Shining Cities 2018

How Smart Local Policies Are Expanding Solar Power in America

ENVIRONMENT RHODE ISLAND
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Executive Summary

Solar power is expanding rapidly. The United States now has over 53 gigawatts (GW) of solar photovoltaic (PV) capacity installed – enough to power 10.1 million homes and 26 times as much capacity as was installed at the end of 2010.[1] Hundreds of thousands of Americans have invested in solar energy 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.

Solar power can allow cities to curb emissions that contribute to global warming, become more resilient to severe weather, help residents stabilize their energy bills, and improve public health through reduced air pollution.

Figure ES-1. Major U.S. Cities by Cumulative Installed Solar PV Capacity, End of 2017 (MW)

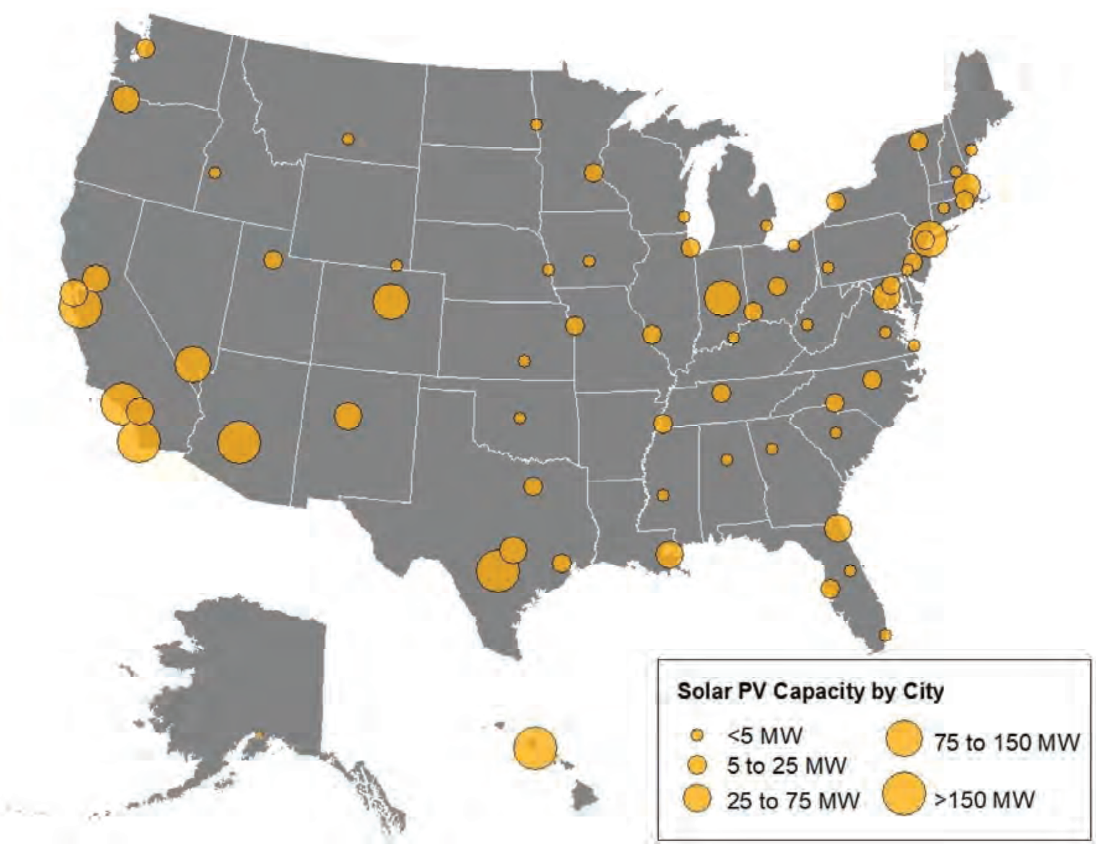

Table ES-1. Top 20 Solar Cities by Total Installed Solar PV Capacity, End of 2017

City	State	Total Solar PV Installed (MW-DC)‡	Total Solar PV Rank	Per Capita Solar PV Installed (Watts-DC/person)	Per Capita Rank	Rooftop Solar PV Potential on Small Buildings (MW)¥
Los Angeles	CA	349.3	1	87.9	15	5,444
San Diego†	CA	287.2	2	204.1	2	2,219
Honolulu	HI	213.3	3	606.4	1	N/A
Phoenix*	AZ	206.4	4	127.8	7	2,981
San Jose	CA	195.9	5	191.0	3	1,639
San Antonio	TX	161.0	6	107.9	11	3,721
New York	NY	147.0	7	17.2	40	1,277
Indianapolis†	IN	117.4	8	137.3	4	N/A
Denver	CO	83.4	9	120.3	8	677
Las Vegas	NV	81.5	10	128.8	6	946
Albuquerque*	NM	57.9	11	103.5	12	1,252
Sacramento	CA	49.8	12	100.5	14	777
Washington	DC	47.3	13	69.4	17	344
San Francisco	CA	47.1	14	54.1	18	672
Jacksonville	FL	42.6	15	48.4	21	1,715
New Orleans	LA	39.7	16	101.4	13	1,277
Austin	TX	39.4	17	41.5	23	1,443
Riverside	CA	36.3	18	111.9	9	612
Boston	MA	33.0	19	49.0	19	341
Portland	OR	31.2	20	48.8	20	1,397

‡ 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 cities, even those 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.

¥ Reflects the maximum technical solar PV capacity that could be installed on appropriate small building rooftops in each city. These figures were calculated by the U.S. Department of Energy (DOE): U.S. DOE, Energy Efficiency & Renewable Energy State & Local Energy Data, available at apps1.eere.energy.gov/sled/#. Data were unavailable for cities with "N/A" listed.

** Due to an improvement in methodology or data source for this city, total and per capita solar PV capacity reported in this table are not directly comparable with estimates for this city in previous editions of this report. See Appendix B for details on specific cities.*

† Solar capacities for these cities appear to be lower than the figures published in last year's report because a new AC to DC conversion factor was used in this year's report. Capacity increased in both cities during 2017. See Methodology for details.

As of the end of 2017, 20 cities—representing just 0.1 percent of U.S. land area—accounted for over 4 percent of U.S. solar PV capacity. These 20 cities have over 2 GW of solar PV capacity—more solar power than the entire country had installed by the end of 2010.[2]

Los Angeles leads the nation in total installed solar PV capacity among the 69 cities surveyed in this report, as it did between 2013 and 2015 before being temporarily overtaken by San Diego in 2016. (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 solar PV capacity installed per person. **Honolulu has nearly three times as much solar PV per capita** as the next leading city, **San Diego**. All of the "Solar Stars" have experienced dramatic growth in solar energy and are setting the pace nationally for solar energy development. In 2013, only eight of the cities surveyed for this report had enough solar PV per capita to be ranked as "Solar Stars," but now 18 cities have earned the title. (See Figure ES-2 and Table ES-2.)

Leaders in per capita solar capacity by census region include **Honolulu** in the Pacific region, **Las Vegas** in the Mountain region, **Indianapolis** in the North Central region, **San Antonio** in the South Central region, **Washington, D.C.,** in the South Atlantic region and **Burlington, Vermont,** in the Northeast region.

Many smaller cities and towns are also going big on solar energy. Many smaller communities have installed as much solar PV per capita as the leading cities included in this survey.

- **Fresno, California,** has 343 watts of solar PV capacity installed per resident – more than any large city surveyed, with the exception of Honolulu.[3]
- **Santa Fe, New Mexico,** would rank among the top "Solar Stars" on our list with 203 watts of solar PV installed per resident.[4]
- **Tucson, Arizona,** would also rank among the top "Solar Stars" with 183 watts of solar PV installed per resident.[5]

Fossil fuel interests and some utilities are working to slow the growth of distributed solar energy. During 2017 alone, 19 utilities in 10 states requested to add or increase electric bill charges for rooftop solar customers.[6] And, over the past few years many states have considered or passed cuts to

Figure ES-2. Major U.S. Cities by Installed Solar PV Capacity Per Capita, End of 2017 (Watts per Person)

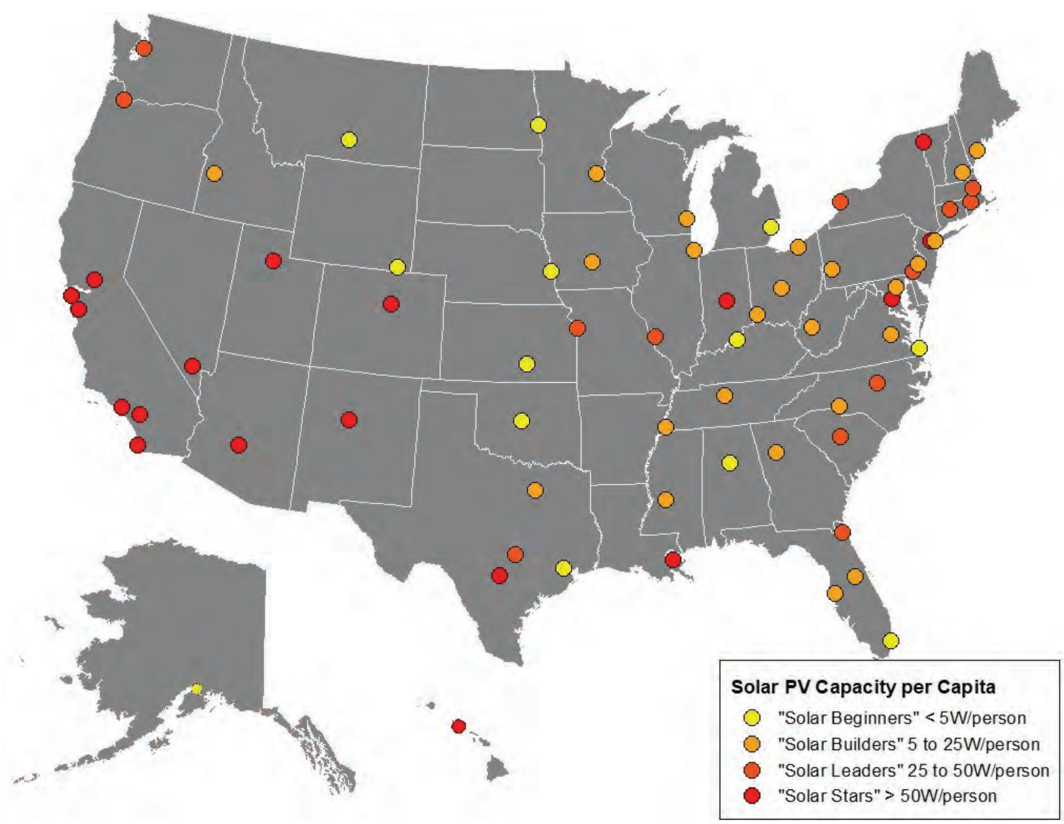

Table ES-2. The "Solar Stars" (Cities with 50 or More Watts of Solar PV per Person, End of 2017)

City	State	Total Solar PV Installed (MW-DC)	Total Solar PV Rank	Per Capita Solar PV Installed (Watts-DC/person)	Per Capita Rank	Change in Per Capita Rank from 2016 to 2017¥
Honolulu	HI	213.3	3	606.4	1	0
San Diego†	CA	287.2	2	204.1	2	0
San Jose	CA	195.9	5	191.0	3	0
Indianapolis†	IN	117.4	8	137.3	4	0
Burlington	VT	5.6	39	132.2	5	+6
Las Vegas	NV	81.5	10	128.8	6	0
Phoenix*	AZ	206.4	4	127.8	7	N/A
Denver	CO	83.4	9	120.3	8	N/A
Riverside	CA	36.3	18	111.9	9	-1
Salt Lake City	UT	21.7	22	111.9	10	+4
San Antonio	TX	161.0	6	107.9	11	+1
Albuquerque*	NM	57.9	11	103.5	12	N/A
New Orleans	LA	39.7	16	101.4	13	-4
Sacramento	CA	49.8	12	100.5	14	-4
Los Angeles	CA	349.3	1	87.9	15	0
Newark	NJ	24.4	21	86.5	16	-3
Washington	DC	47.3	13	69.4	17	+4
San Francisco	CA	47.1	14	54.1	18	-1

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net metering – the critical practice of crediting solar energy customers for the excess energy they supply to the grid.[7]

U.S. cities have only begun to tap their solar energy potential. Some of the cities on this list could generate hundreds of times more solar power, and the majority could generate at least 50 times more solar power than they currently do on the rooftops of small buildings alone, according to a National Renewable Energy Laboratory (NREL) analysis.[8] Cities can go even farther by encouraging solar installations on large buildings and stand-alone utility-scale installations.

To take advantage of that potential and move America toward an economy powered by 100 percent renewable energy, city, state and federal governments should adopt a series of pro-solar policies.

Local governments should, among other things:

- Implement solar access ordinances to protect residents' right to generate solar energy on their own property.
- Make permitting, zoning and inspection processes easy, quick and affordable.
- Expand access to solar energy to apartment dwellers, low-income residents, small businesses, and nonprofits through low-interest financing programs, power purchase agreements (PPAs), collective purchasing programs, and community solar projects.
- Support and push for strong state-level solar policies, especially by combining efforts with other communities.

State governments should, among other things:

- Set or increase renewable energy targets for utilities and adopt specific requirements for solar energy adoption.
- Adopt and preserve strong statewide interconnection and net metering policies.
- Ensure that electric rate designs encourage solar adoption.
- Establish public benefits charges on utility bills or other sustainable financing mechanisms for solar energy.

The federal government should, among other things:

- Continue and expand financing support for solar energy, particularly the Investment Tax Credit.
- Support research to drive solar power innovations, such as the U.S. Department of Energy's Solar Energy Technologies Office.
- Defend and strengthen the requirements of the Clean Power Plan.

Introduction

Solar power is an American success story. A rarity just a decade ago, the United States now has enough solar energy installed to power one in 14 American homes – nearly 1.6 million solar installations.[9] After a year of rapid growth in 2017, U.S. solar photovoltaic (PV) capacity now exceeds 53 gigawatts (GW), enough to power 10.1 million homes.[10] Improvements in solar technology and rapidly declining costs are making solar energy more attractive with each 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 and reduce carbon pollution.

Some cities have demonstrated exceptional leadership in adopting solar power. The key difference between these leaders and cities that are lagging is effective public policy.

State and local policies are 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, are cities where solar energy is taking off.

Solar energy adoption in every city, meanwhile, is affected by federal policies. Federal tax credits for renewable energy are making an important contribution to fueling growth in solar power, but the residential credits are scheduled to phase out in 2022.[11]

American solar energy is at a tipping point. We are nearing the threshold, called "grid parity," where solar power is equivalent in price to electricity generated by fossil fuels and the conditions are in place for mass adoption of solar energy. In fact, over half of all U.S. states have reached grid parity and *Greentech Media* predicts that 42 states will achieve it by 2020.[12]

The rapid spread of low-cost solar power has posed a threat to the business models of fossil fuel interests and some utilities, who have united in an effort to slow the progress of solar energy. In 2017 alone, 19 utilities in 10 states requested to add or increase electric bill charges for rooftop solar customers specifically.[13] And, over the past few years, many states have considered or passed cuts to net metering – the critical practice of crediting solar energy customers for the excess energy they supply to the grid.[14] The outcome of those battles will determine how rapidly our cities and the rest of the nation can reap the benefits of the solar revolution.

Cities continue to lead the way in the transition to a clean energy system powered by renewable energy. With tremendous unmet potential for solar energy in every city, now is the time for cities, as well as state and federal governments, to recommit to the policies that are bringing that clean energy future closer to reality.

Solar Power Is Good for Cities

Solar energy helps cities in many ways, including by combating global warming, reducing air pollution, strengthening the electric grid, and stabilizing energy costs for residents.

Solar Energy Reduces Harmful Carbon Pollution

America can limit the future impact of global warming by slashing its use of the dirty energy sources that cause it.[15] Unlike fossil fuel power plants, solar energy systems produce no carbon emissions. Even when emissions from manufacturing, transportation and installation of solar panels are included, solar power generation produces 96 percent fewer greenhouse gas emissions than electricity from coal over its entire life cycle, and 91 percent fewer greenhouse gas emissions than electricity from gas-fired power plants.[16] By replacing electricity from fossil fuels with solar power, we can dramatically cut carbon pollution and reduce global warming.

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.[17] These conditions can lead to disability, prolonged absences from work or school, and even death.[18] One study found that pollution from electric power plants is responsible for about 50,000 U.S. deaths per year.[19] 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.[20]

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 the economy.

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.[21] 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.[22] In fact, solar PV systems consume 500 times less water than coal power plants over their life-cycle and 80 times less than natural gas plants, per unit of electricity produced.[23]

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 – and sometimes even build – “peaker” power plants, which tend to be highly expensive and polluting.[24] Because the impact of air pollution is most harmful when temperatures are high, relying on solar power during hot weather also helps improve public health.[25]

Solar energy can even help to protect cities in the face of severe storms. If transmission lines are disrupted, solar microgrids can help prevent blackouts by going temporarily "off the grid" and providing power directly to the facilities where they are generating electricity.[26]

Solar Energy Benefits Consumers

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.

Home and business owners who 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 installed, these solar consumers are protected from the volatile prices of fossil fuel markets.

In states with net metering, when solar panel owners generate more energy than they need at a given point in time, they can export this energy to the grid in exchange for credit. They can then use that credit to pay for electricity they receive from the grid later, when their solar panels aren't generating enough energy. On average, about 20 to 40 percent of a solar energy system's output is exported back to the electric grid, serving nearby customers.[27] The credits collected by system owners can help them recoup initial investments made in PV systems over time.

Distributed Solar Electricity Provides Benefits to the Broader Electric Grid

The 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 and can replace expensive and dirty peaker power plants.[28] Generating more electricity closer to the locations where it is used also reduces the need to construct or upgrade expensive transmission capacity. Localized electricity generation minimizes the amount of energy lost during transmission, improving electric system efficiency too.[29]

Staff photo

Solar panels on the South Berwick Public Library, Maine.

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

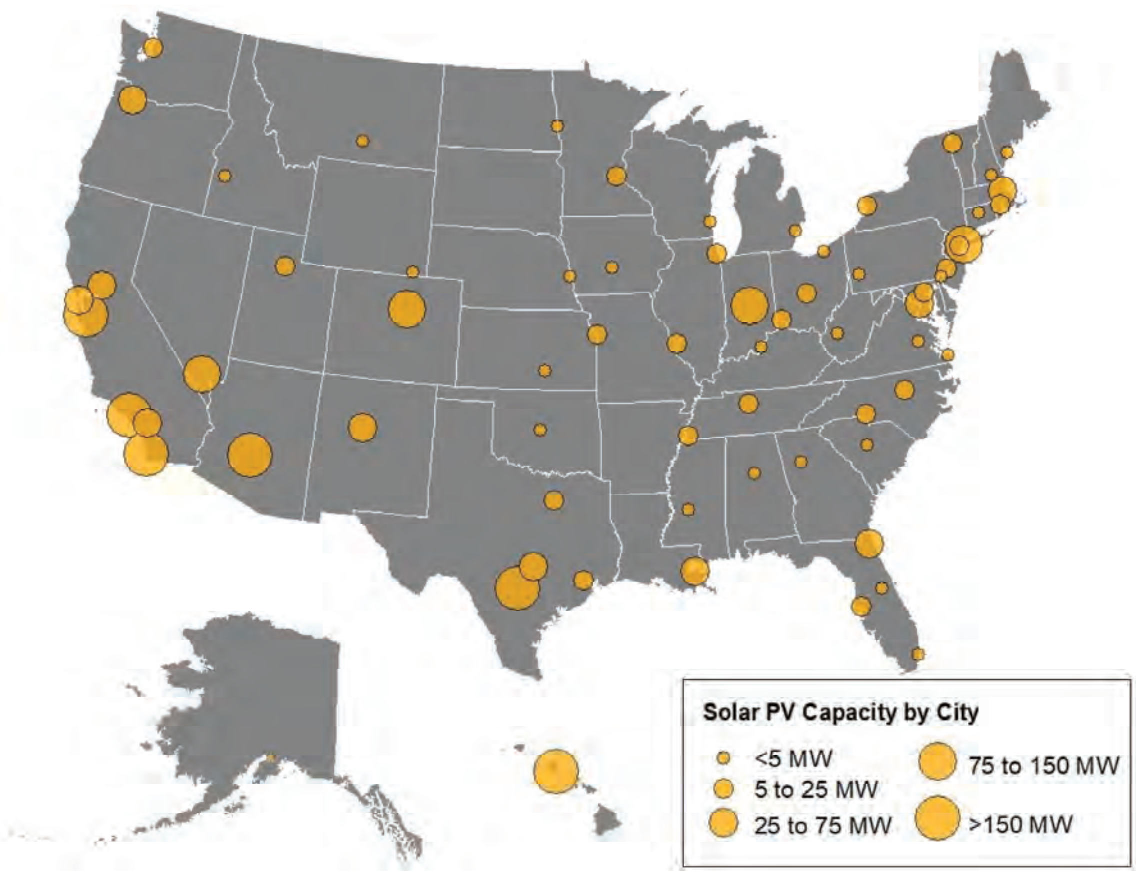
City leaders and residents are taking advantage of the significant opportunities offered by solar energy as the U.S. solar energy boom continues.

In leading cities, officials are setting ambitious goals for solar energy adoption, putting solar panels on city buildings, and working with utilities to upgrade the electric grid and offer electric customers incentives to invest in solar energy systems. In these cities, permitting departments are taking steps to reduce fees and processing times for solar installation applications. As a result, city residents, individually and with their neighbors, are cutting their electricity bills and contributing to a cleaner environment by purchasing solar energy.

This report is our fifth review of installed solar PV capacity 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 according to the U.S. Census Bureau.[30] If a state did not have a city included in that list, its most populous city was added to the list to be surveyed. For a complete list of cities, see Appendix B. We were unable to find reliable data for Little Rock, Arkansas, so the city was dropped from the list. Also, Sioux Valley

With tremendous unmet potential for solar energy in every city, now is the time for cities, as well as state and federal governments, to recommit to the policies that are bringing that clean energy future closer to reality.

Figure 1. U.S. Cities by Cumulative Installed Solar PV Capacity, End of 2017 (MW)



Energy, the utility that serves Sioux Falls, South Dakota, reported that there is no solar capacity installed in Sioux Falls' city limits connected to their grid.[31]

There is no uniform and comprehensive national data source that tracks solar energy capacity by municipality, so the data for this report come from a 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. An updated alternating current (AC) to direct current (DC) conversion factor was used in this report, so all figures involving an AC to DC conversion are not directly comparable with previously reported figures. Cases where this change in methodology led to an artificial decrease in capacity are noted in Appendix B.

The Top 20 Solar Cities Have 2 Gigawatts of Installed Solar Energy Capacity

Cities that lead the nation in installed solar PV capacity come from all regions of the U.S. The top 20 cities in our report host over 2 GW of solar PV capacity – more solar power than the entire country had installed at the end of 2010.[32] **Despite making up only 0.1 percent of the nation's land area, these cities contain over 4 percent of U.S. solar PV capacity.**[33]

In 2017, Los Angeles reclaimed its title as the leading city for total installed solar PV capacity, after San Diego briefly held the title in 2016. (See Table 1 and Figure 1.)

Table 1. Top 20 Solar Cities by Total Installed Solar PV Capacity, End of 2017

City	State	Total Solar PV Installed (MW-DC)‡	Total Solar PV Rank	Per Capita Solar PV Installed (Watts-DC/person)	Per Capita Rank	Rooftop Solar PV Potential on Small Buildings (MW)¥
Los Angeles	CA	349.3	1	87.9	15	5,444
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San Jose	CA	195.9	5	191.0	3	1,639
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Las Vegas	NV	81.5	10	128.8	6	946
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New Orleans	LA	39.7	16	101.4	13	1,277
Austin	TX	39.4	17	41.5	23	1,443
Riverside	CA	36.3	18	111.9	9	612
Boston	MA	33.0	19	49.0	19	341
Portland	OR	31.2	20	48.8	20	1,397

‡ *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 cities, even those 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.*

¥ *Reflects the maximum technical solar PV capacity that could be installed on appropriate small building rooftops in each city. These figures were calculated by the U.S. Department of Energy (DOE): U.S. DOE, Energy Efficiency & Renewable Energy State & Local Energy Data, available at apps1.eere.energy.gov/sled/#. Data were unavailable for cities with "N/A" listed.*

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Table 2. The "Solar Stars" (Cities with 50 or More Watts of Solar PV per Person, End of 2017)

City	State	Total Solar PV Installed (MW-DC)	Total Solar PV Rank	Per Capita Solar PV Installed (Watts-DC/person)	Per Capita Rank	Change in Per Capita Rank from 2016 to 2017¥
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San Jose	CA	195.9	5	191.0	3	0
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Burlington	VT	5.6	39	132.2	5	+6
Las Vegas	NV	81.5	10	128.8	6	0
Phoenix*	AZ	206.4	4	127.8	7	N/A
Denver	CO	83.4	9	120.3	8	N/A
Riverside	CA	36.3	18	111.9	9	-1
Salt Lake City	UT	21.7	22	111.9	10	+4
San Antonio	TX	161.0	6	107.9	11	+1
Albuquerque*	NM	57.9	11	103.5	12	N/A
New Orleans	LA	39.7	16	101.4	13	-4
Sacramento	CA	49.8	12	100.5	14	-4
Los Angeles	CA	349.3	1	87.9	15	0
Newark	NJ	24.4	21	86.5	16	-3
Washington	DC	47.3	13	69.4	17	+4
San Francisco	CA	47.1	14	54.1	18	-1

** Due to an improvement in methodology or data source for this city, total and per capita solar PV capacity reported in this table are not directly comparable with estimates for this city in previous editions of this report. See Appendix B for details on specific cities.*

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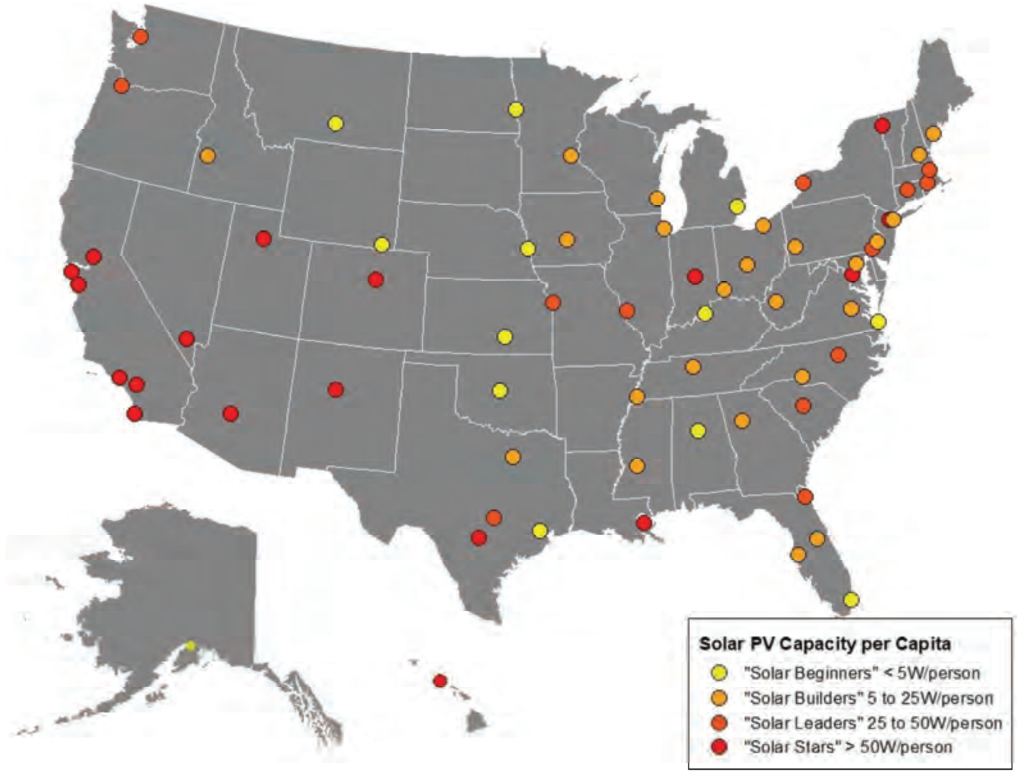
Leading Cities Continue to Grow in Solar Capacity Per Capita

The cities ranked in this report vary in size, population and geography. Measuring solar PV capacity installed per city resident, in addition to comparing total installed solar PV capacity, can provide an idea of how densely developed solar energy is in a city.

"Solar Stars" are cities with 50 or more watts of installed solar PV capacity per person. These are cities that have experienced dramatic growth in solar energy in recent years and are setting the pace nationally for solar energy development. Honolulu has nearly three times as much solar PV per capita as the next highest ranked city, San Diego. San Jose, Indianapolis and Burlington are also in the top five cities in the nation for installed solar PV capacity per person. In 2013, only eight of the cities surveyed for this report had enough solar PV per capita to be ranked as "Solar Stars," but now 18 cities have earned the title.

Figure 2. U.S. Cities by Installed Solar PV Capacity Per Capita, End of 2017 (Watts per Person)



"Solar Leaders" have between 25 and 50 watts of solar PV installed per person. These cities come from across the country and those with strong policies are rising toward the "Solar Star" rank.

Table 3. The "Solar Leaders" (Cities with 25 to 50 Watts of Solar PV per Person, End of 2017)

City	State	Total Solar PV Installed (MW-DC)	Total Solar PV Rank	Per Capita Solar PV Installed (Watts-DC/person)	Per Capita Rank	Change in Per Capita Rank from 2016 to 2017¥
Boston	MA	33.0	19	49.0	19	+6
Portland	OR	31.2	20	48.8	20	-1
Jacksonville	FL	42.6	15	48.4	21	+6
Wilmington	DE	3.2	50	44.4	22	-4
Austin	TX	39.4	17	41.5	23	+1
Raleigh*	NC	18.3	24	39.9	24	N/A
Kansas City	MO	18.7	23	38.9	25	+1
Buffalo	NY	9.6	33	37.4	26	+2
Hartford	CT	4.5	43	36.3	27	-4
St. Louis	MO	10.8	31	34.6	28	-6
Providence	RI	5.7	38	32.0	29	0
Columbia	SC	4.0	45	29.8	30	+9
Seattle	WA	18.1	25	25.7	31	+1

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¥ "N/A" is listed for cities where 2017 data is not directly comparable with 2016 data, either because 2016 data were unavailable or due to an improvement in methodology. See Appendix B for details on specific cities.

Table 4. The "Solar Builders" (Cities with 5 to 25 Watts of Solar PV per Person, End of 2017)

City	State	Total Solar PV Installed (MW-DC)	Total Solar PV Rank	Per Capita Solar PV Installed (Watts-DC/person)	Per Capita Rank	Change in Per Capita Rank from 2016 to 2017¥
Portland	ME	1.7	57	24.9	32	+3
Manchester	NH	2.7	52	24.0	33	-3
Tampa	FL	9.0	35	23.8	34	-3
Minneapolis	MN	9.7	32	23.4	35	+5
Baltimore	MD	13.0	29	21.1	36	-2
Cincinnati	OH	6.0	37	20.1	37	-4
Jackson	MS	3.2	49	19.1	38	N/A
Boise	ID	4.0	46	17.9	39	+3
New York	NY	147.0	7	17.2	40	-2
Charlotte	NC	13.2	28	15.7	41	-4
Orlando	FL	4.1	44	14.8	42	-1
Pittsburgh	PA	3.9	47	12.7	43	+9
Dallas	TX	16.4	26	12.5	44	0
Atlanta	GA	5.0	42	10.5	45	0
Memphis	TN	6.5	36	9.9	46	+2
Richmond*	VA	2.1	54	9.6	47	N/A
Cleveland	OH	3.5	48	8.9	48	-1
Nashville*	TN	5.2	41	7.8	49	N/A
Des Moines	IA	1.6	58	7.3	50	+8
Philadelphia	PA	11.2	30	7.2	51	-2
Columbus	OH	5.3	40	6.2	52	+3
Chicago	IL	15.5	27	5.7	53	N/A
Milwaukee	WI	3.1	51	5.2	54	0
Charleston	WV	0.3	65	5.1	55	-4

** Due to an improvement in methodology or data source for this city, total and per capita solar PV capacity reported in this table are not directly comparable with estimates for this city in previous editions of this report. See Appendix B for details on specific cities.*

¥ "N/A" is listed for cities where 2017 data is not directly comparable with 2016 data, either because 2016 data were unavailable or due to an improvement in methodology. See Appendix B for details on specific cities.

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

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 yet to experience much solar energy development.

Table 5. The "Solar Beginners" (Cities with Less than 5 Watts of Solar PV per Person, End of 2017)

City	State	Total Solar PV Installed (MW-DC)	Total Solar PV Rank	Per Capita Solar PV Installed (Watts-DC/person)	Per Capita Rank	Change in Per Capita Rank from 2016 to 2017¥
Wichita	KS	1.9	55	4.9	56	-6
Billings	MT	0.5	63	4.2	57	-1
Houston	TX	9.5	34	4.1	58	-1
Cheyenne	WY	0.3	64	4.1	59	N/A
Louisville	KY	2.3	53	3.8	60	+1
Miami*	FL	1.3	60	2.9	61	N/A
Oklahoma City	OK	1.7	56	2.6	62	-3
Anchorage	AK	0.7	61	2.2	63	0
Detroit	MI	1.4	59	2.1	64	-4
Omaha*	NE	0.5	62	1.1	65	N/A
Fargo	ND	0.1	68	1.0	66	0
Birmingham	AL	0.2	67	0.8	67	-2
Virginia Beach	VA	0.2	66	0.4	68	-4

** Due to an improvement in methodology or data source for this city, total and per capita solar PV capacity reported in this table are not directly comparable with estimates for this city in previous editions of this report. See Appendix B for details on specific cities.*

¥ "N/A" is listed for cities where 2017 data is not directly comparable with 2016 data, either because 2016 data were unavailable or due to an improvement in methodology. See Appendix B for details on specific cities.

Every Region of the United States Has Leading Solar Cities

Cities in every region of the country have taken leadership in adopting solar energy. 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.[34] 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 606.4 watts of solar PV capacity installed per person. Other regional leaders include **Indianapolis** for the North Central region (137.3 watts/person), **Las Vegas** for the Mountain region (128.8 watts/person), **San Antonio** for the South Central region (107.9 watts/person), **Burlington, Vermont,** for the Northeast region (132.2 watts/person) and **Washington, D.C.** for the South Atlantic region (69.4 watts/person).

Figure 3. Top Two Cities in Each Region Ranked by Solar PV Capacity Installed per Person, End of 2017

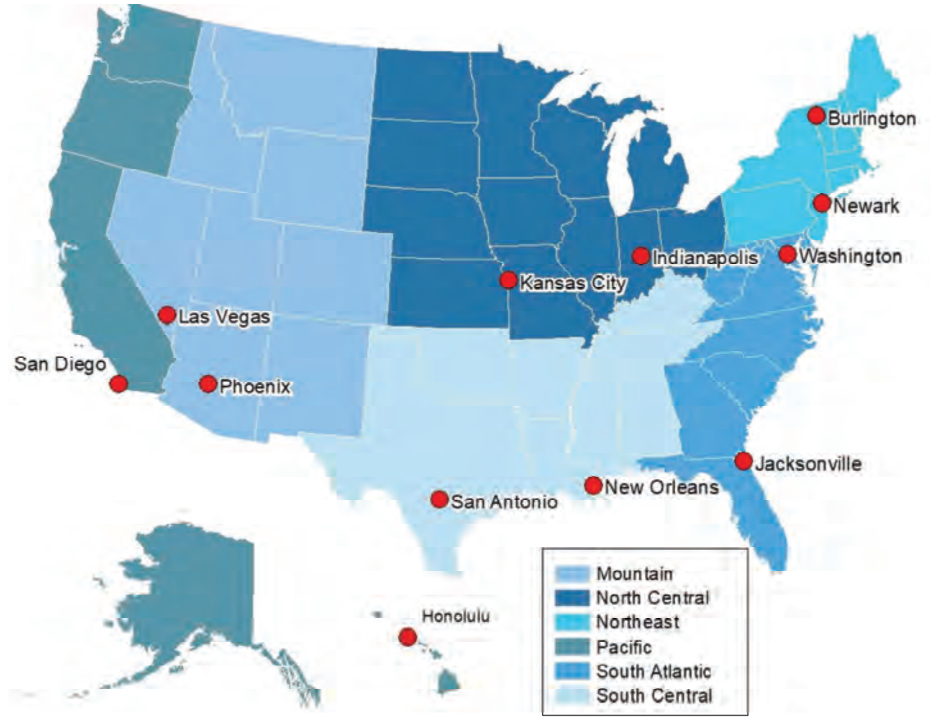


Table 6. Top Two Cities in Each Region Ranked by Solar PV Capacity Installed per Person, End of 2017

City	State	Region	Total Solar PV Installed (MW-DC)	Regional Total PV Rank	Per Capita Solar PV Installed (Watts-DC/person)	Regional Per Capita Rank
Las Vegas	NV	Mountain	81.5	3	128.8	1
Phoenix*	AZ	Mountain	206.4	1	127.8	2
Indianapolis†	IN	North Central	117.4	1	137.3	1
Kansas City	MO	North Central	18.7	2	38.9	2
Burlington	VT	Northeast	5.6	7	132.2	1
Newark	NJ	Northeast	24.4	3	86.5	2
Honolulu	HI	Pacific	213.3	3	606.4	1
San Diego†	CA	Pacific	287.2	2	204.1	2
Washington	DC	South Atlantic	47.3	1	69.4	1
Jacksonville	FL	South Atlantic	42.6	2	48.4	2
San Antonio	TX	South Central	161.0	1	107.9	1
New Orleans	LA	South Central	39.7	2	101.4	2

** Due to an improvement in methodology or data source for this city, total and per capita solar PV capacity reported in this table are not directly comparable with estimates for this city in previous editions of this report. See Appendix B for details on specific cities.*

† Solar capacities for these cities appear to be lower than the figures published in last year's report because a new AC to DC conversion factor was used in this year's report. Capacity increased in both cities during 2017. See Methodology for details.

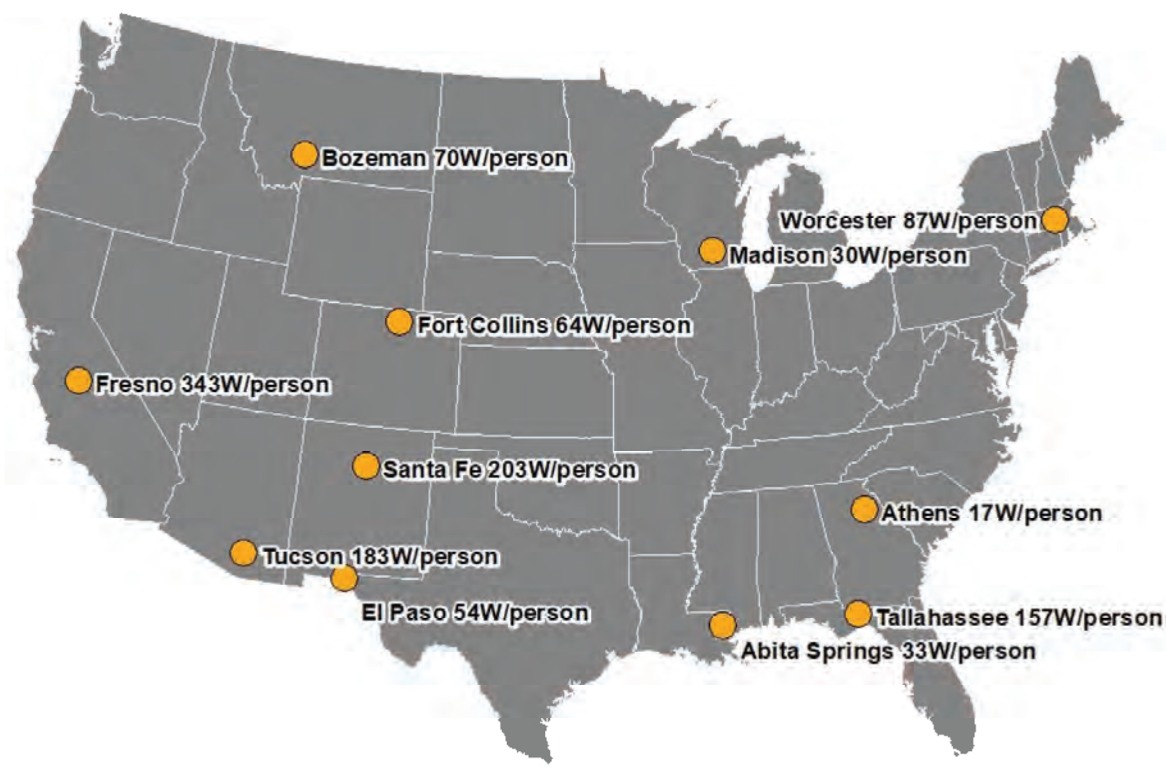
Smaller Cities and Towns Are Going Big on Solar Energy

Progress in adopting solar energy is not limited to the nation's largest cities; many smaller cities and towns are going big on solar energy, too. These communities have followed a variety of paths in developing solar energy. In some cases, local 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 communities 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 places have taken steps to increase the use of solar energy on public facilities, while, in other communities, strong state policies are driving local solar power growth. As demonstrated in the following examples, cities can most effectively promote solar power when local, state and utility policies work together.

Athens, Georgia: In less than five months, the bulk purchasing program "Solarize Athens" more than tripled the residential solar energy capacity in the Athens, Georgia, metropolitan area. Solarize Athens was led by the groups Environment Georgia, the Georgia Climate Change Coalition, Georgia Interfaith Power and Light, and Solar Crowd Source. Bulk purchasing programs like this allow businesses, homeowners and nonprofits to purchase solar energy collectively, thereby lowering the cost for everyone involved.[35] At the end of 2017, Athens had 2 MW of solar energy installed and 17 watts per person.[36] That is enough to rank Athens as a "Solar Builder" on our list.

Santa Fe, New Mexico: In 2014, the city of Santa Fe set a goal to become carbon neutral by 2040

Figure 4. Examples of Smaller U.S. Communities with High Solar PV Capacities Per Capita, End of 2017



and the city government is leading by example in achieving this goal.[37] The city has installed enough renewable energy on city facilities to provide 25 percent of its electricity needs, including over 4.6 MW of solar energy.[38] The city as a whole has 17 MW of solar PV capacity installed as of the end of 2017 and 203 watts per person – that's more solar PV per capita than any city on our list other than Honolulu and San Diego.[39]

Abita Springs, Louisiana: In 2017, Abita Springs became the first community in Louisiana to commit to providing its residents with 100 percent renewable energy by 2030.[40] This commitment put this Louisiana town on the map as one of at least 58 communities in the U.S. to commit to 100 percent renewable energy.[41] The utility Cleco Power and Washinton-St. Tammany Electric Cooperative collectively estimate that 82 kilowatts of solar PV capacity are installed in Abita Springs.[42] At 33 watts per person, Abita Springs has enough solar PV installed to be ranked as a "Solar Leader" in our report.[43]

Bozeman, Montana: In 2011, the city of Bozeman set a goal to reduce its greenhouse gas emissions to 10 percent below 2008 levels by 2025.[44] As part of their plan to achieve this goal, the city has invested in its own solar energy systems and has changed its city code to remove barriers to installing rooftop solar.[45] At the end of 2017, Bozeman had 2.95 MW of grid-tied solar PV capacity installed, equivalent to 70 watts per person, which is enough to rank Bozeman as a "Solar Star" on our list.[46]

El Paso, Texas: In 2017, El Paso was awarded the SolSmart Gold designation by the U.S. Department of Energy (DOE) Solar Energy Technologies Office (SETO) (formerly known as the SunShot Initiative), which helps states lower barriers to installing solar energy systems.[47] El Paso received the award for creating an online checklist to guide residents through the process of switching to solar energy; for streamlining its permitting process to the point that permit applications for small solar PV systems are now turned around in just 24 hours; and for consolidating the number of inspections required for new solar installations.[48] At the end of 2017, 37 MW of solar PV capacity were tied to El Paso Electric's grid, which serves the city.[49] That is 54 watts per person, enough to rank El Paso a "Solar Star" on our list.[50]

Worcester, Massachusetts: During the summer of 2017, Worcester opened the largest municipally-owned solar farm in New England on top of a former landfill.[51] The city expects the project will pay for itself in six years and save the city $60 million over the 30 years it is expected to operate.[52] Multiple nonprofits in Worcester have also invested in solar energy systems to save money, stabilize their costs, and put more of their funding toward their core work.[53] In total, Worcester has 16 MW of solar PV capacity installed and 87 watts per person, enough to be ranked as a "Solar Star."[54]

Fort Collins, Colorado: In 2015, the city of Fort Collins set a goal to be carbon neutral by 2050 and has taken many steps to achieve that goal.[55] The city offers considerable rebates to residents and businesses that install solar energy systems and low-interest financing options are also available in the city.[56] For these and other reasons, Fort Collins was among the first U.S. cities to earn the SolSmart Gold designation for making it easier for residents to install solar energy systems.[57] The city has 10.5 MW solar PV capacity installed as of the end of 2017, enough to be ranked as a "Solar Star" with 64 watts installed per resident.[58]

Fresno, California, has set and achieved many goals to help increase the use of solar energy, including streamlining and standardizing its permitting process.[59] Thanks to these efforts, Fresno has 18 MW of solar PV capacity installed and 343 watts per person – that's more than any city on our list other than Honolulu.[60]

Madison, Wisconsin, is one of nearly 60 communities in the U.S. that has committed to getting 100 percent of its energy needs from renewable resources.[61] As part of this effort, the city government of Madison runs a program called MadiSUN that helps residents purchase solar energy collectively, lowering costs for participants.[62] The program also provides free information sessions, conducts a bidding process with installers to get the lowest price for participants, and helps participants take advantage of low-interest financing options, tax credits and rebates.[63] Thanks in part to this program, Madison is a SolSmart Gold designee.[64] RENEW Wisconsin, a nonprofit promoting renewable energy in the state, estimates that 7.5 MW of solar PV capacity is installed within Madison.[65] This would mean that the city has 30 watts per person installed, enough to be ranked as a "Solar Leader" on our list.[66]

Tucson, Arizona, began promoting solar energy early on and was recognized as one of the 25 Solar America Cities by the U.S. DOE in 2008.[67] Through that program, the City of Tucson created a Clean Renewable Energy Bonds program that allows residents and businesses to borrow money for solar energy installations with no interest. In lieu of interest payments, the lenders receive tax credits.[68] Tucson also passed a "Solar Ready Homes" ordinance requiring new single-family homes and duplexes to include solar energy systems or to be pre-outfitted to easily incorporate solar PV or solar hot water systems later.[69] Thanks to all of this work Tucson has an estimated 97 MW of solar PV capacity installed and 183 watts per person – enough to be a high-ranking "Solar Star" on our list.[70]

Tallahassee, Florida, has enough solar PV capacity installed (30 MW total, or 157 watts per person) to be ranked as a leading "Solar Star."[71] This is thanks in large part to the 28 MW solar farm contracted by the city. Through the Tallahassee Solar program, residents and businesses were allowed to enroll to purchase their electricity from the solar farm at a fixed rate for the next 20 years. The 2,000 slots for this program filled up so quickly that the city is continuing it for another solar farm it plans to build.[72] The City of Tallahassee also offers low interest loans for a variety of energy efficiency measures and clean energy systems, including solar PV.[73]

Fossil Fuel Interests and Utilities Are Dimming the Promise of Solar Energy

The rapid growth of solar energy is seen as a threat to the fossil fuel industry and is changing how utilities operate. In resistance to these changes, fossil fuel interests and some utilities are pushing to slow solar energy's growth across the country through various measures, such as rolling back net metering and implementing solar-specific charges on electric bills. During 2017 alone, 19 utilities in 10 different states requested to add or increase charges for rooftop solar customers specifically.[74] The following are some examples of cities that currently have thriving solar energy markets that may be hurt going forward by recent attacks.

Indianapolis: In May 2017, the state of Indiana passed a law that will gradually reduce the length of time that solar customers can participate in net metering, based on when they enrolled in the program.[75] The law will also decrease the net metering compensation rate for new customers starting in 2022, and will allow utilities to stop accepting new net metering customers once they make up 1.5 percent of the utility's summer peak load.[76] The City of Indianapolis has supported the growth of solar energy for many reasons, citing that it improves public and environmental health and reduces the burden of household energy costs for its residents.[77] Indianapolis has been one of the top cities, both in terms of total and per capita solar PV capacity, in all five editions of this report. But, according to solar energy business owners, the state's recent law regarding net metering will hurt this thriving solar energy market going forward.[78]

Boston: In January 2018, the Massachusetts Department of Public Utilities approved the utility Eversource's request to impose demand charges on its solar energy customers, including in Boston.[79] Demand charges can cause solar energy customers to pay almost as much on their energy bills as traditional customers, even though they demand far less energy from the grid over the course of a month.[80] This structure limits the financial benefits of switching to solar energy, so the solar advocacy organization Vote Solar has said it will appeal the decision in court.[81] The City of Boston has set goals to reduce its greenhouse gas emissions by 25 percent by 2020 and to be carbon neutral by 2050.[82] One way the city is working to meet these goals is through solar energy adoption. Boston has been in the top 25, both for total and per capita solar PV capacity in every edition of this report, but this solar energy progress could be impeded by Massachusetts' recent decision.[83]

Jacksonville, Florida: The Jacksonville Electric Authority, which provides power to Jacksonville and other areas of Florida, made some big changes to its solar energy policies in 2017 to deter grid-tied distributed solar energy. The utility has committed to install a large amount of its own solar PV capacity, but is also rolling back net metering, which will deter homeowners and businesses from adopting solar energy systems themselves.[84]

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

While the exponential growth of solar power has already delivered enormous benefits to communities across the U.S., America is still far from tapping its full solar potential. A National Renewable Energy Laboratory (NREL) study estimated that rooftop solar power on small buildings alone is technically capable of contributing 1,118 GW of generating capacity to the national electric grid.[85] That is enough solar energy to cover the annual electricity needs of more than 135 million homes.[86] Cities also have the potential to develop solar energy on larger buildings and in utility-scale installations on open land – adding significantly to the clean energy they can provide to the grid.

Even the nation's leading solar cities have immense untapped solar energy potential. The NREL study found that this year's leading city, Los Angeles, could host up to 9,000 MW of solar PV capacity on the rooftops of its small buildings alone. That's over 25 times the solar power capacity the city currently has installed in total and could produce 60 percent of the city's current electricity consumption. Newark, New Jersey has developed more of its solar PV potential than any other city on the list and its total solar PV capacity is only 16 percent of what the city could accommodate on its small building rooftops alone. Most cities on this list could install 50 times as much solar PV as they currently have installed in total on their small building rooftops. San Antonio and Chicago, for example, could each accommodate more than 6,000 MW of solar PV capacity on city rooftops and Baltimore, New York, Charlotte, Detroit, Milwaukee, New Orleans, Philadelphia and Portland, Oregon could all install at least 2,000 MW of solar PV capacity.[87]

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 global warming can cause through severe weather, drought, increased heavy precipitation and intense heat waves. 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 – more than the availability of sunshine – dictate which states have successful solar industries and which do not.[88] 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 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.

Photo: Don Shall via Flickr, CC BY-NC-ND 2.0.

Solar panels in a parking lot in Burlington, Vermont, one of the top five cities on this list for solar PV capacity per capita.

Local governments should:

- ***Set ambitious goals for solar energy adoption*** – The cities that are leading in solar energy adoption are not doing so by chance. The second highest-ranked city for total installed solar PV capacity, San Diego, has set the ambitious goal of generating 100 percent of its energy from renewable sources by 2035.[89] A large part of the city's plan to achieve this goal is implementing programs that promote solar energy.[90] Seven other cities on our list – St. Louis, San Francisco, Salt Lake City, Orlando, Atlanta, San Jose, and Portland, Oregon – have set goals to receive 100 percent of their energy from renewable sources and Burlington, Vermont – one of the top-ranked cities for solar capacity per capita – is one of five communities in the U.S. that have already achieved this goal.[91]
- ***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 by right, which will help unlock new solar markets in communities.[92] The Delaware Valley Regional Planning Commission in the Philadelphia area offers a model ordinance guide that cities can apply to their own local laws.[93]
- ***Adopt policies to promote or require "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.[94] The City of San Francisco now requires that all new buildings be constructed with solar energy systems installed and the state of California is considering a similar proposal.[95] The City of Tucson requires that 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.[96] 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.
- ***Make permitting, zoning and inspection processes easy, quick and affordable*** – The "soft" costs of switching to solar energy – such as costs related to zoning and permitting – now make up about two-thirds of the total price of residential solar energy systems.[97] Reducing fees, making permitting rules clear and readily available, speeding up the permitting process, and making inspections convenient for property owners can significantly lower the barriers for residents to switch to solar energy.[98] Making sure that permitting and inspection staff are properly trained is key to achieving these goals. The U.S. DOE helps cities fund programs that work toward these goals, such as Kansas City's work to make its solar energy permitting process available online and to update its building code to be friendlier to solar energy.[99] Vote Solar has also laid out a series of best practices that local governments can follow to ensure that their permitting process is solar-friendly.[100] Cities should also strive to lower the "soft costs" associated with energy storage systems, which are often associated with solar energy systems, and make sure there aren't any barriers in local zoning ordinances to installing them.
- ***Expand access to solar energy*** – Statewide and citywide financing programs, can make solar energy available to low-income households, nonprofits and small businesses. "Solarize" bulk purchasing programs, like "Solarize Athens," lower the costs of solar energy so that more residents can participate.[101] Community solar programs and practices like the Power Purchase Agreements (PPA) utilized in New York and elsewhere can allow apartment occupants and others who cannot install their own solar systems to purchase and benefit

from solar energy, too. The Property Assessed Clean Energy Program (PACE) allows local and state governments to loan money to home and business owners for energy improvements. This program includes an option to tie a loan for a solar installation to the property itself so that it is transferred to the new owner if the property is sold. This program has been key for property owners who are concerned that they may move before they recoup their investment in a solar installation.

- ***Consider creating a municipal utility or community choice aggregation system in communities where investor-owned utilities are unwilling to cooperate to promote solar power*** – Municipally-owned utilities have been among the nation's leaders in promoting solar power. While many investor-owned utilities have been willing partners with cities in promoting solar energy, cities served by less supportive utilities may want to consider forming a municipal utility in order to gain greater control over their local electric grids. The City of Minneapolis, for example, recently partnered with the two investor-owned utilities serving the city in order to meet their goal of reducing emissions by 30 percent by 2025. However, the partnership came only after there was a push for municipalization in Minneapolis that drove the utilities to consider a more aggressive approach to renewable energy.[102] Community choice aggregation is another option in which the city, rather than the utility, is responsible for purchasing power, but unlike a municipal utility, the private utility still maintains the transmission lines and provides customer services.[103]

- ***Install solar panels on public buildings*** – Local governments can promote solar energy by installing solar panels and signing solar PPAs for public buildings. For example, there are about 5,500 K-12 schools across the country that have installed solar energy systems with a combined capacity of 910 MW.[104] In 2016, the city government of Albuquerque committed to generate 25 percent of its energy needs from solar energy by 2025 and the city government of Las Vegas now gets 100 percent of its energy from renewable sources.[105] Not only do solar installations on public buildings save governments money on their electricity bills, but they also serve as a public example of a smart, clean energy investment.

- ***Support and push for strong state policies*** – State policies can have a large impact on a city's ability to expand solar energy, so it is important that cities push their state governments to enact the policies recommended below. These efforts are particularly effective when multiple communities work together.

- ***Implement policies that support energy storage, electric vehicle smart charging and microgrids*** – Technological advances are enabling solar energy to be used in new ways, including to charge electric vehicles and to be integrated with energy storage technologies and other energy resources in microgrids. Local governments should alter their ordinances to allow these technologies to be easily adopted.

State governments should:

- ***Set or increase renewable energy targets for utilities and adopt specific requirements for solar energy adoption*** – States should adopt or increase mandatory "renewable energy standards" (RES) 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 resource plans. Honolulu, the current leader for per capita solar PV capacity, benefits from Hawaii's law that requires utilities to generate 100 percent of the energy they sell from renewable resources by 2045.[106]

- ***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.

- ***Ensure that electric rate designs encourage solar adoption*** – Many utilities are now proposing rate designs that add or increase charges to electric bills in ways that would harm solar adoption, including adoption of demand charges and increases in fixed charges. Structures like these limit the benefits of adopting solar energy, as they cause solar customers to pay almost as much on their energy bills as traditional customers, despite using far less energy from the utility over the course of a month.[107] Some utilities are also beginning to assign monthly charges to solar customers specifically or to charge them a higher monthly rate than other customers.[108] State governments should reject unfair proposals like this that discourage customers from switching to solar energy.

- ***Establish policies that expand solar energy access to all residents*** – According to NREL, 49 percent of Americans don't own a home, have shading on their homes, or cannot afford a solar energy system.[109] Policies such as virtual or aggregate net metering and community solar allow low-income households, renters and apartment dwellers to collectively own solar energy systems and share in the net metering credits they generate. Enabling PACE financing can also expand access to solar power.

- ***Establish public benefits charges on utility bills or other sustainable financing mechanisms for solar energy –*** These practices help 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 or maintain tax credits, rebates and grants for solar energy installations.*** Tax credits are a powerful incentive that have made solar energy a financial option for many more Americans. In 2015, six of the 10 states with the most solar capacity per capita offered tax credits for solar installations, and four offered rebates or grants.[110]

- ***Implement policies that support energy storage, electric vehicle smart charging and microgrids*** – State governments should 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.

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:

- ***Continue and 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.[111] 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. DOE's Solar Energy Technologies Office (SETO) (formerly the SunShot Initiative) has served as a rallying point for federal efforts to encourage the expansion of solar energy.112 SETO and similar initiatives facilitate solar energy adoption by investigating the best ways to integrate solar energy into the grid, deliver solar energy more efficiently and cost-effectively, and lower market barriers to solar energy. The federal government should also invest in research and development of energy storage to ease the integration of renewable energy into the grid, to strengthen cities' electric grids in the face of extreme weather, and for many more reasons.

- ***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 had already installed more than 130 megawatts of solar energy capacity by 2013.[113]

- ***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 subsidized housing units and schools by installing solar power on those facilities or enabling community solar projects. Programs designed to provide fuel assistance to low-income customers, such as the Low-Income Home Energy Assistance Program, should be expanded to include solar energy.

- ***Defend and strengthen the requirements of the Clean Power Plan*** – In October 2017, the Environmental Protection Agency (EPA) submitted a proposal to repeal and rescind the Clean Power Plan.[114] The agency will accept comments on the proposal until April 26, 2018.[115] The federal government should reject this proposal and protect a strong Clean Power Plan to reduce greenhouse gas emissions by at least 30 percent below 2005 levels by 2030 and protect Americans from the worst impacts of climate change. Renewable energy sources such as solar PV can play a dominant role in helping the U.S. achieve these pollution reductions.

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 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 PV capacity (e.g., AC versus DC capacity).

We have worked to obtain data that are as comprehensive as possible, resolve discrepancies in various methods of estimating solar PV capacity, 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. Much of the data is provided by utilities, the majority of which only track grid-tied solar energy systems, so many cities lack data for non-grid-tied installations. 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. The full list of sources of data for each city is provided in Appendix B along with the details of any data analyses performed.

For some cities, our most recent solar capacity estimates are not directly comparable to previous estimates listed in earlier editions of *Shining Cities*. This is because some solar energy systems installed toward the end of the year were not reported by the time we collected data. Also, for some cities, we were able to obtain more specific and reliable data this year. In a few cases, our current estimate is lower than previous estimates for the same city, due either to inconsistencies in the data reported to us by the cities, improved precision in methods for assigning solar installations to cities, or the change in the AC to DC conversion factor used this year. For an explanation of individual discrepancies, see Appendix B.

Selecting the Cities

The cities in this report consist of the principal cities in the top 50 most populous Metropolitan Statistical Areas in the United States according to the U.S. Census Bureau and the most populous cities in each state not represented on that list.[116] For a complete list of cities, see Appendix A. We were unable to find reliable data for Little Rock, Arkansas. Also, Sioux Valley Energy, the utility that serves Sioux Falls, South Dakota, reported that there is no solar capacity installed in Sioux Falls' city limits connected to their grid.[117]

Converting from AC Watts to DC Watts

Jurisdictions and agencies often use different methods of quantifying solar PV 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.[118]

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 DC to AC Ratio in NREL's *PV Watts Calculator* of 1.2.[119] This is a change from the conversion factor used in previous reports and has caused San Diego and Indianapolis' capacities to appear to have decreased, though both increased during 2017.

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

In some cases, we were unable to obtain specific data on solar PV capacity, 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 portion 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

City	State	Total Solar PV Installed (MW-DC)‡	Total Solar PV Rank	Population	Per Capita Solar PV Installed (Watts-DC/person)	Per Capita Rank	Rooftop Solar PV Potential on Small Buildings (MW)¥
Albuquerque*	NM	57.9	11	559,277	103.5	12	1,252
Anchorage	AK	0.7	61	298,192	2.2	63	N/A
Atlanta	GA	5.0	42	472,522	10.5	45	496
Austin	TX	39.4	17	947,890	41.5	23	1,443
Baltimore	MD	13.0	29	614,664	21.1	36	460
Billings	MT	0.5	63	110,323	4.2	57	229
Birmingham	AL	0.2	67	212,157	0.8	67	537
Boise	ID	4.0	46	223,154	17.9	39	428
Boston	MA	33.0	19	673,184	49.0	19	341
Buffalo	NY	9.6	33	256,902	37.4	26	512
Burlington	VT	5.6	39	42,417	132.2	5	44
Charleston	WV	0.3	65	49,138	5.1	55	153
Charlotte	NC	13.2	28	842,051	15.7	41	1,356
Cheyenne	WY	0.3	64	64,019	4.1	59	150
Chicago	IL	15.5	27	2,704,958	5.7	53	2,775
Cincinnati	OH	6.0	37	298,800	20.1	37	510
Cleveland	OH	3.5	48	385,809	8.9	48	734
Columbia	SC	4.0	45	134,309	29.8	30	252
Columbus	OH	5.3	40	860,090	6.2	52	1,905
Dallas	TX	16.4	26	1,317,929	12.5	44	2,083
Denver	CO	83.4	9	693,060	120.3	8	677
Des Moines	IA	1.6	58	215,472	7.3	50	351
Detroit	MI	1.4	59	672,795	2.1	64	1,256
Fargo	ND	0.1	68	120,762	1.0	66	151

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City	State	Total Solar PV Installed (MW-DC)‡	Total Solar PV Rank	Population	Per Capita Solar PV Installed (Watts-DC/person)	Per Capita Rank	Rooftop Solar PV Potential on Small Buildings (MW)¥
Hartford	CT	4.5	43	123,243	36.3	27	118
Honolulu	HI	213.3	3	351,792	606.4	1	N/A
Houston	TX	9.5	34	2,303,482	4.1	58	4,605
Indianapolis†	IN	117.4	8	855,164	137.3	4	N/A
Jackson	MS	3.2	49	169,148	19.1	38	422
Jacksonville	FL	42.6	15	880,619	48.4	21	1,715
Kansas City	MO	18.7	23	481,420	38.9	25	971
Las Vegas	NV	81.5	10	632,912	128.8	6	946
Los Angeles	CA	349.3	1	3,976,322	87.9	15	5,444
Louisville	KY	2.3	53	616,261	3.8	60	N/A
Manchester	NH	2.7	52	110,506	24.0	33	159
Memphis	TN	6.5	36	652,717	9.9	46	1,439
Miami*	FL	1.3	60	453,579	2.9	61	751
Milwaukee	WI	3.1	51	595,047	5.2	54	849
Minneapolis	MN	9.7	32	413,651	23.4	35	359
Nashville*	TN	5.2	41	660,388	7.8	49	N/A
New Orleans	LA	39.7	16	391,495	101.4	13	1,277
New York	NY	147.0	7	8,537,673	17.2	40	1,277
Newark	NJ	24.4	21	281,764	86.5	16	154
Oklahoma City	OK	1.7	56	638,367	2.6	62	2,089
Omaha*	NE	0.5	62	446,970	1.1	65	876
Orlando	FL	4.1	44	277,173	14.8	42	583
Philadelphia	PA	11.2	30	1,567,872	7.2	51	884
Phoenix*	AZ	206.4	4	1,615,017	127.8	7	2,981
Pittsburgh	PA	3.9	47	303,625	12.7	43	388
Portland	ME	1.7	57	66,937	24.9	32	109
Portland	OR	31.2	20	639,863	48.8	20	1,397
Providence	RI	5.7	38	179,219	32.0	29	196
Raleigh*	NC	18.3	24	458,880	39.9	24	674
Richmond*	VA	2.1	54	223,170	9.6	47	401
Riverside	CA	36.3	18	324,722	111.9	9	612
Sacramento	CA	49.8	12	495,234	100.5	14	777

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City	State	Total Solar PV Installed (MW-DC)‡	Total Solar PV Rank	Population	Per Capita Solar PV Installed (Watts-DC/person)	Per Capita Rank	Rooftop Solar PV Potential on Small Buildings (MW)¥
Salt Lake City	UT	21.7	22	193,744	111.9	10	276
San Antonio	TX	161.0	6	1,492,510	107.9	11	3,721
San Diego†	CA	287.2	2	1,406,630	204.1	2	2,219
San Francisco	CA	47.1	14	870,887	54.1	18	672
San Jose	CA	195.9	5	1,025,350	191.0	3	1,639
Seattle	WA	18.1	25	704,352	25.7	31	1,081
St. Louis	MO	10.8	31	311,404	34.6	28	632
Tampa	FL	9.0	35	377,165	23.8	34	783
Virginia Beach	VA	0.2	66	452,602	0.4	68	860
Washington	DC	47.3	13	681,170	69.4	17	344
Wichita	KS	1.9	55	389,902	4.9	56	803
Wilmington	DE	3.2	50	71,442	44.4	22	72

‡ *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 cities, even those 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.*

¥ *Reflects the maximum technical solar PV capacity that could be installed on appropriate small building rooftops in each city. These figures were calculated by the U.S. DOE: U.S. DOE, Energy Efficiency & Renewable Energy State & Local Energy Data, available at apps1.eere.energy.gov/sled/#. Data were unavailable for cities with "N/A" listed.*

** Due to an improvement in methodology or data source for this city, total and per capita solar PV capacity reported in this table are not directly comparable with estimates for this city in previous editions of this report. See Appendix B for details on specific cities.*

† *Solar capacities for these cities appear to be lower than the figures published in last year's report because a new AC to DC conversion factor was used in this year's report. Capacity increased in both cities during 2017. See Methodology for details.*

Appendix B: Detailed Sources and Methodology by City

Albuquerque, New Mexico

The Public Service Company of New Mexico (PNM), which serves the city of Albuquerque, provided us with total solar PV capacity installed within Albuquerque as of December 31, 2017 in DC watts.[120] Last year, PNM provided data for their entire service area, which extends beyond Albuquerque city limits. This year's figure is, therefore, not directly comparable with last year's figure.

Anchorage, Alaska

The two electric utilities serving the city of Anchorage, Chugach Electric and Anchorage Municipal Light and Power, provided us with summary information on the solar PV capacity installed in Anchorage's city limits as of the end of 2017 in AC watts, which we converted to DC watts.[121]

Atlanta, Georgia

Southface (www.southface.org) provided us with a list of solar PV installations in DeKalb and Fulton counties through December 31, 2017 with latitude and longitude coordinates for each installation.[122] This information allowed us to map the installations using ArcGIS, and isolate solar capacity within the city limits of Atlanta. Southface maintains a map of "Georgia Energy Data" at www.GeorgiaEnergyData.org. Some data were provided in AC watts, which we converted to DC watts and some were provided in DC watts.

Austin, Texas

Austin Energy, the municipal utility serving Austin, provided us with a spreadsheet of solar PV installations in the Austin area with capacities listed in DC watts.[123] For installations with zip code information, we multiplied the listed solar PV capacity figure by the proportion of that zip code located within the city of Austin. For installations without zip code information, we multiplied the listed solar capacity figure by the portion of all included zip code areas within Austin city limits. We note that our final figure does not account for solar power generated by the 30 MW Webberville solar farm, which is located in the village of Webberville.[124] 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, Maryland

Data for solar PV installations in Baltimore, as of December 2017, were downloaded in a spreadsheet called "Renewable Generators Registered in GATS" through the Generation Attribute Tracking System (GATS), an online database administered by the PJM regional transmission organization.[125] 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. The GATS database was updated after we collected data for last year's report. The solar PV capacity in Baltimore as of December 31, 2016 was 12 MW, not 11 MW as reported in last year's report.

Billings, Montana

Northwestern Energy, the utility serving Billings, provided the known amount of solar PV capacity installed within the city limits of Billings in DC watts, as of December 31, 2017.[126]

Birmingham, Alabama

Alabama Power, the electric utility serving the city, provided an estimate of installed solar PV capacity in Birmingham through the end of 2017 in AC watts, which we converted to DC watts.[127] This figure is for Birmingham zip codes, some of which extend outside of city limits, so it is possible that projects outside of city limits are included.

Boise, Idaho

Idaho Power, the electric utility serving Boise, provided the total solar PV capacity of net-metered installations tied to their grid within Boise as of December 31, 2017 in DC watts.[128]

Boston, Massachusetts

A spreadsheet of solar PV installations in Massachusetts, the "Solar PV Systems in MA Report," was accessed via the Massachusetts Clean Energy Center online Product Tracking System.[129] We filtered this list to only installations in the city of Boston. This list may be incomplete because it only includes systems that are fully registered with the Production Tracking System. The total solar PV capacity installed within Boston may, therefore, be higher than the reported figure. This spreadsheet was not fully updated when we collected data last year. Boston had 26 MW-DC solar PV capacity installed at the end of 2016, not 20 MW-DC as reported in last year's report.

Buffalo, New York

Data on solar PV installations in the city of Buffalo were obtained from the Open NY Database titled "Solar Electric Programs Reported by NYSERDA: Beginning 2000."[130] We summed the capacities, which are listed in DC watts, for installations completed before December 31, 2017 in the city of Buffalo.

Burlington, Vermont

A list of solar PV installations in Burlington at the end of 2017 was provided by the City of Burlington's Electric Department.[131] Capacity figures were listed in AC watts, which we converted to DC watts.

Charleston, West Virginia

American Electric Power Company, the utility serving Charleston, West Virginia, provided us with the total solar PV capacity installed within Charleston through the end of 2017 in AC watts, which we converted to DC watts.[132]

Charlotte, North Carolina

A list of solar PV installations in North Carolina was compiled by the North Carolina Sustainable Energy Association.[133] We filtered these data for installations within the city of Charlotte. Figures were listed in both AC and DC watts, so we converted all AC figures into DC units. These data were only complete through 2016. Duke Energy, the utility serving Charlotte, provided a figure for solar PV capacity added in Mecklenburg County, North Carolina, during 2017 in AC watts, which we converted to DC watts.[134] We multiplied this by the portion of Mecklenburg County housing units that fall within Charlotte to estimate solar PV capacity added in Charlotte during 2017.[135] We then added this figure to the cumulative capacity in Charlotte at the end of 2016.

Cheyenne, Wyoming

Black Hills Corporation, the electric utility serving Cheyenne, Wyoming, provided us with total solar PV capacity installed within Cheyenne as of December 31, 2017 in AC watts, which we converted to DC watts.[136]

Chicago, Illinois

Commonwealth Edison, the electric utility serving the city of Chicago, provided us with the total solar PV capacity tied to their grid within Chicago as of December 31, 2017 in AC watts, which we converted to DC watts.[137]

Cincinnati, Ohio

Duke Energy, the electric utility serving Cincinnati, provided the total solar PV capacity added in Cincinnati during 2017 in AC watts, which we converted to DC watts.[138] We added this figure to the cumulative solar PV capacity installed within Cincinnati as of December 31, 2016.

Cleveland, Ohio

We downloaded a spreadsheet of approved renewable energy generating facilities in Ohio from the Public Utilities Commission of Ohio's (PUCO) webpage.[139] We filtered this spreadsheet for solar PV installations approved in 2017 in Cuyahoga County, Ohio. To determine which systems were installed in Cleveland, we looked up the corresponding Case Reference numbers on PUCO's website, which included addresses associated with the installations.[140] The Cuyahoga County Department of Sustainability provided us with the total solar PV capacity of residential co-op systems installed within Cleveland during 2017 in DC watts.[141] These installations did not include the Cleveland systems on the PUCO list installed during 2017, so we added both figures to the cumulative capacity installed within Cleveland at the end of 2016 to estimate the total, cumulative capacity at the end of 2017. Neither data source is comprehensive, so it is possible that solar PV capacity in Cleveland at the end of 2017 is higher than the figure listed.

Columbia, South Carolina

We estimated the amount of solar PV capacity in Columbia based on county-level data provided by the South Carolina Energy Office.[142] We multiplied the total capacity of solar PV installations within Richland County by the 2010 proportion of Richland County housing units located in Columbia to estimate what percentage of this capacity fell in Columbia.[143] Data were provided in AC watts, which we converted to DC watts. Data were only available through July 31, 2017, so it is likely that systems were added after that date and, thus, that solar PV capacity in Columbia was higher by December 31, 2017.

Columbus, Ohio

The City of Columbus Department of Public Utilities provided solar PV capacity installed in Columbus as of December 31, 2017 in AC watts, which we converted to DC watts.[144]

Dallas, Texas

The office of State Representative Rafael Anchia provided us with the grid-tied solar PV capacity installed within Dallas as of December 31, 2017 in AC watts, which we converted to DC watts.[145] This data was supplied to them by Oncor, the transmission and distribution operator in Dallas.

Denver, Colorado

The Denver Public Health & Environment department provided us with data on the installed solar PV capacity within Denver as of the end of 2016, which was compiled by Xcel Energy, the utility serving Denver.[146] These data were listed in AC watts, which we converted to DC watts. The City and County of Denver Community Planning and Development Department provided us with a spreadsheet of all permits issued in the city relating to solar PV systems, with capacities listed in DC watts.[147] We filtered these data for new solar PV installation permits completed during 2017. Not all permits contained capacity information, so we multiplied the number of permits without capacity data by the median capacity of all installations with capacity data listed. We added the estimated total capacity of installations added during 2017 to the 2016 cumulative capacity to estimate the cumulative solar PV capacity installed within Denver as of December 31, 2017.

Des Moines, Iowa

MidAmerican Energy, the energy company that serves Des Moines, provided us with the total solar PV capacity installed within the city limits of Des Moines as of December 31, 2017 in AC watts.[148] We converted this figure to DC watts.

Detroit, Michigan

Total solar PV capacity added within the city of Detroit during 2017 was provided by DTE Energy, the electric utility serving the city.[149] Data were provided in AC watts, which we converted to DC watts and added to the cumulative solar PV capacity in Detroit as of December 31, 2016.

Fargo, North Dakota

An estimate of solar PV capacity in Fargo as of December 31, 2017 was provided in DC watts by Cass County Electric Cooperative, which serves part of the city.[150] Xcel Energy, which serves the other part of Fargo, did not have any known solar PV capacity installed in its service area to report.[151]

Hartford, Connecticut

The Connecticut Public Utilities Regulatory Authority provided a spreadsheet listing solar facilities approved under Connecticut's Renewable Portfolio Standard in both AC and DC MW.[152] We totaled all solar PV capacity installed in the city of Hartford through December 31, 2017 and converted all AC figures to DC units.

Honolulu, Hawaii

We estimated the amount of solar PV capacity in Honolulu from county-level data released by Hawaiian Electric, the company serving the County of Honolulu (which is coterminous with the island of O'ahu).[153] Within the island of O'ahu, 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 portion of its land area that falls within Urban Honolulu CDP to estimate the solar PV capacity in Honolulu. Solar PV capacity figures are reported to Hawaiian Electric in a combination of AC and DC watts and we were unable to determine which values were given in which units, so we made the conservative assumption that all data were listed in DC watts.

Houston, Texas

Cumulative installed solar PV capacity within Houston city limits as of December 31, 2017 was provided by CenterPoint Energy, the electric utility serving the city, in AC watts, which we converted to DC watts.[154]

Indianapolis, Indiana

Indianapolis Power and Light, the electric utility serving the Indianapolis provided total installed solar PV capacity within the city limits of Indianapolis as of December 31, 2017 in AC watts, which we converted to DC watts.[155] The 2017 solar PV capacity published in this report is lower than the figure published in last year's report due to the change in the AC/DC conversion factor used. In reality, solar PV capacity increased in Indianapolis during 2017.

Jackson, Mississippi

Entergy Mississippi, the electric utility serving Jackson, provided us with the total installed solar PV capacity in Jackson, Mississippi as of December 31, 2017.[156]

Jacksonville, Florida

The Jacksonville Electric Authority (JEA), the utility serving Jacksonville, provided us with a spreadsheet of net-metered solar PV installations within their service area through December 31, 2017.[157] We filtered these data for installations within the city of Jacksonville. Capacities were provided in DC watts.

Kansas City, Missouri

Kansas City Power & Light, the electric utility serving the city provided total installed solar PV capacity at the end of 2017 in DC watts.[158]

Las Vegas, Nevada

The City of Las Vegas' Office of Sustainability provided us with a spreadsheet of solar PV installations within the city of Las Vegas through December 31, 2017.[159] The capacities were listed in AC watts, which we converted to DC watts. Las Vegas receives a significant amount of solar energy from its larger metro area, which is not included in the totals of this report. Our totals include the approximately 8,100 systems currently installed within the city limits of Las Vegas, but NV Energy, the utility serving Las Vegas, has over 17,000 systems installed in its southern service territory.[160]

Los Angeles, California

Total installed solar PV capacity in Los Angeles as of December 31, 2017 was provided by the Los Angeles Department of Water and Power, the city's municipal electric utility, in AC watts, which we converted to DC watts.[161]

Louisville, Kentucky

Louisville Gas & Electric, the electric utility serving Louisville, provided the total solar PV capacity installed in the city as of December 31, 2017 in DC watts.[162]

Manchester, New Hampshire

Eversource Energy, the electric utility serving Manchester, provided the solar PV capacity installed within the city limits of Manchester through December 31, 2017 in AC watts, which we converted to DC watts.[163]

Memphis, Tennessee

Memphis Light, Gas and Water, the city's municipal electric utility, provided total solar PV capacity installed in Memphis as of December 31, 2017 in DC watts.[164]

Miami, Florida

Florida Power & Light (FPL), the municipality serving the city, provided the total solar PV capacity installed within Miami city limits as of December 31, 2017 in DC watts.[165] Last year, FPL provided data for the Miami metro area, not the city of Miami. This year's figure is, therefore, not comparable with the figure published in last year's report.

Milwaukee, Wisconsin

An estimate of the total capacity of solar PV systems installed in Milwaukee during 2017 was provided by the City of Milwaukee's Environmental Collaboration Office in DC watts.[166] We added this total to the cumulative capacity at the end of 2016 published in last year's report.

Minneapolis, Minnesota

Xcel Energy, the electric utility serving the city of Minneapolis, provided us with total solar PV capacity installed within the city as of the end of 2017.[167] These data were reported in DC watts.

Nashville, Tennessee

The total solar PV capacity installed within Davidson County as of December 31, 2017 was provided by Nashville Electric Service in DC watts.[168] To estimate the capacity within Nashville, we multiplied this capacity by the portion of Davidson County households that fall within the U.S. Census Bureau designated place of Nashville-Davidson (balance), the area most comparable with other U.S. cities.[169] In previous years, Nashville Electric Service provided data for their entire service area, not for the city of Nashville. This year's figure is, therefore, not directly comparable with figures published for Nashville in previous editions of this report.

New Orleans, Louisiana

Entergy New Orleans, the electric utility serving the city of New Orleans, provided us with an estimate of total installed solar PV capacity within New Orleans' city limits as of December 31, 2017 in DC watts.[170]

New York, New York

Data on solar PV capacity installed within the city limits of New York as of December 31, 2017 were provided by Consolidated Edison, the utility serving the city in AC watts, which we converted to DC watts.[171]

Newark, New Jersey

The solar PV installations supported by New Jersey's Clean Energy Program (NJCEP) are made available online in the "NJCEP Solar Activity Report" with city and zip code information, updated through December 31, 2017.[172] Within the Projects List tab, we filtered for solar installations registered in the city of Newark. Data were assumed to be in DC watts.

Oklahoma City, Oklahoma

The Oklahoma City Office of Sustainability provided us with the total solar PV capacity of net-metered solar installations in Oklahoma City, which was provided in DC watts by the Oklahoma Gas & Electric, the utility serving the city.[173] To this total, we added 1 MW for an installation at a Veteran's Hospital within city limits.[174]

Omaha, Nebraska

Omaha Public Power District (OPPD), the electric utility serving the city of Omaha, provided us with the total capacity of solar PV systems tied to their grid within Omaha city limits at the end of 2017 in DC watts.[175] In previous years, OPPD provided data for their entire service area, not for the city of Omaha. This year's figure is, therefore, not directly comparable with previously published figures.

Orlando, Florida

Total solar PV capacity installed within the city of Orlando, as of December 31, 2017 and serviced by the Orlando Utilities Commission (OUC) was provided by OUC in DC watts.[176]

Philadelphia, Pennsylvania

Data were downloaded from the Solar Renewable Energy Certificates PJM-GATS registry, administered by regional electric transmission organization PJM.[177] These data include installations through December 2017 and were filtered for Primary Fuel Type "SUN" and County "Philadelphia," which is coterminous with the city of Philadelphia. Capacities were listed in DC watts.

Phoenix, Arizona

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, 2017 in DC watts.[178]

Pittsburgh, Pennsylvania

Data for solar PV installations in Allegheny County, Pennsylvania, were downloaded in a spreadsheet called "Renewable Generators Registered in GATS" through the online GATS database administered by PJM.[179] To focus on solar PV installations, we filtered by primary fuel type "SUN." To estimate the amount of solar capacity installed within the city of Pittsburgh only, we looked up the number of solar installation permits within Pittsburgh completed between 1/1/13 – 12/31/17 (395 installations) on a city website.[180] Based on the PJM data, 1519 installations were completed in Allegheny County during the same time span. This yields that 26 percent of Allegheny County solar projects were installed in Pittsburgh during this time. Based on this, we estimated that 26 percent of the total solar PV capacity installed within Allegheny County as of December 31, 2017 was installed within Pittsburgh.

Portland, Maine

Central Maine Power Company, the utility company serving central and southern areas of Maine, provided us with the total solar PV capacity connected to their grid in Portland through the end of 2017 in DC watts.[181]

Portland, Oregon

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 city limits through December 31, 2017 were provided by the City of Portland's Bureau of Planning and Sustainability in DC watts.[182]

Providence, Rhode Island

Total solar PV capacity within Providence city limits as of December 31, 2017 was provided by the Rhode Island Office of Energy Resources.[183] Figures were given in AC watts, which we converted to DC watts.

Raleigh, North Carolina

The North Carolina Sustainable Energy Association (NCSEA) provided us with a spreadsheet listing solar PV installations in the state of North Carolina with capacities in DC watts.[184] We filtered these data for installations within the city of Raleigh. These data were not complete through 2017, so the City of Raleigh provided us with a list of solar PV projects that were permitted in Raleigh during 2017.[185] We conservatively assumed figures were in DC watts. Some of these permits did not include capacity information. For those, we assumed the median capacity of permits that did include capacity information. Last year the data provided by NCSEA included a 2 MW system with incorrect location information that appeared to be in Raleigh but is not. The figure reported in last year's report is, therefore, 2 MW too high.

Richmond, Virginia

The Virginia Department of Mines, Minerals and Energy (DMME) provided us with a spreadsheet listing all net metered solar PV and wind energy installations in Virginia through 2016 in AC watts, which we converted to DC watts.[186] We used ArcGIS to determine which installations fell within Richmond city limits. This figure is lower and not comparable with previously published figures for Richmond because in previous years, we simply filtered the spreadsheet for installations registered to addresses with a "City Name" of "Richmond" and/or Richmond zip codes, some of which fall partially outside of the city. Data were only complete through 2016, so Dominion Energy, the utility serving Richmond, provided us with the total PV capacity added in the Richmond metro area during 2017 in AC watts, which we converted to DC watts.[187] To estimate what portion of this capacity fell within the city limits of Richmond, we multiplied the figure by the portion of the Richmond metro area that falls within Richmond city limits.[188] We added a non-net-metered, 60 kilowatt system at Virginia Union University to our total. This system was installed and is owned by Dominion Virginia Power under their Solar Partnership program.

Riverside, California

The total installed solar PV capacity for Riverside as of December 31, 2017 was provided in DC watts by Riverside Public Utilities.[189]

Sacramento, California

Solar PV installation data were provided in a spreadsheet compiled by the Sacramento Municipal Utility District, the city's publicly-owned electric utility.[190] Capacity was given in AC watts, which we converted to DC watts.

Salt Lake City, Utah

The total year-end 2017 capacity of residential and non-residential net-metered solar PV installations within Salt Lake City limits was provided by the Salt Lake City Office of Sustainability in DC watts.[191]

San Antonio, Texas

Data for total installed solar PV capacity within San Antonio through the end of 2017 were provided in DC watts by CPS Energy, the utility serving San Antonio.[192]

San Diego, California

San Diego Gas & Electric, the electric utility serving the city, provided us with a figure of total solar PV capacity installed within San Diego city limits as of December 31, 2017 in AC watts, which we converted to DC watts.[193] The 2017 solar PV capacity published in this report is lower than the figure published in last year's report due to the change in the AC/DC conversion factor used. In reality, solar PV capacity increased in San Diego during 2017.

San Francisco, California

Pacific Gas & Electric, the electric utility serving the city, provided us with a figure of total solar PV capacity installed within San Francisco city limits as of December 31, 2017 in AC watts, which we converted to DC watts.[194]

San Jose, California

Pacific Gas & Electric, the electric utility serving the city, provided us with total solar PV capacity installed within the city limits of San Jose as of December 31, 2017 in AC watts, which we converted to DC watts.[195]

Seattle, Washington

Seattle City Light, Seattle's municipal utility, provided us with the total installed solar PV capacity within Seattle city limits as of December 31, 2017 in DC watts.[196]

St. Louis, Missouri

Ameren Missouri, the utility serving the city of St. Louis, provided us with total solar PV capacity in St. Louis as of December 31, 2017 in DC watts.[197] 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.

Tampa, Florida

We were unable to secure data for Tampa through 2017, so the figure listed is only through 2016. Therefore, the current solar PV capacity in Tampa is likely higher than the figure listed. TECO Energy, the electric utility serving the city of Tampa, provided us with the total installed solar PV capacity in Tampa as of December 31, 2016, in DC watts.[198]

Virginia Beach, Virginia

Dominion Energy, the electric utility serving Virginia Beach, was only able to provide capacity information for the greater Virginia Beach metropolitan area at the end of 2017. Because of this, we used the figure the utility previously reported for Virginia Beach at the end of 2015.[199] This figure was reported in AC watts, which we converted to DC watts. Because this figure is not up-to-date, it is likely that solar PV capacity installed in Virginia Beach is higher than the figure listed.

Washington, D.C.

Pepco, the utility serving Washington, D.C., provided us with total solar PV capacity installed within the city as of the end of 2017 in AC watts, which we converted to DC watts.[200]

Wichita, Kansas

Westar Energy, the electric utility serving Wichita, provided us with solar PV capacity data for Wichita as of December 31, 2017 in AC watts, which we converted to DC watts.[201]

Wilmington, Delaware

The Delaware Public Service Commission maintains a List of Certified Eligible Energy Resources. We downloaded the most updated version of this spreadsheet and filtered the list for Fuel Type "SUN" and all Generation Units Locations containing "Wilm."[202] We conservatively assumed the capacities were listed in DC watts. Not all Wilmington postal code addresses fall within the city limits of Wilmington, so we multiplied each installation's capacity by the portion of its zip code area that falls within Wilmington. For installations without zip code information or with incorrect zip code information, we multiplied the listed solar capacity figure by the total portion of all included zip code areas that fell within Wilmington city limits.

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