions and cumulative per-capita capacity did not align perfectly for the top solar states, so we chose to highlight only the Top 10 states, ranked by solar electricity capacity installed per-capita. This report notes changes from last year's rankings, as well as policy developments over the last year – in both the Top 10 states and in selected states with accelerated solar energy deployment, nationwide.

Solar Energy Is Good for the Environment, Consumers and the Economy

America has enough solar energy potential to power the nation several times over. Using the sun's energy to power our homes and businesses reduces our dependence on polluting fossil fuels, provides consumers with a reliable source of electricity at a dependable price, and reduces the need for expensive investments in peaking power plants and long-distance electricity transmission lines.

Solar Energy Is Good for the Environment

Power plants are America's largest source of carbon dioxide, the leading global warming pollutant. In 2012, U.S. power plants were responsible for about one-third of the nation's global warming pollution.[3] America's power plants produced more global warming pollution in 2011 than the entire economy of any nation in the world other than China, Russia and India.[4]

Generating solar power produces no global warming pollution. Even when emissions from manufacturing, transportation and installation of solar panels are included, solar power produces 96 percent less global warming pollution than coal-fired power plants over its entire life-cycle, and 91 percent less global warming pollution than natural gas-fired power plants.[5]

Solar power also reduces or eliminates emissions of several pollutants known to cause severe damage to the environment and public health, specifically:

- **Nitrogen oxides** – Power plants are responsible for 23 percent of U.S. emissions of nitrogen oxides, which contribute to the formation of ozone "smog."[6] Ozone reacts with airway tissues and produces inflammation similar to sunburn on the inside of the lungs. This inflammation makes lung tissues less elastic, more sensitive to allergens, and less resistant to infections.[7] Minor exposure to ozone can cause coughing, wheezing and throat irritation. Constant exposure to ozone over time can permanently damage lung tissues, decrease the ability to breathe normally, and exacerbate or potentially even cause chronic diseases like asthma.[8]
- **Sulfur dioxide** – Power plants produce two-thirds of the nation's emissions of sulfur dioxide, which contributes to the formation of small particles in the air that can penetrate deep into the lungs. Pollution from small particulates can trigger respiratory diseases such as bronchitis and emphysema and has been linked to increased rates of hospital admissions and premature death.[9]

- **Mercury** – Coal-burning power plants produce more than half of all emissions of airborne mercury, a potent neurotoxicant that is converted by microorganisms in water into a form that accumulates up the food chain.[10] All 50 states have fish consumption advisories urging limited or no consumption of fish from certain local waters due to the threat posed by mercury contamination, especially to children, nursing mothers and pregnant women.[11]

By reducing the need for electricity from fossil fuel-fired power plants, solar power reduces the threat posed by global warming and helps clean the nation's air.

In addition, unlike fossil fuel-fired steam power plants, which consume vast amounts of water, solar photovoltaics consume virtually no water in everyday operation, reducing the strain on water supplies in arid regions of the country and those experiencing drought.

Solar Energy Is Good for Consumers

Homeowners and businesses that invest in solar energy derive many important benefits. The benefits of solar energy, however, extend even to those consumers who continue to rely on electricity from the grid, reducing the need for costly investments in electricity generation and transmission capacity.

Consumers who install solar energy benefit from paying a predictable, steady price for electricity over the long term. Electricity prices are often volatile – changing dramatically along with prices for fossil fuels such as natural gas. Because energy from the sun is free, consumers who purchase solar panels are insulated from the volatility of fossil fuel markets.

Consumers who own their solar energy systems also benefit from that ownership. They are less dependent on utilities for energy, may be more conscious of their use of energy, can explore novel ways of maximizing their investment in solar energy (such as using solar panels to charge an electric vehicle), and can exercise their desire to take meaningful, personal action to reduce pollution and curb global warming.

Solar energy can also be a near-term economic winner for consumers and businesses – especially in states where electricity prices are high, owners of solar panels are compensated fairly for the excess electricity they supply to the grid, and there are strong pro-solar policies in place. In Hawaii, solar energy has already achieved "grid parity" – that is, solar electricity is cheaper than electricity from the grid, even without government incentives.[12] According to a recent analysis by Barclays, a multinational bank and financial services company, California is likely to hit grid parity by 2017, followed closely by Arizona and New York.[13] The Institute for Local Self-Reliance estimates that as many as 100 million Americans will live in areas where solar energy is cheaper than electricity from the grid within a decade.[14] In the meantime, residents and businesses in many of these areas can benefit from government incentives that reduce the cost of solar energy to the point where it is less expensive than grid electricity.

The benefits of solar energy extend far beyond the home or commercial building where solar panels are installed – indeed, solar energy benefits all consumers by reducing many of the costs of operating the electricity system.

Among the benefits of distributed solar electricity to the grid are:

- **Reduced energy losses** – Roughly five to seven percent of the electricity transmitted over long-distance transmission lines is lost.[15] Distributed solar energy avoids these losses by generating electricity at or near the location where it is used.

- **Reduced need for investment in transmission capacity** – Similarly, generating more electricity closer to the locations where it is used reduces the need to construct expensive new transmission capacity.
- **Reduced need for expensive "peaking" power** – Solar panels usually produce the most electricity on hot, sunny days, when demand for power is at its highest. These are the times when utilities must generate or purchase power from expensive, often inefficient "peaking" power plants that may operate for only a few hours each year. Expanding solar power can reduce the cost of providing power during these daytime periods of peak demand.[16] Soon, solar power may also help lower peak demand in the evening hours as electricity storage capacity improves and expands. (See "Integration and Storage Policies" on page 26.)

Several recent studies have estimated the value that distributed solar photovoltaics (PV) provide to electricity consumers. A study by the solar energy industry estimated that solar PV in Pennsylvania and New Jersey delivered value equivalent to 25.6 to 31.8 cents/kilowatt-hour.[17] Solar energy delivers that value by reducing the need to operate and maintain fossil fuel power plants, insuring against volatility in fossil fuel prices, reducing demand for transmission system upgrades, reducing wholesale power prices, and delivering broader environmental, economic, social and other benefits. A similar study in New York estimated the value of solar PV to consumers there at 15 to 41 cents/kilowatt-hour.[18] Those values are within the range of costs of current solar PV installations.[19]

Solar Energy Is Good for the Economy

Solar energy creates local jobs that can't be outsourced. More than 140,000 Americans worked in the solar energy industry in 2013, a 20 percent increase from the previous year, according to The Solar Foundation's annual solar jobs census.[20] According to the foundation, growth in the solar industry from November 2012 to November 2013 was 10 times faster than the national average employment growth rate of 1.9 percent.[21]

About half of all workers in the solar industry install solar energy systems. Jobs in solar energy installation are rising rapidly along with the growth in solar energy nationwide – in 2013 alone, employment in installation increased by 22 percent.[22]

About 20 percent of all solar workers are in manufacturing.[23] U.S. solar manufacturers have experienced difficulty in recent years as low-priced imports (largely from China) have come to dominate the global solar energy market. However, U.S. manufacturers continue to play important roles in developing the next wave of solar energy technologies, and many American firms are key suppliers of materials and components for solar panels manufactured abroad.[24] After a significant decrease in manufacturing employment in 2012, manufacturing jobs recovered somewhat in 2013.[25] However, solar industry analysts expect 2014 to be a much bigger year for manufacturing employment, projecting this sector to grow by eight percent with the addition of 32,400 jobs.[26]

Not surprisingly, the states that have experienced the greatest growth in solar industry employment also happen to be those with the greatest amount of installed solar energy capacity. A 2013 study by The Solar Foundation found that seven of the Top 10 states for total installed solar energy capacity (California, New Jersey, Arizona, Colorado, New York, Massachusetts and North Carolina) were also ranked in the Top 10 for solar industry employment.[27]

America's Solar Energy Potential Is Virtually Endless

America has enough solar energy potential to power the nation several times over. A recent analysis by researchers with the National Renewable Energy Laboratory estimated that rooftop photovoltaic systems

could generate more than 20 percent of the electricity used in the United States each year.[28] The potential for utility-scale photovoltaics in rural areas is even greater – representing *70* more electricity than is used in the United States each year. (See Figure 1.)

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.)

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.

Even when one looks at solar electricity generation on rooftops – a form of solar energy development with virtually no environmental drawbacks and many benefits for the electricity system and consumers – there is vast potential for solar energy to displace electric-

Figure 1. Solar Electricity Generating Technical Potential (top and bottom charts present same data at different scales)[29]

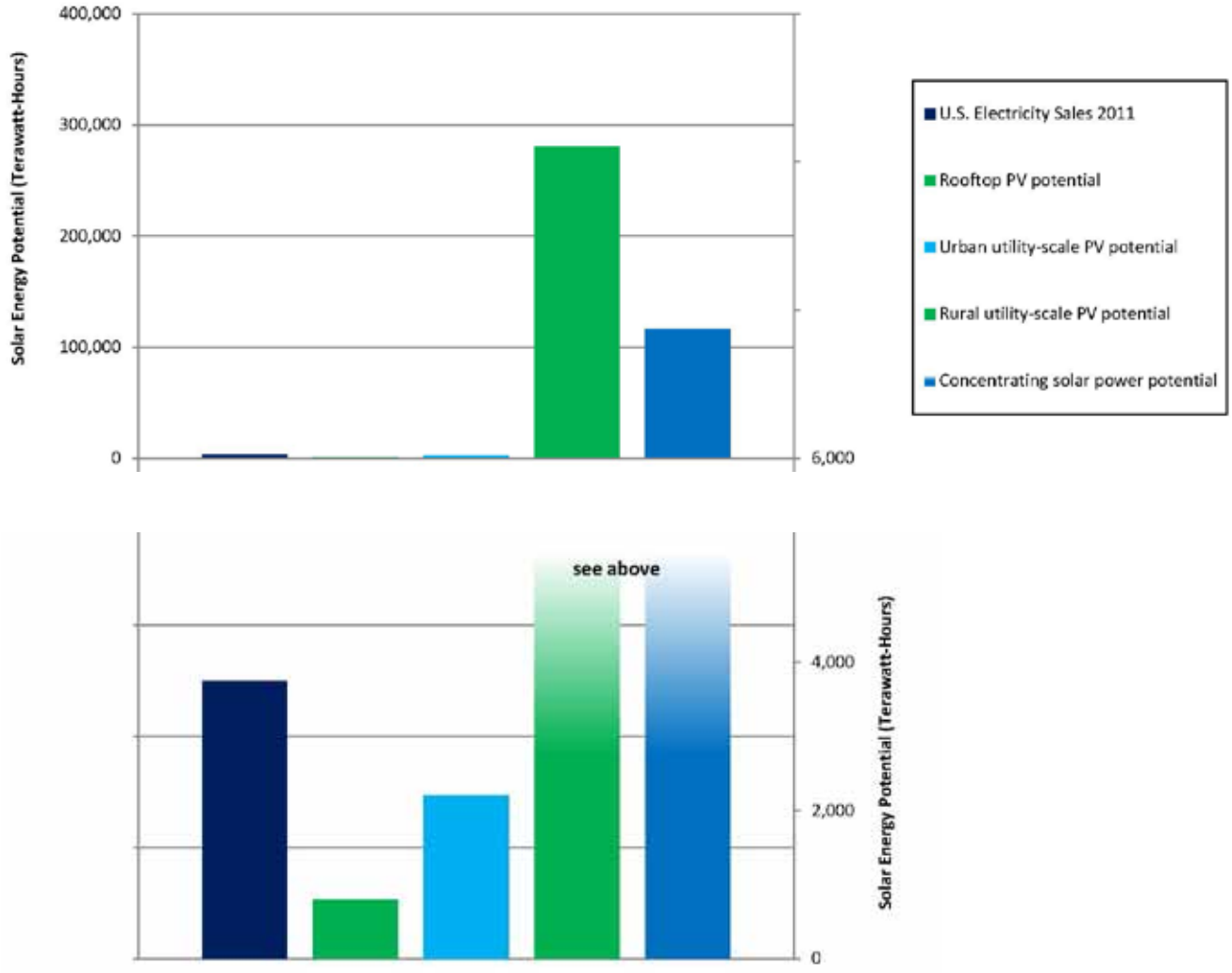
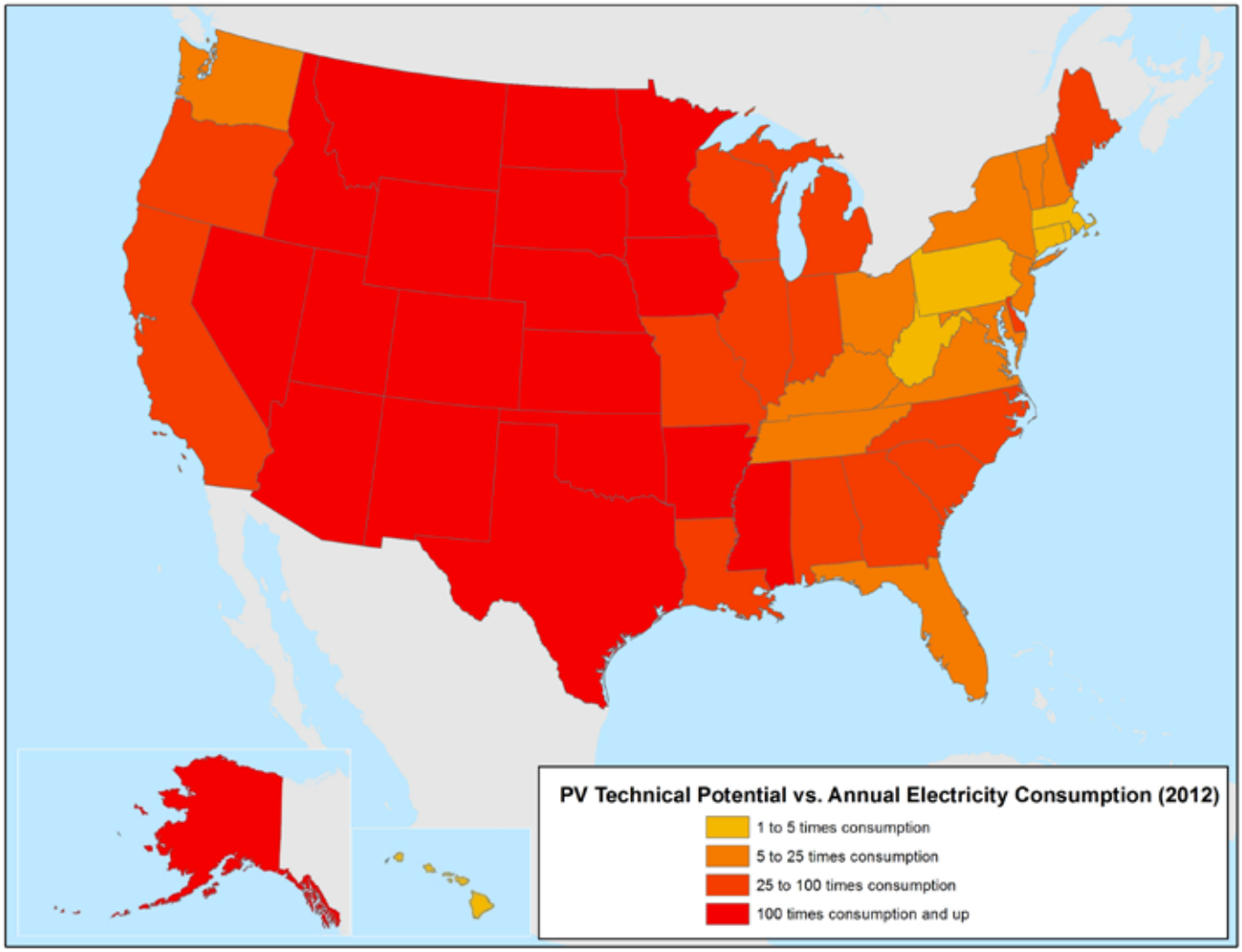


Figure 2. Solar PV Technical Potential versus Annual Electricity Consumption by State[30]



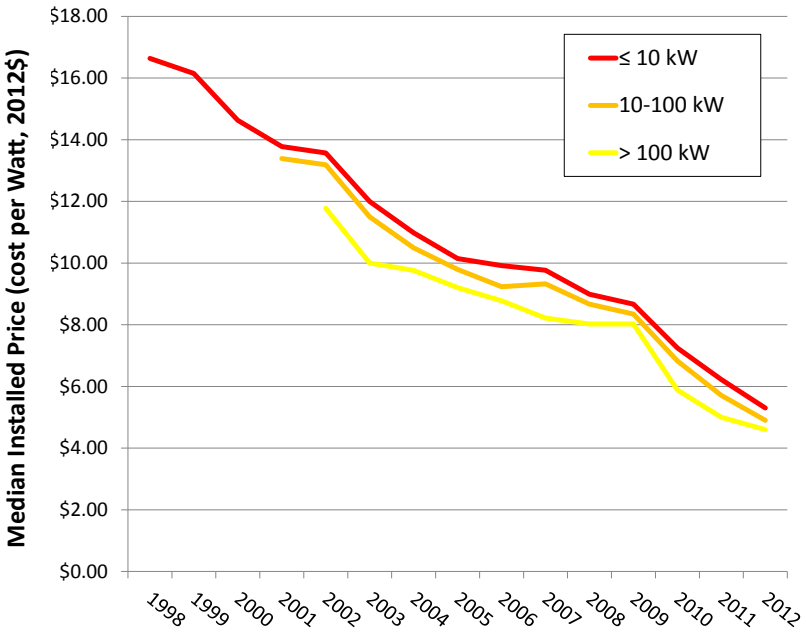
ity from fossil fuels. More than half of the 50 states have the technical potential to generate more than 20 percent of the electricity they currently use from solar panels on rooftops.[31] In several western states – California, Arizona, Nevada and Colorado – the share of electricity that could technically be replaced with rooftop solar power exceeds 30 percent.[32]

Every region of the United States has enough solar energy potential to power a large share of the economy. But states vary greatly in the degree to which they have begun to take advantage of that potential. In at least 10 U.S. states, strong public policies have led to the development of a substantial amount of solar energy capacity in recent years.

Solar Power Is on the Rise

The amount of solar energy in the United States is rising rapidly – reducing America's dependence on dirty sources of energy. America's solar revolution is being led by 10 states where a strong, long-term public policy commitment is leading to the rapid adoption of solar energy by homeowners, businesses, local governments and electric utilities. Another three "advancing" states have also made significant progress by adopting many of the pro-solar policies embraced by the top solar leaders.

Figure 3. Median Installed Price of Residential and Commercial Solar Photovoltaic Systems by Size[35]



The Promise of Solar Energy Has Arrived

Solar energy has evolved from a novelty – one sure to attract interest from passers-by and questions from neighbors – into a mainstream source of energy.

That evolution has been made possible by innovations that have taken place throughout the solar energy industry. Decades of research has resulted in solar cells that are more efficient than ever at converting sunlight into energy – enabling today's solar energy systems to generate more electricity using the same amount of surface area than those of a decade ago.[33] A massive global scale-up in manufacturing, the creation of new financing and business models for solar energy, and improvements in other areas have also helped solar energy to become more accessible and less costly over time.

As a result of these innovations and growing economies of scale, the cost of solar energy has plummeted in recent years and continues to fall. The cost of installed solar energy systems fell by 15 percent in 2013 from 2012, and has fallen by 60 percent since the beginning of 2011.[34] (See Figure 3.)

Evidence from elsewhere in the world suggests that solar energy prices still have room to fall further. The cost per Watt of an installed solar energy system in Germany, for example, is roughly half that of the United States, due to a variety of factors, including larger average system size, quicker project development timelines, and lower overhead.[36]

While there are still opportunities to reduce the cost of solar panels, the greatest savings can be achieved by reducing "soft costs" – costs such as those associated with attracting customers, installing the systems, completing paperwork, and paying taxes and fees.[37] The U.S. Department of Energy and the solar industry are engaged in efforts to reduce soft costs, which, if successful, will make solar energy even more cost competitive in the years to come.

America's Solar Energy Capacity Tripled in Two Years

Over the course of the last decade, the amount of solar energy capacity in the United States has increased more than 120-fold, from 97 megawatts in 2003 to more than 12,000 megawatts at the end of 2013.[38] In 2013 alone, the United States installed 4,750 MW of solar PV capacity – more than the nation had installed in its entire history up to 2011.[39] (See Figure 4.) And in the first quarter of 2014, solar energy accounted for 74 percent of all the new electric generation capacity installed in the United States.[40]

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 states that have opened the door for solar energy with the adoption of strong public policies.

Solar 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. 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. (See "Quantifying Solar Energy Capacity" on page 16.) Most of these states also led the nation in new capacity additions in 2013, indicating that they have continued to lead the nation in solar energy adoption.

These 10 states account for:

- 26 percent of the U.S. population[42]
- 20 percent of U.S. electricity consumption[43]
- 87 percent of the nation's solar electricity capacity, and
- 89 percent of the solar power installed during 2013.[44]

Solar Electricity Capacity per Capita

Arizona leads the nation in solar electricity capacity per capita, with 275 Watts of solar electricity capacity per resident.[45] That is nearly seven times as much solar electricity capacity per person as the national average. Arizona's solar energy success is due in part to the state's early commitment to solar energy – it was the first state

Figure 4. Annual and Cumulative Installed Photovoltaic Capacity, United States[41]

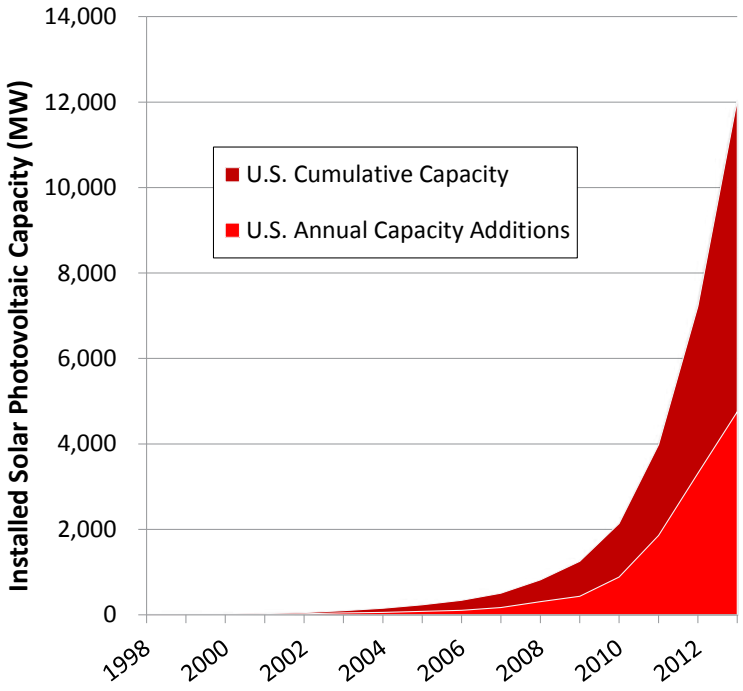
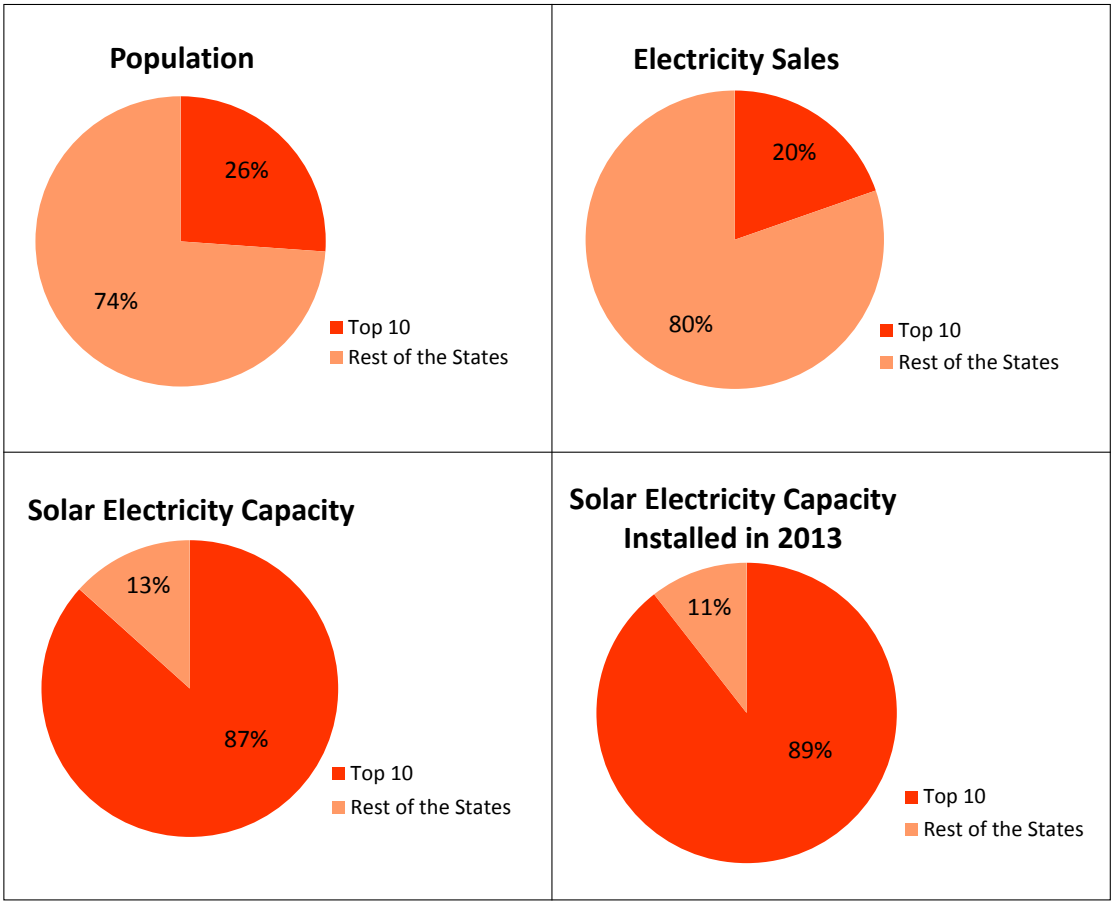


Figure 5. a-d. Solar Energy in the Top 10 Solar States versus the Rest of the U.S.



to require utilities to obtain a certain percentage of their electricity from solar energy.[46] Arizona also ranks second in the nation (behind California) in large, utility-scale solar energy projects – as of March 2014, Arizona had 1,129 MW of utility-scale solar energy capacity, about 530 MW of which was installed in 2013 at two locations in Gila Bend and Yuma County.[47] (Arizona's continued status as a solar energy leader is in doubt, however. See "Is Arizona Stepping Back From Solar Energy Leadership?" on page 18.)

Quantifying Solar Energy Capacity

In this report, we present two measures of solar energy adoption:

- **Solar photovoltaic capacity** refers to installed solar photovoltaic systems, both distributed and utility-scale.
- **Solar electricity capacity** refers to all solar technologies that produce electricity, including concentrating solar power systems that use the sun's heat, rather than its light, to generate electricity.

The figures in this report do not include other solar energy technologies, such as solar water heating, that are increasingly important sources of clean energy.

While several Western states with excellent solar resources (including Nevada, California, New Mexico and Colorado) are on the list of solar energy leaders, so too are a number of small eastern states (such as New Jersey, Massachusetts and Delaware) where sunlight is less abundant but where grid electricity prices are high and public concern about pollution has led to strong support for clean local energy. North Carolina, ranked 10th, owes its presence on the list to several large-scale solar energy installations by utilities, which helped grow the state's per-capita capacity by more than 140 percent since 2012.

Table 1. Cumulative Solar Electricity Capacity per Capita[48]

State	Cumulative Solar Electricity Capacity per Capita 2013 (Watts/person)	Rank
Arizona	275	1
Hawaii	243	2
Nevada	161	3
California	148	4
New Jersey	136	5
New Mexico	113	6
Delaware	82	7
Massachusetts	66	8
Colorado	63	9
North Carolina	57	10

Many of the Top 10 states with the most cumulative capacity per capita were the same as those with the most capacity installed during 2013, suggesting that these same states continued to demonstrate leadership in solar energy deployment. (See Tables 1 and 2.) Arizona and Hawaii led the list with more than 100 Watts per person installed during 2013, with Nevada, California and New Jersey rounding out the top five for new solar PV capacity per capita.

Table 2. Solar Photovoltaic Capacity Installed During 2013 per Capita[49]

State	Solar Electricity Capacity Installed During 2013 per Capita (Watts/person)	Rank
Arizona	109	1
Hawaii	107	2
California	72	3
Massachusetts	37	4
North Carolina	33	5
New Jersey	27	6
New Mexico	22	7
Vermont	17	8
Nevada	17	9
Delaware	14	10

Total Solar Electricity Capacity

In terms of total solar electricity capacity, California leads the nation with more than 5.6 gigawatts – more than 40 percent of the nation's total, and nearly double its year-end capacity from 2012. Arizona, New Jersey, North Carolina and Nevada round out the top five. (See Table 3.) Despite having only one-quarter of the U.S. population, the Top 10 states in this category account for 87 percent of total U.S. solar electricity capacity.

Nearly all of the Top 10 states for total solar electricity capacity are also those with the most per-capita solar capacity. The exceptions are New York and Delaware; New York appears in the Top 10 for total solar capacity, but because of its large population, it falls out of the Top 10 for per-capita solar capacity. In contrast, Delaware is ranked 21st in the nation for total solar electricity capacity, but because of its small population, it ranks seventh for per-capita solar capacity.

Table 3. Top 10 States for Cumulative Solar Electric Capacity Through 2013[54]

State	Cumulative Solar Electricity Capacity (MW)	Rank
California	5,661	1
Arizona	1,821	2
New Jersey	1,211	3
North Carolina	557	4
Nevada	450	5
Massachusetts	442	6
Hawaii	341	7
Colorado	331	8
New York	250	9
New Mexico	236	10

Table 4. Top 10 States for Solar Electricity Capacity Installed in 2013[55]

State	Solar Electricity Capacity Installed During 2013 (MW)	Rank
California	2,760	1
Arizona	724	2
North Carolina	328	3
Massachusetts	244	4
New Jersey	240	5
Hawaii	150	6
Georgia	91	7
New York	75	8
Texas	62	9
Colorado	61	10

California led the way with the most solar photovoltaic capacity installed in 2013 by adding more than 2.7 gigawatts of solar electricity capacity. Arizona, North Carolina, Massachusetts and New Jersey rounded out the list of the top five states for new solar energy capacity. Georgia ranked seventh for solar capacity additions in 2013, due largely to an aggressive effort by the state public service commission and Georgia Power to add more than 500 MW of solar energy by the end of 2016. (See "Georgia" on page 21.)

Is Arizona Stepping Back from Solar Energy Leadership?

Arizona is well-positioned to reap the benefits of solar energy. Blessed with some of the world's best solar energy resources, and facing the need to meet increasing demands for electricity from a growing population, Arizona has long been a leader in the adoption of cutting-edge policies to promote solar energy.

Recently, however, the state took a major step backwards when the Arizona Corporation Commission (ACC), the state's utility regulator, voted to eliminate tax incentives for businesses that install solar panels and to reduce incentives for residential solar customers.[50] In November 2013, the ACC opted to allow utilities to charge a monthly fee of $0.70/kW (a $3.50 monthly charge for a 5 kW system) for new residential solar customers, after it had earlier rejected a utility proposal to place a $50-$100 monthly fee on customers who net meter.[51] Finally, the ACC also considered a proposal to weaken the state's renewable electricity standard in February 2014.[52]

As a result of these actions, Arizona risks a slowdown in its adoption of solar energy – as well as the 8,500 solar industry jobs in the state that bring income and vitality to the state's economy.[53]

Beyond the Top 10: Emerging Leaders

While the Top 10 solar states are responsible for the vast majority of solar energy in the United States, there are several "advancing" states with large or fast-growing solar energy markets and strong new solar policies or programs implemented in late 2013 and early 2014.

New York

Solar energy is booming in New York. At the end of 2013, the state had 250 MW of solar electric capacity installed, placing it in ninth place nationwide for cumulative installed solar capacity.

New York's solar energy market is growing so quickly because it continues to ramp up its commitment to solar power. One key driver of growth has been Gov. Andrew Cuomo's NY-Sun Initiative, a public-private partnership launched in 2012 designed to expand the state's solar energy market and drive down the cost of solar power for New Yorkers. The program increased financial incentives for large, commercial-sized photovoltaic (PV) projects and expanded incentives for small-to-medium residential and commercial systems.[56] It also boosted funding for the state's competitively bid solar program for larger-scale and aggregated PV systems and created a special program to standardize and streamline permitting and interconnection procedures across the state.[57] According to the governor's office, the program has already resulted in 316 MW of solar PV installed or under development, more than was installed in the entire decade before the program.[58]

In late 2013, Gov. Cuomo announced a 10-year extension of the NY-Sun Initiative, and the Public Service Commission authorized the New York State Energy Research and Development Authority (NYSERDA), the program administrator, to make improvements and enhancements through 2023.[59] NYSERDA immediately proposed funding for a 3,000 MW statewide solar deployment goal, as well as a new, market-based structure for the state's incentive programs, which was approved in spring 2014.[60] The new "Megawatt Block" incentive structure allocates MW targets to specific regions of the state (based on historic demand, market potential, installed cost per watt and equity), then breaks these targets into "blocks," which are assigned various incentives. As the blocks are fulfilled, the incentives are scaled back.[61]

The new incentive structure is similar to that employed by the highly successful California Solar Initiative (see page 32), and is meant to help New York transition to market-based solutions for the solar industry. To assist with this transition, the state

Photo: istockphoto.com, Daniel Schoenen Fotografie

Utility-scale solar energy facilities in areas of the country with high solar energy potential can make a meaningful contribution to the nation's energy supply.

recently committed an additional $1 billion in funding for NY-SUN programs (including the Megawatt Block program) over the next 10 years.[62] This stable, long-term funding source will help create certainty in New York's solar energy market and attract more investments in solar power.

By expanding its policy commitment to solar energy and developing new, market-based approaches to building its solar industry, New York is ensuring strong, reliable solar market growth over the long term.

Vermont

Vermont, with 51 W/person of solar power installed 2013, ranked 11th for installed solar capacity per capita and was highlighted as one of the "Dazzling Dozen" states in the 2013 version of this report.[63] The state ranked eighth in per-capita solar energy capacity installed during 2013. Even though Vermont is the only state in the Northeast without a renewable electricity standard, it has many other strong policies to support solar energy development, including strong net metering and interconnection standards, solar rights laws, a feed-in tariff, virtual net metering for the owners of community solar PV systems, creative financing options and cash incentives. (For more information on these policies, see "Key Solar Energy Policies" section on page 23.)

Vermont continues to expand and improve these policies. In April 2014, Vermont lawmakers voted to expand the state's net metering program by raising its net metering cap from four percent of a utility's peak load to 15 percent.[64] In sharp contrast to battles over net metering taking place in Colorado, Arizona, California and other states (see page 29), the expansion of Vermont's net metering program had broad support not only from the legislature but also from the state's utilities.[65] According to the Solar Energy Industries Association (SEIA), the successful expansion of the state's net metering program was attributable to four key factors:[66]

- **A broad recognition of the economic benefits of solar power**. For example, a 2013 study by the state Public Service Commission comparing the benefits of solar power with the cost of the state's net metering program found that net metering for a 4 kW fixed solar PV residential system produced a *net benefit* to individual ratepayers of 4.3 cents/kWh.[67] In addition, Vermont's governor cited a report estimating $400 million in transmission line deferments resulting from distributed generation in his 2014 budget address.[68]
- **Leadership by the state Public Service Department.** According to SEIA, Vermont avoided a contentious fight over net metering as the state approached its four percent cap by working with stakeholders of both the solar and utility industries to "artfully draft a compromise that preserved a policy that provided a predictable and fair path for the industry to grow in an uninterrupted manner through at least 2016."[69]
- **Strong support for distributed generation by the state's largest utility**. At the stakeholder meetings over changes to the state's net metering policy, Green Mountain Power (GMP), an investor-owned utility that serves about 75 percent of the state, repeatedly affirmed its commitment to distributed generation – and to meeting its customers' increasing demand for solar power – to the leaders of the state's 16 other utilities. In 2014, Vote Solar named GMP as its 2014 Utility Solar Champion for its leadership.[70]
- **Visible growth in the state's solar job market**. In 2013, The Solar Foundation named Vermont as the state with the highest number of solar industry jobs per capita.[71] The growth of local solar industry jobs – as well as the proliferation of net metered businesses, farms and nonprofits – made the state's net metering policy quite popular among Vermonters, according to SEIA.

Like many of the Top 10 solar states outlined in this report, Vermont laid the foundation for a strong solar market by adopting many essential pro-solar energy policies. However, the leadership demonstrated in the negotiations over the state's net metering law is unparalleled. As the growth of solar power prompts more states to consider changes to their clean energy laws, Vermont provides a model to emulate.

Georgia

In 2013, Georgia's solar energy capacity increased dramatically. In just one year, the state's cumulative solar energy capacity grew from 25 MW to 116 MW – a 364 percent increase.[72] Georgia ranked 13th for per-capita solar energy capacity installed in 2013. However, unlike many states with fast-growing solar markets, Georgia has weak solar energy policies. The state has no net metering program, no renewable electricity standard, and state law explicitly prohibits solar energy customers from participating in power purchase agreements, a key financing mechanism that has helped unlock solar energy markets in many other states.

Instead, the rapid growth of the solar industry in Georgia can be attributed to the leadership of the Public Service Commission, which recently voted in favor of a plan to require the state's largest utility to increase its commitment to solar power. In July 2013, the PSC voted to require Georgia Power Co. to increase its solar energy capacity to 525 MW by the end of 2016.[73] Known as the Advanced Solar Initiative, this plan will require Georgia Power to procure 425 MW from utility-scale projects, and 100 MW from small-scale residential and commercial installations.[74] This capacity is in addition to the 260 MW Georgia Power was already developing in two projects previously approved by the PSC.[75]

Shining City: Washington, D.C.'s solar market is poised for growth

Despite its small size and relatively limited rooftop space, Washington, D.C., is poised to rapidly grow its solar energy market. In early 2014 Environment America Research & Policy Center ranked Washington, D.C. 25th among 57 major American cities for per capita solar PV capacity.[82] However, the city has several new clean energy policies that are making solar energy more attractive and accessible to people who aren't normally able to take advantage of solar energy, such as renters in apartment buildings or people with shaded properties.

For example, the Community Renewable Energy Act of 2013 legalized net metering for community solar gardens up to 5 MW.[83] The owners of these shared solar energy systems also retain the rights to the associated renewable energy credits, which may be sold in markets across the country.[84] In the D.C. market, these credits are valuable because they are in short supply but high demand by the District's electricity suppliers, which must get 2.5 percent of their power from solar energy by 2023.[85] According to The Energy Collective, the 2.5 percent solar carve-out equates to about 250 MW of demand by 2023.[86]

Through the Advanced Solar Initiative, Georgia Power is offering 13 cents per kilowatt-hour for distributed generation and 12 cents per kilowatt-hour for utility-scale solar energy for a period of 20 years.[76] These attractive terms have resulted in a flood of applications from utility-scale solar developers. In April 2014 alone, the utility received 1,204 applications for 200 medium-scale solar energy projects.[77] According to a report in *The Augusta Chronicle,* the chief executive officer of Atlanta-based Hannah Solar estimated that those applications represent about $1 billion that developers are ready to invest, though only $100 million in contracts will be awarded.[78]

It remains to be seen whether small-scale rooftop and community solar will emerge in Georgia in ways that can benefit residential, small commercial and low-income customers. But, as Georgia's utility-scale solar energy market grows, lawmakers are considering removing some barriers to expand the state's small-scale solar energy market, particularly the state's law prohibiting power purchase agreements.[79] In early 2014, some lawmakers proposed legislation to allow customers to lease solar panels – rather than buy them outright – from solar energy companies, who would also be allowed to sell the electricity directly to customers.[80] A vote on the legislation isn't expected until 2015.[81]

America's Leading Solar States Have Cutting-Edge 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 Delaware do not receive as much sunlight as states such as Texas or Florida, but their solar energy markets are much more developed. High electricity prices aren't necessarily a factor, either – five of the Top 10 states have retail electricity rates that are below the national average.[87] 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.

States where "going solar" is easy, affordable and supported by a range of attractive financing options are seeing dramatic growth in solar energy. That is especially true in states that have made long-term policy commitments that inspire confidence among consumers and solar businesses. On the other hand, states where consumers are not paid fair value for the electricity they supply to the grid, where utilities hostile to solar energy can tie up would-be solar homeowners in red tape, where public policies are unpredictable, and where homeowners and businesses have no choice but to bear the upfront cost of solar energy alone, are seeing much slower growth in solar energy.

All states benefit from robust federal policies to promote solar energy, especially federal tax credits for residential and business solar installations and efforts by federal agencies to "lead-by-example" by expanding solar energy on government property and buildings. Those and other federal policies create a foundation on which states can choose to build a strong policy infrastructure to support solar energy development.

The experience of the Top 10 states shows that there is a clear, proven pathway to solar energy leadership – one that every state can and should follow.

Key Solar Energy Policies

The link between strong public policies and the growth of solar energy is clear. According to a 2011 study by researchers with the National Renewable Energy Laboratory (NREL), about 70 percent of the difference in solar photovoltaic capacity among states could be explained by the existence of a set of specific public policies, as well as population.[88]

NREL researchers have identified three types of public policies that help build strong markets for solar energy:[89]

Market Preparation Policies

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 preparation policies include:

- *Interconnection standards*, which clarify how and under what conditions utilities must connect solar panels to the grid while preserving the reliability and safety of the electricity system at the value-of-solar rate.
- *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. Net metering essentially allows the customer's power meter to "spin backwards" at times when solar power production exceeds on-site needs.
- *CLEAN (Clean Local Energy Accessible Now)* contracts (otherwise known as feed-in tariffs) can provide support for solar in states or localities where net metering policies are weak or don't exist. *Value-of-solar* rates can also play an important role in ensuring that consumers receive a fair price for solar energy, so long as they do not undercut successful net-metering programs and payments fully account for the benefits of solar energy. (See "Minnesota Enacts First Value-of-Solar Tariff" below.)
- *Solar rights policies*, which override local ordinances or homeowners' association policies that bar citizens from installing solar energy equipment on their properties.

Minnesota Enacts First Value-of-Solar Tariff

In 2013, Minnesota became the first state to establish a value-of-solar tariff. In contrast to net metering, in which utilities compensate solar energy customers at the retail rate for the excess electricity they feed into the grid, a value-of-solar tariff sets a long-term fixed price for solar energy that accounts for all the benefits solar customers provide to the environment and the grid. Under Minnesota's value-of-solar tariff, solar energy customers purchase all of the electricity they consume on-site from the utility, and then sell all the electricity they produce to the utility at the value-of-solar rate.[90]

In Minnesota, utilities may choose whether to apply net metering or the value-of-solar tariff to compensate solar energy customers. Proponents of the value-of-solar tariff argue that it is a more transparent and precise valuation of the benefits of solar power, and that it does not require subsidy. In Minnesota and in Austin, Texas (the only other place with an established value-of-solar tariff), accounting for all of these benefits has pushed the rate of compensation above the retail rate for electricity, at least in the short term.[91]

However, the solar industry has made several criticisms of value-of-solar tariffs, charging that they represent an attempt by utilities to undermine net metering, a proven policy that is simple for consumers to understand and has been highly successful in building solar energy markets across the country, particularly in the residential sector.[92] The industry also argues that the tariff gives utilities too much power to disrupt the solar market, given that after the first three years of the 25-year term of the value-of-solar tariff in Minnesota, utilities may recalculate the rate of compensation for new contracts annually.[93]

Well-designed and publicly vetted value-of-solar tariffs may prove effective in situations where net metering and other policies have not led to the expansion of solar power. However, policymakers should be cautious about replacing effective net metering programs with policies such as value-of-solar tariffs, which require good-faith engagement by utilities and close oversight by regulators.

State utility regulators also develop and approve *utility rate structures* that have a major impact on the financial desirability of solar energy. Rate structures that have a higher ratio of per-kilowatt-hour to per-customer charges, and those that charge higher rates at times of day when the cost of providing power is highest, 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.

In addition to these state-level policies, local governments can play an important role in preparing the way for solar energy through the adoption of smart *permitting and zoning rules* that eliminate unnecessary obstacles to solar development. The cost of permitting, interconnection and inspection of solar energy systems represent about three percent of the cost of a residential solar energy system.[94] State policies 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.[95] Many local zoning regulations, meanwhile, were written without solar energy in mind. These regulations – which often limit "accessory uses" of property or limit the presence of rooftop equipment – can be interpreted in ways that raise insurmountable barriers to the installation of solar energy on homes and businesses.[96] The adoption of solar-friendly zoning policies can ensure that homeowners and businesses who wish to go solar may do so.

Finally, *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.

Market Creation Policies

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.

These policies include:

- *Renewable electricity standards (RESs)* or *renewable portfolio standards (RPSs)*, which set minimum renewable energy requirements for utilities.
- RESs with a *solar carve-out* – a specific minimum requirement for solar energy – can be particularly effective in developing a stable solar energy market.

Market Expansion Policies

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. These policies include:

- *Grants*, *rebates*, *tax incentives* and *loans,* which are among the many **financial incentives** that help reduce the cost of solar energy.
- Policies that enable *third-party ownership* of solar panels, *solar leases*, or *on-bill* or *Property Assessed Clean Energy (PACE) financing* of solar panels, which are among the many **financing options** that can relieve consumers from having to pay the upfront cost of solar panels by spreading the costs over time, enabling solar homeowners and businesses to reap financial savings from Day 1. V*irtual net metering* enables shared, community solar projects that allow those who are unable to install solar panels on their own properties to "go solar."
- **Lead-by-example** policies, which expand solar markets by requiring government agencies to consider or install solar energy on public buildings.

Federal policies – especially the 30 percent investment tax credit for solar photovoltaic installations on residential and commercial properties – have provided a strong foundation as the United States has expanded the market for solar energy over the past decade. Leading solar states build upon that foundation by adopting strong policies of their own in all three categories.[97] As will be shown below, most of the Top 10 states can trace their leadership in solar energy development to their leadership in the development and implementation of strong solar energy policies.

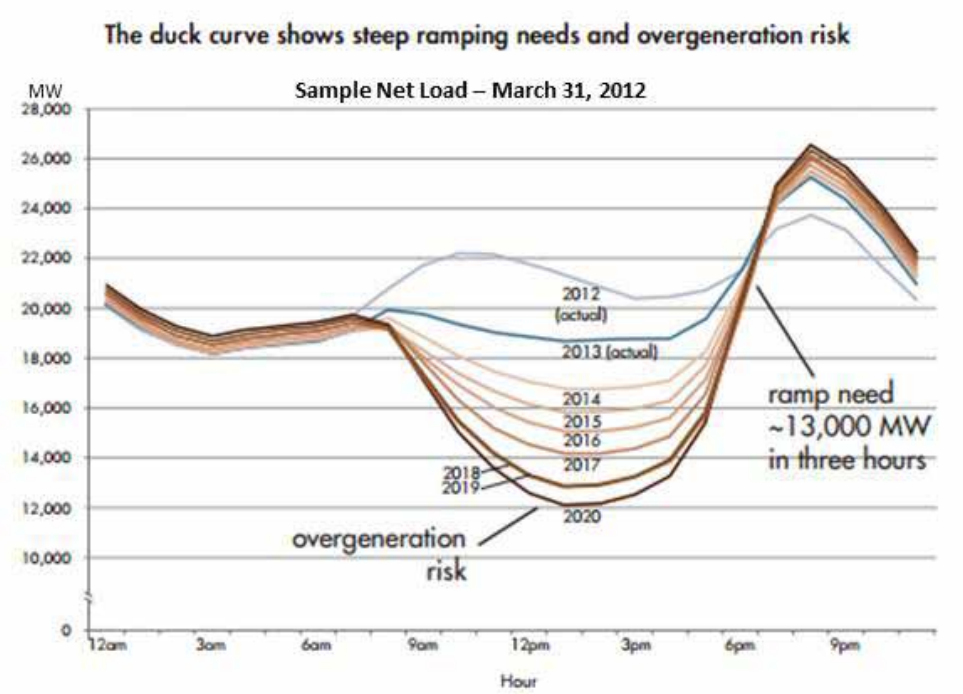
On the Horizon: Grid Integration and Storage Policies

In states where large amounts of solar or wind power are going online, one emerging challenge for regulators is ensuring that grid remains stable when the sun isn't shining or the wind isn't blowing. In California, for example, where solar energy is growing quickly, the state's major grid operator has warned that, by 2020, daily patterns of electricity consumption could change to result in the need for a rapid ramp-up in power generation each evening after the sun sets. The operator released a sample energy demand curve that illustrates this problem, which has been dubbed the "duck curve." (See Figure 6.)

In order to keep the amount of power on the grid stable with increasing penetrations of solar energy, grid operators need efficient and flexible power resources that can mirror the variability of solar energy output.

There are many solutions grid operators can employ to flatten out the duck curve as they integrate more renewable energy, including, but not limited to, energy efficiency, demand response and energy storage.[98] Energy storage technologies – including electric battery storage in the fast-emerging electric vehicle market – intelligently deployed throughout the electricity grid would both allow grid operators to tap into clean, renewable power anytime and deliver stabilizing benefits to the grid.

Figure 6. A Chart by California's Grid Operator Illustrating the "Duck Curve"



(from the California Independent System Operator)

California, which has a high renewable energy target of 33 percent by 2020, has already taken steps to support the expansion of battery storage technology. In late 2013, the state required that investor-owned utilities procure 1,325 MW of electricity and thermal storage by 2020.[99]

The energy storage requirement is likely to boost California's already fast-growing customer-sited energy storage industry, and potentially the state's electric vehicles market, as well.[100] Some solar PV installation companies such as SolarCity are now offering battery storage to their customers, giving them a back-up source of power during outages and allowing them to avoid drawing energy from the grid during peak hours of the day, when electricity rates are usually higher. The state also has a growing number of energy storage start-up companies, some of which focus on customer-sited energy storage (such as Solar Grid Storage, Green Charge Network, and Stem), and others that are developing new technologies for the transmission and distribution sectors, for shaving peak demand, and for providing ancillary services that benefit the entire grid.[101]

California isn't the only place where energy storage is catching on. In October, Maryland's first "microgrid" went online in one community impacted by Hurricane Sandy power outages. The microgrid includes 402 kW of solar PV, two EV charging stations, and enough battery storage to supply up to 50 kW for just over four hours in the event of another outage.[102] NRG Solar, known for developing large solar power plants, is attempting to penetrate the commercial and residential solar energy markets in California, Texas and New York with a new solar pergola, or shade structure, that also stores power.[103]

Public policies that increase energy efficiency, make the grid more secure and intelligent, and boost energy storage can help states prepare for the eventual integration of large amounts of renewable energy into the grid, and to create a more reliable electricity system.

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 to the development of a vigorous market for solar power in a particular state.

Interconnection and net metering policies for solar energy are evaluated annually by a coalition of organizations in a report called *Freeing the Grid*.[104] In 2013, nine of the Top 10 states had net metering policies that received an "A" or "B" grade in the *Freeing the Grid* report. Only North Carolina received a lower ("D") grade because it places size limitations on eligible systems, does not require municipal or co-operative utilities to net meter, does not protect customers from unanticipated fees, and in most cases requires customers to surrender all of the renewable energy credits earned from their system to utilities.[105] In nearly all of the Top 10 states (with the exception of New Mexico), consumers are compensated for the value of the excess solar electricity they feed into the grid at or near the full retail rate.[106]

Net metering has been the single most important policy for expanding rooftop and distributed solar power. Net metering has proven to be essential for the development of a strong solar energy market among residential and small business consumers.[107] However, utilities and fossil fuel interests seeking to slow the spread of solar energy have targeted net metering policies for rollback or repeal. (See "Attacks by Fossil Fuel Interests on State Net Metering Policies" on page 29.) California, for example, withstood a challenge from utilities to the existence of its current net metering policy, opting in March 2014 to allow current solar energy customers to keep their existing net metering benefits for the next 20 years.[108] The state is currently in the process of developing the next phase of its net metering programs, which will apply to customers who "go solar" after 2017.[109]

Nine of the Top 10 states also had interconnection policies that merited an "A" or "B" grade in the *Freeing the Grid* report. Arizona does not yet have a statewide interconnection standard, leaving individual utilities to develop their own.[110] It therefore received no grade in the *Freeing the Grid* report.

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

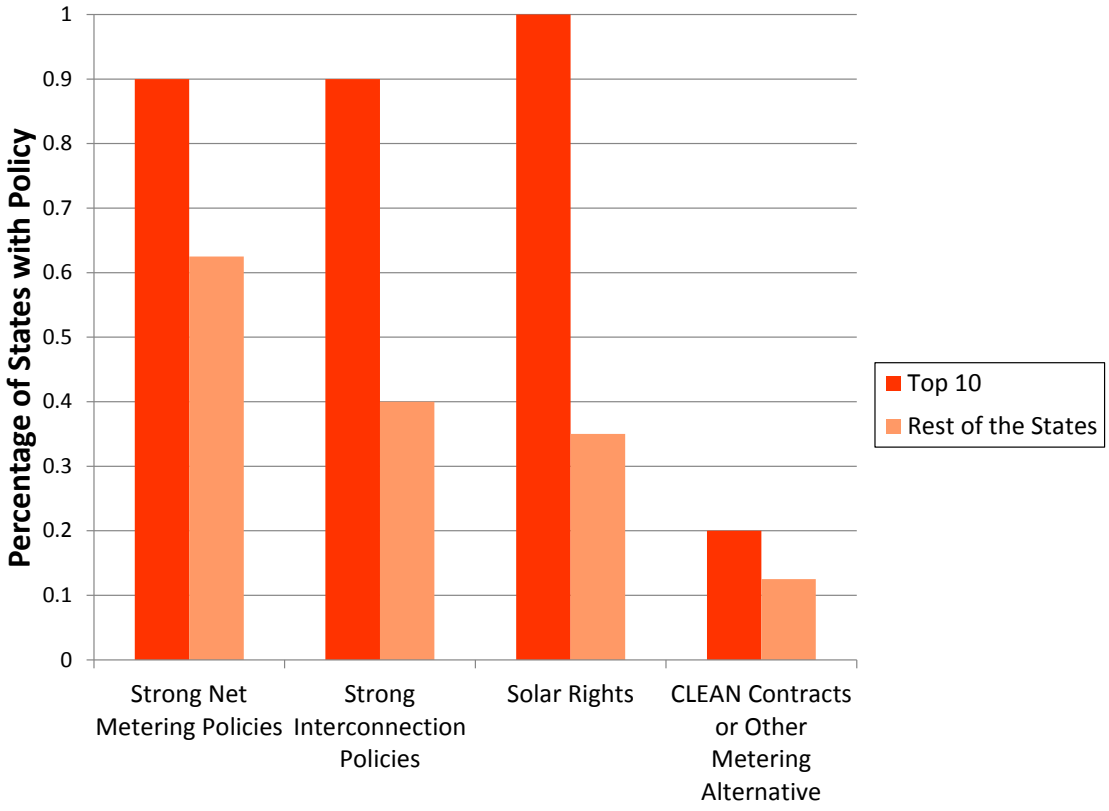
Several of the Top 10 states have other market preparation policies. Hawaii has a feed-in tariff that offers 21.8 cents per kilowatt-hour to small-scale residential solar projects.[111] In California, all publicly-owned and investor-owned utilities with more than 75,000 customers must make a standard feed-in-tariff available for small-scale systems less than 3 MW.[112] Owners of larger systems in the state may sell their electricity through individual power purchase agreements.

The Top 10 states are far more likely to have market preparation policies on the books than other states with less solar energy. (See Figure 7.)

Market Creation Policies

Market creation policies – especially renewable electricity standards with solar carve-outs – enable states with strong market preparation policies to take the next step in developing a healthy solar energy market. Market creation policies ensure that a growing market for solar energy will exist for a significant period of time, sending a message to those looking to invest in or start a solar energy company or train for jobs in solar energy that their investment of time and money is likely to be rewarded.

Figure 7. Prevalence of Market Preparation Policies, Top 10 States versus Others



Attacks by Fossil Fuel Interests on State Net Metering Policies

Few policies have been as effective at bringing down the cost of solar power for consumers as net metering. Net metered solar energy systems not only allow customers to reduce their consumption of grid electricity, but also receive credit for any excess electricity they provide to the electricity grid, usually at the full retail rate. Nine of the 10 states with the strongest solar energy markets also have strong net metering policies.

However, electric utilities across the country see the proliferation of solar energy customers locally generating their own electricity as a threat to their business model, which relies on generating, transmitting and distributing power produced at large, centralized power plants. And as solar power becomes increasingly cost-competitive with fossil fuel-generated electricity, they also see it as a threat to their bottom line.[113] In 2013, utilities aggressively stepped up their attempts to slow the growth of solar power in several states by attacking net metering policies. Primarily, these attacks have taken the form of proposals to impose hefty monthly fees on net metering customers, or to reduce the rate of compensation below the retail electricity rate. In summer of 2013, for example, Arizona Public Service, Arizona's largest utility, submitted a proposal to charge net metering customers $50-$100 per month – a charge that was ultimately reduced after significant pushback from the public and the solar industry. (See text box on page 18.)[114]

There are at least 22 states that are considering changes to their net metering policies – more than half of the 43 states that have the policy.[115] In some places, revisiting net metering policies has been long-planned or brought about in response to rapid industry growth. However, several of the other states where policy changes are being considered have very little or virtually no solar power. In these states – which include Utah, Idaho, Iowa, Kansas and Washington – utilities and fossil fuel interests have sought to prevent the emergence of solar energy markets by weakening net metering.[116]

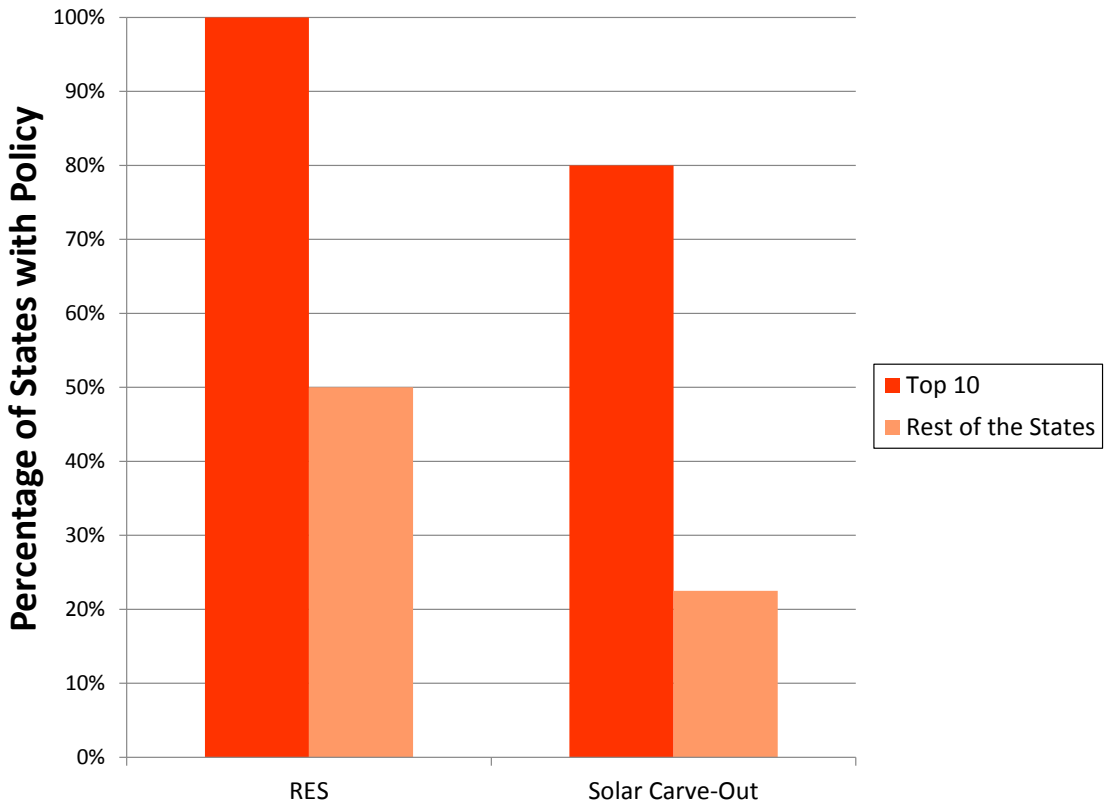
Utility efforts to stifle growth in smaller solar energy markets have received significant support from the American Legislative Exchange Council (ALEC), a conservative group that drafts legislation favorable to corporate interests and submits them to Republican statehouses.[117] In 2013, ALEC engaged in largely unsuccessful attempts to roll back renewable portfolio standards in 16 states.[118] In early 2014, ALEC and its utility industry partners circulated "model" legislation among several states that would require solar energy customers to pay fixed monthly charges.[119] So far, ALEC-inspired net metering policy changes have been rejected in Utah, Washington and Kansas, but adopted in Oklahoma.[120]

Not all utilities are opposed to solar energy expansion.[121] In fact, many are investing tremendous resources in their own solar energy installations, and some are even facilitating the growth of distributed generation. However, the utilities that do oppose solar expansion have joined an increasingly coordinated effort to destroy one of the most important tools for solar industry growth. In order to assure the long-term health of solar energy markets, policymakers must resist attempts by special interest to roll back net metering and other clean energy laws.

All of the Top 10 states have renewable electricity standards, and eight (all but Hawaii and California) have renewable electricity standards with a carve-out for solar electricity or for customer-sited distributed renewable electricity technologies, of which solar power is the most common.

States with solar carve-outs often use solar renewable energy credits (SRECs) as the mechanism for utilities to meet their obligations for the generation of solar electricity. Utilities must obtain the number of SRECs (each of which generally corresponds to the production of a megawatt-hour of solar electricity) required by the carve-out under the renewable electricity standard (RES). The price of SRECs fluctuates with the market, decreasing when there are large numbers of solar panels coming on line and increasing at times when the solar market must be stimulated to meet the solar generation requirements of the RES. While SRECs have helped drive solar market growth in states such as New Jersey and Massachusetts, they have been much less important in states such as North Carolina, where certain weaknesses in energy policy have kept the value of SRECs too low to effectively stimulate market growth.[122] For example, the state's SREC market is dominated by a few major utilities that have met or are close to meeting their RPS solar requirements by building their own large-scale solar installations, giving them little incentive to purchase RECs.[123] North Carolina is also missing a Solar Alternative Compliance Payment, which is a fine that a utility must pay for not meeting its renewable energy requirement.[124] Without an enforcement mechanism such as a fine, utilities do not have an incentive to grow the solar energy market by offering high SREC prices. Finally, North Carolina utilities are allowed to purchase 25 percent of SRECs from out-of-state, which guarantees that local SREC markets will be over-supplied.[125]

Figure 8. Percentage of Top 10 versus Other States with Key Market Creation Policies



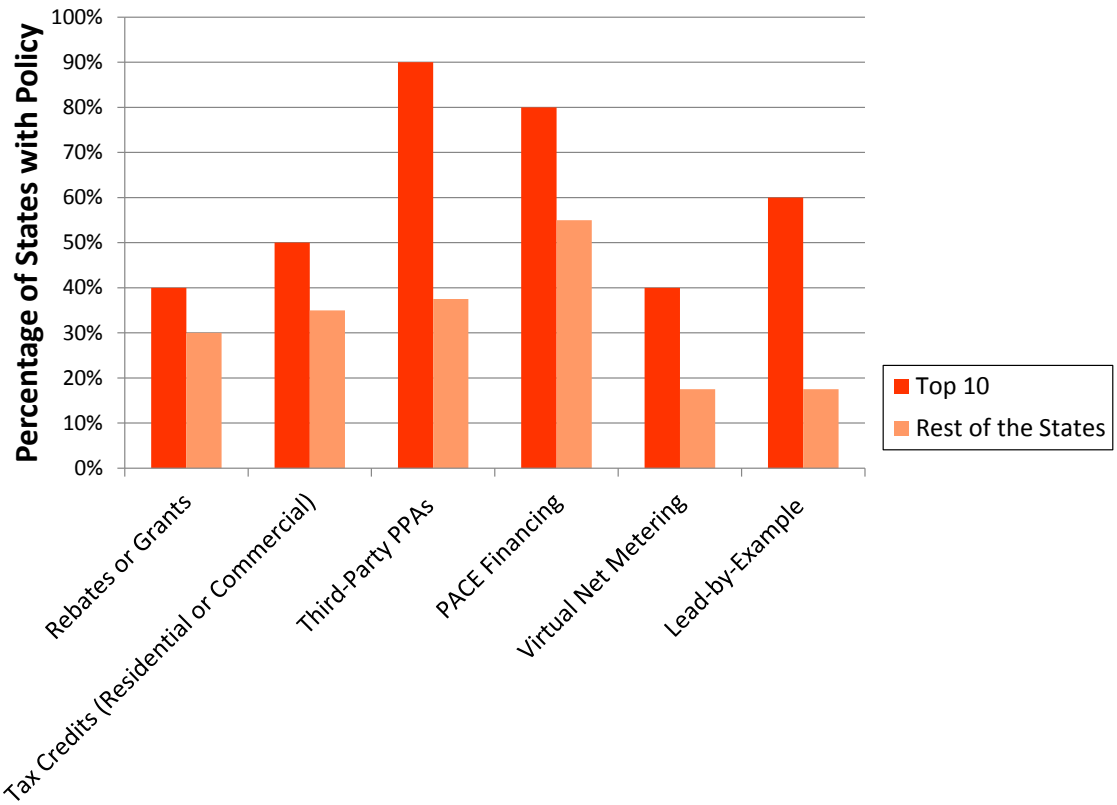
The nine Top 10 states with a solar carve-out represent more than one-half of all states nationwide with that policy (see Figure 8), and include several of the states with the strongest solar energy requirements. New Jersey, for example, has set a target of obtaining 4.1 percent of its electricity from the sun by 2028.[126] The solar energy "carve-out" within Massachusetts's RPS is not expressed as a percentage, but rather as a goal of 400 MW of solar PV capacity additions by 2016.[127] In 2013, Massachusetts exceeded this target, leading Governor Deval Patrick to adopt a new, more aggressive solar carve-out of 1,600 MW by 2020, which took effect in May of 2014.[128] Massachusetts is also considering legislation that would phase out the solar carve-out once it reaches 1600 MW and replace it with to a MW block incentive program.[129]

The two Top 10 states without solar carve-outs, California and Hawaii, have other aggressive policies to encourage the spread of solar energy. The California Solar Initiative was launched in 2007 with the goal of achieving three gigawatts of distributed solar energy capacity by 2016 through the use of consumer rebates and other targeted initiatives.[130] Hawaii and California also possess two of the strongest renewable electricity standards in the country, helping to drive the adoption of solar power even in the absence of a specific carve-out. Both states also have good net metering policies that credit solar customers at the full retail rate – which is higher than the national average in both states – for the excess electricity they supply to the grid.[131]

Market Expansion Policies

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

Figure 9. Percentage of Top 10 versus Other States with Key Market Expansion Policies



Financial Incentives

Financial incentives include rebates and grants that provide direct cash assistance for individuals or businesses seeking to install solar energy systems, as well as tax credits that reduce the tax burden of an individual or business choosing to "go solar."

As with other key solar policies, direct rebates or grants are more common in the Top 10 states than in other states, but they are less common than most other solar policies explored in this report. Some states in the Top 10 have moved from the use of direct rebates to other mechanisms – such as the sale of solar renewable energy credits (SRECs) – to provide financial incentives for solar energy.

Some states are also pioneering another creative market expansion policy that provides a pathway to solar energy deployment without incentives. *Declining megawatt block programs* leverage private capital to drive down the cost of buying or building solar energy projects and provide long-term funding certainty for solar energy developers. In these programs, MW targets for solar energy deployment are divided into "blocks" to which various incentives are assigned. Incentives are highest within the first MW block, when solar deployment is low, and are scaled back over time as solar deployment increases and higher MW blocks are achieved. At these higher levels of deployment, the solar industry can increasingly operate without subsidy and can offer more of its own capital to help consumers "go solar." This block structure also provides funding certainty for solar providers by establishing a clear schedule of incentives over the long term.

California pioneered this MW block structure beginning in 2006 with the launch of the California Solar Initiative, resulting in rapid solar market growth that has driven down the cost of going solar. Now, thousands of new solar installations are going up without CSI incentives. According to the Natural Resources Defense Council, "As much as a quarter of the market in PG&E territory and over 10 percent of SDG&E territory are now going up without CSI incentives."[132] New York recently adopted its own MW block program (see page 19), and in June 2014 the Massachusetts Department of Energy Resources presented a legislative proposal for switching the state's SREC program to a MW block incentive program.[133]

Financing Options

Often, the biggest hurdle standing in the way of solar energy adoption is not the total cost, but rather the *upfront* cost, the amount due at the time of installation. 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. Creative financing options can expand access to solar energy to those who are unwilling or unable to bear the upfront costs.

There are several ways in which states can facilitate the creation of attractive financing options for solar energy. The first is by allowing third parties – parties other than the home or business owner or the utility that supplies them with power – to own and operate solar energy facilities on residential or commercial properties. Third party arrangements come in two forms:

- In a *solar lease*, the third-party company installs, owns and maintains the solar panels but leases them to the consumer on whose property they generate power. Consumers may make the lease payment up front or make payments over time. The consumer benefits from lower electricity consumption and from net metering credits on their electricity bill; the third-party entity benefits by claiming the value of financial incentives and tax credits.
- A *third-party sales agreement* is similar to a solar lease, except that the third party retains ownership over the electricity produced by the solar

panels, selling that electricity to the consumer at a fixed price. In a third-party sales agreement, the consumer does not pay for the solar panels – avoiding upfront costs entirely – but only purchases the electricity they produce.

Third-party arrangements have many advantages – they foster economies of scale that make solar energy more affordable and remove from the property owner the uncertainty and hassle of filling out paperwork or maintaining the panels – and they have become increasingly popular in states where the policy playing field has been friendly to solar energy. Third-party arrangements can give residents or businesses that "go solar" immediate financial savings, rather than having to wait for several years until the initial investment in solar panels has been paid off with savings from reduced electricity consumption from the grid. Finally, third-party sales agreements are also attractive alternatives for non-profits and government agencies – which are unable to benefit from tax incentives – to gain access to solar energy.

Third-party sales agreements, however, have run into legal roadblocks in several states, including North Carolina, where state laws have been interpreted as categorizing third-party solar companies as regulated utilities. Some states that prohibit third-party sales allow solar leases, in which solar energy companies do not sell electricity to customers, but instead lease the use of the solar panels to customers, who then receive credit for the electricity they produce from the utility through net metering, but legal questions remain about those arrangements, as well.[134] Leading solar states have passed laws clarifying the legal status of third-party sales agreements, giving consumers and the solar industry the confidence they need to develop the business model in their states.

Long-term power purchase agreements (PPAs) with electric utilities can also be helpful in making solar financing models possible in states where third-party sales agreements are prohibited. In these arrangements, solar producers enter into long-term contracts with utilities who agree to buy the electricity they produce at a fixed price, making financing easier to structure over the production life of the PV system. PPAs tend to encourage the growth of large commercial and utility-scale solar energy systems, rather than residential systems. PPAs are used extensively in North Carolina, which has a strong utility-scale solar energy market but a weak residential solar energy market, partially because of its prohibition of third-party sales.

Property Assessed Clean Energy (PACE) financing is another mechanism for eliminating 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. By financing the costs of the installations with municipal bonds – which typically come with much lower interest rates than other types of credit – cities and towns can also reduce the overall cost of solar energy to their residents. 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.

While many states have adopted legislation enabling local governments to create PACE financing programs, the implementation of residential PACE programs was brought to a halt in 2010 when mortgage finance giants Fannie Mae and Freddie Mac raised objections. Commercial PACE programs do not face similar constraints. In some states, owners of multifamily residential buildings may apply for commercial PACE financing.[135]

An alternative to PACE financing – called *on-bill financing* – allows consumers to pay for solar energy installations over time on their utility bills. In 2013, the Hawaii Legislature adopted a measure that enables on-bill financing for solar energy and other forms of clean energy technology.[136] New York lawmakers also authorized on-bill financing for residents in Long Island, and the state is working to revise its well established on-bill

financing program for energy efficiency improvements to include residential solar power projects.[137] The California PUC has authorized the continuation of its existing utility-run on-bill financing programs, in addition to introducing new pilot programs for commercial and residential on-bill repayment for the state's three investor owned-utilities.[138]

In contrast to on-bill financing programs, which use ratepayer, utility shareholder or public funds, *on-bill repayment* programs use private capital from third-party companies.[139] In these programs, customers repay these third-party loans on their utility bills. In February 2014, Connecticut introduced an on-bill repayment program for solar energy projects, and in May, lawmakers in Minnesota approved on-bill repayment for solar energy projects for electric and gas utility customers.[140]

Finally, *virtual net metering* and other policies to enable shared, community solar projects open the door for individuals to band together with their friends and neighbors to develop "solar gardens" or other solar energy installations, the benefits of which are shared among the sponsors. These policies enable even those who are unable to install solar panels on their own properties to "go solar." In 2013, Minnesota, New Hampshire and Washington D.C., joined nine other states that have some form of a virtual net metering policy.[141] Pending legislation in Massachusetts would replace virtual net-metering for some larger projects with a MW block incentive program.[142]

Lead-by-Example

Government agencies have a special role in fostering the growth of solar energy. First, they have a responsibility to model environmentally responsible behavior and to take leadership in the adoption of technologies that benefit society. In addition, many government buildings – from schools to libraries to government offices – are excellent candidates for solar energy.

Unfortunately, many incentives that are used to encourage the adoption of solar energy in the private sector – such as tax credits – are unavailable to governments and non-profit entities. To exert solar leadership, therefore, state governments must be fully committed to integrating clean energy into new and renovated buildings.

There are many ways in which government agencies have set a strong example in the development of solar energy. Some governments have established revolving loan programs that supply upfront capital for agencies that wish to go solar, or programs that pay for the upfront cost of solar equipment with payback in the form of energy savings over time. In other cases, governments have used money from public benefits funds (which are supported by small levies on consumers' electric bills) or revenues from carbon cap-and-trade systems to support public-sector installations of solar power.[143]

Several states have made a sustained commitment to the integration of clean energy technologies by setting standards for energy consumption in state buildings. In some cases, states have adopted specific goals or targets for the reduction of fossil fuel and electricity consumption in government buildings. In other cases, states have required that solar energy and other clean energy technologies be considered in any new state building project or major renovation, and that it be employed if it meets certain cost and performance thresholds.

This latter type of lead-by-example commitment has been adopted by a majority of states in the Top 10, but fewer other states. In addition, several states in the Top 10 have either established specific rebate or incentive strategies or other efforts to reduce barriers to solar energy for local government agencies (such as schools) or have designed their solar markets in ways (such as the allowance of third-party PPAs) that enable public-sector entities to benefit from some of the incentives available to the private sector.

Conclusion

The Top 10 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.

There is no reason why other states cannot follow the path established by the Top 10 states to create vigorous markets for solar energy in their own states – reaping the benefits in cleaner air, reduced dependence on fossil fuels, and a more vigorous local economy. The following section lays out a series of recommendations that local, state and federal governments can follow to achieve – and ultimately build upon – the success of the Top 10 solar states.

Recommendations: Building a Solar Future

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. 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.[144] The Vote Solar Initiative has laid out a series of best practices that local governments can follow in ensuring that their permitting process is solar-friendly.[145] Local governments can also ensure that their zoning regulations are clear and unambiguous in allowing solar energy installations on residential and commercial rooftops. In January, the North Carolina Solar Center and the North Carolina Sustainable Energy Association 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 would otherwise be a barrier to entry.[146]

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 programs, in which cities purchase solar PV installations in bulk for homes and businesses, can also help reduce the cost of going solar. 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. Two California towns – Lancaster and Sebastopol – have adopted requirements that newly built and renovated homes and commercial buildings incorporate solar energy.[147]

Cities with municipal utilities have even greater potential to encourage solar energy. The establishment of local renewable electricity standards, strong net metering and interconnection policies, and other pro-solar policies can help fuel the rapid spread of solar energy in the territories of municipal utilities.

State Government

State governments should set ambitious targets for the growth of solar energy that guide public decision-making. For many states, a goal of getting 10 percent of their energy from the sun – both through solar electricity technologies such as photovoltaic systems and through solar thermal technologies such as solar water heating – would set an ambitious standard and make a major difference in reducing the state's dependence on fossil fuels well into the future.

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 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 sell their excess power back to the electric grid and receive a fair price when they do. In states without strong net metering programs, CLEAN contracts (also known as feed-in tariffs) and value-of-solar payments can play an important role in ensuring that consumers receive a fair price for solar energy, so long as the payments fully account for the benefits of solar energy and are sufficient to spur participation in the market.

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 renewable energy technologies such as solar power in their PPA options for generators as well as their own resource investment decisions. In addition, as solar power comes to supply an increasing share of the nation's energy supply, 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.

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:

- **Continue policies that work** – The federal government has often taken an "on-again/off-again" approach to its support of renewable energy. With a key financial incentive for solar energy – federal tax credits for residential and business solar installations – now scheduled to expire at the end of 2016, the federal government should consider extending these tax credits to encourage the development of solar energy markets nationwide.

- **Use regulatory powers wisely** – The federal government has a great deal of influence over the development of solar energy, both through 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 also ensure that solar energy can be delivered to electricity consumers in ways that are efficient and fair.

- **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 fuel systems. 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 continuing to investigate how to best 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.

- **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 within the next seven years.[148] 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. The military has already installed more than 130 megawatts of solar energy capacity and has plans to install more than a gigawatt of solar energy by 2017.[149] 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 Adoption in the States*

State	Cumulative Solar Electricity Capacity per Capita 2013 (Watts/person)	Rank	Solar Electricity Capacity Installed During 2013 per Capita (Watts/person)	Rank	Cumulative Solar Electricity Capacity (MW)	Rank	Solar Electricity Capacity Installed During 2013 (MW)	Rank
Arizona	274.8	1	109	1	1,821	2	724	2
California	147.7	4	72	3	5,661	1	2,760	1
Colorado	62.8	9	12	11	331	8	61	10
Connecticut	20.6	13	10	12	74	18	37	15
D.C.	7.6	23	3	20	7	28	2	29
Delaware	82.0	7	14	10	53	21	9	23
Florida	10.9	19	1	26	213	12	27	17
Georgia	11.6	17	9	13	116	15	91	7
Hawaii	242.9	2	107	2	341	7	150	6
Illinois	3.7	25	0	31	48	22	2	31
Indiana	8.2	20	8	14	54	20	54	11
Maryland	24.0	12	6	15	142	14	33	16
Massachusetts	66.0	8	37	4	442	6	244	4
Minnesota	2.6	28	3	21	14	27	14	21
Missouri	5.8	24	4	16	35	23	25	18
Nevada	161.3	3	17	9	450	5	47	12
New Hampshire	1.5	29	2	25	2	31	2	30
New Jersey	136.1	5	27	6	1,211	3	240	5
New Mexico	113.2	6	22	7	236	10	46	13
New York	12.7	16	4	17	250	9	75	8
North Carolina	56.6	10	33	5	557	4	328	3
Ohio	7.6	21	2	23	88	16	21	20
Oregon	19.3	14	2	24	76	17	7	25
Pennsylvania	18.4	15	3	19	235	11	39	14
Tennessee	10.9	18	3	18	71	19	22	19
Texas	7.6	22	2	22	201	13	62	9
Utah	1.0	30	1	28	3	30	3	27
Vermont	51.1	11	17	8	32	24	11	22
Virginia	0.7	31	1	29	6	29	6	26
Washington	3.4	26	1	27	24	25	8	24
Wisconsin	3.0	27	0	30	17	26	3	28

*Year-end 2013 data courtesy of the Solar Energy Industries Association (SEIA). SEIA actively monitors solar power in 30 states and Washington, D.C. States for which SEIA has no data have been excluded from this table.

Appendix B: Solar Energy Policies

State	Strong net metering policies	Strong inter-connection policies	Solar rights	CLEAN contracts or other solar rates	Renewables and Alternative Portfolio Standards	Solar (or distributed) carve-out	Rebates or grants	Tax credits	Virtual net metering for community solar	Third-party PPAs	PACE financing	Public buildings
Alabama												
Alaska							■					
Arizona	■		■		■	■		■		■		■
Arkansas	■										■	
California	■	■	■	■	■		■		■	■	■	■
Colorado	■	■	■		■	■			■	■	■	■
Connecticut	■	■			■		■		■	■	■	
D.C.	■	■			■	■	■		■	■	■	
Delaware	■	■	■		■	■	■		■	■		■
Florida	■		■					C			■	■
Georgia								■			■	
Hawaii	■	■	■	■	■			■		■	■	■
Idaho												
Illinois	■	■	■		■	■	■			■	■	
Indiana	■	■	■									
Iowa	■	■			■			■				
Kansas	■				■							
Kentucky	■							■				
Louisiana			■					R			■	
Maine	■	■	■		■		■		■	■	■	
Maryland	■	■	■		■	■	■	■	■	■	■	■
Massachusetts	■	■	■		■	■	■	R	■	■	■	■
Michigan	■				■					■	■	

Continued on page 41

Continued from page 40

State	Strong net metering policies	Strong inter-connection policies	Solar rights	CLEAN contracts or other solar rates	Renewables and Alternative Portfolio Standards	Solar (or distributed) carve-out	Rebates or grants	Tax credits	Virtual net metering for community solar	Third-party PPAs	PACE financing	Public buildings
Minnesota	■			■	■				■		■	■
Mississippi												
Missouri	■		■		■	■					■	■
Montana					■			■				
Nebraska	■							■				
Nevada	■	■	■		■	■	■			■	■	
New Hampshire	■				■	■	■		■	■	■	
New Jersey	■	■	■		■	■				■	■	
New Mexico	■	■	■		■	■		■		■	■	
New York	■	■			■		■	R		■	■	
North Carolina		■	■		■	■		■			■	
North Dakota								C				
Ohio	■	■			■	■				■	■	
Oklahoma								C			■	
Oregon	■	■	■	■	■	■	■	R		■	■	■
Pennsylvania	■	■			■	■	■			■		
Rhode Island	■	■		■	■		■		■	■	■	
South Carolina								■				
South Dakota												
Tennessee												
Texas			■		■					■	■	■
Utah	■	■						■		■	■	
Vermont	■	■	■	■			■	C	■	■	■	
Virginia		■	■								■	
Washington	■	■	■	■	■					■		■
West Virginia	■	■	■									
Wisconsin			■		■		■				■	
Wyoming	■										■	

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: Statewide net metering policies obtaining an "A" or "B" grade in 2013 *Freeing the Grid* report. (Justin Barnes, et al., Interstate Renewable Energy Council and The Vote Solar Initiative, *Freeing the Grid 2013: Best Practices in State Net Metering Policies and Interconnection Procedures*, November 2013.)

Strong interconnection policies: Statewide interconnection policies obtaining an "A" or "B" grade in 2013 *Freeing the Grid* report. (Justin Barnes, et al., Interstate Renewable Energy Council and The Vote Solar Initiative, *Freeing the Grid 2013: Best Practices in State Net Metering Policies and Interconnection Procedures*, November 2013.)

Solar rights: Presence of a solar rights policy according to DSIRE Solar. (U.S. Department of Energy, Interstate Renewable Energy Council and North Carolina Solar Center, *DSIRE Solar: State Solar Access Laws,* May 2013.)

CLEAN contracts or other solar rates: Presence of a CLEAN contracts/feed-in tariffs policy, or value-of-solar rates policy, according to DSIRE Solar. (Based on a review of each state's detailed entries in the DSIRE Solar database.)

Renewable electricity standard: Presence of a mandatory RES according to DSIRE Solar. (Based on a review of each state's detailed entries in the DSIRE Solar database.)

Solar carve-out: Center for Climate and Energy Solutions, *Detailed Table of State Policies* (PDF), accessed at www.c2es.org/us-states-regions/policy-maps/renewable-energy-standards, 22 April 2014. Does not include RESs with credit multipliers but no mandatory solar or distributed generation target. We did not give credit to New York, Connecticut, or other states with renewable energy carve-outs that can be met without solar power or distributed generation.

Rebates or grants: Presence of a statewide rebate or grant program directed toward solar PV according to DSIRE Solar. (Based on a review of each state's detailed entries in the DSIRE Solar database.)

Tax credits: Presence of a residential or commercial tax credit policy according to DSIRE Solar. Blue shading indicates the presence of both residential and commercial tax credits; states with one tax credit are indicated in gray shading with an "R" or "C." (Based on a review of each state's detailed entries in the DSIRE Solar database.)

Virtual net metering for community solar: Includes all net metering policies that allow meter aggregation (including those that apply only to municipal governments). States with virtual net metering based on data through February 2014 from Institute for Local Self-Reliance, *Virtual Net Metering*, accessed at www.ilsr.org/virtual-net-metering, 22 April 2014. Delaware added to the list of states permitting community solar based on consultation of DSIRE Solar database. Washington, D.C. was added to this list based on its adoption of virtual net metering policies (Jeff Spross, "Washington D.C. Just Massively Expanded Its Residents' Ability to Participate in Solar Power," *ThinkProgress.org,* 3 October 2013). Illinois excluded as utilities are permitted, but not required, to allow virtual net metering.

Third-party PPAs: States in which third-party power purchase agreements are legal, according to DSIRE Solar. (U.S. Department of Energy, Interstate Renewable Energy Council and North Carolina Solar Center, *DSIRE Solar: 3rd Party Solar PV Power Purchase Agreements (PPAs),* February 2013.) For states where the DSRIRE database lists the legal status of third-party PPAs as "unknown," we called the public service or public utilities commission to obtain verbal confirmation of the legal status of PPAs. In Maine, there are no legal barriers preventing PPAs; any entity that

produces electricity (including solar energy companies) may sell power to the public as long as they are licensed to do so by the state.[150] In Washington, regulators recently issued a policy decision that allowed net metered customers to participate in power purchase agreements with solar energy companies. See Washington Utilities and Transportation Commission, *In the Matter of Amending and Repealing Rules in WAC 480-108 Relating to Electric Companies-Interconnection Interconnection with Electric Generators, Docket UE-112133, General Order R-571,* 18 July 2013.

PACE financing: Center for Climate and Energy Solutions, *Property Assessed Clean Energy* (map), accessed at www.c2es.org/us-states-regions/policy-maps/property-assessed-clean-energy, 22 April 2014.

Lead-by-example: States were included that had efficiency or green building standards for public buildings according to DSIRE Solar. 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.

Notes

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