Shining Cities 2016

How Smart Local Policies Are Expanding Solar Power in America

ENVIRONMENT CALIFORNIA RESEARCH & POLICY CENTER

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Executive Summary

Solar power grew at a record-breaking pace in 2015. The United States now has more than 27,000 megawatts (MW) of cumulative solar electric capacity, enough to power more than 5.4 million American homes. Hundreds of thousands of Americans – especially in our cities – have invested in solar panels on their roofs or solar projects in their communities, and millions more are ready to join them.

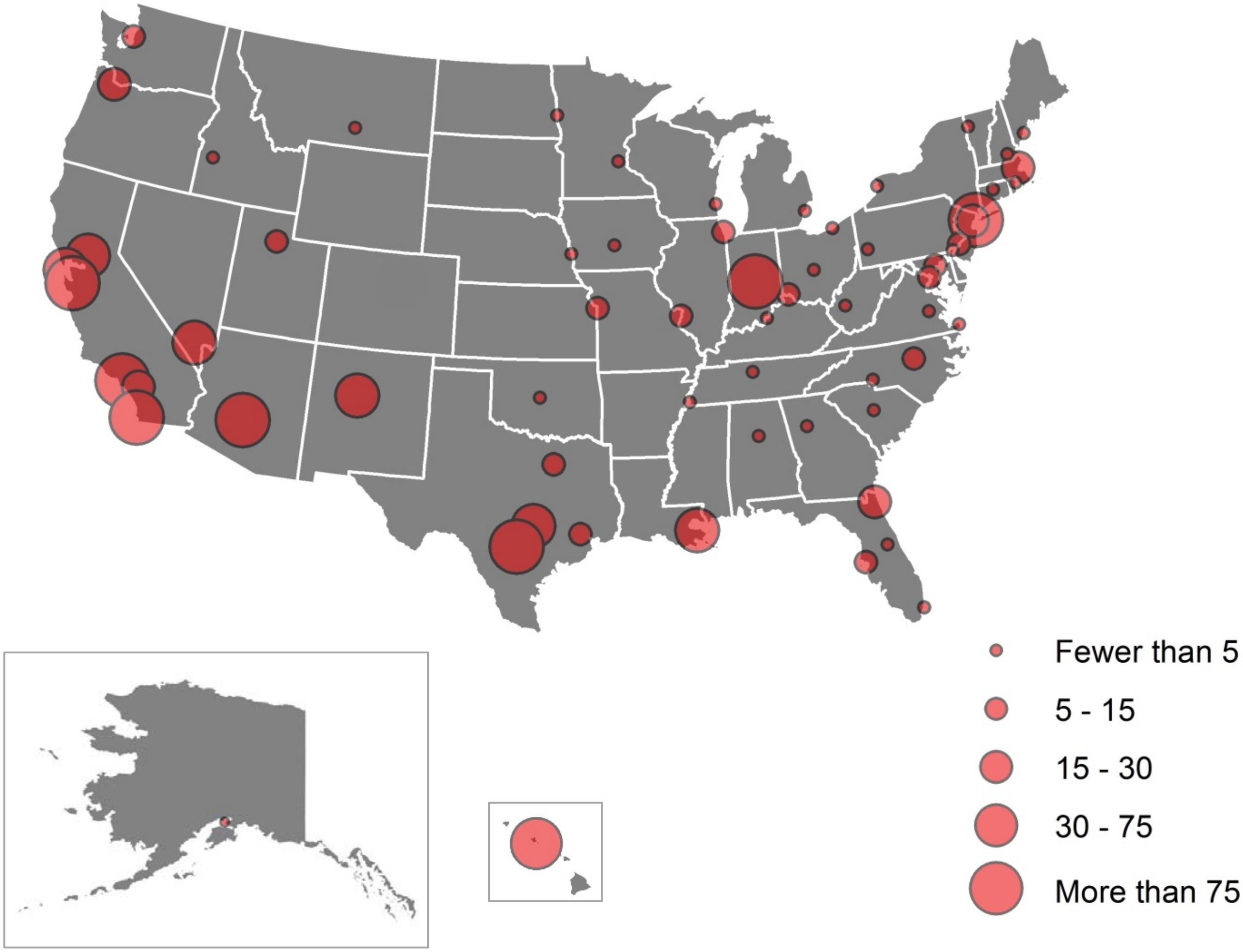
America's major cities have played a key role in the clean energy revolution and stand to reap tremendous benefits from solar energy. As population centers, they are major sources of electricity demand, and with millions of rooftops suitable for solar panels, they have the potential to be major sources of clean energy as well.

Table ES-1: Top 20 Solar Cities by Total Installed Solar PV Capacity, End of 2015*

City	State	Total Solar PV Installed (MW-DC)	Total Solar PV Rank	Per Capita Solar PV Installed (Watts-DC)	Per Capita Rank
Los Angeles	CA	215	1	55	15
San Diego	CA	189	2	136	4
Phoenix	AZ	147	3	96	6
Honolulu	HI	146	4	417	1
San Jose	CA	141	5	139	3
Indianapolis	IN	124	6	146	2
San Antonio	TX	108	7	75	10
New York	NY	84	8	10	37
Albuquerque	NM	64	9	114	5
Las Vegas	NV	58	10	94	7
San Francisco	CA	41	11	48	16
New Orleans	LA	35	12	90	8
Austin	TX	33	13	36	18
Sacramento	CA	32	14	66	12
Riverside	CA	28	15	88	9
Jacksonville	FL	24	16	28	21
Newark	NJ	21	17	75	11
Portland	OR	19	18	31	20
Boston	MA	15	19	23	24
Washington	DC	14	20	20	29

**This includes all solar PV capacity (rooftop and utility-scale solar installations) within the city limits of each city. It does not include solar power installed in the extraterritorial jurisdictions of some cities, nor does it include solar power installed by or under contract to municipal utilities. See methodology for an explanation of how these rankings were calculated. See Appendix B for city-specific sources of data.*

Figure ES-1: U.S. Cities by Cumulative Installed Solar PV Capacity, End of 2015 (MW)



As of the end of 2015, 20 cities – representing just 0.1 percent of U.S. land area – accounted for 6 percent of U.S. solar photovoltaic (PV) capacity. **The 64 cities in this report have installed over 1,700 MW of solar PV capacity – nearly as much solar power as the entire country had installed at the end of 2010.** Los Angeles leads the nation in total installed solar PV capacity, followed by San Diego, Phoenix, Honolulu and San Jose. (See Table ES-1.)

The cities with the most solar PV installed per capita are the "Solar Stars" – cities with 50 or more watts of installed solar PV capacity per person. These cities have experienced dramatic growth in solar energy and are setting the pace nationally for solar energy development. **Honolulu, Indianapolis, San Jose, San Diego and Albuquerque are the top five cities in the nation for installed solar PV capacity per person**.

Table ES-2: The "Solar Stars" (Cities with 50 or More Watts of Solar PV per Person, End of 2015)

City	State	Total Solar PV Installed (MW-DC)	Total Solar PV Rank	Per Capita Solar PV Installed (Watts-DC)	Per Capita Rank
Honolulu	HI	146	4	417	1
Indianapolis	IN	124	6	146	2
San Jose	CA	141	5	139	3
San Diego	CA	189	2	136	4
Albuquerque	NM	64	9	114	5
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New Orleans	LA	35	12	90	8
Riverside	CA	28	15	88	9
San Antonio	TX	108	7	75	10
Newark	NJ	21	17	75	11
Sacramento	CA	32	14	66	12
Burlington	VT	3	45	65	13
Salt Lake City	UT	12	24	61	14
Los Angeles	CA	215	1	55	15

(See Figure ES-2 and Table ES-2.) Between 2014 and 2015, Burlington, Riverside, Las Vegas and Los Angeles joined the ranks of the Solar Stars.

Regional leaders for per capita solar capacity include **Honolulu** in the Pacific region, **Albuquerque** in the Mountain region, **Indianapolis** in the North Central region, **New Orleans** in the South Central region, **Wilmington, Delaware,** in the South Atlantic region and **Newark, New Jersey,** in the Northeast region.

America's leading solar cities are those that have adopted strong pro-solar public policies or that are located within states that have done so. Among the most important steps cities have taken to advance solar energy are:

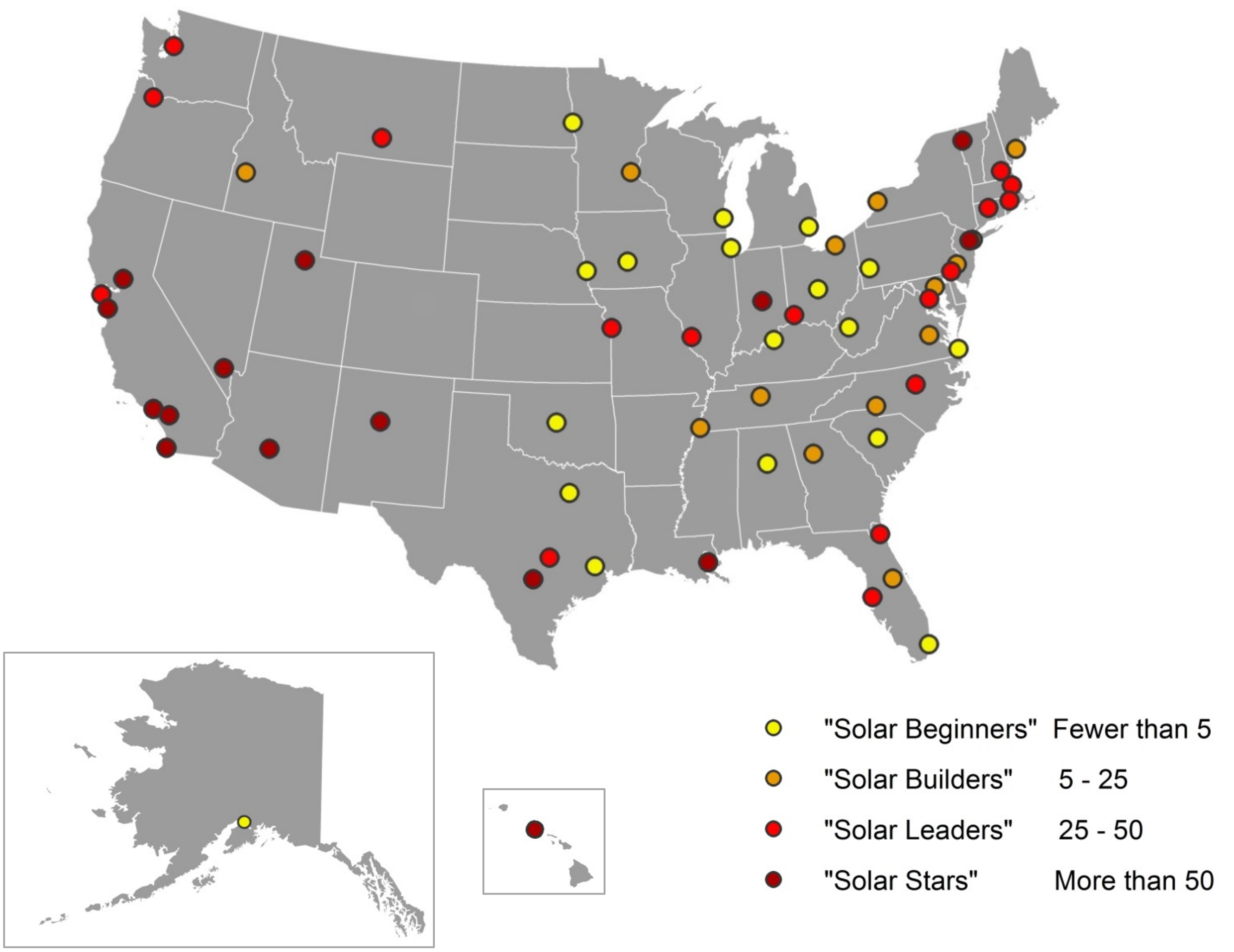
- **Leading by example.** Las Vegas has installed a total of 6.2 MW of solar electric capacity on 37 public buildings, community centers, fire stations and parks, including a 3.3 MW generating station at the city's wastewater treatment plant. Tampa and Raleigh have also installed large PV systems on city facilities. The city of Atlanta recently unveiled a new plan to install about 2 MW of solar power on 28 city buildings. Cites that invest in solar power on public buildings not only save money on electricity, but they also demonstrate the value of solar energy to their residents.
- **Power purchases by municipal utilities.** The city of Austin is taking steps to add 450 MW of solar power capacity to its electric grid. Austin Energy, the city's municipal electric utility, already supplies over 60 MW of solar energy to the local region. (As not all of these solar installations are within the Austin city limits, they do not appear within the tables above.)
- **Expanding access through community solar policies.** New York City is making it possible for multiple people to benefit from the same solar energy system. Residents who are unable to install solar panels on their own buildings will soon be able to purchase shares of solar power from other electric utility accounts.

In addition, cities with strong policies to compensate consumers for the solar energy they supply to the grid – such as net metering – are often leaders in solar development. Like rollover minutes on a cell phone bill, net metering gives renewable energy customers fair credit on their utility bills for the excess clean power they deliver to the grid. This simple billing arrangement is one of the most important state policies for clearing the way for customer investment in solar. Many of the leading solar cities and three out of four new "Solar Stars" have net metering policies that rank among the nation's best.

Attacks by utilities and fossil fuel interests on net metering have the potential to remove some cities from solar leadership. For example, the controversial December 2015 decision by the Nevada Public Utility Commission to weaken net metering policies jeopardizes Las Vegas' status as a solar energy leader.

U.S. cities have only begun to tap their solar energy potential. Cities such as Los Angeles, New York, Chicago and San Antonio have the technical potential to generate tens to hundreds of times more solar energy than they currently do, according to a recent National Renewable Energy Laboratory (NREL)

Figure ES-2: U.S. Cities by Per Capita Installed Solar PV Capacity, End of 2015 (Watts Per Person)



analysis of rooftop solar potential. By maintaining strong pro-solar public policies, these and other cities can continue to lead America toward a future of 100 percent clean, renewable energy.

Strong public policies at every level of government can help the United States continue to harness clean solar energy and overcome legislative and regulatory barriers to distributed electricity generation. To achieve the nation's full solar potential:

- **Local governments** should follow the lead of top solar cities by setting strong goals for solar energy adoption, implementing programs that promote the rapid expansion of solar energy, installing solar energy systems on government buildings, and urging state and federal officials and investor-owned utilities to facilitate that expansion.

- **State governments** should set ambitious goals for solar energy adoption and adopt policies to meet them. It is critical that states have strong policies, such as net metering, to fairly compensate owners of solar energy systems for the energy they supply to the grid. States can also enact strong renewable electricity standards with solar carve-outs, community solar legislation, tax credits for solar energy, and public benefits charges on electricity bills to raise funds for solar energy programs, as well as promote solar programs for low-income households. State governments should also use their role as the primary regulators of electric utilities to encourage utility investments in solar energy and implement rate structures that maximize the benefits of solar energy to consumers.

- **The federal government** should maintain federal tax credits for solar energy including provisions to enable nonprofit organizations, housing authorities and others who are not eligible for tax credits to benefit from those incentives. Investments should be increased for research, development and deployment programs designed to reduce the cost of solar energy and to speed the integration of renewable energy, energy storage and smart grid technologies into the grid.

Introduction

Solar power is an American success story. A rarity just a decade ago, solar panels can now be found on more than 780,000 U.S. residential and business rooftops, with a new system installed every two minutes.[1] After a year of record-breaking growth in 2015, U.S. solar capacity now exceeds 27,000 megawatts (MW), enough to power 5.4 million homes.[2] Improvements in solar technology and rapidly-declining costs are making solar energy more attractive with every passing year.

The rise of solar power over the past decade has been largely driven by cities. In these densely populated areas, solar power is helping to clean the air, create local jobs, and reduce global warming pollution, delivering benefits for the environment and people of all walks of life.

Some cities have demonstrated exceptional leadership in adopting solar power. The key difference between these cities and those that are lagging is effective public policy. The recent extension of federal tax credits for renewable energy will make an important contribution to fueling further growth in solar power, but state and local policies are also core ingredients of a successful solar market. Cities where solar homeowners are paid a fair price for the energy they supply to the grid, where installing solar panels is easy and hassle-free, where there are attractive options for solar financing, and where there has been a strong commitment to support solar energy development, including through financial incentives, are those where solar energy is taking off.

American solar energy is at a tipping point. We are nearing the threshold where solar power is cheaper than electricity generated by fossil fuels, and the conditions are in place for mass adoption of solar energy. Across the country, utilities and fossil fuel interests are fighting to slow the progress of solar energy. The outcome of those battles – taking place now in cities and states across the country – will determine how rapidly our cities and the rest of the nation can reap the benefits of the solar revolution.

Solar Power Is Good for Cities

Solar energy helps cities fight global warming, reduce air pollution, strengthen electric grids and grow local economies.

Solar Energy Reduces Harmful Global Warming Pollution

America can limit the future impact of global warming by slashing our use of the dirty energy sources that cause it.[3] Unlike electricity produced from fossil fuels, solar power generation produces no global warming pollution. Even when emissions from manufacturing, transportation and installation of solar panels are included, solar power generation 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.[4] By replacing fossil fuels with solar-powered electricity, we can dramatically cut carbon emissions and reduce global warming. During the 12-month period between November 2014 and November 2015, solar-powered electricity offset nearly 24 million metric tons of carbon dioxide, equivalent to taking more than 5 million vehicles off the road.[5]

Solar Energy Reduces Air Pollution, Improving Public Health

Pollution from fossil fuel combustion causes major health problems in American cities. According to the World Health Organization, outdoor air pollution is linked to stroke, heart disease, acute respiratory disease, asthma and lung cancer.[6] These conditions can lead to disability, prolonged absences from work or school, and even death.[7] One study found that pollution from electric power plants is responsible for about 50,000 U.S. deaths per year.[8] Cities in the Midwest and Mid-Atlantic, such as Baltimore, Cleveland, St. Louis and Washington, D.C., bear a particularly heavy health burden from power plant pollution.[9]

Solar energy reduces the need for polluting, fossil fuel-generated electricity. Given the high social and economic costs of air pollution-related illnesses, solar energy is a smart investment in human health and productivity.

Solar Energy Makes Cities More Resilient to Severe Weather

Solar energy helps cities conserve water in times of drought. Nationally, electricity production accounts for about 40 percent of freshwater withdrawals.[10] Unlike the fossil fuel-fired power plants that currently generate the bulk of American electricity, solar PV systems do not require high volumes of water for cooling.[11] In fact, the life-cycle water consumption of solar PV 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.[12]

During periods of hot weather, solar power – which is most available when it is sunny – helps meet demand for electric power for air conditioning. The close alignment of power supply and power demand at these times helps cities avoid the need to turn on "peaker" power plants – plants that are too expensive to run regularly.[13] Because the impact of air pollution is most harmful when temperatures are high, relying on solar power during hot weather helps improve public health.[14]

Under some circumstances, rooftop solar energy can help to protect cities in the face of severe storms. If transmission lines are disrupted, solar energy attached to batteries can help avoid blackouts by giving a solar PV system the option to go temporarily "off the grid," dropping non-essential loads and continuing to power essential services.[15]

Solar Energy Benefits Cities Economically

Cities that make solar energy accessible and affordable provide direct and indirect economic benefits to their residents. These benefits are enjoyed by both solar energy customers and other members of the community.

Homeowners and businesses that install solar panels on their buildings – known as distributed solar PV systems – can generate their own electricity. Because energy from the sun is free once the system is in-

Challenges to Solar Energy Growth: The Nevada PUC's Attack on Fair Rate Design and Net Metering

The rapid growth of solar energy is good news for local economies, but it represents a challenge to the traditional business model of electric utilities.[17] Despite the benefits of bedrock solar policies such as net metering for both consumers and their communities, states such as Nevada have fought to protect utility profits at the expense of solar customers, severely impacting solar energy growth.

The Nevada Public Utilities Commission (NPUC) recently dealt a huge blow to the state's rooftop solar industry. In a December 2015 decision, regulators voted to triple the fixed charges solar customers will pay and reduce net metering credits by three-quarters.[18] These changes not only affect new solar customers but are set to apply retroactively to Nevada's nearly 18,000 existing solar customers. Even if these changes are phased in gradually over 12 years, the average solar customer in Nevada will have to pay an additional $8,000-$9,000 over the lifetime of their solar energy system.[19]

Solar companies argue that these changes effectively erase all savings from going solar and may actually increase customers' monthly electricity bills, rendering rooftop solar economics unworkable. Since the new rate took effect in 2016, demand for solar power has plummeted, forcing installation companies to lay off workers. After rooftop solar system applications in Southern Nevada fell by 93 percent in January, local installer Summerlin Energy Las Vegas went out of business.[20] Solar City, along with other major solar companies Sunrun and Vivint, has announced its intention to cease all Nevada operations.[21]

Attacks on solar energy are wildly out of step with Nevada voter opinion, with one survey finding that 70 percent of Nevada voters support continuation of net metering.[22] It is also out of step with the policy decisions of leading solar states like California, whose Public Utilities Commission (CPUC) recently ruled to keep retail-rate net metering in place.[23]

Providing solar customers fair compensation for the power they supply to the grid is a necessary prerequisite for growth in solar energy. Cities and states that do so can be expected to continue to take the lead in solar energy development.

stalled, these solar consumers are also insulated from the volatile prices of fossil fuel markets.

In addition, many states allow customers whose solar PV systems produce more electricity than they need to sell excess power back to energy suppliers at the retail rate – a practice known as "net metering." Net metering functions similarly to rollover minutes on a cell phone plan, adding credits to a solar customer's future electric bill. On average, only 20 to 40 percent of a solar energy system's output is exported back to the electric grid, serving nearby customers.[16] The credits collected by system owners can help them recoup initial investments made in PV systems over time.

Notably, many of our leading solar cities and three out of four new "Solar Stars" are located in states that received an "A" for net metering policies in 2015 by the Interstate Renewable Energy Council's website "Freeing the Grid," which evaluates distributed solar energy policies based on factors including transparency, consistency and value offered to solar customers.[24]

Distributed Solar Electricity Provides Benefits to the Broader Electric Grid

The economic benefits of solar energy extend beyond the buildings on which PV panels are installed. Distributed solar energy provides additional electric generating capacity during periods of peak demand, reducing a utility's need to generate or purchase power from expensive, often inefficient "peaking" power plants that may operate only a few hours each year.[25] Generating more electricity closer to the locations where it is used reduces the need to construct or upgrade expensive transmission capacity. Localized electricity generation also minimizes the amount of energy lost during transmission, improving electric system efficiency.[26]

The Solar Industry Spurs Economic Activity and Creates Jobs

As of November 2015, the United States solar industry employed 208,859 people, a 20.2 percent increase from November 2014.[27] Among U.S. solar industry workers, 57.5 percent are employed by installation companies.[28] Installation jobs are created in local communities and, due to the hands-on nature of the work, cannot be outsourced. Jobs in sales and project development make up 11.7 percent and 10.8 percent, respectively.[29] Employment in manufacturing, which accounts for 14.5 percent of solar jobs, is expected to grow in 2016, with new solar plants under construction in cities like Jackson, Mississippi, and Buffalo, New York.[30] Median wages for solar installers, sales representatives, designers and assembly workers are higher than the national median hourly wage.[31]

The economic future of the solar industry is bright for consumers, suppliers and job-seekers. The cost per watt of solar energy systems continues to fall, increasing consumer demand for solar power.[32] According to the Department of Energy, the solar energy workforce could grow to 340,000 employees by 2030 and reach 440,000 by 2050.[33] Increased demand for solar installations drives prices down further, reinforcing a virtuous economic cycle that allows more and more people to benefit from locally-generated clean electricity.

America's Top Solar Cities Are Building a Clean Energy Future

City leaders and residents are taking advantage of the significant opportunities offered by solar energy as the U.S. solar energy boom continues to escalate.

In leading cities, city officials are setting ambitious goals for solar energy adoption and putting solar panels on city buildings; city leaders and utilities are working together to update the electric grid and offer electricity customers incentives to invest in solar energy systems; city permitting departments are taking steps to reduce fees and processing time for solar installation applications; and city residents – individually and with their neighbors – are cutting their electricity bills and contributing to a cleaner environment by putting solar panels on their homes and apartment buildings. Solar energy is a key part of a cleaner energy economy and a more efficient, local and sustainable electric grid in densely populated places.

This report is our third review of solar photovoltaic (PV) installations in U.S. cities. This year, the list of cities to be surveyed started with the primary cities in the top 50 most populous Metropolitan Statistical Areas in the United States. If a state did not have a city included in that list, its largest city was added to the list to be surveyed. For a complete list of cities, see Appendix B. If reliable data was ultimately unavailable for a city, it was dropped from the list.[34]

There is no uniform national data source that tracks solar energy by municipality, so the data for this report come from a wide variety of sources. (See Methodology.) This may lead to variation among cities in how solar capacity is quantified and in the comprehensiveness of the data. While we endeavored to correct for many of these inconsistencies, readers should be aware that some discrepancies may remain. In some cases, more precise methods were found for measuring solar capacity for this year's report, meaning that comparisons with data reported in previous reports may not be valid. Such cases are noted in Appendix B.

The Top 20 Solar Cities Have 1.5 Gigawatts of Solar Energy Capacity

Cities that lead the nation in installed solar PV capacity come from all regions of the United States. The 64 cities included in this report have installed over 1.7 gigawatts (GW) of solar PV through the end of 2015. (See Appendix A.) **That is nearly the amount of solar power installed across the entire country by the end of 2010.**[35]

As of the end of 2015, the United States has installed over 27 GW of solar PV capacity (27,000 MW).[36] The top 20 cities in our report hosted more than 1.5 GW of that capacity. **Despite making up only 0.1 percent of the nation's land area, these cities contain 6 percent of U.S. solar PV capacity.**[37] Los Angeles leads the nation in total installed solar PV capacity, followed by San Diego, Phoenix, Honolulu and San Jose. (See Table 1 and Figure 1.)[38]

Cities Ranked by Per Capita Solar PV Capacity

The cities ranked in this report vary in size and geography. Measuring solar PV capacity installed per city resident in addition to comparing total solar PV capacity installed can provide an idea of how deeply solar power has permeated the community.

Table 1: Top 20 Solar Cities by Total Installed Solar PV Capacity, End of 2015†

City	State	Total Solar PV Installed (MW-DC)	Total Solar PV Rank	Per Capita Solar PV Installed (Watts-DC)	Per Capita Rank
Los Angeles	CA	215	1	55	15
San Diego	CA	189	2	136	4
Phoenix	AZ	147	3	96	6
Honolulu	HI	146	4	417	1
San Jose	CA	141	5	139	3
Indianapolis	IN	124	6	146	2
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Albuquerque	NM	64	9	114	5
Las Vegas	NV	58	10	94	7
San Francisco	CA	41	11	48	16
New Orleans*	LA	35	12	90	8
Austin	TX	33	13	36	18
Sacramento	CA	32	14	66	12
Riverside	CA	28	15	88	9
Jacksonville	FL	24	16	28	21
Newark*	NJ	21	17	75	11
Portland*	OR	19	18	31	20
Boston	MA	15	19	23	24
Washington	DC	14	20	20	29

**Due to a change in methodology or source of data for this city, estimated solar PV capacity per person at the end of 2015 is lower than estimated solar PV capacity per person at the end of 2014. The figure listed in this table is therefore not directly comparable with previously-reported estimates for this city.*

†This includes all solar PV capacity (rooftop and utility-scale solar installations) within the city limits of each city. It does not include solar power installed in the extraterritorial jurisdictions of some cities, nor does it include solar power installed by or under contract to municipal utilities. See methodology for an explanation of how these rankings were calculated. See Appendix B for city-specific sources of data.

Figure 1: U.S. Cities by Cumulative Installed Solar PV Capacity, End of 2015 (MW)

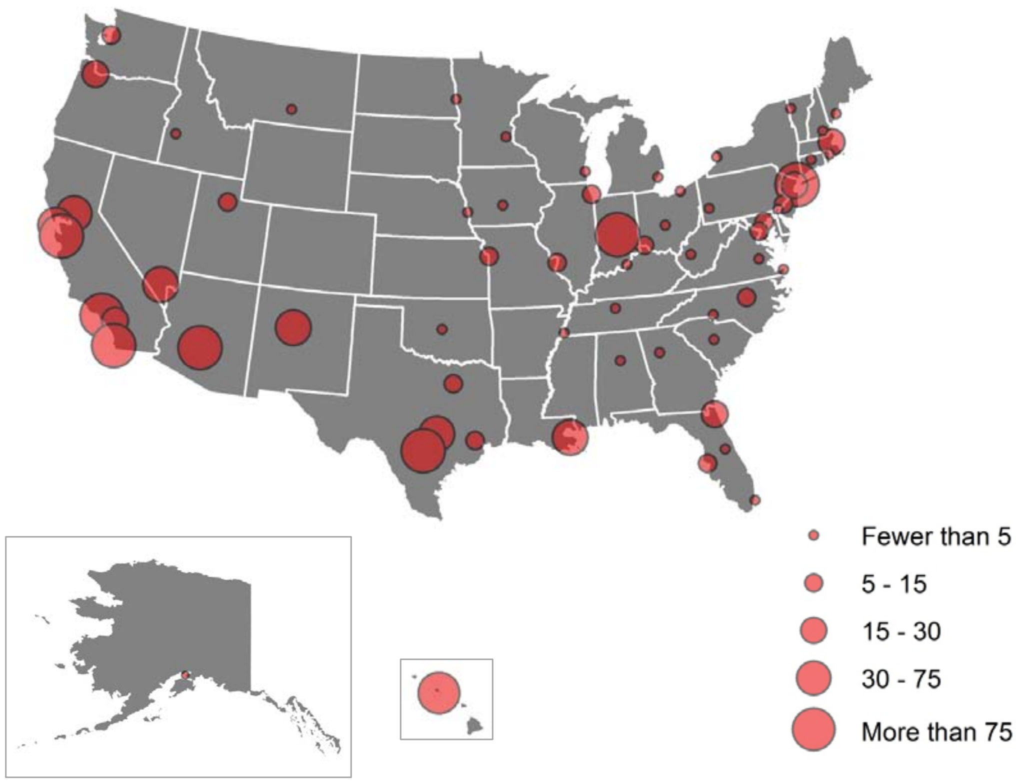
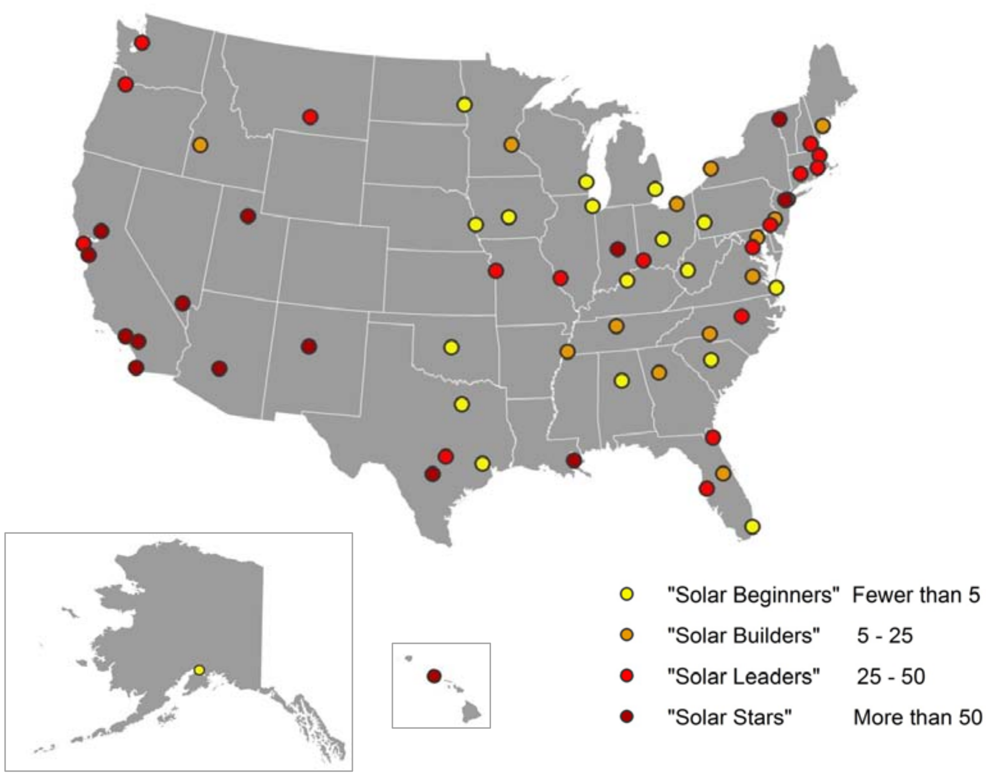


Figure 2: U.S. Cities by Per Capita Installed Solar PV Capacity, End of 2015 (Watts Per Person)



"Solar Stars" are cities with 50 or more watts of installed solar PV capacity per person. They are cities that have experienced dramatic growth in solar energy in recent years and are setting the pace nationally for solar energy development. Honolulu, Indianapolis, San Jose, San Diego and Albuquerque are the top five cities in the nation for installed solar PV capacity per person.

As solar energy has spread in the United States in recent years, the number of cities achieving "Solar Star" status has increased. In 2013, eight U.S. cities had more than 50 watts of solar PV capacity per capita. In 2014, 12 cities had achieved that mark, with 15 cities making the list in 2015.[39] Burlington, Las Vegas, Riverside and Los Angeles have now joined the ranks of the Solar Stars.

Table 2: The "Solar Stars" (Cities with 50 or More Watts of Solar PV per Person, End of 2015)

City	State	Total Solar PV Installed (MW-DC)	Total Solar PV Rank	Per Capita Solar PV Installed (Watts-DC)	Per Capita Rank
Honolulu	HI	146	4	417	1
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Riverside	CA	28	15	88	9
San Antonio	TX	108	7	75	10
Newark*	NJ	21	17	75	11
Sacramento	CA	32	14	66	12
Burlington	VT	3	46	65	13
Salt Lake City	UT	12	24	61	14
Los Angeles	CA	215	1	55	15

**Due to a change in methodology or source of data for this city, estimated solar PV capacity per person at the end of 2015 is lower than estimated solar PV capacity per person at the end of 2014. The figure listed in this table is therefore not directly comparable with previously-reported estimates for this city.*

"Solar Leaders" have between 25 and 50 watts of solar PV installed per person. These cities include San Francisco, Wilmington, DE, Austin, St. Louis, Portland, OR, Jacksonville and Kansas City. (See Table 3.)

The "Solar Builders" are those with between 5 and 25 watts of installed solar PV capacity per person. This diverse group of cities includes cities that have a history of solar energy leadership as well as cities that have only recently experienced significant solar energy development. (See Table 4.)

The "Solar Beginners" are cities with less than 5 watts of installed solar PV capacity per person. Many of these cities are just beginning to experience significant development of solar energy, while a few have experienced little solar energy development at all. (See Table 5.)

Table 3: The "Solar Leaders" (Cities with Less than 50 and 25 or More Watts of Solar PV Per Person, End of 2015)

City	State	Total Solar PV Installed (MW-DC)	Total Solar PV Rank	Per Capita Solar PV Installed (Watts-DC)	Per Capita Rank
San Francisco	CA	41	11	48	16
Wilmington*	DE	3	39	47	17
Austin†	TX	33	13	36	18
St. Louis	MO	10	25	32	19
Portland*	OR	19	18	31	20
Jacksonville	FL	24	16	28	21
Kansas City	MO	13	21	28	22

**Due to a change in methodology or source of data for this city, estimated solar PV capacity per person at the end of 2015 is lower than estimated solar PV capacity per person at the end of 2014. The figure listed in this table is therefore not directly comparable with previously-reported estimates for this city.*

†The listed solar capacity figures for the city of Austin do not account for solar power generated by the 35 MW Webberville solar farm, which is located in the village of Webberville. While the Webberville Solar Farm supplies solar energy to Austin residents through a PPA with Austin Energy, the facility is located outside of city limits and therefore did not meet criteria for inclusion in Austin city estimates.

Table 4: The "Solar Builders" (Cities with Less than 25 and 5 or More Watts of Solar PV Per Person, End of 2015)

City	State	Total Solar PV Installed (MW-DC)	Total Solar PV Rank	Per Capita Solar PV Installed (Watts-DC)	Per Capita Rank
Providence	RI	4	36	23	23
Boston	MA	15	19	23	24
Raleigh*	NC	10	26	23	25
Tampa	FL	8	28	23	26
Hartford	CT	3	45	22	27
Billings	MT	2	47	22	28
Washington	DC	14	20	20	29
Cincinnati	OH	5	32	18	30
Manchester	NH	2	48	18	31
Seattle	WA	12	23	18	32
Richmond	VA	3	44	13	33
Buffalo	NY	3	40	13	34
Orlando	FL	3	41	12	35
Minneapolis	MN	4	35	11	36
Baltimore	MD	6	29	10	37
New York	NY	84	8	10	38
Cleveland	OH	3	42	8	39
Atlanta	GA	3	38	8	40
Nashville	TN	5	34	8	41
Portland	ME	< 1	59	7	42
Charlotte	NC	5	33	6	43
Boise	ID	1	51	6	44
Memphis	TN	4	37	6	45
Philadelphia	PA	9	27	6	46
Dallas	TX	6	30	5	47
Chicago	IL	13	22	5	48
Charleston	WV	< 1	62	5	49

**Due to a change in methodology or source of data for this city, estimated solar PV capacity per person at the end of 2015 is lower than estimated solar PV capacity per person at the end of 2014. The figure listed in this table is therefore not directly comparable with previously-reported estimates for this city.*

Table 5: The "Solar Beginners" (Cities with Less than 5 Watts of Solar PV Per Person, End of 2015)

City	State	Total Solar PV Installed (MW-DC)	Total Solar PV Rank	Per Capita Solar PV Installed (Watts-DC)	Per Capita Rank
Columbus	OH	3	43	3	50
Pittsburgh	PA	1	53	3	51
Milwaukee	WI	2	49	3	52
Houston	TX	6	31	3	53
Columbia	SC	< 1	60	3	54
Des Moines	IA	1	57	2	55
Oklahoma City	OK	1	50	2	56
Omaha	NE	1	55	2	57
Louisville	KY	1	52	2	58
Virginia Beach	VA	1	56	1	59
Detroit	MI	1	54	1	60
Miami*	FL	< 1	58	1	61
Anchorage	AK	< 1	61	1	62
Birmingham	AL	< 1	63	1	63
Fargo	ND	< 1	64	< 1	64

**Solar PV capacity figures are only current through the end of 2014.*

Cities Ranked by Region

We also ranked the cities by region to highlight the leaders from different parts of the United States. Table 6 lists the top two cities in each region with the most installed solar PV capacity per city resident. For this analysis, we used regional designations from the U.S. Census, grouping some regions together for more logical comparisons. We compared cities in the following regions: Pacific, Mountain, North Central, South Central, South Atlantic and the Northeast.

In the Pacific region, Honolulu leads with 417 watts of solar PV capacity installed per person. Other regional leaders include Indianapolis for the North Central region (146 watts/person), Albuquerque for the Mountain region (114 watts/person), New Orleans for the South Central region (90 watts/person), Newark for the Northeast region (75 watts/person) and Wilmington, Delaware, for the South Atlantic region (47 watts/person).

The Promise of Solar Power for U.S. Cities Is Enormous

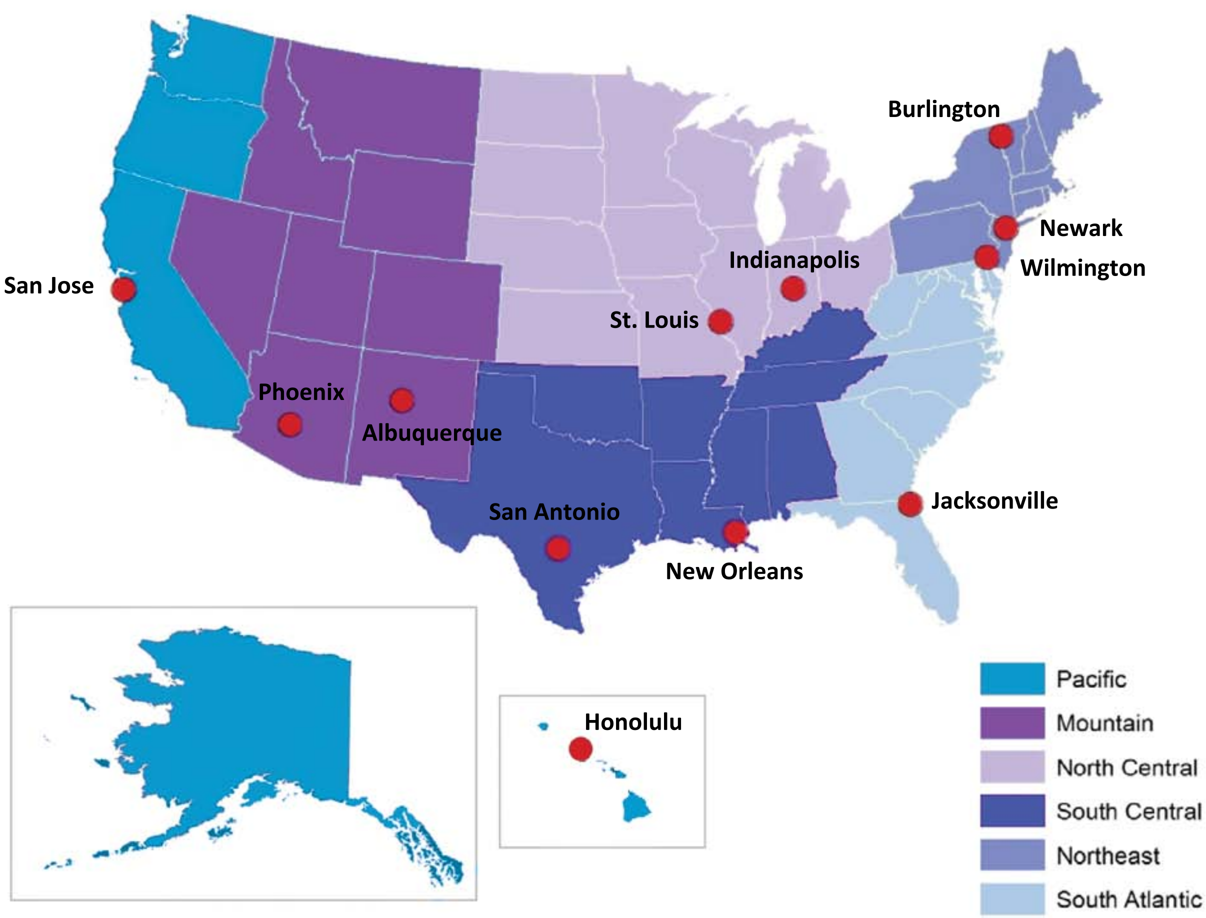
While the exponential growth in U.S. solar power has already delivered enormous benefits to communities across the nation, America is still far from tapping its full solar potential. A recent National Renewable Energy Laboratory (NREL) study estimated that rooftop solar power alone is technically capable of contributing 1,118 GW of generating capacity to the national electric grid.[40] That is enough solar energy to cover the annual electricity needs of more than 135 million homes.[41]

Even the nation's leading solar cities have immense untapped solar energy potential. The NREL study found that top-ranked city Los Angeles, which currently has 215 MW of solar PV capacity, could host up to 9,000 MW of solar PV capacity on its rooftops, providing up to 60 percent of the city's electricity. New York, San Antonio and Chicago could each ac-

Table 6: Top Two Cities in Each Region Ranked by Solar PV Capacity Installed Per Person, End of 2015

City	State	Region	Total Solar PV Installed (MW-DC)	Regional Total PV Rank	Per Capita Solar PV Installed (Watts-DC)	Regional Per Capita Rank
Albuquerque	NM	Mountain	64	2	114	1
Phoenix	AZ	Mountain	147	1	96	2
Indianapolis	IN	North Central	124	1	146	1
St. Louis	MO	North Central	10	4	32	2
Newark	NJ	Northeast	21	2	75	1
Burlington	VT	Northeast	3	8	65	2
Honolulu	HI	Pacific	146	3	417	1
San Jose	CA	Pacific	141	4	139	2
Wilmington	DE	South Atlantic	3	8	47	1
Jacksonville	FL	South Atlantic	24	1	28	2
New Orleans	LA	South Central	35	2	90	1
San Antonio	TX	South Central	108	1	75	2

Figure 3. Top Two Cities in Each Region Ranked by Solar PV Capacity Installed Per Person, End of 2015



commodate more than 6,000 MW of solar PV capacity on city rooftops. Other cities with the rooftop resources to install at least 2,000 MW of solar PV capacity include Baltimore, Charlotte, Detroit, Milwaukee, New Orleans, Philadelphia and Portland, OR.

Cities with Ambitious Solar Energy Goals and Pro-Solar Policies Are Creating a Clean Electric Grid

Those cities that have opened the door for solar energy with the adoption of strong, smart public policies are building the nation's most successful solar markets. These are not necessarily the cities that receive the most sunlight. Cities seeing explosive growth in solar power are ones where homeowners are paid a fair price for the energy they supply to the grid, where installing solar panels is easy and hassle-free, where there are attractive options for solar financing, and where there has been a strong commitment to support solar energy development.

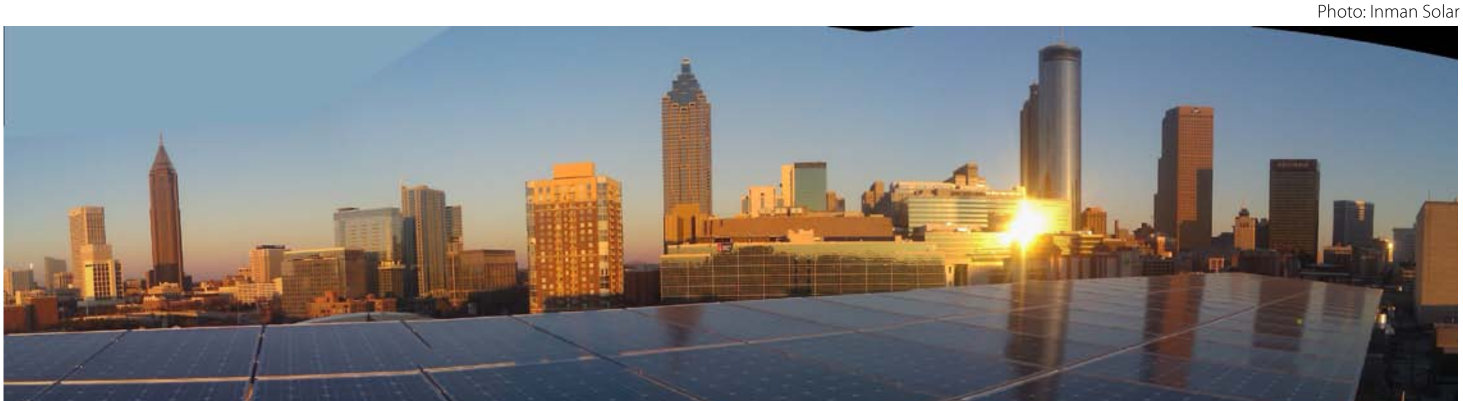
Top solar cities have followed a variety of paths in developing solar energy. In some cases, city governments have played an important role in jumpstarting local solar growth by setting goals for installed solar capacity, implementing solar-friendly laws, and expediting zoning and permitting processes. Some cities with municipal utilities have had an even more direct influence on solar power adoption by establishing ambitious requirements for solar energy and implementing effective financial incentives. Some cities have taken steps to increase the use of solar energy on public facilities, while, in other cities, strong state policies are driving local solar power growth. As demonstrated in the following case studies, cities can most effectively promote solar power when city, state and utility policies work together.

Smart Policies Are Working in Concert to Grow Solar Energy in Atlanta

Solar power in Atlanta is on the rise. The city has already installed nearly 3.5 MW within city limits and has recently taken new steps to expand its market for solar power.

In November of 2015, the city of Atlanta unveiled "Solar Atlanta," a new plan to install about 2 MW of solar power on 28 city buildings.[42] The program builds on existing state legislation and takes advantage of federal tax credits to purchase and install solar panels on recreation centers, fire stations and a police station.[43] These solar installations will not only enable the city to save on its electric bills, but they are also projected to reduce the city's carbon dioxide emissions by over 33,000 metric tons and save 216 million gallons of water through the year 2030.[44]

Photo: Inman Solar



Legacy Properties solar project in downtown Atlanta, GA.

With the May 2015 passage of House Bill 57, the Solar Power Free Market Financing Act, Georgia became the first state in the Southeast to approve private sales of electricity from non-utility solar systems.[45] This means that a company can work with a property owner to install solar panels on a rooftop and sell the resulting electricity directly to the property owner. With this legislation and the support of federal tax credits, Solar Atlanta will allow Atlanta residents to install solar energy systems with no up-front costs.[46]

Austin is Rapidly Adding Utility-Scale Solar Power through Power Purchase Agreements

Texas' capital city of Austin already has an estimated 33 MW of solar electric capacity within city limits. That is not even counting the vast amount of solar energy that the city's municipal utility, Austin Energy, has purchased through third-party agreements. As part of a 25-year contract with FRV AE Solar, LLC, the city of Austin began to receive emissions-free solar power from the 35 MW Webberville Solar Farm in 2011.[47] The Webberville solar farm is located just a few miles away on a 380-acre site owned by the city of Austin, where it generates over 50,000 megawatt-hours of solar power per year, or enough to power 5,000 homes.[48]

Austin's embrace of solar energy does not end there. In 2014, Austin Energy signed a 20-year contract with developer Recurrent Energy to construct a 150 MW solar PV facility in West Texas.[49] In the fall of 2015, the Austin City Council gave the utility the green light to purchase 300 additional MW of West Texas solar power.[50] With more than 65 MW of operating solar capacity and 450 MW more in the development pipeline, the city of Austin is on track to meet its goal of generating 55 percent of its energy from renewable sources by 2025.[51]

New York City is Extending Solar Power to Urban Residents through Community Solar Programs

Solar power in New York City has grown exponentially since 2012 as a result of the statewide NY-SUN Initiative.[52] The city now ranks eighth for cumulative solar PV installed, with 84 MW of solar power installed within the five boroughs – more than twice the capacity installed at the end of 2014. Looking ahead, the city has committed to installing 100 MW of solar power on public buildings and spurring the installation of 250 MW on private buildings by 2025.[53] However, many city residents lack access to solar energy because they are unable to install solar panels on their own rooftops. This includes residents who rent apartments and those who live in multi-unit buildings.

In his 2015 Opportunity Agenda, New York Governor Cuomo called for a new campaign to extend access to solar power to these residents.[54] New York City is now developing "community solar" policies that will allow multiple utility account-holders to subscribe to a portion of electricity produced from a solar panel system.[55] By revising the state's current net metering policies to make it possible for multiple people to benefit from the same solar energy system, New York City is on track to dramatically increase the amount of energy it sources from the sun.

Community net metering has proven to be a successful model in other cities around the country. Washington, D.C., for example, passed the Community Renewable Energy Act in 2013 in order to help achieve the requirements of its renewable electricity standard.[56] The act allows residents to buy ownership in local community solar projects and receive credit on their utility bills for the power produced by their shares. This is particularly beneficial for low-income customers, who spend a larger proportion of their budgets on energy.[57] Innovative policies such as these will allow cities to become more active participants in the solar energy revolution.

Las Vegas Moves Forward with Renewable Electricity, but Lacks State Support for Solar Power

By the end of 2015, the city of Las Vegas had installed a total of 6.2 MW of solar electric capacity on 37 buildings, community centers, fire stations and parks, including a 3.3 MW generating station at the city's wastewater treatment plant.[58]

Building on this progress, the city recently announced that beginning in 2017, through an agreement with electric utility NV Energy, it will receive solar energy generated by a new 100 MW (AC) plant near Boulder City. In combination with its current renewable power, the Las Vegas city government will soon meet 100 percent of electricity needs with renewable energy.[59] That includes "every streetlight, city park, community center, fire station, service yard and public building owned by the city."[60] Cities that invest in solar power on public buildings not only save money on electricity, but they also demonstrate the value of solar energy to their residents.

While the city of Las Vegas is taking positive steps to expand solar energy, the recent NPUC decision to dramatically increase costs for distributed solar PV customers in Nevada threatens to block hard-earned progress in the future.

Policy Recommendations

U.S. cities, as centers of population growth and energy consumption, must lead the way in building a grid powered by clean, renewable energy. Many cities have already experienced the havoc that a future fraught with severe weather, drought, increased precipitation and intense heat waves fueled by global warming can cause. Increasing solar energy capacity, encouraging innovation, and expanding access to PV systems will be critical tools for creating a clean electricity system and addressing global warming.

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.[61] The most effective policies facilitate the wide-scale adoption of small-scale solar energy systems on homes, businesses, and other institutions, while also speeding up solar energy development with large solar projects. Policy-makers at every level of government – federal, state and local – have an important role to play in making solar energy in American cities a reality.

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:

- ***Expand financing support for solar energy*** – In December 2015, the federal government extended the Investment Tax Credit, a key incentive program for solar energy, with a gradual phase down after 2019.[62] The federal government should maintain federal tax credits for solar energy, but add provisions as necessary to enable nonprofit organizations, housing authorities and others who are not eligible for tax credits to benefit from those incentives.

- ***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 encourage the expansion of solar energy.[63] 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 facilitate solar energy adoption. The federal government should invest in research and development of energy storage to expand the integration of renewable energy into the grid, and to strengthen cities' electric grids in the face of extreme weather.

- ***Lead by example*** – The federal government consumes vast amounts of energy and manages thousands of buildings. If the federal government were to put 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.[64]

- ***Expand access to solar energy –*** Federal agencies such as the Department of Housing and Urban Development and the Department of Education should work to expand access to solar energy for schools and in subsidized housing through system installations or community solar projects. Programs designed to provide fuel assistance to low-income customers, such as the Low Income Home Energy Assistance Program (LIHEAP), should be expanded to include solar energy.

- ***Defend and strengthen the requirements of the Clean Power Plan –*** The federal government should protect a strong Clean Power Plan to reduce global warming emissions by at least 30 percent below 2005 levels by 2030. Renewable energy sources such as solar PV can play a dominant role in helping the United States achieve these pollution reductions.

State governments should:

- ***Ensure that utilities invest in solar energy*** – States should adopt or increase mandatory 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 ensure that utilities implement solar power wherever it is a beneficial solution for meeting electricity needs, including as part of utilities' long-term resources.

- ***Adopt and preserve strong statewide interconnection and net metering policies*** – These critical 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.

- ***Establish policies that expand access to solar to all Americans*** – According to NREL, 49 percent of Americans don't own a home, have shading on their homes, or cannot afford a solar system. Policies such as virtual or aggregate net metering or shared solar allow low-income households, renters, and apartment dwellers to access to the benefits of solar energy.[65] See Vote Solar's ***Low Income Solar Policy Guidebook*** for more policy ideas at www.votesolar.org.

- ***Establish public benefits charges on utility bills or other sustainable financing mechanisms*** to fund solar energy for low-income households, non-profits, small businesses, and local municipalities to ensure that all categories of customers have access to the benefits of solar power.

- ***Enable third-party sales of electricity*** – Financing rooftop solar energy systems through third-party electricity sales significantly lowers the up-front cost of installing solar PV systems for commercial and residential consumers. States should allow companies that install solar panels to sell electricity to their customers without subjecting them to the same regulations as large utilities.

- ***Implement policies that support energy storage, electric vehicle smart charging and microgrids*** – State governments must design policies that facilitate the transition 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. Such state policies should support the expansion of energy storage technologies, electric vehicle smart charging networks, and microgrids.

- ***Use solar energy to meet and exceed targets set by the Clean Power Plan*** – States should include the expansion of solar-powered electricity generation in their strategies to reduce power plant emissions under the federal Clean Power Plan.

Local governments should:

- ***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.[66] The Delaware Valley Regional Planning Commission offers a model ordinance guide that cities can apply to their own local laws.[67]

- ***Adopt policies to promote "solar ready" or zero-net energy homes*** – Solar energy is most efficient and cost-effective when it is designed into new construction from the start. State and local governments have adopted policies to require new homes or commercial buildings to have solar power or to be designed so that solar energy can be easily installed. The city of Lancaster, CA requires that all single family homes built within the city provide an average of 1 kW of solar-generated electricity per housing unit.[68] The city of Tucson requires that any new single family homes or duplexes either include a solar energy system or be pre-outfitted so that future solar PV and hot water systems can be easily installed.[69] Other jurisdictions set goals for new zero-net energy homes that employ energy efficiency and renewable energy technologies such that they produce as much energy as they consume.

- ***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."[70] The Department of Energy's SunShot Initiative helps cities to fund programs that work toward this goal, and 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.[71]

- ***Expand access to solar energy*** – "Solarize" programs and community solar programs have been successful at lowering the cost of solar energy systems for low-income communities, and allowing more people to benefit from solar power.[72]

- ***Install solar panels on public buildings*** – Local governments can promote solar energy by installing solar panels and signing solar PPAs for public buildings. According to a report from The Solar Foundation for the U.S. Department of Energy, at least 3,752 schools across the country have installed solar energy systems with a combined capacity of 490 MW.[73] Not only do these installations save governments money on their electricity bills, they also serve as a public example of a smart, clean energy investment.

Methodology

There is no uniform national data source that tracks solar energy by municipality and there are only a handful of states that compile this information in a comparable format. As a result, the data for this report come from a wide variety of sources – municipal and investor-owned utilities, city and state government agencies, operators of regional electric grids and non-profit organizations. These data sources have varying levels of comprehensiveness, with varying levels of geographic precision, and often use different methods of quantifying solar photovoltaic capacity (e.g., alternating current (AC) versus direct current (DC) capacity).

We have worked to obtain data that are as comprehensive as possible, to resolve discrepancies in various methods of estimating solar PV capacity, to limit the solar facilities included to only those within the city limits of the municipalities studied, and, where precise geographic information could not be obtained, to use reasonable methods to estimate the proportion of a given area's solar energy capacity that exists within a particular city. The data are sufficiently accurate to provide an overall picture of a city's adoption of solar power and to enable comparisons with its peers. Readers should note, however, that inconsistencies in the data can affect individual cities' rankings. We look forward to building on and further developing our methodology and data sources in future reports and encourage other researchers to do the same. The full list of sources of data for each city is provided in Appendix B along with the details of any data analysis made.

For some cities, our most recent solar capacity estimates are not directly comparable to previous estimates listed in the first and second editions of ***Shining Cities***, released in 2014 and 2015. This is because we were able to obtain more specific and reliable data this year. In a few cases, our current estimate is smaller than previous estimates for the same city, due either to inconsistencies in the data reported to us by cities or improved precision in methods for assigning solar installations to cities. For an explanation of individual discrepancies, see Appendix B.

Selecting the Cities

The list of cities to be surveyed started with the primary cities in the top 50 most populous Metropolitan Statistical Areas in the United States, according to the U.S. Census Bureau's 2013 American Community Survey 1-Year Estimates. If a state did not have a city included in that list, its largest city – according to the U.S. Census Bureau's 2011-2013 American Community Survey 3-Year Estimates – was added to the list to be surveyed. For a complete list of cities, see Appendix A. If we were unable to find reliable data for a city, we dropped it from our list. Cities for which we were unable to find reliable data are: Cheyenne, Wyoming; Denver, Colorado; Little Rock, Arkansas; Jackson, Mississippi; Sioux Falls, South Dakota; and Wichita, Kansas.

Converting from AC watts to DC watts

Jurisdictions and agencies often use different methods of quantifying solar photovoltaic capacity (e.g. alternating current (AC) and direct current (DC)). Solar PV panels produce energy in DC, which is then converted to AC in order to power a home or business or enter the electric grid. Solar capacity reported in AC watts accounts for the loss of energy that occurs when DC is converted to AC.[74]

We attempted to convert all data to DC watts for the sake of accurate comparison across cities. When we could not determine whether the data were reported in AC watts or DC watts, we made the conservative estimate that the data were in DC watts. To convert the numbers from AC to DC megawatts (MW), we used the default derate factor in NREL's ***PV Watts*** tool of 0.769. See NREL's website for a detailed explanation of this conversion factor, available at http://rredc.nrel.gov/solar/calculators/PVWATTS/derate.cgi.

Using Data on Solar PV Installations by Zip Code to Estimate Capacity within City Limits

In some cases, we were unable to obtain data on solar PV capacity within city limits, but we were able to find data on solar PV capacity installed by zip code in an urban area. Zip codes do not necessarily conform to city boundaries; in many cases, a zip code will fall partially inside and partially outside of a city's boundaries. For these cities, we used ArcGIS software and U.S. Census Bureau cartographic boundary files for Zip Code Tabulation Areas to determine the share of the area in each zip code that fell within municipal boundaries. We then multiplied the total solar PV capacity within each zip code by that percentage to approximate solar capacity installed within city limits. Details of calculations for cities for which a geospatial analysis was performed are given in Appendix B.

Appendix A: Solar Energy in Major U.S. Cities

Table A-1: Cumulative Installed Solar PV Capacity by City (MW-DC), End of 2015 (Alphabetical Order)

City	State	Region	Total Solar PV Installed (MW-DC)	Total Solar PV Rank	Population	Per Capita Solar PV Installed (watts-DC)	Per Capita Rank
Albuquerque	NM	Mountain	64	9	557,169	114	5
Anchorage	AK	Pacific	< 1	61	301,010	1	62
Atlanta	GA	South Atlantic	3	38	456,002	8	40
Austin	TX	South Central	33	13	912,791	36	18
Baltimore	MD	South Atlantic	6	29	622,793	10	37
Billings	MT	Mountain	2	47	108,869	22	28
Birmingham	AL	South Central	< 1	63	212,247	1	63
Boise	ID	Mountain	1	51	216,282	6	44
Boston	MA	Northeast	15	19	655,884	23	24
Buffalo	NY	Northeast	3	40	258,703	13	34
Burlington	VT	Northeast	3	46	42,211	65	13
Charleston	WV	South Atlantic	< 1	62	50,404	5	49
Charlotte	NC	South Atlantic	5	33	809,958	6	43
Chicago	IL	North Central	13	22	2,722,389	5	48
Cincinnati	OH	North Central	5	32	298,165	18	30
Cleveland	OH	North Central	3	42	389,521	8	39
Columbia	SC	South Atlantic	< 1	60	132,067	3	54
Columbus	OH	North Central	3	43	835,957	3	50
Dallas	TX	South Central	6	30	1,281,047	5	47
Des Moines	IA	North Central	1	57	209,220	2	55
Detroit	MI	North Central	1	54	680,250	1	60
Fargo	ND	North Central	< 1	64	115,863	< 1	64
Hartford	CT	Northeast	3	45	124,705	22	27
Honolulu	HI	Pacific	146	4	350,399	417	1
Houston	TX	South Central	6	31	2,239,558	3	53
Indianapolis	IN	North Central	124	6	848,788	146	2
Jacksonville	FL	South Atlantic	24	16	853,382	28	21

Continued on page 29

Continued from page 28

City	State	Region	Total Solar PV Installed (MW-DC)	Total Solar PV Rank	Population	Per Capita Solar PV Installed (watts-DC)	Per Capita Rank
Kansas City	MO	North Central	13	21	470,800	28	22
Las Vegas	NV	Mountain	58	10	613,599	94	7
Los Angeles	CA	Pacific	215	1	3,928,864	55	15
Louisville	KY	South Central	1	52	612,780	2	58
Manchester	NH	Northeast	2	48	110,448	18	31
Memphis	TN	South Central	4	37	656,861	6	45
Miami*	FL	South Atlantic	< 1	58	430,332	1	61
Milwaukee	WI	North Central	2	49	599,642	3	52
Minneapolis	MN	North Central	4	35	407,207	11	36
Nashville	TN	South Central	5	34	612,000	8	41
New Orleans	LA	South Central	35	12	384,320	90	8
New York	NY	Northeast	84	8	8,491,079	10	38
Newark	NJ	Northeast	21	17	280,579	75	11
Oklahoma City	OK	South Central	1	50	620,602	2	56
Omaha	NE	North Central	1	55	446,599	2	57
Orlando	FL	South Atlantic	3	41	262,372	12	35
Philadelphia	PA	Northeast	9	27	1,560,297	6	46
Phoenix	AZ	Mountain	147	3	1,537,058	96	6
Pittsburgh	PA	Northeast	1	53	305,412	3	51
Portland	ME	Northeast	< 1	59	66,666	7	42
Portland	OR	Pacific	19	18	619,360	31	20
Providence	RI	Northeast	4	36	179,154	23	23
Raleigh	NC	South Atlantic	10	26	439,896	23	25
Richmond	VA	South Atlantic	3	44	217,853	13	33
Riverside	CA	Pacific	28	15	319,504	88	9
Sacramento	CA	Pacific	32	14	485,199	66	12
Salt Lake City	UT	Mountain	12	24	190,884	61	14
San Antonio	TX	South Central	108	7	1,436,697	75	10
San Diego	CA	Pacific	189	2	1,381,069	136	4
San Francisco	CA	Pacific	41	11	852,469	48	16
San Jose	CA	Pacific	141	5	1,015,785	139	3
Seattle	WA	Pacific	12	23	668,342	18	32
St. Louis	MO	North Central	10	25	317,419	32	19
Tampa	FL	South Atlantic	8	28	358,699	23	26
Virginia Beach	VA	South Atlantic	1	56	450,980	1	59
Washington	DC	South Atlantic	14	20	658,893	20	29
Wilmington	DE	South Atlantic	3	39	71,817	47	17

**Solar PV capacity figures are only current through the end of 2014.*

Appendix B. Detailed Sources and Methodology by City

Albuquerque

The Public Service Company of New Mexico (PNM), which serves the city of Albuquerque, provided us with total solar PV capacity in DC watts as of December 31, 2015.[75] Figures included all distributed and utility-scale solar PV installations registered to addresses within the city of Albuquerque.

Anchorage

Two electric utilities serving the city of Anchorage – Chugach Electric and Anchorage Municipal Power and Light – provided us with summary information on the solar PV capacity installed in the city limits as of the end of 2015.[76] These data were provided in AC watts and converted to DC watts.

Atlanta

Southface (www.southface.org) provided us with a list of solar PV installations in DeKalb and Fulton counties through December 31, 2015, with latitude and longitude coordinates for each installation.[77] This information allowed us to map the installations using ArcMap, and isolate solar capacity within the city limits of Atlanta. Southface maintains a map of "Georgia Energy Data" at www.georgiaenergydata.org/solarmap, which is believed to be the most comprehensive source of data on solar energy installations in the state of Georgia. Data were provided in DC watts.

Austin

Data were provided in spreadsheets compiled by Austin Energy, the municipal utility serving Austin, in DC watts.[78] Most installations were listed with location coordinates and zip codes, allowing us to determine whether they were located within city limits. For installations without location information, we relied on Austin Energy to determine which systems should be counted as within Austin.

We note that our final figure does not account for solar power generated by the 35 MW Webberville solar farm, which is located in the village of Webberville.[79] While the Webberville Solar Farm supplies solar energy to Austin residents through a PPA with Austin Energy, the facility is located outside of city limits and therefore did not meet criteria for inclusion in Austin city estimates.

Baltimore

Data for solar PV installations in Baltimore as of December 2015 was downloaded in a spreadsheet called "Renewable Generators Registered in GATS" through the Generation Attribute Tracking System (GATS), an online database administered by PJM.[80] To focus on solar PV installations within Baltimore city limits, we filtered by primary fuel type "SUN" for "Baltimore City." Data were assumed to be in DC watts.

Billings

Northwestern Energy, the utility serving Billings, provided the known amount of solar PV capacity installed in the city of Billings in DC watts, as of the end of 2015.[81]

Birmingham

An estimate of installed solar PV capacity in Birmingham through year-end 2015 was provided by Alabama Power, the electric utility serving the city.[82] Figures were provided in AC watts, which we converted to DC watts.

Boise

The total solar PV capacity of 235 active commercial and residential solar installations in Boise was provided by Idaho Power, the electric utility serving Boise, via the city of Boise's Public Works Department.[83] Data were provided in DC watts and current as of January 26, 2016. Therefore, it is possible that our estimate may include solar capacity installed after the end of 2015.

Boston

The city of Boston provided data on installed solar capacity in DC watts via the Massachusetts Clean Energy Center (MassCEC). Based on records from MassCEC's Production Tracking System, there are currently 1,263 solar energy systems registered in the City of Boston with a total capacity of 15.12 MW.[84] However, MassCEC officials noted that this may be an underestimate because many system owners do not register until about three months after installation.

Buffalo

Data on solar PV installed in the city of Buffalo were obtained from the Open NY Database titled "Statewide 200kW or Less Residential/Non-Residential Solar Photovoltaic Incentive Program: Beginning 2000," which can be found at data.ny.gov/Energy-Environment/Solar-Photovoltaic-PV-Incentive-Program-Beginning-/3x8r-34rs. We summed "Total Nameplate KW" for installations registered in the system through December 31, 2015 to addresses with zip codes corresponding to the city of Buffalo. To estimate solar PV installed in systems with more than 200 kW of solar capacity, we searched NREL's OpenPV database for projects in this range. Our search results listed a single commercial solar PV installation in a Buffalo city zip code, with a capacity of 364.65 kW-DC, which we added to our Open NY database total for smaller installations.

Burlington

A list of solar PV installations in Burlington at the end of 2015 was provided by the city of Burlington's Electric Department.[85] Capacity figures were listed in AC watts, which we converted to DC watts.

Charleston

American Electric Power Company provided us with an aggregate sum of solar PV capacity in Charleston through the end of 2015, counting all installations registered to a Charleston city mailing address.[86] Data were provided in AC watts and converted to DC watts.

Charlotte

A list of solar PV installations in North Carolina was compiled by the North Carolina Sustainable Energy Association and provided to us by the city of Raleigh, NC.[87] Using ArcGIS, we identified and totaled all solar PV capacity located within Charlotte city limits. Figures were listed in both AC and DC watts, so we converted all AC figures into DC units. Figures without unit identifiers were assumed to be listed in DC watts. Because the spreadsheet was only updated through April 2015, it is likely that our final estimate omits a number of recent solar PV installations in Charlotte.

Chicago

ComEd, the electric utility serving the city of Chicago, reported that 724.795 kW (DC units) of solar capacity was connected to the electric grid within the city of Chicago between January 1, 2015 and December 31, 2015.[88] We added this new capacity to our 2014 cumulative figure of 11,856.41 kW-DC, provided by the utility last year. Our updated total was 12,581.205 kW, or approximately 12.6 MW.

Cincinnati

Data for solar PV installations within the city of Cincinnati were provided by Duke Energy, the electric utility serving the city, as of December 31, 2015.[89] These data were provided in AC watts and converted to DC watts.

Cleveland

The Mayor's Office of Sustainability for the City of Cleveland provided us with an estimate of installed solar PV capacity in DC watts as of the end of 2015.[90] Only installations known to be located within city limits were counted and it is possible that our estimate does not account for all installed PV capacity in Cleveland.

Columbia

Solar PV capacity within Columbia was provided to us in a spreadsheet compiled by the South Carolina Energy Office.[91] The spreadsheet includes solar PV installations in the city limits as of July 2015, the most recent data available. Data were provided in AC watts, which we converted to DC watts.

Columbus

Data were provided in DC watts by the City of Columbus Department of Public Utilities, covering solar electric capacity installed in Columbus as of December 31, 2015.[92]

Dallas

Total installed solar PV capacity within the city of Dallas at the end of 2015 was provided in DC watts by the North Texas Renewable Energy Group (NTREG), the local chapter of the Texas Solar Energy Society.[93]

Denver

Although we requested solar PV capacity data from Xcel Energy, the electric utility serving the city of Denver, the company did not provide us with the information. Xcel Energy informed us that it expects 2015 solar PV capacity data to become available in the spring of 2016.[94] We are currently pursuing this data and plan to publish an update when the data becomes available.

Des Moines

Estimated capacity figures for commercial and residential solar PV installations were provided by the city of Des Moines in AC watts, which we totaled and converted to DC watts.[95]

Detroit

Total installed solar PV capacity within the city of Detroit was provided by DTE Energy, the electric utility serving the city, in DC watts.[96]

Fargo

An estimate of solar PV capacity in Fargo was provided in DC watts by Cass County Electric Cooperative, which serves part of the city.[97] Xcel Energy, which serves the other part of Fargo, did not have any known solar PV capacity to report.[98] Cass County Electric Cooperative is currently working to develop a community solar project that will add additional capacity to Fargo in the future.

Hartford

Data were provided in AC watts by the Connecticut Public Utilities Regulatory Authority (PURA) in a spreadsheet listing solar facilities approved under Connecticut's Renewable Portfolio Standard.[99] We totaled all solar PV capacity installed in the city of Hartford through December 30, 2015. We then converted our figure into DC units.

Honolulu

We estimated the amount of solar PV capacity in urban Honolulu from county-level data released by Hawaiian Electric, the company serving the county of Honolulu (which is coterminous with the island of Oahu).[100] Within the island of Oahu, the census designated place "Urban Honolulu CDP" is the area most comparable with other U.S. cities. We multiplied the total capacity of solar PV installations within Honolulu County by the 2014 proportion of housing units located in urban Honolulu to estimate what percentage of this capacity falls in urban Honolulu.[101]

- 343 MW (2015 year-end capacity in Honolulu County) x 0.4254 = 145.92 MW

To compute per capita solar PV capacity for the city of Honolulu, we divided our household-weighted estimate of total installed solar capacity (145.92 MW) by the 2014 U.S. Census population estimate for "Urban Honolulu CDP."

Solar PV capacity figures are reported to Hawaiian Electric in a combination of AC and DC units and we were unable to determine which values were given in which currency. We therefore made the conservative assumption that all data were listed in DC watts.

We note that since our previous report, new data on 2014 solar PV installations in Honolulu became available. Based on this data, we have revised our 2014 year-end estimate for total installed solar electric capacity in Honolulu from 96 MW to 120 MW. Units were assumed to be in DC watts.

Houston

Data were provided by CenterPoint Energy, the electric utility serving the city, as of December 31, 2015.[102] Cumulative installed solar capacity within Houston city limits was provided in AC watts and we converted it to DC watts.

Indianapolis

Data were provided by Indianapolis Power and Light, the electric utility serving the city, as of December 31, 2015.[103] Figures were reported in AC watts, which we converted to DC watts.

Jacksonville

Data were provided by Jacksonville Electric Authority (JEA), the utility serving the city, as of December 31, 2014.[104] Capacity was provided in AC watts, which we converted to DC watts for this report.

Kansas City

Total installed solar PV capacity at the end of 2015 was provided to us in DC watts by Kansas City Power & Light, the electric utility serving the city.[105]

Las Vegas

Data were provided by the City of Las Vegas, as of December 31, 2015 (in a spreadsheet compiled for the city by NV Energy, the city's electric utility).[106] The capacity was provided in AC watts and we converted it to DC watts. NV Energy has now installed a total of 58 MW of solar PV capacity within the city of Las Vegas and 139 MW-DC throughout its entire southern service territory.[107]

Los Angeles

Data were provided by the Los Angeles Department of Water & Power, the city's municipal electric utility, as of December 31, 2015.[108] The capacity was provided in AC watts and we converted it to DC watts.

Louisville

Data on solar PV capacity for Jefferson County were provided by Louisville Gas & Electric, the electric utility serving the city, as of December 31, 2015.[109] Figures were assumed to be in DC watts. While most solar energy systems are installed in the City of Louisville, it is possible that our estimate includes some solar capacity from surrounding areas in Jefferson County. Per capita calculations were based on U.S. Census population estimates for "Louisville/Jefferson County (balance)," which excludes other incorporated places and semiautonomous towns within the county.

Manchester

Eversource Energy, an electric utility serving Manchester, provided us with an aggregate total of installed solar PV capacity within the city limits of Manchester, through 31 December 2015.[110] Figures were given in AC watts, which we converted to DC watts.

Memphis

Data were provided by Memphis Light, Gas and Water, the city's municipal electric utility, as of December 31, 2015 in DC watts.[111]

Miami

Despite requesting information from a number of sources, we were unable to obtain 2015 solar PV capacity data for the city of Miami. We therefore listed the most current figure we had available, which was estimated based on 2014 year-end data. For our previous edition of this report, Florida Power & Light provided us with solar PV installed in their service area, broken down by zip code, as of December 31, 2014, in DC watts.[112] To estimate the amount of solar PV capacity within Miami, we used ArcMap to isolate zip codes centered within the city limits of Miami and counted only solar PV installations in those zip codes.

Milwaukee

An estimate of total installed solar PV capacity in Milwaukee through the end of 2015 was provided by the City of Milwaukee's Environmental Collaboration Office in DC watts.[113]

Minneapolis

Xcel Energy, the electric utility serving the city of Minneapolis, provided us with data on the solar PV capacity of installations within the city as of the end of 2015.[114] These data were reported in DC watts.

Nashville

Data were provided by Nashville Electric Service, the electric utility serving the city, in DC watts.[115] Reported figures covered solar PV installations within the city of Nashville, as of the end of 2015. Because our U.S. Census source for population data covers Nashville-Davidson County (balance), a geographical region that includes areas outside of the city of Nashville, we based our per capita calculations on World Population Review estimates for the 2014 population of "Nashville city proper."[116]

New Orleans

The Gulf States Renewable Energy Industries Association (GSREIA) connected us with Entergy New Orleans, the electric utility serving the city of New Orleans. Entergy New Orleans provided us with an estimate of installed solar PV capacity within New Orleans city limits in DC watts as of the end of 2015.[117]

Last year's report stated that the city had installed 27.496 MW-AC of capacity, leading to a DC-converted estimate of approximately 36 MW. It has since come to our attention that the original figure was most likely provided in DC units, and therefore the correct estimate of total installed solar capacity in New Orleans through the end of 2014 should have been 27.5 MW (rounded), or 72.6 watts per capita.

New York

Data on solar PV capacity in the city limits of New York as of December 31, 2015 were provided by Con Edison, the utility serving New York City.[118] Figures were reported in AC watts, which we converted to DC watts.

Newark

The solar PV installations supported by New Jersey's Clean Energy Program (NJCEP) are made available online in the "NJCEP Solar Installations Report" with city and zip code information, updated through December 31, 2015.[119] Within the Projects List tab, we filtered for solar installations registered to addresses with Newark city zip codes. Data were assumed to be in DC watts.

We revised our estimate of total installed solar capacity in the city of Newark downward after discovering that a few installations that we had previously counted were actually located outside of Newark city limits. As a result, our updated figure for Newark is lower than the figure in last year's report by about 1 MW.

Oklahoma City

The total solar PV capacity of net-metered solar installations in Oklahoma City was provided in DC watts by the city's Planning Department via Oklahoma Gas & Electric.[120] To this total, we added a known 1 MW installation at a Veteran's Hospital within city limits.[121]

Omaha

Estimated solar PV capacity in Omaha was provided by Omaha Public Power District, the electric utility serving the city of Omaha.[122] The estimate may include a small amount of solar capacity installed outside of city limits.[123] These data were reported in AC watts and were converted to DC watts.

Orlando

Total solar PV capacity installed in 2015 within Orlando Utilities Commission (OUC) service territory in the city of Orlando was provided by the OUC's Renewable Energy Manager in DC watts.[124] We added this capacity to our 2014 cumulative estimate for the city of Orlando, obtained from the OUC for the previous edition of this report.[125]

Philadelphia

Data were provided by the city of Philadelphia after being downloaded from the Solar Renewable Energy Certificates (SREC) registry PJM-GATS, administered by regional electric transmission organization PJM.[126] These data include solar PV installations that are registered in Philadelphia through December 2015. Capacity is listed in DC watts.

Phoenix

Phoenix is served by two electric utilities, Arizona Public Service (APS) and Salt River Project (SRP). Data from both service territories were provided by the City of Phoenix as of December 31, 2015 in DC watts.[127]

Pittsburgh

Data for solar PV installations in Allegheny County was downloaded in a spreadsheet called "Renewable Generators Registered in GATS" through the online GATS database administered by PJM.[128] To focus on solar PV installations, we filtered by primary fuel type "SUN" for Allegheny County, PA. The spreadsheet lists solar PV installations by county through November 1, 2015, but does not provide more detailed location data. To estimate the amount of solar capacity installed within the city of Pittsburgh only, we multiplied the total capacity listed for Allegheny County by 0.263, the 2014 U.S. Census estimated proportion of county households located within Pittsburgh.[129]

Portland, ME

Central Maine Power Company, the utility company serving central and southern areas of the state, provided us with the sum of solar PV capacity connected to their grid in Portland through the end of 2015.[130] Capacity data is reported to the company in a combination of AC and DC units and we were unable to determine which values were given in which unit. We therefore made the conservative assumption that all figures were in DC watts.

Portland, OR

The city of Portland is served in part by Portland General Electric and in part by Rocky Mountain Power, which operates as Pacific Power in the state of Oregon. Data on solar PV capacity installed by these utilities within Portland, OR, city limits through the end of the third quarter of 2015 were provided by the city of Portland's Bureau of Planning and Sustainability in DC watts.[131] Because fourth quarter solar power data were not available to us, it is likely that the actual amount of solar PV capacity installed in Portland at the end of 2015 is higher than our estimate.

Our current estimate of solar PV capacity within Portland is not directly comparable to the estimate listed in our 2015 edition, which erroneously double-counted solar PV capacity reported by Rocky Mountain Power. We have revised our 2014 year-end capacity estimate to 17,141 kW-DC to eliminate the redundancy.

Providence

Data were provided from the Rhode Island Office of Energy Resources as of December 31, 2015.[132] Figures were given in AC watts, which we converted to DC watts.

We note that this figure should not be compared with the estimate reported for Providence in the last report since the data provided to us for last year's report erroneously included all renewable energy capacity within the city. Our revised estimate for 2014 year-end solar PV capacity installed in the city of Providence is 2.1 MW-DC. In 2015, Providence actually doubled its solar PV capacity to 4.2 MW-DC by the end of the year.

Raleigh

The North Carolina Sustainable Energy Association (NCSEA) provided us with a spreadsheet listing solar PV capacity in the state of North Carolina installed through the end of April 2015, obtained from the North Carolina Utilities Commission.[133] We used ArcMap to identify installations located within Raleigh City limits and counted solar capacity listed for those installations.

To estimate capacity installed between May and December 2015, we used a list of solar PV projects permitted during that time period, which was provided by the city of Raleigh. We assumed, conservatively, that all 90 projects listed were residential PV installations, and that all were completed by the end of the year. Because this list did not include capacity figures for most of these permitted projects, we assumed that each installation had a capacity of 5.41kW-DC, the average solar PV capacity computed for January-April residential installations in Raleigh. Finally, as recommended by the city of Raleigh, we added one additional city-owned installation – a 1.3 MW solar facility at the city's water treatment plant – to our estimated total for the 12 months of 2015.

Richmond

The Virginia Department of Mines, Minerals and Energy (DMME) provided us with a spreadsheet listing all net metered solar PV installations through 2015.[134] Within this list, we filtered for solar PV systems registered to addresses with a "city name" of Richmond. The DMME collects capacity data in both AC and DC watts and we were unable to determine specific unit types for individual installations. Because we were informed that the reporting standard for solar PV systems was AC current, we processed all capacity data as AC figures. The list does not include any non-net metered installations, but our contact at VMME did not know of any such systems within the city of Richmond.

Riverside

The installed solar PV capacity total for Riverside was taken from a solar map maintained by the city of Riverside, available at http://www.greenriverside.com/Green-Map-9. This map is updated daily, and the total we used was recorded on January 27, 2016; therefore, our total may include solar PV systems after December 2015. According to the webpage administrator, the difference between the end of December 2015 and the date of recording "would be minor."[135] Solar capacity data are listed in DC watts and cover installations within Riverside city limits.

Sacramento

Solar PV capacity data were provided in a spreadsheet compiled by the Sacramento Municipal Utility District (SMUD), the city's publicly-owned electric utility.[136] A team of GIS analysts at SMUD had pre-filtered the data set to list only installations within Sacramento city limits at the end of 2015. Capacity was given in AC watts, which we converted to DC watts.

Salt Lake City

The total year-end 2015 capacity of residential and non-residential net-metered solar PV installations within Salt Lake City limits was provided through the Salt Lake City Office of Sustainability in DC watts.[137]

San Antonio

Data for installed solar PV capacity within San Antonio through the end of 2015 were provided in DC watts by CPS Energy, the electric utility serving the city.

San Diego

Data were provided by San Diego Gas & Electric, the electric utility serving the city, as of December 31, 2015.[138] The capacity was provided in AC watts and we converted it to DC watts.

San Francisco

Data for solar PV capacity installed in San Francisco through end of 2015 were provided by Pacific Gas & Electric, the electric utility serving the city.[139] Figures were given in AC watts, which we converted to DC watts.

San Jose

Data were provided by Pacific Gas & Electric, the electric utility serving the city of San Jose.[140] Solar PV capacity as of December 31, 2015 was given in AC watts, which we converted to DC watts.

Seattle

An estimate of installed solar PV capacity as of December 31, 2015 was provided in DC watts by the Seattle City Light, the city's municipal utility.[141]

St. Louis

Ameren Missouri, the utility serving the city of St. Louis, provided us with a total capacity number as of December 31, 2015, in DC watts, for the city of St. Louis.[142] The utility company totaled installed solar PV capacity in the following St. Louis zip codes to estimate how much solar PV fell within the city limits: 63101, 63102, 63103, 63104, 63106, 63107, 63108, 63109, 63110, 63111, 63112, 63113, 63115, 63116, 63118, 63139, 63147 and 63155.

Tampa

TECO Energy, the electric utility serving the city of Tampa, provided us with a total installed capacity number, updated through the end of 2015, in DC watts, for the city of Tampa.[143] This includes 323 customer-owned solar PV systems and a recently-completed 2 MW PV system at Tampa International Airport, which is within Tampa city limits.

Virginia Beach

Dominion Virginia Power, the electric utility serving Virginia Beach, provided us with the total solar PV capacity registered to a Virginia Beach city address as of the end of 2015.[144] The figure was reported in AC watts, which we converted to DC watts.

Washington, D.C.

The estimated total solar PV capacity for installations in Washington, D.C. was provided by the Public Service Commission of the District of Columbia as of December 31, 2015 in DC watts.[145]

Wilmington

The Delaware Public Service Commission maintains a spreadsheet of certified renewable energy facilities.[146] We downloaded the most updated version of this spreadsheet (11.18.2015) and filtered the list of solar PV installations for those with Wilmington listed as the city name.

Because we knew not all installations listed fell within Wilmington city boundaries, we used ArcMap to analyze the data geographically. For installations with zip code information, we multiplied the listed solar PV capacity figure by the proportion of that zip code located in the city of Wilmington. The proportion of total listed solar capacity estimated to be in Wilmington, among all zip-coded items, was 0.391. For installations without zip code information, we multiplied the listed solar capacity figure by 0.391. The resulting total of 3,405.9 kW, which we assumed to be in DC watts, is lower than the figure listed in the previous report. Because we were able to improve the geographic precision of our Wilmington-specific methodology, our 2014 and 2015 year-end figures are not directly comparable.

Notes

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5. Energy Information Administration, Electric Power Monthly, Table 1.1.A. Net Generation from Renewable Sources: Total (All Sectors), 2005-November 2015, 26 January 2016; U.S. EPA, Greenhouse Gas Equivalency Calculator, accessed at www.epa.gov/energy/greenhouse-gas-equivalencies-calculator, 17 February 2016; Note: This greenhouse gas equivalency calculation assumes that solar power displaces non-baseload electricity only. The calculator does not account for geographical variation in electricity consumption or emissions rates. As a result of these assumptions, the greenhouse gas equivalency estimate may differ from the actual amount of pollution averted by solar PV systems.

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9. Earth Justice, *Meet the Power Plants*, accessed at earthjustice.org/features/map-meet-the-power-plants, 11 February 2016; Fabio Caiazzo et al., "Air pollution and early deaths in the United States. Part I: Quantifying the impact of major sectors in 2005," *Atmospheric Environment*, 79: 198–208, November 2013.

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11. Union of Concerned Scientists, *The Energy- Water Collision: 10 Things You Should Know,* September 2010.

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13. For relationship between heat and electricity demand: See Note 42; For peaker plant information: Jeff St. John, "Dueling Charts of the Day: Peaker Plants vs. Green Power," *GreenTech Media,* 17 January 2014.

14. Natural Resources Defense Council, *Air Pollution: Smog, Smoke and Pollen (fact sheet)*, accessed 06 February 2016 at www.nrdc.org/health/climate/airpollution.asp.

15. Robert G. Sanders and Lewis Milford, Clean Energy Group, *Clean Energy for Resilient Communities: Expanding Solar Generation in Baltimore's Low-Income Neighborhoods,* February 2014.

16. Solar Energy Industries Association, *Net Metering*, accessed at www.seia.org/policy/distributed-solar/net-metering, 9 February 2016.

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31. See Note 27.

32. Jon Weiner, Lawrence Berkeley National Laboratory, *U.S. Distributed Solar Prices Fell 10 to 20 Percent in 2014, with Trends Continuing into 2015 (press release)*, 12 August 2015.

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34. After requesting data from a number of sources and finding ourselves unable to procure reliable information, we did not include Cheyenne, Wyoming; Denver, Colorado; Jackson, Mississippi; Little Rock, Arkansas; Sioux Falls, South Dakota; or Wichita, Kansas.

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39. Fourteen cities were listed as "Solar Stars" in last year's report based on 2014 data. Due to an update in methodology, however, two cities on that list -- Raleigh and Wilmington, DE – have had their solar capacity revised downward for this report and no longer qualify as "Solar Stars" in this year's report. A third city, Denver, CO, was removed from the list because we were unable to obtain reliable solar capacity data for the city.

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46. See Note 44.

47. Webberville Solar Farm, *Project Overview*, accessed at webbervillesolar.com/ProjectOverview.html, 18 February 2016; While the Webberville Solar Farm supplies solar energy to Austin residents through a PPA with Austin Energy, the facility is located outside of city limits and therefore did not meet criteria for inclusion in Austin city estimates.

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51. Ibid.

52. Solar Energy Industries Association, *Solar Spotlight: New York (fact sheet),* 9 September 2015; Solar Energy Industries of America, *Gov. Cuomo's Successful NY-Sun Solar Program Will Shine Through 2023*, accessed at www.seia.org/news/gov-cuomo-s-successfulny-sun-solar-program-will-shine-through-2023, 24 April 2014.

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56. United States Department of Energy, *Virtual Net-Metering Now Available to Washington D.C. Residents (press release*), accessed at apps3.eere.energy.gov/greenpower/news/news_template.shtml?id=1871, 2 February 2015.

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