

Lighting the Way

**What We Can Learn from
America's Top 12 Solar States**



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Executive Summary

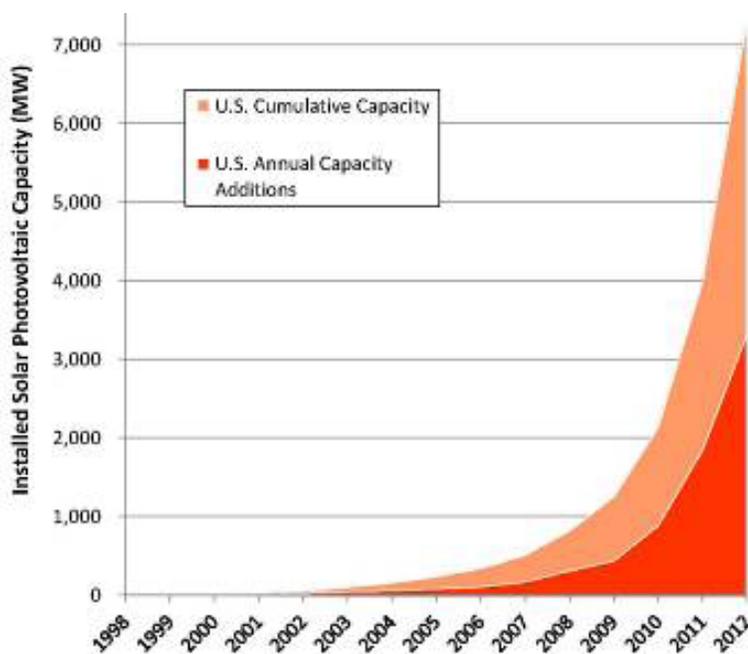
Solar energy is on the rise. America has more than three times as much solar photovoltaic capacity today as in 2010, and more than 10 times as much as in 2007. In the first three months of 2013, solar power accounted for nearly half of the new electricity generating capacity in the United States. The price of solar energy is falling rapidly, and each year tens of thousands of additional Americans begin to reap the benefits of clean energy from the sun, generated right on the rooftops of their homes or places of business.

America's solar energy revolution has been led by 12 states – the “Dazzling Dozen” – that have used public policies to open the door for solar energy and are reaping the rewards as a result.

The Dazzling Dozen states account for only 28 percent of the U.S. population but 85 percent of the nation's installed solar electricity capacity.* These 12 states – Arizona, California, Colorado, Delaware, Hawaii, Maryland, Massachusetts, Nevada, New Jersey, New Mexico, North Carolina and Vermont – possess strong policies that are enabling increasing numbers of homeowners, businesses, communities and utilities to “go solar.”

The pathway to a solar future laid out by the Dazzling Dozen is open to every state. By following their lead and implementing a new wave of public policies to expand access to solar energy, the United States can work toward the goal of getting at least 10 percent of our energy from the sun by 2030.

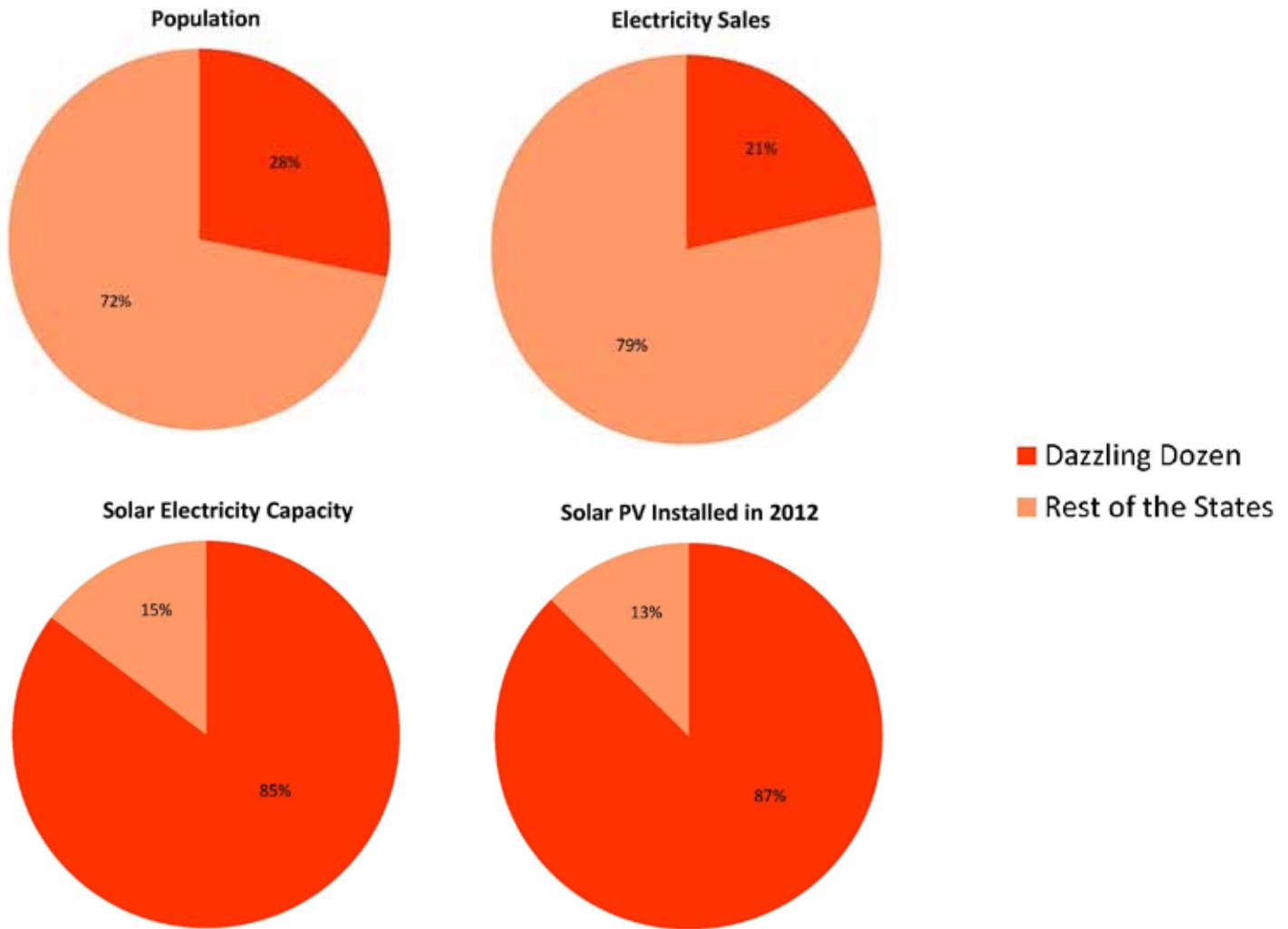
Figure ES-1. Cumulative U.S. Grid-Connected Solar Photovoltaic Capacity



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

- Solar photovoltaics (PV) produce 96 percent less global warming pollution per unit of energy than coal-fired power plants over their entire life cycle, and 91 percent less global warming pollution than natural gas-fired power plants.
- Solar energy benefits consumers by reducing the need for expensive investments in long-distance transmission lines.
- Solar energy can lower electricity costs by providing power at times of peak demand.

Figure ES-2, a-d. Solar Energy in the Top 12 Solar States versus the Rest of the U.S.



- Solar energy costs are falling rapidly. The cost of installed solar energy systems fell by 27 percent during 2012, on top of a 20 percent decline between the beginning of 2010 and the end of 2011.
- Solar energy creates local clean energy jobs that can't be outsourced. More than 119,000 people currently work in America's solar energy industry, most of them in jobs such as installation that are located in close proximity to the places where solar panels are installed.

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

- The amount of solar photovoltaic capacity* in the United States has increased more than tenfold in the last six years. (See Figure ES-1.)
- America's solar energy revolution is being led by 12 states – the Dazzling Dozen – which have the

highest per-capita solar electricity capacity* in the nation. These 12 states – Arizona, Nevada, Hawaii, New Jersey, New Mexico, California, Delaware, Colorado, Vermont, Massachusetts, North Carolina and Maryland – account for 28 percent of the U.S. population and 21 percent of U.S. electricity consumption, but 85 percent of total U.S. solar electricity capacity and 87 percent of the solar photovoltaic capacity installed in 2012. (See Figure ES-2 and Table ES-1.)

America’s leading solar states have adopted strong policies to encourage homeowners and businesses to “go solar.” Among the Dazzling Dozen states:

- 11 of the 12 have strong *net metering policies*. In nearly all of these states, consumers are compensated at the full retail rate for the excess electricity they supply to the grid. Net metering ensures that consumers receive reliable and fair compensation for the excess electricity they provide to the grid.

Table ES-1. Solar Electricity Capacity in the Top 12 Solar States (ranked by cumulative capacity per resident, data from the Solar Energy Industries Association)

State	Cumulative Solar Electricity Capacity per Capita (Watts/person)	Rank	Solar PV Capacity Installed During 2012 per Capita (Watts/person)	Rank	Cumulative Solar Electricity Installations (MW)	Rank	2012 Annual PV Installed Capacity (MW)	Rank
Arizona	167	1	108	1	1,097	2	710	2
Nevada	146	2	72	3	403	4	198	4
Hawaii	137	3	78	2	191	9	109	7
New Jersey	110	4	47	4	971	3	415	3
New Mexico	91	5	11	11	190	10	24	18
California	76	6	27	6	2,901	1	1,033	1
Delaware	69	7	28	5	44	19	18	19
Colorado	52	8	8	12	270	5	40	12
Vermont	34	9	26	7	21	22	16	20
Massachusetts	30	10	19	8	198	7	129	6
North Carolina	23	11	14	9	229	6	132	5
Maryland	19	12	13	10	109	14	74	8

- 10 of the 12 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.
- 11 of the 12 have **renewable electricity standards** that set minimum requirements for the share of a utility's electricity that must come from renewable sources, and 9 of them have **solar carve-outs** that set specific targets for solar or other forms of clean, distributed electricity.
- The vast majority of the states allow for **creative financing options** such as third-party power purchase agreements and property assessed clean energy (PACE) financing.
- States in the Dazzling Dozen 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.

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

- **Local governments** should adopt policies guaranteeing homeowners and businesses the right to generate power from the sunlight that strikes their properties and (where permitted) implement property-assessed clean energy (PACE)

financing programs to expand access to solar energy. Local governments with municipal utilities should promote solar energy by providing financial incentives – such as feed-in-tariffs – to customers and investing in community-scale and utility-scale solar projects. In addition, local governments should adopt solar-friendly zoning rules and streamlined permitting procedures to eliminate red tape and make it easier and cheaper for Americans to “go solar.”

- **State governments** should set ambitious goals for solar energy and adopt policies to meet them. State governments should also use their role as the primary regulators of electric utilities to encourage utility investments in solar energy, implement rate structures that maximize the benefits of solar energy to consumers, and support smart investments to move toward a more intelligent electric grid in which distributed sources of energy such as solar power play a larger role.
- **The federal government** should continue key tax credits for solar energy, encourage responsible development of prime solar resources on public lands in the American West, and support research, development and deployment efforts designed to reduce the cost of solar energy and smooth the incorporation of large amounts of solar energy into the electric grid.
- **All levels of government** should lead by example by installing solar energy technologies on government buildings.

* 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, that are increasingly important sources of clean energy.

Introduction

A decade ago, New Jersey faced a challenge. Demand for electricity was rising. The network of power plants and interstate transmission lines that provided power for New Jersey's residents and businesses was having a hard time keeping up. Building more power plants in the Garden State risked adding more pollution to New Jersey's already unhealthy air. On the other hand, building new transmission lines to bring in power from dirty, out-of-state coal-fired power plants threatened to undermine the state's commitment to addressing global warming.

New Jersey needed a power source that was clean and local – ideally one that could also create jobs to spark the state's economy, and could produce energy at reliable prices for decades to come.

To find the answer, New Jersey turned to the sun.

In 2004, the state adopted a renewable electricity standard with a solar energy carve-out, committing the state to generating 2.1 percent of its electricity from the sun by 2021.¹ To get there, the state created a system in which utilities compensated homeowners and businesses for every unit of solar electricity they generated. The state also put in place or maintained a series of other policies designed to make it as easy as possible for New Jersey residents to “go solar.”

Today, New Jersey has the fourth-most solar energy capacity per capita of any state in the nation – more even than states such as California, Colorado and

New Mexico with far more sunlight. In early 2013, New Jersey became the third state – following California and Arizona – to install 1 gigawatt of solar energy. More than 15,000 homes, 3,000 businesses, 300 schools and 200 government facilities in New Jersey now get at least part of their electricity from the sun.²

And that's just the beginning. In 2012, seeing the benefits solar energy had brought to the Garden State, a bipartisan coalition in the state legislature (with the support of Gov. Chris Christie) enacted legislation to increase its solar energy target to 4.1 percent of all electricity by 2028.³

New Jersey's rapid adoption of solar energy is the direct result of conscious decisions by policymakers to make “going solar” easy and affordable for residents and businesses. The Garden State isn't the only one to follow this path – this report documents how 12 states (the “Dazzling Dozen”) have used public policy to unlock the potential of solar energy to provide clean, sustainable, locally generated power.

Those 12 states are leading the way toward a future in which the United States gets a sizeable share of its energy from the sun – curbing our dependence on fossil fuels, reducing our contribution to global warming, and rebuilding our economy on a sustainable foundation. Local, state and federal governments should learn from their example and implement similar policies to move the nation toward a bright solar future.



Twelve states are leading the way toward a future in which the United States gets a sizeable share of its energy from the sun – curbing our dependence on fossil fuels, reducing our contribution to global warming, and rebuilding our economy on a sustainable foundation.

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

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

Solar Energy Is Good for the Environment

Power plants are America's largest source of carbon dioxide, the leading global warming pollutant. In 2011, U.S. power plants were responsible for one-third of the nation's global warming pollution.⁴ America's power plants produced more global warming pollution in 2011 than the entire economy of any nation in the world other than China, the United States, Russia and India.⁵

Solar power produces no global warming pollution. Even when emissions from manufacturing, transportation and installation of solar panels are included, solar power produces 96 percent less global warming pollution than coal-fired power plants over their entire life-cycle, and 91 percent less global warming pollution than natural gas-fired power plants.⁶

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

- **Nitrogen oxides** – Power plants are responsible for 23 percent of U.S. emissions of nitrogen oxides, which contribute to the formation of ozone “smog.”⁷ 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 able to ward off infections.⁸ 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.⁹
- **Sulfur dioxide** – Power plants produce two-thirds of the nation's emissions of sulfur dioxide, which contributes to the formation of small particles in the air that can penetrate deep into the lungs. Pollution from small particulates can trigger respiratory diseases such as bronchitis and emphysema and has been linked to increased rates of hospital admissions and premature death.¹⁰
- **Mercury** – Coal-burning power plants produce more than half of all emissions of airborne mercury, a potent neurotoxicant that is converted by microorganisms into a form that accumulates up the food chain.¹¹ 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.¹²

By reducing the need for electricity from fossil fuel-fired power plants, solar power reduces the threat

posed by global warming and helps to clean the nation's air.

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

Solar Energy Is Good for Consumers

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

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

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

Solar energy can also be a near-term economic winner for consumers and businesses – especially in states where electricity prices are high, owners of solar panels are compensated fairly for the excess electricity they supply to the grid, and there are strong pro-solar policies in place. In Hawaii, solar

energy has already achieved “grid parity” – that is, solar electricity is cheaper than electricity from the grid, even without government incentives.¹³ The Institute for Local Self-Reliance estimates that as many as 100 million Americans will live in areas where solar energy is cheaper than electricity from the grid within a decade.¹⁴ In the meantime, residents and businesses in many of these areas can benefit from government incentives that reduce the cost of solar energy to the point where it is less expensive than grid electricity.

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

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

- **Reduced energy losses** – Roughly 5 to 7 percent of the electricity transmitted over long-distance transmission lines is lost.¹⁵ Distributed solar energy avoids these losses by generating electricity at or near the location where it is used.
- **Reduced need for investment in transmission capacity** – Similarly, generating more electricity closer to the locations where it is used reduces the need to construct expensive new transmission capacity.
- **Reduced need for expensive “peaking” power** – Solar panels usually produce the most electricity on hot, sunny days when demand for power is at its highest. These are the times when utilities must generate or purchase power from expensive, often inefficient “peaking” power plants that may operate only a few hours each year. Expanding solar power can reduce the cost of providing power during these peak periods.¹⁶

Several recent studies have estimated the value that distributed solar photovoltaics (PV) provide to



More than 100,000 Americans are employed in the solar energy industry, with the number growing each year. Here, workers install solar panels on a Colorado home.

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

Solar Energy Is Good for the Economy

Solar energy creates local clean energy jobs that can't be outsourced. More than 119,000 Americans worked in the solar energy industry in 2012, a 13 percent increase from the previous year.²⁰

Over half of all workers in the solar industry install solar energy systems. Jobs in solar energy installation are rising rapidly along with the growth in solar energy nationwide – in 2012 alone, employment in installation increased by 17.5 percent.²¹

About one-quarter of all solar workers are in manufacturing.²² U.S. solar manufacturers have experienced difficulty in recent years as low-

priced imports (largely from China) have come to dominate the global solar energy market. However, U.S. manufacturers continue to play important roles in developing the next wave of solar energy technologies, and many American firms are key suppliers of materials and components for solar panels manufactured abroad.²³ Solar industry analysts project that manufacturing employment will rebound in 2013 after a significant decrease in 2012.²⁴

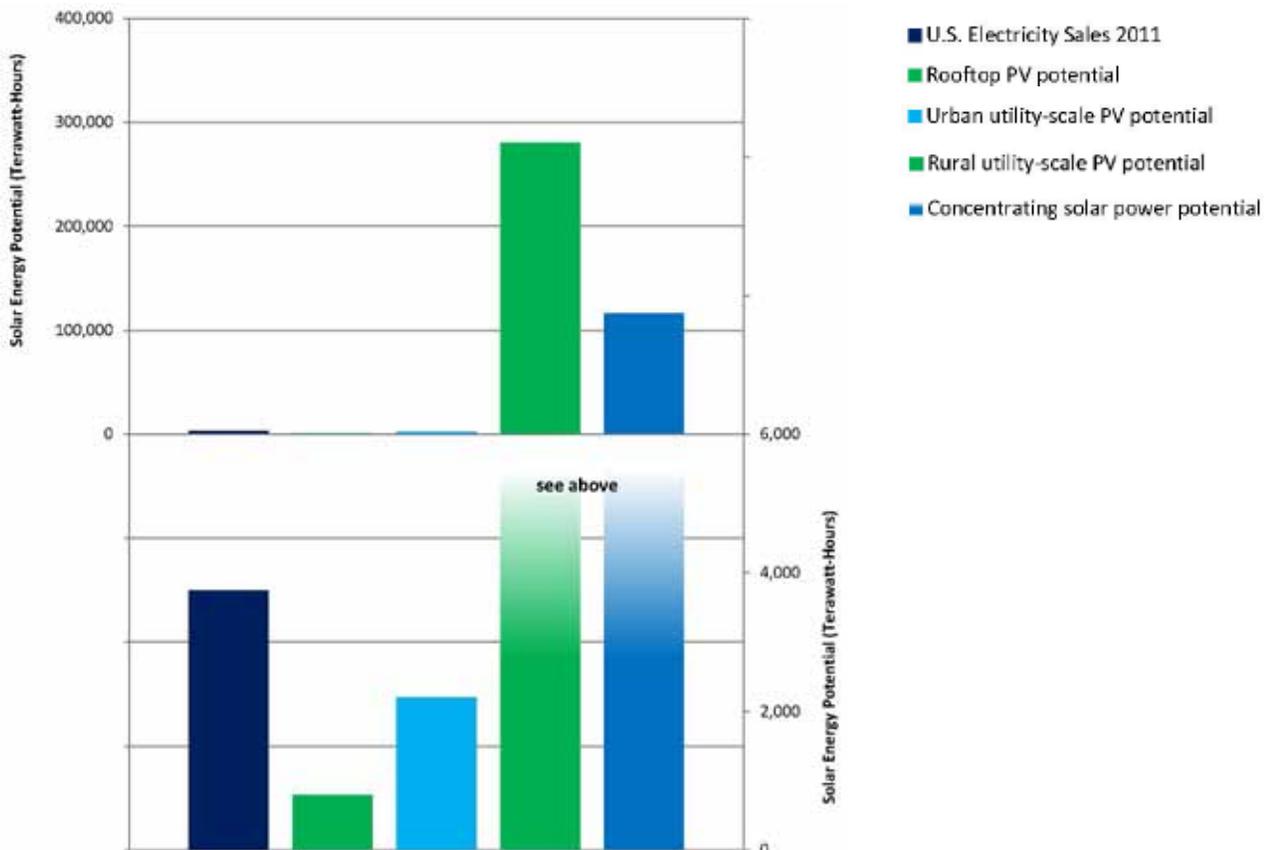
Not surprisingly, the states that have experienced the greatest growth in solar industry employment also happen to be those with the greatest amount of installed solar energy capacity. A 2012 study by the Solar Foundation found that seven of the top 10 states for total installed solar energy capacity (California, New Jersey, Arizona, Colorado, Pennsylvania, New York and Texas) were also ranked in the top 10 for solar industry employment.²⁵

America's Solar Energy Potential Is Virtually Endless

America has enough solar energy potential to power the nation several times over. A recent analysis by researchers with the National Renewable Energy Laboratory estimated that rooftop photovoltaic systems could generate more than 20 percent of the electricity used in the United States each year.²⁶ The potential for utility-scale photovoltaics in rural areas is even greater – representing *70 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 electricity from the sun than it uses in the average year. In 19 states, the technical potential for electricity generation from solar photovoltaics

Figure 1. Solar Electricity Generating Technical Potential (top and bottom charts present same data at different scales)²⁷



Solar Energy Is on the Rise

The amount of solar energy in the United States is rising rapidly – reducing America’s dependence on dirty sources of energy.

America’s solar revolution is being led by 12 states – the “Dazzling Dozen” –where a strong, long-term public policy commitment is leading to the rapid adoption of solar energy by homeowners, businesses and electric utilities.

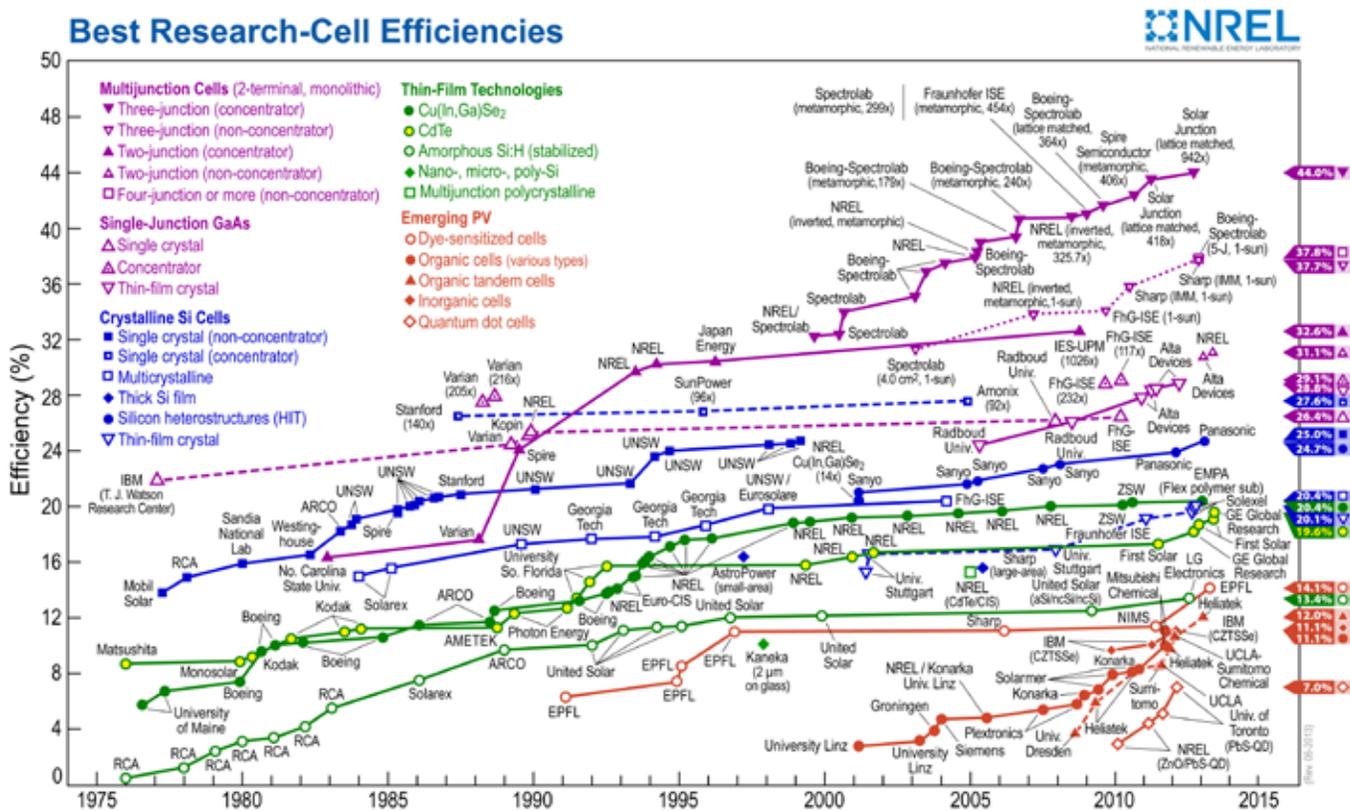
The Promise of Solar Energy Is Increasingly within Reach

Solar energy is evolving quickly from a curiosity – one sure to attract stares from passers-by and

questions from neighbors – into a mainstream source of energy.

That evolution has been made possible by a series of innovations that have taken place throughout the solar energy industry. Decades of research has resulted in solar cells that are more efficient than ever at converting sunlight into energy – enabling today’s solar energy systems to generate more electricity using the same amount of surface area as those of a decade ago.³⁰ (See Figure 3.) Innovations 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.

Figure 3. Improvements in Efficiency of Various Solar Technologies²⁹

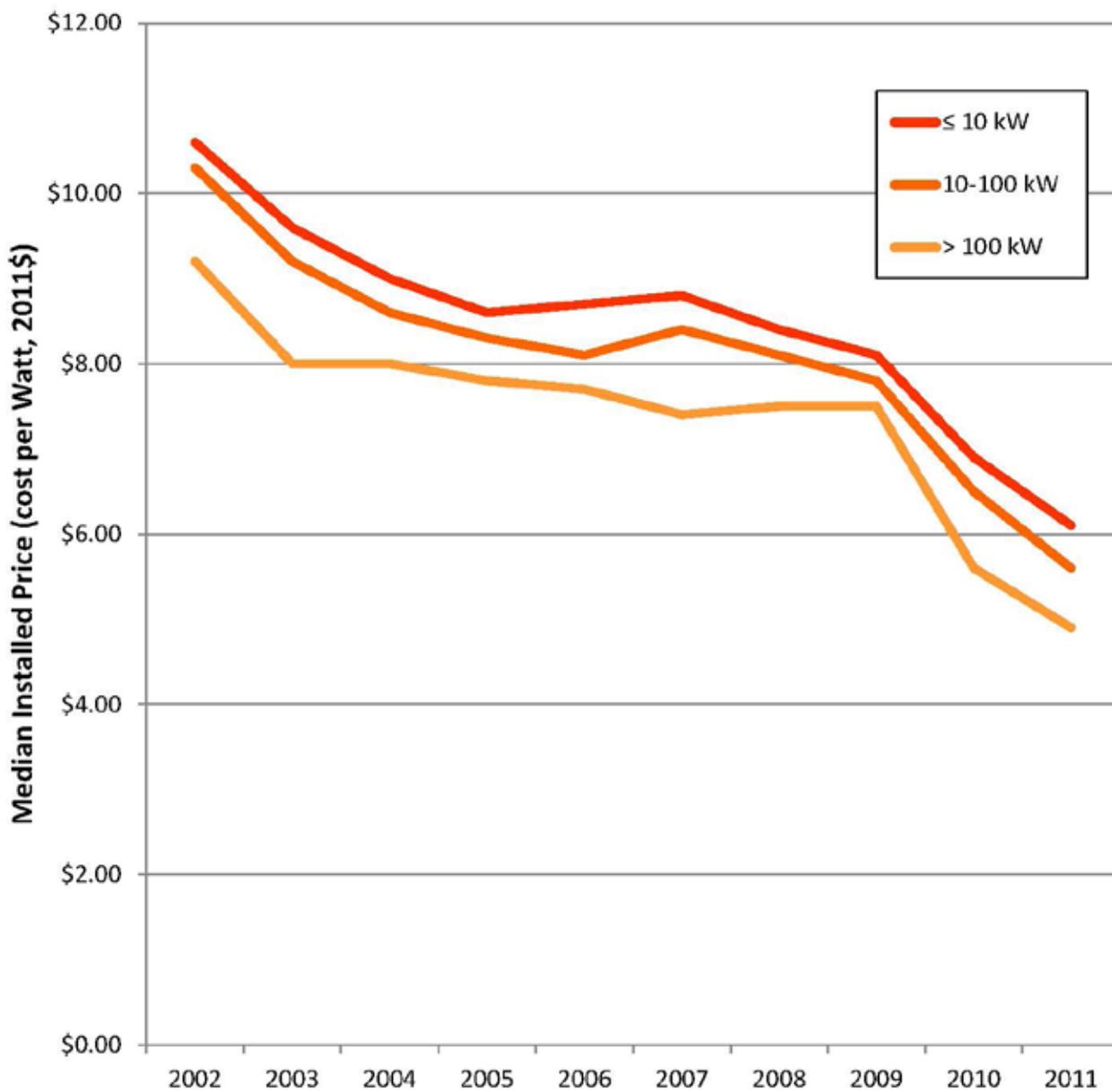


This chart from the National Renewable Energy Laboratory illustrates the steadily improving efficiency of solar photovoltaic systems in converting sunlight to energy – as well as the emergence of a variety of new photovoltaic technologies with the potential for breakthrough performance in the years to come.

As a result of these innovations and growing economies of scale, the cost of solar energy has plummeted in recent years and continues to fall. The cost of installed solar energy systems fell by 27 percent in 2012 alone³¹, on top of a 20 percent decline between the beginning of 2010 and the end of 2011.³² (See Figure 4.)

Evidence from elsewhere in the world suggests that solar energy prices still have room to fall further. The cost per Watt of an installed solar energy system in Germany, for example, is roughly half that of the United States, due to a variety of factors, including larger average system size, quicker project development timelines, and lower overhead.³⁴

Figure 4. Median Installed Price of Residential and Commercial Solar Photovoltaic Systems by Size³³

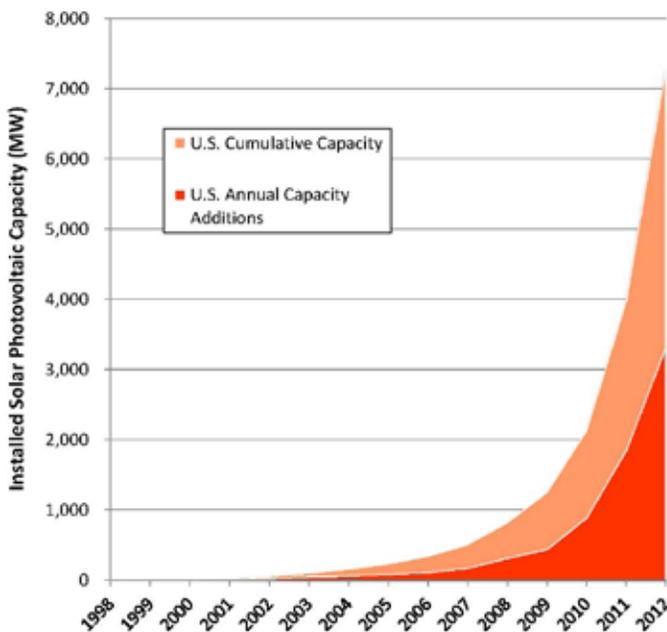


While there are still opportunities to reduce the cost of solar panels, the greatest immediate savings can be achieved by reducing “soft costs” – costs such as those associated with attracting customers, installing the systems, completing paperwork, and paying taxes and fees.³⁵ The U.S. Department of Energy and the solar industry are engaged in efforts to reduce soft costs, which, if successful, will make solar energy even more cost competitive in the years to come.

America’s Solar Energy Capacity Tripled in Two Years

Over the course of the last decade, the amount of solar PV capacity in the United States has increased nearly 140-fold, from 52 megawatts in 2002 to more than 7,200 megawatts at the end of 2012.³⁶ In just the fourth quarter of 2012, the United States installed 1,300 megawatts of solar power – more than the nation had installed in its entire history up to 2010.³⁷ (See Figure 5.) And in the first quarter of 2013, solar

Figure 5. Annual and Cumulative Installed Photovoltaic Capacity, United States³⁹



energy accounted for nearly half of all the new electric generation capacity installed in the United States.³⁸

The 12 Top 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.

The vast majority of America’s solar power capacity is located in 12 states – the “Dazzling Dozen” – that have seen high rates of per-capita adoption of solar energy. These states, not coincidentally, have also demonstrated the most foresight in developing public policies that pave the way for solar power.

The Dazzling Dozen: America’s Top 12 Solar States

Twelve U.S. states lead the nation in the amount of installed solar electricity capacity per capita. (See “Quantifying Solar Energy Capacity,” next page.) Not only do these 12 states lead for cumulative solar electricity capacity (according to data provided by the Solar Energy Industries Association), but they are also the 12 states with the greatest amount of solar PV capacity installed per capita in 2012, meaning that these states have continued to lead the nation in solar energy adoption.

These 12 states account for:

- 28 percent of the U.S. population⁴⁰
- 21 percent of U.S. electricity consumption⁴¹
- 85 percent of the nation’s solar electricity capacity, and
- 87 percent of the solar power installed during 2012.⁴²

Solar Electricity Capacity per Capita

Arizona leads the nation in solar electricity capacity per capita, with 167 Watts of solar electricity capacity per resident.⁴³ That is nearly seven times as much solar electricity capacity per person as the national average. Arizona's solar energy success is due in part to the state's early commitment to solar energy – it was the first state to require utilities to obtain a certain percentage of their electricity from solar energy.⁴⁴ Arizona also ranks second in the nation (behind California) in large, utility-scale solar energy projects – as of May 2013, Arizona had 633 MW of utility-scale solar energy capacity, with another 495 MW under construction.⁴⁵ (Arizona's continued status as a solar energy leader is in doubt, however. See "Is Arizona Stepping Back From Solar Energy Leadership?" next page.)

Quantifying Solar Energy Capacity

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

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

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

While several southwestern 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, Delaware, Maryland and Vermont) where the solar resource is less abundant but grid electricity prices are high and demand for locally produced clean energy is great. North Carolina, ranked 11th, owes its presence on the list to several large-scale solar energy installations by utilities in the state.

Table 1. Cumulative Solar Electricity Capacity per Capita⁴⁶

State	Solar Electricity Capacity per Capita (Watts/person)	Rank
Arizona	167	1
Nevada	146	2
Hawaii	137	3
New Jersey	110	4
New Mexico	91	5
California	76	6
Delaware	69	7
Colorado	52	8
Vermont	34	9
Massachusetts	30	10
North Carolina	23	11
Maryland	19	12

The 12 states with the greatest growth in photovoltaic capacity during 2012 are the same as those with the largest cumulative capacity, suggesting that these same states continued to demonstrate leadership in solar energy deployment last year. (See Table 2, next page.) Arizona again led the list with more than 100 Watts per person installed during 2012, with Hawaii, Nevada, New Jersey and Delaware rounding out the top five for new solar PV installations.

Table 2. Solar Photovoltaic Capacity Installed During 2012 per Capita⁴⁷

Photo: groSolar/NREL 15622

State	Solar PV Installed in 2012 per Capita (Watts/person)	Rank
Arizona	108	1
Hawaii	78	2
Nevada	72	3
New Jersey	47	4
Delaware	28	5
California	27	6
Vermont	26	7
Massachusetts	19	8
North Carolina	14	9
Maryland	13	10
New Mexico	11	11
Colorado	8	12



States such as Massachusetts have used strong public policies to encourage homeowners to “go solar.”

Is Arizona Stepping Back from Solar Energy Leadership?

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

Recently, however, the state took a major step backwards when the Arizona Corporation Commission (ACC), the state’s utility regulator, voted to eliminate tax incentives for businesses that install solar panels and to reduce incentives for residential solar customers.⁴⁸ The ACC also considered a proposal to weaken the state’s renewable electricity standard.

As a result of these actions, Arizona risks its ranking as the state with the greatest amount of solar electricity capacity per person – as well as the 9,800 solar industry jobs that rank the state first in the nation for solar jobs per capita and bring income and vitality to the state’s economy.⁴⁹

Total Solar Electricity Capacity

In terms of total solar electricity capacity, California leads the nation with more than 2.9 gigawatts – more than one-third of the nation’s total. Arizona, New Jersey, Nevada and Colorado round out the top five for total solar electricity capacity. (See Table 3.)

Several large, populous states – Pennsylvania, Florida and New York – with lower levels of per-capita solar capacity than the “Dazzling Dozen” appear on the top 12 list for total solar capacity. On the other hand, several small states – Vermont, Delaware and Maryland – with high levels of solar electricity capacity per capita fall out of the top 12 for total solar capacity.

Table 3. Top 12 States for Cumulative Solar Electric Capacity Through 2012⁵⁰

State	Cumulative Solar Electric Installations (MW)
California	2,901
Arizona	1,097
New Jersey	971
Nevada	403
Colorado	270
North Carolina	229
Massachusetts	198
Pennsylvania	196
Hawaii	191
New Mexico	190
Florida	186
New York	175

In terms of solar photovoltaic capacity installed in 2012, California again led the way with more than 1 gigawatt of solar photovoltaic capacity. Arizona, New Jersey, Nevada and North Carolina rounded out the list of the top five states for new solar energy capacity, followed closely by Massachusetts. Texas ranks as the ninth-highest state for solar capacity additions in 2012, due largely to aggressive efforts to expand solar power by municipal utilities in Austin and San Antonio. (See page 22.)

Table 4. Top 12 States for Solar PV Capacity Installed in 2012⁵¹

State	2012 Annual PV Installed Capacity (MW)
California	1,033
Arizona	710
New Jersey	415
Nevada	198
North Carolina	132
Massachusetts	129
Hawaii	109
Maryland	74
Texas	64
New York	61
Pennsylvania	54
Colorado	40

Beyond the Dazzling Dozen: Emerging Solar Energy Leaders

While the top 12 solar states are responsible for the vast majority of solar energy in the United States, there are other states where efforts to promote solar energy deserve special attention, as well as cities that are demonstrating leadership within their states in the adoption of solar energy policies.

Minnesota

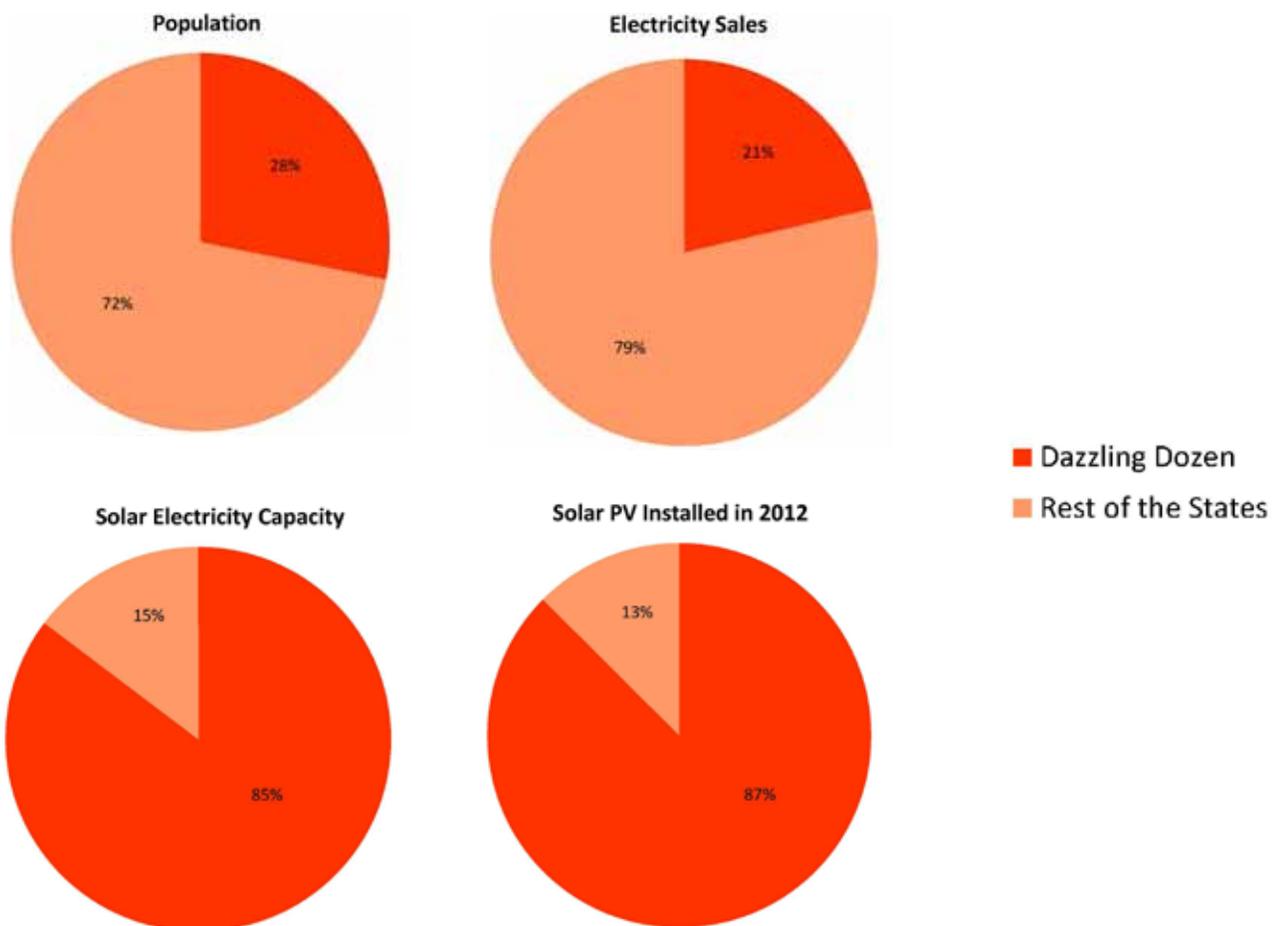
Minnesota currently has little in the way of solar energy capacity. That should change dramatically, however, following the adoption of transformative solar energy legislation in 2013.

The new law requires that all investor-owned utilities get 1.5 percent of their power from solar energy by 2020. It also sets a goal of getting 10 percent of Minnesota's electricity from the sun by 2030 and puts in place important measures that help incentivize solar expansion.

In addition to establishing ambitious goals for solar energy, the Minnesota law takes several practical steps to make solar energy more convenient and

affordable for Minnesotans. The law raises the customer net-metering cap to 1 MW for investor-owned utilities and provides new protections for consumers. It also makes Minnesota one of the first states in the country to adopt a statewide "value of solar tariff," which sets a predictable rate of compensation for customers who go solar that is based on the benefits solar homeowners and business-owners deliver to other customers and to society. The law establishes property assessed clean energy (PACE) financing to help businesses invest in energy improvements, including on-site renewable energy, and will empower groups of citizens to collaborate in the development of community "solar gardens."

Figure 6, a-d. Solar Energy in the Top 12 Solar States versus the Rest of the U.S.



Minnesota may not currently be among the Dazzling Dozen, but the state's new solar energy law should result in a surge in solar energy in the state and vault the North Star State into national leadership.

San Antonio and Austin, Texas

Texas ranks 13th in the nation for total installed solar energy capacity. Unlike many of the other states with large amounts of solar energy, however, Texas' solar policies are weak – the state has no statewide net metering program, no solar-carve out in its renewable electricity standard, and provides minimal financial support for consumers seeking to go solar.

Texas' solar leadership can be attributed almost entirely to the actions of local governments and publicly-owned utilities – especially the cities of Austin and San Antonio. The publicly-owned utilities serving those cities have installed four times more solar capacity than the rest of Texas combined and account for 85 percent of the state's total solar energy.⁵²

The solar policies adopted by these cities and their municipal utilities provide an example for how the rest of Texas can reach its solar energy potential. The publicly owned utilities in San Antonio and Austin have set aggressive goals to obtain significant portions of their electricity from solar power. San Antonio and Austin have strong loan and rebate programs for solar PV systems to help minimize the up-front costs of solar power installation.

Historically, both Austin and San Antonio have had strong net metering policies that compensate consumers fairly for the solar energy systems they install on their homes and businesses. Recently, however, both cities have moved toward changing those policies. Austin has switched to a "value of solar tariff" that compensates solar homeowners for the economic value of solar energy. While the level of compensation currently exceeds the retail cost

of electricity under most circumstances, the tariff is revised annually, creating uncertainty for individuals considering adoption of solar energy.⁵³ In San Antonio, the publicly owned utility recently put off a decision on the fate of net metering – the utility had proposed replacing net metering with a dramatically lower "solar credit" for customers who supply excess electricity to the grid.⁵⁴

Austin and San Antonio demonstrate that strong local solar energy policies can achieve results – even in states that have otherwise done little to advance solar energy. The state of Texas should follow their example to tap its best-in-the-nation potential for solar energy, and both cities should work to maintain and build upon their track record of solar leadership.

Gainesville, Florida

Despite the vast availability of sunlight in Florida, the "Sunshine State" ranks 22nd in the nation for per-capita solar energy capacity. At least one Florida city, however, is taking advantage of its potential to produce energy from the sun. Officials in Gainesville, Florida, have implemented several effective policies making solar energy more accessible to its citizens.

The most prominent program contributing to Gainesville's solar success is the city's feed-in tariff for solar photovoltaic systems. The city was first in the nation to introduce per-kilowatt hour incentive payments for solar power. The city's municipal utility, Gainesville Regional Utilities, provides predetermined rate payments to owners of qualified photovoltaic systems based on the amount of electricity generated. The program is open to both residential and commercial customers and is expected to result in an installation of 32 MW of solar generation capacity by 2016.

In 2012, the Gainesville utility's total solar capacity reached 15.1 MW.⁵⁵ While Gainesville accounts for only 0.6 percent of Florida's population, the service

area of the Gainesville utility (which includes some outlying areas) accounts for 8.1 percent of the state's total installed solar energy capacity.⁵⁶ Like Austin and San Antonio, Gainesville demonstrates the potential for strong local action to help move the nation toward a solar energy future.

Conclusion

A dozen U.S. states are responsible for the vast majority of the growth of solar energy in the nation in recent years, including in 2012. What makes these states special? In the following section, we document the ways in which leading U.S. states – especially the “Dazzling Dozen” – have created vigorous solar energy industries through strong and forward-thinking public policies.

America's Leading Solar States Have Cutting-Edge Solar Policies

What separates the leading solar energy states from those that lag? In general, it is not the availability of sunlight – rather, it is the degree to which state and local governments have recognized the benefits of solar energy and created a fertile public policy atmosphere for the development of the solar industry.

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

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

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

Essential Solar Energy Policies

The link between strong public policies and the growth of solar energy is clear. According to a 2012 study by researchers with the National Renewable Energy Laboratory (NREL), about 70 percent of the difference in solar photovoltaic capacity among states could be explained by the existence of a set of specific public policies, as well as population.⁵⁷

NREL researchers have identified three types of public policies that help build strong markets for solar energy.⁵⁸

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. In some states, net metering is supplemented by or replaced by *CLEAN (Clean Local Energy Accessible Now) contracts* (otherwise known as feed-in tariffs) or *value of solar rates*, which, if properly constructed, can be alternative ways of compensating consumers fairly for 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 utilities regulators also develop and approve *utility rate structures* that have a major impact on the financial desirability of solar energy. Rate structures that have a higher ratio of per-kilowatt-hour to per-customer charges, and those that charge higher rates at times of day when the cost of providing power are highest, will tend to encourage solar energy by ensuring that customers receive the maximum benefit for reducing their consumption of electricity from the grid, especially during peak times.

In addition to these state-level policies, local governments can play an important role in preparing the way for solar energy through the adoption of smart *permitting and zoning rules* that eliminate unnecessary obstacles to solar development. The cost of permitting, interconnection and inspection of solar energy systems, coupled with permit fees, represent about 3 percent of the cost of a residential solar energy system.⁵⁹ 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.⁶⁰ 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.⁶¹ 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)*, 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 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 Assisted Clean Energy (PACE) financing* of solar panels, which are among the many **financing options** that can relieve consumers from having to pay the high up-front cost of solar panels by spreading the costs over time, enabling solar homeowners and businesses to reap financial savings from Day 1.
- **Lead-by-example** policies, which expand solar markets by requiring government agencies to consider or install solar energy on public buildings.

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

* The data sources used and criteria employed for determining whether a state is credited with having a particular policy can be found in Appendix B.

Market Preparation Policies

Clear and solar-friendly interconnection policies, policies that ensure fair compensation for consumers who install solar panels, and solar rights policies are essential to the development of a vigorous market for solar power in a particular state.

Interconnection and net metering policies for solar energy are evaluated annually by a coalition of organizations in a report called *Freeing the Grid*.⁶² In 2012, 11 of the Dazzling Dozen 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. Much of North Carolina’s recent solar energy development has been in the form of utility-scale projects not subject to net metering. In nearly all of these states (with the exception of New Mexico), consumers are compensated for the value of the excess solar electricity they feed into the grid at the full retail rate.⁶³

Similarly, 10 of the Dazzling Dozen states had interconnection policies that merited an “A” or “B” grade in the *Freeing the Grid* report. Only Vermont, with a “C,” and Arizona, which lacks a statewide interconnection policy, received lower grades.

All 12 of the Dazzling Dozen states also had solar rights laws that protect the individual homeowner’s right to “go solar.”

Several states have other model market preparation policies. Vermont’s CLEAN contract (feed-in tariff) policy recently moved to a bidding system in which new solar projects will receive 13 to 14 cents per kilowatt-hour for the solar energy they feed into the grid.⁶⁴ Hawaii’s program offers 21.8 cents

per kilowatt-hour to small-scale residential solar projects.⁶⁵ California also offers a CLEAN contract program.

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

Market Creation Policies

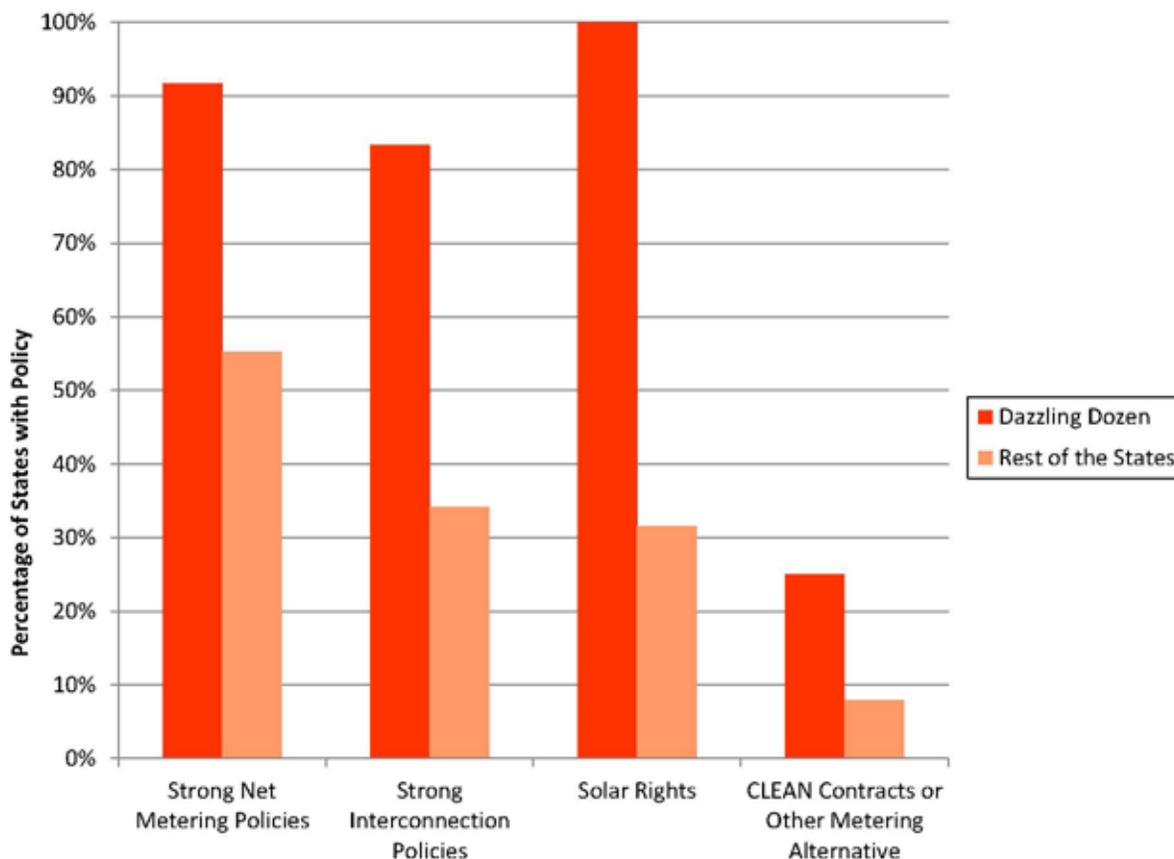
Market creation policies – especially renewable electricity standards with solar carve-outs – enable states with strong market preparation policies to take the next step in developing a healthy solar energy market. Market creation policies ensure that a growing market for solar energy will exist for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

company or train for jobs in solar energy that their investment of time and money is likely to be rewarded.

Of the Dazzling Dozen states, 11 (all but Vermont) have renewable electricity standards and nine (all but Vermont, 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 represents the production of a certain amount of solar electricity) corresponding to their solar requirements under the

Figure 7. Prevalence of Market Preparation Policies, Top 12 States versus Others



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.

The nine Dazzling Dozen states with a solar carve-out represent more than one-half of the states nationwide with that policy, 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 2028.⁶⁶

The three Dazzling Dozen states without solar carve-outs have other aggressive policies to encourage the spread of solar energy. The California Solar Initiative was launched in 2007 with the goal of achieving 3 gigawatts of distributed solar energy capacity by 2016 through the use of consumer rebates

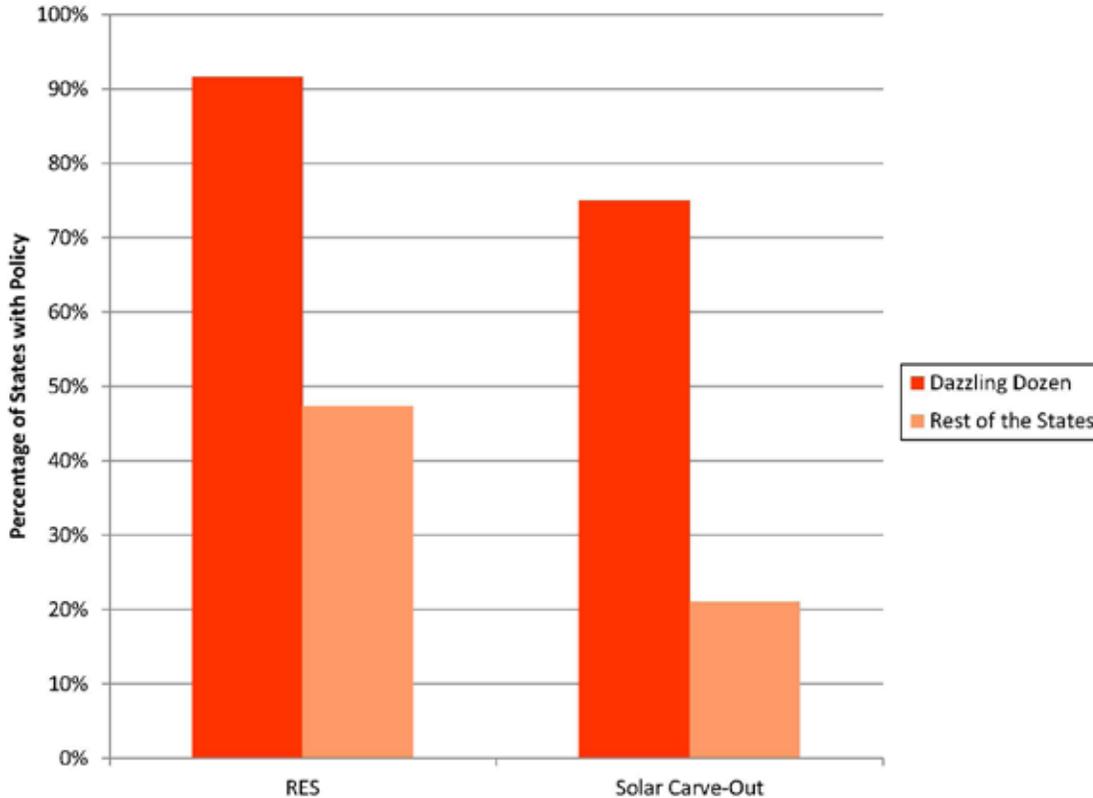
and other targeted initiatives.⁶⁷ Vermont funds a similar program of rebates to help consumers go solar.⁶⁸ Hawaii and California also possess two of the strongest renewable electricity standards in the country, helping to drive the adoption of solar power even in the absence of a specific carve-out.

In addition, as mentioned earlier (see “Market Preparation Policies”), all three states have CLEAN contract policies (otherwise known as feed-in tariff policies) that guarantee a fair rate of return on investments in solar power made by individuals or businesses.

Market Expansion Policies

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

Figure 8. Percentage of Top 12 versus Other States with Key Market Creation Policies





Strong public policies, such as renewable electricity standards with solar carve-outs, can support the installation of commercial-scale solar energy facilities on warehouses, shopping centers and vacant land.

Financial Incentives

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

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

Financing Options

Often, the biggest hurdle standing in the way of solar energy adoption is not the total cost, but rather the *up-front* cost, the amount due at the time of installation. For many homeowners and small businesses, the prospect of buying 20 years’ worth of electricity up-front 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 would be 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

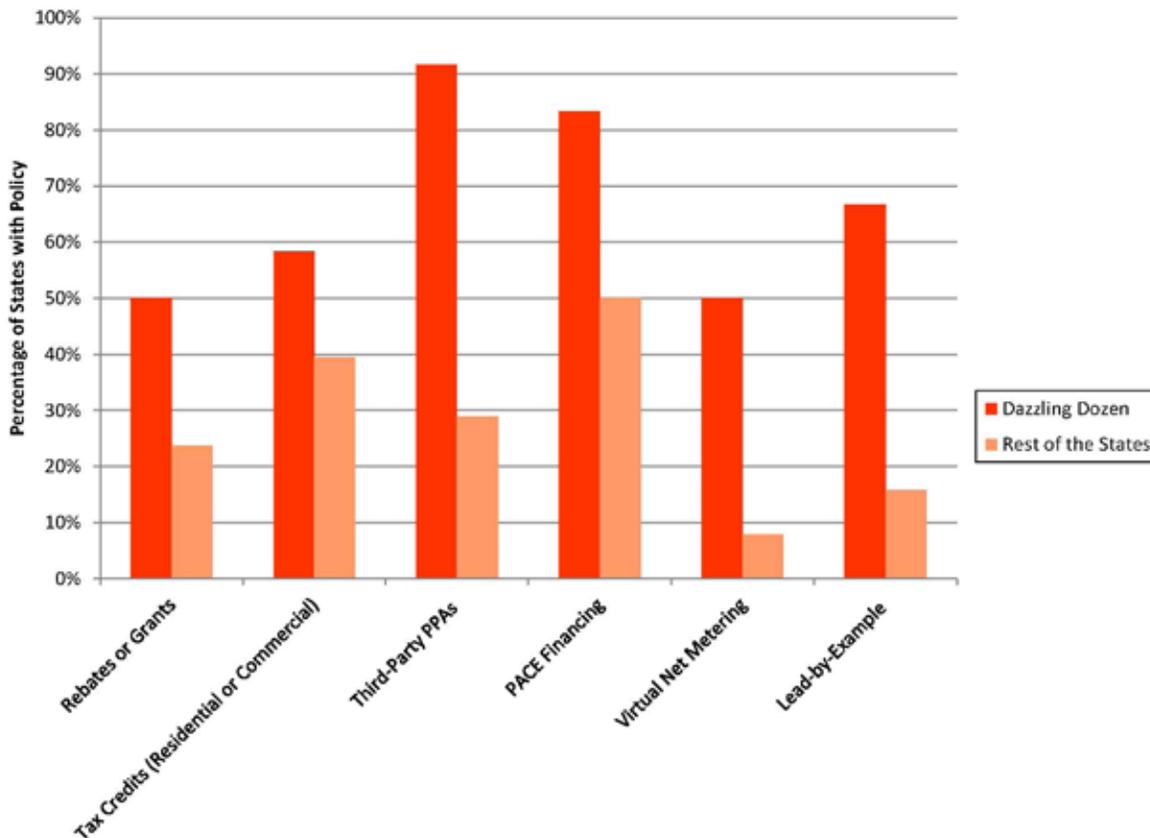
other than the home or business owner or the utility that supplies them with power – to own and operate solar energy facilities on residential or commercial properties. Third party arrangements come in two forms:

- 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 pay it off over time. The consumer benefits from lower electricity consumption and from net metering credits on their electricity bill; the third-party entity benefits by claiming the value of financial incentives and tax credits.

- A *third-party 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 low price. In a third-party PPA, the consumer does not pay for the solar panels – avoiding up-front costs entirely – but only purchases the electricity they produce.

Third-party arrangements have many advantages – they foster economies of scale that make solar energy more affordable and remove from the property owner the uncertainty and hassle of filling out paperwork or maintaining the panels – and they have become increasingly popular in states where

Figure 9. Percentage of Top 12 versus Other States with Key Market Expansion Policies



the policy playing field has been friendly to solar energy. Third-party arrangements 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. Finally, solar leases and 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.

Third-party solar PPAs, however, have run into legal roadblocks in several states, where state laws have been interpreted as categorizing third-party solar companies as regulated utilities. Third-party solar leases have been used in some states where the lawfulness of third-party PPAs has been challenged, but legal questions remain in some of those states as well.⁶⁹ Leading solar states have passed laws clarifying the legal status of third-party PPAs, giving consumers and the solar industry the confidence they need to develop the business model in their states.

Property assessed clean energy (PACE) financing is another mechanism for eliminating the up-front cost of solar energy. PACE financing enables consumers to pay back the cost of solar energy systems over time on their property tax bills. By financing the costs of the installations with municipal bonds – which typically come with much lower interest rates than other types of credit – cities and towns can also reduce the overall cost of solar energy to their residents. PACE financing not only spreads the cost of solar energy over time, but by tying responsibility for repayment to the property – not the owner of the property – it ensures that a consumer will receive savings even if he or she must move in a few years.

While many states have adopted legislation enabling local governments to create PACE financing programs, the implementation of residential PACE programs was brought to a halt in 2010 when mortgage finance giants Fannie Mae and Freddie

Mac raised objections. Commercial PACE programs do not face similar constraints.

An alternative to PACE financing – called *on-bill financing* – allows consumers to pay for solar energy installations over time on their utility bills. In 2013, the Hawaii Legislature adopted a measure that enables on-bill financing for solar energy and other forms of clean energy technology.

Finally, *virtual net metering* and other policies to enable community solar projects open the door for individuals to band together with their friends and neighbors to develop “solar gardens” or other solar energy installations, the benefits of which are shared among the sponsors. These policies enable even those who are unable to install solar panels on their own properties to “go solar.”

Lead by Example

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

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

There are many ways in which government agencies have set a strong example in the development of solar energy. Some governments have established revolving loan programs that supply upfront capital for agencies that wish to go solar, or programs that pay for the upfront cost of solar equipment with

payback in the form of energy savings over time. In other cases, governments have used money from public benefits funds (which are supported by small levies on consumers' electric bills) or revenues from carbon cap-and-trade systems to support public-sector installations of solar power.⁷⁰

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

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

Conclusion

The Dazzling Dozen 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 Dazzling Dozen to create vigorous markets for solar energy in their own states – reaping the benefits in cleaner air, reduced dependence on fossil fuels, and a more vigorous local economy. The following section lays out a series of recommendations that local, state and federal governments can follow to mimic – and ultimately build upon – the success of the Dazzling Dozen.

Recommendations: Building a Solar Future

The path to a clean energy future powered increasingly by solar energy is open to every city and state. 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 Dazzling Dozen.

Every state should adopt aggressive targets for the development of solar energy. States in the Dazzling Dozen should build upon their track record of leadership by continuing to lead the way in the development of new policies to move the nation toward a solar energy future. Other states should follow the policy lead of the Dazzling Dozen 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.⁷¹ 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.⁷² Local governments can also ensure that their zoning regulations are clear and unambiguous in allowing solar energy installations on residential and commercial rooftops.

Cities in states where property assisted 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. 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. In recent months, two California towns – Lancaster and Sebastopol – have adopted requirements that newly built and renovated homes and commercial buildings incorporate solar energy.⁷³

Cities with municipal utilities have even greater potential to encourage solar energy. Public utilities in cities such as Austin and San Antonio have shown that a strong municipal commitment to solar energy can meet with great success, even in states where overall statewide policies to promote solar energy

are lacking. The establishment of local renewable electricity standards, strong net metering and interconnection policies, and other pro-solar policies can help fuel the rapid spread of solar energy in the territories of municipal utilities.

State Government

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

To help achieve that vision, states should adopt renewable electricity standards with solar carve-outs that require a significant and growing share of that state's electricity to come from the sun. States should also adopt strong statewide interconnection and net metering policies, along with community solar policies and virtual net metering, to ensure that individuals and businesses are able to sell their excess power back to the electric grid and receive a fair price when they do. CLEAN contracts and value-of-solar payments can play an important role in ensuring that consumers receive a fair price for solar energy, so long as the payments fully account for the benefits of solar energy and are sufficient to spur participation in the market.

As the nation's primary regulators of electric utilities, state governments have a critical role to play in ensuring that interconnection rules and net metering policies are clear and fair and that utilities are considering renewable energy technologies such as solar power in their own resource investment decisions. In addition, as solar power comes to supply an increasing share of the nation's energy supply, state governments will need to be at the forefront of designing policies that transition the nation from

a power grid reliant on large, centralized power plants to a "smart" grid where electricity is produced at thousands of locations and shared across an increasingly nimble and sophisticated infrastructure. The development of policies that allow for the integration of high percentages of solar energy in the electric grid will present the next challenge to the growth of solar energy. States should take action now to begin planning for that future.

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

Federal Government

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

- **Continue policies that work** – The federal government has often taken an "on-again/off-again" approach to its support of renewable energy. With a key financial incentive for solar energy – federal tax credits for residential and business solar installations – now scheduled to expire at the end of 2016, the federal government should consider extending these tax credits to encourage the development of solar energy markets nationwide.
- **Use regulatory powers wisely** – The federal government has a great deal of influence over the development of solar energy, both through its control of millions of acres of land with strong solar resources in the American West and as the primary regulator of the interstate system of electricity

transmission. The federal government should continue to work for environmentally responsible expansion of solar energy on federal lands. Energy regulators should adopt rules that recognize 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 to competitiveness 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 are emerging around the question of how to bring solar energy to large-scale adoption. By continuing to investigate how to best integrate solar energy into the grid, how to deliver solar energy more efficiently and cost-effectively, and how to lower market barriers to solar energy, the SunShot Initiative and other efforts play a key supporting role in the nation’s drive to embrace the promise of solar energy.

- **Lead by example** – In his June 2013 speech on global warming, President Obama committed to obtaining 20 percent of the federal government’s electricity from renewable sources within the next seven years.⁷⁴ Solar energy will likely be a major contributor to reaching that goal. The U.S. military has been particularly aggressive in developing its renewable energy capacity, committing to getting one-quarter of its energy from renewable sources by 2025. The military has already installed more than 130 megawatts of solar energy capacity and has plans to install more than a gigawatt of solar energy by 2017.⁷⁵ 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 courtesy of the Solar Energy Industries Association)

State	Cumulative Solar Electric Installations (MW)	Rank	2012 Annual PV Installations (MW)	Rank	Cumulative Solar Electric Installations per Capita (W/person)	Rank	Solar PV Installed During 2012 per Capita (W/person)	Rank
Alabama								
Alaska								
Arizona	1,097	2	710	2	167	1	108	1
Arkansas								
California	2,901	1	1,033	1	76	6	27	6
Colorado	270	5	40	12	52	8	8	12
Connecticut	37	20	11	21	10	15	3	17
D.C.	5	26	2	25	5	21	2	21
Delaware	44	19	18	19	69	7	28	5
Florida	186	11	24	17	10	16	1	22
Georgia	25	21	11	22	3	23	1	24
Hawaii	191	9	109	7	137	3	78	2
Idaho								
Illinois	46	18	30	13	4	22	2	19
Indiana								
Iowa								
Kansas								
Kentucky								
Louisiana								
Maine								
Maryland	109	14	74	8	19	12	13	10
Massachusetts	198	7	129	6	30	10	19	8
Michigan								
Minnesota								
Mississippi								
Missouri	10	25	7	23	2	26	1	23

* = states for which solar PV installations in 2012 did not rank among the top 26 states according to data from the Solar Energy Industries Association.

State	Cumulative Solar Electric Installations (MW)	Rank	2012 Annual PV Installations (MW)	Rank	Cumulative Solar Electric Installations per Capita (W/person)	Rank	Solar PV Installed During 2012 per Capita (W/person)	Rank
Montana								
Nebraska								
Nevada	403	4	198	4	146	2	72	3
New Hampshire								
New Jersey	971	3	415	3	110	4	47	4
New Mexico	190	10	24	18	91	5	11	11
New York	175	12	61	10	9	17	3	16
North Carolina	229	6	132	5	23	11	14	9
North Dakota								
Ohio	67	16	25	16	6	19	2	20
Oklahoma								
Oregon	69	15	27	15	18	13	7	13
Pennsylvania	196	8	54	11	15	14	4	14
Rhode Island								
South Carolina								
South Dakota								
Tennessee	49	17	27	14	8	18	4	15
Texas	139	13	64	9	5	20	2	18
Utah								
Vermont	21	22	16	20	34	9	26	7
Virginia								
Washington	16	23	4	24	2	25	1	25
West Virginia								
Wisconsin	14	24	1	26	2	24		26
Wyoming								

= states for which solar PV installations in 2012 did not rank among the top 26 states according to data from the Solar Energy Industries Association.

Appendix B: Solar Energy Policies

State	Strong Net Metering Policies	Strong Inter-connection Policies	Solar Rights	CLEAN Contracts or Other Solar Rates	Renewable Electricity Standard	Solar (or Distributed) Carve-Out	Rebates or Grants	Tax Credits	Virtual Net Metering for Community Solar	Third-Party PPAs	PACE Financing	Public Buildings
Alabama												
Alaska												
Arizona												
Arkansas												
California												
Colorado												
Connecticut												
D.C.												
Delaware												
Florida								C				
Georgia												
Hawaii												
Idaho												
Illinois												
Indiana												
Iowa												
Kansas												
Kentucky												
Louisiana								R				
Maine												
Maryland												
Massachusetts								R				
Michigan												
Minnesota												
Mississippi												
Missouri												

Appendix B: Solar Energy Policies (continued)

State	Strong Net Metering Policies	Strong Inter-connection Policies	Solar Rights	CLEAN Contracts or Other Solar Rates	Renewable Electricity Standard	Solar (or Distributed) Carve-Out	Rebates or Grants	Tax Credits	Virtual Net Metering for Community Solar	Third-Party PPAs	PACE Financing	Public Buildings
Montana												
Nebraska												
Nevada												
New Hampshire												
New Jersey												
New Mexico												
New York								R				
North Carolina								C				
North Dakota												
Ohio												
Oklahoma								C				
Oregon								R				
Pennsylvania												
Rhode Island								R				
South Carolina												
South Dakota												
Tennessee												
Texas												
Utah												
Vermont								C				
Virginia												
Washington												
West Virginia								R				
Wisconsin												
Wyoming												

Appendix B: Solar Energy Policies

(continued)

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 2012 *Freeing the Grid* report. (Joseph Wiedman, et al., Interstate Renewable Energy Council and The Vote Solar Initiative, *Freeing the Grid 2012*, 2012.)

Strong interconnection policies: Statewide interconnection policies obtaining an “A” or “B” grade in 2012 *Freeing the Grid* report. (Joseph Wiedman, et al., Interstate Renewable Energy Council and The Vote Solar Initiative, *Freeing the Grid 2012*, 2012.)

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

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

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

Solar carve-out: Presence of a specific percentage requirement for solar energy or distributed renewable technology under a state RES according

to DSIRE Solar. Does not include RESs with credit multipliers but no mandatory solar or distributed generation target. (Based on a review of each state’s detailed entries in the DSIRE Solar database.)

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

Tax credits: Presence of a residential or commercial tax credit policy according to DSIRE Solar. Dark shading indicates the presence of both residential and commercial tax credits; states with one tax credit are indicated in light shading with an “R” or “C.” (U.S. Department of Energy, Interstate Renewable Energy Council and North Carolina Solar Center, *DSIRE Solar: State Tax Credits for Solar Projects*, February 2013.)

Virtual net metering for community solar: States with virtual net metering based on data through August 2012 from Institute for Local Self-Reliance, *Virtual Net Metering*, 17 August 2012. Delaware added to the list of states permitting community solar based on consultation of DSIRE Solar database. Illinois excluded as utilities are permitted, but not required, to allow virtual net metering.

Third-party PPAs: States in which third-party power purchase agreements are legal, according to DSIRE Solar. (U.S. Department of Energy, Interstate Renewable Energy Council and North Carolina Solar Center, *DSIRE Solar: 3rd Party Solar PV Power Purchase Agreements (PPAs)*, February 2013.)

PACE financing: States where PACE financing enabling legislation exists, according to DSIRE Solar.

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

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