WeatherPower Year in Review: 2022

CLIMATE CENTRAL

WeatherPower Year in Review

SUMMARY

America's capacity to generate carbon-free energy from solar and wind power grew during 2022.

Climate Central's WeatherPower™ tool produces daily estimates and forecasts of solar and wind generation at local scale across the continental United States. To study America's growing renewable electricity capacity and generation, we analyzed WeatherPower data from 2022 and compared the findings to data from 2021.

We found that capacity to generate electricity from solar and wind increased across the country to more than 238 gigawatts (GW) in 2022—up nearly 13 GW from 2021. The U.S. generated 683,130 gigawatt-hours (GWh) of electricity from solar (27%) and wind (73%) combined in 2022—up 16% from 588,471 GWh in 2021.

The electricity generated from solar and wind in 2022 is enough to power the equivalent of 64 million average American households. At the average retail price of 12 cents per kilowatt-hour in 2022 (as reported by the U.S. Energy Information Administration), this equates to $82 billion of revenue generation.

The largest contributions to national solar and wind electricity generation came from a few states—for example, California generated 58,664,084 megawatt-hours (MWh) of solar and Texas generated 129,578,478 MWh of wind. But many states saw relative growth in capacity and generation for solar and wind.

These data—combined with federal capacity forecasts—suggest that America's ability to produce electricity from sunlight and wind can grow fast enough to support net-zero carbon emissions targets in the U.S. by 2050.

This report and supplementary data show:

- where solar and wind capacity increased in 2022, and by how much
- which states were the biggest producers of solar and wind energy in 2022
- what this means for our progress toward renewable energy goals

Download the data.

Introduction

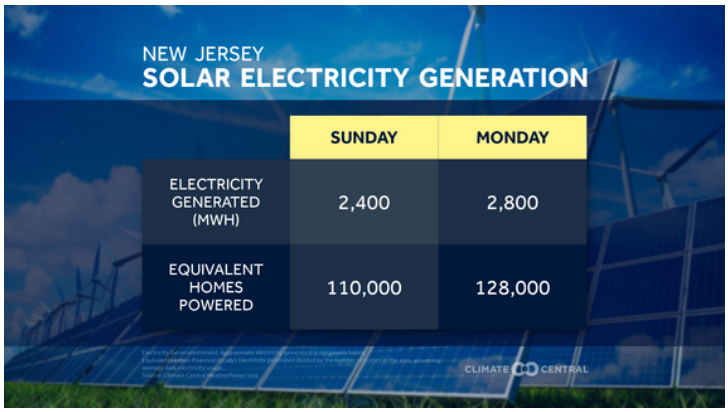
Renewable energy from solar panels and wind turbines is increasingly important in the United States, as costs for these technologies continue to rapidly decline. These electricity sources provide electricity without producing greenhouse gasses and other air pollutants. Renewable energy projects create jobs, support local economies, and are a key strategy to meet U.S. commitments to reduce carbon pollution in the coming decades.

WeatherPower™ daily forecasts reflect the influence of weather on local solar and wind generation in the U.S. This means that WeatherPower data provide us with a snapshot of solar and wind energy in our country, at local scale, on any given day.

For more information on WeatherPower methodology, see Box 1.

This report uses data from WeatherPower and the U.S. Energy Information Administration (EIA) to analyze solar and wind capacity and generation during 2022 in the 48 contiguous states and the District of Columbia. Data are compared across states and against figures from 2021 to show which areas achieved the most growth in solar and wind energy. The analysis also shows America's progress toward the goal of net-zero carbon pollution by 2050.

The key figures in this report—capacity and generation—demonstrate separate factors for assessing renewable energy in the U.S. Capacity reflects the number and size of solar and wind installations that are on line. Generation reflects how much energy is produced by those installations, influenced by the weather (namely, how much the sun shines on solar panels or wind blows on turbines).



Box 1. What is WeatherPower?

To produce daily forecasts, WeatherPower utilizes information about solar and wind installed capacity, combined with observed and forecast weather data.

Information on solar and wind installed capacity comes from a number of sources, including the U.S. Energy Information Administration, the Solar Energy Industries Association, the Lawrence Berkeley National Laboratory, and Google's Project Sunroof. It takes about two months for new utility-scale capacity to be incorporated into the WeatherPower system.

Weather data come from National Oceanic and Atmospheric Administration databases.

See the full, detailed methodology for WeatherPower.

WeatherPower can be used to generate figures relevant to a state, media market, county, or congressional district in the continental U.S. For example, this WeatherPower figure shows solar generated for New Jersey for January 24, 2023.

Full tables with state data for solar and wind can be found in the Appendix. Additionally, the full datasets (CSV) can be downloaded.

National summary

CAPACITY

Renewable energy from solar panels and wind turbines is increasingly important in the United States, as costs for these technologies continue to rapidly decline. These electricity sources provide electricity without producing greenhouse gasses and other air pollutants. Renewable energy projects create jobs, support local economies, and are a key strategy to meet U.S. commitments to reduce carbon pollution in the coming decades.

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Box 2. Energy Terminology: Capacity and Generation

Capacity (sometimes called installed capacity) is a measure of the maximum rate at which electricity can be generated by equipment on the ground, reported in watts (W).

Generation (or production) is the amount of electricity produced over a period of time, reported in watt-hours (Wh).

Because WeatherPower works with large numbers, this analysis will typically reference megawatt-hours (MWh) or gigawatt-hours (GWh). One MWh equals 1 thousand kWh. One GWh equals 1 million kWh or 1,000 MWh.

For example, if a solar farm has a capacity of 2 MW, that farm could produce 2 MWh of electricity when operating for 1 hour in the middle of a sunny day. For reference, the average American household consumed 10.6 MWh of electricity in 2021.

GENERATION

The U.S. generated about 683,130 gigawatt-hours (GWh) of electricity from solar and wind combined in 2022 (compared to nearly 588,471 GWh in 2021). At the average retail price of 12 cents per kilowatt-hour in 2022 (as reported by the U.S. Energy Information Administration), this equates to $82 billion of revenue generation.

Solar power produced around 183,284 GWh in 2022 ($22 billion), and wind power produced around 499,846 GWh in 2022 ($60 billion).

SEASONAL DIFFERENCES FOR SOLAR AND WIND GENERATION

April was the highest-producing month nationally, with 73,540 GWh from solar and wind combined.

Solar generation peaks in the summer (see Figure 1) when days are long and the sun's rays strike the U.S. more directly. In 2022, July (20,919 GWh), June (20,829 GWh), and May (19,954 GWh) produced the most solar electricity across the country.

Wind energy generation is highest during the spring and fall (see Figure 2). In 2022, the most wind energy was produced across the U.S. in April (55,831 GWh) and March (50,050 GWh). The U.S. EIA reported that wind power was the nation's second-largest source of electricity on one particular day in March (29th).

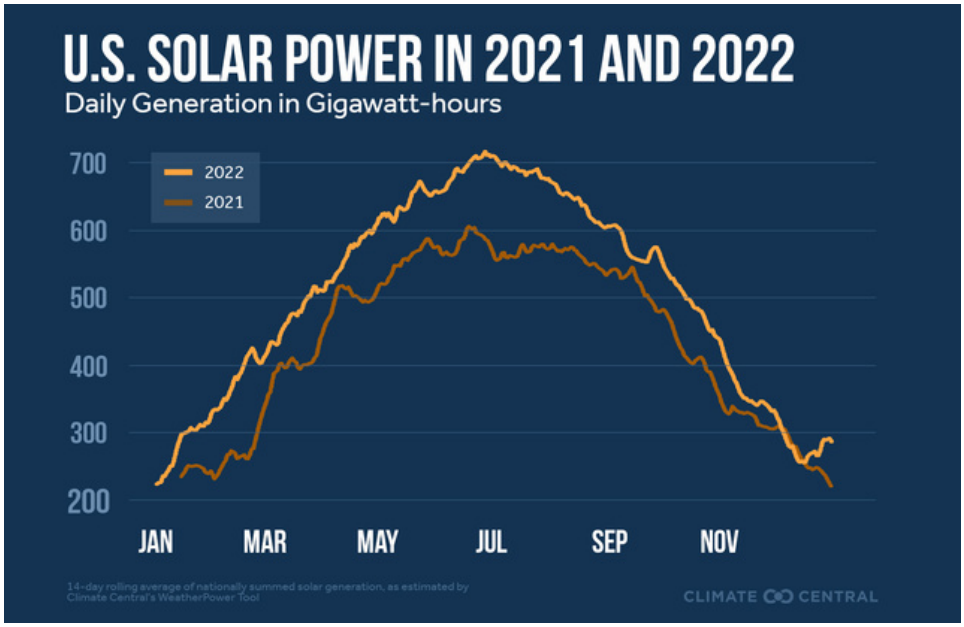

Figure 1: Daily generation of U.S. solar power (gigawatt-hours) in 2021 and 2022, using a 14-day rolling average of nationally summed solar generation

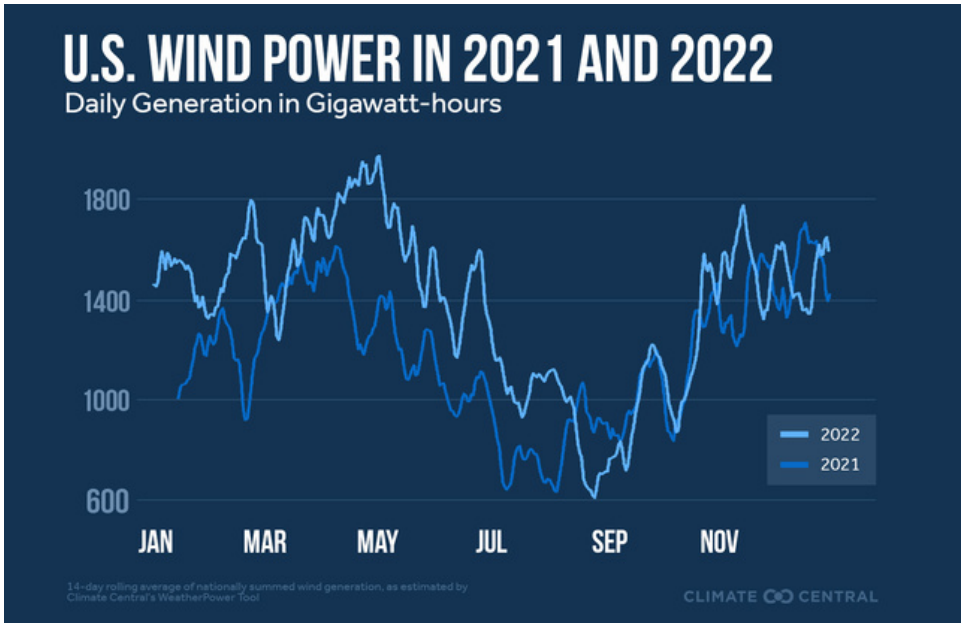

Figure 2: Daily generation of U.S. wind power (gigawatt-hours) in 2021 and 2022, using a 14-day rolling average of nationally summed wind generation

State-level summary

Full tables with state data for both solar and wind can be found in the Appendix.

Capacity

SOLAR

The states with the most solar capacity in 2022 were California, with 28,493 megawatts (MW), and Texas (12,702 MW).

Texas led with the largest increase in MW of solar capacity from 2021 to 2022, with an addition of 1,664 MW. California followed with an addition of 1,308 MW of solar capacity.

WIND

Texas had the largest capacity for wind power in 2022, with 37,365 MW—followed by Iowa (12,259 MW) and Oklahoma (11,715 MW).

Texas took the lead again for the largest increase in MW of wind capacity from 2021 to 2022—an addition of 3,034 MW. Oklahoma followed with an addition of 1,303 MW.

Generation

Generation data for solar and wind power by state illustrates where renewable energy is produced across the country, and identifies which states generated the most power.

SOLAR

California generated the most solar (58,664,084 megawatt-hours) in 2022, followed by Texas (22,863,146 MWh), Florida (13,595,456 MWh), North Carolina (11,532,539 MWh), and Arizona (10,408,801 MWh).

Texas saw the largest increase in MWh of solar generation from 2021 to 2022 (an increase of 6,252,720 MWh). California followed with an increase of 4,722,732 MWh of solar power generation.

WIND

By a wide margin, Texas generated the most wind power (129,578,478 MWh) in 2022. Iowa followed with 48,442,412 MWh, then Oklahoma with 45,757,509 MWh, and Kansas with 34,239,591 MWh.

Again, Texas saw the largest increase in MWh of wind generation from 2021 to 2022 (an increase of 19,081,615 MWh). Iowa followed distantly with an increase of 8,857,850 MWh, and Oklahoma with an increase of 7,538,338 MWh.

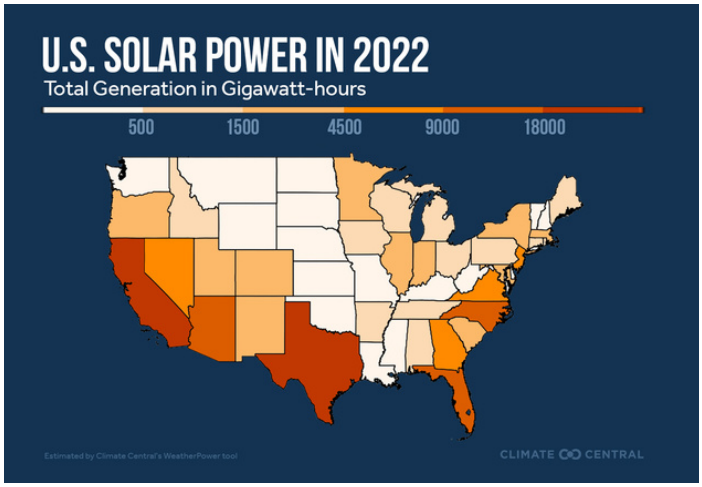

Figure 3: U.S. Solar power in 2022, total generation in gigawatt-hours

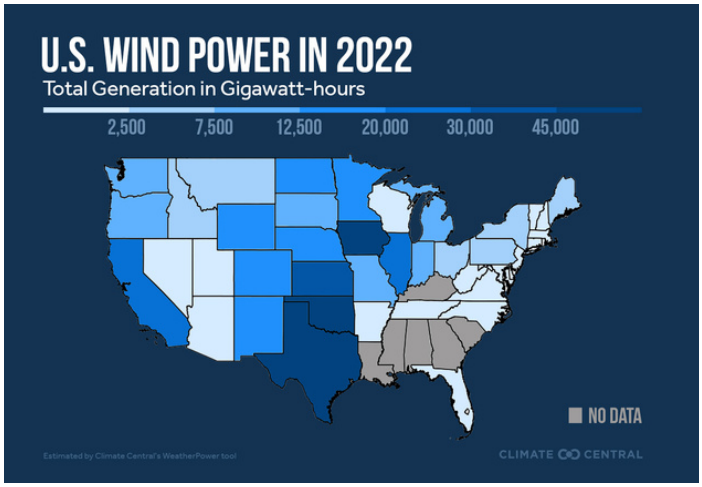

Figure 4: U.S. wind power in 2022, total generation in gigawatt-hours

National growth relative to net-zero benchmarks

The U.S. government has committed the country to reducing net carbon pollution to zero by 2050, as part of the global effort to meet goals set forth in the Paris Agreement. Renewable energy growth is essential for reducing carbon pollution and meeting this target. There are several studies that have modeled how quickly renewable energy capacity in the U.S. must grow to reach the 2050 goals.

One study—the Net-Zero America project (NZAP)—sets benchmarks between 2025 and 2050 for progress toward the net-zero goal. In NZAP's high-electrification pathway, solar and wind utility-scale capacity in the U.S. reach 324 GW and 419 GW, respectively, by 2030. If solar and wind capacity additions were to continue at recent historical rates, the U.S. would fall short of the 2030 benchmarks.

But renewable electricity capacity is poised for more rapid expansion in the wake of federal legislation signed into law in August 2022, the Inflation Reduction Act (see Box 3). A report released by the Federal Energy Regulatory Commission in January 2023 indicates that as much as 202 GW of solar and 68 GW of wind installations (utility-scale) could be added through November 2025.

Box 3. What the Inflation Reduction Act means for renewable energy

The Inflation Reduction Act, signed into law by President Biden in August 2022, provides numerous incentives to accelerate the transition to carbon-free energy in the United States. These provisions include tax credits, grants, and loan programs aimed at rapidly transitioning the U.S. energy economy toward carbon-free energy sources.

Renewable energy projects, including solar panel and wind turbine installations, that meet certain qualifications are eligible for financial incentives under the IRA.

Some of these incentives are aimed at households and individual consumers, including tax credits or rebates for residential solar projects and other energy-efficient household improvements.

Other incentives are geared toward utility-scale solar, wind, and energy storage projects. These credits and programs are designed to support investment in large renewable energy projects, as well as support technology developments that will advance the carbon-free energy transition.

Learn more about the Inflation Reduction Act.

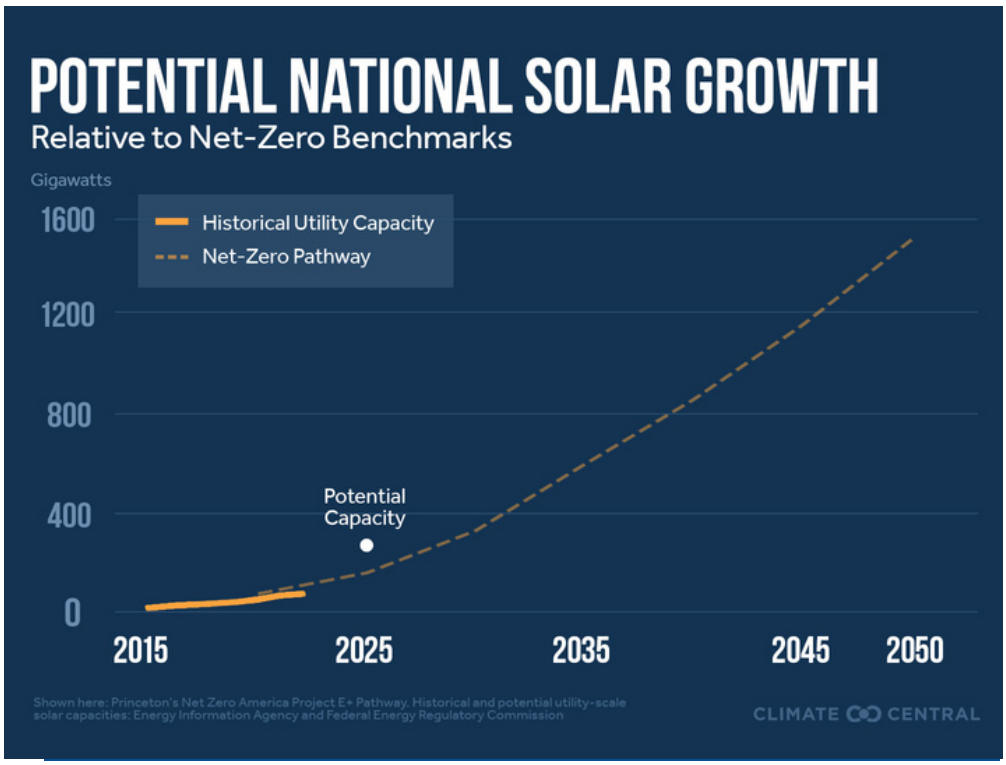

Figure 5: National solar capacity growth relative to net-zero benchmarks

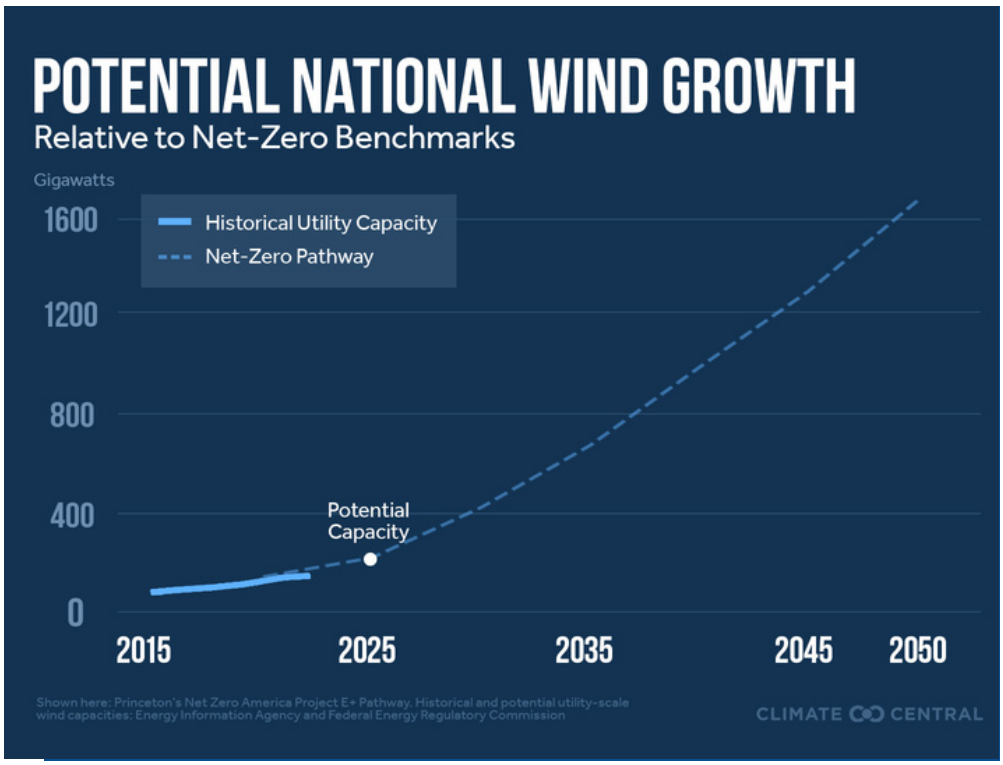

Figure 6: National wind capacity growth relative to net-zero benchmarks

Methodology

See the full, detailed methodology for WeatherPower: https://wp-static-prod.s3.amazonaws.com/WeatherPower_v3.4_Methodology_05Aug2021.pdf

Numbers in this report may vary slightly from other sources because of differences in methodology. Capacity figures in this report reflect the absolute value at year end, which means that timing of new installations (e.g., late-year additions) can affect the relationship between capacity and generation shown in the data. Limitations in publicly available information on smaller rooftop solar installations may cause WeatherPower to underestimate capacity. A comparison of WeatherPower estimates to 2021 solar panel shipments (which closely track capacity additions) suggests a 2- to 3-percent undercount. Equivalent price estimates in this report are based on average retail electricity prices between January and November 2022.

Additional Resources

- Wind and Solar Power 101
- Climate Central Solutions Brief: Solar Energy
- Climate Central Solutions Brief: Wind Energy

Appendix

SOLAR CAPACITY AND GENERATION IN THE CONTINENTAL U.S. (2021/2022)

State	Solar Generation (MWH) 2022	2022 Average Retail Electricity Price per kWh ($)	2022 Value of Electricity from Solar Generation ($)	Solar Generation (MWh) 2021	Solar Capacity (MW) 2022	Solar Capacity (MW) 2021
Alabama	729,985	0.12	87,598,200	455,552	432	432
Arizona	10408801.41756	0.11	1,144,968,110	10,021,645	4,841	4,739
Arkansas	721,233	0.10	72,123,300	494,152	399	299

State	Solar Generation (MWH) 2022	2022 Average Retail Electricity Price per kWh ($)	2022 Value of Electricity from Solar Generation ($)	Solar Generation (MWh) 2021	Solar Capacity (MW) 2022	Solar Capacity (MW) 2021
California	58,664,084	0.22	12,906,098,480	53,941,351	28,493	27,185
Colorado	3,164,210	0.12	379,705,200	2,652,732	1,774	1,754
Connecticut	1,232,496	0.21	258,824,160	1,048,333	774	774
Delaware	198,804	0.12	23,856,480	195,685	122	122
District of Columbia	142,096	0.15	21,314,400	139,766	90	89
Florida	13,595,456	0.12	1,631,454,720	11,144,393	7,170	6,335
Georgia	5,835,776	0.12	700,293,120	4,118,464	3,323	3,117
Idaho	705,199	0.08	56,415,920	736,718	437	437
Illinois	1,706,503	0.12	204,780,360	938,142	1,262	1,000
Indiana	1,648,451	0.12	197,814,120	1,269,723	1,066	1,050
Iowa	823,343	0.10	82,334,300	657,241	586	426
Kansas	117,354	0.12	14,082,480	109,387	66	64
Kentucky	85,947	0.11	9,454,170	77,307	52	51
Louisiana	259,327	0.10	25,932,700	219,823	189	139
Maine	557,017	0.18	100,263,060	325,721	379	320
Maryland	1,749,014	0.13	227,371,820	1,692,129	1,164	1,075
Massachusetts	4,390,563	0.21	922,018,230	3,892,984	2,731	2,699
Michigan	922,913	0.13	119,978,690	608,535	640	519
Minnesota	1,897,039	0.12	227,644,680	1,931,400	1,266	1,245
Mississippi	459,179	0.11	50,509,690	371,451	332	232
Missouri	437,735	0.11	48,150,850	383,375	262	248
Montana	133,483	0.10	13,348,300	137,056	90	90

State	Solar Generation (MWH) 2022	2022 Average Retail Electricity Price per kWh ($)	2022 Value of Electricity from Solar Generation ($)	Solar Generation (MWh) 2021	Solar Capacity (MW) 2022	Solar Capacity (MW) 2021
Nebraska	85,804	0.09	7,722,360	76,256	54	54
Nevada	8,767,747	0.10	876,774,700	7,835,824	4,210	3,900
New Hampshire	164,855	0.21	34,619,550	156,028	108	108
New Jersey	4,751,581	0.15	712,737,150	4,534,289	2,954	2,921
New Mexico	2,146,276	0.10	214,627,600	1,940,942	1,066	964
New York	3,799,491	0.18	683,908,380	3,281,364	2,567	2,416
North Carolina	11,532,539	0.10	1,153,253,900	10,330,392	6,242	6,026
North Dakota	1,208	0.08	96,640	1,270	1	1
Ohio	1,159,983	0.11	127,598,130	1,054,265	777	777
Oklahoma	104,150	0.10	10,415,000	102,118	64	64
Oregon	1,562,824	0.09	140,654,160	1,595,732	1,038	987
Pennsylvania	951,308	0.12	114,156,960	931,828	615	615
Rhode Island	673,700	0.19	128,003,000	533,283	409	396
South Carolina	2,505,030	0.11	275,553,300	2,356,465	1,473	1,439
South Dakota	2,690	0.11	295,900	2,669	1	1
Tennessee	751,179	0.11	82,629,690	442,810	436	285
Texas	22,863,146	0.10	2,286,314,600	16,610,426	12,702	11,038
Utah	3,800,650	0.09	342,058,500	3,568,715	2,149	2,068
Vermont	469,552	0.17	79,823,840	427,988	305	302
Virginia	5,186,862	0.11	570,554,820	3,913,839	3,260	2,836
Washington	293,558	0.09	26,420,220	262,480	356	196
West Virginia	14,681	0.10	1,468,100	14,469	10	10
Wisconsin	894,752	0.12	107,370,240	579,657	741	630
Wyoming	214,477	0.08	17,158,160	212,540	124	124

WIND CAPACITY AND GENERATION IN THE CONTINENTAL U.S. (2021/2022)

State	Wind Generation (MWh) 2022	2022 Average Retail Electricity Price per KWh ($)	2022 Value of Electricity from Wind Generation ($)	Wind Generation (MWh) 2021	Wind Capacity (MW) 2022	Wind Capacity (MW) 2021
Alabama	-	0.12	-	-	-	-
Arizona	1,571,681	0.11	172,884,910	1,607,609	617	617
Arkansas	-	0.10	-	-	-	-
California	23,301,741	0.22	5,126,383,020	24,853,911	6,269	6,199
Colorado	19,686,904	0.12	2,362,428,480	17,775,437	5,177	5,032
Connecticut	15,039	0.21	3,158,190	14,057	5	5
Delaware	6,235	0.12	748,200	5,794	2	2
District of Columbia	-	0.15	-	-	-	-
Florida	-	0.12	-	-	-	-
Georgia	-	0.12	-	-	-	-
Idaho	2,744,247	0.08	219,539,760	2,894,668	974	974
Illinois	23,819,521	0.12	2,858,342,520	19,457,871	7,057	7,195
Indiana	10,714,436	0.12	1,285,732,320	8,456,039	3,452	3,452
Iowa	48,442,412	0.10	4,844,241,200	39,584,563	12,259	11,804
Kansas	34,239,591	0.12	4,108,750,920	28,791,326	8,261	8,261
Kentucky	-	0.11	-	-	-	-

State	Wind Generation (MWh) 2022	2022 Average Retail Electricity Price per KWh ($)	2022 Value of Electricity from Wind Generation ($)	Wind Generation (MWh) 2021	Wind Capacity (MW) 2022	Wind Capacity (MW) 2021
Louisiana	-	0.10	-	-	-	-
Maine	2,800,348	0.18	504,062,640	2,633,511	1,012	1,012
Maryland	595,022	0.13	77,352,860	578,148	190	190
Massachusetts	307,541	0.21	64,583,610	284,800	100	100
Michigan	9,112,551	0.13	1,184,631,630	7,312,574	3,242	3,169
Minnesota	19,486,021	0.12	2,338,322,520	16,255,100	4,710	4,710
Mississippi	-	0.11	-	-	-	-
Missouri	7,799,309	0.11	857,923,990	6,453,356	2,436	2,436
Montana	4,215,104	0.10	421,510,400	3,240,533	1,122	1,122
Nebraska	13,359,216	0.09	1,202,329,440	9,784,446	3,218	2,961
Nevada	383,018	0.10	38,301,800	410,645	150	150
New Hampshire	461,074	0.21	96,825,540	429,289	214	214
New Jersey	20,893	0.15	3,133,950	20,414	8	8
New Mexico	16,630,332	0.10	1,663,033,200	12,026,976	4,410	4,265
New York	7,062,395	0.18	1,271,231,100	6,100,713	2,189	2,189
North Carolina	431,703	0.10	43,170,300	403,058	208	208
North Dakota	19,709,431	0.08	1,576,754,480	17,471,062	4,333	4,333
Ohio	3,249,550	0.11	357,450,500	2,541,787	1,102	1,102
Oklahoma	45,757,509	0.10	4,575,750,900	38,219,171	11,715	10,412
Oregon	9,554,546	0.09	859,909,140	10,521,707	3,851	3,649
Pennsylvania	4,409,825	0.12	529,179,000	4,260,747	1,463	1,463
Rhode Island	255,826	0.19	48,606,940	228,885	26,941	78
South Carolina	-	0.11	-	-	-	-
South Dakota	11,838,450	0.11	1,302,229,500	10,046,334	1,792,116	2,759
Tennessee	67,666	0.11	7,443,260	62,928	29	29

State	Wind Generation (MWh) 2022	2022 Average Retail Electricity Price per KWh ($)	2022 Value of Electricity from Wind Generation ($)	Wind Generation (MWh) 2021	Wind Capacity (MW) 2022	Wind Capacity (MW) 2021
Texas	129,578,478	0.10	12,957,847,800	110,496,863	37,365	34,331
Utah	1,021,618	0.09	91,945,620	1,087,314	390	390
Vermont	421,148	0.17	71,595,160	371,305	151	151
Virginia	-	0.11	-	-	-	-
Washington	9,096,239	0.09	818,661,510	10,553,577	3,510	3,510
West Virginia	2,181,540	0.10	218,154,000	1,848,491	856	741
Wisconsin	2,418,419	0.12	290,210,280	1,979,770	735	735
Wyoming	13,078,931	0.08	1,046,314,480	11,077,476	3,130	3,130

*Because of data limitations, Alaska and Hawaii are not included in this analysis.