Electric Utility Performance

A STATE-BY-STATE DATA REVIEW

PRODUCED BY THE
CITIZENS UTILITY BOARD (CUB)

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Electric Utility Performance: A State-by-State Data Review
was produced by the Citizens Utility Board (CUB)

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DATA SOURCES

Although the data in this report come from publicly accessible sources, these sources do not share this information in ways that are accessible and meaningful to most people. This report puts these data in the context of three key benchmarks of utility performance: affordability, reliability, and environmental responsibility. The comparative rankings can help interested and engaged citizens compare the performance and characteristics of their state's utilities relative to national peers.

Most of the data in this report come from the Energy Information Administration (EIA) of the U.S. Department of Energy—a federal entity tasked with the aggregation and dissemination of information about the American energy industry, and trends in energy uses, sources, reliability, and efficiency. The majority of figures are for 2019, because of a time lag in reporting on the part of the utilities. The other data sources used to compile this report include the U.S. Census Bureau's American Community Survey, the Environmental Protection Agency (EPA), and more.

In all of the figures, the states are ranked from best to worst.

GLOSSARY

TERMS AND ABBREVIATIONS

- **ACS:** American Community Survey
- **CAIDI:** Customer Average Interruption Duration Index
- **CO2:** Carbon Dioxide
- **EIA:** Energy Information Administration
- **EPA:** Environmental Protection Agency
- **IEEE:** Institute of Electrical and Electronics Engineers
- **MED:** Major Event Days
- **NOx:** Nitrogen Oxides of Multiple Types
- **RPS:** Renewable Portfolio Standard
- **SAIDI:** System Average Interruption Duration Index
- **SAIFI:** System Average Interruption Frequency Index
- **SEDS:** State Energy Data System
- **SO2:** Sulfur Dioxide

UNITS OF MEASUREMENT

- **GWh/Gigawatt-hour:** one million kilowatt-hours
- **kWh/Kilowatt-hour:** a unit of electricity measurement typical on U.S. electric bills, the average American household uses about 11,000 kWh per year.
- **Metric Ton:** one million grams or 2,204.6 pounds
- **MMBTU:** one million British thermal units, equivalent to 293.07 kWh
- **MWh/Megawatt-hour:** one thousand kilowatt-hours
- **TWh/Terawatt-hour:** one billion kilowatt-hours

Introduction

Electric Utility Performance: A State-by-State Data Review represents a comprehensive ranking of electric utility performance in every state in America on the key public interest metrics of affordability, reliability, and environmental responsibility. It's a landmark analysis that arrives at a climactic moment in the United States.

By the time of this report's publication:

- The continuing economic woes caused by the Coronavirus pandemic left millions of American households with less money to pay their electricity costs, exacerbating preexisting conditions that already plagued lower-income and environmental justice communities with disproportionately burdensome energy bills.
- Texas consumers had been pummelled by pervasive power outages and skyrocketing electricity costs after a winter deep freeze caused a deadly energy crisis.
- Hurricane Ida had barreled into the Gulf Coast, and then careened toward the Northeast. The storm left New Orleans in the dark for more than a week, while producing floodwaters that turned Manhattan subways and Philadelphia expressways into life-threatening rapids.
- A chain of massive wildfires had burned for months along the West Coast and spewed enough smoke to leave a visible haze along the Atlantic.

Problems like these, which are growing in frequency and intensity in the U.S., attest to the profound challenges that the coming decades portend for our electricity infrastructure—and prove how important utility performance will be to our ability to adapt and thrive.

Meanwhile, the pace and scope of technological innovation, and the onus to curb climate change through the increased use of clean power sources, will likely boost demand for electricity. The need for reliable, affordable power is a unifying theme of our existence. In matters of culture and lifestyle, we use apps to bank or shop, digital portals to attend school or a medical appointment, streaming platforms for entertainment—to name just a few. All of this technology requires massive data centers that are sometimes the largest single customer of electric utilities. And when it comes to our future environmental security, the electrification of both our transportation system and buildings is a critical part of the strategy to meet our climate change commitments.

Against this backdrop, the Citizens Utility Board (CUB) has compiled a comprehensive assessment of electric utility performance across all 50 states. Based on publicly available data, this analysis rates each state's residential utilities on the three core standards that indicate whether a power provider is meeting its fundamental obligations to customers:

- Affordability.
- Reliability.
- Environmental responsibility.

The report includes a composite score and a corresponding ranking of states and the District of Columbia from 1 to 51 — or best to worst — for overall utility performance. This score is an average of a state's rankings within those three core categories of reliability, affordability and environmental responsibility. These metrics afford us a consistent scale to quantify and compare utility performance across the country over time, pinpointing areas where policymakers in each state can focus efforts to unleash untapped potential for lower energy costs, better electricity service, and a cleaner environment. Simply put, policymakers can't improve what they don't measure.

By the same token, for states that fare well in this inaugural edition of the performance ranking, this report shouldn't be regarded as a license to coast. The rankings of states reflect their performance relative to each other — but there is ample room for even the top-performers, both overall and in each of the three component categories, to raise the bar exponentially. By redoubling their efforts they can harness extra savings for customers, minimize power disruptions even further, and make the U.S. more resilient against a changing climate.

There is more research to be conducted on the precise socio-demographic characteristics that best explain utility performance. In future reports we will examine those questions in further detail through econometric analyses. For now we will highlight a few general observations and conclusions about the results contained in this report:

- While some voices in both the energy industry and political circles have long sought to promote a belief that fossil fuels contribute to lower electricity costs, the rankings in this report fail to corroborate that relationship. Instead, states heavily dependent on coal-fired electricity, such as West Virginia and Indiana, recorded below-average affordability.
- On the surface, at least, the connection between Advanced Metering Infrastructure (AMI) and reliability is not as strong as one might assume. While states that have launched AMI upgrades, such as Nevada and Florida, do comparatively well, states like Michigan, Oklahoma, and Ohio that have invested heavily in grid modernization continue to lag in reliability performance. While likely a necessary condition for future improved resiliency, it appears that smart grid infrastructure, by itself, is not enough to improve reliability.
- It is noteworthy that many of the states with the lowest per unit power costs actually have some of the highest average residential bills. Partly this is due to differences in weather, but energy efficiency and other cost-effective clean energy resources suppress power bills over time, particularly in restructured states. Consumers at the end of the day pay bills, not rates, so analysis of any program or policy suite must examine the impact over time on energy bills.
- Finally, states that tend to be at the top of any one category are often high performers across the board. The same pattern shows itself for states huddled along the bottom of any metric — they tend to do poorly across all metrics. While it requires further investigation, this suggests an interrelated socio-policy landscape producing consistent results.

In 2021, the United Nations' Intergovernmental Panel on Climate Change declared that the U.S. and the globe were at a crossroads in efforts to avert the most dire fallout from the carbon emissions unleashed by fossil fuels. That warning has particularly formidable implications for American electricity production, which accounts for one quarter of all U.S. carbon emissions, according to the U.S. Environmental Protection Agency (EPA). And it underscores why the performance of our nation's electric utilities warrants close and urgent attention.

As the country grapples with the challenge of transitioning to zero-carbon sources of electricity while also protecting the affordability and reliability of electricity service, we hope that this report helps policymakers identify which states are headed in the right direction and the policies that are propelling them there.

TABLE 1: STATE RANKINGS ON OVERALL UTILITY PERFORMANCE

Ranking (Best to Worst)	State	Affordability Average	Reliability Average	Environmental Average	Average Rank
1	Nevada	14.2	5.7	20.9	13.6
2	Washington	4.2	29.0	8.9	14.0
3	Idaho	6.6	24.2	13.8	14.9
4	Oregon	11.2	24.8	10.3	15.4
5	Illinois	17.2	7.7	22.4	15.8
6	Nebraska	15.6	7.5	29.0	17.4
7	North Dakota	20.2	8.7	26.2	18.4
8	Arizona	29.2	5.7	22.3	19.1
9	Minnesota	23.0	13.2	22.4	19.5
10	Utah	3.6	19.7	35.3	19.5
11	Colorado	13.4	18.2	27.4	19.7
12	District of Columbia	18.4	8.2	34.3	20.3
13	Iowa	26.3	13.0	21.6	20.3
14	Montana	18.4	22.2	22.6	21.1
15	New York	32.6	19.7	12.6	21.6
16	New Mexico	16.0	24.0	25.3	21.8
17	South Dakota	29.3	25.8	10.4	21.8
18	Florida	28.6	7.7	32.4	22.9
19	Kansas	28.2	25.8	15.4	23.1
20	New Jersey	28.8	18.2	23.2	23.4
21	Delaware	30.8	7.5	31.9	23.4
22	Wyoming	13.6	22.2	35.5	23.8
23	Oklahoma	16.4	38.8	16.7	24.0
24	California	25.8	31.5	16.0	24.4
25	Maryland	33.0	15.3	25.4	24.6
26	Tennessee	29.2	32.3	20.7	27.4
27	Wisconsin	23.0	27.2	32.6	27.6
28	South Carolina	34.9	29.2	18.9	27.7
29	Texas	27.4	28.5	27.2	27.7
30	Alabama	39.2	23.5	21.6	28.1
31	North Carolina	26.2	34.7	24.9	28.6
32	Georgia	34.9	21.5	29.6	28.7
33	Vermont	31.4	41.2	14.9	29.2
34	Pennsylvania	32.4	28.7	26.9	29.3
35	Rhode Island	41.8	17.8	28.9	29.5
36	New Hampshire	36.2	39.3	14.8	30.1
37	Missouri	24.8	25.8	40.3	30.3
38	Massachusetts	39.0	24.2	29.2	30.8
39	Arkansas	16.2	44.7	31.6	30.8
40	Kentucky	22.0	28.7	43.1	31.3
41	Virginia	31.8	39.3	26.9	32.7
42	Maine	32.8	47.5	17.8	32.7
43	Connecticut	46.2	31.3	20.8	32.8
44	Louisiana	18.6	45.0	37.9	33.8
45	Ohio	25.5	35.7	40.7	34.0
46	Michigan	30.6	44.2	31.1	35.3
47	Mississippi	30.4	44.2	31.8	35.5
48	Indiana	31.4	33.5	41.6	35.5
49	Hawaii	46.2	25.5	37.5	36.4
50	Alaska	42.6	38.7	31.4	37.6
51	West Virginia	26.7	50.0	41.1	39.3

Sources: EIA and U.S. Census Bureau

Affordability Metrics

Electricity bills often have many components: fixed monthly charges; a charge per kilowatt-hour (kWh) of electricity; charges based on the customer's peak rate of power usage in the billing month or previous year; and others. The way utilities assign costs to these components of the bill varies among companies, classes of customers and across states. Because, for customer purposes, each kWh is identical, dividing the total bill by the kWh used is generally the best way to compare utility costs.

The Energy Information Administration (EIA) collects monthly data from each utility in each state on the amounts of electricity sold and revenue from electricity by customer class. Customer classes include residential, commercial, industrial and transportation, with almost all electricity delivered in most states going to the first three classes. EIA makes the data available through its Electricity Data Browser.

HOUSEHOLD ELECTRICITY COSTS AND EXPENDITURES

As one of the essentials of life, the cost of electricity is an existential matter for consumers. In the worst-case scenario, it can force lower-income households to choose between keeping the refrigerator running and buying the food that would go in it. And for industry, it is instrumental to staying competitive and promoting job growth.

The affordability of electricity is a nuanced calculation. For households, climate and the availability of alternative heating fuels can affect the amount of electricity they consume. While this report focuses on electric costs (Figure 1 presents the average monthly electric bill; Figure 4 the average annual cost of electricity in dollars), it also recognizes the importance of non-electricity expenditures for many states, and includes those statistics in Figure 2. Also, expenditures on electricity must be considered in the context of income—thus the metric of energy expenditures as a percentage of state median income (Figure 3) is an important measure of affordability.

Commercial and industrial users of electricity are less affected by climate and heating fuels, so the technologies of commerce and production can be more consistent from place to place. However, different types of businesses have very different energy requirements and often are clustered in different states for reasons having little to do with energy costs. Thus, total commercial and industrial energy cost is not a good basis for comparison; and in this case, a comparison of rates is more useful. After examining household expenditures and residential electricity rates and costs, this report then looks at electricity rates for residential customers (Figure 5), as well as for all customers: the residential, commercial, and industrial sectors combined (Figure 6).

This section shows that the prices of electricity and heating fuels are far from the only determining factor for overall energy affordability. For example, whereas households in warmer climates may consume more electricity on an annual basis to run air conditioning units than households in colder climates, those same households will not spend as much on natural gas, propane or other heating fuels during the winter. Energy expenditures are measured by the EIA in the State Energy Data System (SEDS) database at https://www.eia.gov/state/seds/. The explanation for high costs in Alaska and Hawaii is simply their isolation relative to the U.S. mainland's comparatively interconnected grid and access to energy resources.

It's interesting to note that some states—including Tennessee and Louisiana—that have some of the lowest electricity rates in the country nonetheless have some of the higher overall bills. While a state's per-kWh electricity rate must be part of any analysis, it is wise to remember that customers pay bills, not rates, and final conclusions about energy affordability must include other metrics, such as average monthly and annual electric bill.

TABLE 2: AFFORDABILITY RANKINGS (ALPHABETICAL)

State	Cost of Household Energy Expenditures	Total Household Electricity Costs as a Percentage of Income	Electricity Cost per Kilowatt-Hour For All Customers	Electricity Cost per Kilowatt-Hour for Residential Customers	Annual Electricity Expenditures
Alabama	38	50	29	30	49
Alaska	47	26	50	50	40
Arizona	13	34	35	25	39
Arkansas	8	41	4	5	23
California	12	8	47	46	16
Colorado	4	3	31	26	3
Connecticut	51	32	49	49	50
Delaware	35	25	34	31	29
District of Columbia	11	2	39	29	11
Florida	6	44	33	18	42
Georgia	37	46	27	21	43
Hawaii	41	37	51	51	51
Idaho	7	14	3	4	5
Illinois	19	7	23	33	4
Indiana	33	35	27	27	34
Iowa	32	28	17	34	20
Kansas	31	22	32	32	24
Kentucky	18	43	9	9	31
Louisiana	9	48	2	1	33
Maine	45	21	41	42	15
Maryland	42	10	37	35	41
Massachusetts	48	15	46	48	38
Michigan	36	23	40	41	13
Minnesota	24	6	36	37	12
Mississippi	25	51	15	14	47
Missouri	27	39	20	10	28
Montana	28	24	16	17	7
Nebraska	16	17	13	11	21
Nevada	10	19	8	15	19
New Hampshire	50	12	45	44	30
New Jersey	39	5	42	40	18
New Mexico	1	20	21	36	2
New York	44	16	43	43	17
North Carolina	14	42	22	16	37
North Dakota	30	27	12	6	26
Ohio	34	31	17	23	22
Oklahoma	15	38	1	3	25
Oregon	5	11	14	12	14
Pennsylvania	43	29	25	38	27
Rhode Island	46	33	48	47	35
South Carolina	26	47	26	27	48
South Dakota	29	36	30	19	32
Tennessee	21	49	24	8	44
Texas	20	40	10	22	45
Utah	2	1	7	7	1
Vermont	49	9	44	45	10
Virginia	40	30	19	24	46
Washington	3	4	6	2	6
West Virginia	22	45	11	19	36
Wisconsin	17	13	38	39	8
Wyoming	23	18	5	13	9

Source: EIA

TABLE 3: AFFORDABILITY RANKINGS (BEST-TO-WORST)

Rank Based on Average Performance	State	Cost of Household Energy Expenditures	Total Household Electricity Costs as a Percentage of Income	Electricity Cost per Kilowatt-Hour For All Customers	Electricity Cost per Kilowatt-Hour for Residential Customers	Annual Electricity Expenditures
1	Utah	2	1	7	7	1
2	Washington	3	4	6	2	6
3	Idaho	7	14	3	4	5
4	Oregon	5	11	14	12	14
5	Colorado	4	3	31	26	3
6	Wyoming	23	18	5	13	9
7	Nevada	10	19	8	15	19
8	Nebraska	16	17	13	11	21
9	New Mexico	1	20	21	36	2
10	Arkansas	8	41	4	5	23
11	Oklahoma	15	38	1	3	25
12	Illinois	19	7	23	33	4
13	District of Columbia	11	2	39	29	11
13	Montana	28	24	16	17	7
15	Louisiana	9	48	2	1	33
16	North Dakota	30	27	12	6	26
17	Kentucky	18	43	9	9	31
18	Minnesota	24	6	36	37	12
18	Wisconsin	17	13	38	39	8
20	Missouri	27	39	20	10	28
21	Ohio	34	31	17	23	22
22	California	12	8	47	46	16
23	North Carolina	14	42	22	16	37
24	Iowa	32	28	17	34	20
25	West Virginia	22	45	11	19	36
26	Texas	20	40	10	22	45
27	Kansas	31	22	32	32	24
28	Florida	6	44	33	18	42
29	New Jersey	39	5	42	40	18
30	Arizona	13	34	35	25	39
30	Tennessee	21	49	24	8	44
32	South Dakota	29	36	30	19	32
33	Mississippi	25	51	15	14	47
34	Michigan	36	23	40	41	13
35	Delaware	35	25	34	31	29
36	Vermont	49	9	44	45	10
36	Indiana	33	35	27	27	34
38	Virginia	40	30	19	24	46
39	Pennsylvania	43	29	25	38	27
40	New York	44	16	43	43	17
41	Maine	45	21	41	42	15
42	Maryland	42	10	37	35	41
43	South Carolina	26	47	26	27	48
43	Georgia	37	46	27	21	43
45	New Hampshire	50	12	45	44	30
46	Massachusetts	48	15	46	48	38
47	Alabama	38	50	29	30	49
48	Rhode Island	46	33	48	47	35
49	Alaska	47	26	50	50	40
50	Connecticut	51	32	49	49	50
50	Hawaii	41	37	51	51	51

Source: EIA

FIGURE 1: 2019 AVERAGE MONTHLY COST OF ELECTRICITY BILLS

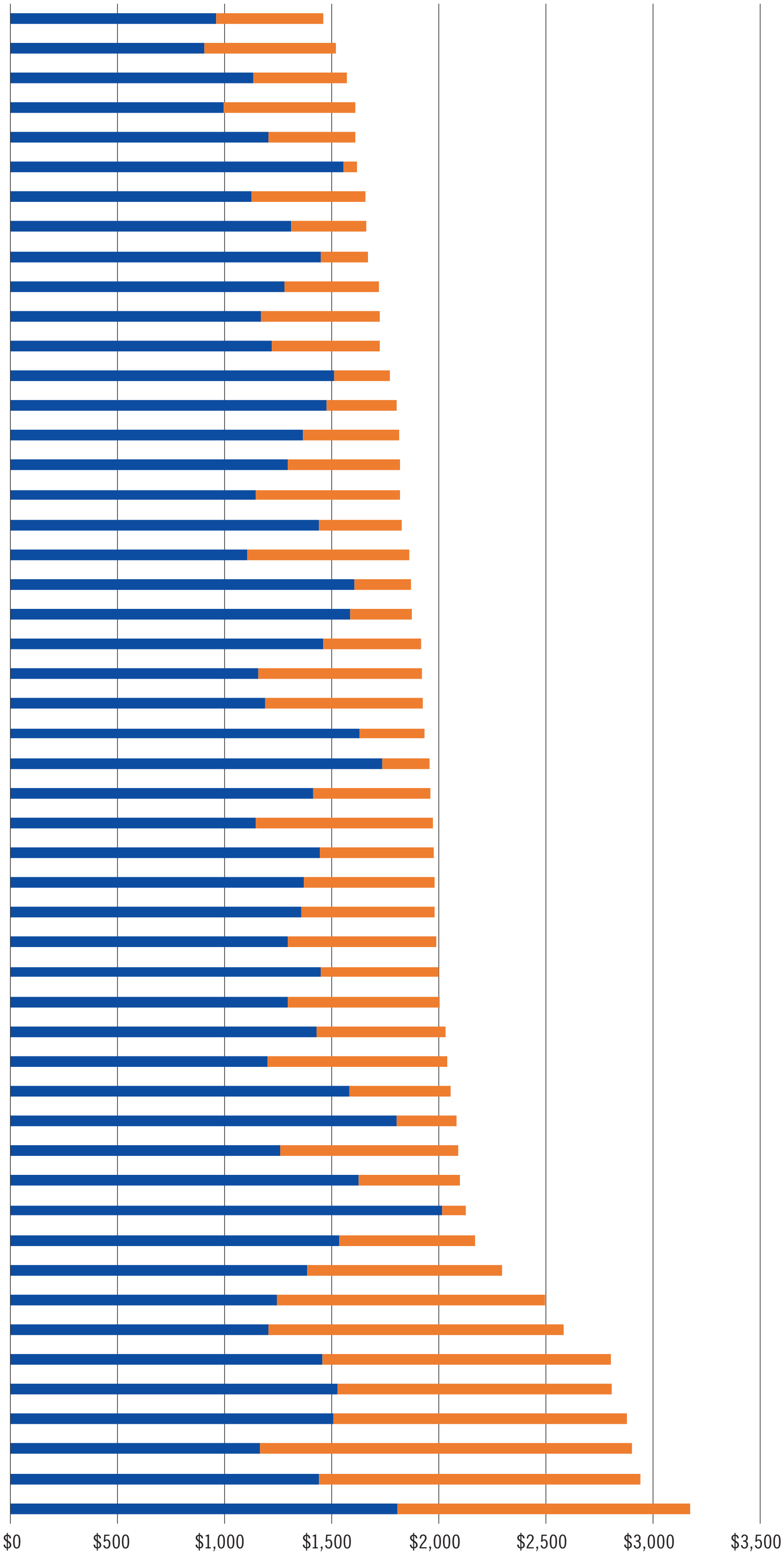
State	Yearly Residential Electricity Sales per Customer in Kilowatt Hours	Residential Electricity Price in Dollars per Kilowatt Hour	Average Residential Monthly Electricity Bill
Utah	8,726	$0.10	$76
New Mexico	7,677	$0.13	$80
Colorado	8,187	$0.12	$83
Illinois	8,509	$0.13	$92
Idaho	11,386	$0.10	$94
Washington	11,680	$0.10	$95
Montana	10,286	$0.11	$95
Wisconsin	8,086	$0.14	$96
Wyoming	10,366	$0.11	$97
Vermont	6,583	$0.18	$97
District of Columbia	9,023	$0.13	$98
Minnesota	9,112	$0.13	$99
Michigan	7,640	$0.16	$100
Oregon	10,935	$0.11	$100
Maine	6,744	$0.18	$101
California	6,385	$0.19	$102
New York	6,930	$0.18	$104
New Jersey	7,955	$0.16	$105
Nevada	10,679	$0.12	$107
Iowa	10,406	$0.12	$108
Nebraska	12,047	$0.11	$108
Ohio	10,485	$0.12	$108
Arkansas	13,410	$0.10	$110
Kansas	10,691	$0.13	$113
Oklahoma	13,396	$0.10	$114
North Dakota	13,311	$0.10	$114
Pennsylvania	10,038	$0.14	$115
Missouri	12,693	$0.11	$118
Delaware	11,395	$0.13	$119
New Hampshire	7,185	$0.20	$120
Kentucky	13,346	$0.11	$120
South Dakota	12,526	$0.12	$121
Indiana	11,517	$0.13	$121
Louisiana	14,787	$0.10	$121
Rhode Island	6,715	$0.22	$122
West Virginia	13,004	$0.11	$122
North Carolina	12,953	$0.11	$123
Massachusetts	6,893	$0.22	$126
Arizona	12,169	$0.12	$126
Alaska	6,665	$0.23	$127
Maryland	11,704	$0.13	$128
Florida	13,295	$0.12	$130
Georgia	13,449	$0.12	$132
Tennessee	14,605	$0.11	$132
Texas	13,679	$0.12	$134
Virginia	13,469	$0.12	$135
Mississippi	14,472	$0.11	$136
South Carolina	13,368	$0.13	$145
Alabama	14,411	$0.13	$150
Connecticut	8,269	$0.22	$151
Hawaii	6,296	$0.32	$168

Source: EIA

FIGURE 2: 2019 AVERAGE ANNUAL COST OF HOUSEHOLD ENERGY EXPENDITURES

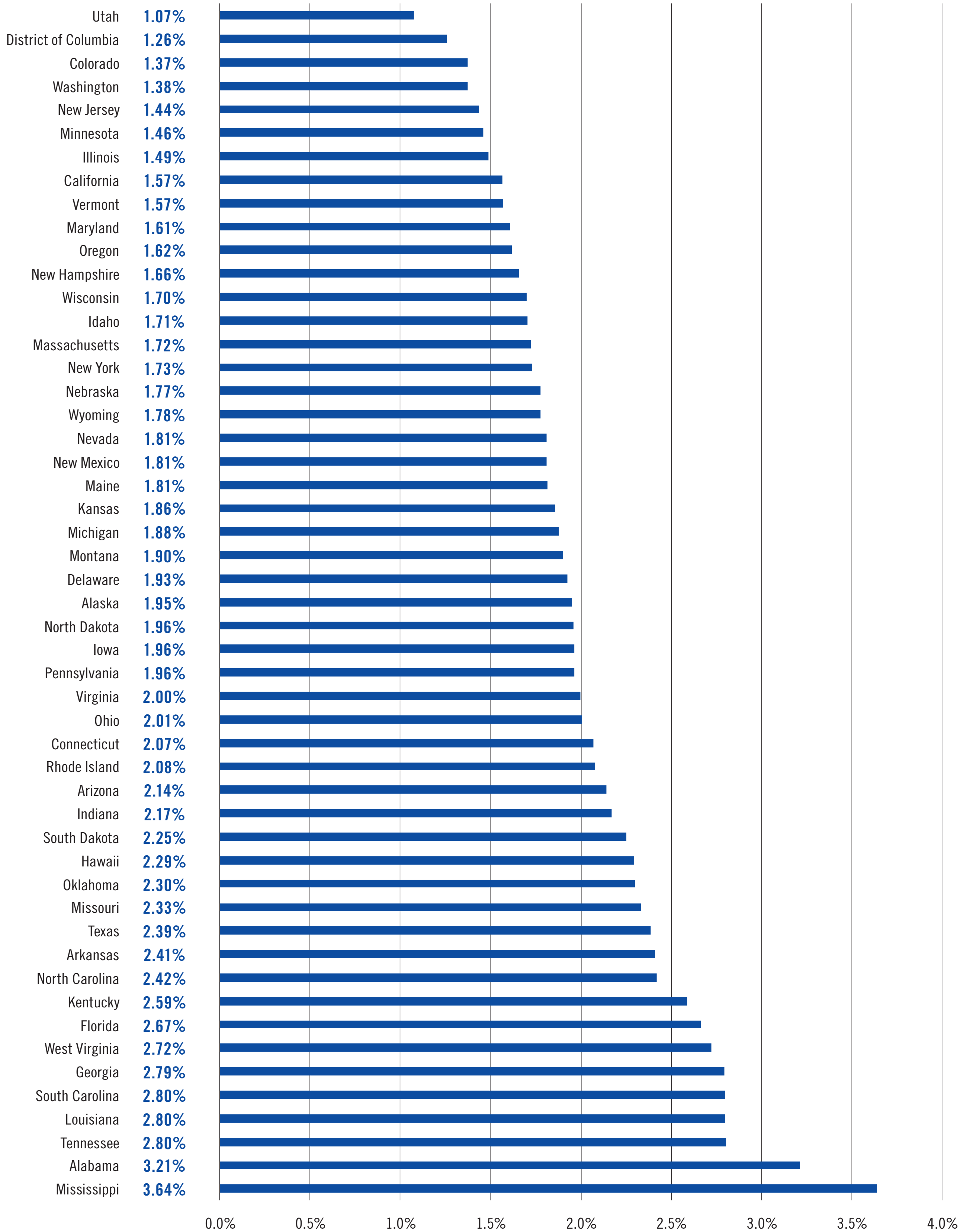
■ Electricity Expenditures ■ Non-Electricity Energy Expenditures ■ Total Expenditures

State	Electricity Expenditures	Non-Electricity Energy Expenditures	Total Expenditures
New Mexico	$960	$501	$1,461
Utah	$908	$613	$1,521
Washington	$1,134	$437	$1,571
Colorado	$997	$613	$1,610
Oregon	$1,204	$408	$1,612
Florida	$1,556	$62	$1,618
Idaho	$1,126	$531	$1,657
Arkansas	$1,314	$349	$1,663
Louisiana	$1,448	$223	$1,671
Nevada	$1,282	$439	$1,721
District of Columbia	$1,172	$552	$1,724
California	$1,223	$501	$1,724
Arizona	$1,513	$261	$1,774
North Carolina	$1,479	$326	$1,805
Oklahoma	$1,367	$449	$1,816
Nebraska	$1,297	$522	$1,819
Wisconsin	$1,146	$674	$1,820
Kentucky	$1,441	$385	$1,826
Illinois	$1,108	$755	$1,863
Texas	$1,609	$261	$1,870
Tennessee	$1,588	$289	$1,877
West Virginia	$1,463	$456	$1,919
Wyoming	$1,158	$764	$1,922
Minnesota	$1,188	$737	$1,925
Mississippi	$1,630	$304	$1,934
South Carolina	$1,737	$223	$1,960
Missouri	$1,414	$547	$1,961
Montana	$1,145	$828	$1,973
South Dakota	$1,447	$531	$1,978
North Dakota	$1,371	$608	$1,979
Kansas	$1,359	$622	$1,981
Iowa	$1,296	$692	$1,988
Indiana	$1,449	$550	$1,999
Ohio	$1,298	$709	$2,007
Delaware	$1,430	$603	$2,033
Michigan	$1,203	$838	$2,041
Georgia	$1,582	$473	$2,055
Alabama	$1,805	$280	$2,085
New Jersey	$1,261	$832	$2,093
Virginia	$1,626	$473	$2,099
Hawaii	$2,018	$108	$2,126
Maryland	$1,535	$634	$2,169
Pennsylvania	$1,386	$909	$2,295
New York	$1,243	$1,254	$2,497
Maine	$1,206	$1,378	$2,584
Rhode Island	$1,459	$1,346	$2,805
Alaska	$1,528	$1,280	$2,808
Massachusetts	$1,511	$1,368	$2,879
Vermont	$1,166	$1,734	$2,900
New Hampshire	$1,441	$1,500	$2,941
Connecticut	$1,809	$1,365	$3,174



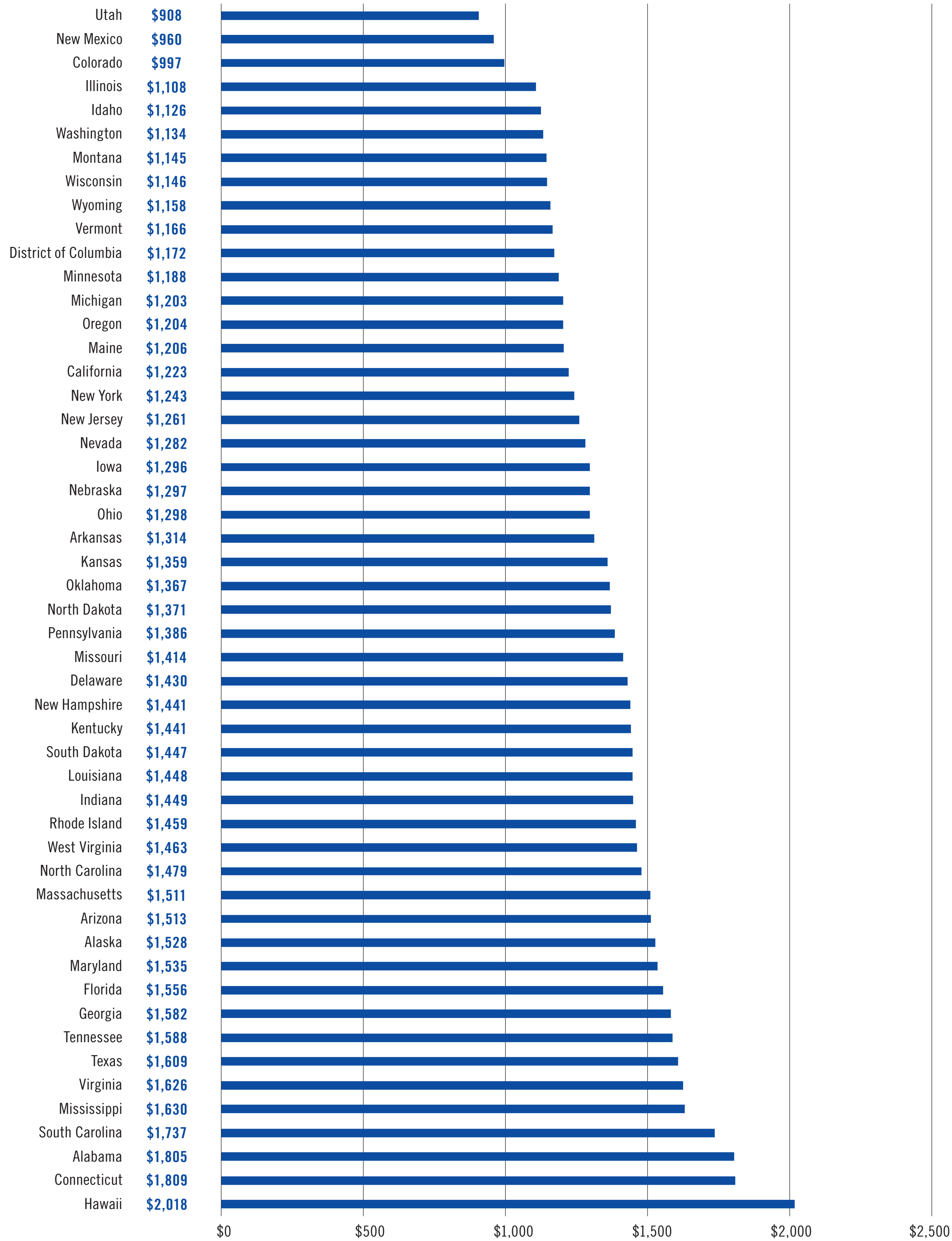
Source: EIA

FIGURE 3: 2019 AVERAGE ANNUAL HOUSEHOLD ELECTRICITY COSTS AS A PERCENTAGE OF MEDIAN INCOME



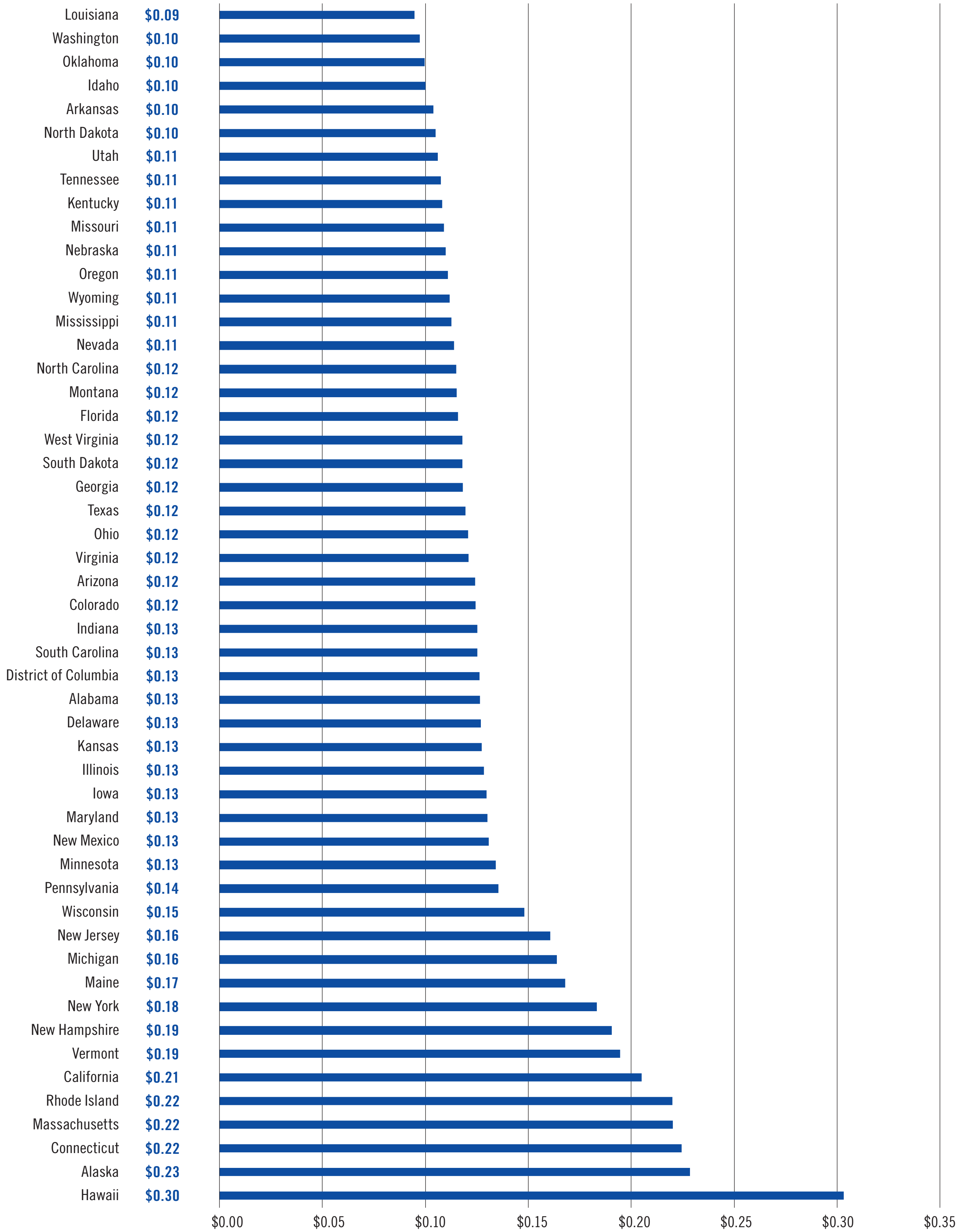
Source: EIA and U.S. Census Bureau

FIGURE 4: 2019 AVERAGE ANNUAL RESIDENTIAL ELECTRICITY EXPENDITURES



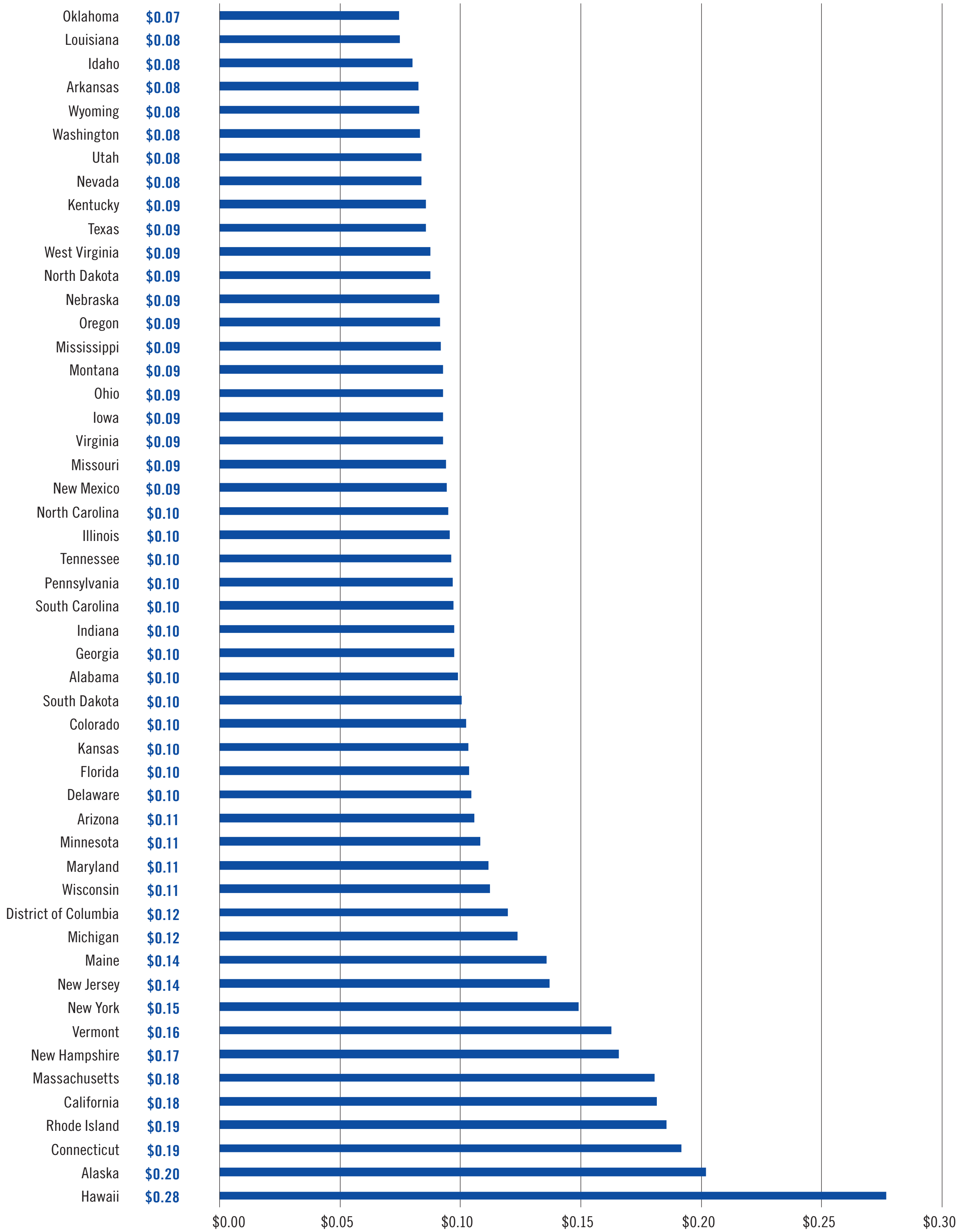
Source: EIA

FIGURE 5: 2020 AVERAGE ANNUAL ELECTRICTY COST PER KILOWATT-HOUR FOR RESIDENTIAL CUSTOMERS



Source: EIA

FIGURE 6: 2020 AVERAGE ANNUAL ELECTRICITY COST PER KILOWATT-HOUR FOR ALL CUSTOMERS (RESIDENTIAL, COMMERCIAL, INDUSTRIAL)



Source: EIA

Utility Reliability and Performance Metrics

Electricity is a universal need. It protects us from hazardous weather, fends off the darkness, and propels our economy. Without it, contemporary life would be virtually uninhabitable. So providing reliable electricity service is one of the foremost responsibilities we entrust to utilities and a critical bellwether of their performance.

Much of the public discussion about electric utility reliability focuses on what regulators and utilities call "Resource Adequacy." This ensures there is sufficient power generation capacity to satisfy each utility's peak customer demand.

However, loss of electricity supply due to generation or transmission problems accounts for only about 1% of outage minutes nationally. Power outages that utility customers experience on a regular basis are not caused by insufficient generation capacity or long-distance transmission, but by breakdowns in the electricity delivery system—the distribution grid. Such disruptions happen for many reasons, including power lines downed by the violent weather that has become more common as climate change intensifies; animals that disturb lines and cause a "short;" and equipment failures.

The electric power industry, led by the Institute of Electrical and Electronics Engineers (IEEE), has determined that the best overall measure of an electric utility's reliability is the average number of minutes of outages per year per customer, calculated by a method referred to as the System Average Interruption Duration Index (SAIDI).

SAIDI (Figures 7 and 8) is a primary metric for electric reliability, but it is the product of two other reliability metrics. The Customer Average Interruption Duration Index (CAIDI), Figures 9 and 10, measures the average time for the utility to restore power to a customer after an outage starts. The System Average Interruption Frequency Index (SAIFI), displayed in Figures 11 and 12, measures outages per customer.

These metrics are interrelated. Poor SAIDI scores can be driven by SAIFI or CAIDI, or both. For example, the relatively high SAIDI scores for California and Michigan are driven more by CAIDI (long outages) than by SAIFI (frequent outages). The reverse is true of Louisiana and Mississippi.

Beginning in 2013, the EIA began collecting annual reports of SAIDI, SAIFI and CAIDI from utilities and publishing the data in annual compilations. The information is collected on form EIA-861 and may be downloaded at the EIA website. The latest available reliability data from EIA are for calendar year 2019.

The EIA collects SAIDI and SAIFI metrics with and without Major Event Days (MED). MED are often the result of ice storms, windstorms, wildfires, and hurricanes, and can materially affect annual reliability statistics. While reliability metrics that include MED can fluctuate greatly year-to-year, they provide a more accurate representation of customer experience in a given year than metrics excluding MED. For this reason, reliability data are presented with and without MED.

When looking at the figures in this report, it is worth understanding the statistical classification of MED: IEEE defines it as any day on which more than 10% of utility customers are without power. The result of this hard threshold is that sometimes reliability scores without MED may, in fact, be driven by major events. For example, in the case of storm recovery that lasts multiple days, the time toward the beginning of that recovery may be considered MED because more than 10% of utility customers are without power. However, the time near the end may not be considered MED because fewer than 10% of customers are without power—even though all the days of the outage were caused by the same event.

We computed SAIDI, SAIFI and CAIDI with and without MED by state using an average of the reporting utilities within each state, weighted by the number of customers served by each utility.

TABLE 4: RELIABILITY RANKINGS (ALPHABETICAL)

State	Average Duration of Power Outages: With Major Event Days (SAIDI)	Average Duration of Power Outages: Without Major Event Days (SAIDI)	Average Time to Restore Power Per Customer: With Major Event Days (CAIDI)	Average Time to Restore Power Per Customer: Without Major Event Days (CAIDI)	Average Frequency of Power Outages: With Major Event Days (SAIFI)	Average Frequency of Power Outages: Without Major Event Days (SAIFI)
Alabama	19	27	12	24	30	29
Alaska	33	43	22	39	49	46
Arizona	3	3	2	12	6	8
Arkansas	44	49	41	46	43	45
California	49	19	51	32	23	15
Colorado	20	12	29	20	15	13
Connecticut	23	44	46	51	8	16
Delaware	6	6	6	4	9	14
District of Columbia	1	1	19	26	1	1
Florida	5	7	1	2	13	18
Georgia	13	31	5	14	28	38
Hawaii	21	24	9	17	45	37
Idaho	15	35	13	27	22	33
Illinois	8	5	11	9	7	6
Indiana	30	38	26	35	36	36
Iowa	9	14	7	11	16	21
Kansas	25	26	30	21	27	26
Kentucky	22	39	10	18	40	43
Louisiana	46	45	43	40	48	48
Maine	51	47	50	38	50	49
Maryland	10	15	17	19	14	17
Massachusetts	28	17	39	28	21	12
Michigan	48	46	49	49	38	35
Minnesota	12	11	20	16	10	10
Mississippi	47	50	38	37	46	47
Missouri	29	23	31	25	24	23
Montana	16	29	8	15	26	39
Nebraska	2	2	14	23	2	2
Nevada	4	9	3	8	3	7
New Hampshire	36	48	33	48	31	40
New Jersey	26	13	28	3	19	20
New Mexico	17	33	18	29	20	27
New York	18	10	35	47	5	3
North Carolina	34	36	34	42	32	30
North Dakota	7	8	16	6	4	11
Ohio	39	37	37	36	33	32
Oklahoma	42	34	45	41	37	34
Oregon	31	18	40	45	11	4
Pennsylvania	27	30	32	33	25	25
Rhode Island	24	4	25	1	29	24
South Carolina	41	20	36	22	34	22
South Dakota	37	22	24	5	39	28
Tennessee	32	40	15	10	47	50
Texas	35	28	23	13	41	31
Utah	11	25	21	30	12	19
Vermont	45	41	42	31	44	44
Virginia	40	42	27	43	42	42
Washington	38	21	44	44	18	9
West Virginia	50	51	47	50	51	51
Wisconsin	43	16	48	34	17	5
Wyoming	14	32	4	7	35	41

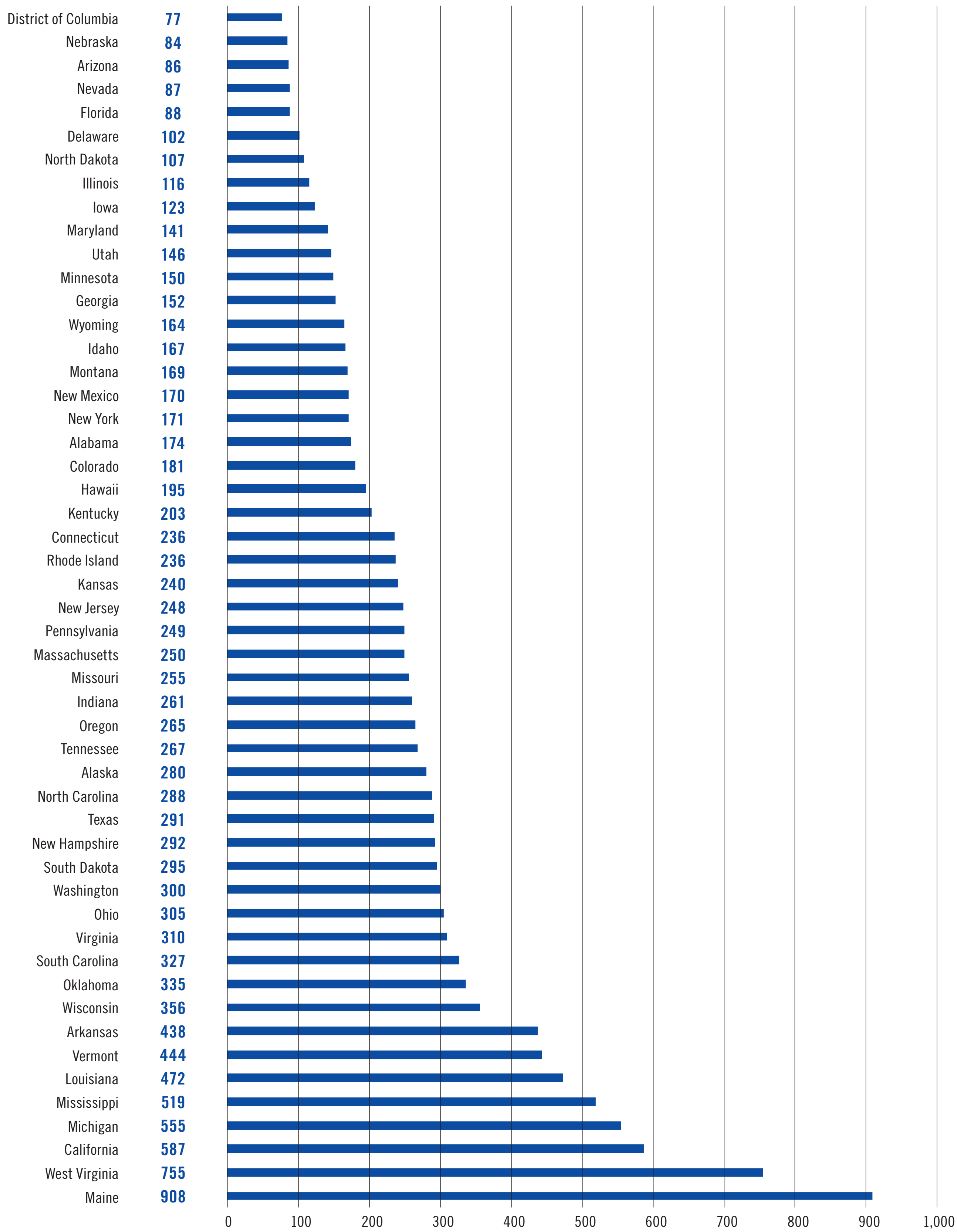
Source: EIA

TABLE 5: RELIABILITY RANKINGS (BEST-TO-WORST)

Rank Based on Average Performance	State	Average Duration of Power Outages		Average Time to Restore Power Per Customer		Average Frequency of Power Outages	
		With Major Event Days (SAIDI)	Without Major Event Days (SAIDI)	With Major Event Days (CAIDI)	Without Major Event Days (CAIDI)	With Major Event Days (SAIFI)	Without Major Event Days (SAIFI)
1	Nevada	4	9	3	8	3	7
1	Arizona	3	3	2	12	6	8
3	Nebraska	2	2	14	23	2	2
3	Delaware	6	6	6	4	9	14
5	Illinois	8	5	11	9	7	6
5	Florida	5	7	1	2	13	18
7	District of Columbia	1	1	19	26	1	1
8	North Dakota	7	8	16	6	4	11
9	Iowa	9	14	7	11	16	21
10	Minnesota	12	11	20	16	10	10
11	Maryland	10	15	17	19	14	17
12	Rhode Island	24	4	25	1	29	24
13	Colorado	20	12	29	20	15	13
13	New Jersey	26	13	28	3	19	20
15	Utah	11	25	21	30	12	19
15	New York	18	10	35	47	5	3
17	Georgia	13	31	5	14	28	38
18	Montana	16	29	8	15	26	39
18	Wyoming	14	32	4	7	35	41
20	Alabama	19	27	12	24	30	29
21	New Mexico	17	33	18	29	20	27
22	Idaho	15	35	13	27	22	33
22	Massachusetts	28	17	39	28	21	12
24	Oregon	31	18	40	45	11	4
25	Hawaii	21	24	9	17	45	37
27	South Dakota	37	22	24	5	39	28
27	Kansas	25	26	30	21	27	26
27	Missouri	29	23	31	25	24	23
29	Wisconsin	43	16	48	34	17	5
30	Texas	35	28	23	13	41	31
31	Pennsylvania	27	30	32	33	25	25
31	Kentucky	22	39	10	18	40	43
33	Washington	38	21	44	44	18	9
34	South Carolina	41	20	36	22	34	22
35	Connecticut	23	44	46	51	8	16
36	California	49	19	51	32	23	15
37	Tennessee	32	40	15	10	47	50
38	Indiana	30	38	26	35	36	36
39	North Carolina	34	36	34	42	32	30
40	Ohio	39	37	37	36	33	32
41	Alaska	33	43	22	39	49	46
42	Oklahoma	42	34	45	41	37	34
43	New Hampshire	36	48	33	48	31	40
43	Virginia	40	42	27	43	42	42
45	Vermont	45	41	42	31	44	44
46	Michigan	48	46	49	49	38	35
46	Mississippi	47	50	38	37	46	47
48	Arkansas	44	49	41	46	43	45
49	Louisiana	46	45	43	40	48	48
50	Maine	51	47	50	38	50	49
51	West Virginia	50	51	47	50	51	51

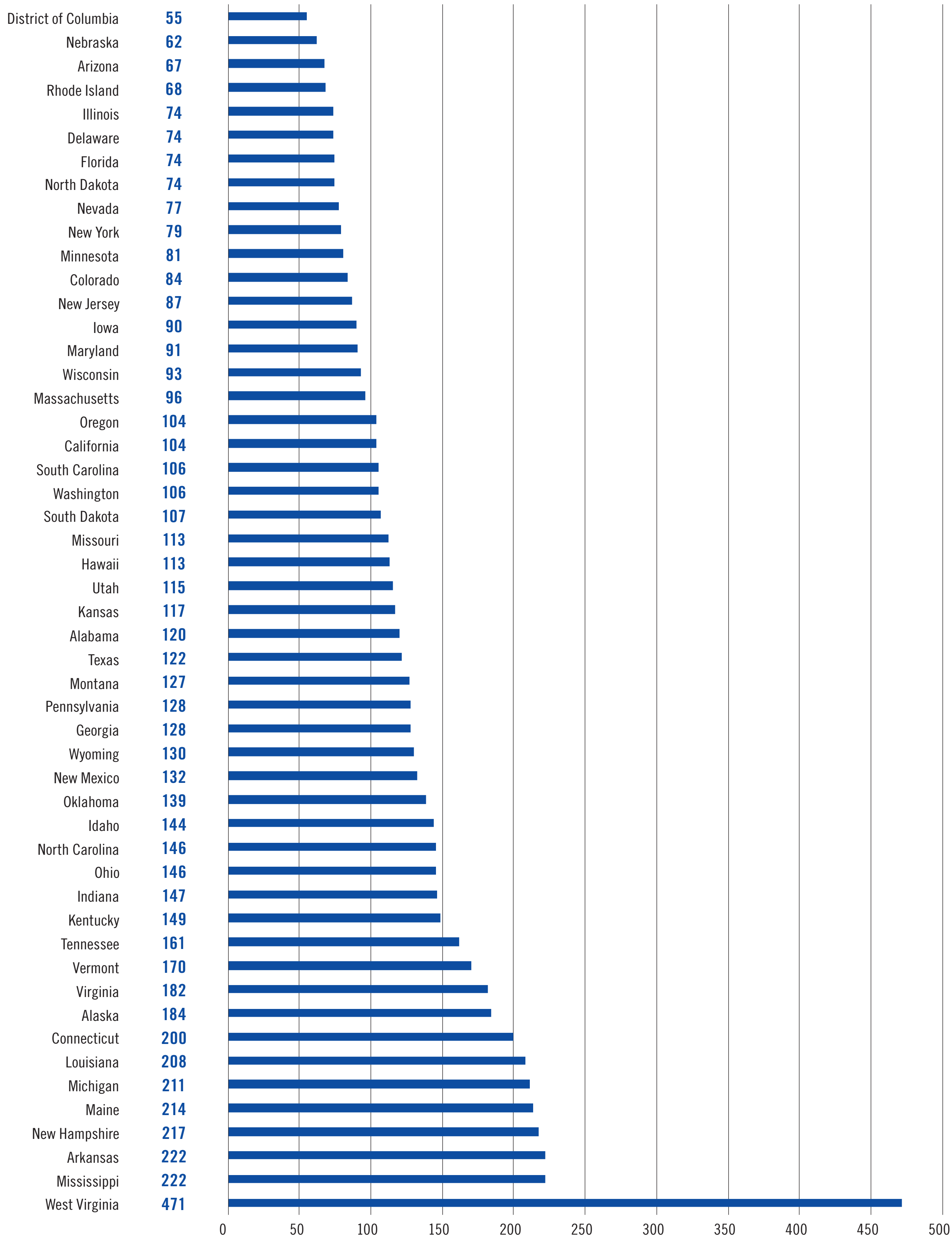
Source: EIA

FIGURE 7: AVERAGE DURATION OF POWER OUTAGES PER YEAR PER CUSTOMER, IN MINUTES (SAIDI) WITH MAJOR EVENT DAYS



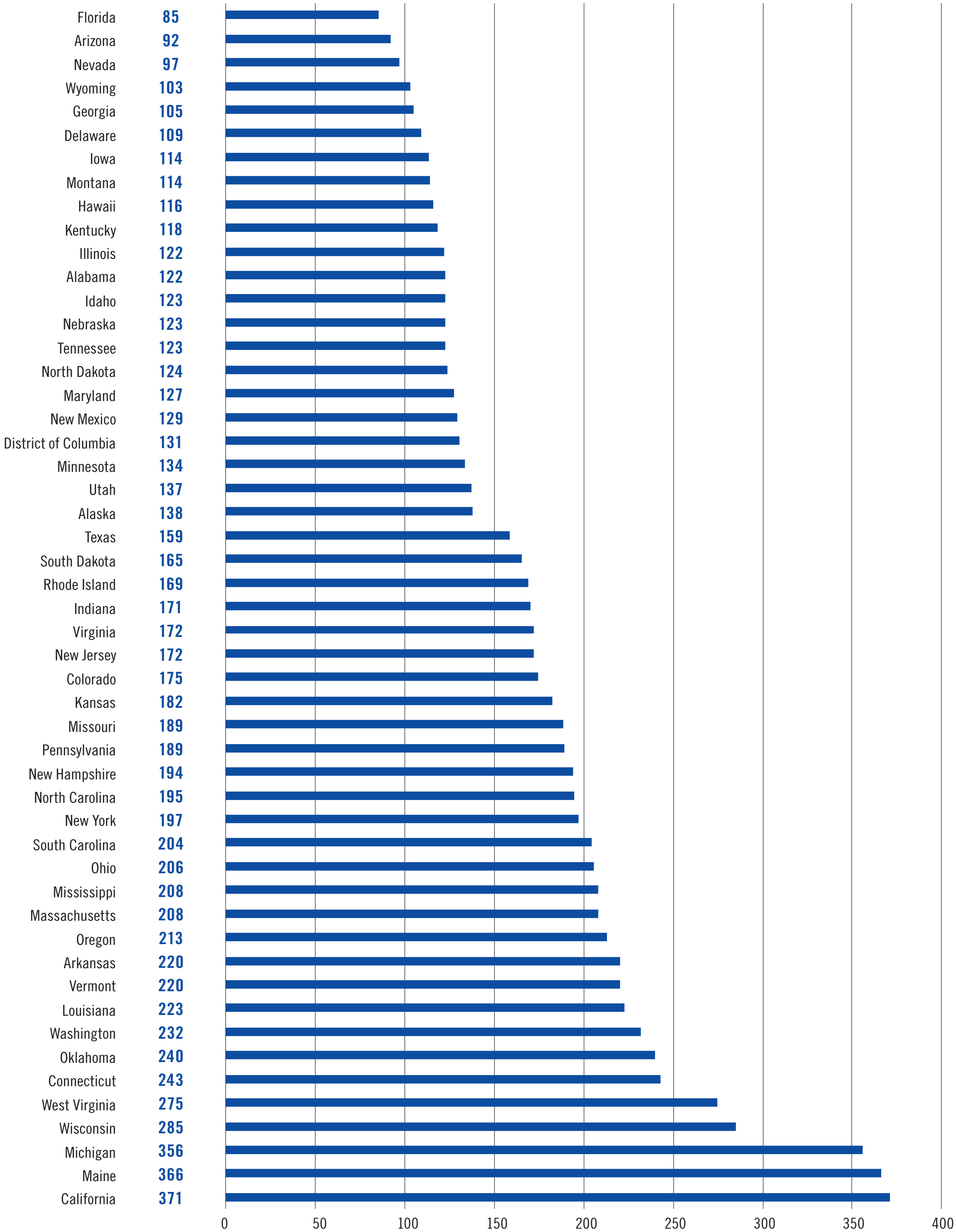
Source: EIA

FIGURE 8: AVERAGE DURATION OF POWER OUTAGES PER YEAR PER CUSTOMER, IN MINUTES (SAIDI)
WITHOUT MAJOR EVENT DAYS



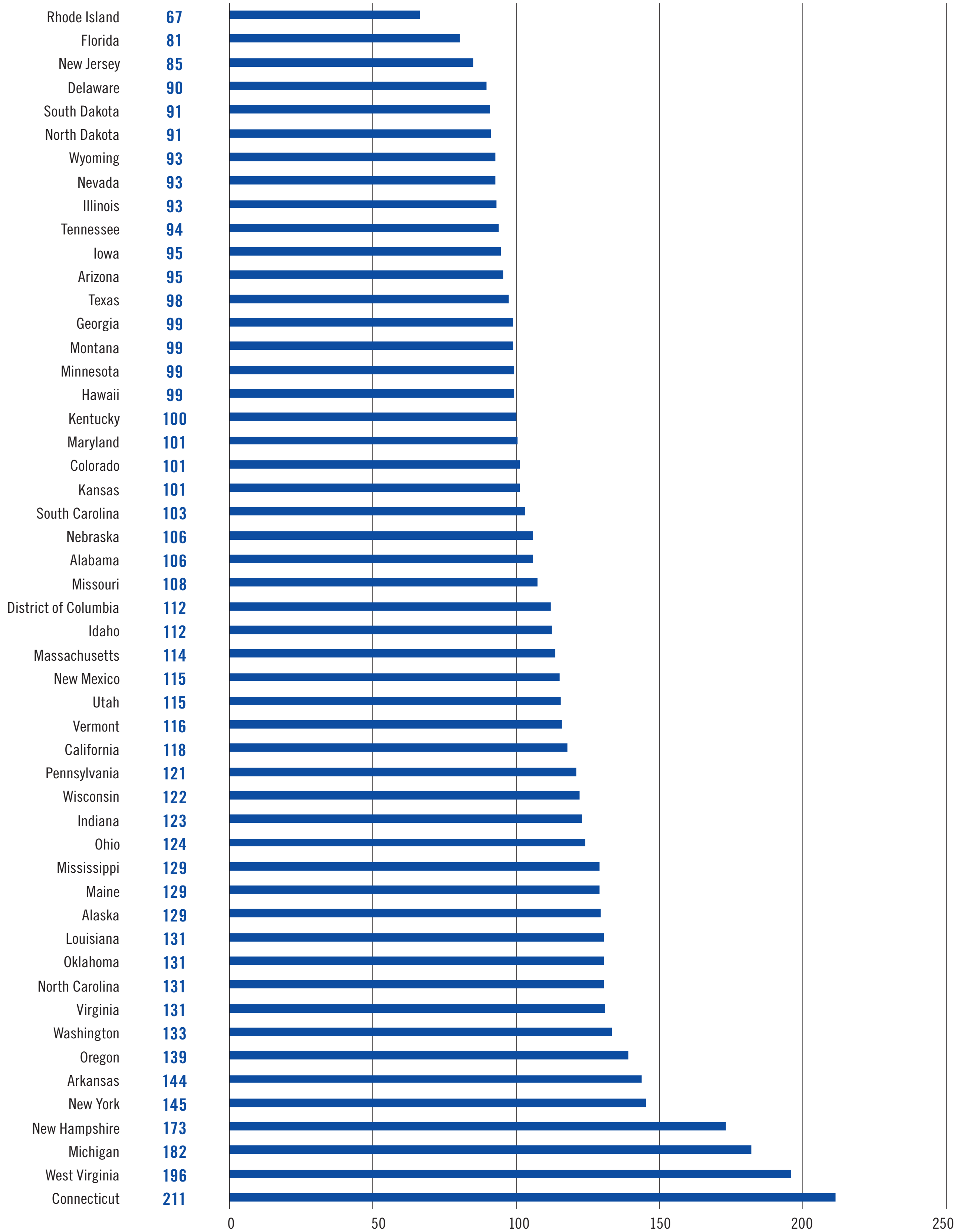
Source: EIA

FIGURE 9: AVERAGE AMOUNT OF TIME TO RESTORE POWER PER CUSTOMER, IN MINUTES (CAIDI) WITH MAJOR EVENT DAYS



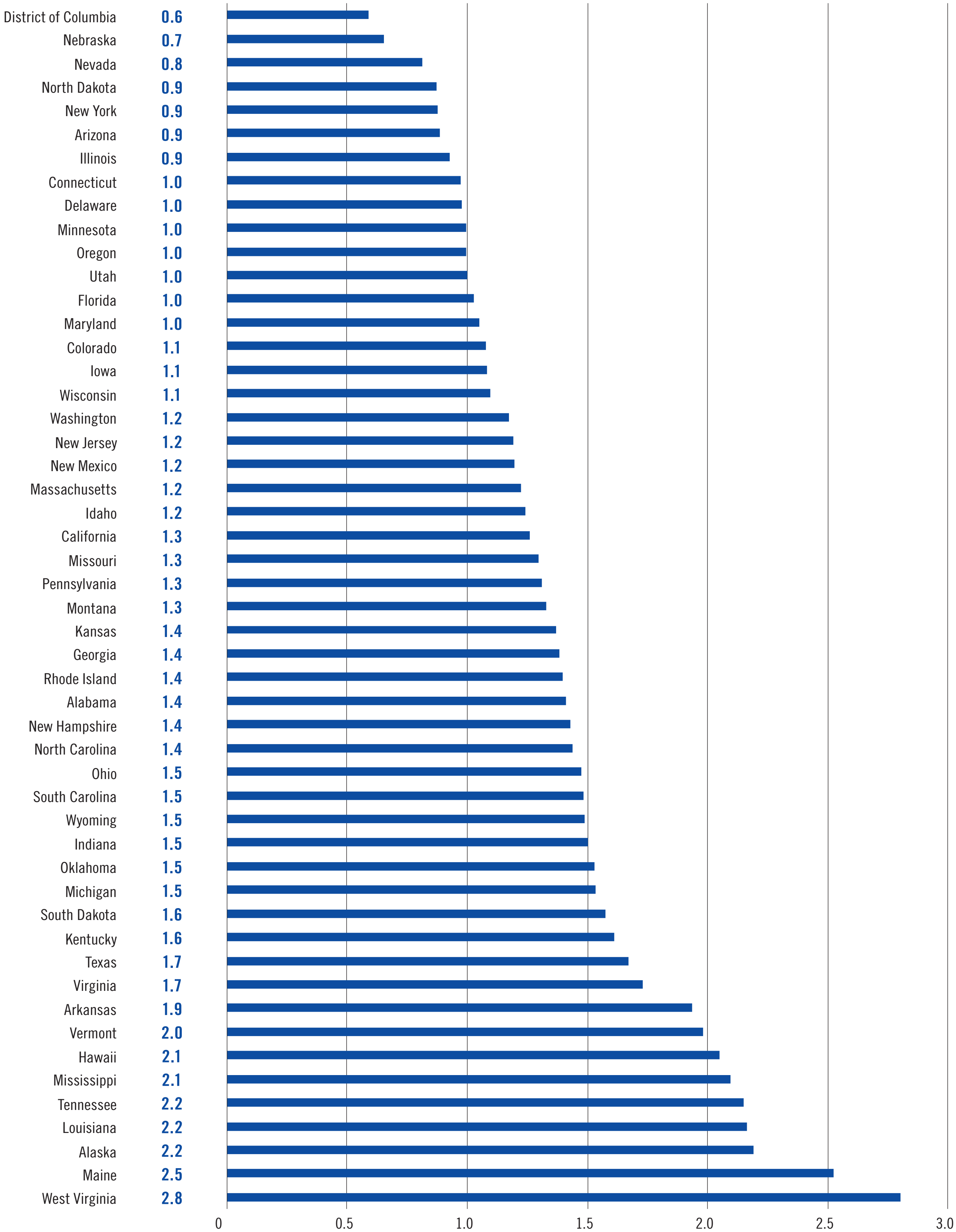
Source: EIA

FIGURE 10: AVERAGE AMOUNT OF TIME TO RESTORE POWER PER CUSTOMER, IN MINUTES (CAIDI) WITHOUT MAJOR EVENT DAYS



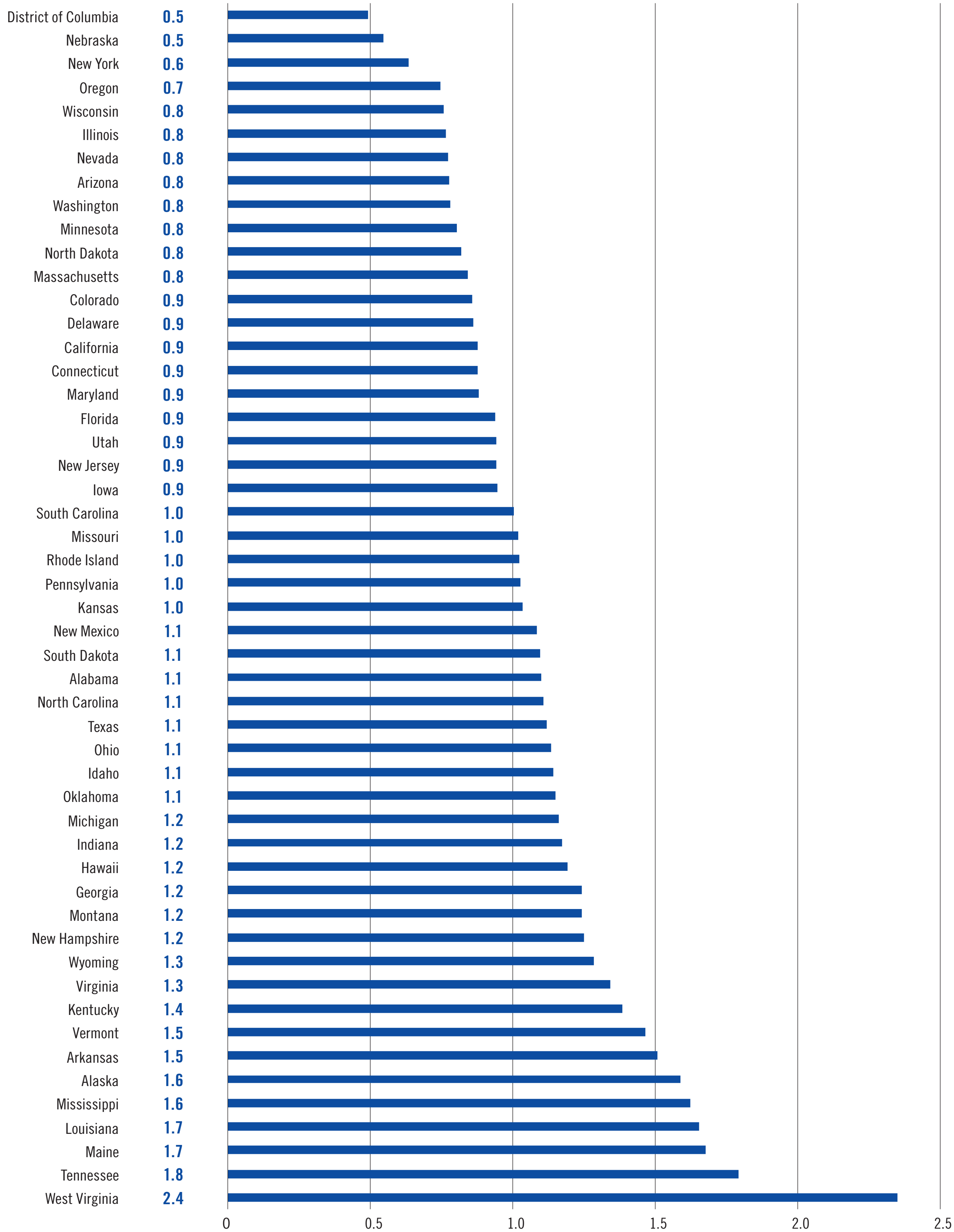
Source: EIA

FIGURE 11: AVERAGE FREQUENCY OF POWER OUTAGES PER CUSTOMER, IN NUMBER OF OUTAGES (SAIFI) WITH MAJOR EVENT DAYS



Source: EIA

FIGURE 12: AVERAGE FREQUENCY OF POWER OUTAGES PER CUSTOMER, IN NUMBER OF OUTAGES (SAIFI) WITHOUT MAJOR EVENT DAYS



Source: EIA

Environmental Metrics

This section of the report compares states by the sources of electricity that power them, and it ranks states according to the emissions of key pollutants by power plants. The data come from the EIA's State Energy Data System (SEDS) database as well as state electricity profiles.

Electric utilities report emissions of key pollutants from each power plant to the Environmental Protection Agency (EPA), which compiles this information and makes it available to the EIA. 2019 is the most recent data available.

ELECTRICITY SOURCES

The electricity grid interconnects states and generation resources such that at any given time customers cannot know precisely where their electricity is coming from. For example, the power could originate at an in-state windfarm or at a coal plant across state lines.

Figures 13 through 18 show each state's renewable and clean generation, in terawatt-hours, and the states' clean and renewable generation and imports as a percentage of electricity sales. In this report, renewable resources are defined as: hydroelectric, utility-scale solar, wind, geothermal and biomass. The definition of clean resources, meanwhile, includes all renewable resources, except for biomass, and with the addition of nuclear. While Biomass is considered a renewable resource (it comprises a variety of organic sources that can be regrown and is technically net-zero emissions), it is not considered a clean resource. That is because it produces substantial emissions when burned, which may contaminate the atmosphere at the site of burning.

Some states with largely clean and renewable generation mixes import electricity generated with fossil fuels from out of state to meet their energy demands. This is the case for Idaho, which has a 79% renewable generation mix, but renewable generation is only 54% (Figure 17) of the state's electricity sales.

States on the US border with Canada may import hydropower across the international border, which contributes to the percentage of renewables in their electricity sales. Vermont, a small state, brings almost three times its domestic electricity needs into the state from Canada and resells that hydropower to adjacent states (Figure 15).

The Figure 19 map illustrates where states rank in fossil fuel generation and imports. Note that states with a high percentage of fossil fuels in their energy mix (Indiana, Kentucky, West Virginia) often rank below-average in affordability metrics, raising questions about claims that traditional generation tends to be more affordable for consumers.

EMISSIONS

Emissions of pollutants into the atmosphere is the most ubiquitous and important pathway through which power generation affects the environment. Power plants produce many pollutants, but the largest quantities with arguably the most detrimental effects are from these gases:

- Carbon dioxide (CO2) is the principal gas causing climate change, and can reduce cognitive function. (Figure 20)
- Sulfur dioxide (SO2) causes acid rain, asthma attacks and cardiopulmonary diseases. It also is a chemical precursor to the formation of small particles that cause respiratory problems, miscarriages and birth defects. (Figure 21)
- Nitrogen oxides (NOx) cause respiratory problems, including wheezing and asthma, as well as numerous other health problems as a chemical precursor to the formation of small particles and ozone in the air. (Figure 22)

Effects on the environment and human health can be determined by the quantity of pollution released and, in the cases of sulfur dioxide and nitrogen oxides, by location relative to human population and natural resources. However, as a measure of overall utility performance, it is most appropriate to also consider "intensity"—emissions per unit of power generated (Figures 23-25). So, for example, while Texas's electricity sector produces the most emissions of all pollutants by a wide margin, its emissions intensity for all pollutants is around the median.

Pollution quantities are in metric tons (approximately 2,200 pounds per metric ton), pollution rates are in metric tons per gigawatt-hour (million kilowatt-hours) of electricity generated. For the pollution-related figures that follow, lower numbers signify better performance.

TABLE 6: ENVIRONMENTAL RANKINGS (ALPHABETICAL)

State	Carbon Dioxide Emissions From the Electricity Generation per Gigawatt Hour	Carbon Dioxide Emissions From the Electric Sector	Sulfur Dioxide and Nitrogen Oxide Emissions From Electricity Generation per Gigawatt Hour	Sulfur Dioxide and Nitrogen Oxide Emissions From the Electric Sector	Renewable Electricity Generation	Renewable Generation and Imports, as a % of Sales	Clean Electricity Generation	Clean Generation and Imports, as a % of Sales
Alabama	20	40	18	34	14	22	9	16
Alaska	38	9	46	19	45	17	46	32
Arizona	23	37	18	31	19	23	11	17
Arkansas	35	32	37	36	34	29	23	27
California	8	36	14	29	3	12	3	23
Colorado	41	33	26	23	12	20	29	36
Connecticut	10	12	4	7	48	44	28	14
Delaware	34	6	12	4	50	50	50	50
District of Columbia	42	2	26	1	51	51	51	51
Florida	27	50	16	44	22	45	16	40
Georgia	26	41	29	42	18	34	13	34
Hawaii	47	10	50	25	47	28	48	45
Idaho	3	5	22	10	15	8	30	18
Illinois	18	46	24	43	10	31	2	6
Indiana	48	49	41	46	28	37	38	47
Iowa	31	30	36	33	6	10	15	13
Kansas	28	20	17	17	8	9	17	8
Kentucky	49	45	43	43	35	40	42	48
Louisiana	32	39	39	44	38	47	24	41
Maine	5	3	42	13	27	2	41	10
Maryland	16	14	19	16	41	42	25	31
Massachusetts	25	11	22	10	37	38	45	46
Michigan	33	43	40	47	23	26	14	24
Minnesota	29	25	31	27	13	15	20	19
Mississippi	22	23	19	22	46	46	39	37
Missouri	46	44	45	45	33	36	34	39
Montana	40	17	41	23	17	5	33	5
Nebraska	43	21	45	33	24	19	27	20
Nevada	19	15	19	14	20	16	36	29
New Hampshire	2	4	4	6	42	24	35	1
New Jersey	12	18	7	11	43	48	21	26
New Mexico	39	19	25	15	26	14	37	28
New York	7	22	11	26	5	13	6	12
North Carolina	21	38	31	41	9	27	8	25
North Dakota	44	29	47	35	11	7	26	11
Ohio	37	47	40	48	40	49	22	43
Oklahoma	14	27	14	22	7	11	18	21
Oregon	6	13	18	17	4	6	12	7
Pennsylvania	17	48	20	45	25	41	5	15
Rhode Island	24	7	10	4	49	39	49	49
South Carolina	11	24	14	23	29	35	7	9
South Dakota	9	8	6	6	16	3	32	4
Tennessee	15	26	19	23	21	30	10	22
Texas	30	51	30	51	1	21	1	33
Utah	45	28	37	27	36	25	43	42
Vermont	1	1	21	2	44	1	47	2
Virginia	13	31	17	28	30	43	19	35
Washington	4	16	14	25	2	4	4	3
West Virginia	50	42	40	38	39	32	44	44
Wisconsin	36	34	29	28	32	33	31	38
Wyoming	51	35	45	35	31	18	40	30

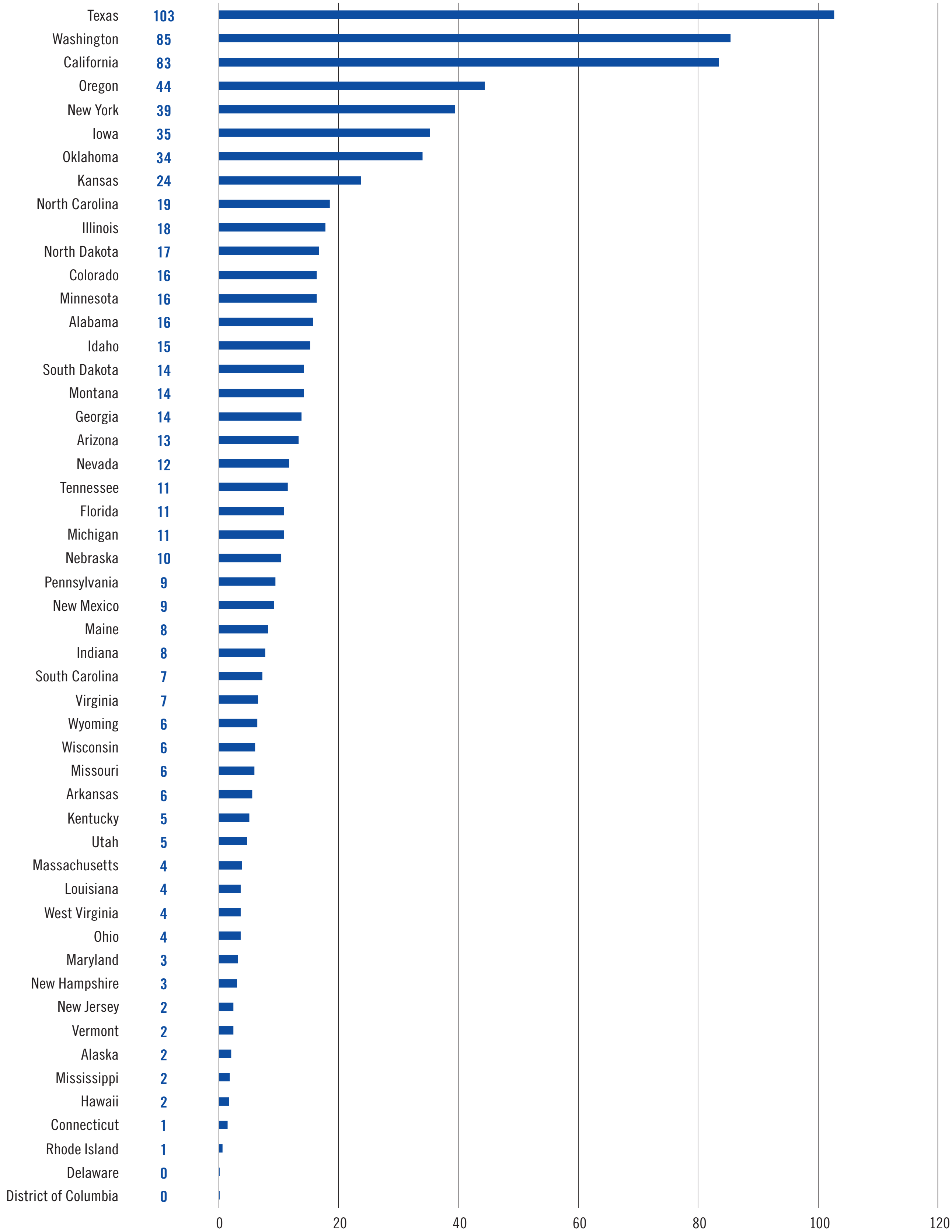
Source: EIA

TABLE 7: ENVIRONMENTAL RANKINGS (BEST-TO-WORST)

Rank Based on Average Performance	State	Carbon Dioxide Emissions From the Electricity Generation per Gigawatt Hour	Carbon Dioxide Emissions From the Electric Sector	Sulfur Dioxide and Nitrogen Oxide Emissions From Electricity Generation per Gigawatt Hour	Sulfur Dioxide and Nitrogen Oxide Emissions From the Electric Sector	Renewable Electricity Generation	Renewable Generation and Imports, as a % of Sales	Clean Electricity Generation	Clean Generation and Imports, as a % of Sales
1	Washington	4	16	14	25	2	4	4	3
2	Oregon	6	13	18	17	4	6	12	7
3	South Dakota	9	8	6	6	16	3	32	4
4	New York	7	22	11	26	5	13	6	12
5	Idaho	3	5	22	10	15	8	30	18
6	New Hampshire	2	4	4	6	42	24	35	1
7	Vermont	1	1	21	2	44	1	47	2
8	Kansas	28	20	17	17	8	9	17	8
9	California	8	36	14	29	3	12	3	23
10	Oklahoma	14	27	14	22	7	11	18	21
11	Maine	5	3	42	13	27	2	41	10
12	South Carolina	11	24	14	23	29	35	7	9
13	Tennessee	15	26	19	23	21	30	10	22
14	Connecticut	10	12	4	7	48	44	28	14
15	Nevada	19	15	19	14	20	16	36	29
16	Alabama	20	40	18	34	14	22	9	16
17	Iowa	31	30	36	33	6	10	15	13
18	Arizona	23	37	18	31	19	23	11	17
19	Minnesota	29	25	31	27	13	15	20	19
20	Illinois	18	46	24	43	10	31	2	6
21	Montana	40	17	41	23	17	5	33	5
22	New Jersey	12	18	7	11	43	48	21	26
23	North Carolina	21	38	31	41	9	27	8	25
24	New Mexico	39	19	25	15	26	14	37	28
25	Maryland	16	14	19	16	41	42	25	31
26	North Dakota	44	29	47	35	11	7	26	11
27	Pennsylvania	17	48	20	45	25	41	5	15
28	Virginia	13	31	17	28	30	43	19	35
29	Texas	30	51	30	51	1	21	1	33
30	Colorado	41	33	26	23	12	20	29	36
31	Rhode Island	24	7	10	4	49	39	49	49
32	Nebraska	43	21	45	33	24	19	27	20
33	Massachusetts	25	11	22	10	37	38	45	46
34	Georgia	26	41	29	42	18	34	13	34
35	Michigan	33	43	40	47	23	26	14	24
36	Alaska	38	9	46	19	45	17	46	32
37	Arkansas	35	32	37	36	34	29	23	27
38	Mississippi	22	23	19	22	46	46	39	37
39	Delaware	34	6	12	4	50	50	50	50
40	Florida	27	50	16	44	22	45	16	40
41	Wisconsin	36	34	29	28	32	33	31	38
42	District of Columbia	42	2	26	1	51	51	51	51
43	Utah	45	28	37	27	36	25	43	42
44	Wyoming	51	35	45	35	31	18	40	30
45	Hawaii	47	10	50	25	47	28	48	45
46	Louisiana	32	39	39	44	38	47	24	41
47	Missouri	46	44	45	45	33	36	34	39
48	Ohio	37	47	40	48	40	49	22	43
49	West Virginia	50	42	40	38	39	32	44	44
50	Indiana	48	49	41	46	28	37	38	47
51	Kentucky	49	45	43	43	35	40	42	48

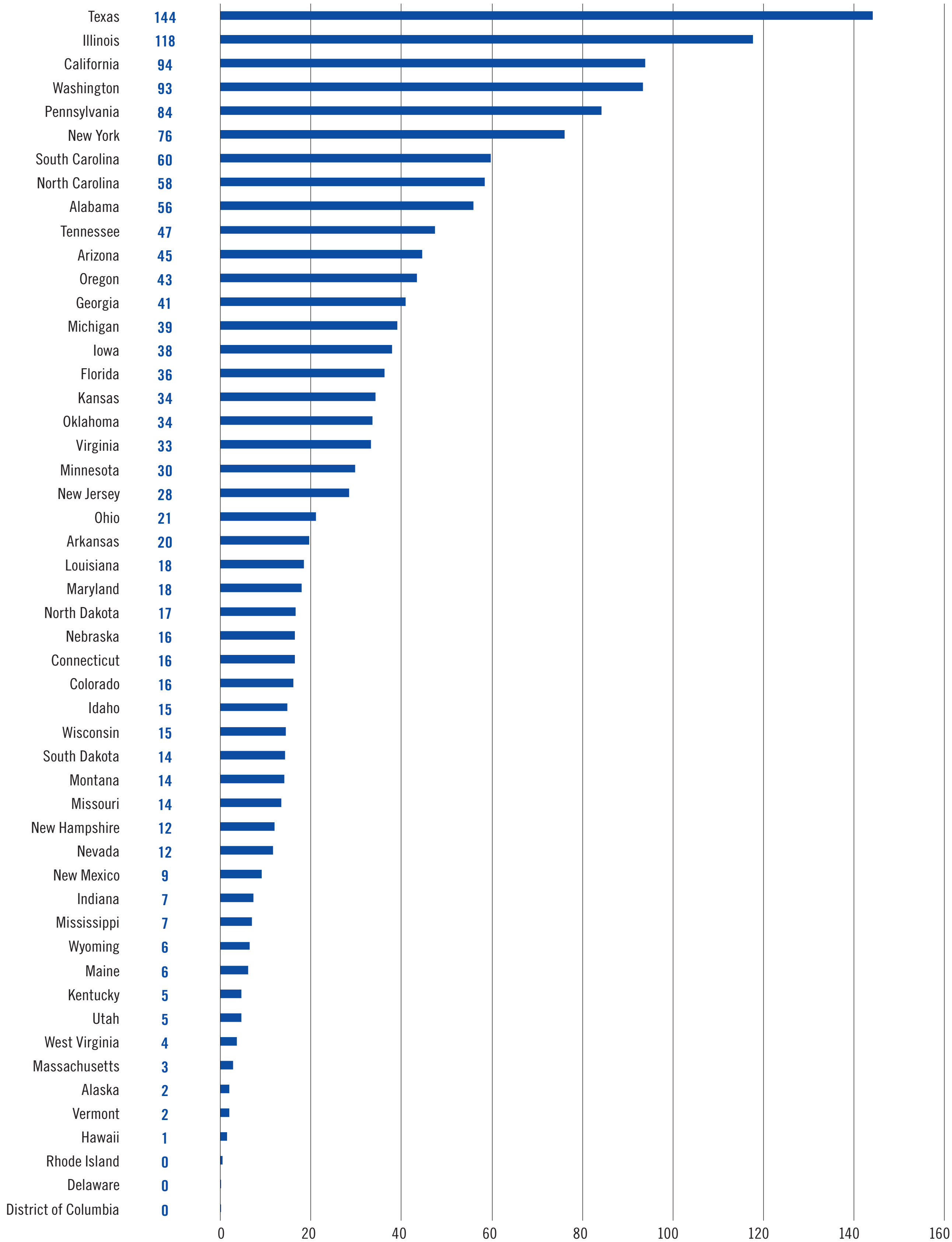
Source: EIA

FIGURE 13: 2020 RENEWABLE ELECTRICITY GENERATION, IN TERAWATT-HOURS



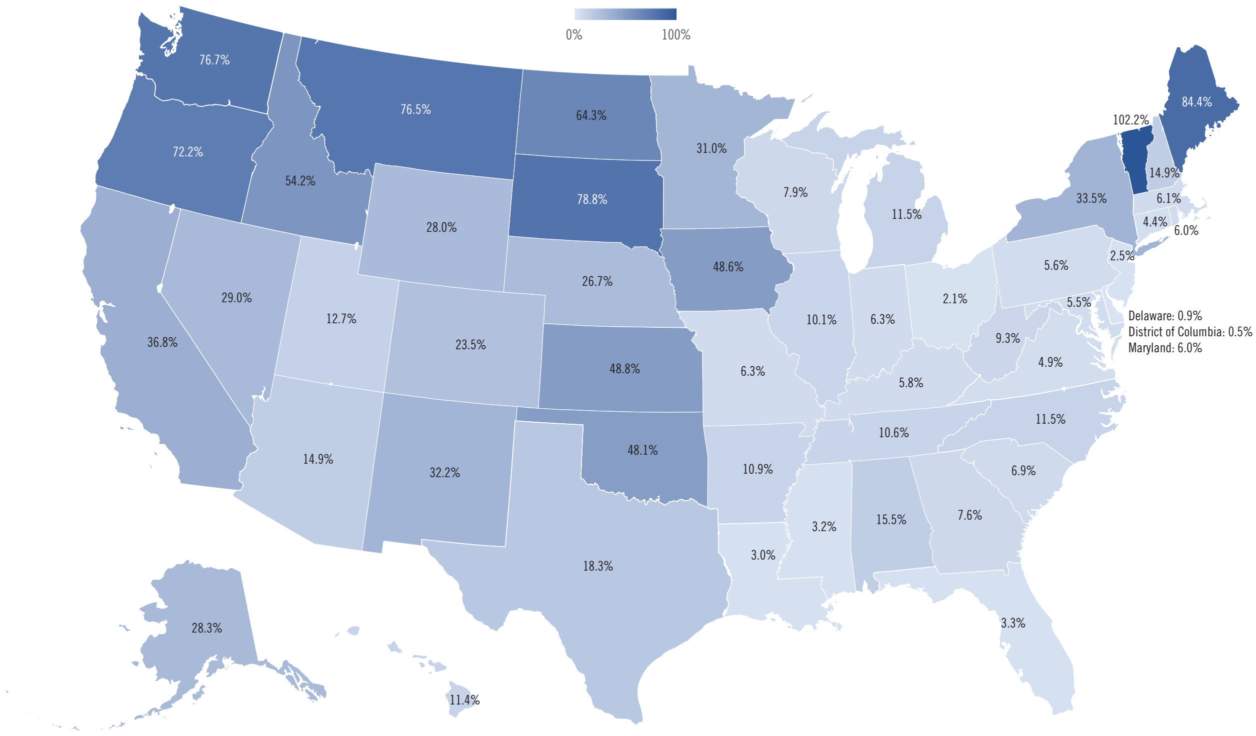
Source: EIA

FIGURE 14: 2020 CLEAN ELECTRICITY GENERATION, IN TERAWATT-HOURS



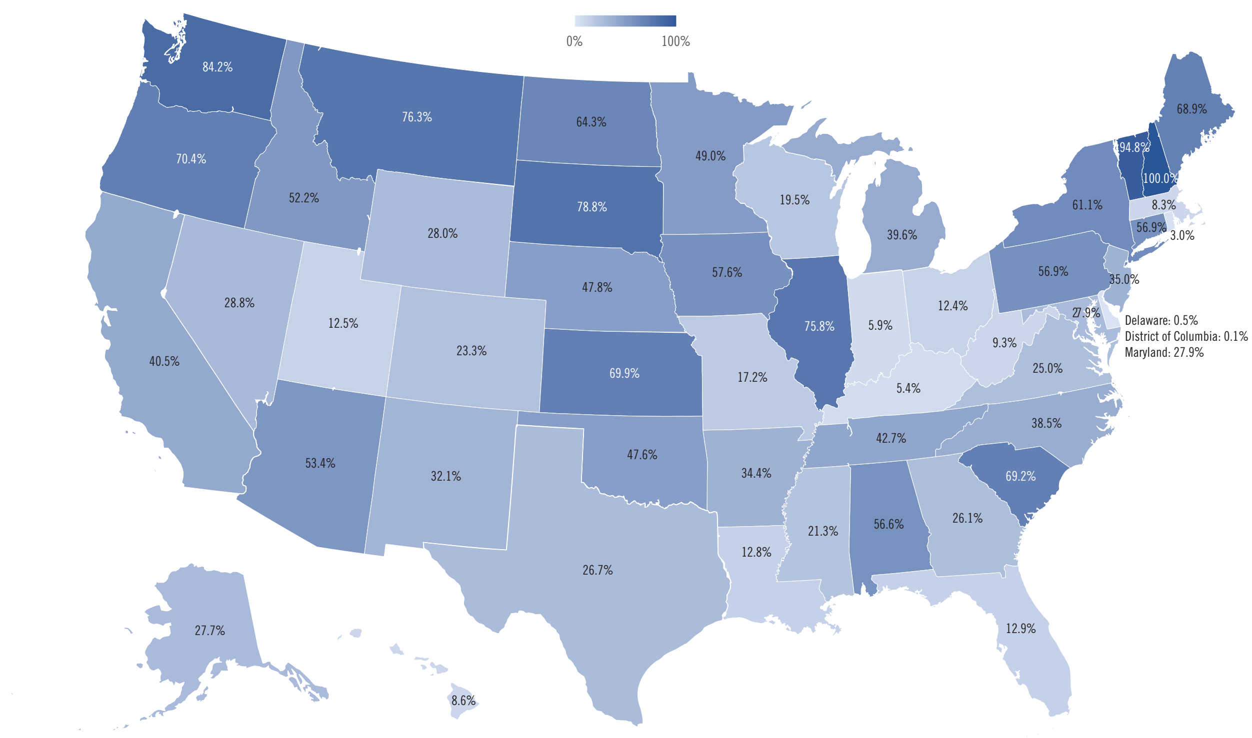
Source: EIA

FIGURE 15: MAP OF 2019 RENEWABLE ELECTRICITY GENERATION AND RENEWABLE IMPORTS, AS A PERCENTAGE OF SALES



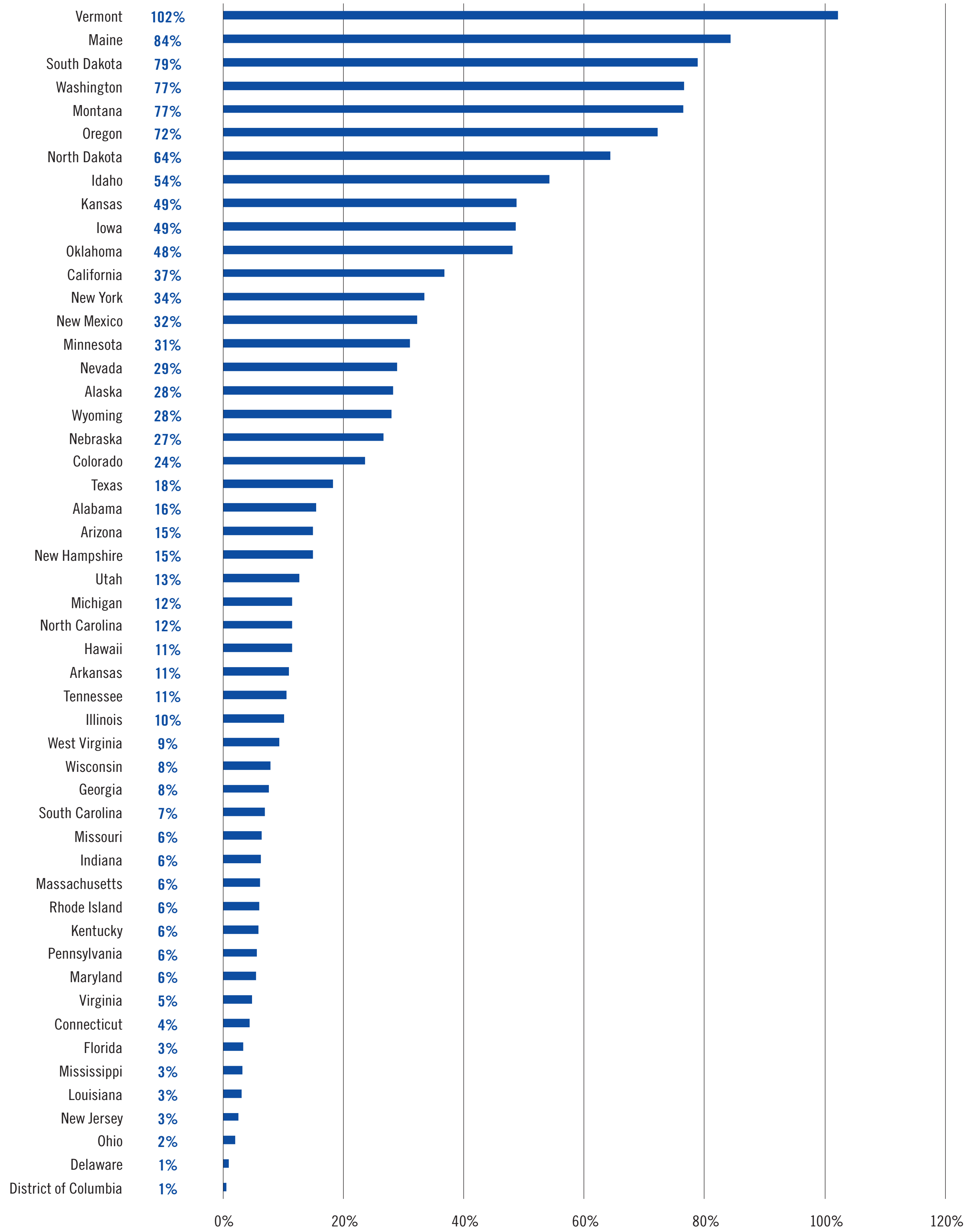
Source: EIA

FIGURE 16: MAP OF 2019 CLEAN ELECTRICITY GENERATION AND CLEAN IMPORTS, AS A PERCENTAGE OF SALES



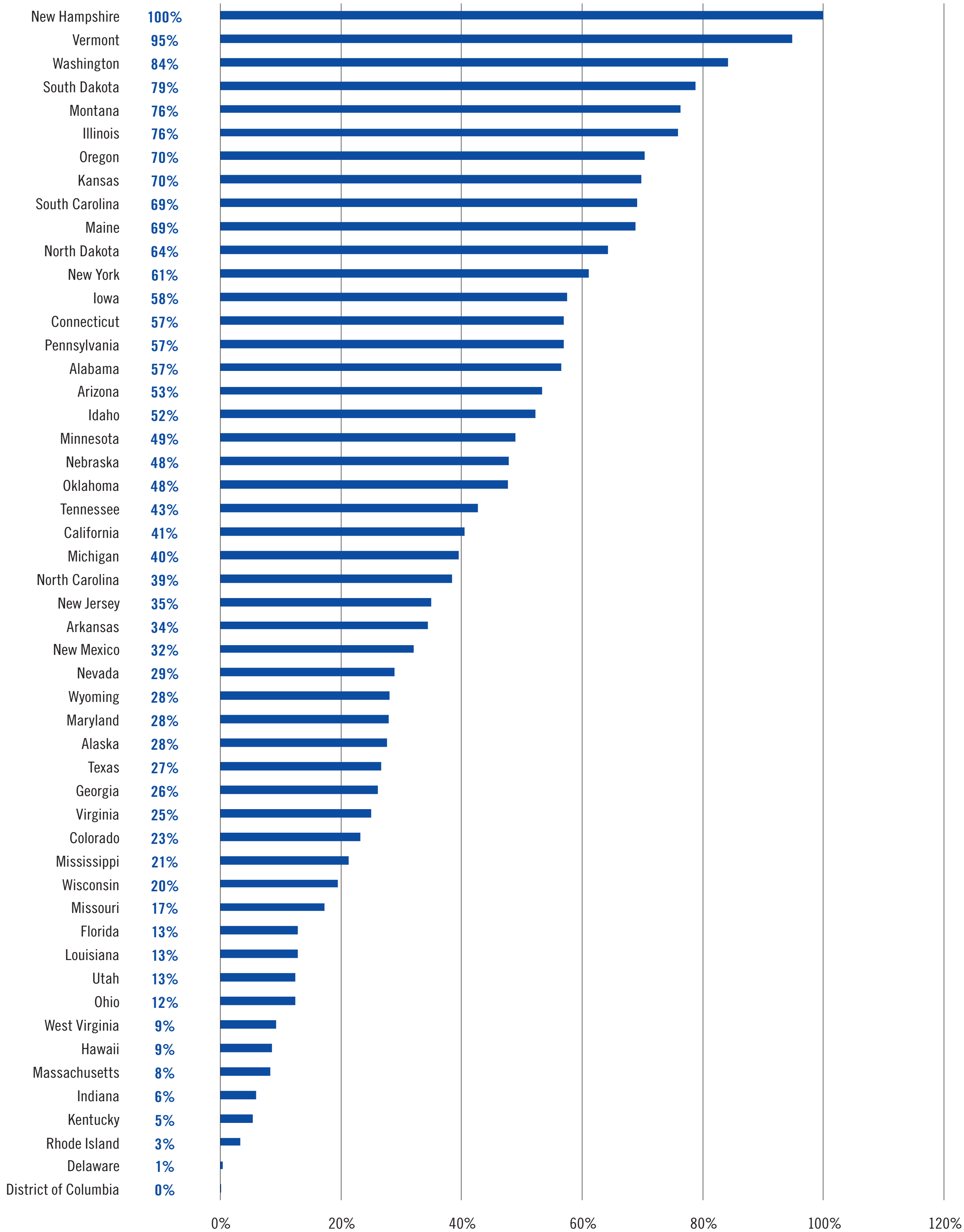
Source: EIA

FIGURE 17: 2019 RENEWABLE ELECTRICITY GENERATION AND RENEWABLE IMPORTS, AS A PERCENTAGE OF SALES



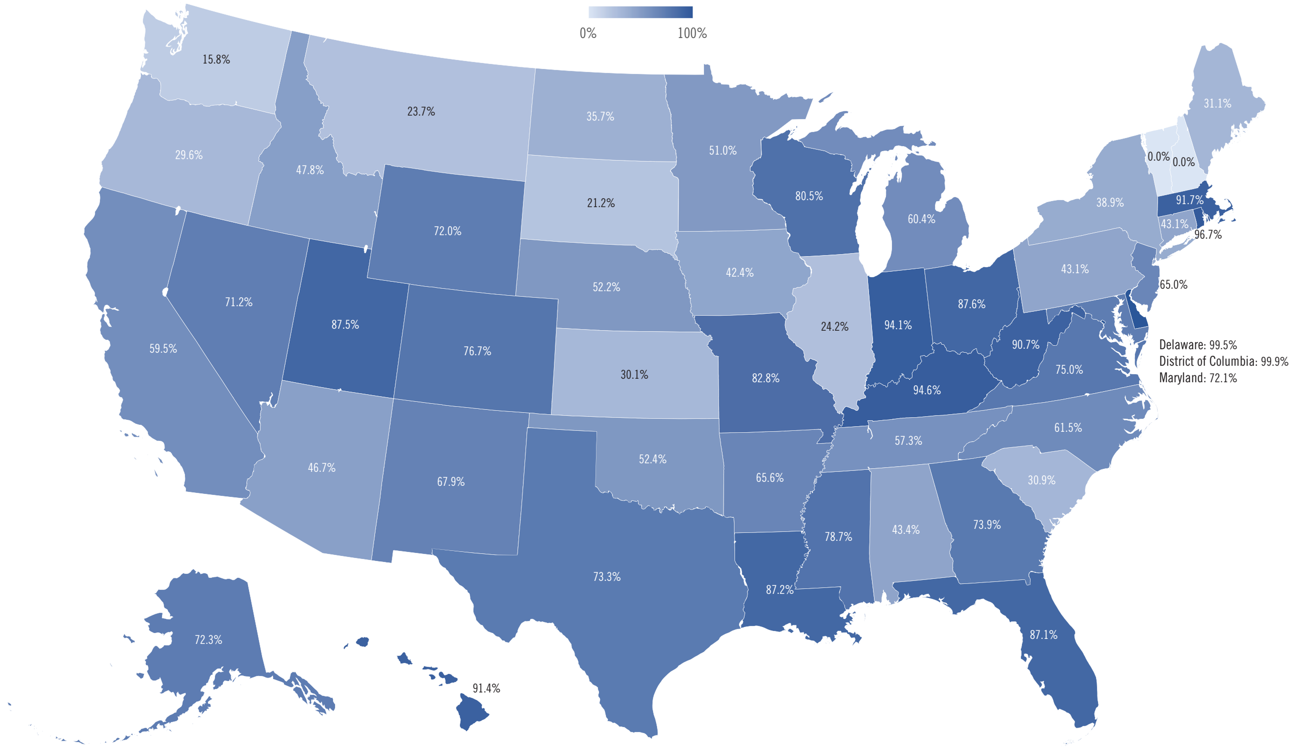
Source: EIA

FIGURE 18: 2019 CLEAN ELECTRICITY GENERATION AND CLEAN IMPORTS, AS A PERCENTAGE OF SALES



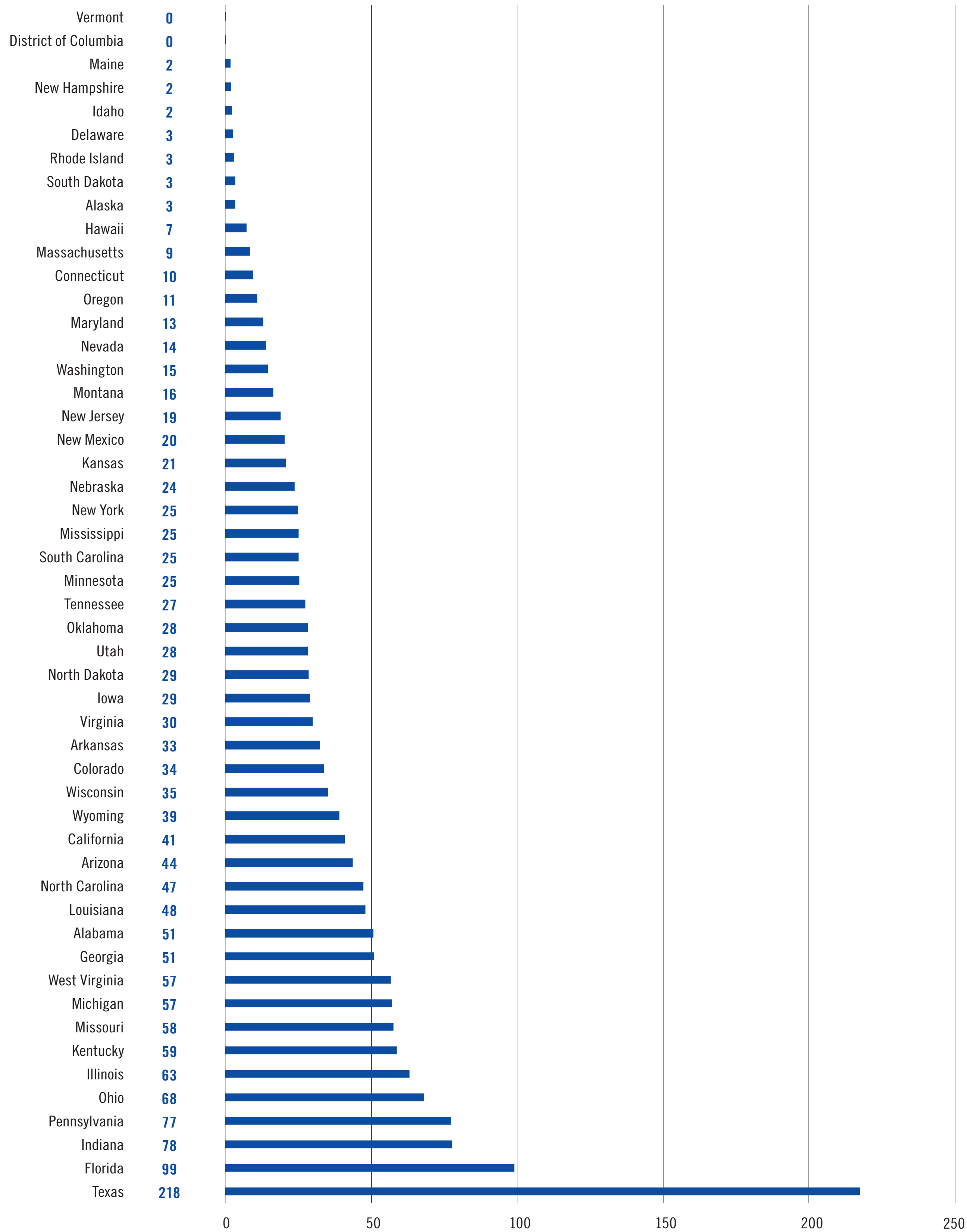
Source: EIA

FIGURE 19: MAP OF 2019 FOSSIL ELECTRICITY GENERATION AND FOSSIL IMPORTS, AS A PERCENTAGE OF SALES



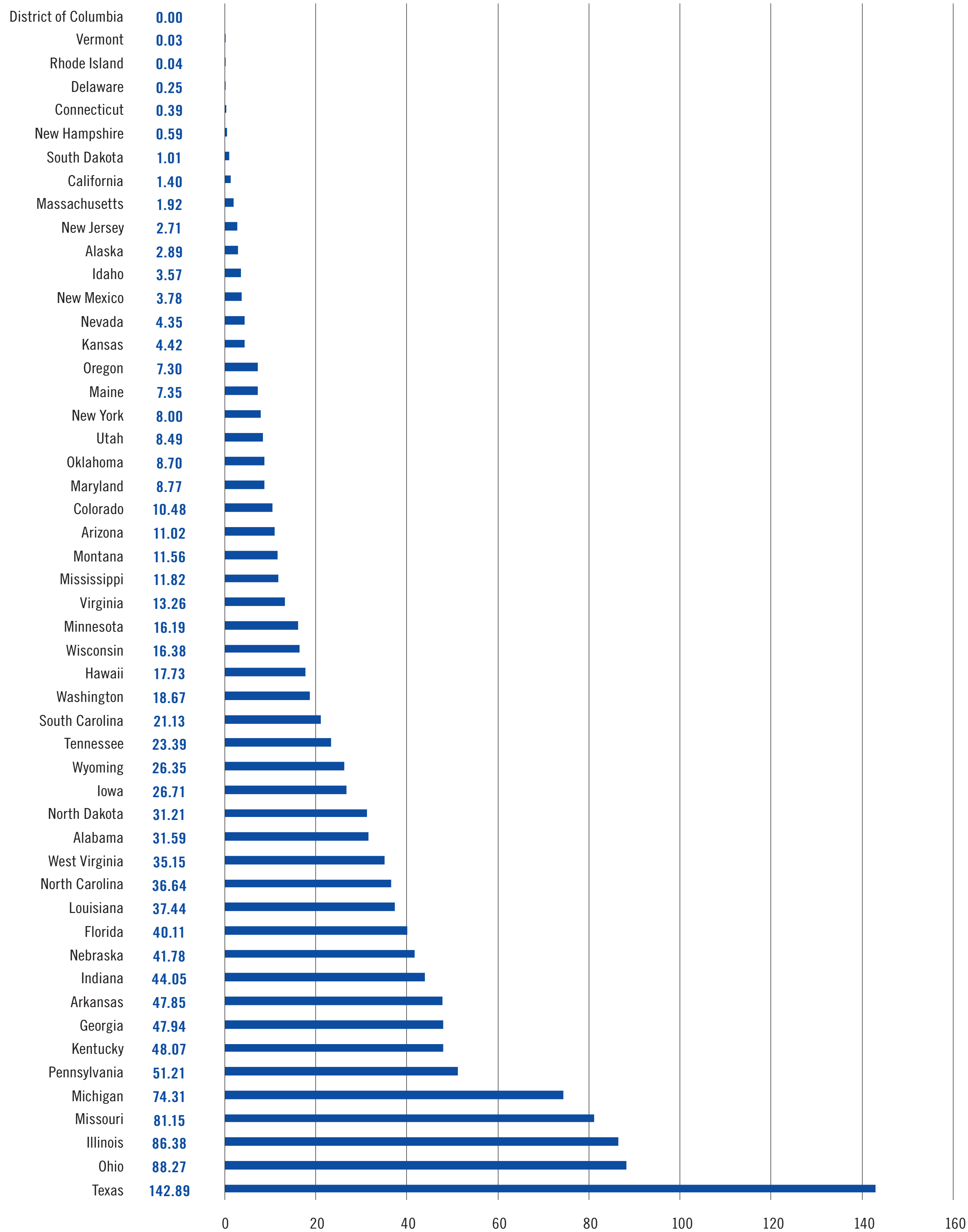
Source: EIA

FIGURE 20: 2019 CARBON DIOXIDE EMISSIONS FROM THE ELECTRIC SECTOR, IN MILLIONS OF METRIC TONS



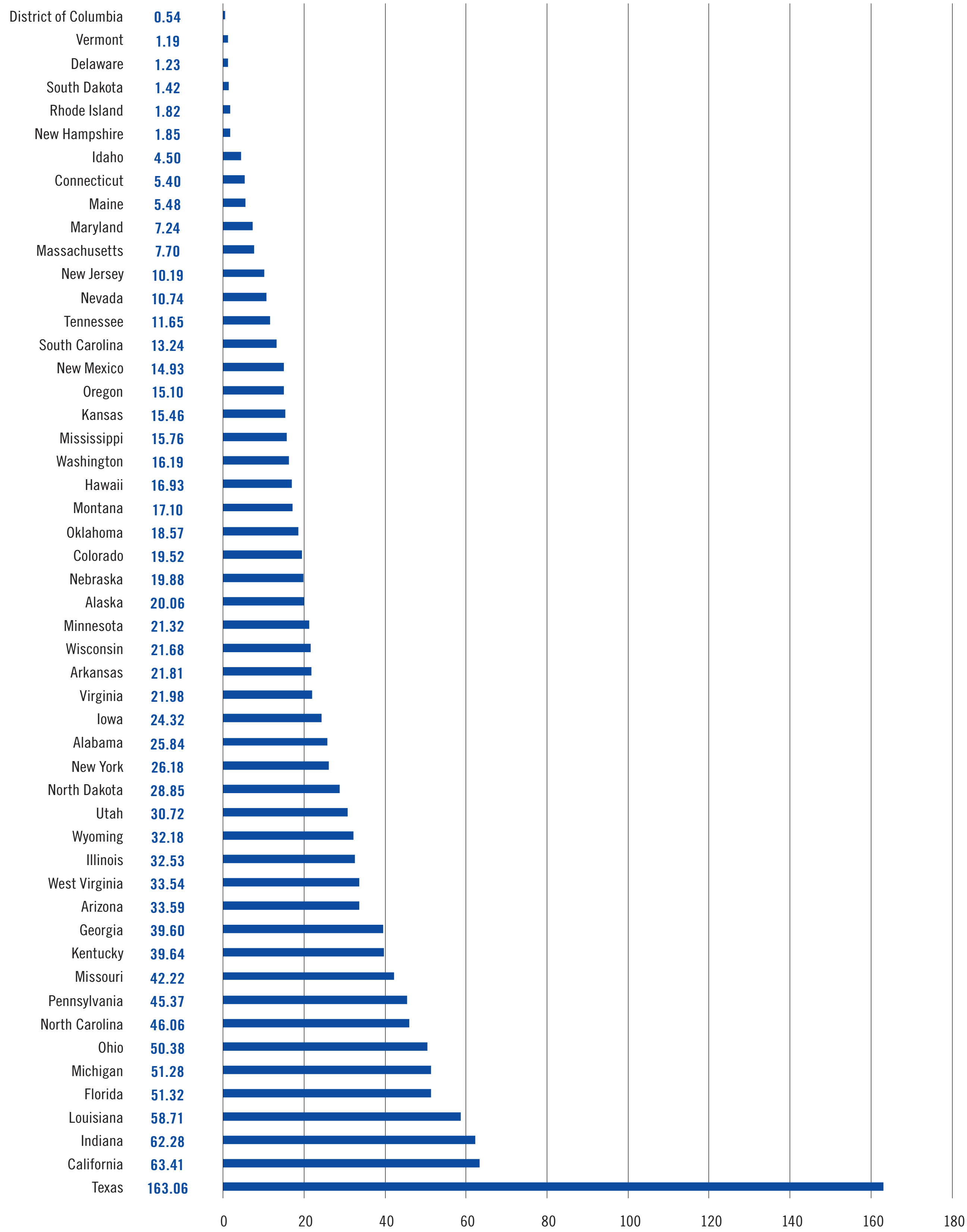
Source: EIA

FIGURE 21: 2019 SULFUR DIOXIDE EMISSIONS FROM THE ELECTRIC SECTOR, IN THOUSANDS OF METRIC TONS



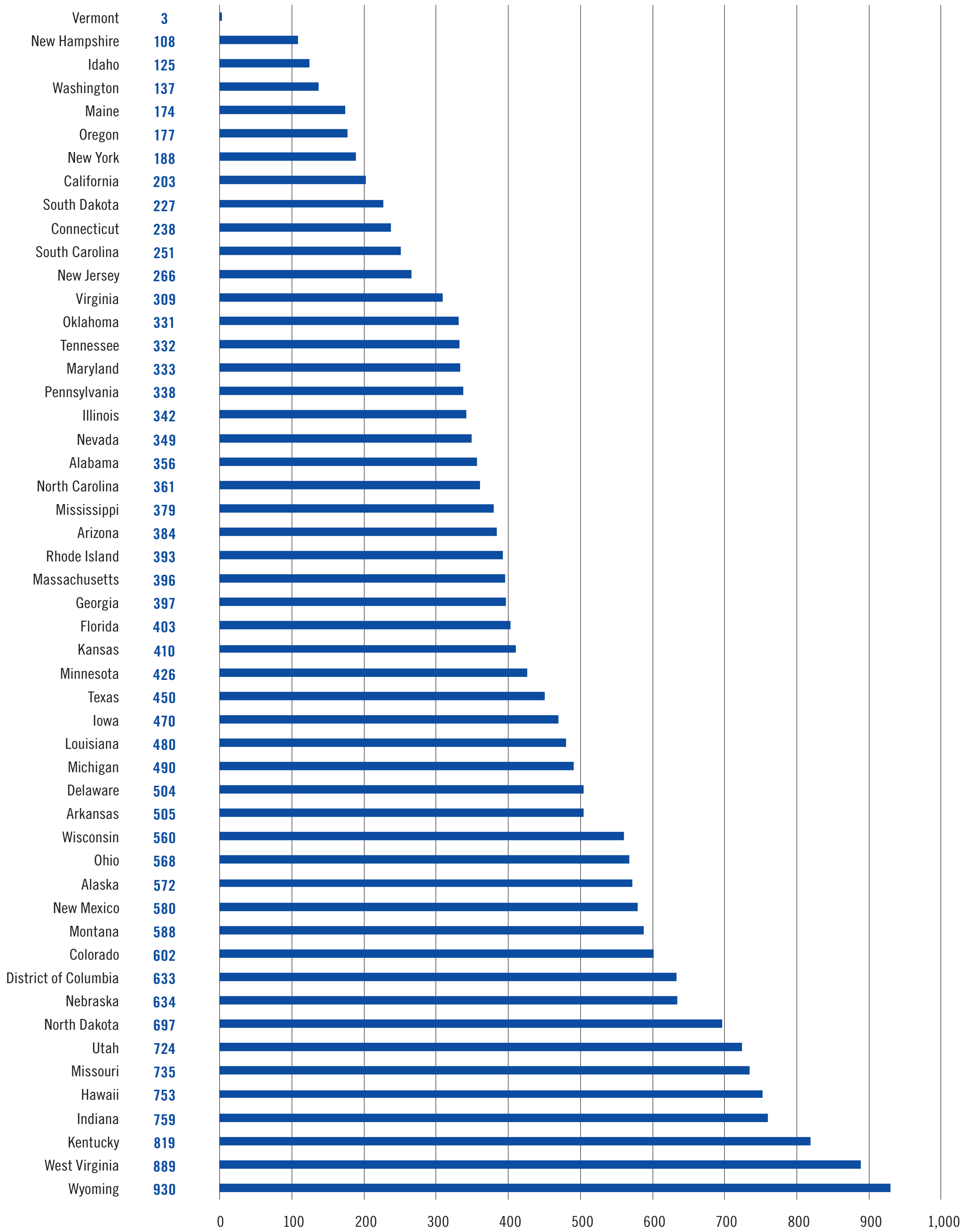
Source: EIA

FIGURE 22: 2019 NITROGEN OXIDE EMISSIONS FROM THE ELECTRIC SECTOR, IN THOUSANDS OF METRIC TONS



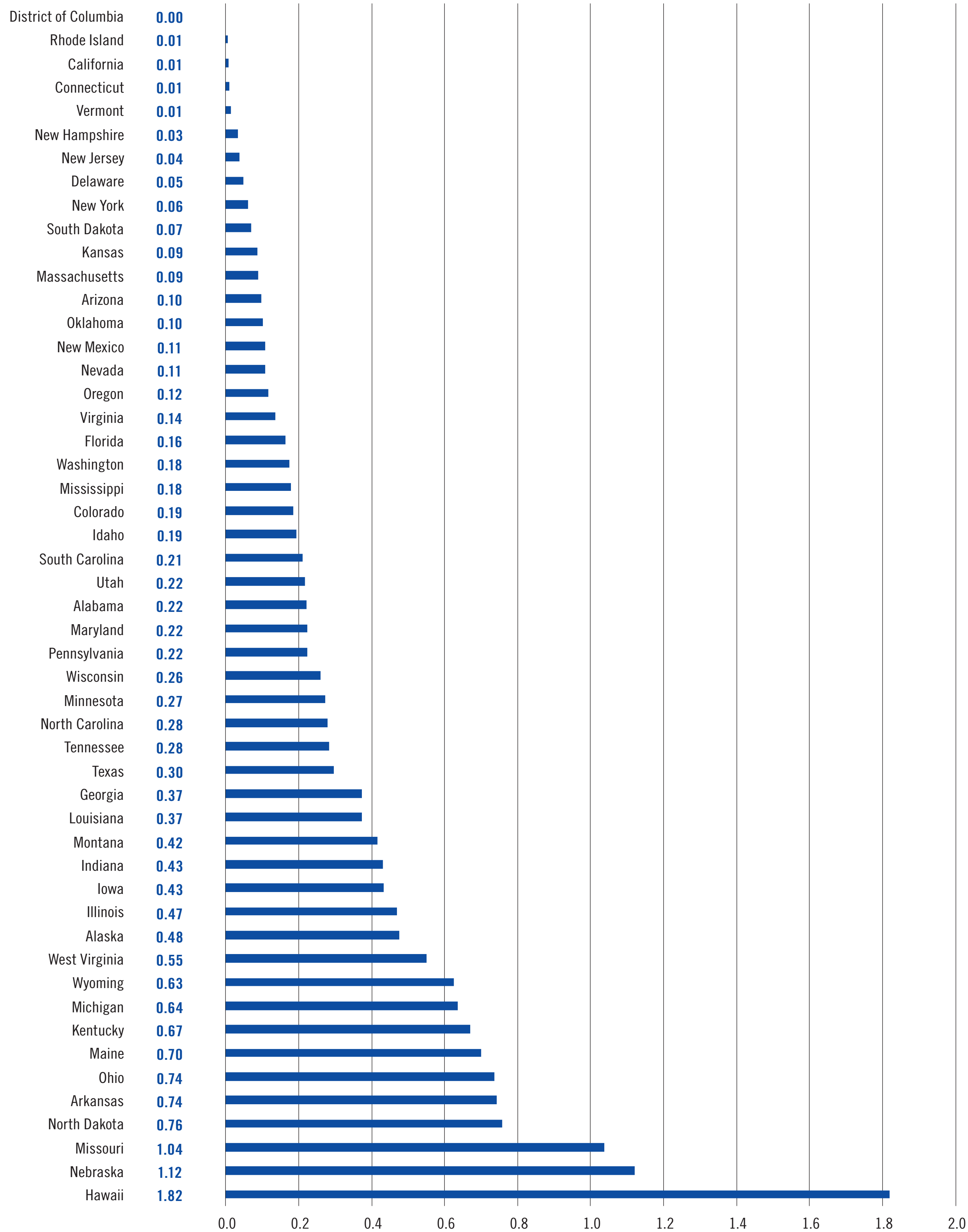
Source: EIA

FIGURE 23: 2019 CARBON DIOXIDE EMISSIONS FROM ELECTRICITY GENERATION, IN METRIC TONS PER GIGAWATT-HOUR



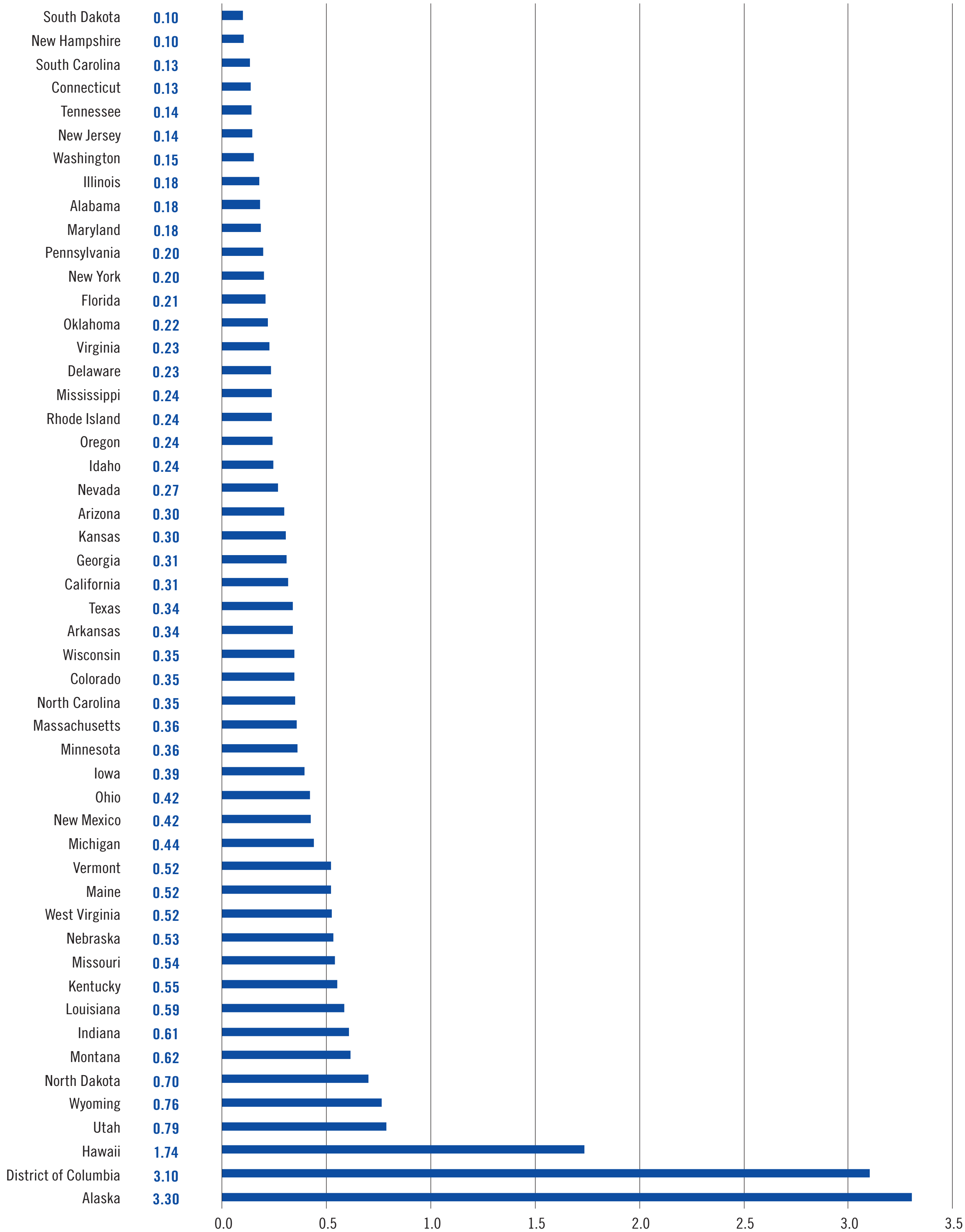
Source: EIA

FIGURE 24: 2019 SULFUR DIOXIDE EMISSIONS FROM ELECTRICITY GENERATION, IN METRIC TONS PER GIGAWATT-HOUR



Source: EIA

FIGURE 25: 2019 NITROGEN OXIDE EMISSIONS FROM ELECTRICITY GENERATION, IN METRIC TONS PER GIGAWATT-HOUR



Source: EIA

Conclusion

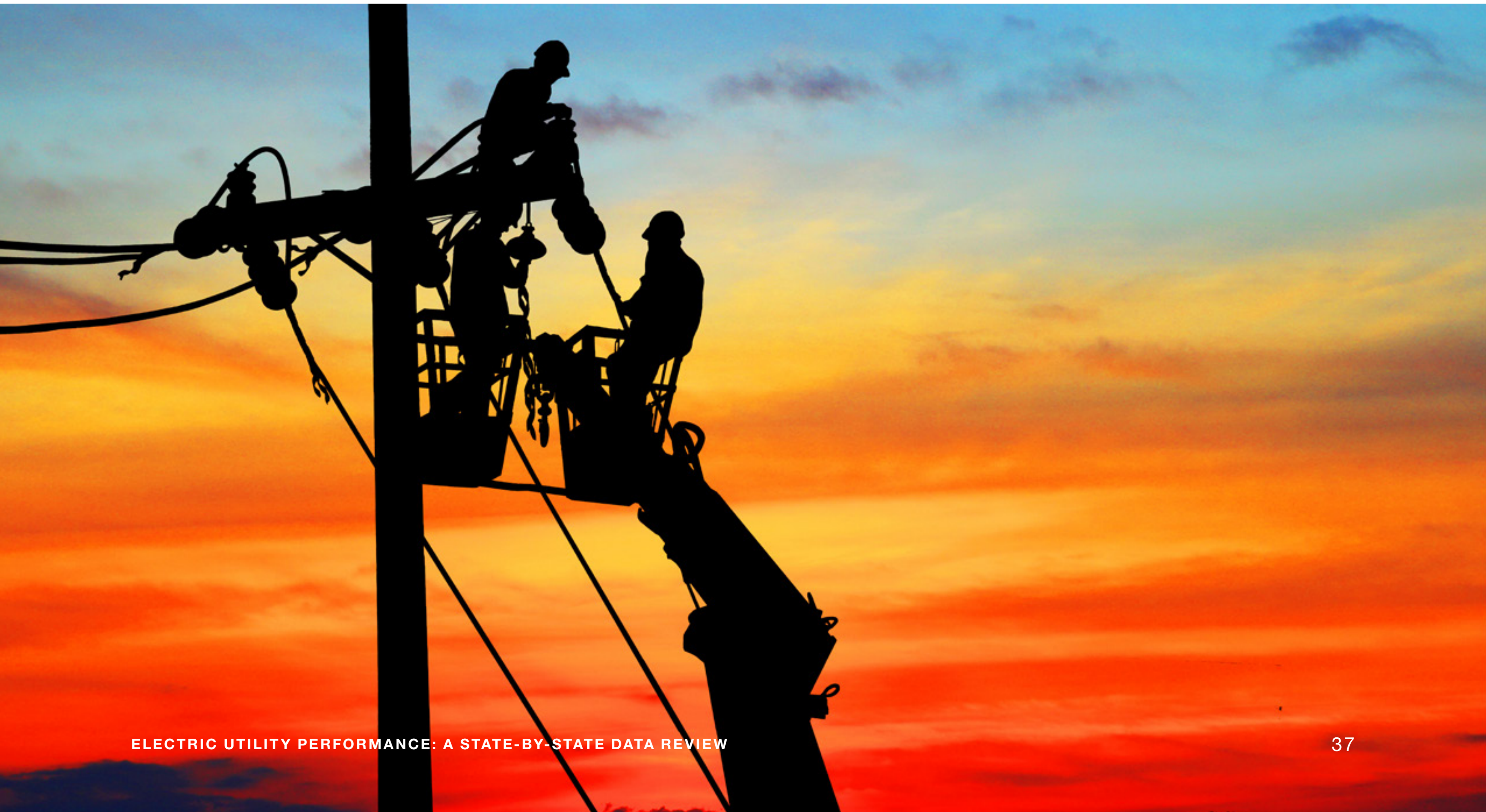
Economist Steven Levitt describes data as “one of the most powerful mechanisms for telling stories,” and the value of “Electric Utility Performance: A State-by-State Data Review” is in the questions it raises about each state’s energy story and the overall narrative for the country for affordability, reliability and environmental performance. This report must be a springboard for further discussion and analysis from regulators, policymakers, consumer advocates and all players so that we can better identify our energy problems and solutions.

The Citizens Utility Board (CUB) looks forward to producing future econometric analyses to further explain the utility-performance data set presented in these pages. Our initial review of the report’s findings does raise some intriguing questions.

Why do the data in this report fail to support claims by critics of clean energy that fossil fuels are less expensive for consumers? In fact, West Virginia and other states associated with coal-fired power tend to rank poorly in customer affordability—likely reflecting market trends that have pushed the cost of fossil fuels up as the price tag for renewables declines.

Why are some states that invested heavily in grid modernization not also achieving favorable reliability rankings? For example, while Florida and Michigan have both launched Advanced Metering Infrastructure (AMI) power grid upgrades, Florida has relatively strong reliability rankings, while Michigan struggles with reliability. The metrics indicate that while AMI has great potential to improve the lives of energy customers, it is only one piece to the puzzle, and can’t alone fix the nation’s reliability challenges.

There are a plethora of additional questions that arise from the data, and CUB hopes this report first sparks lively discussion and then earnest study. Finding answers is vital as we wrestle with a two-headed beast, trying to solve for both catastrophic climate change as well as energy burden. The solutions will never come easy and will require sometimes heated discussion among consumer advocates and policymakers. But when it comes to the climate and our power bills, the costliest option is inaction. We hope this report helps individual states and the country move a step closer to a clean and affordable energy future.



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