Lighting The Way

The Top States that Helped Drive America's Solar Energy Boom in 2014

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Executive Summary

Solar energy is booming. In just the last three years, America's solar photovoltaic capacity tripled. In 2014, a third of the United States' new installed electric capacity came from solar power. And in three states – California, Hawaii, and Arizona – solar power now generates more than 5 percent of total electricity consumption.

With the cost of solar energy declining rapidly, tens of thousands more Americans each year are experiencing 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 continues to be led by a small group of 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 86 percent of the nation's total installed solar electricity capacity.* These 10 states – Arizona, California, Colorado, Hawaii, Massachusetts, Nevada, New Jersey, New Mexico, North Carolina, and Vermont – possess strong

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

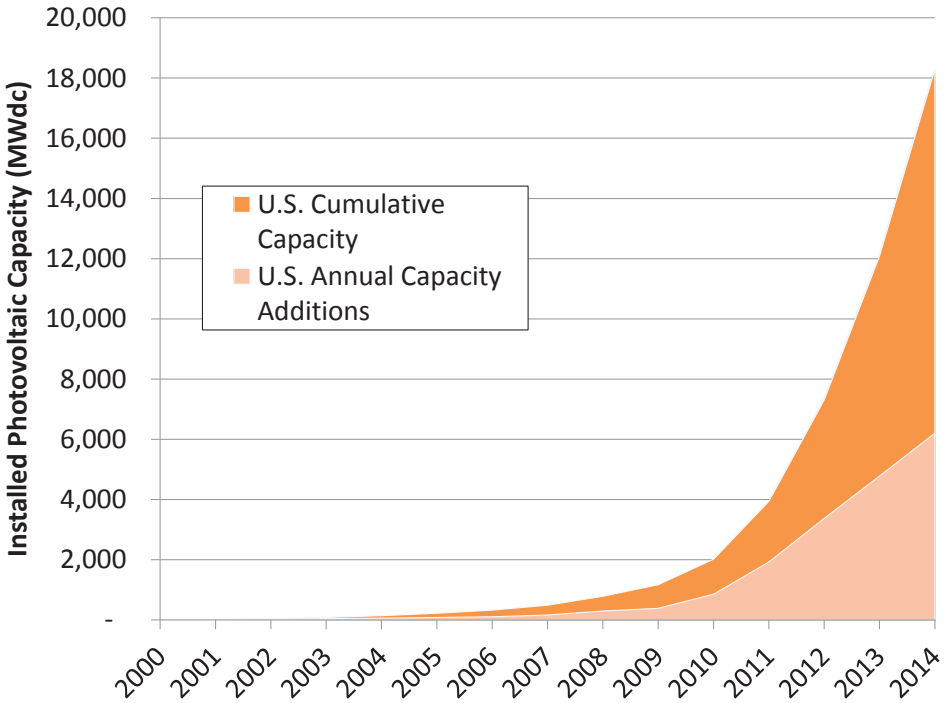
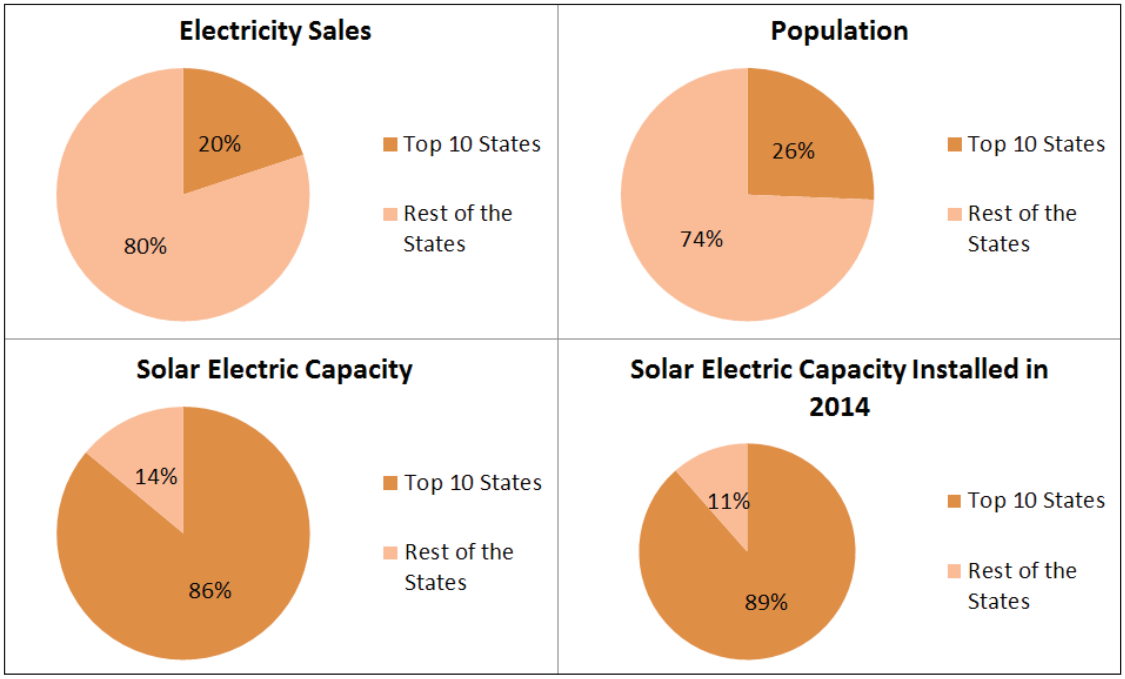


Figure ES-2. Solar Energy in the Top 10 Solar States versus the Rest of the U.S.



policies that are enabling increasing numbers of homeowners, businesses, communities and utilities to "go solar."

The continued success of solar power in these and other states has been threatened, however, 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.

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 on the rise – especially in states that have adopted strong public policies to encourage solar power. In 2014:

- Hawaii surpassed Arizona to become the state with the most cumulative solar capacity per capita. In 2015, Hawaii signaled its intention to continue its solar energy leadership by passing America's first 100 percent renewable electricity standard.
- Nevada and California added the most solar capacity per capita. Nevada's solar growth reflects a booming solar industry, with more solar jobs per capita than any other state, while California added more total solar capacity in 2014 than all other states combined.
- Arizona slipped from first in 2013 to eighth in 2014 for installations of new solar energy 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.

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	Rank	Cumulative Solar Electricity Capacity per Capita 2014 (watts/person)	Solar Electricity Capacity Installed During 2014 per Capita (watts/person)	Cumulative Solar Electricity Capacity (MW)
Hawaii	1	312	72	443
Arizona	2	307	37	2,067
Nevada	3	278	119	789
California	4	257	111	9,977
New Jersey	5	162	27	1,451
New Mexico	6	155	42	324
Vermont	7	112	61	70
Massachusetts	8	111	46	750
North Carolina	9	96	40	954
Colorado	10	74	13	398

per capita, as new fees levied on solar customers in much of the state dampened demand for solar energy.

- Vermont joined the Top 10 after 100 percent of its new electric generating capacity in 2014 came from solar energy.
- New York and Texas are among the Top 10 states for total solar energy capacity, though not for capacity per capita. New York has seen dramatic solar energy growth as a result of strong policy support from state leaders. Texas has benefited from local solar energy policies in cities such as Austin and San Antonio, despite poor policy support at the state level.

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 "carve-outs" that set specific targets for solar or other forms of clean, distributed electricity.
- Nine allow for creative financing options such as third-party power purchase agreements, and nine 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.
- Within three days of each other in June 2015, two Top 10 states passed the strongest renewable electricity standards in the country: Hawaii passed the nation's first 100 percent renewable electricity standard, and Vermont passed a 75 percent renewable electricity standard with the nation's strongest solar carve-out.

Strong public policies at every level of government can help unlock America's potential for clean solar energy, while helping states comply with the Environmental Protection Agency's Clean Power Plan. To achieve America's full solar potential:

- Local governments should implement financing programs such as property-assessed clean energy (PACE) and on-bill 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." Local governments should also pass solar access ordinances to ensure homeowners' right to generate electricity from the sunlight that hits their property. Municipally owned utilities should promote solar energy through rate design (including rate structures that have a higher ratio of per-kilowatt-hour to per-customer charges), by providing net metering or fair value-of-solar rates, and through investments in community-scale and utility-scale solar projects.
- State governments should set ambitious goals for solar energy and adopt policies – including 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. Finally, state governments should adopt policies guaranteeing homeowners and businesses the right to use or sell power from the sunlight that strikes their properties, and should allow third party ownership agreements.
- 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 where it is feasible to do so.

Introduction

Solar energy is booming. Since 2010, America's solar energy capacity has grown more than seven-fold.[1] While solar energy has barely begun to reach its almost endless potential, it is already bringing transformative changes to our economy, along with cleaner air, a growing job market, and benefits for consumers.

These benefits are adding up quickly. In 2014, American solar energy:

- Offset 27.5 million metric tons of carbon dioxide pollution, equivalent to taking nearly 6 million vehicles off the road for a year, by reducing the need for electricity generated by burning fossil fuels.[2] In addition to reducing carbon dioxide emissions, the leading cause of global warming, solar energy also contributed to the reduction of emissions of toxic mercury and smog-forming nitrogen oxides.[3]
- Supported an industry that employed 173,000 Americans, and saw investments of nearly $18 billion.[4] Today, the solar industry is creating jobs nearly 20 times faster than the overall U.S. economy.[5]
- Benefitted consumers and business-owners, including the owners of 1.2 GW of new residential solar PV installations and 1 GW of new small commercial PV installations.[6] Owners of distributed solar energy systems are insulated from the volatile prices of fossil fuels such as natural gas, and deliver benefits to all electricity consumers through the reduced need for expensive electric grid infrastructure.[7]

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

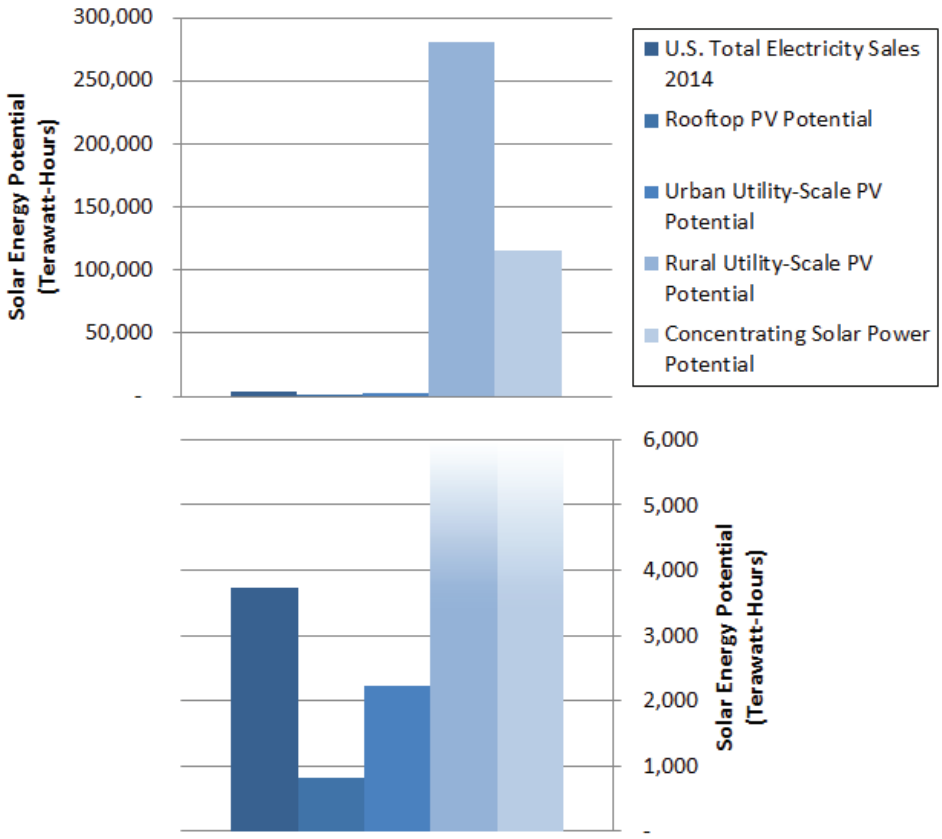
This report is our third annual analysis of solar energy adoption in the states and the links between solar energy growth and public policy. The benefits of solar energy for America's environment, economy, and consumers have become clear. By understanding the keys to the growth of solar energy, other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

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 (NREL) estimated that rooftop photovoltaic systems could generate more than 20 percent of the electricity used in the United States each year.[8] The potential for utility-scale photovoltaics in rural areas is even greater – representing 75 times 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

Figure 1. Solar Electricity Generating Technical Potential (top and bottom charts present same data at different scales)[9]



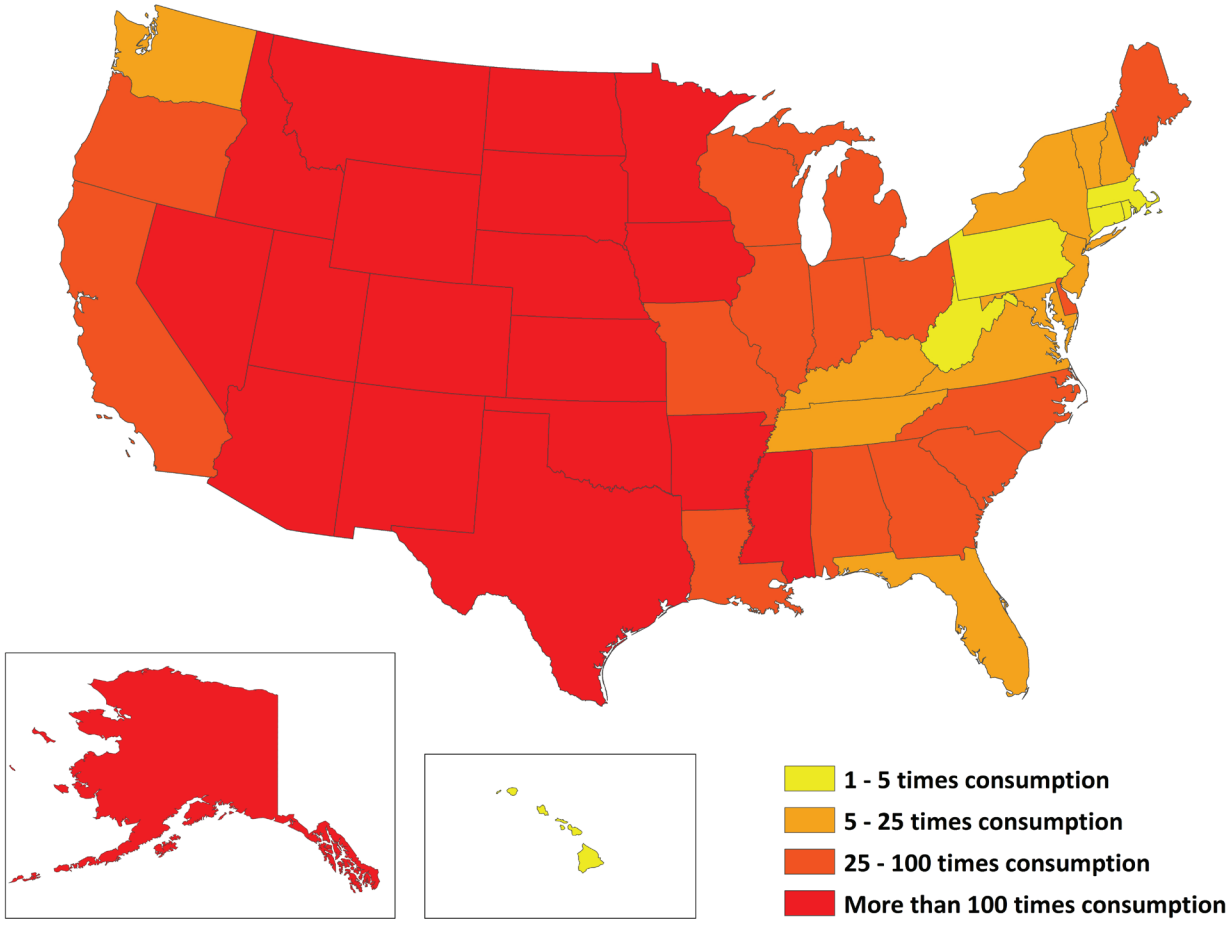
electricity from the sun than it uses in an average year. In 19 states, the technical potential for electricity generation from solar photovoltaics exceeds annual electricity consumption by a factor of 100 or more. (See Figure 2.)

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 electricity 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.[11] In several western states – California, Arizona, Nevada and Colorado – the share of electricity that could technically be generated by rooftop solar power exceeds 30 percent.[12]

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.

Figure 2. Solar PV Technical Potential versus Annual Electricity Consumption by State[10]



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. Data supplied by the Solar Energy Industries Association (SEIA) shows that 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.

The Promise of Solar Energy Has Arrived

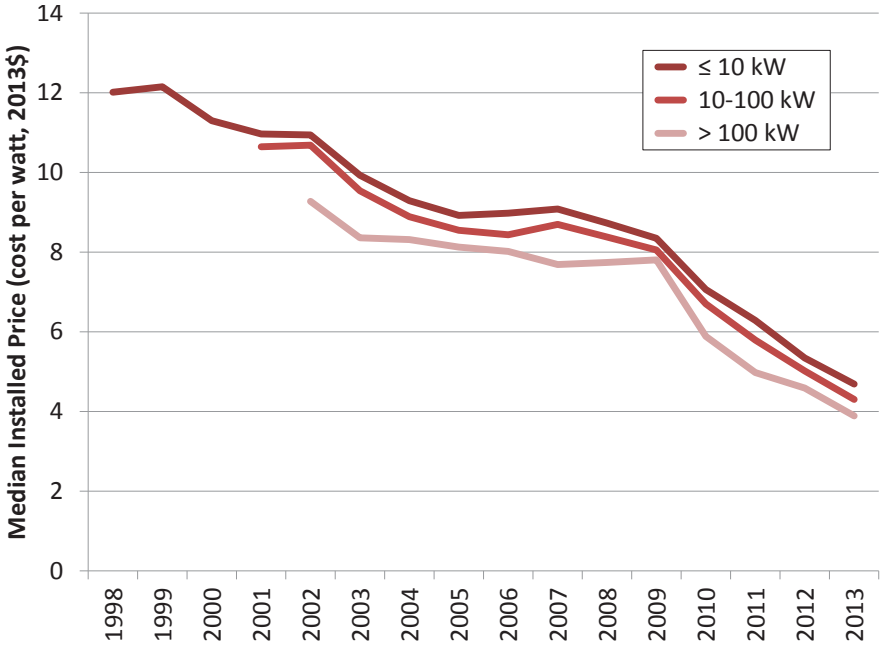
Solar energy has evolved from a novelty – one sure to attract interest from passers-by and questions from neighbors – into a mainstream source of energy.

That evolution has been made possible by innovations that have taken place throughout the solar energy industry. Decades of research have 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.[13] 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 average cost of solar energy has plummeted in recent years and continues to fall. For non-utility solar energy systems of between 10 and 100 kW, the price per watt of installed systems fell by 14 percent from 2012 to 2013, and by more than 50 percent from 2007 to 2013.[14] (See Figure 3.) And from 2010 to 2013, the cost of generating utility-scale solar electricity dropped dramatically, from 21.4 to 11.2 cents per kilowatt-hour.[15]

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 expenses related to permitting and interconnection.[17]

Figure 3. Median Installed Price of Residential and Commercial Solar Photovoltaic Systems by Size[16]

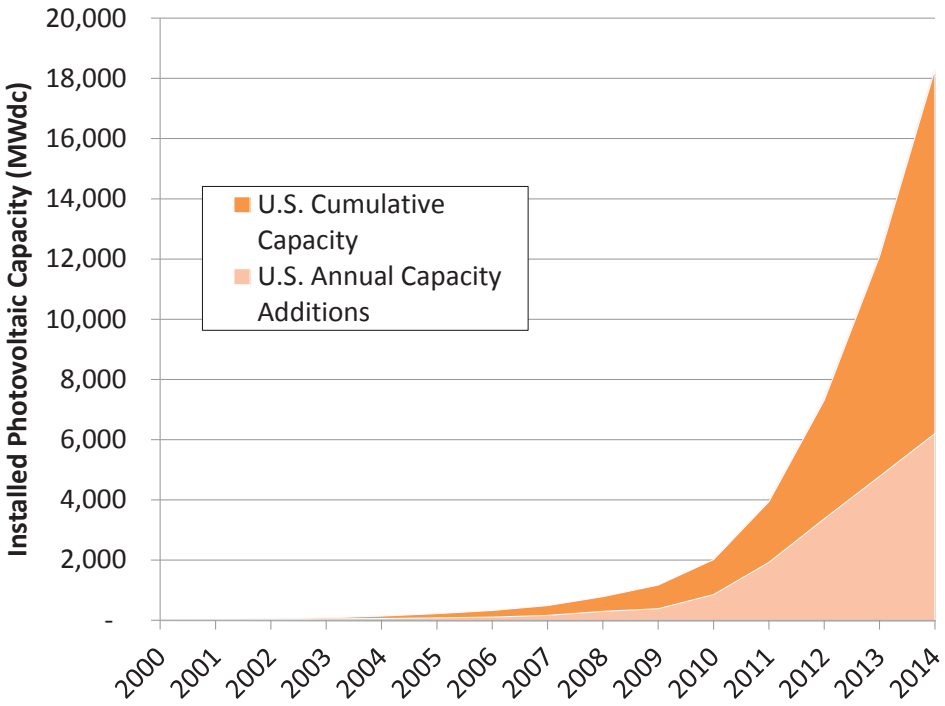


While there are still opportunities to reduce the cost of solar panels, the greatest savings can be achieved by reducing "soft costs" – costs such as those associated with attracting customers, installing the systems, completing paperwork, and paying taxes and fees.[18] The U.S. Department of Energy's SunShot Initiative is working to reduce soft costs as part of its goal to bring solar energy's cost down to $0.06 per kWh by 2020.[19]

America's Solar Energy Capacity Tripled in Three Years

In the last three years, America's solar photovoltaic capacity tripled – and over the course of the last decade, solar photovoltaic capacity increased 130-fold, from 141 megawatts in 2004 to 18.3 gigawatts in 2014.[20] In 2014 alone, the United States installed 6,201 MWdc of solar PV capacity – more than the nation had installed in its entire history up to 2011.[21] (See Figure 4.)

Figure 4. Annual and Cumulative Installed Photovoltaic Capacity, United States[24]



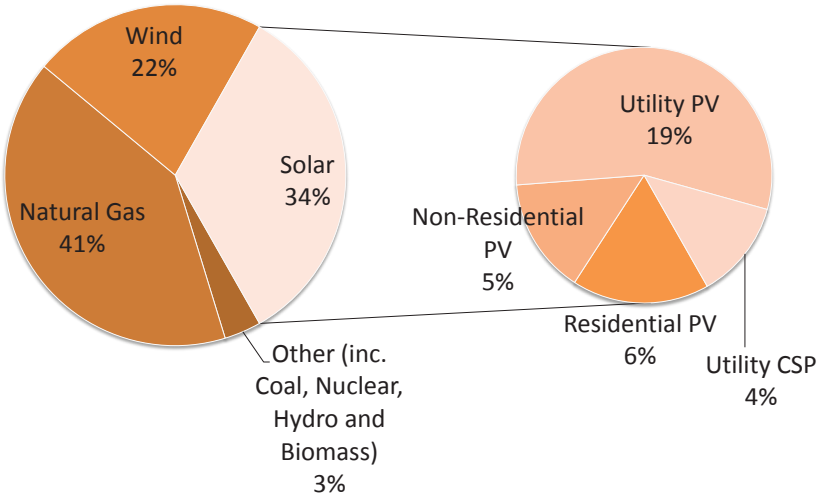
Quantifying Solar Energy Capacity

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 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.

Figure 5. Solar Energy Accounted for a Third of New U.S. Electric Capacity in 2014[25]



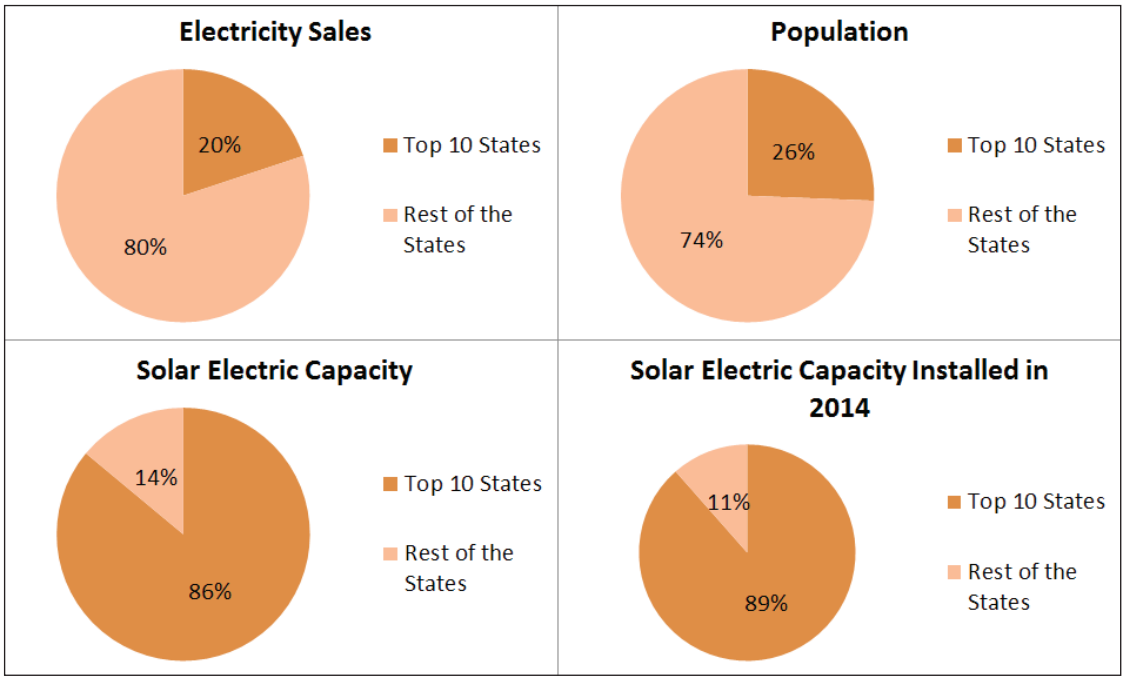
Solar power now accounts for a sizable share of the American energy market. In three states – California, Hawaii, and Arizona – solar power now generates more than 5 percent of total state electricity consumption.[22] In 2014, solar energy (including from concentrated solar power) accounted for a third of the United States' newly installed electric generating capacity.[23] (See Figure 5.)

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 energy is seeing tremendous growth in many states across the country. But, the vast majority of

Figure 6. Solar Energy in the Top 10 Solar States versus the Rest of the U.S.



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 12.) Most of these states also led the nation in new capacity additions in 2014, indicating their sustained commitment to solar energy.

These 10 states account for:

- 26 percent of the U.S. population,[26]
- 20 percent of U.S. electricity consumption,[27]
- 86 percent of U.S. solar electric capacity, and[28]
- 89 percent of U.S. solar electric capacity installed in 2014.[29]

Table 1. Cumulative Solar Electricity Capacity per Capita

2014 Rank	State	Cumulative Solar Electricity Capacity per Capita 2014 (watts/person)	2013 Rank	2012 Rank
1	Hawaii	312	2	3
2	Arizona	307	1	1
3	Nevada	278	3	2
4	California	257	4	6
5	New Jersey	162	5	4
6	New Mexico	155	6	5
7	Vermont	112	11	9
8	Massachusetts	111	8	10
9	North Carolina	96	10	11
10	Colorado	74	9	8

Solar Electricity Capacity per Capita

Hawaii leads the nation in solar electricity capacity per capita, with 312 watts of solar electricity capacity per resident.[30] That is more than seven times as much solar electricity capacity per person as the national average.[31] Hawaii's solar success is due to high prices of grid electricity, abundant levels of sunlight, and state leaders' ongoing commitment to renewable energy. In 2015, Hawaii became the first state to create a 100 percent renewable electricity standard. (See "Vermont and Hawaii Pass the Next Generation of Renewable Electricity Standards" on page 26.) Hawaii's jump from number two in the rankings last year is due in part to the construction of Hawaii's largest solar farm. The Grove Farm solar PV plant on Kauai has a 12 MW capacity, and will generate 5.5 percent of Kauai's annual electricity use.[32]

Hawaii has overtaken Arizona as the number one state for solar capacity per capita. Arizona's fall from its perch as the nation's leading state for per-capita solar energy comes after years of attacks against solar energy by state utilities, and the creation of new fees for Arizona solar customers. While Arizona still ranks second in cumulative solar electric capacity per capita, Arizona slipped from first to eighth in terms of solar capacity *added* per capita during 2014. (See Table 2.)

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 Vermont) 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. (See Table 1.)

Table 2. Solar Photovoltaic Capacity Installed During 2013 per Capita

Rank	State	Solar Electricity Capacity Installed During 2014 per Capita (watts/person)
1	Nevada	119
2	California	111
3	Hawaii	72
4	Vermont	61
5	Massachusetts	46
6	New Mexico	42
7	North Carolina	40
8	Arizona	37
9	New Jersey	27
10	Connecticut	13

In 2014, Vermont joined the Top 10 (replacing Delaware, which now ranks 11th) for solar capacity per capita after 100 percent of the state's new electrical capacity came from solar energy in 2014.[33]

Nevada and California led the list for solar capacity added per capita in 2014 with more than 100 watts per person installed during 2014, with Hawaii, Vermont and Massachusetts rounding out the top five for new solar capacity per capita. (See Table 2.)

Nevada's solar energy growth reflects a booming state solar industry. Nevada has more solar jobs per capita than any other state, and its 2014 solar capacity was boosted by the completion of the 110 MW Crescent Dunes Solar Energy Project.[34]

Arizona Takes a Step Back from Solar Leadership

Arizona solar capacity additions dropped sharply in 2014, with just 37 MW of solar capacity added, compared to 109 MW in 2013. Arizona's drop in solar capacity additions came following the imposition of new fees on solar customers, and near-constant attacks on distributed solar generation from the state's biggest utilities.

In February 2015, Arizona's Salt River Project utility approved a new demand charge of about $50 per month for new solar customers, which, according to solar company SolarCity, resulted in applications for rooftop solar energy falling by 96 percent.[35] In November 2013, the Arizona Corporation Commission (which regulates Arizona utilities) voted to allow Arizona Public Service, the state's biggest utility, to charge a monthly fee of $0.70/kW for new residential solar customers.[36] Today, APS is asking the ACC for permission to quadruple that fee, which would amount to an average charge of $21 per month for the typical new solar customer.[37] Also in Arizona, Tucson Electric Power has asked the ACC to reduce the net metering reimbursement for its solar customers.[38] Arizona also saw fewer utility-scale solar projects placed into service in 2014 than in 2013.[39]

As a result of its slowing solar energy growth, Arizona dropped from first to eighth in terms of per capita solar capacity additions from 2013 to 2014, and from first to second in terms of per capita cumulative solar capacity. If APS is successful in its attempt to further expand fees for its solar customers, Arizona may see growth in solar energy continue to slacken.

Total Solar Electricity Capacity

In terms of total solar electricity capacity through 2014, California led the nation with nearly 10 gigawatts – more than half of the nation's total, and nearly double its year-end capacity from 2013. Arizona, New Jersey, North Carolina and Nevada round out the top five. (See Table 3.)

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 Texas; both appear in the Top 10 for total solar capacity, but fall out of the Top 10 for per-capita solar capacity because of their large populations. (See: "New York and Texas Are Among Leaders for Total Solar Capacity.") In contrast, Vermont and New Mexico appear in the Top 10 for per capita solar capacity, but do not crack the Top 10 for total solar electricity capacity.

Table 3. Top 10 States for Cumulative Solar Electric Capacity Through 2014

Rank	State	Cumulative Solar Electricity Capacity (MW)
1	California	9,977
2	Arizona	2,067
3	New Jersey	1,451
4	North Carolina	954
5	Nevada	789
6	Massachusetts	750
7	Hawaii	443
8	Colorado	398
9	New York	397
10	Texas	330

Minnesota Solar Energy Gets Boost from Solar Carve-Out and Community Solar Garden Policies

Minnesota is not currently in the Top 10 of solar states, but it may be on the way. Recently passed legislation should help Minnesota take advantage of its potential to generate 160 times its annual electricity consumption with solar energy.

In 2013, Minnesota passed HF 729, sweeping solar legislation that created a suite of policies to boost solar energy, including a carve-out requiring 1.5 percent of electricity generation to come from solar energy, and a provision to allow virtual net metering and community solar gardens.

Since the passage of the law, Minnesota has seen a flurry of new solar energy activity.

The law's community solar garden provision created a brand new segment for Minnesota's solar market.[52] On June 17, 2015, SolarCity announced plans to build 100 community solar gardens in Minnesota working with Sunrise Energy Ventures of Minnetonka.[53] That same week, Denver-based SunShare announced plans to sign up 5,000 Minnesotans for solar gardens by December 2015. And on June 29, 2015, the city of Cologne announced a plan to power all of its municipal buildings, plants and pumps with solar energy within the next two years.[54]

Minnesota's new solar carve-out also seems to have pushed forward utility solar plant plans. After the law's passage, Xcel Energy moved forward with plans to build three utility-scale solar energy plants, including one 100 MW-capacity plant, which will be the biggest solar energy plant in the Midwest.[55] The three new plants, which will fulfill Xcel's carve-out requirement, will boost Minnesota's solar energy production tenfold. [56]

Floridians Fight Back Against Restrictive Solar Policies

Florida, the "Sunshine State," has not lived up to its name when it comes to solar energy. Florida lacks a renewable electricity standard, and is one of the few states to explicitly bar individuals and business from entering into power purchase agreements with solar energy suppliers.[40] As a result, despite having the fifth most rooftop solar potential in the country, Florida ranks 23rd in installed solar capacity per capita.[41]

Florida's dearth of good solar policy has a lot to do with the state's utilities – Duke Energy, Gulf Power, Florida Power & Light, and Tampa Electric – which have spent a combined $12 million on campaigns for Florida lawmakers since 2010 as part of a coordinated effort to build legislative influence and to keep public officials hostile to solar energy in office.[42] Much of the money was spent to reelect Gov. Rick Scott – whose administration has overseen the dismantling of clean energy programs including solar installation rebates – in an election in which his opponent had pledged to institute a renewable electricity standard.[43]

Some efforts are under way to help Florida reach its solar potential. In January 2015, a diverse collection of organizations including the Libertarian Party of Florida, the Christian Coalition, and the Florida Solar Energy Industries Association formed the coalition Floridians for Solar Choice, with the goal of enabling more Florida homes and businesses to get their electricity from the sun.[44] The coalition is currently working to pass a ballot measure that would allow Floridians to install solar energy using third-party power purchase agreements.[45]

California led the way with the most solar photovoltaic capacity installed in 2014 by adding more than 4.3 gigawatts of solar electricity capacity – more than the cumulative solar capacity of any other state, and more than the capacity additions of all other states combined in 2014. North Carolina, Nevada, Massachusetts, and Arizona rounded out the list of the top five states for new solar energy capacity. (See Table 4.)

Table 4. Top 10 States for Solar Electricity Capacity Installed in 2014

Rank	State	Solar Electricity Capacity Installed During 2014 (MW)
1	California	4,316
2	North Carolina	397
3	Nevada	339
4	Massachusetts	308
5	Arizona	246
6	New Jersey	240
7	New York	147
8	Texas	129
9	Hawaii	102
10	New Mexico	88

New York and Texas Are Among Leaders for Total Solar Capacity

New York and Texas rank among the Top 10 states for total solar capacity but miss the Top 10 for solar capacity per capita. Both states have seen substantial solar growth in recent years, but for markedly different reasons.

In New York, state leaders have encouraged solar growth with a combination of market preparation policies (like strong net metering and interconnection policies) and new forward-looking market expansion policies that promise to drive solar growth in the years ahead. (See Appendix B.) In July 2015, New York adopted new rules allowing community net metering, expanding its previous net metering aggregation policy, which was only available to non-residential customers.[46] The new rule follows other recent moves to encourage solar energy, including a 10-year commitment to invest $1 billion in New York solar energy through a megawatt block program, with the goal of adding 3,000 MW of solar capacity.[47] New data suggests that New York is already on pace to leapfrog other states in the rankings for solar installations in 2015.[48]

Texas, on the other hand, has seen solar growth in spite of, not because of, state leadership. Texas lacks critical solar polices like statewide net metering, strong interconnection standards, or financial incentives. (See Appendix B.) Texas' solar growth has largely occurred in two cities – Austin and San Antonio – whose publicly owned utilities acted independently to boost solar installations by offering their own solar incentives. [49] The city of Austin has taken additional steps to encourage solar growth, including: a policy exempting solar panels from city zoning height limitations; the recent passage of a resolution to strengthen Austin's Value of Solar tariff, which will create an annual price floor for the tariff and will allow credits to roll over from year to year; and the recent creation of a goal for 700 MW of city energy to come from solar energy within the decade.[50] At the end of 2014, one third of Texas' total solar capacity was within the city limits of those two cities.[51] As a result of weak policy support, Texas ranks just 22nd for per capita cumulative solar energy, despite being one of America's biggest and sunniest states.

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 Vermont do not receive as much sunlight as states like Texas or Florida, but their solar energy markets are much more developed. High electricity prices are not necessarily a factor, either – five of the Top 10 states have retail electricity rates that are below the national average.[57] Instead, the most important determinant of a successful solar energy market is the degree to which state and local governments have recognized the benefits of solar energy and created a fertile public policy atmosphere for the development of the solar industry.

The presence of strong solar policies has been consistently linked with the emergence of strong solar energy markets. Of the 10 states with the most solar capacity per person, nine have strong net metering policies; nine have strong interconnection policies; nine have policies that allow creative financing options like power purchase agreements; and all have renewable electricity standards. A recent study by the U.S. Department of Energy's National Renewable Energy Laboratory confirmed that renewable portfolio standards, provisions for third-party ownership, and net metering and interconnection standards are important indicators of state solar capacity.[58]

Key Solar Energy Policies

NREL researchers have identified three types of public policies that help build strong markets for solar energy:[59]

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.
- *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.

- *Feed-in tariffs*, which can provide support for solar in states or localities where net metering policies are weak or do not exist.
- *Value-of-solar* rates can also play an important role in ensuring that consumers receive fair credit for solar energy, so long as their credits fully account for the value of solar energy.
- *Solar rights policies*, which override local ordinances or homeowners' association policies that bar citizens from installing solar energy equipment on their properties.

State utility regulators also develop and approve *utility rate structures* that have a major impact on the financial desirability of solar energy. For example, rate structures that have a higher ratio of per-kilowatt-hour to per-customer charges will tend to encourage solar energy by ensuring that customers receive the maximum benefit for reducing their consumption of electricity from the grid, especially during peak times.

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 represents about 3 percent of the cost of a residential solar energy system.[60] 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.[61] 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.[62] 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.

- *Virtual net metering* enables those who are unable to install solar panels on their own properties to "go solar" by entering into agreements to apply net metering credits to their electricity bill, even if they are not physically connected to the solar energy system.[63] *Aggregated net metering,* a similar but less flexible policy, allows a single utility customer (usually a commercial or government entity) to apply net metering credits to multiple buildings that it owns.
- **Lead-by-example policies** expand solar markets by requiring government agencies to consider or install solar energy on public buildings.

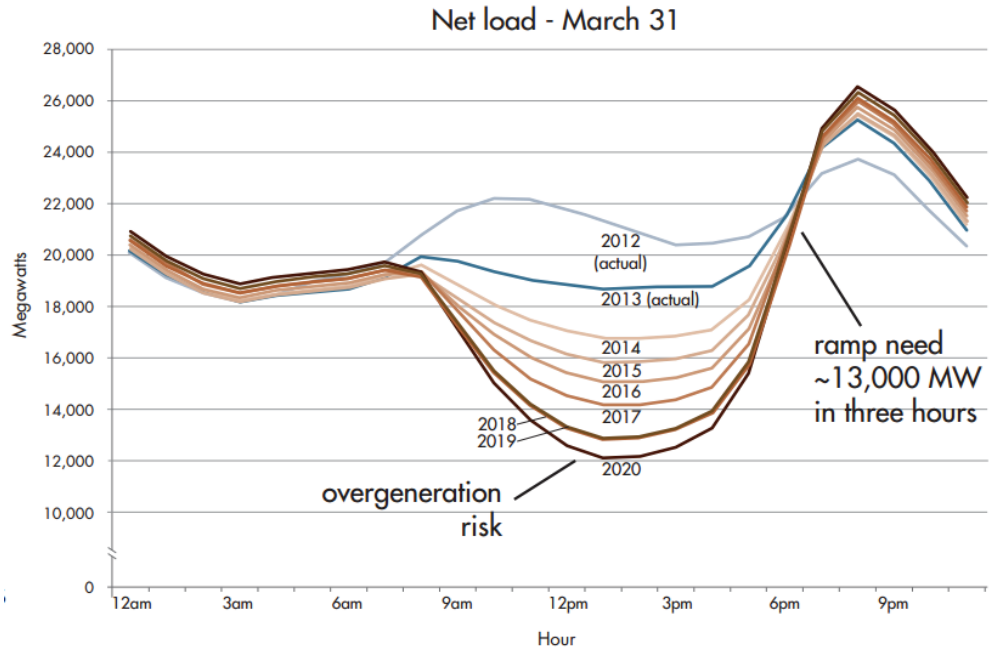
Federal policies – especially the 30 percent investment tax credit for solar photovoltaic installations on residential and commercial properties – have provided a strong foundation as the United States has expanded the market for solar energy over the past decade. Leading solar states build upon that foundation by adopting strong policies of their own in all three categories.[64] 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 order to keep the grid stable with increasing penetrations of solar energy, grid operators will need efficient and flexible power resources that can adapt to the variability of solar energy output. There are many solutions grid operators can employ as they integrate more renewable energy, including demand response and energy storage.[65] Energy storage technologies – including battery storage that has quickly improved thanks to the fast-emerging electric vehicle market – intelligently deployed throughout the electricity grid can both allow grid operators to tap into clean, renewable power anytime and deliver stabilizing benefits to the grid.

In California, where solar energy is growing quickly and where there is a renewable energy target of

Figure 7. A Chart by California's Grid Operator Illustrating the "Duck Curve"[68]



33 percent by 2020 (and a proposal by Gov. Jerry Brown to increase the goal to 50 percent), the state's major grid operator has warned that by 2020 daily patterns of electricity consumption could require a rapid ramp-up in power generation each evening after the sun sets.[66] The operator released a sample energy demand curve that illustrates this problem, which has been dubbed the "duck curve."[67] (See Figure 7.) Figure 7 illustrates that, by 2020, California's grid may need the capability to ramp up generation capacity by 13,000 MW in three hours as the sun sets and evening electricity use increases.

To help prevent an extreme version of this "duck curve," California has taken a step 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, with differing amounts of energy storage to be connected at the transmission, distribution, and customer levels.[69] And just as solar carve-outs boost solar energy investment, California's solar storage mandate is expected to spur investment (and technological progress) in both utility and residential-scale energy storage systems.[70] Today, California has a growing number of companies focused on energy storage and other solar integration systems, 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.[71]

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 by a coalition of organizations in a report and interactive website called Freeing the Grid.[72] As of June 2015, 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 provide net metering, does not protect customers from unanticipated fees, and in most cases requires customers to surrender all of the renewable energy credits earned from their systems to utilities. [73]

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.[74] However, utilities and fossil fuel interests seeking to slow the spread of solar energy have targeted net metering policies for rollback or repeal. (See "Utilities and Fossil Fuel Interests are Waging a National Campaign Against Solar Energy" on page 23.) 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.[75] 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.[76]

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.[77] 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."

Utilities and Fossil Fuel Interests are Waging a National Campaign Against Solar Energy

To companies that sell coal, oil and natural gas, solar energy represents an obvious long-term threat to the viability of their businesses. To electric utilities, solar energy – especially the solar energy systems installed by individuals and businesses – represents a different type of threat, one with much more immediate consequences. Many electric utilities fear that, as more individuals and businesses "go solar," utility costs will be divided among fewer paying customers. And as the price of energy storage technology declines, more customers will have the ability and the incentive to abandon the grid altogether, triggering a "utility death spiral."

Recent research from Lawrence Berkeley Lab suggests that concerns about the death spiral are probably overblown.[80] But, utilities and the fossil fuel industry have waged an expensive and coordinated effort to slow the growth of solar energy, particularly by pushing to reverse or block net metering policies, and by making changes to utility rate structures to make distributed generation less financially viable. Today, there are more than 20 ongoing net metering or rate structure proceedings that could inhibit the growth of solar energy.[81]

The anti-solar energy efforts are nationally coordinated by powerful industry organizations, using extensive utility and fossil fuel funding. The American Legislative Exchange Council, or ALEC, provides its utility and fossil fuel industry funders with convenient access to its more than 2,000 state legislator members, who have introduced upwards of 20 ALEC-inspired bills to repeal renewable electricity standards and restrict net metering. To craft its anti-RES bill, ALEC worked closely with the Edison Electric Institute, the trade group that represents all American investor-owned utilities. Meanwhile, David and Charles Koch, the Koch brothers, have provided extensive funding to anti-solar energy efforts, along with ground and media campaign support, through their grassroots organization Americans for Prosperity.

Efforts to reel in solar energy are wide ranging, taking place both in booming solar energy states, and in states where the solar energy industry is still in its early stages.

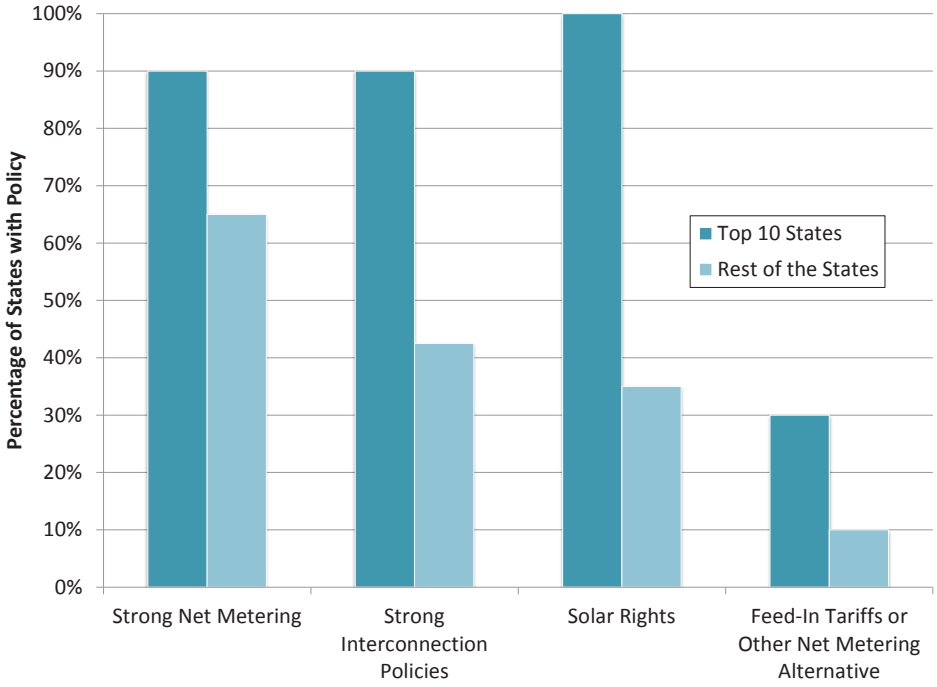
In Arizona, one of the first states to see a solar energy boom, solar energy growth is slipping as a result of utility attacks. (See "Arizona Takes a Step Back from Solar Leadership," page 15.)

In Wisconsin, where solar energy has not yet found a sizeable foothold, state utilities and outside fossil fuel interests are working to stop solar energy from taking off. The utility We Energies has submitted a near constant stream of proposals to limit net metering and to impose surcharges on solar owners. [82]

As solar energy takes off, utilities are taking a wide variety of approaches. Some utilities are trying to evolve to incorporate all solar energy into their business models; some utilities are investing heavily in utility-scale solar plants while actively fighting customer-sited solar energy; and some utilities are resistant to solar energy of any kind. [83] The utilities that do oppose solar expansion have joined an increasingly coordinated effort to destroy solar 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.

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.[78] In California, all publicly-owned and investor-owned utilities with more than 75,000 customers must make a standard feed-in-tariff available

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



Attacks on Net Metering Could Derail Colorado's Solar Energy Growth

Colorado has enormous potential for solar energy. Rooftop PV alone could power 30 percent of the state, and a combination of rooftop and utility scale PV could power Colorado nearly 200 times over. Yet while Colorado ranks in the Top 10 for solar capacity per capita, near-constant battles over the future of net metering and rate polices threaten to derail what should be a booming solar industry.

Xcel Energy, Colorado's dominant utility, has been asking the Colorado Public Utilities Commission since at least summer 2013 for permission to roll back net metering in its territory.[84] Colorado's largest electric cooperative, Intermountain Rural Electric Association (IREA), has also proposed a series of rate changes that would increase costs for solar panel owners.[85]

If Xcel and IREA move forward with plans to increase costs for solar panel owners, solar growth in their territories could slow. Already, their attacks on key solar policies are leaving some investors uncertain about the future value of solar installations.[86]

To maintain the state's momentum toward clean energy and tap its solar energy potential, Colorado decision-makers should keep in place important existing policies like net metering, and reject rate proposals that impose unfair costs on solar owners.

for small-scale systems less than 3 MW.[79] 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 8.)

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.

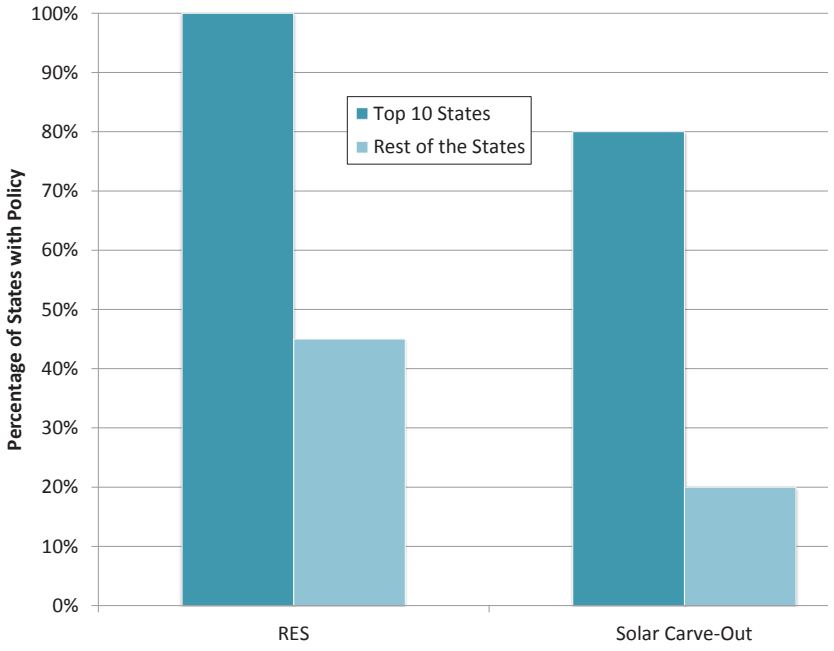
All of the Top 10 states have renewable electricity standards, and eight (all but Hawaii and California) have renewable electricity standards with a carve-out for solar electricity or for customer-sited distributed renewable electricity technologies, of which solar power is the most common.

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 weaknesses in energy policy have kept the value of SRECs too low to effectively stimulate market growth.[87]

The eight Top 10 states with a solar carve-out represent one-half of all states nationwide with that policy (see Figure 9), 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.[88] The solar energy "carve-out" within Massachusetts's RES is not expressed as a percentage, but rather as a goal of 1,600 MW by 2020 (a goal which was put in place after Massachusetts exceeded its previous goal of 400 MW by 2016).[89] And Vermont's brand new RES requires 10 percent distributed generation by 2032.[90]

The two Top 10 states without solar carve-outs, California and Hawaii, both possess a number of supportive policies, including two of the strongest renewable electricity standards in the country, and good net metering policies that credit solar customers at the full retail rate for the excess electricity they supply to the grid – a particularly meaningful policy in Hawaii, which has the highest retail electricity rates in the country by far.[91]

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



Vermont and Hawaii Pass the Next Generation of Renewable Electricity Standards

Most states' renewable electricity standards were passed in the 1990s and early-to-mid 2000s. Until recently, the most recent passage of a new RES was in Kansas in 2009.[92] Yet in June 2015, within three days of each other, Vermont and Hawaii each passed new renewable energy standards – the two strongest in the nation.[93]

On June 8, Hawaii updated its renewable electricity standard to require 100 percent renewable electricity by 2045 (with a steady ramp up of interim requirements). The 100 percent RES is the first of its kind in the U.S. And although Hawaii's new RES does not include a solar energy or distributed generation carve-out, Hawaii's big solar potential and its new status as the state with the most solar energy per capita suggest that solar energy will play an important role in the fulfillment of its new standard.

Three days later, on June 11, Vermont set a requirement of 75 percent renewable electricity, and 10 percent distributed generation, by 2032. Vermont's new standard replaces what had been a weak and non-binding renewable electricity target; it also helps ensure that renewables will play a major role in filling the void left by the 2014 retirement of the Vermont Yankee nuclear plant, which had previously produced 70 percent of the electricity generated in the state.[94] The distributed generation carve-out – the most aggressive in the country – promises a dramatic boost to Vermont's newly booming solar industry, which for 2014 ranked fourth in the country in solar capacity additions per capita.

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:

Financial Incentives

Financial incentives include rebates and grants that provide direct cash assistance for individuals or businesses seeking to install solar energy systems; tax credits that reduce the tax burden of an individual or business choosing to "go solar;" and programs that allow solar customers to sell solar renewable energy credits to utilities seeking to comply with state solar generation targets.

Some states have incentivized solar energy by providing direct rebates of a set amount to defray the upfront cost of solar panels. *Declining megawatt block programs* are long-term rebate programs that reduce and ultimately phase-out rebates as increasing amounts of solar energy are added to the grid. Such systems set a cap on the expenditure of public dollars for solar subsidies, while providing long-term certainty for solar energy providers. California pioneered the MW block structure 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.[95] New York recently adopted its own MW block program, 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 (although the legislation did not pass in 2014).[96]As with other solar policies, financial incentive programs are more common in the Top 10 states than in the rest of the country. Tax credit programs are almost twice as common in Top 10 states than in the rest of the country, although

rebate and grant programs are less common in general and only slightly more common among the Top 10. (See Figure 10.)

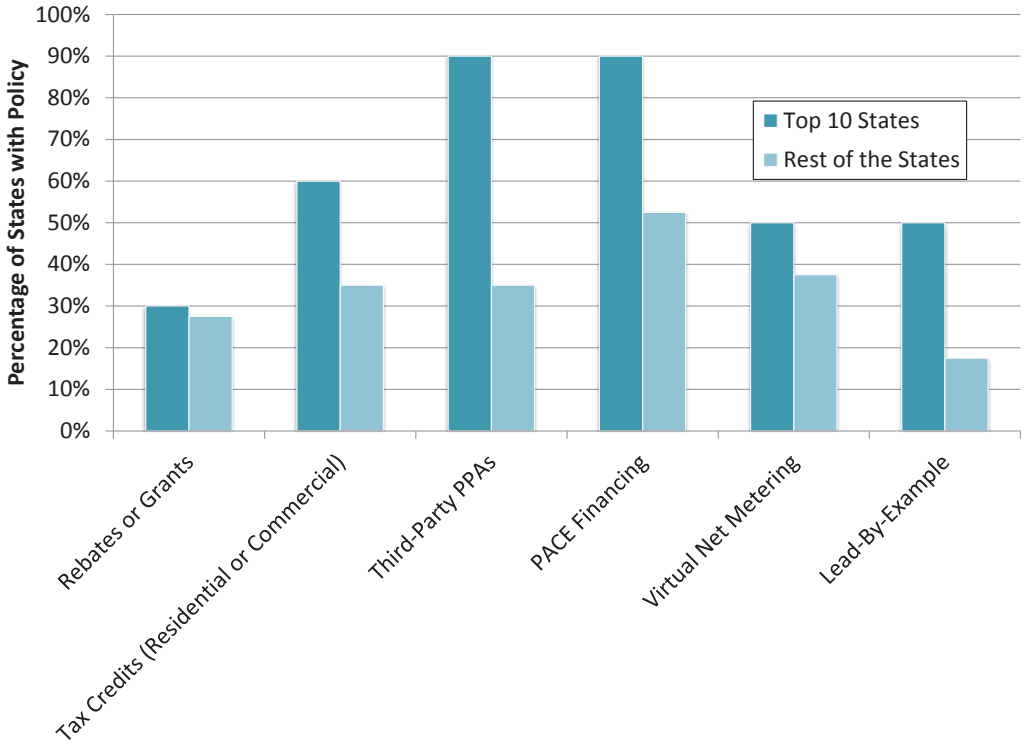
Financing Options

Often, the biggest financial 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 from the grid and from net metering credits on their electricity bill; the third-party entity benefits from lease payments and by claiming the value of financial incentives and tax credits.
- A *third-party power purchase agreement (PPA)* 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 PPA, the consumer does not pay for the solar panels – avoiding upfront costs entirely – but only purchases the electricity they produce.

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



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. Third-party PPAs are also attractive alternatives for non-profits and government agencies – which are unable to benefit from tax incentives – to gain access to solar energy. In 2014, 72 percent of new residential solar energy was installed through third-party ownership agreements.[97]

Third-party PPAs, 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 (which are described above), but legal questions remain about those arrangements, as well.[98] 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. Third-party sales are becoming more widespread: In May 2015, Georgia became the first state in the southeastern U.S. to approve of third-party ownership agreements, in North Carolina state legislation is currently being considered that would legalize third-party sales, and in Florida there is an ongoing effort to put a third-party solar ownership measure on the 2016 ballot.[99]

Long-term utility power purchase agreements with electric utilities can also be helpful in making solar energy more widely available where third-party PPAs 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 system. These agreements are used extensively in North Carolina, where state law encourages the development of mid-size utility-scale solar by requiring that utilities enter 15-year PPAs with companies for renewable energy systems of up to 5 megawatts.[100] North Carolina's mix of a strong utility PPA law with a prohibition of third-party ownership agreements has played a part in creating a solar market with large amounts of utility-scale solar energy but small amounts of residential solar energy.[101]

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 were complicated in 2010 when the Federal Housing Finance Agency raised objections.[102] Commercial PACE programs do not face similar constraints.[103] In some states, owners of multifamily residential buildings may apply for commercial PACE financing.[104]

On-bill financing, similar to PACE financing, allows consumers to pay for solar energy installations over time on their utility bills. In New York state, low-interest on-bill loans for solar installations are currently available through NY-Sun.[105] In Hawaii, the Hawaii PUC is currently working to implement on-bill financing for solar energy and other forms of renewable technology.[106]

In contrast to on-bill financing programs, which use funds from ratepayers, utility shareholders or the public, *on-bill repayment programs* use private capital from third-party companies.[107] In these programs, customers repay these third-party loans on their utility bills. In 2014, both Connecticut and Minnesota approved new on-bill repayment programs.[108] And in California, the CPUC recently expanded a program that allows on-bill utility collection of privately arranged loans for distributed generation systems.[109]

Finally, rules that enable shared, community solar projects – *virtual net metering, community net metering,* and *meter aggregation* – open the door for more individuals and businesses to reap the benefits of net metering and to "go solar." *Virtual net metering* is the most flexible of these rules, as it allows individuals to receive net metering credits even if they are not physically connected to a solar installation. *Community net metering* allows "community solar gardens," where neighbors can all receive net metering credits from a connected solar energy system; and *meter aggregation* allows a single utility customer (usually commercial or government) to apply net metering credits to multiple meters. As of July 2015, 21 states allow some kind of shared net metering.[110]

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, some incentives that are used to encourage the adoption of solar energy in the private sector – such as tax credits and accelerated depreciation – 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.[111]

Several states have made a sustained commitment to the integration of clean energy technologies by setting standards for energy consumption in state buildings; or by requiring 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.

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, a more vigorous local economy, and help complying with the EPA's Clean Power Plan. 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. 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.[112]

Local governments can also ensure that their zoning regulations are clear and unambiguous in allowing solar energy installations on residential and commercial rooftops. The North Carolina Clean Energy Technology Center and the North Carolina Sustainable Energy Association have released a model solar energy zoning ordinance for local governments to use as a template to develop their own ordinances for solar energy development, which will help unlock new solar markets in communities where a poor understanding of how to regulate solar development would otherwise be a barrier to entry.[113]

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.[114] 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 build-

ings incorporate solar energy; and Tucson, Arizona, requires all new homes to be built "solar ready."[115]

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. Municipal utilities can also encourage solar energy through rate structures, including rate structures with a higher ratio of per-kilowatt-hour to per-customer charges.

State Government

State governments should set ambitious targets for the growth of solar energy 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 return when they do. In states without strong net metering programs, feed-in tariffs (sometimes known as CLEAN contracts) and value-of-solar bill credits can play an important role in ensuring that consumers receive fair compensation for solar energy, so long as the compensation they receive fully accounts for the benefits of solar energy and is sufficient to spur participation in the market. States should also allow third-party ownership agreements as a means to reduce the upfront costs associated with "going solar."

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

In addition, as solar power comes to supply an increasing share of the nation's energy, state governments will need to be at the forefront of designing policies that transition the nation from a power grid reliant on large, centralized power plants to a "smart" grid where electricity is produced at thousands of locations and shared across an increasingly nimble and sophisticated infrastructure. In order to begin planning for that future, states should develop policies that support the expansion of energy storage technologies and microgrids.[116]

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 poli-

cies 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 extend 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 largescale adoption. By investigating and funding research into 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.[117]

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.[118] 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.[119] As of May 2013, the military had already installed more than 130 megawatts of solar energy capacity and has plans to install more than a gigawatt of solar energy by 2017.[120] 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 (data from the Solar Energy Industries Association)*

State	Cumulative Solar Electricity Capacity per Capita 2014 (watts/person)	Rank	Solar Electricity Capacity Installed During 2014 per Capita (watts/person)	Rank	Cumulative Solar Electricity Capacity (MW)	Rank	Solar Electricity Capacity Installed During 2014 (MW)	Rank
Arizona	307	2	37	8	2,067	2	246	2
California	257	4	111	2	9,977	1	4,316	1
Colorado	74	10	13	11	398	8	67	8
Connecticut	33	13	13	10	119	17	45	17
Delaware	64	11	7	16	60	23	7	23
District of Columbia	15	21	5	20	10	30	3	30
Florida	12	23	1	27	235	13	22	13
Georgia	16	20	4	21	161	15	45	15
Hawaii	312	1	72	3	443	7	102	7
Illinois	4	27	0	31	54	24	6	24
Indiana	17	19	9	14	113	18	59	18
Maryland	36	12	12	12	215	14	73	14
Massachusetts	111	8	46	5	750	6	308	6
Minnesota	4	29	1	28	20	26	6	26
Missouri	18	18	12	13	108	19	73	19
Nevada	278	3	119	1	789	5	339	5
New Hampshire	4	28	2	23	5	31	3	31
New Jersey	162	5	27	9	1,451	3	240	3
New Mexico	155	6	42	6	324	11	88	11
New York	20	15	7	17	397	9	147	9
North Carolina	96	9	40	7	954	4	397	4
Ohio	9	24	1	26	103	20	15	20
Oregon	21	14	2	24	84	21	8	21
Pennsylvania	19	17	1	29	245	12	10	12
Tennessee	19	16	9	15	127	16	56	16
Texas	12	22	5	19	330	10	129	10
Utah	5	26	4	22	15	28	12	28
Vermont	112	7	61	4	70	22	38	22
Virginia	1	31	1	30	12	29	6	29
Washington	5	25	2	25	38	25	14	25
Wisconsin	3	30	0	32	19	27	2	27

*Year-end 2014 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

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

State	Strong net metering policies	Strong inter-connection policies	Solar rights	Feed-in tariffs or other solar rates	Renewables and Alternative Portfolio Standards	Solar (or distributed) carve-out	Rebates or grants	Tax credits	Virtual, community or aggregate net metering	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	■		■					■			■	
Maine	■	■	■		■				■		■	
Maryland	■	■	■		■	■	■		■	■	■	
Massachusetts	■	■	■		■	■	■	R	■	■	■	■
Michigan	■				■					■	■	
Minnesota	■			■	■	■			■		■	■

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

Appendix C: 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 2015 Freeing the Grid report. (Freeing The Grid, *Freeing the Grid 2015*, accessed at freeingthegrid.org on 19 June 2015.)

Strong interconnection policies: Statewide interconnection policies obtaining an "A" or "B" grade in 2015 Freeing the Grid report. (Freeing The Grid, *Freeing the Grid 2015*, accessed at freeingthegrid.org on 19 June 2015.)

Solar rights: Presence of a solar rights policy according to DSIRE Solar. (NC Clean Energy Technology Center, *DSIRE: State Solar Access Laws*, July 2015.)

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

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

Solar carve-out: Presence of a requirement for solar energy or distributed generation in the state renewable electricity standard. States were not included if they only had solar or distributed generation multipliers in their RES, but no requirement. (Based on DSIRE's detailed summary map, "Renewable Portfolio Standards with Solar and DG Provisions," available at http://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2015/01/RPS-carveout-map2.pdf, March 2015.)

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

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

Virtual, community or aggregate net metering: Includes all net metering policies that allow meter aggregation (including those that apply only to municipal governments). (Based on a review of each state's detailed entries in the DSIRE database.)

Third-party PPAs: States in which third-party power purchase agreements are legal. (Based on DSIRE's detailed summary map, "3rd Party Solar PPA Policies," available at http://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2015/01/3rd-Party-PPA_0302015.pdf, March 2015.)

PACE financing: Center for Climate and Energy Solutions, Property Assessed Clean Energy policy table, accessed at http://c2es.cartodb.com/tables/area_policy_table/public on 10 July 2015.

Lead-by-example: States were included that had efficiency or green building standards for public buildings according to DSIRE. This category includes only those states where agencies are required to evaluate or implement renewable energy technologies if they are cost-effective, as well as states with zero net energy building requirements or renewable energy procurement requirements. This category includes programs designed specifically to promote solar water heating.

Appendix D: State Per Capita Solar Growth Since 2012 and 2013[121]

State	Cumulative Solar Capacity per Capita 2014 (watts/person)	Cumulative Solar Capacity per Capita 2013 (watts/person)	Cumulative Solar Capacity per Capita 2012 (watts/person)	Solar Capacity per Capita Growth Since 2013	Solar Capacity per Capita Growth Since 2012	Growth Since 2013 Rank	Growth Since 2012 Rank
Arizona	307	274	167	12%	84%	27	16
California	257	147	76	75%	237%	8	5
Colorado	74	63	52	18%	43%	23	20
Connecticut	33	21	10	61%	221%	13	7
Delaware	64	57	48	12%	34%	26	22
District of Columbia	15	11	8	41%	93%	18	14
Florida	12	11	10	9%	23%	30	24
Georgia	16	12	3	37%	533%	19	2
Hawaii	312	242	137	29%	128%	21	11
Illinois	4	4	4	13%	17%	25	26
Indiana	17	8	-	108%	N/A	5	N/A
Maryland	36	24	19	50%	94%	16	13
Massachusetts	111	66	30	69%	274%	11	4
Minnesota	4	3	-	42%	N/A	17	N/A
Missouri	18	6	2	208%	973%	2	1
Nevada	278	161	146	72%	90%	9	15
New Hampshire	4	2	-	149%	N/A	3	N/A
New Jersey	162	136	109	19%	48%	22	19
New Mexico	155	113	91	37%	70%	20	17
New York	20	13	9	58%	125%	14	12
North Carolina	96	57	23	70%	308%	10	3
Ohio	9	8	6	17%	53%	24	18
Oregon	21	19	18	9%	20%	29	25
Pennsylvania	19	18	15	4%	25%	31	23
Tennessee	19	11	8	77%	155%	7	8
Texas	12	8	5	61%	130%	12	10
Utah	5	1	-	377%	N/A	1	N/A
Vermont	112	51	34	119%	233%	4	6
Virginia	1	1	-	99%	N/A	6	N/A
Washington	5	3	2	56%	132%	15	9
Wisconsin	3	3	2	11%	35%	28	21

Notes

1. Shayle Kann et al., GTM Research and SEIA, *U.S. Solar market insight report - 2014 year in review*, 10 March 2015.

2. Carbon dioxide emissions offset by solar power in 2014 were calculated by accounting for a reduction in fossil fuel electricity generation on a state by state basis.

Solar capacities for each state were calculated in the following ways: utility-scale PV capacity was based on the most recent EIA Form 860 from the year 2013; distributed PV capacity was calculated by subtracting utility-scale solar PV capacity from SEIA solar PV capacity totals; concentrated solar power (CSP) capacity is from SEIA's Major Solar Projects list, with NREL's online database of CSP projects used to determine when each plant started producing solar electricity. To estimate generation, we used "capacity factors" in the National Renewable Energy Laboratory's U.S. Renewable Energy Technical Potentials report, using distinct capacity factors for distributed PV capacity, utility-scale PV capacity, and CSP capacity.

Carbon dioxide emission reductions from solar energy generation were calculated assuming that solar energy added to the grid would offset fossil fuel generation only, and would offset coal and gas-fired generation in proportion to their contribution to each state's particular electricity mix, as defined by the regional electricity grids that serve that state. The EIA's Annual Energy Outlook provided data on actual annual electricity generation and emissions for coal and natural gas power plants in each EIA region between 2008 and 2013 (compiled from EIA Form 759). We assigned each EMM region to one of the interconnection regions identified by the North American Electric Reliability Corporation (NERC), using maps of EMM regions and NERC regions. We estimated an emissions factor for fossil fuel-fired generation for each NERC region, using the generation and emissions data for the constituent EMM regions. We used 2013-specific emissions factors for the year 2014. To arrive at an emissions factor for each state, we determined the percentage of electricity sales in each state that come from within each NERC region, using data from U.S. Department of Energy, Energy Information Administration, *Electric Power Sales, Revenue, and Energy Efficiency Form EIA-861*, 29 October 2013. State emission factors were created by multiplying each state's percent of sales per NERC region in 2012 by each region's emission factor. For Hawaii and Alaska, where NERC regions could not be identified, different methods were used to calculate emission factors. For Alaska, we divided annual carbon dioxide emissions from coal and natural gas sources in the electric power industry by total electricity generation from coal and natural gas sources in the electric power industry. For Hawaii, where most electricity is generated from petroleum, the emissions factor was calculated by dividing annual carbon dioxide emissions from petroleum by annual electricity generation from petroleum. For both Alaska and Hawaii emission factors were based on 2012 data, the most recent available.

Finally, to estimate total emissions savings numbers for each state, we multiplied solar generation by each state's emission factor. The national estimate in this report is based on a sum of all state estimates.

3. Power plants produce more than two-thirds of the nation's emissions of sulfur dioxide, more than half of our nation's airborne mercury emissions, and 13 percent of U.S. nitrogen oxide emissions: U.S. EPA, *The 2011 National Emissions Inventory*, data downloaded from www.epa.gov/ttn/chief/net/2011inventory.html on 1 July 2015.

4. Solar jobs: The Solar Foundation, *National Solar Jobs Census 2014*, January 2015; solar investment: SEIA, *Solar Energy Facts: 2014 Year in Review*, 17 December 2014.

5. The Solar Foundation, *National Solar Jobs Census 2014*, January 2015.

6. See note 1.

7. Because solar panels generate electricity close to home, they reduce the need for investment in transmission capacity; and because solar panels usually produce the most electricity on hot, sunny days, when power demand is at its highest, they reduce the need for expensive and often inefficient "peaking" plants that may operate for only a few hours each year.

8. Anthony Lopez, et al., National Renewable Energy Laboratory, *U.S. Renewable Energy Technical Potentials: A GIS-Based Analysis*, July 2012. Note: "Technical potential" for rooftop solar PV systems does not consider economic factors or policies to drive solar market development; it is merely an accounting of how much rooftop space can support solar PV systems, accounting for factors such as shading, building orientation, roof structural soundness and obstructions such as chimneys and fan systems.

9. Data on solar potential: See note 8; data on 2014 U.S. electricity sales: Energy Information Administration, *Table 5.1. Retail Sales of Electricity to Ultimate Customers: Total by End-Use Sector, 2005 - April 2015* , accessed at eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_1 on 30 June 2015.

10. Data on solar potential: See note 8; state data on 2014 U.S. electricity sales: Energy Information Administration, downloaded from *Electricity Data Browser* at eia.gov/electricity/data/browser/ on 30 June 2015.

11. Ibid.

12. Ibid.

13. National Renewable Energy Laboratory, *Best Research Cell Efficiencies*, downloaded from www.nrel.gov/ncpv/images/efficiency_chart.jpg, 30 June 2015.

14. Galen Barbose et al., Laurence Berkeley National Laboratory, *Tracking the Sun VII: An Historical Summary of the Installed Price of Photovoltaics in the United States from 1998 to 2013*, September 2014.

15. U.S. Dept. of Energy, *Progress Report: Advancing Solar Energy Across America*, available at energy.gov/articles/progress-report-advancing-solar-energy-across-america, 12 February 2014.

16. See note 14.

17. Joachim Seel, Galen Barbose and Ryan Wiser, Lawrence Berkeley National Laboratory, *An Analysis of Residential PV System Price Differences Between the United States and Germany*, March 2014.

18. Ibid.

19. SunShot soft costs: U.S. Dept. of Energy, *SunShot Soft Costs,* archived at web.archive.org/web/20150803152655/http://energy.gov/eere/sunshot/soft-costs; NREL's soft cost roadmap: Kristen Ardani et al., National Renewable Energy Laboratory and Rocky Mountain Institute, *Non-Hardware ("Soft") Cost Reduction Roadmap for Residential and Small Commercial Solar Photovoltaics, 2013-2020*, August 2013.

20. Shayle Kann et al., GTM Research and SEIA, *U.S. Solar market insight report - 2014 year in review*, 10 March 2015.

21. Ibid.

22. Jason Kaminsky and Justin Baca, "US Solar Electricity Production 50% Higher Than Previously Thought," *GreenTech Media*, available at www.greentechmedia.com/articles/read/us-solar-electricity-production-50-higher-than-previously-thought, 30 June 2015.

23. Non-solar capacity: FERC, *Office of Energy Projects Energy Infrastructure Update For December 2014*, available at ferc.gov/legal/staff-reports/2014/dec-infrastructure.pdf, 2015; solar capacity: See note 1. PV solar capacities were converted from MWdc to MWac assuming an 87 percent derate factor.

24. See note 1.

25. See note 23.

26. Population: U.S. Census, *Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010 to July 1, 2014*, downloaded from www.census.gov/popest/data/state/totals/2014/index.html on 13 July 2015.

27. State electricity consumption: U.S. Energy Information Administration, *2013 Utility Bundled Retail Sales- Total*, downloaded from www.eia.gov/electricity/data.cfm, released November 8, 2013.

28. Cumulative solar capacity data provided courtesy of SEIA. SEIA solar capacity added in 2014 was collected from a variety of sources. Capacity data for California, North Carolina, Nevada, Massachusetts, Arizona, New Jersey, New York, Texas, Hawaii and New Mexico: SEIA, *2014 Top 10 Solar States*, archived at web.archive.org/web/20150506030949/http://www.seia.org/research-resources/2014-top-10-solar-states.

Data for all other states was collected from following state SEIA websites (links are to archived sites):

CO: web.archive.org/web/20150506174308/http://www.seia.org/state-solar-policy/colorado;

CT: web.archive.org/web/20150506174517/http://www.seia.org/state-solar-policy/connecticut;

DC: web.archive.org/web/20150506180939/http://www.seia.org/state-solar-policy/washington-dc;

DE: web.archive.org/web/20150506174629/http://www.seia.org/state-solar-policy/delaware;

FL: web.archive.org/web/20150506174824/http://www.seia.org/state-solar-policy/florida;

GA: web.archive.org/web/20150506174953/http://www.seia.org/state-solar-policy/georgia;

IL: web.archive.org/web/20150506175140/http://www.seia.org/state-solar-policy/illinois;

IN: web.archive.org/web/20150506175331/http://www.seia.org/state-solar-policy/indiana-solar;

LA: web.archive.org/web/20150506175422/http://www.seia.org/state-solar-policy/louisiana-solar;

MD: web.archive.org/web/20150506175520/http://www.seia.org/state-solar-policy/maryland;

MN: web.archive.org/web/20150506175629/http://www.seia.org/state-solar-policy/minnesota-solar;

MO: web.archive.org/web/20150807162017/http://www.seia.org/state-solar-policy/missouri;

NH: web.archive.org/web/20150506175917/http://www.seia.org/state-solar-policy/new-hampshire-solar;

OH: web.archive.org/web/20150506180112/http://www.seia.org/state-solar-policy/ohio;

OR: web.archive.org/web/20150506180157/http://www.seia.org/state-solar-policy/oregon;

PA: web.archive.org/web/20150506180240/http://www.seia.org/state-solar-policy/pennsylvania;

SC: web.archive.org/web/20150506180320/http://www.seia.org/state-solar-policy/south-carolina-solar;

TN: web.archive.org/web/20150506180537/http://www.seia.org/state-solar-policy/tennessee;

UT: web.archive.org/web/20150506180636/http://www.seia.org/state-solar-policy/utah-solar;

VA: web.archive.org/web/20150506180717/http://www.seia.org/state-solar-policy/virginia-solar;

VT: web.archive.org/web/20150506172943/http://www.seia.org/news/vermont-posts-significant-gains-solar-capacity-2014;

WA: web.archive.org/web/20150506180850/http://www.seia.org/state-solar-policy/washington;

WI: web.archive.org/web/20150506181020/http://www.seia.org/state-solar-policy/wisconsin.

29. Ibid.

30. Ibid.

31. Ibid.

32. Capacity: SEIA, *Hawaii Solar,* archived at web.archive.org/web/20150713172921/http://www.seia.org/state-solar-policy/hawaii; 5.5 percent of Kauai electricity use: Associated Press, "Kauai offers view of state's largest solar farm," *Star Adviser,* 24 September 2014.

33. SEIA, *Vermont Posts Significant Gains in Solar Capacity in 2014 (Press Release)*, available at seia.org/news/vermont-posts-significant-gains-solar-capacity-2014, 2 April 2015.

34. SEIA, *Nevada Solar*, archived at web.archive.org/web/20150714014310/http://www.seia.org/state-solar-policy/nevada.

35. Approval of new charge: Ryan Randazzo, "SRP board OKs rate hike, new fees for solar customers," *The Arizona Republic*, 27 February 2015; 96 percent drop in SolarCity applications: SolarCity, *Our response to anti-competitive behavior in Arizona (press release),* available at web.archive.org/web/20150713180438/http://blog.solarcity.com/our-response-to-anti-competitive-behavior-in-arizona, 3 March 2015.

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