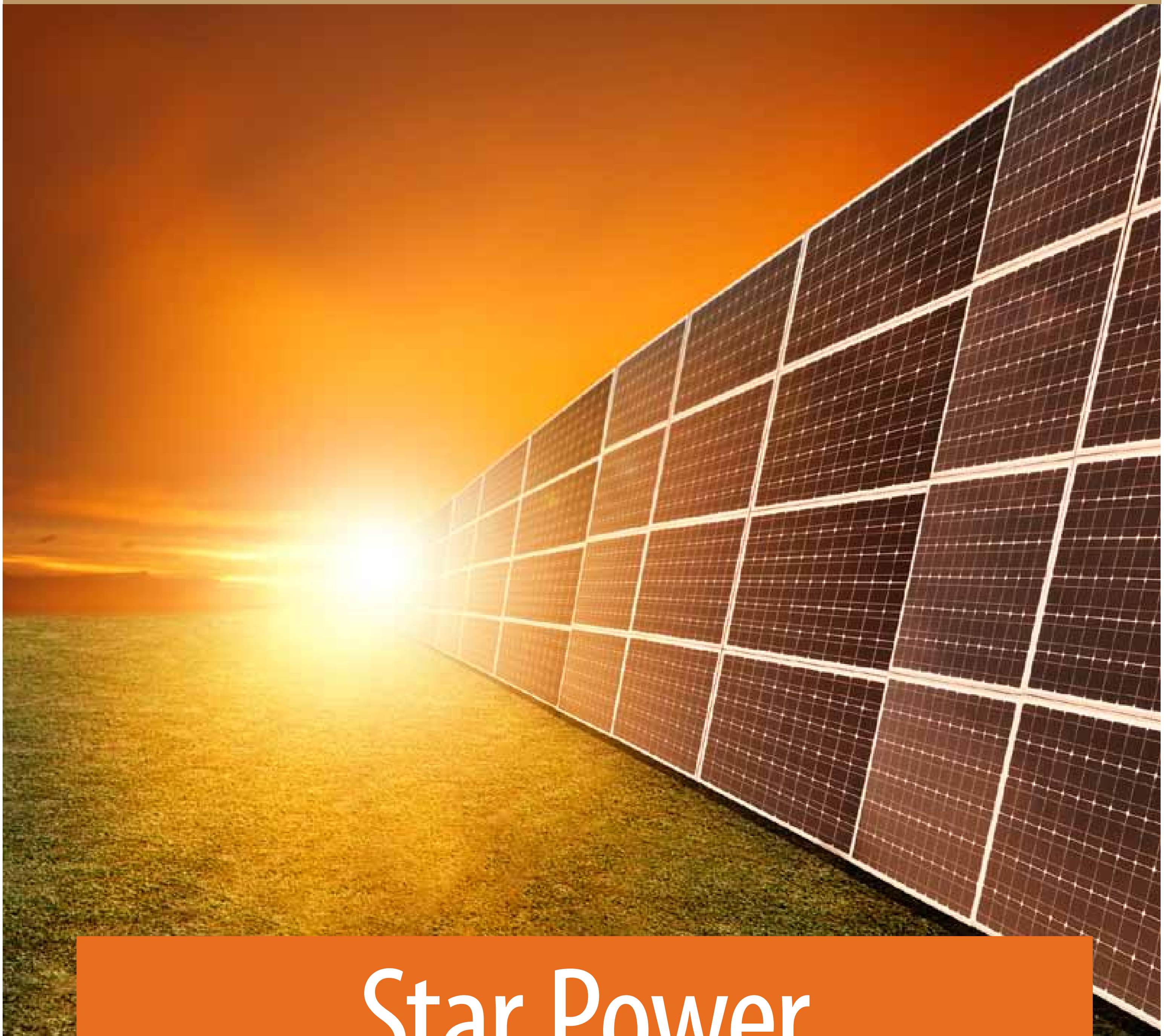

Star Power

The Growing Role of Solar Energy in New Jersey

ENVIRONMENT NEW JERSEY
RESEARCH & POLICY CENTER

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Executive Summary

America could meet its energy needs by capturing just a sliver of the virtually limitless and pollution-free energy that strikes the nation every day in the form of sunlight. With solar installation costs falling, the efficiency of solar cells rising, and the threats of air pollution and global warming ever-looming, solar power is becoming a more attractive and widespread source of energy every day.

Solar energy is on the rise across the country. The amount of solar photovoltaic (PV) capacity* in the United States has tripled in the past two years. More than half of all new U.S. electricity generating capacity came from solar installations in the first half of 2014, and the United States now has enough solar electric capacity installed to power more than 3.2 million homes. New Jersey is a national leader in the adoption of solar energy, as the state with the third-greatest amount of cumulative installed solar capacity as of the end of 2013.

New Jersey should continue to incentivize growth in solar energy by setting a goal of obtaining 20 percent of its electricity from solar power by 2025. Achieving that goal would result in a cleaner environment, less dependence on fossil fuels, and a stronger economy.

New Jersey's solar energy potential far exceeds what the state has captured to date. Based on renewable energy technical potential reported by the National Renewable Energy Laboratory:

- New Jersey has the potential to produce more than six times as much electricity from solar power as the state consumes each year. Each of the 50 states has the potential to generate far more electricity from the sun than its residents consume. (See Figure ES-1.)
- There are 35 million residential and commercial rooftops that could host solar panels across the United States, including more than 800,000 rooftops in New Jersey.

Continued growth in solar energy in New Jersey would bring a goal of 20 percent solar electricity within reach.

- Solar PV capacity in New Jersey increased at a rate of 66 percent per year from 2010 to 2013. If solar PV installations continue to increase at one-third of that rate (22 percent) annually between 2013 and 2025, New Jersey would have enough solar energy to generate 20 percent of its electricity. (See Figure ES-2.)

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

Figure ES-1. Solar Electricity Technical Potential Compared with Electricity Consumption

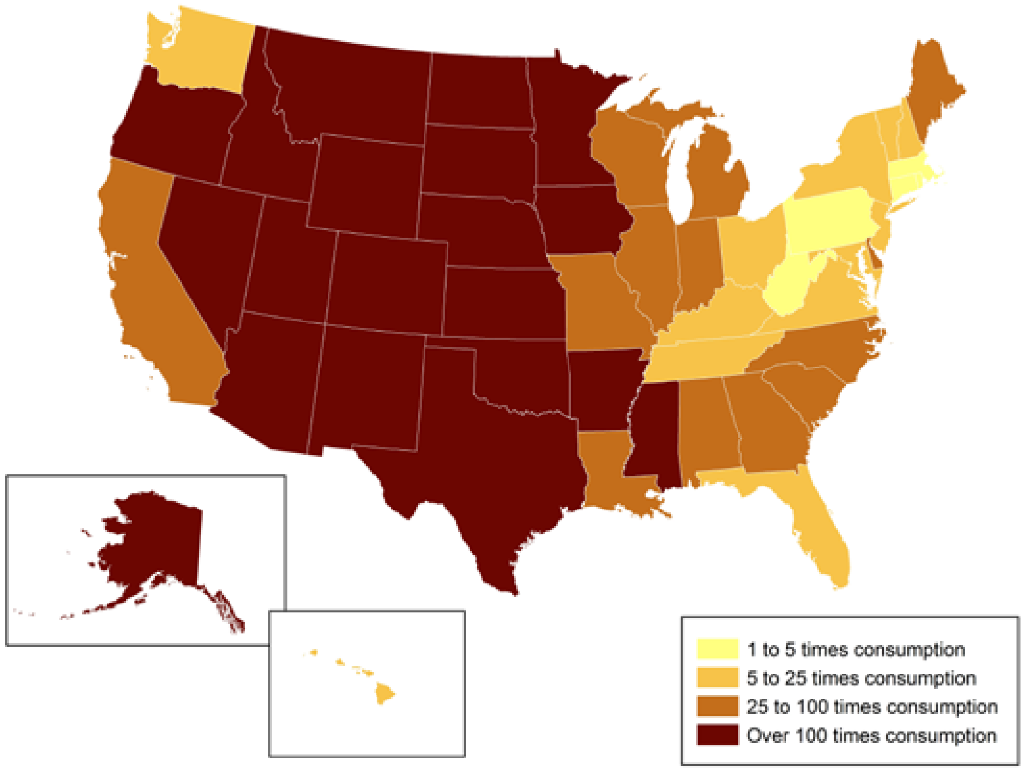
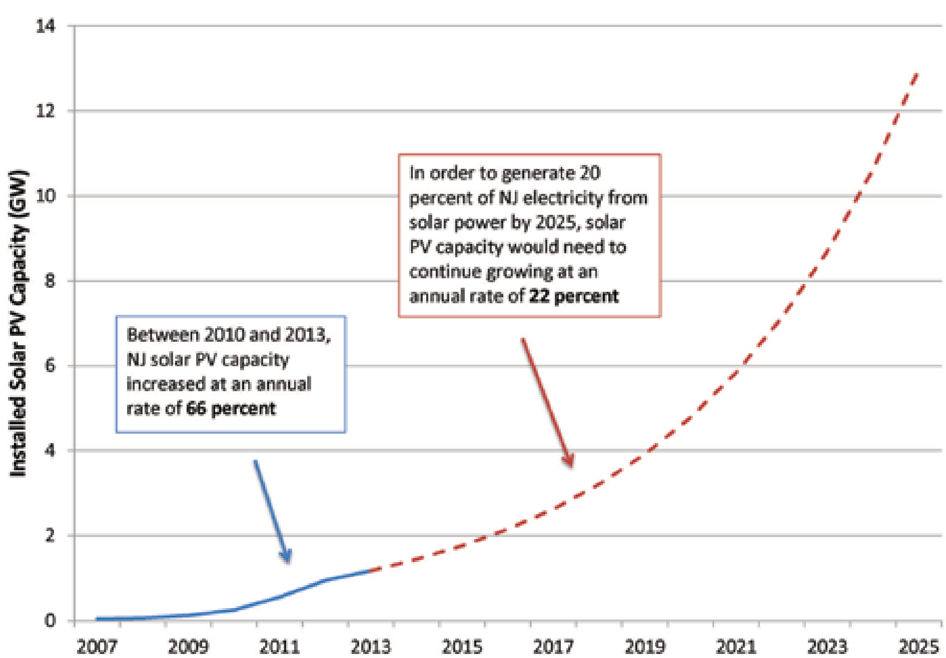


Figure ES-2. New Jersey Can Generate 20 Percent of Its Electricity from Solar Power by 2025



Getting at least 20 percent of New Jersey's electricity from the sun by 2025 would represent a major step toward stabilizing the climate, cleaning our air and building a prosperous, sustainable economy.

- Producing 20 percent of its electricity from clean, solar power would reduce New Jersey's global warming pollution by 12 million metric tons in 2025 – the equivalent of taking 2.6 million cars off the road. Solar energy at that scale would help New Jersey comply with the goals of the Clean Power Plan – the Environmental Protection Agency's (EPA's) proposed plan to reduce U.S. global warming pollution from the power sector by 30 percent below 2005 levels by 2030. If the EPA decides that distributed generation can help states achieve their goals under the Clean Power Plan, producing 20 percent of New Jersey's electricity from clean, solar power would enable the state to achieve more than three-quarters of its 2030 emission reduction goal.
- Expanding solar energy will also reduce emissions of pollutants that contribute to the formation of smog and soot and threaten public health, especially the health of vulnerable populations like children, the elderly and those with respiratory disease.
- Obtaining 20 percent of New Jersey's electricity from solar energy would reduce water consumption from power plants dramatically. Using a life-cycle assessment, solar photovoltaics consume 1/500th of the water consumed by coal power plants and 1/80th of the water consumed by natural gas plants per unit of electricity produced.
- Solar energy creates local clean energy jobs that can't be outsourced. Growth in the solar industry from November 2012 to November 2013 was 10 times faster than the national average for employment; the New Jersey solar industry employed 6,500 people in 2013.

A future in which New Jersey gets 20 percent of its electricity from the sun is achievable and will help America generate at least 10 percent of its electricity from solar power by 2030. The tools to build this vision are available and the momentum exists – now federal, state and local governments should adopt aggressive goals for solar integration and implement policies that encourage the adoption of solar power.

To achieve New Jersey's full solar potential:

- **New Jersey's state government** should commit to obtain at least 20 percent of its electricity from solar power by 2025 and adopt policies to achieve that goal. State officials should expand the renewable electricity standard and the solar carve-out. New Jersey should also maintain strong net metering and interconnection standards, promote community solar and virtual net metering that can deliver the benefits of solar power to low income communities, facilitate third-party sales of solar power to provide access to successful solar leasing programs, and make smart investments to move toward a more intelligent electric grid in which distributed sources of energy such as solar power play a larger role. The state should utilize solar energy wherever possible on public buildings and properties. New Jersey should adopt a strategy for complying with the Clean Power Plan, and solar power should play a significant role in New Jersey's plans to meet or exceed the emission reduction targets.
- **The federal government** should commit to obtain 10 percent of the nation's electricity from solar energy by 2030. The federal government should utilize solar energy on government buildings and also continue successful solar policies, including federal incentives, programs to responsibly site solar energy on public lands, and research, development and deployment efforts designed to help local and state governments

reduce the cost of solar energy and smooth the incorporation of large amounts of solar energy into the electric grid. It should consider adopting a baseline standard for net metering. In addition, the federal government should strengthen and finalize the Clean Power Plan and ensure that distributed electricity resources such as rooftop solar panels can be used as a tool for compliance.

- **Local governments** should adopt strong solar goals, utilize solar energy wherever possible on public buildings and properties, ensure that homeowners and businesses can "go solar" easily and with a minimum amount of red tape, implement financing programs, such as property-assessed clean energy (PACE) financing, and adopt bulk purchasing programs for solar installations. Local governments should also establish zoning and building codes that facilitate the use of solar energy. Municipally owned utilities should promote solar energy by providing net metering or other rate structures to compensate solar homeowners fairly, and by making investments in community-scale and utility-scale solar projects.

Introduction

Two decades ago, the Internet was just beginning to emerge as a fixture in American homes and businesses. A decade ago, the modern smartphone didn't exist. Today, it is hard to imagine life in America without them.

Will we say the same thing about solar energy in 2030?

Solar energy has evolved rapidly from an exotic technology sure to provoke stares from passers-by into an increasingly mainstream form of energy. Technological improvements, innovations in finance and marketing, and growing economies of scale – along with creative and strong public policies – have brought solar energy within reach of an increasing number of Americans.

Solar energy is poised to make the same leap that the Internet, the smartphone and countless other technologies have made, from niche technology to household staple. The availability of sunshine is certainly no barrier – enough sunlight strikes the United States each day to power the nation 100 times over.[1] Nor is public opinion; solar energy routinely tops the list of energy sources that Americans would like to see grow.[2] Increasingly, cost is not an obstacle either: costs continue to fall and solar energy is on track to become cost-competitive with fossil fuel-generated electricity in most states in the next decade.[3] Solar energy is already a smart investment that prevents air pollution, protects electricity consumers from price fluctuations and creates thriving, local job markets.

The obstacles that could keep solar energy from meeting its potential to help clean our air, reduce carbon emissions, and free us from reliance on fossil fuels are systemic, and largely political. Powerful interests that benefit from our current, largely fossil fuel-fired electricity grid are already fighting to slow the growth of solar energy. Many cities and states continue to make the process of "going solar" unnecessarily inconvenient and costly. And the integration of large amounts of solar energy into the grid will require concerted effort – effort that will only happen with a clear signal from policy-makers and the public.

The time has come for public officials at both the state and federal levels to articulate ambitious goals for solar energy development – goals that can serve as a rallying point for industry, policy-makers and citizens as they undertake the many concrete steps needed to bring about a solar energy future.

Obtaining 10 percent or more of America's electricity from solar energy by 2030 – with leading states and those with excellent solar resources going even further, faster – is such a goal. It is an achievable target for the nation, and one that would deliver benefits for our environment, economy and public health.

By embracing ambitious goals for solar energy and implementing policies to achieve them, we can build a future in which, 20 years from now, our children ask us what life in America was like before we generated our electricity from clean, abundant solar energy.

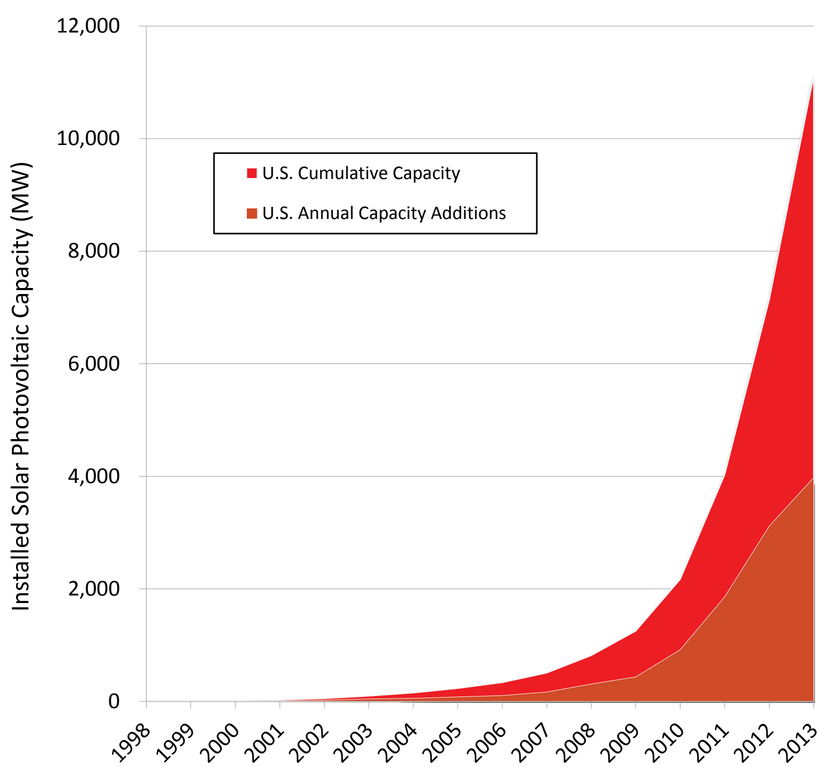
Solar Energy Is on the Rise in America

Solar power is booming across America. Over the course of the last decade, the amount of solar photovoltaic (PV) capacity in the United States has increased more than 140-fold, from 97 megawatts in 2003 to more than 14,000 megawatts in the second quarter of 2014, enough to power 3.2 million homes.[4] Solar power was the largest source of new electricity generating capacity in the United States in the first half of 2014.[5]

Although solar power currently composes less than 1 percent of our electricity generation mix, it is growing quickly.[7] Solar power installed in the first half of 2014 was up 23 percent over the first half of 2013 and accounted for 53 percent of all new electricity generating capacity in the United States.[8]

The rise in solar power across the country 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 surface area as those

Figure 1. Annual and Cumulative Installed Solar PV Capacity through 2013, United States[6]



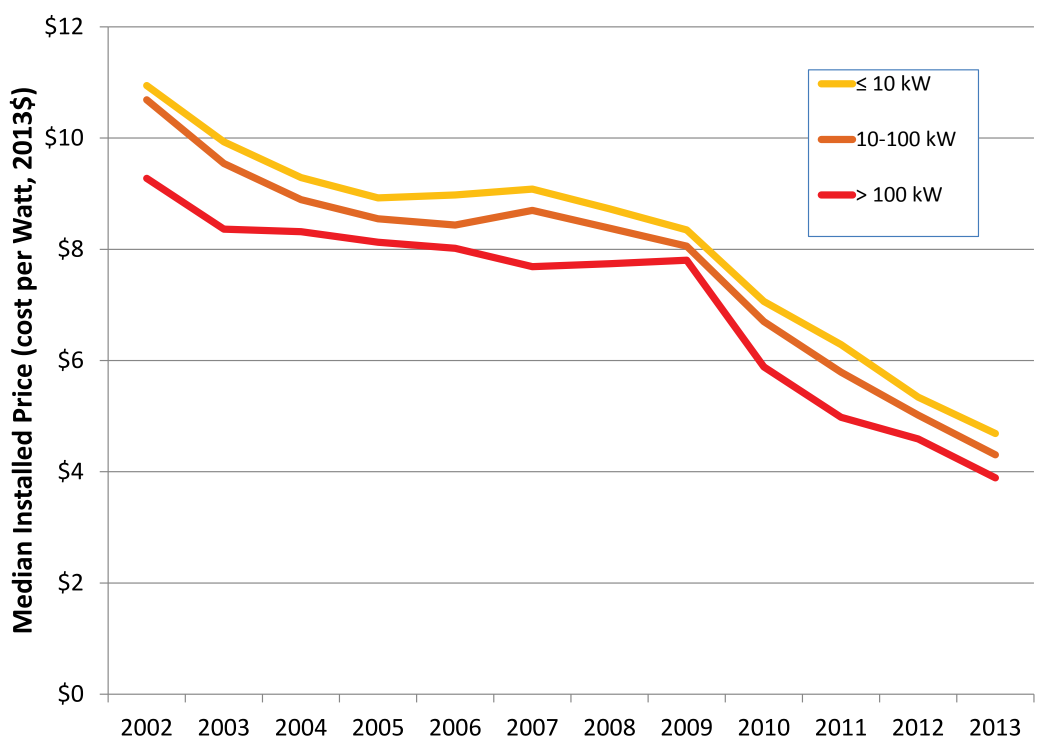
of a decade ago.[9] Innovations in manufacturing, the creation of new financing and business models, and improvements in other areas are also helping solar energy become more accessible and less costly over time. An analysis by the National Renewable Energy Laboratory (NREL) shows that large-scale solar manufacturing operations can produce solar equipment at a lower cost.[10] As solar panels become cheaper, demand for panels is increasing and manufacturers are achieving greater economies of scale, which can further drive down the cost of solar panels per unit.[11]

Companies are also racing to build affordable batteries that can store solar power on a larger scale. Solar energy storage options will allow utilities to balance the variable supply of solar power with the demand for electricity, enabling the sun to power homes even at night and on cloudy days.[12]

As a result of these innovations and economies of scale, the cost of solar energy has plummeted in recent years and continues to fall. From 2010 to 2013, the cost of solar panels fell by 35 percent.[13] (See Figure 2.)

According to a recent analysis by Barclays, California is likely to hit "grid parity" by 2017 – that is, when solar electricity is cheaper than electricity from the grid, even without government incentives; it will be followed closely by Arizona and New York.[14] The Institute for Local Self-Reliance estimates that as many as 100 million Americans will live in areas where solar energy is cheaper than electricity from the grid within a decade.[15] In countries such as Germany, Italy and Spain, which have strongly encouraged large-scale solar production, grid parity has already been achieved.[16]

Figure 2. The Median Installed Price of Residential and Commercial Solar PV Systems Continues to Fall[17]



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 is roughly half that of the United States due to a variety of factors, including larger average system size, but primarily due to lower "soft costs"—costs such as those associated with attracting customers, installing the systems, completing paperwork, and paying taxes and permitting fees.

While the price of solar panels is falling rapidly, soft costs are not decreasing at the same pace in the United States; non-equipment costs now account for two-thirds of the cost of installation in the United States.[18] Installations in Germany have quicker project development timelines and lower overhead, significantly lowering the soft costs associated with installations.[19] The U.S. Department of Energy and the solar industry are engaged in efforts to reduce soft costs, which, if successful, will make solar energy even more cost competitive in the years to come.

Solar energy is quickly emerging as a major global industry, capable of sustaining large-scale installations of solar technologies year in and year out. The rapid growth in solar energy over the last decade suggests that a future in which America relies on solar energy for a significant share of its electricity is within reach.

America Can Obtain a Large Share of Its Electricity from the Sun

The recent growth of solar energy is only the beginning of what could be achieved. The number of solar installations is increasing exponentially across the country – on the roofs of our houses, apartment buildings and office towers, blanketing big box retail stores, covering unusable brownfields, and generating water-wise and pollution-free power in rural areas – and there is plenty of room for it to continue to grow.[20]

America can obtain at least 10 percent of its electricity from solar power by 2030.

Every one of the 50 states has the technical potential to generate more electricity from the sun than it uses in an average year. If the cost of solar panels achieves the target price reductions set by the U.S. Department of Energy (reductions of 75 percent between 2010 and 2020), the agency predicts that solar PV generation alone will compose 11 percent of the U.S. electricity mix by 2030 (14 percent including concentrating solar power) and 19 percent by 2050 (27 percent including concentrating solar power).[21]

Solar Energy Has the Potential to Power America More Than 100 Times Over

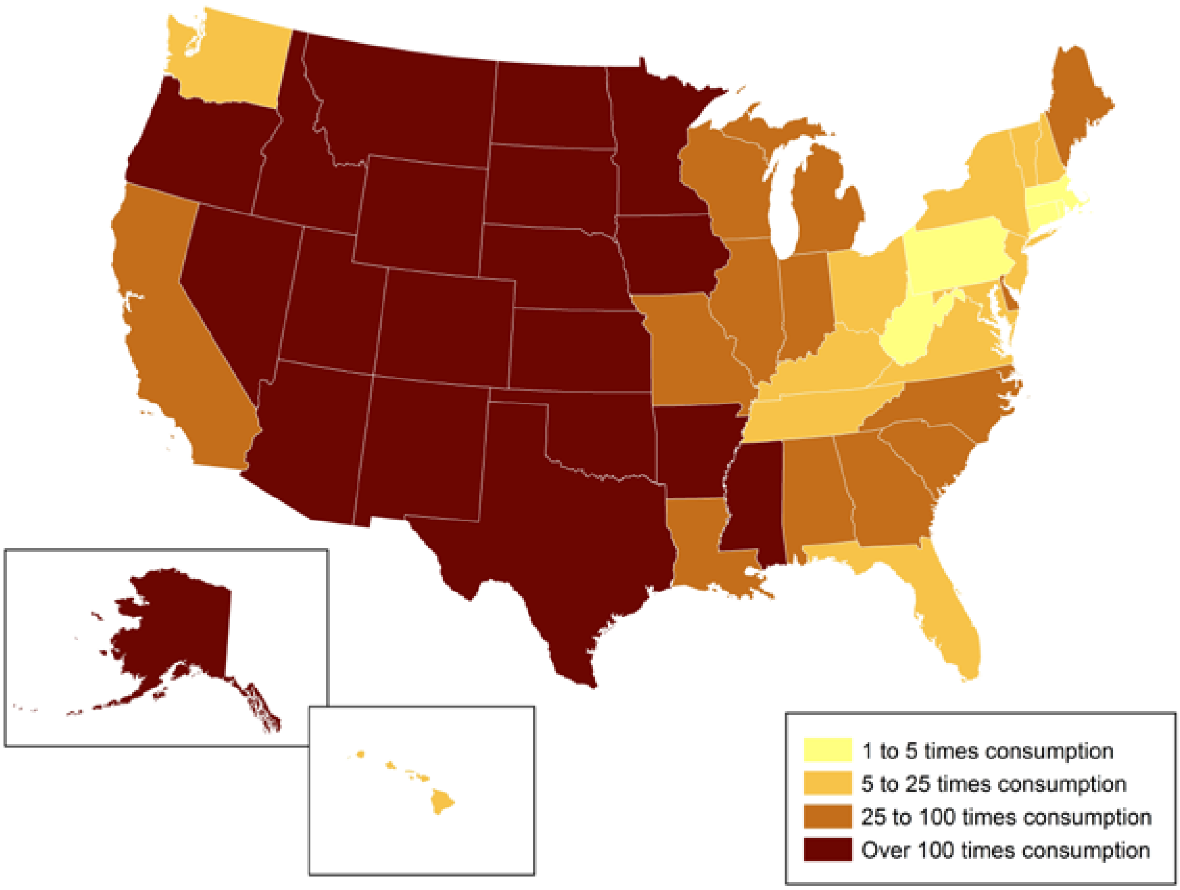
Solar power is growing exceptionally fast, but America is nowhere near the limit of the solar capacity it can support. America has the technical potential to install enough solar electricity capacity to meet the nation's electricity needs more than 100 times over.[22] This includes potential solar power generation from rooftop solar panels, large utility-scale solar installations, and concentrating solar power plants.

In 20 states, the technical potential for electricity generation from solar photovoltaics and concentrating solar power exceeds annual electricity consumption by a factor of 100 or more. (See Figure 3.)

The high potential for solar 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 all forms of electricity production require some land

America has the technical potential to install enough solar electricity capacity to meet the nation's electricity needs more than 100 times over.

Figure 3. Solar Electricity Technical Potential Compared with Electricity Consumption[23]



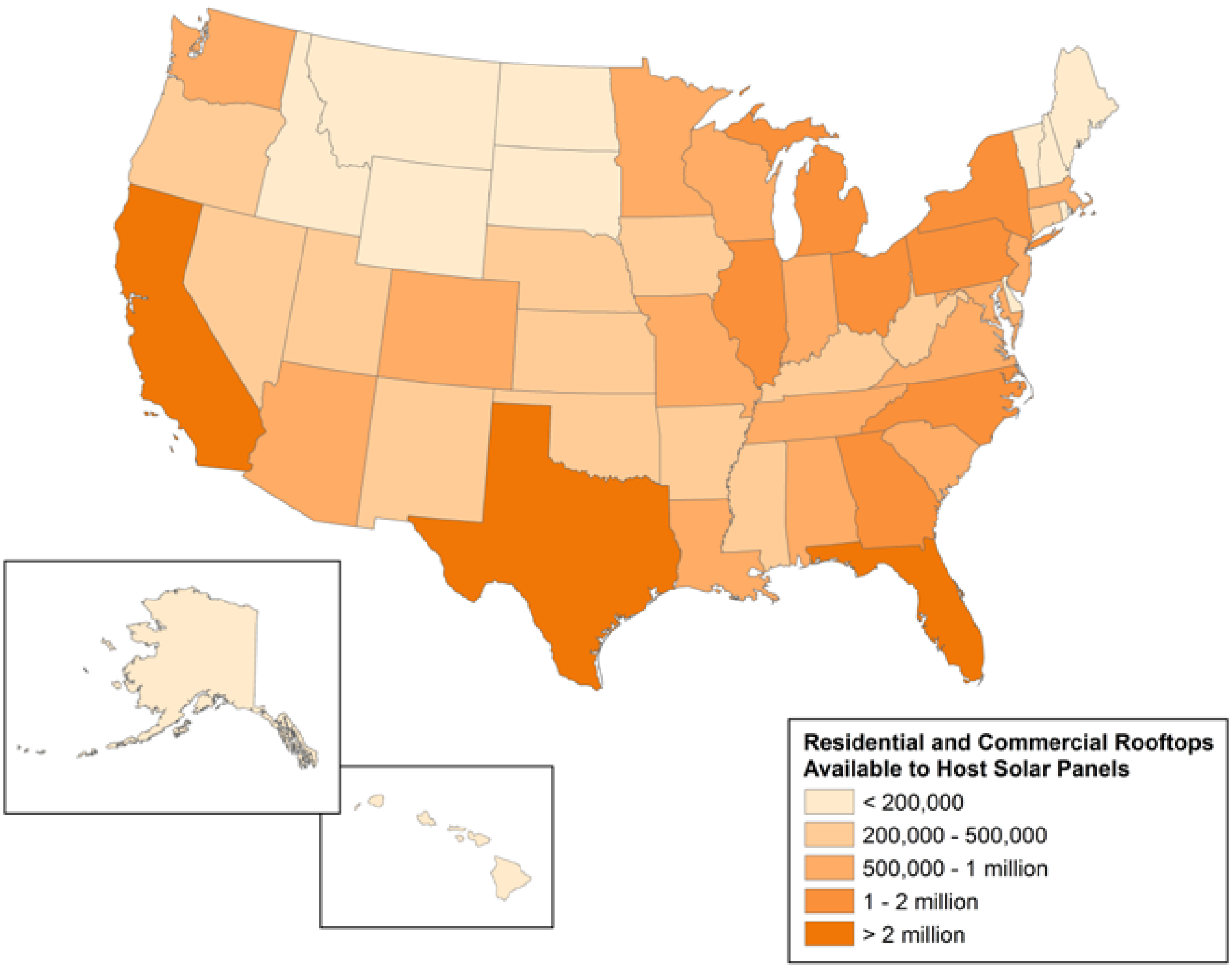
area: 1.4 million acres of Appalachian forest have been disrupted or destroyed during mountaintop removal coal mining practices in the United States, but 1.1 million acres of land covered with solar panels could generate the same amount of electricity as all of the coal burned in the United States for electricity each year.[24]

The existence of America's vast technical potential for solar energy shows that the availability of sunshine is not the limiting factor in the development of solar energy.

Millions of American Rooftops Could Host Solar Panels

Even when one looks only 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 – America has significant solar energy potential. In each of 10 states, there are more than a million residential and commercial rooftops available to host solar panels. (See Figure 4.)

Figure 4. Over 35 Million Rooftops Can Host Solar Panels Across the United States[25]



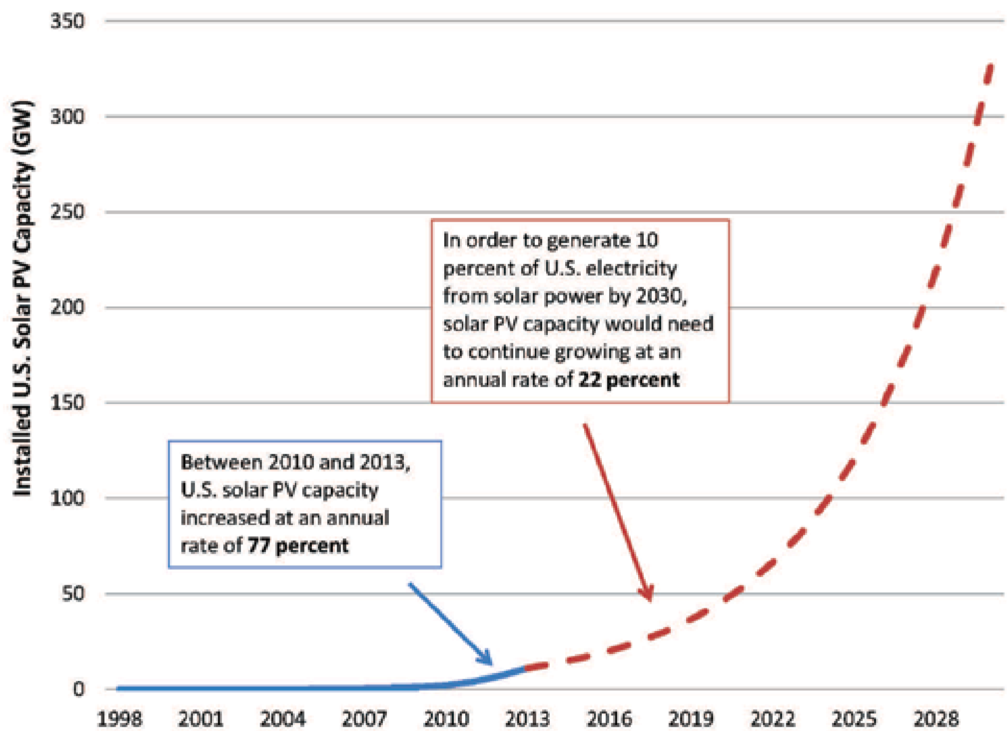
A Solar Future Is Within Reach

The amount of solar energy in the United States is increasing exponentially. Between 2010 and 2013, the amount of solar PV capacity in the United States grew 77 percent per year.[26]

Continued growth of solar energy at even one-third of that annual rate would result in the nation obtaining 10 percent of its electricity from the sun by 2030.[27] If every state captured 0.1 percent of its technical potential for solar power, the United States would be generating 10 percent of its electricity from the sun by 2030.[28]

The 22 percent annual growth rate needed for solar energy to supply 10 percent of the nation's electricity was also surpassed by every one of the top 25 solar states between 2010 and 2013. In 17 of those states,

Figure 5. The United States Can Generate 10 Percent of Its Electricity from the Sun by 2030[29]



installations of PV capacity have *more than doubled* annually over the past several years.[30]

Rapid growth in solar energy has even been sustained by several states that had significant amounts of solar capacity prior to 2010. In 2010, Arizona had already installed enough solar capacity to power 15,000 homes and continued to annually more than double the amount of solar PV capacity installed statewide through 2013.[32] California, the nation's leader in installed solar PV capacity, has seen solar PV capacity continue to grow at a rate of 72 percent each year since 2010. (See Table 1.)

This growth has occurred even as a major solar incentive program, the California Solar Initiative, has wound down.

Meeting a theoretical growth rate leaves important questions about the feasibility of a 10 percent national solar goal unanswered. Could manufacturers worldwide make enough solar panels to achieve that goal? And could the grid support large volumes of solar energy?

The answer to both questions appears to be "yes."

Solar manufacturing capacity: Solar panel manufacturing capacity has grown dramatically in recent years. A study by GTM Research predicts that "the 50 largest PV module suppliers alone will add more than 10 gigawatts in manufacturing capacity in 2014."[33] Ten gigawatts of solar manufacturing capacity is greater than the total amount of solar power installed in U.S. history up until 2013 and the rapid scale-up of solar manufacturing bodes well for the prospect of meeting

Table 1. Solar Energy Growth in Top 25 States for Cumulative Installed Solar PV Capacity[31]

Rank	State	Total Solar PV Capacity Installed in 2010 (MW-DC)	Total Solar PV Capacity Installed in 2013 (MW-DC)	Percent Annual Growth in Solar PV Capacity by State, 2010-2013
1	California	1,021.7	5,183.4	72%
2	Arizona	109.8	1,563.1	142%
3	New Jersey	259.9	1,184.6	66%
4	North Carolina	40	469	127%
5	Massachusetts	38.2	445	127%
6	Nevada	104.7	424	59%
7	Colorado	121.1	360.4	44%
8	Hawaii	44.7	358.2	100%
9	New Mexico	43.3	256.6	81%
10	New York	55.5	240.5	63%
11	Texas	34.5	215.9	84%
12	Pennsylvania	54.8	180.2	49%
13	Maryland	10.9	175.4	152%
14	Florida	73.5	137.3	23%
15	Georgia	1.8	109.9	294%
16	Ohio	20.7	98.4	68%
17	Connecticut	24.6	77.1	46%
18	Tennessee	4.7	64.8	140%
19	Delaware	5.6	62.8	124%
20	Oregon	23.9	62.8	38%
21	Indiana	0.5	49.4	362%
22	Missouri	0.7	48.9	312%
23	Louisiana	0.2	46.6	515%
24	Illinois	15.5	43.4	41%
25	Vermont	2.9	41.5	143%

rising demand for solar energy.[34]

Integrating solar energy into the grid: The U.S. Department of Energy SunShot Initiative conducted a study to evaluate the impacts of higher grid penetration of solar energy, examining the impacts of 20 percent renewable energy penetration and concluding that utilities can reliably bring large amounts of distributed solar power generation online. Using demand response programs that take advantage of smart grid investments and intelligently vary customer loads, modifying utility equipment to function at lower minimum power levels, incorporating and deploying battery storage, and managing flexible operating schedules for some baseload power units, among other strategies, can allow utilities to effectively manage high levels of solar penetration.[35]

Energy storage technologies that are intelligently deployed throughout the electricity grid could allow grid operators to tap into even greater amounts of clean, renewable power. California, for example, has already taken steps to support the expansion of battery storage technology. In late 2013, the state required that investor-owned utilities procure 1,325 MW of electricity and thermal storage by 2020.[36] This energy storage requirement is likely to boost California's already fast-growing customer-sited energy storage industry, and potentially the state's electric vehicles market, as well.[37] Concentrating solar power with thermal storage is already a proven technology and can help address the challenges of variability in solar energy as well.[38]

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. With the right pro-solar policies in place, states can meet their solar energy potential and reap the range of environmental, economic and consumer benefits that come with using clean, locally produced electricity from the sun on a large scale.

A Solar Energy Future Would Transform America's Environment and Economy

Meeting 10 percent or more of America's electricity needs with clean, solar power by 2030 is possible. Achieving that vision would deliver substantial benefits to our environment, consumers, and the economy.

Addressing Global Warming

By making the sun a major source of America's energy, our nation can reduce the environmental and public health threats of pollution from fossil-fueled power plants. Solar power produces no global warming pollution while generating electricity. Even when emissions from manufacturing, transportation and installation of solar panels are included, solar power produces 96 percent less global warming pollution than coal-fired power plants over its entire life cycle, and 91 percent less global warming pollution than natural gas-fired power plants.[39]

Rooftop solar energy could also help communities deal with the erratic weather and climatic stresses exacerbated by global warming. If transmission lines are disrupted from a severe storm or heat wave, solar energy attached to batteries can help avoid blackouts.[40] Distributed solar generation paired with microgrids – electricity systems that can operate independently of the central grid and create intentional islands – can also keep the power on after severe weather events that disrupt electricity transmission on the centralized grid.[41] Solar PV panels also reduce water issues during times of drought, using far less water than conventional fossil fuel and nuclear power plants. (See page 19.)

Planning and achieving large-scale solar energy production will also help us break from fossil fuel dependency and achieve the goals of the U.S. EPA's Clean Power Plan.

Proposed in June 2014, the Clean Power Plan sets national and state-by-state targets and deadlines for the reduction of power plant emissions, with the aim of reducing CO2 emissions from electricity production by 30 percent compared with 2005 levels.[42] Each state is free to achieve its target in its own way, and one of the main building blocks encouraged by the EPA is an increase in renewable energy.[43] Increasing solar energy production could help states achieve the goals of the Clean Power Plan by reducing dependence on fossil fuel-fired power plants, and a recent study from the Union of Concerned Scientists shows that renewable energy can do even more to reduce states' fossil fuel consumption than the EPA projects in its proposed state targets.[44]

Cleaning Up Our Air

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

- **Nitrogen oxides** – Nitrogen oxides contribute to the formation of ozone "smog." Ozone reacts with airway tissues and produces inflammation similar to sunburn on the inside of the lungs. This inflammation makes lung tissues less elastic, more sensitive to allergens, and less resistant to infections.[45] Minor exposure to ozone can cause coughing, wheezing and throat irritation. Constant exposure to ozone over time can permanently damage lung tissues, decrease the ability to breathe normally, and exacerbate or potentially even cause chronic diseases like asthma.[46] Power plants are responsible for 23 percent of U.S. emissions of nitrogen oxides.[47]

- **Sulfur dioxide** – Sulfur dioxide contributes to the formation of small particles in the air that can penetrate deep into the lungs and trigger respiratory diseases such as bronchitis and emphysema. Small particle pollution has been linked to increased rates of hospital admissions and premature death.[48] Two-thirds of sulfur dioxide emissions come from fossil fuel-fired power plants.[49]
- **Mercury** – Coal-burning power plants produce more than half of all emissions of airborne mercury, a potent neurotoxicant that is converted by microorganisms in water into a form that accumulates up the food chain.[50] All 50 states have fish consumption advisories urging limited or no consumption of fish from certain local waters due to the threat posed by mercury contamination, especially to children, nursing mothers and pregnant women.[51]

Saving Water

Broad integration of solar photovoltaics could significantly reduce water use in the U.S. power sector. Electricity production accounts for 40 percent of freshwater withdrawals nationally, making reductions in water consumption in this sector increasingly important to protect aquatic environments and increase community resilience to droughts.[52] In addition, the increasing production of electricity with natural gas produced through water-intensive "fracking" exacerbates the burden of power production on water supplies. Between 2005 and 2013, fracking wells used 250 billion gallons of water. In 2012 alone, fracking wells produced 280 billion gallons of toxic wastewater.[53]

Solar photovoltaics, by contrast, use almost no water once they are installed. The life-cycle water consumption of solar photovoltaics is 1/500th of the life-cycle water consumption of coal power plants and 1/80th of that of natural gas plants per unit of electricity produced.[54] According to a study by the Union of Concerned Scientists, an electric system that transitions to renewable sources and cuts energy use with energy efficiency programs would withdraw and consume half the amount of water as a business-as-usual scenario in the power sector by 2030.[55]

Because solar power does not rely on water for electricity production, communities that generate a significant amount of electricity from the sun will be less susceptible to electricity disruption during droughts. During the Midwest drought of 2012, many fossil-fuel power plants that require cooling water to operate were forced to limit or suspend electricity production.[56] The California drought caused a drop in hydroelectricity generation at the beginning of 2014, but the state's solar energy helped to compensate and guard against electricity outages.[57] Climate change will only exacerbate these types of issues and solar power can be a real solution to stabilize electricity production under these conditions.

Protecting Electricity Consumers

Scaling up U.S. solar electricity generation would deliver important benefits to homeowners and businesses, including low-income consumers. With 10 percent of electricity being delivered by solar power, all consumers would see less price volatility from fossil fuels, reduced loss of electricity in transmission and distribution, and, when paired with battery storage, reduced impacts from power outages.

An electric grid that relies more on solar power and less on fossil fuels can deliver electricity to all customers at a less volatile cost. With solar energy as a significant energy source, consumers would experience much less fossil-fuel related volatility in the price of electricity.[58] Rooftop solar panels also capture the most solar energy during sunny, hot periods of high electricity demand when the cost of producing electricity is normally the highest – saving money for all consumers on their power bills. By capturing the most solar energy during heat waves, solar power can also insulate communities against blackouts.[59]

With smart public policies and declining prices, more and more people have the opportunity to benefit from solar energy, including low-income households and those living in multi-family housing. Low income families participating in California's Single-Family Affordable Solar Homes program, for example, cut their monthly electricity bills by 80 percent on average.[60] In multi-family homes, programs that allow for "virtual net metering" can distribute the benefits of one solar installation to multiple families in a housing complex. Virtual net metering enables shared, community solar projects that allow those who are unable to install solar panels on their own properties or live in multi-family homes to "go solar."[61]

Using more distributed solar power for U.S. electricity production would also result in a more efficient electric grid. Five to eight percent of the electricity transmitted over long-distance transmission lines is lost between its production at power plants and final consumption – distributed solar energy avoids these losses by generating electricity at or near the location where it is used.[62] This allows more energy to go straight into homes, and avoids high-cost investments in expanding transmission capacity.

Creating American Jobs

Installing more solar power is not only good for the environment and for electricity consumers; it also creates a significant number of local jobs for Americans in a growing industry. The number of solar industry jobs in manufacturing and installation for solar PV and concentrating solar power (CSP) is increasing rapidly and will continue to grow as America works to meet its vast solar potential.

America is already experiencing significant job growth in the solar energy industry. More than 140,000 Americans worked in the solar energy industry in 2013, a 20 percent increase from the previous year, according to The Solar Foundation's annual solar jobs census.[63] According to The Solar Foundation, growth in the solar industry from November 2012 to November 2013 was 10 times faster than the national average employment growth rate of 1.9 percent.[64] Solar industry investment in the U.S. economy is almost $15 billion each year.[65]

Jobs in solar energy installation are rising rapidly along with the growth in solar energy nationwide – in 2013 alone, employment in installation increased by 22 percent. About half of all workers in the solar industry install solar energy systems.[66]

U.S. manufacturers continue to play important roles in developing the next wave of solar energy technologies, and many American firms are key suppliers of materials and components for solar panels manufactured abroad.[67] About 20 percent of all solar workers are in manufacturing.[68] Solar industry analysts expect 2014 to be an even bigger year for manufacturing employment, projecting this sector to grow by 8 percent from 2013 to a total of 32,400 jobs.[69]

A future in which solar energy is deployed widely across the country is both possible and beneficial to the nation. It is up to local, state and federal decision makers to put policies in action that will make solar power broadly available, accessible and an effective energy source for the American electricity market.

Achieving a Solar Future: Policy Recommendations

A future in which America gets 10 percent of electricity from the sun is achievable and is coming sooner than one might think. By 2030, the nation could be on its way to a solar energy future of dramatically reduced global warming pollution, cleaner air and a more vigorous economy. Every state has the potential to take part in this transformation – each has a vast reserve of untapped solar potential to draw upon. The vision of a solar energy future is one that is broadly supported by the American people. More than four out of five Americans – 81 percent — want to see an increase in our use of solar power.[70]

New Jersey is already experiencing the benefits of solar energy adoption. New Jersey is a national leader in the adoption of solar energy, as the state with the third-greatest amount of cumulative installed solar capacity as of the end of 2013.[71] New Jersey's solar energy industry employed 6,500 people in 2013.[72] A future with more solar power is within reach: solar PV capacity in New Jersey increased at a rate of 66 percent per year from 2010 to 2013. If solar PV installations continue to increase at one-third of that rate (22 percent) annually between 2013 and 2025, New Jersey would have enough solar energy to generate 20 percent of its electricity.[73]

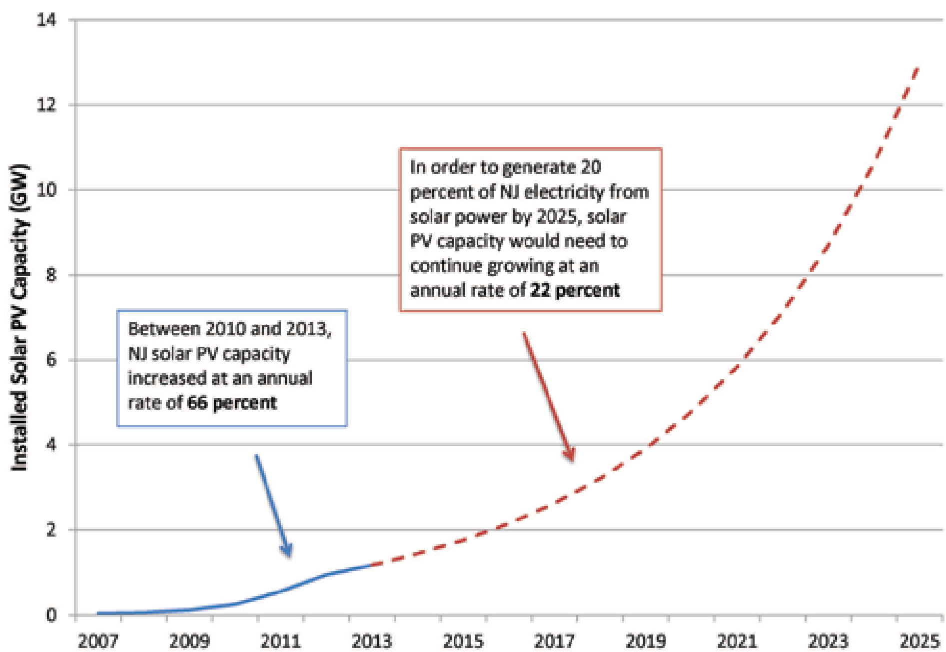
To lay the groundwork for achieving that future, **New Jersey should commit to obtain 20 percent of its electricity from the sun by 2025.** New Jersey has the potential to produce more than six times the amount of electricity from solar power installations that the state consumes each year. The state has more than 800,000 buildings available that can host rooftop solar panels.[75]

The adoption of ambitious solar energy goals can then guide the development of strong pro-solar policies. Research shows that solar energy policies – far more than the availability of sunshine – dictate which states have successful solar industries and which ones do not.[76] Policy-makers at every level of government – federal, state and local – have an important role to play in making a solar energy future for America a reality.

State governments should set high goals for solar energy adoption, implement net metering policies that allow residents to realize the full benefits of solar power and use public policies to incentivize continued innovation and growth in the solar industry.

- *Set renewable energy standards with a solar carve-out* – States should adopt renewable energy standards with solar carve-outs that require a significant and growing share of that state's electricity to come from the sun. New Jersey's state government should lead the way toward meeting these goals by installing solar power on all available government buildings.
- *Adopt and preserve strong statewide interconnection and net metering policies* – These critical

Figure 6. New Jersey Can Generate 20 Percent of Its Electricity from Solar Power by 2025[74]



policies ensure that individuals and businesses are appropriately compensated for the electricity that they export to the grid, and allow them to move seamlessly between producing their own electricity and using electricity from the grid. In states without strong net metering programs, carefully implemented CLEAN contracts (also known as feed-in tariffs) and value-of-solar payments can play an important role in ensuring that consumers receive a fair price for solar energy, so long as the payments fully account for the benefits of solar energy and are sufficient to spur participation in the market. Policies such as virtual net metering or shared solar allow the solar market to expand to low income households, renters, and apartment dwellers and allow community financing and ownership of solar.

- *Implement policies that support energy storage and microgrids* – 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.[77]

- *Achieve the goals of the Clean Power Plan* – States should set effective plans for meeting or surpassing the goals of the Clean Power Plan, with clean and renewable sources of energy such as solar playing a leading role. New Jersey has a goal of reducing its rate of global warming emissions per unit of electricity generation by 43 percent below 2012 emissions levels.[78] Producing 20 percent of its electricity from clean, solar power would reduce New Jersey's global warming pollution by 12 million metric tons in 2025 – the equivalent of taking 2.6 million cars off the road. If the EPA allows distributed generation as a compliance strategy for states, solar electricity generation that at least meets 20 percent of New Jersey's electricity needs would enable the state to achieve more than three-quarters of its 2030 emission reductions goal under the Clean Power Plan.[79]

Strong and thoughtful **federal policies** can promote solar power, make it more accessible, and lay an important foundation on which state and local policy initiatives can be built. Among the key policy approaches that the federal government should take are the following:

- *Extend tax credits for solar energy* – 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 incentives and consider making them permanent with the value phasing down over time as solar expands. Non-profit organizations and local governments that are ineligible for tax credits should be able to for grants and similar benefits.
- *Support research to drive solar power innovations* – 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. By continuing to investigate how to best integrate solar energy into the grid, how to deliver solar energy more efficiently and cost-effectively, and how to lower market barriers to solar energy, the SunShot Initiative and other efforts play a key supporting role in the nation's drive to embrace the promise of solar energy. The federal government should invest in energy storage for solar power as an important way to expand the integration of renewable energy into the grid and increase community resilience in the face of extreme weather.
- *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.[80] Solar energy will likely be a major contributor to reaching that goal. The federal government consumes vast amounts of energy and manages thousands of buildings – If the government puts solar installations on every possible rooftop, it would set a strong example for what can be done to harness the limitless and pollution-free energy of the sun. The U.S. military has committed to getting one-quarter of its energy from renewable sources by 2025 and has already installed more than 130 megawatts of solar energy capacity.[81] Federal agencies should continue to invest in solar energy, and 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. Programs designed to provide fuel assistance to low-income consumers, such as the Low Income Heating Assistance Program (LIHEAP), should be expanded to include solar energy as an energy saving option. In addition, the federal government should continue to work for environmentally responsible expansion of solar energy on federal lands.
- *Finalize and strengthen the requirements of the Clean Power Plan* – The federal government should adopt the standards of the Clean Power

Plan to reduce global warming emissions 30 percent below 2005 levels by 2030. Renewable energy deployment must play a significant role in helping the United States achieve these pollution reductions.

Local governments should adopt strong solar goals, enact local initiatives to help make solar power available to all residents and eliminate red tape that makes solar power more expensive and less accessible to customers.

- *Implement solar access ordinances* – These critical protections guard homeowners' right to generate electricity from the sunlight that hits their property, regardless of the actions of neighbors or homeowners' associations. Local governments should also offer clear zoning regulations that allow solar energy installations on residential and commercial rooftops, 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.[82]
- *Eliminate red tape by reforming permitting processes* – Reducing fees, making permitting rules clear and readily available, speeding up the permitting process, and making inspections convenient for property owners can help residents "go solar."[83] The Vote Solar Initiative has laid out a series of best practices that local governments can follow to ensure that their permitting process is solar-friendly.[84]
- *Help reduce the cost of solar power* – Cities in states where property assessed clean energy (PACE) financing is an option for taxpayers can allow for property tax bills to be used for the collection of payments toward financing a solar energy system. Municipalities can also incentivize solar power adoption with tax credits for solar energy projects. Bulk purchasing or "Solarize" programs, in which cities or communities purchase solar PV installations in bulk for homes and businesses, can also help reduce the cost of going solar. Cities can also provide financial or zoning incentives to encourage the construction of green buildings that incorporate small-scale renewable energy technologies such as solar power.
- *Install solar panels on public buildings* – Local governments can promote clean energy, boost their local solar energy markets and cut air pollution by installing solar panels on public buildings, like schools and municipal office buildings. According to a report from the U.S. Department of Energy and the Solar Energy industries Association, 3,727 schools across the country currently host 490 MW of solar capacity.[85] Not only do these panels save money on electricity bills, they also serve as a public example of a smart clean energy investment.

In order to embrace this cutting-edge, clean energy resource, decision makers at all levels of government must endorse ambitious goals for solar energy adoption and enact the policies that will encourage Americans to put solar power on the grid. Solar energy has the potential to power the nation and every individual state many times over. Our state and national policies will determine whether America can harness a significant portion of its solar potential by 2030 and prepare for cleaner air, lower electricity prices and more resilient, local electricity grids into the future.

Appendix A. Methodology

Quantifying State-by-State Solar Potential

In this report, we quantify the solar potential of each state in terms of:

- Percentage of the state's electricity that could come from all solar electricity generation;
- Number of rooftops in each state that could host solar panels; and
- Recent percent annual growth in solar energy in the state.

Data on the potential solar PV capacity and total potential solar electricity capacity of each state came from the National Renewable Energy Laboratory's 2012 report *U.S. Renewable Energy Technical Potentials: A GIS-Based Analysis*: Anthony Lopez et al., National Renewable Energy Laboratory, *U.S. Renewable Energy Technical Potentials: A GIS-Based Analysis*, July 2012.

Total Solar Electricity Potential

To calculate how many times a state's electricity demand could be met by all potential in-state solar electricity generation (including utility-scale solar projects and concentrating solar power), we divided potential solar electricity generation as estimated in NREL's 2012 report by the state's 2012 annual electricity sales, as documented by the U.S. Energy Information Administration. [86]

Number of Times Solar Electricity Capacity Could Power the State = (Potential Solar Electricity Generation/ Annual State Electricity Sales)

Rooftops that Could Host Solar Panels, by State

To calculate how many rooftops in each state could host solar panels, we compiled "total housing units" by state from the U.S. Census Bureau and regional commercial building totals from the preliminary results of the 2012 U.S. Energy Information Administration's Commercial Buildings Energy Consumption Survey.[87] Regional commercial building totals were scaled to state estimates using state and regional populations from the U.S. Census Bureau.[88]

Number of Commercial Buildings in State = Regional Commercial Buildings*(State Population/Regional Population)

According to NREL's methodology in its report on technical potential, 65 percent of commercial rooftop area and 22 percent of residential rooftop area in cool climates is available to host solar panels and 60 percent of commercial rooftop area and 27 percent of residential rooftop area in warm climates is available to host solar panels.[89] Applying these availability factors to residential and commercial building totals by state, we came up with estimates for the number of rooftops that are technically available to host solar panels by state.

Calculating Annual Solar PV Growth Rates

Percent Annual Growth of Solar Power in Each State

We used data from the Interstate Renewable Energy Council on state solar PV capacity to determine the percent annual growth of solar PV in each state and the country between 2010 and 2013.[90]

Percent Annual Growth Rate Formula: ((final value/start value) $^{1/\text{number of years}}$ **)-1**

Percent Annual Growth Rate of Solar PV: ((2013 Solar Capacity/2010 Solar Capacity) $^{1/3}$ **)-1**

Percent Annual Growth Rate Needed for U.S. to Generate 10 Percent of Its Electricity from Solar by 2030

To determine the percent annual growth of solar photovoltaic capacity necessary for the United States to generate 10 percent of its electricity from solar power by 2030, we found the projected percent annual growth of electricity consumption in the country from the U.S. Energy Information Administration's (EIA's) *Annual Energy Outlook*.[91] We applied this growth rate to the United States' 2012 electricity sales to estimate how much electricity the country would consume in 2030.[92] This allowed us to calculate how much electricity (in GWh) would need to be generated by solar power in 2030 in order to hit 10 percent of America's electricity consumption.

Estimating 2013 Solar Generation from Installed Solar Capacity

To calculate 2013 electricity generation from solar PV in the U.S., we used end-of-year 2013 solar PV capacity as reported by Lawrence Berkeley National Laboratory in the report *Tracking the Sun*.[93] We assigned solar capacity factors for solar PV by calculating the average capacity factors implied in NREL's 2012 report, which lists potential capacity and generation for each solar technology by state. We used the *rooftop* PV capacity factor to determine how much electricity solar PV capacity installed would be able to produce over the course of a year – this is a lower/more conservative estimate of the capacity at which solar generation operates than capacity factors based on utility-scale PV generation.[94]

We then calculated the percent annual growth in solar energy generation that would be needed to produce 10 percent of the nation's electricity from solar power in 2030. We did not account for changes in PV efficiency over time.

Percent Annual Growth Rate Needed to Achieve the State Solar Goal

To determine the percent annual growth of solar photovoltaic capacity necessary for the state to hit its solar goal, we followed the same procedure as described above to calculate the national annual growth rate. We estimated the projected percent annual growth of electricity consumption in the state using regional estimates from the U.S. Energy Information Administration's (EIA's) *Annual Energy Outlook*.[95] We applied this growth rate to the state's 2012 electricity sales to calculate how much electricity would need to be generated by solar power in order to hit the state's solar goal.[96]

Estimating 2013 Solar Generation from Installed Solar Capacity

To calculate 2013 electricity generation from solar PV in the state, we used end-of-year 2013 solar PV capacity as reported by the Interstate Renewable Energy Council.[97] We assigned solar capacity factors for solar PV by calculating the average capacity factors implied in NREL's 2012 report, which lists potential capacity and generation for each solar technology by state. We used the rooftop PV capacity factor to determine how much electricity solar PV capacity installed would be able to produce over the course of a year – this is a lower/more conservative estimate of the capacity at which solar generation operates, since utility-scale PV generation tends to operate at higher capacity factors.[98]

We then calculated the percent annual growth in solar energy generation that would be needed to hit the state's solar goal.

Estimating Avoided Global Warming Emissions

To estimate carbon dioxide emission reductions, we assumed that solar electricity added to the grid would offset generation from coal and natural gas power plants in proportion to each state's consumption of electricity from coal and natural gas.

We first used AEO 2014, Tables 73-94, to obtain data on 2025 and 2030 electricity generation and emissions for coal and natural gas power plants in each EIA electricity market module (EMM) region. 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.[99] We estimated an emissions factor for each NERC region, using the generation and emissions data for the constituent EMM regions.

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. NERC regions could not be identified for utilities responsible for a total of 1.5 percent of electricity sales nationally. The majority of those sales were in Texas. State emission factors were created by multiplying each state's percentage of sales per NERC region by each region's emissions factor.

For Alaska and Hawaii, which are not included in the NERC regions, we calculated an emissions factor using 2011 data on total electricity generation and total carbon dioxide emissions from electricity generation in each state. Generation data came from: U.S. Department of Energy, Energy Information Administration, *Net Generation by State by Type of Producer by Energy Source (EIA-906, EIA-920, and EIA-923)*, December 2013. Emissions data came from: U.S. Department of Energy, Energy Information Administration, *U. S. Electric Power Industry Estimated Emissions by State, Back to 1990 (EIA-767 and EIA-906)*, February 2013.

The use of a constant emissions factor for each state masks hourly variations in the carbon intensity of electricity on the grid, meaning that the estimates in this report do not fully reflect the ways in which additional solar energy might affect hourly dispatch of different electricity generators in each region of the country.

Estimating the Percentage of the EPA's 2030 Clean Power Plan National Emission Reductions Goal That Could Come from Meeting the State's Solar Energy Goal

To estimate the percentage of the state's emission reductions goals under the Clean Power Plan that could be met by achieving its solar goal, we used the EPA's methodology to calculate the percentage change between the state's baseline 2012 emissions rate (including EPA-designated existing non-hydro renewable energy and "at risk" nuclear sources that could count towards the state goal) and its emissions rate were the state to achieve the solar goal.[100] We compared this percent reduction in the state's emissions rate from achieving its solar goal to the percent reduction represented by the EPA's proposed 2030 emissions rate goal for the state.[101]

Baseline 2012 Emission Rate = 2012 Fossil Fuel Emissions/(2012 Fossil Fuel Generation + Historical Generation from Non-Hydro Renewables + "At Risk" Nuclear Generation)

Emission Rate after Meeting State Solar Goal = 2012 Fossil Fuel Emissions/(2012 Fossil Fuel Generation + Historical Generation from Non-Hydro Renewables + "At Risk" Nuclear Generation + MWh of Solar Power Needed to Meet State Goal)

EPA's 2030 Proposed State Emissions Rates = See the EPA's "Goal Computation Technical Support Document" for a detailed breakdown of how this state goal is calculated based on modifications to states' 2012 generation and emissions. The EPA developed a "Best System of Emissions Reductions" to guide state plans to hit their reductions goals, including improvements to states' coal fleets and natural gas combined cycle plants, increased deployment of renewable and nuclear energy sources, and decreased electricity generation from energy efficiency measures.[102]

The 2012 baseline emissions rate includes some "historical generation from non-hydro renewables," which includes some existing solar power. Because existing solar generation accounts for such a small percentage of existing electricity generation, we considered it negligible and proceeded without adjusting for solar power already included in the 2012 baseline.[103]

Appendix B. State Tables

Table B-1. State Electricity Sales vs. Total Potential Solar Electricity Production

State	Electricity Production from All Potential Solar Electricity Capacity (GWh)	Total 2012 Annual Retail Sales (GWh)	Number of Times Solar Energy Could Power the State[104]
Alabama	3,758,165	86,183	44
Alaska	8,283,142	6,416	1,291
Arizona	24,556,070	75,063	327
Arkansas	5,023,834	46,860	107
California	17,699,253	259,538	68
Colorado	19,452,241	53,685	362
Connecticut	33,961	29,492	1
Delaware	289,375	11,519	25
District of Columbia	2,499	11,259	0
Florida	5,274,479	220,674	24
Georgia	5,566,467	130,979	42
Hawaii	57,127	9,639	6
Idaho	7,466,971	23,712	315
Illinois	8,224,624	143,540	57
Indiana	4,992,152	105,173	47
Iowa	7,029,897	45,709	154
Kansas	22,515,073	40,293	559
Kentucky	1,862,803	89,048	21
Louisiana	4,184,643	84,731	49
Maine	1,105,986	11,561	96
Maryland	629,350	61,814	10
Massachusetts	111,397	55,313	2
Michigan	5,290,013	104,818	50
Minnesota	10,840,506	67,989	159
Mississippi	5,016,233	48,388	104
Missouri	5,381,978	82,435	65
Montana	9,741,194	13,863	703
Nebraska	14,131,977	30,828	458
Nevada	16,945,868	35,180	482
New Hampshire	63,453	10,870	6
New Jersey	499,848	75,053	7
New Mexico	33,208,762	23,179	1,433
New York	1,574,149	143,163	11

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State	Electricity Production from All Potential Solar Electricity Capacity (GWh)	Total 2012 Annual Retail Sales (GWh)	Number of Times Solar Energy Could Power the State[104]
North Carolina	4,329,556	128,085	34
North Dakota	9,777,286	14,717	664
Ohio	3,742,742	152,457	25
Oklahoma	14,472,440	59,341	244
Oregon	6,586,711	46,689	141
Pennsylvania	631,733	144,710	4
Rhode Island	17,135	7,708	2
South Carolina	2,803,221	77,781	36
South Dakota	11,645,189	11,734	992
Tennessee	2,295,918	96,381	24
Texas	62,153,732	365,104	170
Utah	10,290,431	29,723	346
Vermont	57,475	5,511	10
Virginia	1,932,186	107,795	18
Washington	1,947,153	92,336	21
West Virginia	59,938	30,817	2
Wisconsin	5,111,137	68,820	74
Wyoming	11,142,414	16,971	657

Table B-2. Percent Annual Growth Rate of Solar PV by State, 2010-2013

Rank (based on 2013 Installed Solar PV Capacity)	State	Total Solar PV Capacity Installed in 2010 (MW-DC)	Total Solar PV Capacity Installed in 2013 (MW-DC)	Percent Annual Growth in Solar PV Capacity by State, 2010-2013	Percent of Electricity Sales Met by Solar PV Generation in 2013
1	California	1,021.7	5,183.4	71.8%	2.8%
2	Arizona	109.8	1,563.1	142.4%	3.2%
3	New Jersey	259.9	1,184.6	65.8%	1.8%
4	North Carolina	40	469	127.2%	0.5%
5	Massachusetts	38.2	445	126.7%	0.9%
6	Nevada	104.7	424	59.4%	1.8%
7	Colorado	121.1	360.4	43.8%	0.9%
8	Hawaii	44.7	358.2	100.1%	4.6%
9	New Mexico	43.3	256.6	81.0%	1.7%
10	New York	55.5	240.5	63.0%	0.2%
11	Texas	34.5	215.9	84.3%	0.1%
12	Pennsylvania	54.8	180.2	48.7%	0.1%
13	Maryland	10.9	175.4	152.5%	0.3%
14	Florida	73.5	137.3	23.2%	0.1%
15	Georgia	1.8	109.9	293.8%	0.1%
16	Ohio	20.7	98.4	68.1%	0.1%
17	Connecticut	24.6	77.1	46.3%	0.3%
18	Tennessee	4.7	64.8	139.8%	0.1%
19	Delaware	5.6	62.8	123.8%	0.6%
20	Oregon	23.9	62.8	38.0%	0.1%
21	Indiana	0.5	49.4	362.3%	0.1%
22	Missouri	0.7	48.9	311.8%	0.1%
23	Louisiana	0.2	46.6	515.3%	0.1%
24	Illinois	15.5	43.4	40.9%	0.0%
25	Vermont	2.9	41.5	142.8%	0.8%
26	Washington	8	27.4	50.7%	0.0%
27	Wisconsin	8.7	22.5	37.3%	0.0%
28	Michigan	2.6	22.2	104.4%	0.0%
29	District of Columbia	4.5	16.5	54.2%	0.2%
30	Utah	2.1	16	96.8%	0.1%
31	Minnesota	3.6	15.1	61.3%	0.0%
32	Virginia	2.8	12.6	65.1%	0.0%
33	New Hampshire	2	9.6	68.7%	0.1%
34	South Carolina	0.2	8	242.0%	0.0%
35	Kentucky	0.2	7.9	240.6%	0.0%
36	Rhode Island	0.6	7.6	133.1%	0.1%

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Rank (based on 2013 Installed Solar PV Capacity)	State	Total Solar PV Capacity Installed in 2010 (MW-DC)	Total Solar PV Capacity Installed in 2013 (MW-DC)	Percent Annual Growth in Solar PV Capacity by State, 2010-2013	Percent of Electricity Sales Met by Solar PV Generation in 2013
37	Maine	0.3	5.3	160.4%	0.1%
38	Iowa	n/a or < 0.1	4.6	*	0.0%
39	Montana	0.7	3	62.4%	0.0%
40	West Virginia	n/a or < 0.1	2.2	*	0.0%
41	Alabama	0.4	1.9	68.1%	0.0%
42	Arkansas	1	1.8	21.6%	0.0%
43	Idaho	0.4	1.8	65.1%	0.0%
44	Kansas	n/a or < 0.1	1.1	*	0.0%
45	Mississippi	0.3	1	49.4%	0.0%
46	Wyoming	0.2	1	71.0%	0.0%
47	Oklahoma	n/a or < 0.1	0.7	*	0.0%
48	Nebraska	0.2	0.6	44.2%	0.0%
49	Alaska	n/a or < 0.1	0.2	*	0.0%
50	North Dakota	n/a or < 0.1	0.2	*	0.0%
51	South Dakota	n/a or < 0.1	n/a or < 0.1	*	*

Table B-3. Estimated Number of Commercial and Residential Rooftops that Could Host Solar Panels by State

Rank	State	Commercial Rooftops that Could Host Solar Panels	Residential Rooftops that Could Host Solar Panels	Total Rooftops that Could Host Solar Panels
1	California	415,508	3,701,213	4,116,721
2	Texas	327,770	2,741,805	3,069,575
3	Florida	207,209	2,438,513	2,645,722
4	New York	155,619	1,787,189	1,942,807
5	Pennsylvania	101,493	1,226,008	1,327,501
6	Illinois	131,600	1,163,833	1,295,433
7	Ohio	117,995	1,128,346	1,246,341
8	Georgia	106,406	1,109,040	1,215,445
9	Michigan	101,019	995,518	1,096,537
10	North Carolina	113,322	962,588	1,075,910
11	New Jersey	70,489	786,448	856,937
12	Virginia	95,122	747,646	842,768
13	Arizona	57,309	775,301	832,611
14	Washington	81,610	641,251	722,861
15	Massachusetts	89,510	618,287	707,797
16	Tennessee	83,306	623,658	706,964
17	Missouri	94,998	598,419	693,417
18	Indiana	66,819	617,855	684,674
19	Alabama	57,434	591,183	648,617
20	Wisconsin	58,530	579,178	637,708
21	South Carolina	50,669	582,327	632,996
22	Minnesota	84,857	519,436	604,293
23	Maryland	68,380	527,040	595,420
24	Louisiana	57,882	536,506	594,388
25	Colorado	49,147	490,718	539,865
26	Kentucky	56,522	426,211	482,732
27	Oklahoma	51,981	369,082	421,063
28	Oregon	46,140	370,157	416,297
29	Mississippi	35,552	346,652	382,205
30	Connecticut	48,355	327,360	375,715
31	Iowa	48,496	296,056	344,552
32	Nevada	24,127	319,367	343,495
33	Arkansas	40,185	292,210	332,395
34	Kansas	45,526	272,515	318,040
35	New Mexico	18,238	244,846	263,085
36	Utah	27,051	219,291	246,342
37	West Virginia	21,560	194,216	215,776

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Rank	State	Commercial Rooftops that Could Host Solar Panels	Residential Rooftops that Could Host Solar Panels	Total Rooftops that Could Host Solar Panels
38	Nebraska	29,271	176,940	206,212
39	Maine	17,902	159,321	177,223
40	Idaho	15,118	148,071	163,188
41	Hawaii	15,208	141,584	156,792
42	New Hampshire	17,787	135,741	153,529
43	Montana	9,523	106,955	116,478
44	Rhode Island	14,145	101,776	115,921
45	Delaware	10,657	90,268	100,925
46	South Dakota	13,146	81,014	94,161
47	North Dakota	11,037	72,435	83,472
48	Vermont	8,431	71,291	79,723
49	Alaska	8,655	67,678	76,333
50	District of Columbia	7,348	66,054	73,402
51	Wyoming	5,461	58,346	63,806
	Total	**3,491,426**	**31,644,743**	**35,136,169**

Notes

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