UTILITY PERFORMANCE REPORT

RANKING MICHIGAN AMONG THE STATES

2022 EDITION

CITIZENS UTILITY BOARD
CUB
Empowering Michigan Consumers

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GLOSSARY

Terms and Abbreviations

- ACS: American Community Survey
- CAIDI: Customer Average Interruption Duration Index
- CO_2: carbon dioxide
- EIA: Energy Information Administration
- EPA: Environmental Protection Agency
- IEEE: Electrical and Electronics Engineers
- MED: Major Event Days
- NO_x: 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
- SO_2: sulfur dioxide
- Trend CAGR: average yearly change of the fitted trendline

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 2204.6 pounds
- MMBTU—one million British thermal units, equivalent to 293.07 kWh
- MWh: megawatt hour—one thousand kilowatt hours
- Therm: one hundred cubic feet of natural gas
- TWh: terawatt hour—one billion kilowatt hours

INTRODUCTION

Report Overview

The 2022 Citizens Utility Performance Report shows that Michigan utilities, compared to those in the 50 states plus the District of Columbia, have below average performance on most metrics that measure the primary purposes of a utility: the delivery of reliable and affordable energy service to customers. While aspects of utility performance are affected by location, climate and the composition of the state's economy, these rankings mostly reflect how effective the state's utility regulation policy has been, historically.

Compared to the 2021 version of this report, Michigan utilities score marginally better on some measures of reliability. But that result is mostly due to other utilities in other states experiencing more power outages due to particularly severe weather events that year, as opposed to Michigan utilities improving their basic reliability performance.

When it comes to everyday delivery of electricity under normal conditions, Michigan utilities continue to struggle, especially on power restoration times. Climate change has made weather events more severe on average, but also more variable, implying that "good" years with relatively fewer instances of severe weather can be expected along with the "bad" years with relatively more. Compared to previous years, 2020 was relatively "good" for Michigan weather. A key takeaway is that even in a good year, Michigan utilities show a vulnerability to power outages and poor restoration performance that is likely to be magnified in "bad" years.

The role of extreme weather is significant across the categories of this report, not just regarding reliability. Extreme weather is on the rise due to climate change, and the extent to which weather events affect how well utilities can perform is rising with it. Over time, however, some utilities are more prepared than others for the challenges posed by extreme weather, and Michigan utilities show signs of an underlying vulnerability that should be concerning.

On affordability, Michigan continues to have higher than average rates, particularly for residential customers. One of the most important reasons for rising unaffordability is natural gas becoming more expensive after over a decade of low prices, a span of time during which the electricity sector became much more reliant on natural gas for generation. While this is a national trend, Michigan utilities are already starting from a place of relatively expensive energy and plans from major utilities like DTE and Consumers Energy to replace retiring coal-fired power plants with natural gas-fired power plants suggest that exposure to natural gas price volatility may get worse, not better. In addition, Michigan customers have relatively high reliance on natural gas for heating.

Natural gas is also going to become a bigger and bigger source of emissions. On environmental impacts, Michigan utilities rank in the top half of states for volume of emissions like CO2 and SO2. In absolute terms, Michigan has been decreasing these emissions as coal plants retire. But, relative to other states, the switch to natural gas is stymying Michigan's progress on reducing its emissions.

New to this year's report are data on electric utility energy efficiency programs, which we are able to report both at the state level and the utility level. These numbers reveal, among other findings, that Michigan industrial customers use more energy efficiency measures than the national average.

What's New in 2022: Ranking Michigan Electric Utilities

This year's report adds rankings of all investor-owned electric utilities in Michigan on reliability metrics and affordability of electricity. These utilities vary greatly based on size and service territory, from DTE and Consumers Energy, which serve millions of customers, to Northern Michigan and Upper Peninsula utilities that serve tens of thousands of customers. These rankings, therefore, should be viewed not as a comparison, but rather a reference to how these differently situated utilities perform based on their individual circumstances.

The utilities ranked are:

- Alpena Power Co.
- Consumers Energy
- DTE Energy
- Indiana Michigan Power Co.
- Northern States Power Co.
- Upper Michigan Energy Resources Corp.
- Upper Peninsula Power Co.

Figure 1: Michigan Summary Table

Metric	Data Year	Units	Value	Rank
SAIDI with Major Event Days	2020	Minutes	411	18
SAIDI without Major Event Days	2020	Minutes	167	10
SAIFI with Major Event Days	2020	Outages	1.38	24
SAIFI without Major Event Days	2020	Outages	1.08	20
CAIDI with Major Event Days	2020	Minutes	301	13
CAIDI without Major Event Days	2020	Minutes	156	2
Unaccounted for Natural Gas	2020	Thousands of Cubic Feet	(3,334)	33
Lost Natural Gas	2020	Thousands of Cubic Feet	6,444,171	6
Residential Energy Expenditures as a Percentage of Household Income	2020	Percentage	3.2%	14
Energy Expenditures per Household	2020	Dollars	$ 2,054	12
Percentage of Households Heating with Electricity	2020	Percentage	10.1%	48
Percentage of Households Heating with Gas	2020	Percentage	76.1%	3
Percentage of Households Heating with Other Heating Fuels	2020	Percentage	13.7%	23
Electricty Use per Household	2020	kWh	8,107	41
Natural Gas Use per Household	2020	Therms	900	3
Other Heating Fuel Use per Household	2020	MMBTU	132	12
Residential Electricity Cost per kWh	2021	Dollars	$ 17.53	10
Household Electricity Expenditures	2020	Dollars	$ 1,318.27	33

Metric	Data Year	Units	Value	Rank
Residential Natural Gas Cost per Therm	2020	Dollars	$ 0.83	39
Residential Natural Gas Expenditures	2020	Dollars	$ 742.83	16
Household Other Heating Fuel Cost per MMBTU	2020	Dollars	$ 15.34	33
Household Expenditures on Other Heating Fuels	2020	Dollars	$ 1,758.90	14
Commercial Electricity Cost per kWh	2021	Dollars	$ 0.123	13
Industrial Electricity Cost per kWh	2021	Dollars	$ 0.078	16
Commercial Natural Gas Cost per Therm	2020	Dollars	$ 0.69	37
Industrial Natural Gas Cost per Therm	2020	Dollars	$ 0.59	18
Interstate Imports and Exports (Higher Rank Implies More Exports)	2020	GWh	(3,992)	31
CO2 Emissions	2020	Metric Tons	49,523,270	7
SO2 Emissions	2020	Metric Tons	40,651	6
NOX Emissions	2020	Metric Tons	48,173	6
CO2 Emission Intensity	2020	Metric Tons per GWh	464	16
SO2 Emission Intensity	2020	Metric Tons per GWh	0.381	12
NOX Emission Intensity	2020	Metric Tons per GWh	0.452	14
Water Withdrawals	2020	Millions of Gallons	2,326,798	5
Water Consumption	2020	Millions of Gallons	31,520	9
Water Withdrawal Intensity	2020	Gallons per MWh	29,017	13
Water Consumption Intensity	2020	Gallons per MWh	386	31
Residential Electricity Use	2020	Gigawatt Hours	35,764	15
Residential Natural Gas Use	2020	Millions of Cubic Feet	304,194	4
Residential Other Heating Fuel Use	2020	Billions of BTU	69,400	0
Commercial Electricity Use	2020	Gigawatt Hours	36,891	10
Commercial Natural Gas Use	2020	Millions of Cubic Feet	160,487	6
Commercial Other Heating Fuel Use	2020	Billions of BTU	30,298	0
Industrial Electricity Use	2020	Gigawatt Hours	26,745	13
Industrial Natural Gas Use	2020	Millions of Cubic Feet	158,646	13
Industrial Other Heating Fuel Use	2020	Billions of BTU	184,610.00	0
Cost per kWh of Residential Energy Efficiency Savings	2020	Dollars	$ 0.025	24
Cost per kWh of Commercial Energy Efficiency Savings	2020	Dollars	$ 0.015	22
Cost per kWh of Industrial Energy Efficiency Savings	2020	Dollars	$ 0.019	10
Residential Energy Efficiency Savings as a % of Residential Electricity Sales	2020	Percentage	1.42%	36
Commercial Energy Efficiency Savings as a % of Residential Electricity Sales	2020	Percentage	2.25%	47
Industrial Energy Efficiency Savings as a % of Residential Electricity Sales	2020	Percentage	0.67%	42
Kerosene and Distillate Fuel Use per Heating Household	2020	MMBTU	71	22
Propane Use per Heating Household	2020	MMBTU	108	12
Wood Use per Heating Household	2020	MMBTU	202	10
CO2 Equivalent Emissions from Lost Natural Gas	2020	Metric Tons	2,204,485	7
CO2 Emissions from Natural Gas Use Outside the Electric Sector	2020	Metric Tons	33,928,713	8
SO2 Emissions from Natural Gas Use Outside the Electric Sector	2020	Metric Tons	170	8
NOX Emissions from Natural Gas Use Outside the Electric Sector	2020	Metric Tons	35,807	9
Current Largest Source of Generation	2021		Coal	
Renewable Generation as a % of Total Generation	2021	Percentage	10%	18
Clean Generation as a % of Total Generation	2021	Percentage	38%	26

About This Report

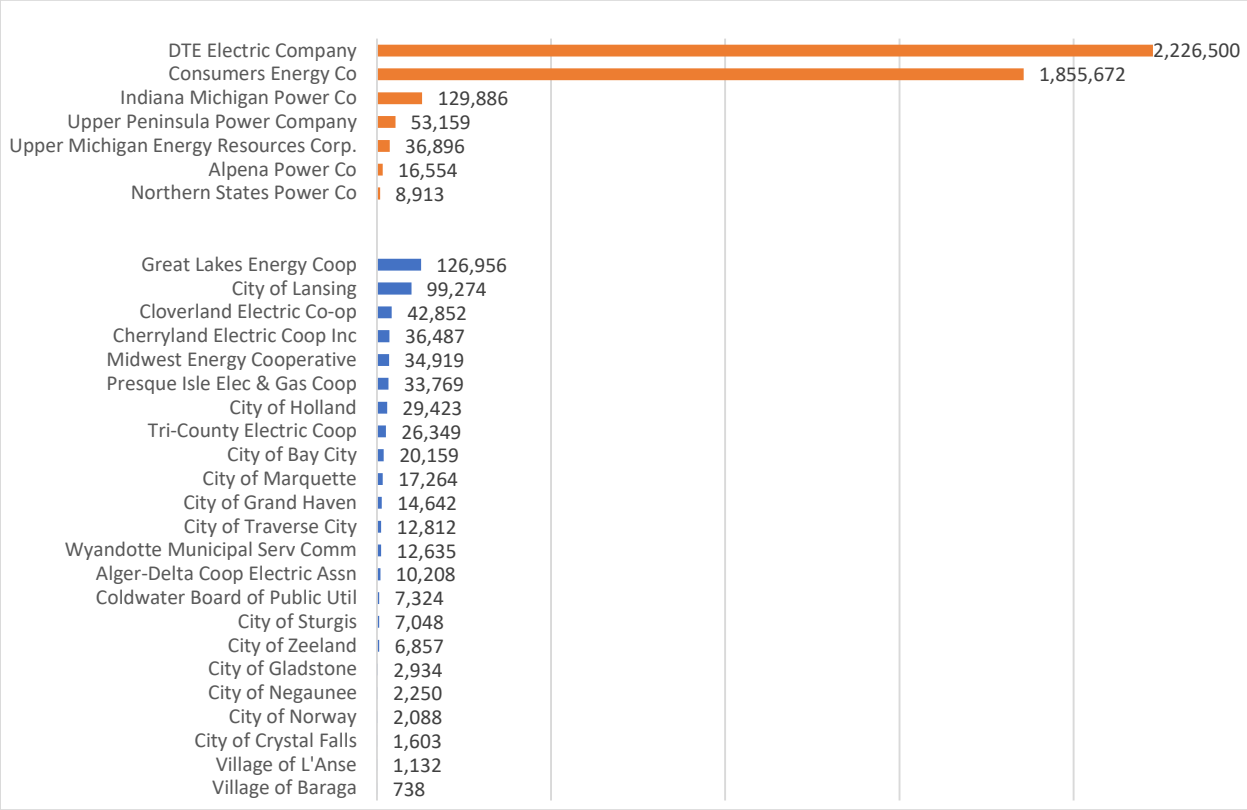
For each metric reported, states are ranked in order from worst performance to best; a high number implies better performance than a low number. In most cases, this means that a larger value will produce a worse rank—a rank closer to 1. For example, with "SAIDI with Major Event Days," a larger value means more minutes of outage, and subsequently worse performance. However, this paradigm is not true for all metrics. A higher value for "Residential Energy Efficiency Savings as a % of Residential Electricity Sales" is assumed to be a positive outcome. Thus, a lower value in this metric produces a worse rank. In the case of non-hierarchical metrics such as "residential electricity use," a lower number rank implies more use, such that ranking "1" in a non-hierarchical metric simply implies that a state has the largest value in that metric.

Because some data are released earlier than others by the Energy Information Administration (EIA) of the US Department of Energy, this report displays some data from 2021, but mostly shows data from calendar year 2020.

This report discusses Michigan in relation to a "peer group" consisting of Ohio, Indiana, Illinois, Wisconsin and Minnesota. These states generally have similar weather, population dynamics, industrial activity and market conditions, and this comparison introduces some context for the statistics in this report.

The figure below shows the number of customers of each of Michigan's utilities. In this figure (and all utility-level figures in this report), the upper set of bars represents Michigan's regulated utilities, and the lower set of bars represents Michigan's municipal and cooperative utilities. Given the relative scale of Consumers Energy and DTE Energy, Michigan's national statistics are dominated by these two utilities, which sell both electricity and natural gas to Michigan's residents.

Figure 2: 2020 Number of Electricity Customers



RANKING MICHIGAN ELECTRIC UTILITIES ON RELIABILITY, AFFORDABILITY AND EFFICIENCY

These rankings of all Michigan investor-owned electric utilities include key reliability metrics, price of electricity for different customer classes and one metric showing how well utilities' residential energy efficiency programs are performing. We briefly summarize the reliability metrics here; please see the following section, *Electric and Natural Gas Utility Reliability and Performance,* for a more detailed explanation.

- Length (in minutes) of the average interruption for each customer served (System Average Interruption Duration Index, or SAIDI)
- Average number of outages per customer (System Average Interruption Frequency Index, SAIFI)
- Average length (in minutes) to restore power following an outage (Customer Average Interruption Duration Index, or CAIDI)

Price metrics are explained in *Household Energy* and *Non-Residential Costs* and the energy efficiency metric is explained in *Energy Efficiency.*

Of all Michigan IOUs, Northern Michigan utility Alpena Power Co. had the best score for SAIDI and SAIFI and the second-best score for CAIDI without major event days. Alpena Power tended to have cheaper electricity, regardless of customer class.

Figure 3: 2020 Alpena Power Co Performance Summary

Metric	Value	Michigan	US Average	IOU Rank*
Number of Electricity Customers	16,554	4,423,595	-	6
SAIDI with Major Event Days (Minutes)	213.5	410.7	491.9	7
SAIDI without Major Event Days (Minutes)	89.2	167.2	119.0	7
SAIFI with Major Event Days (# of Outages)	1.10	1.38	1.40	7
SAIFI without Major Event Days (# of Outages)	0.90	1.08	1.00	7
CAIDI with Major Event Days (Minutes)	194.1	300.8	341.7	4
CAIDI without Major Event Days (Minutes)	99.1	156.2	114.7	6
Residential Electricity Price in (Dollars)	$0.141	$0.163	$ 0.132	6
Commercial Electricity Price in (Dollars)	$0.125	$0.117	$ 0.106	4
Industrial Electricity Price in (Dollars)	$0.059	$0.072	$ 0.067	5
Residential Energy Efficiency Savings as a % of Sales	0.00%	1.42%	0.90%	-

**Ranks are 1-7 (1 is the worst/largest-value)*

Consumers Energy is the second-largest electric utility in Michigan by number of customers. Its reliability performance varied from second-worst for CAIDI and fifth-worst out of the seven IOUs for SAIFI. For SAIDI, the results were mixed—second-worst with major event days and fifth-worst without. Consumers Energy's price of electricity was third-highest for residential and commercial customers and second-highest for industrial customers.

Figure 4: 2020 Consumers Energy Co Performance Summary

Metric	Value	Michigan	US Average	IOU Rank*
Number of Electricity Customers	1,855,672	4,423,595	-	2
SAIDI with Major Event Days (Minutes)	510.3	410.7	491.9	2
SAIDI without Major Event Days (Minutes)	194.7	167.2	119.0	5
SAIFI with Major Event Days (# of Outages)	1.35	1.38	1.40	5
SAIFI without Major Event Days (# of Outages)	1.03	1.08	1.00	5
CAIDI with Major Event Days (Minutes)	378.6	300.8	341.7	2
CAIDI without Major Event Days (Minutes)	188.3	156.2	114.7	2
Residential Electricity Price in (Dollars)	$0.156	$0.163	$0.132	3
Commercial Electricity Price in (Dollars)	$0.131	$0.117	$0.106	3
Industrial Electricity Price in (Dollars)	$0.082	$0.072	$0.067	2
Residential Energy Efficiency Savings as a % of Sales	1.30%	1.42%	0.90%	4

**Ranks are 1-7 (1 is the worst/largest-value)*

DTE, Michigan's largest electric utility, scored low for SAIFI with or without major event days, and SAIDI without, suggesting the utility performed relatively well on frequency of outages during the period. DTE was the third-worst utility, however, when it comes to CAIDI (without or without major event days) and SAIDI with major event days. DTE had the second-highest residential electricity price, but the second-lowest commercial price, with industrial in roughly the middle of Michigan IOUs at third-highest.

Figure 5: 2020 DTE Electric Company Performance Summary

Metric	Value	Michigan	US Average	IOU Rank*
Number of Electricity Customers	2,226,500	4,423,595	-	1
SAIDI with Major Event Days (Minutes)	351.8	410.7	491.9	3
SAIDI without Major Event Days (Minutes)	141.9	167.2	119.0	6
SAIFI with Major Event Days (# of Outages)	1.29	1.38	1.40	6
SAIFI without Major Event Days (# of Outages)	1.01	1.08	1.00	6
CAIDI with Major Event Days (Minutes)	273.6	300.8	341.7	3
CAIDI without Major Event Days (Minutes)	139.9	156.2	114.7	3
Residential Electricity Price in (Dollars)	$0.173	$0.163	$0.132	2
Commercial Electricity Price in (Dollars)	$0.113	$0.117	$0.106	6
Industrial Electricity Price in (Dollars)	$0.070	$0.072	$0.067	3
Residential Energy Efficiency Savings as a % of Sales	1.71%	1.42%	0.90%	3

**Ranks are 1-7 (1 is the worst/largest-value)*

Indiana Michigan Power, a subsidiary of American Electric Power primarily serving Indiana, has just under 130,000 customers in the southwestern corner of Michigan. I&M scored worst among Michigan IOUs in CAIDI and worst or second-worst on SAIDI, with or without major event days, respectively. It scored in the middle of the pack in terms of affordability, with the highest industrial price but the fourth- and fifth-highest residential and commercial prices, respectively.

Figure 6: 2020 Indiana Michigan Power Co Performance Summary

Metric	Value	Michigan	US Average	IOU Rank*
Number of Electricity Customers	129,886	4,423,595	-	3
SAIDI with Major Event Days (Minutes)	644.0	410.7	491.9	1
SAIDI without Major Event Days (Minutes)	239.8	167.2	119.0	2
SAIFI with Major Event Days (# of Outages)	1.43	1.38	1.40	4
SAIFI without Major Event Days (# of Outages)	1.08	1.08	1.00	4
CAIDI with Major Event Days (Minutes)	450.7	300.8	341.7	1
CAIDI without Major Event Days (Minutes)	221.2	156.2	114.7	1
Residential Electricity Price in (Dollars)	$0.152	$0.163	$0.132	4
Commercial Electricity Price in (Dollars)	$0.123	$0.117	$0.106	5
Industrial Electricity Price in (Dollars)	$0.106	$0.072	$0.067	1
Residential Energy Efficiency Savings as a % of Sales	1.07%	1.42%	0.90%	5

**Ranks are 1-7 (1 is the worst/largest-value)*

Northern States Power Co. is a subsidiary of Minnesota-based holding company Xcel Energy and serves just under 9,000 customers in the western portion of Michigan's Upper Peninsula. Notably, this utility scored the worst for SAIDI without major event days. It had the cheapest residential and commercial electricity price but the fourth-highest industrial price.

Figure 7: 2020 Northern States Power Co Performance Summary

Metric	Value	Michigan	US Average	IOU Rank*
Number of Electricity Customers	8,913	4,423,595	-	7
SAIDI with Major Event Days (Minutes)	346.0	410.7	491.9	4
SAIDI without Major Event Days (Minutes)	244.0	167.2	119.0	1
SAIFI with Major Event Days (# of Outages)	2.41	1.38	1.40	2
SAIFI without Major Event Days (# of Outages)	2.27	1.08	1.00	2
CAIDI with Major Event Days (Minutes)	143.7	300.8	341.7	5
CAIDI without Major Event Days (Minutes)	107.7	156.2	114.7	5
Residential Electricity Price in (Dollars)	$0.122	$0.163	$0.132	7
Commercial Electricity Price in (Dollars)	$0.112	$0.117	$0.106	7
Industrial Electricity Price in (Dollars)	$0.066	$0.072	$ 0.067	4
Residential Energy Efficiency Savings as a % of Sales	2.47%	1.42%	0.90%	2

**Ranks are 1-7 (1 is the worst/largest-value)*

Upper Michigan Energy Resources is owned by Wisconsin's WEC Energy Group and serves just under 37,000 customers in the portions of the Upper Peninsula that border Wisconsin. Upper Michigan Energy Resources had the worst score among Michigan utilities for SAIFI but the best for CAIDI, suggesting that the utility has relatively frequent outages that are of relatively short duration. The utility had low electric prices for residential and industrial customers but the second-highest price for commercial customers.

Figure 8: 2020 Upper Michigan Energy Resources Corp. Performance Summary

Metric	Value	Michigan	US Average	IOU Rank*
Number of Electricity Customers	36,896	4,423,595	-	5
SAIDI with Major Event Days (Minutes)	253.0	410.7	491.9	6
SAIDI without Major Event Days (Minutes)	222.0	167.2	119.0	3
SAIFI with Major Event Days (# of Outages)	2.71	1.38	1.40	1
SAIFI without Major Event Days (# of Outages)	2.56	1.08	1.00	1
CAIDI with Major Event Days (Minutes)	93.4	300.8	341.7	7
CAIDI without Major Event Days (Minutes)	86.7	156.2	114.7	7
Residential Electricity Price in (Dollars)	$0.142	$0.163	$0.132	5
Commercial Electricity Price in (Dollars)	$0.132	$0.117	$0.106	2
Industrial Electricity Price in (Dollars)	$0.055	$0.072	$0.067	6
Residential Energy Efficiency Savings as a % of Sales	0.00%	1.42%	0.90%	-

**Ranks are 1-7 (1 is the worst/largest-value)*

Upper Peninsula Power Co. serves more electric customers in the Upper Peninsula than any other IOU. UPPCO scored mostly in the median of Michigan IOUs for the reliability metrics. UPPCO had the most expensive residential and commercial electricity price of any Michigan IOU but the lowest industrial price.

Figure 9: 2020 Upper Peninsula Power Company Performance Summary

Metric	Value	Michigan	US Average	IOU Rank*
Number of Electricity Customers	53,159	4,423,595	-	4
SAIDI with Major Event Days (Minutes)	292.9	410.7	491.9	5
SAIDI without Major Event Days (Minutes)	206.2	167.2	119.0	4
SAIFI with Major Event Days (# of Outages)	2.30	1.38	1.40	3
SAIFI without Major Event Days (# of Outages)	1.77	1.08	1.00	3
CAIDI with Major Event Days (Minutes)	127.3	300.8	341.7	6
CAIDI without Major Event Days (Minutes)	116.5	156.2	114.7	4
Residential Electricity Price in (Dollars)	$0.223	$0.163	$0.132	1
Commercial Electricity Price in (Dollars)	$0.187	$0.117	$0.106	1
Industrial Electricity Price in (Dollars)	$0.051	$0.072	$0.067	7
Residential Energy Efficiency Savings as a % of Sales	2.80%	1.42%	0.90%	1

**Ranks are 1-7 (1 is the worst/largest-value)*

ELECTRIC AND NATURAL GAS UTILITY RELIABILITY AND PERFORMANCE

This section takes a deep dive into the available metrics for the reliability and performance of natural gas and electric utilities.

Electric Utilities Overview

Electricity is essential to modern life. As the U.S. moves towards decarbonizing its economy through electrification, electric reliability will become increasingly important, and, in turn, a more reliable electric system will promote electrification. Much of the public discussion about electric utility reliability focuses on what utility regulators and utilities call Resource Adequacy. Resource Adequacy ensures that there is sufficient power generation capacity to satisfy utility customer peak 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. Distribution breakdowns may occur due to storms breaking powerlines, wildfires, animals touching pairs of power lines and causing a "short," equipment failures and many other reasons.

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 outage per year per customer, calculated by a method referred to as the System Average Interruption Duration Index (SAIDI). SAIDI is our primary metric for electric reliability, but it is the product of two other reliability metrics: the System Average Interruption Frequency Index (SAIFI), which measures outages per customer, and the Customer Average Interruption Duration Index (CAIDI), which measures the average time for the utility to restore power to a customer after an outage starts.

Beginning in 2013, the EIA began collecting annual reports of SAIDI, SAIFI, and CAIDI from utilities and publishing those data in annual compilations. These data are collected on form EIA-861 and may be downloaded here. The latest available reliability data from EIA are for calendar year 2020. 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 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 that MED are a statistical classification, defined by the IEEE 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. If recovery from a storm lasts multiple days, the day/s toward the beginning of that recovery may be considered MED because over 10% of

utility customers are without power, but the day/s towards the end of the recovery may not be considered MED because fewer than 10% of utility of utility customers are without power, even though all the days of 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.

Michigan's performance on several reliability measures ranks among the worst performing states, or, in some cases, places it in the middle of the pack. More detailed analysis of the reliability of Michigan's electric utilities compared to that of other states follows.

SAIDI – Average Minutes of Outage per Customer per Year

As can be seen in Figure 10, in 2020 Michigan ranked 18th-worst among the states in overall average number of minutes of outage per customer (SAIDI with MED) over the year and 10th-worst in number of minutes of outage per customer (SAIDI without MED) over the year.

Annual data from 2013-2020 in Figure 147 and Figure 146 show that Michigan's performance in SAIDI without MED has remained very high relative to other states over the last eight years, with 2020 being notably better than the previous several years, while SAIDI with MED has ranged from high to very high relative to other states, with its 2020 rank being better than most previous years.

Figure 10: 2020 System Average Interuption Duration Index (SAIDI) in Minutes

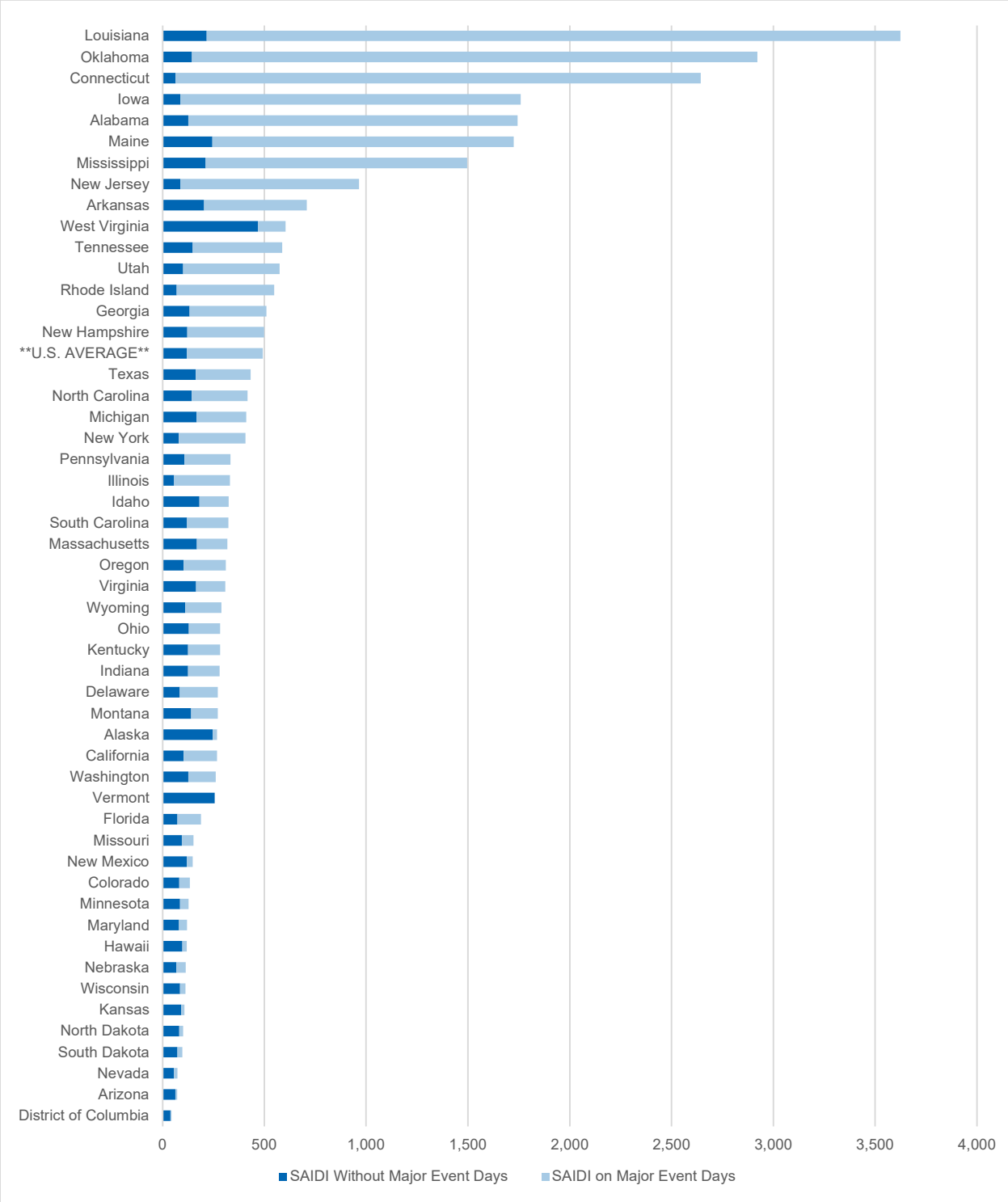


Figure 11: 2020 System Average Interuption Duration Index (SAIDI) with Major Event Days in Minutes

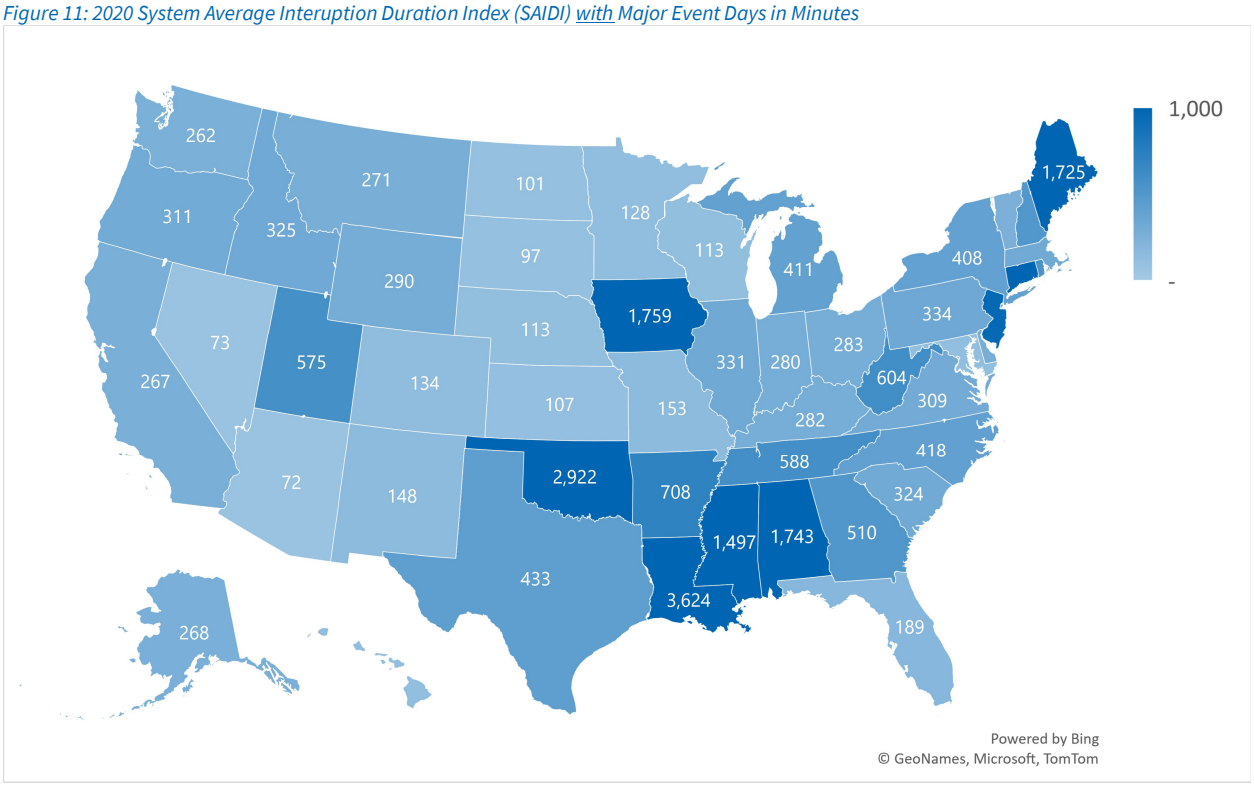
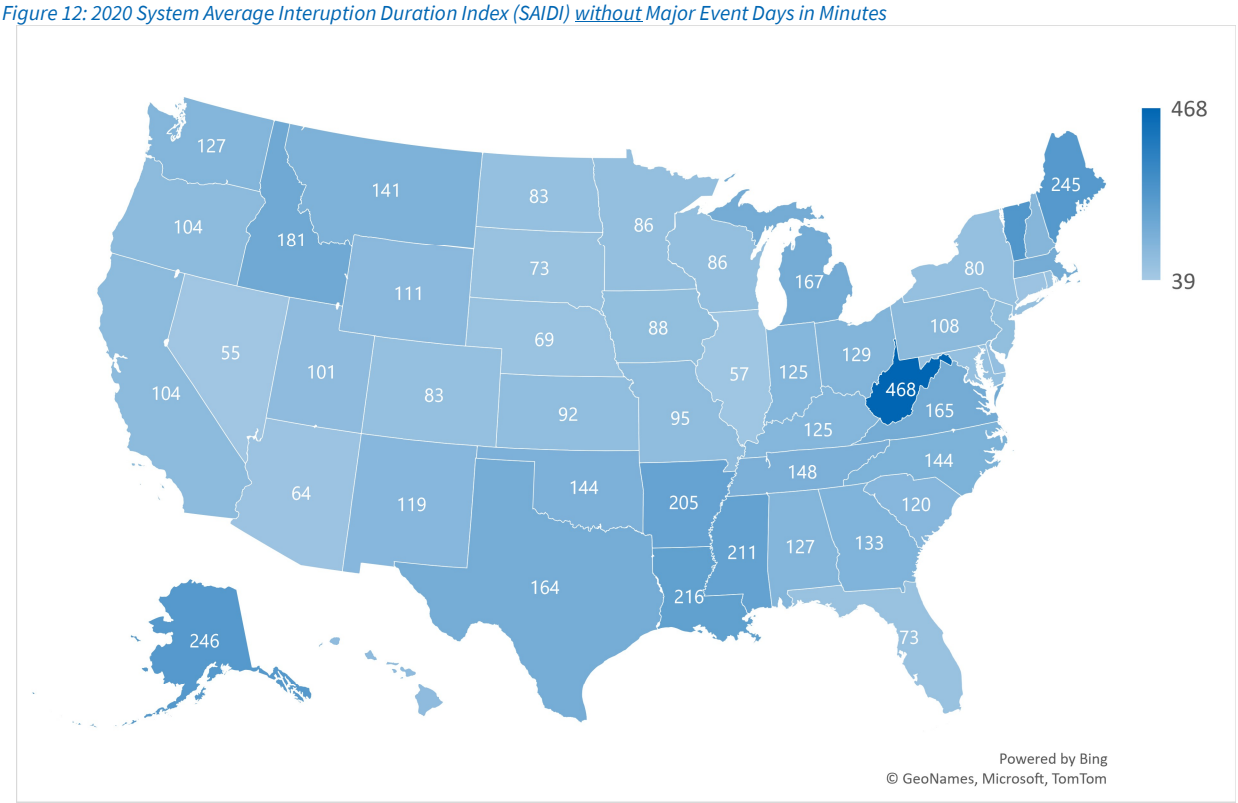


Figure 12: 2020 System Average Interuption Duration Index (SAIDI) without Major Event Days in Minutes



SAIFI – Outages per Customer per Year

Figure 13 shows Michigan's number of outages per customer per year compared to other states, with and without MED. In 2020, Michigan performed near the median, ranking 24th-worst overall. When MED are excluded, Michigan average ranking is 20th-worst overall.

Figure 149 and Figure 148 show that Michigan's number of outages without MED has gotten somewhat worse over the last eight years since mandated SAIFI reporting began, but SAIFI with MED has improved somewhat over the same period.

Figure 13: 2020 System Average Interruptions Frequency Index (SAIFI) in Number of Power Outages per Customer

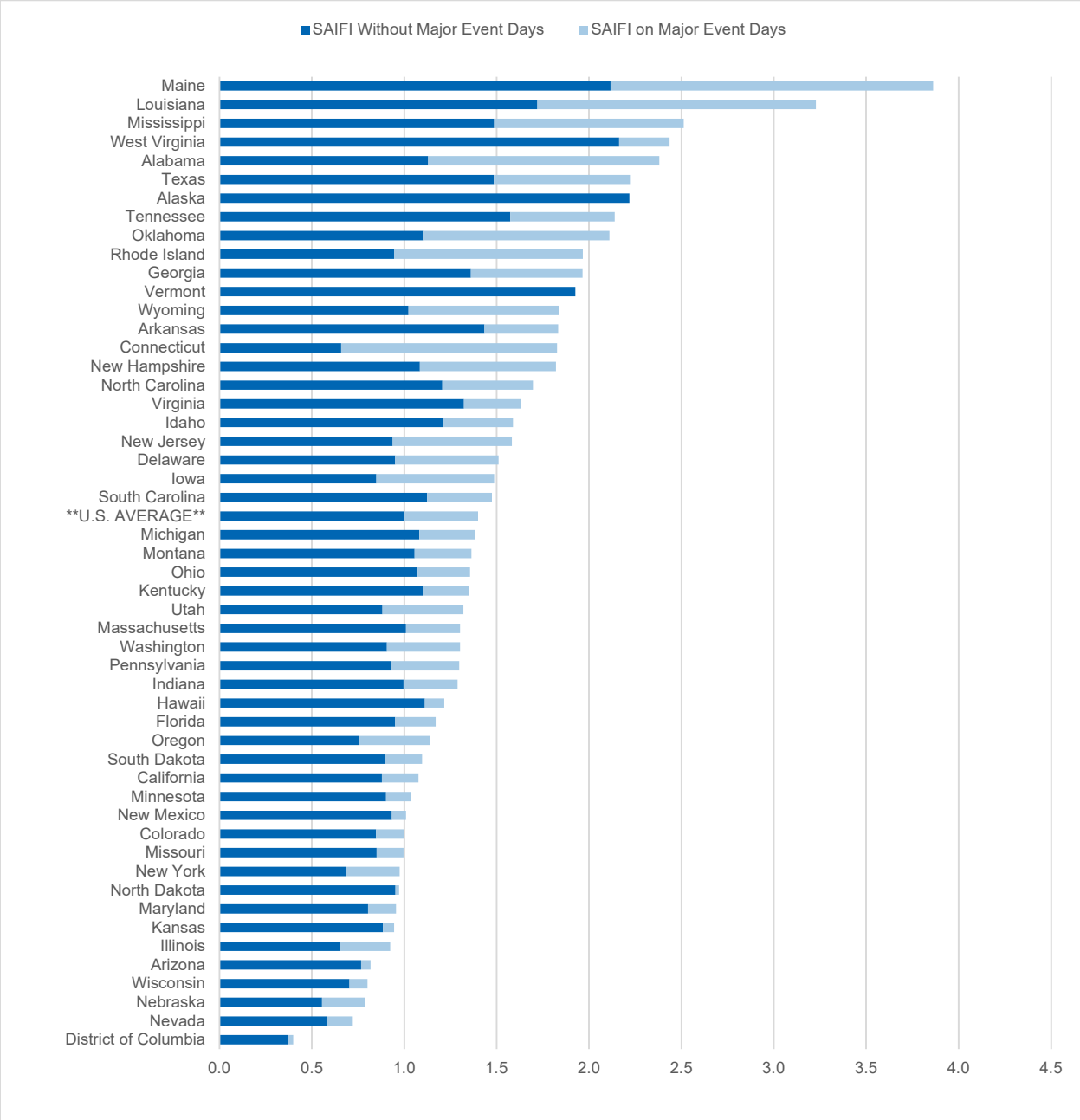


Figure 14: 2020 System Average Interuption Frequency Index (SAIFI) with Major Event Days in Number of Power Outages Per Customer

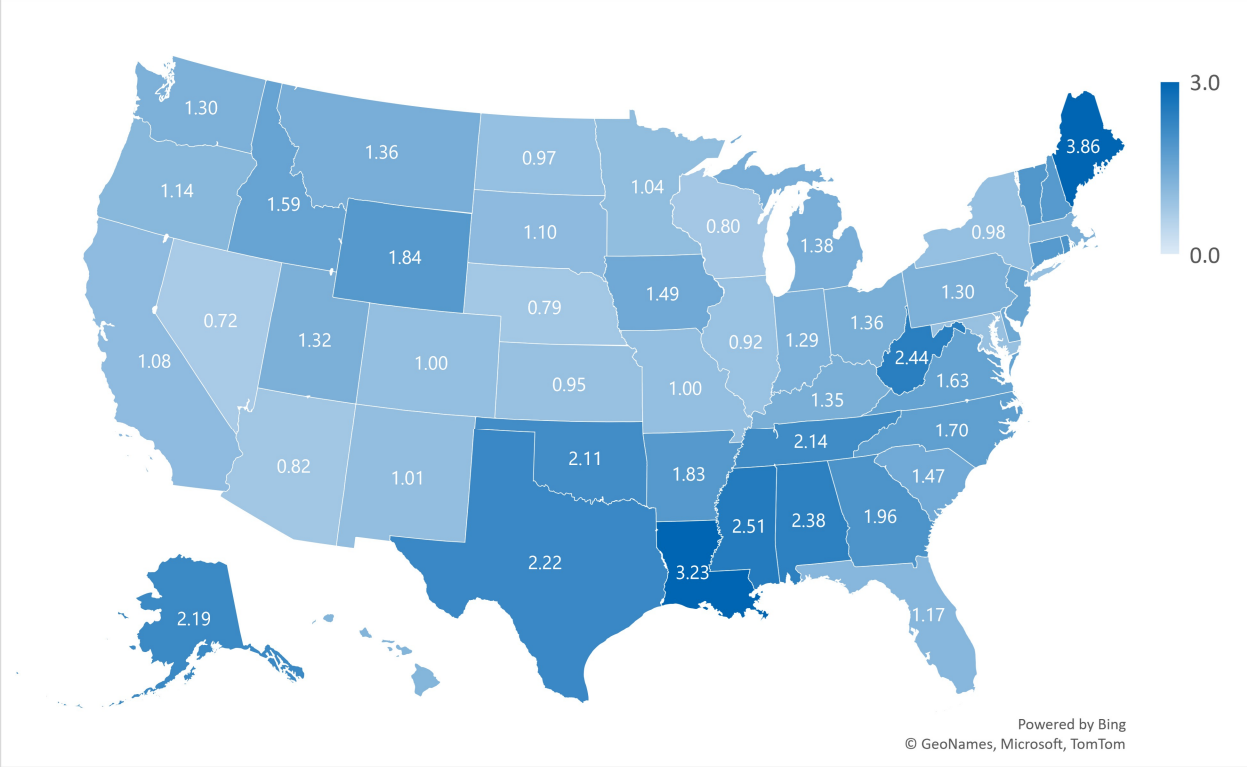
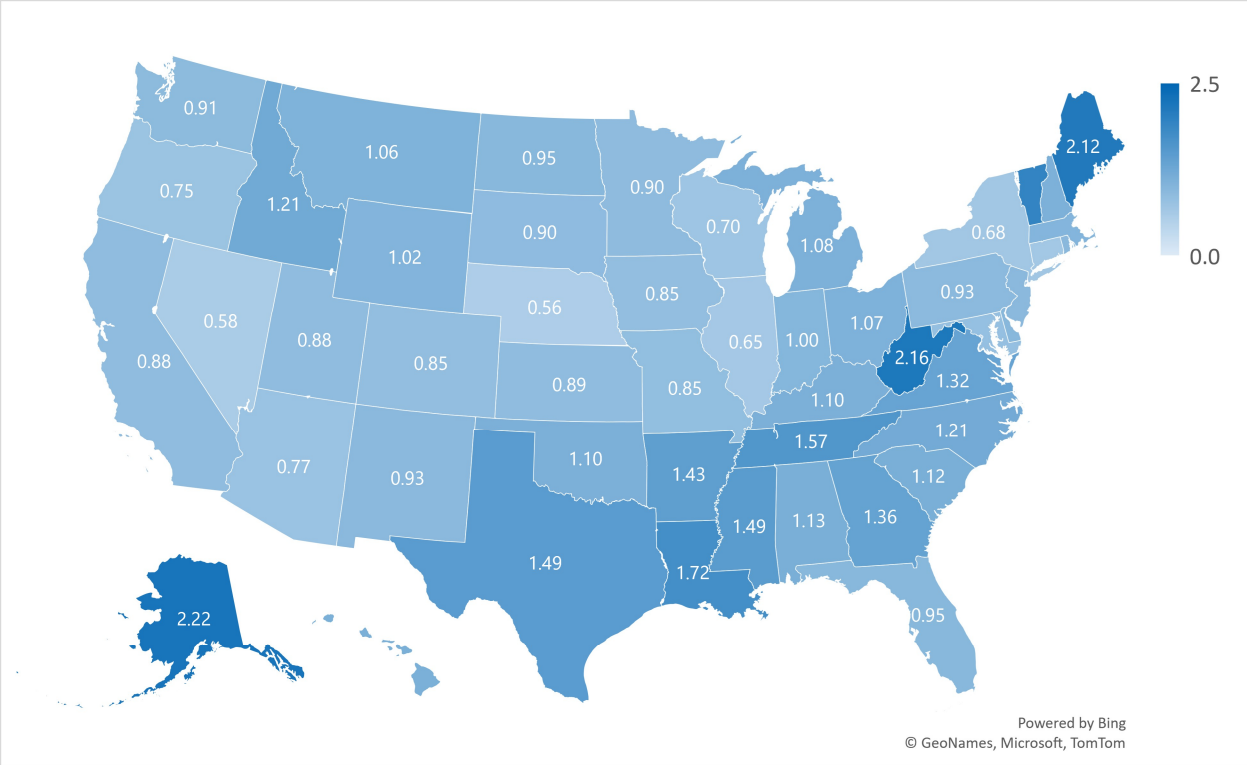


Figure 15: 2020 System Average Interuption Frequency Index (SAIFI) without Major Event Days in Number of Power Outages Per Customer



CAIDI – Average Minutes to Restore Power to a Customer

Michigan's power restoration time following an outage (CAIDI) is among the worst in the country, with and without MED. In 2020, Michigan ranked 13th-worst in CAIDI with MED, a substantial improvement from 2019, and second-worst without MED, making it worse even than the prior year (Figure 16).

Figure 150 and Figure 151 show Michigan's CAIDI with and without MED have modestly improved since reliability reporting began in 2013, but this was from a very poor baseline, which is why Michigan's CAIDI scores are still some of the worst in the country.

Figure 16: 2020 Customer Average Interruption Duration Index (CAIDI) in Minutes

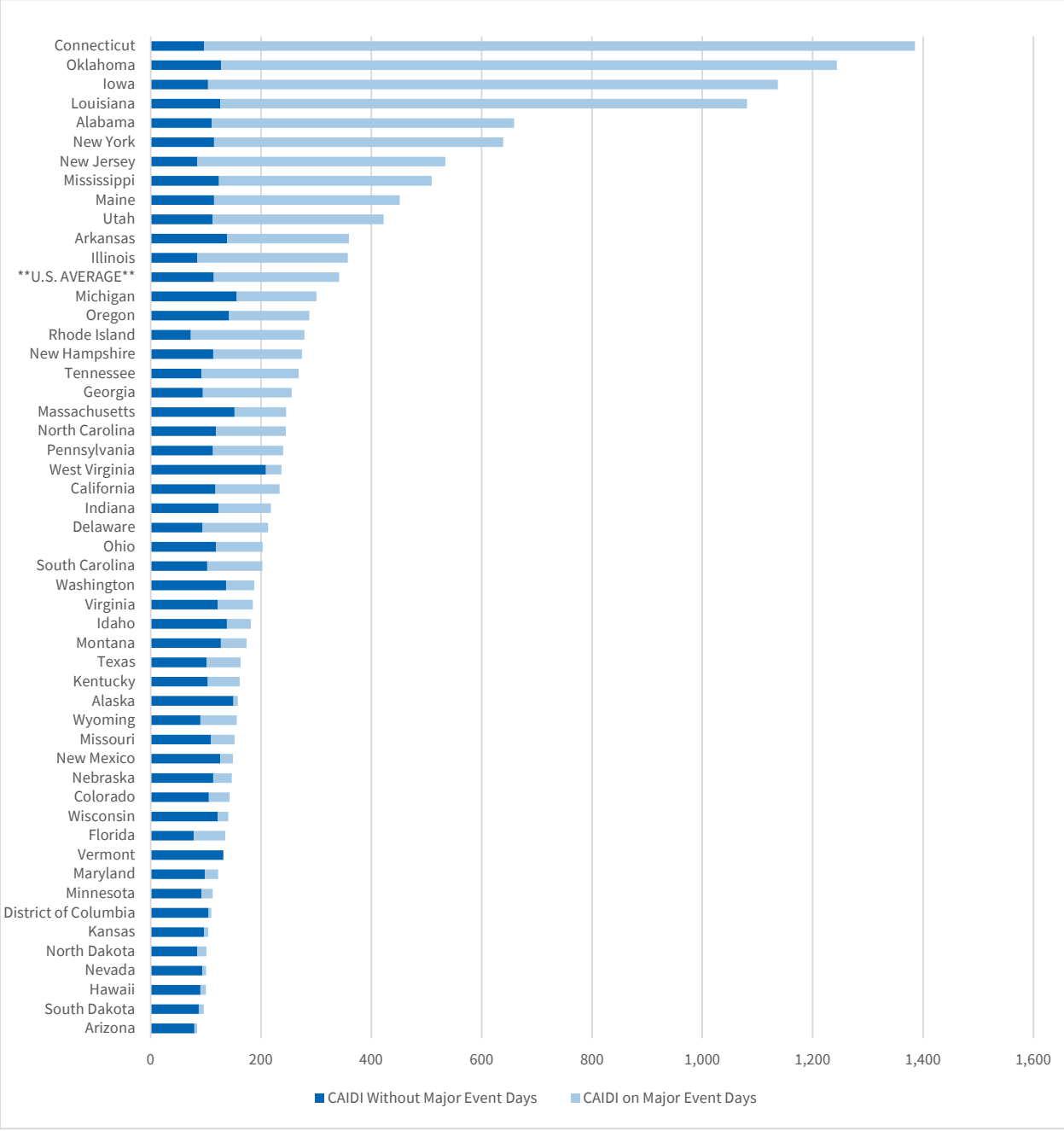


Figure 17: 2020 Customer Average Interruption Duration Index (CAIDI) with Major Event Days in Minutes

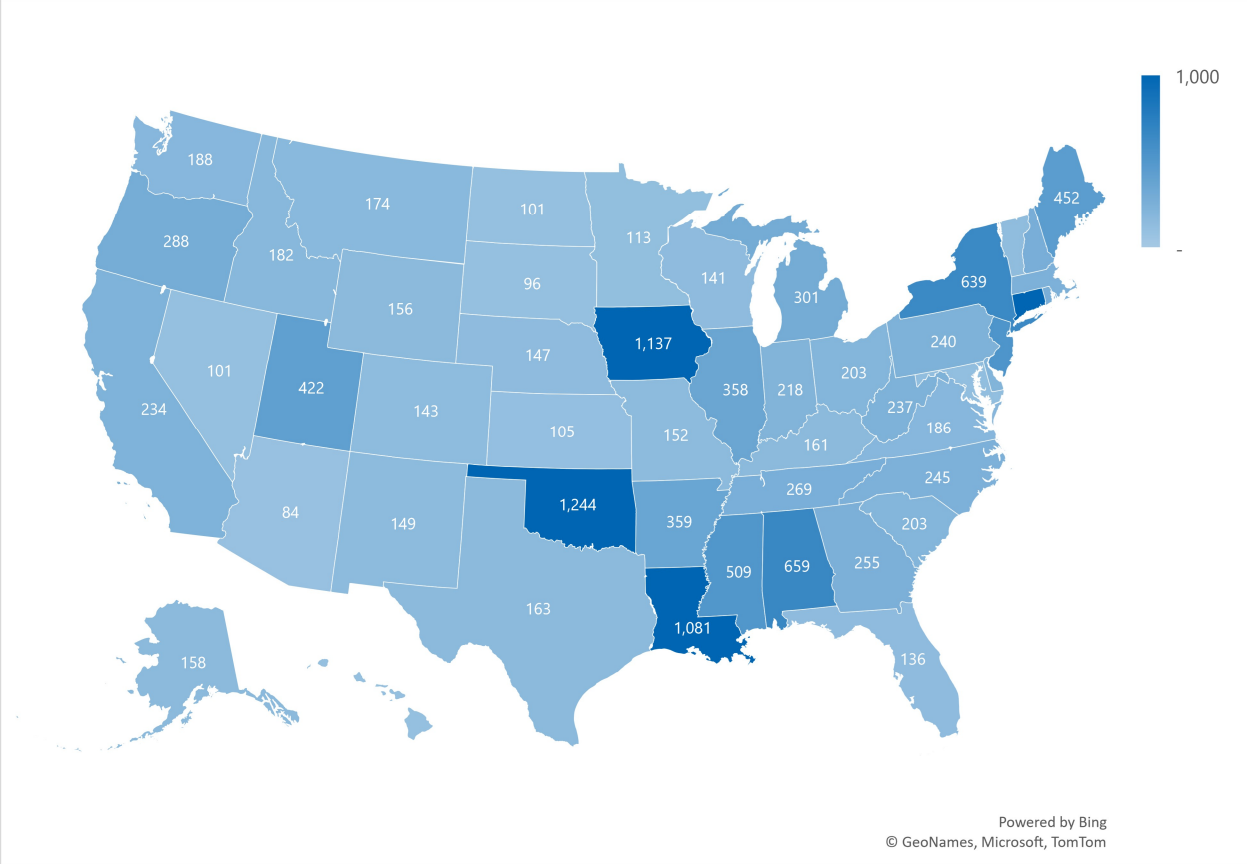
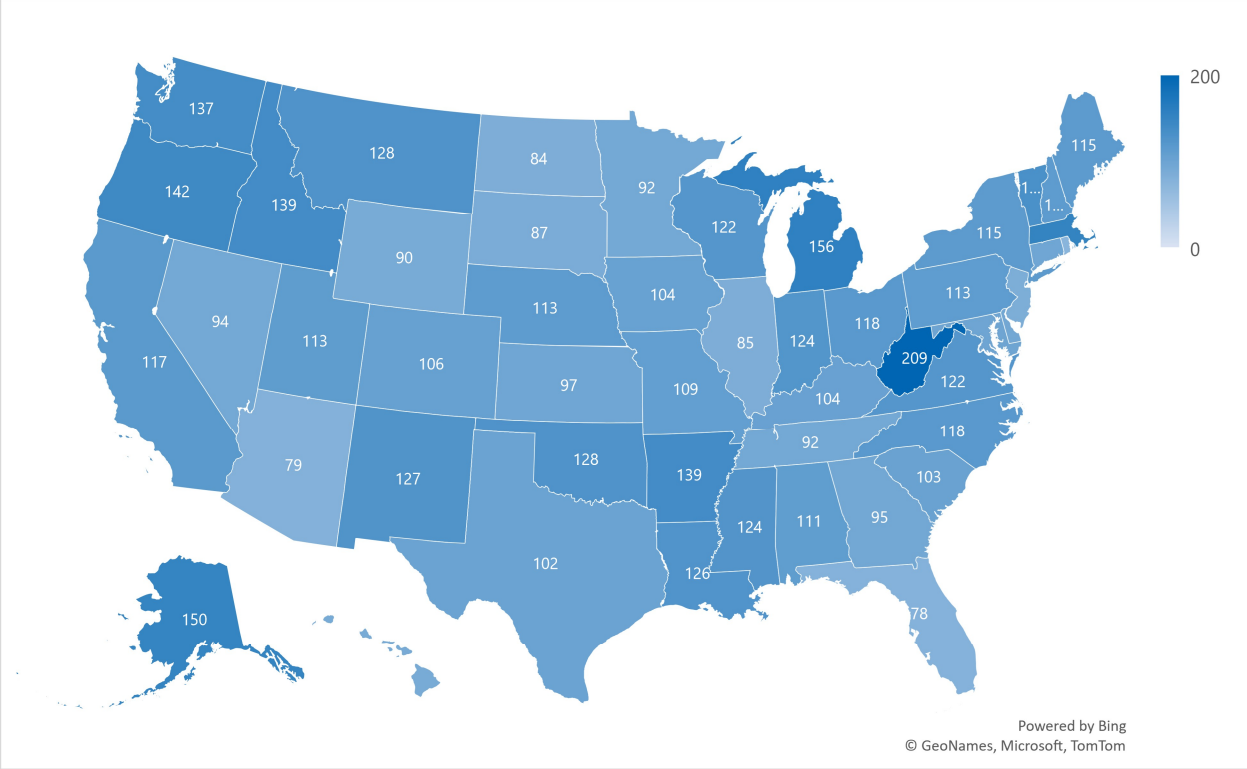


Figure 18: 2020 Customer Average Interruption Duration Index (CAIDI) without Major Event Days in Minutes



Michigan Electric Utility Performance

Electric co-ops are the least reliable utilities in Michigan and municipal utilities are the most reliable, with investor-owned utilities (IOUs) landing somewhere in between.

The causes of these trends are reasonably clear. Michigan's cooperative utilities serve predominantly rural areas and include many miles of distribution lines to serve comparatively few customers. These lines are almost always above ground and are exposed to weather and tree damage. Conversely, Michigan's municipal utilities serve the discrete boundaries of cities or towns, have lower total mileage of distribution lines and may have some of these lines buried, making them less susceptible to the weather and tree damage that plague the co-ops' lines. Michigan's IOUs serve a mix of areas and are thus subject to both sets of conditions in differing measures.

Figure 19: 2020 System Average Interruption Duration Index (SAIDI) in Minutes for Michigan Utilities

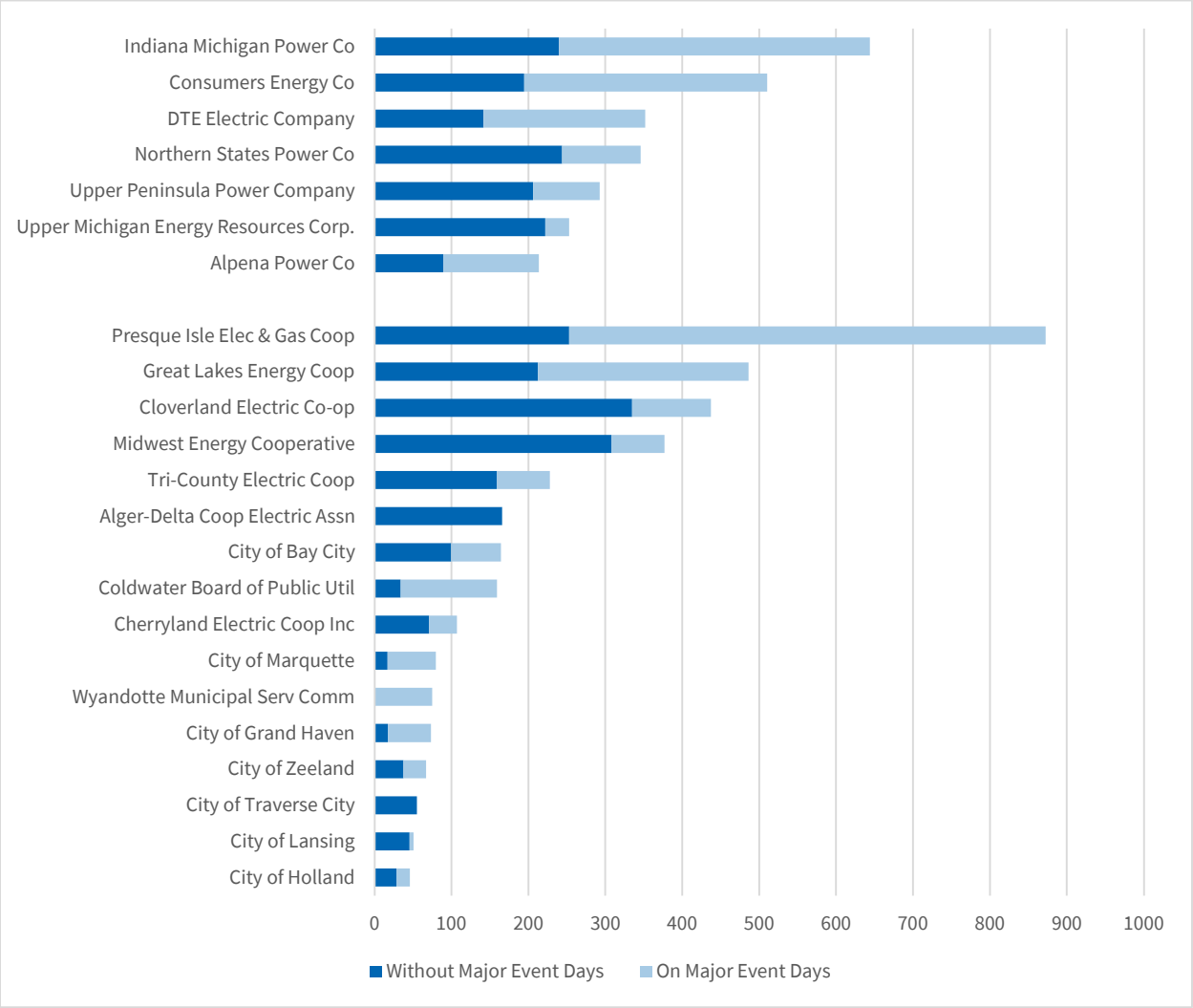


Figure 20: 2020 System Average Frequency Interruption Index (SAIFI) in Number of Outages for Michigan Utilities

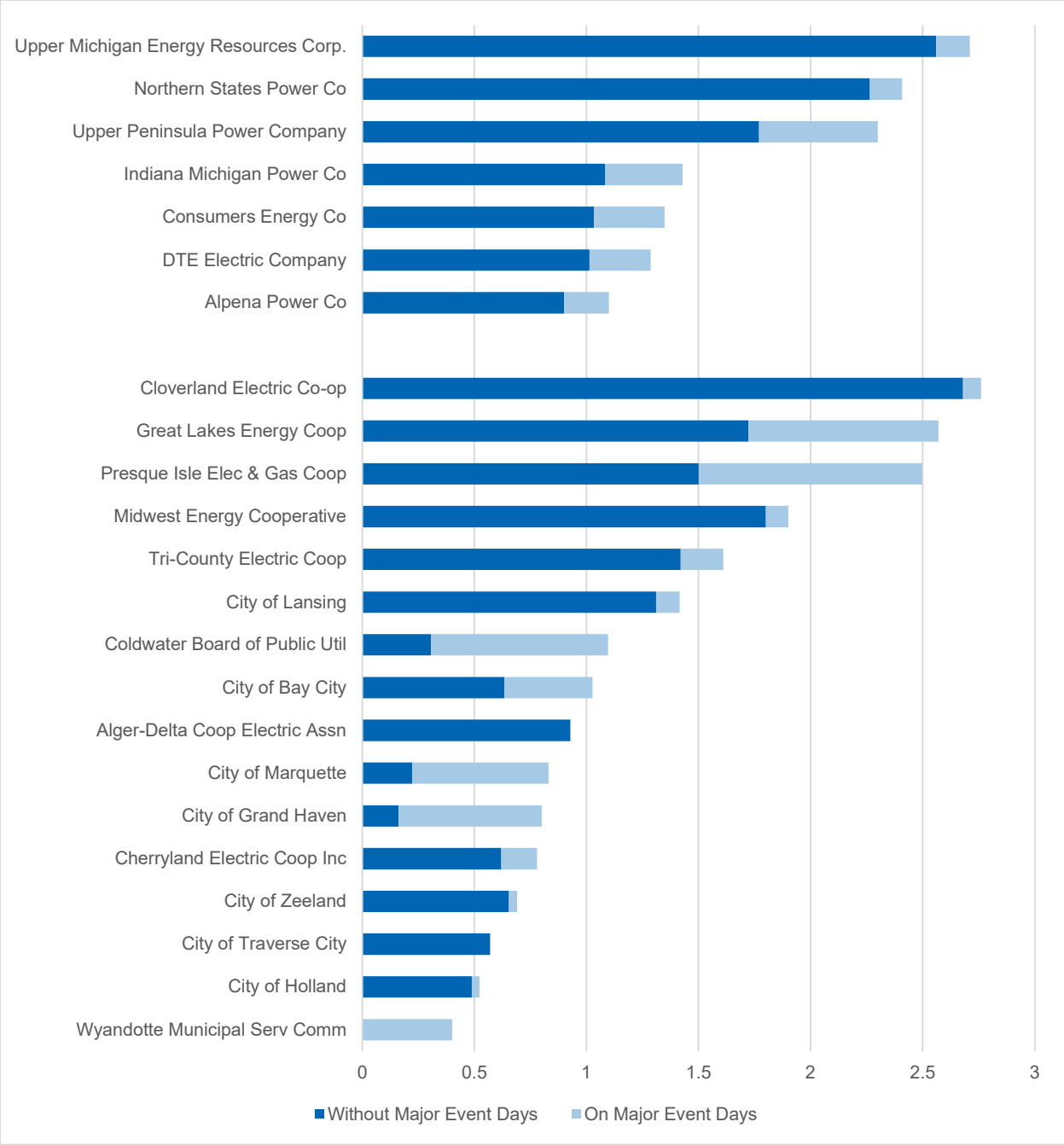
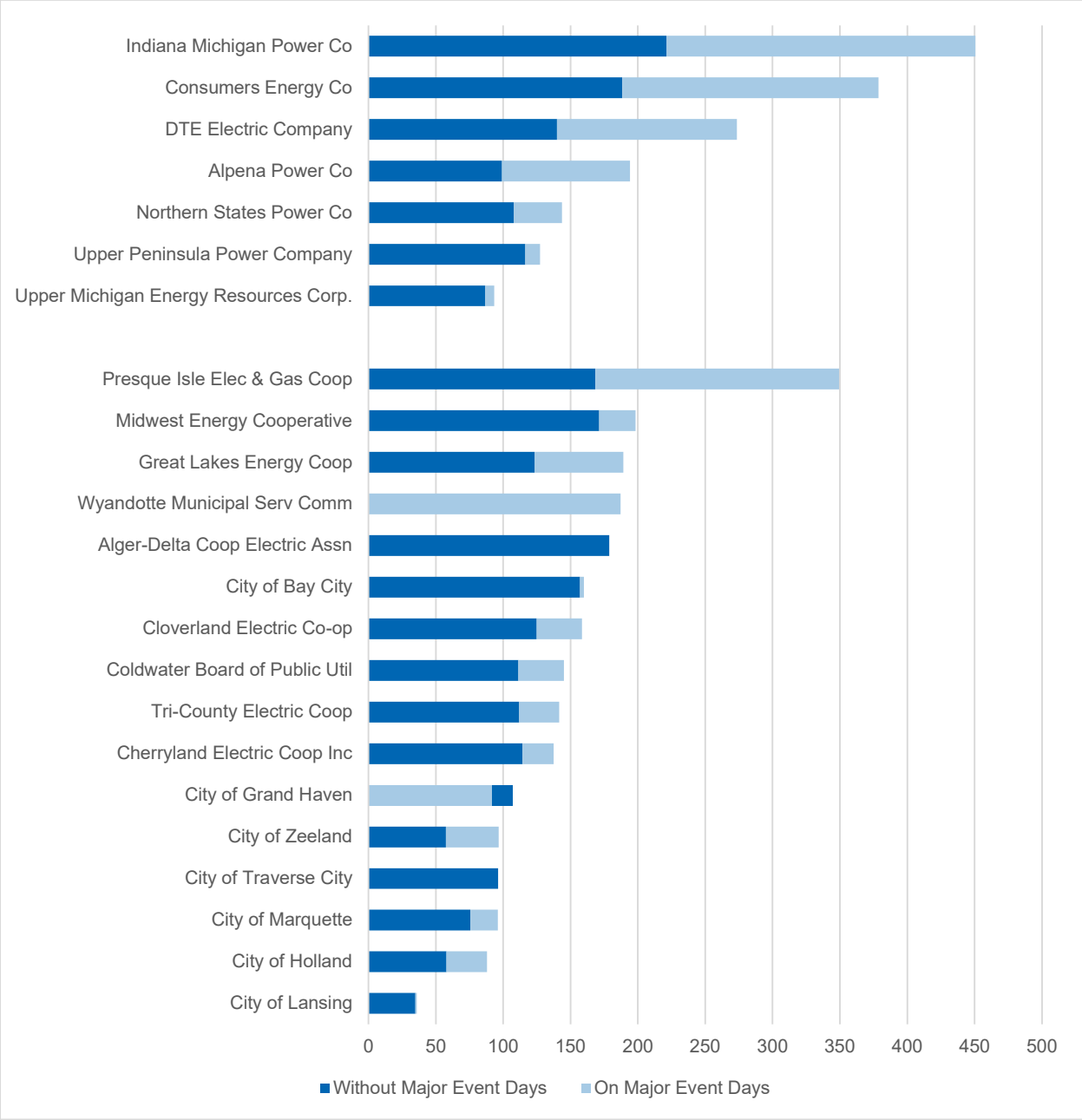


Figure 21: 2020 Customer Average Interruption Duration Index (CAIDI) in Minutes for Michigan Utilities



Gas Utilities Overview

Gas utilities do not record reliability metrics like electric utilities. This dearth of reliability data may be due to our natural gas infrastructure being generally more reliable than our electricity infrastructure since natural gas lines are mostly buried and less likely to be damaged by storms, wildfires or wildlife.

Furthermore, when natural gas lines are disrupted only slightly, they continue to function. Unless a natural gas line is severed or leaking massively, the system may still be pressurized well enough to fulfill customers' needs, leading to the problem of long-term undetected leaks. These leaks are dangerous because natural gas is highly flammable if ignited and can cause asphyxiation in high concentrations. In addition, natural gas is a potent greenhouse gas, with a lifetime atmospheric heating capacity 25 times that of carbon dioxide. The Emissions from Natural Gas section of this report quantifies the potential greenhouse effects of leaked natural gas.

Natural gas data are collected as part of form EIA-176. This form records total supply, disposition, losses and unaccounted-for gas. Losses are due to pipeline leaks, accidents, damage, thefts or blow down. Pipeline leaks tend to occur in a utilities' distribution infrastructure—the numerous smaller pipes that run to homes and businesses. Unaccounted-for gas is the difference between the total supply and the total disposition (accounting for consumption, deliveries, or losses). Sources of unaccounted-for gas could be recording errors or physical losses not included in the previous list.

Unaccounted-for gas can take on positive or negative values, depending on the difference between total supply and total disposition, with a negative value implying more gas was delivered than a utility accounted for purchasing or producing.

Figure 23 shows natural gas losses as a percentage of sales as an indication of gas utility reliability. This is a useful statistic, but it is imperfect, because states that produce natural gas for export may show leaks from their production and export infrastructure as losses, thus skewing the ratio of losses to in-state sales and absorbing some of the losses that could be attributable to the states that import their natural gas.

Losses

As shown in Figure 22, Michigan recorded the sixth-highest amount of natural gas losses. As a percentage of total sales, losses amounted to 1.32%, ninth-highest among states in 2020 as shown in Figure 23.

Figure 22: 2020 Lost Natural Gas in Billions of Cubic Feet

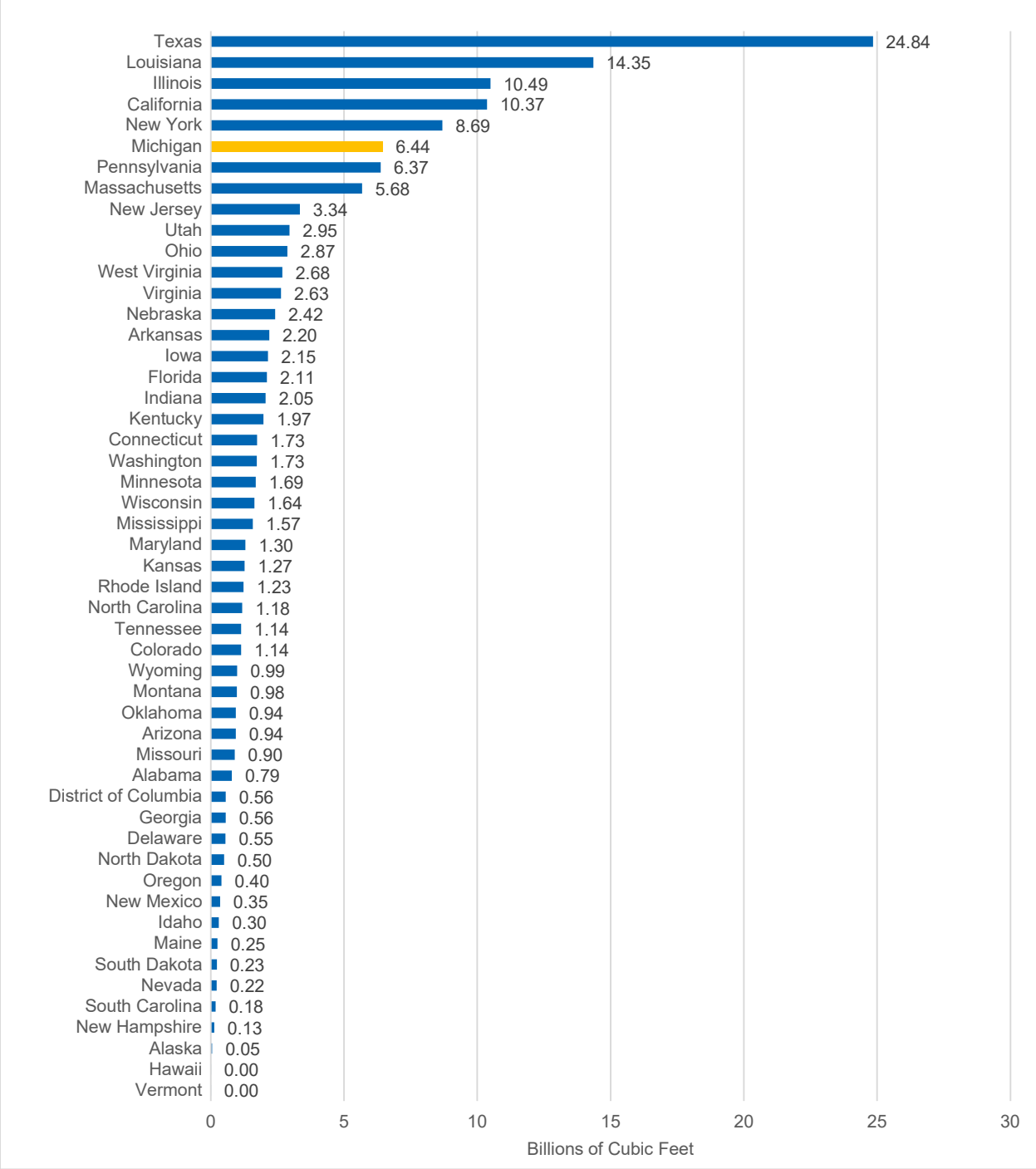


Figure 23: 2020 Lost Natural Gas as a Percentage of Sales

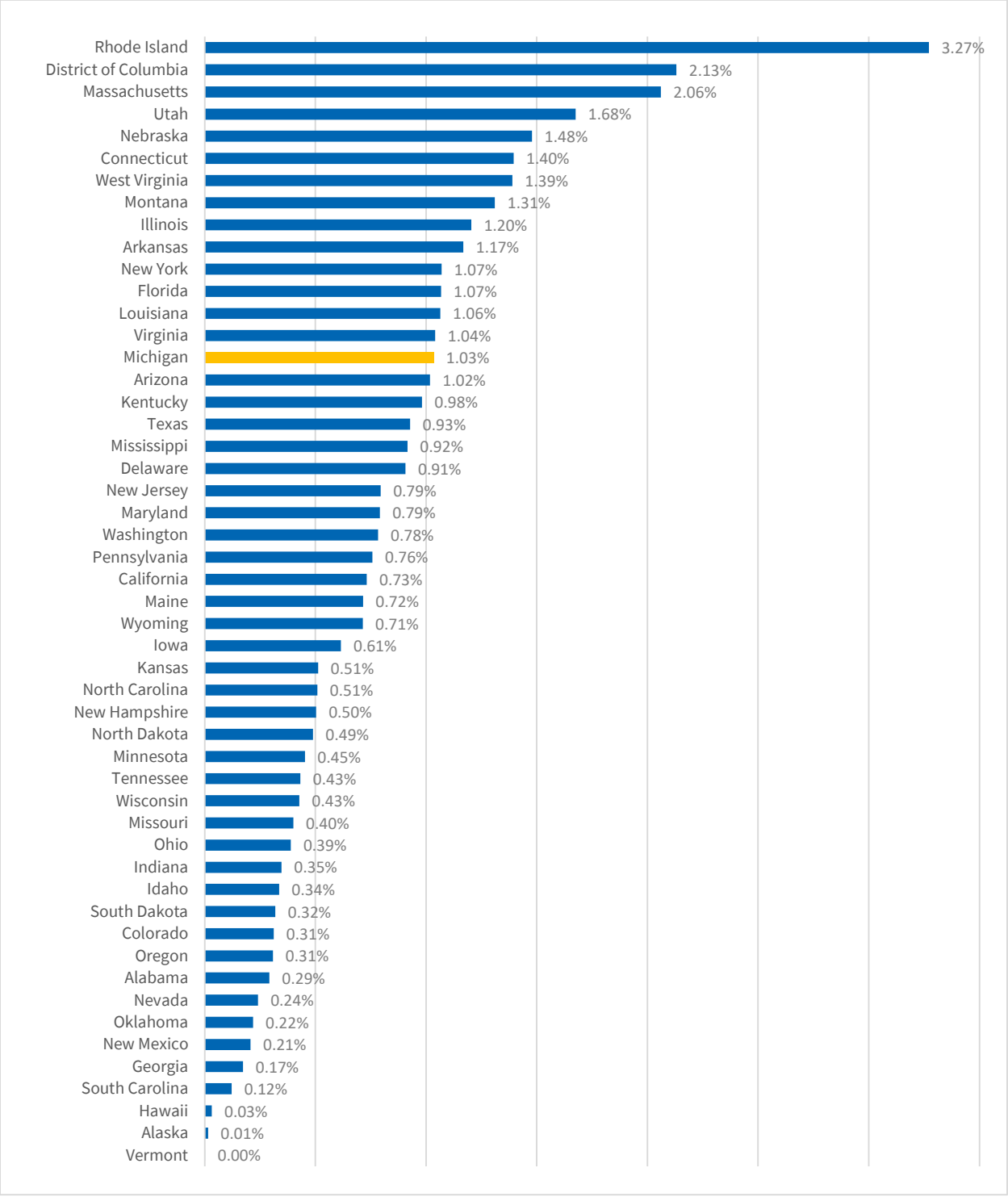


Figure 24: 2020 Lost Natural Gas in Billions of Cubic Feet Map

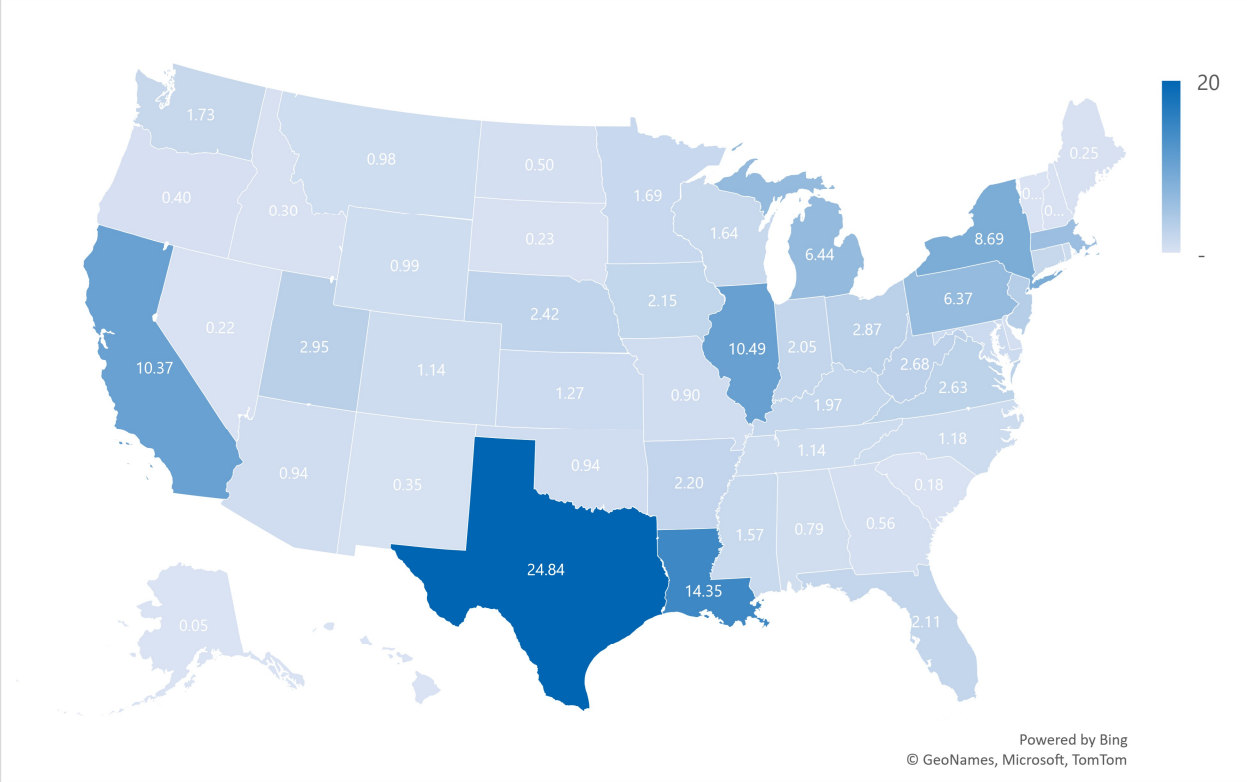
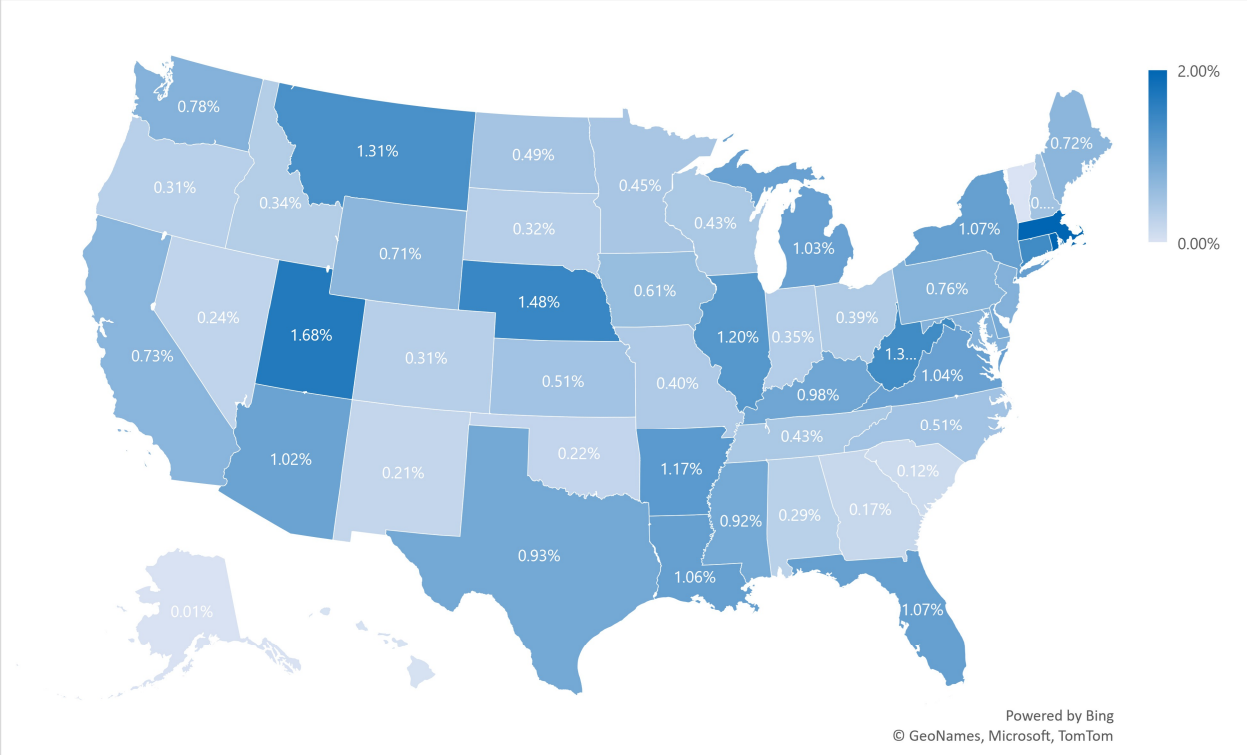


Figure 25: 2020 Lost Natural Gas as a Percentage of Total Sales Map



Unaccounted

Unaccounted-for natural gas can take on positive or negative values, depending on the difference between total supply and total disposition.

Figure 27 shows unaccounted-for gas amounted to only 0.28% of total sales in Michigan in 2020, while 1,985 million cubic feet were unaccounted-for in Michigan, 33rd highest total among the states (Figure 26).

Figure 26: 2020 Unaccounted for Natural Gas in Billions of Cubic Feet

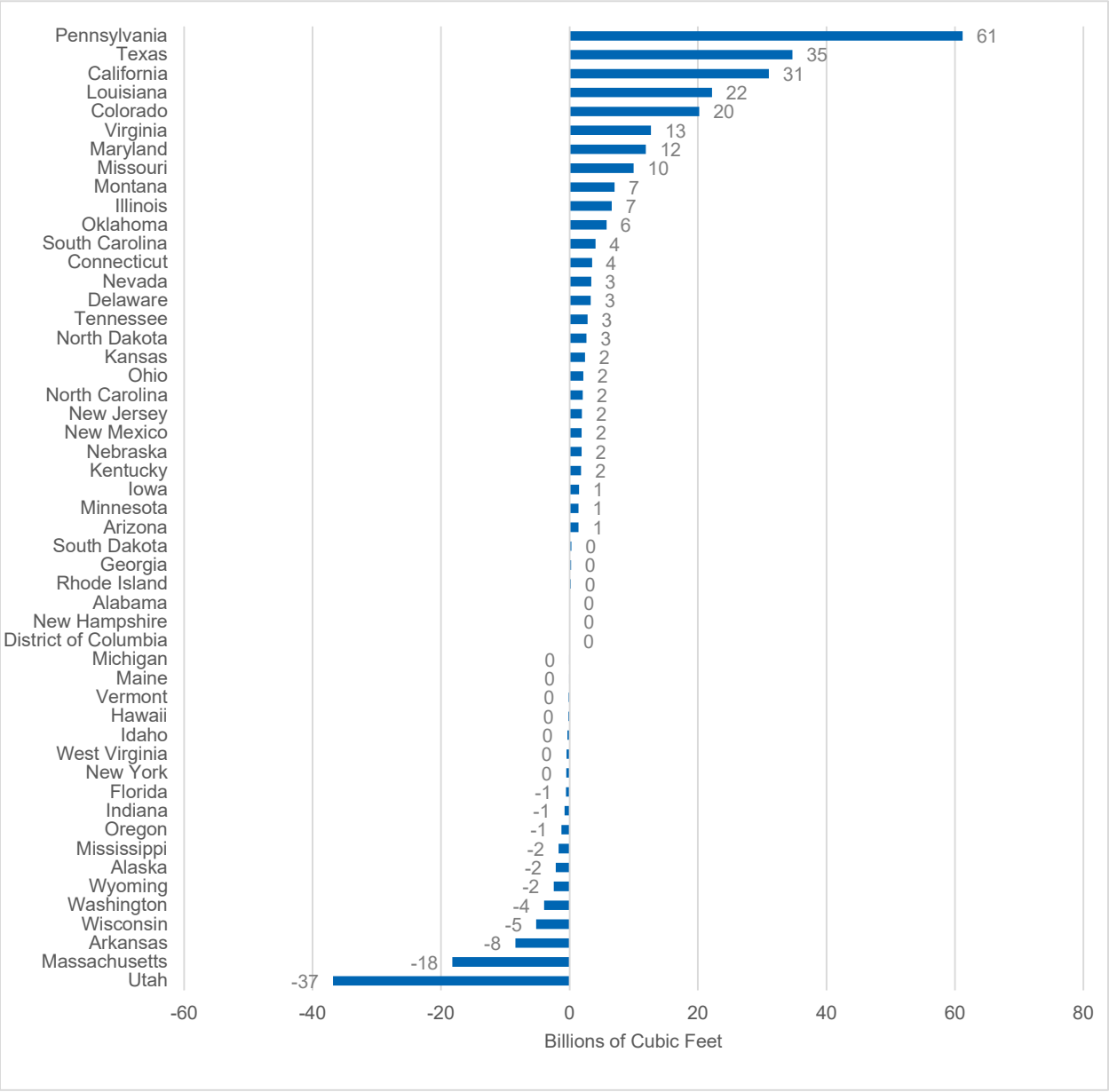


Figure 27: 2020 Unaccounted for Natural Gas as a Percentage of Sales

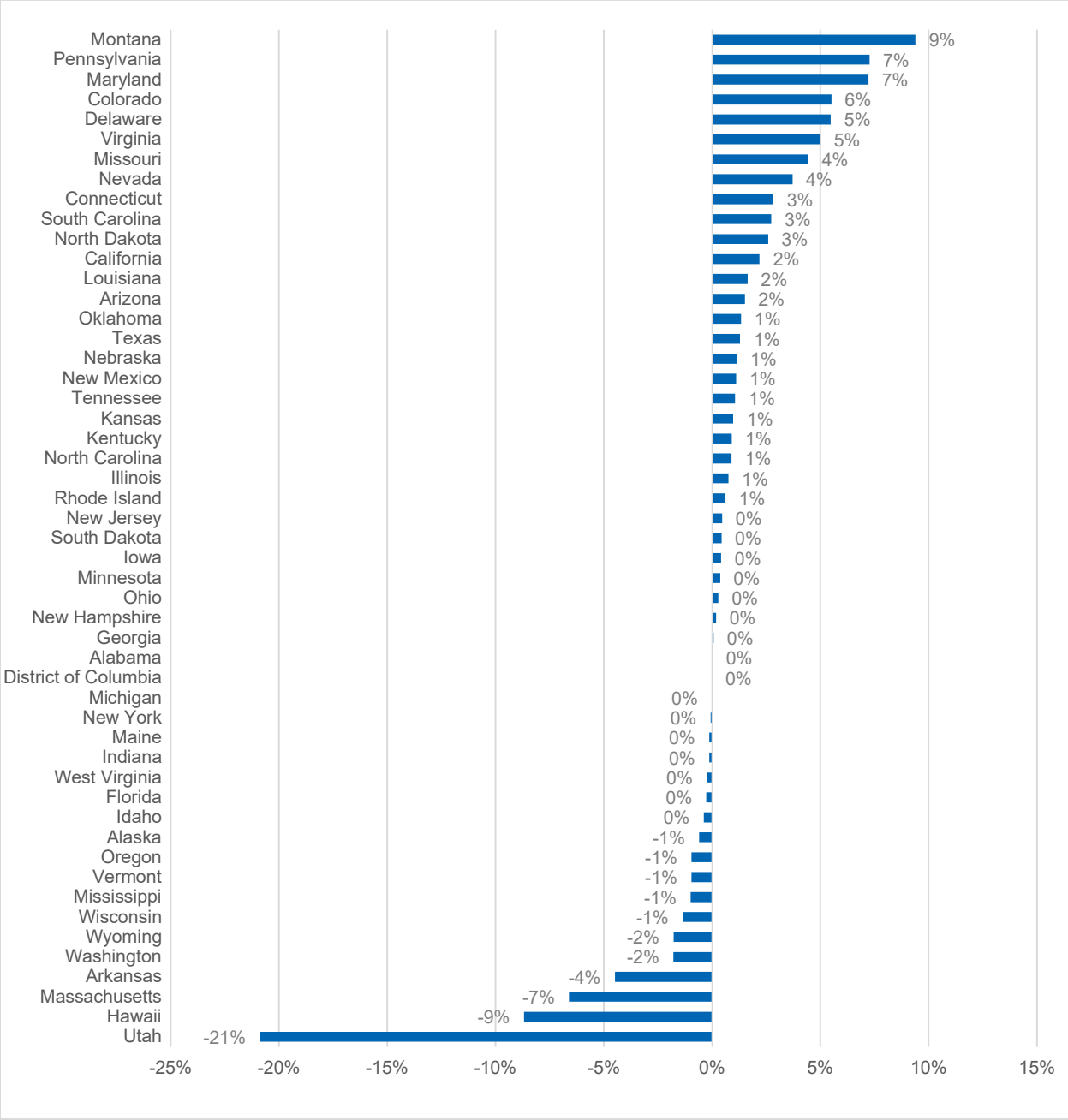


Figure 28: 2020 Unaccounted for Natural Gas in Billions of Cubic Feet Map

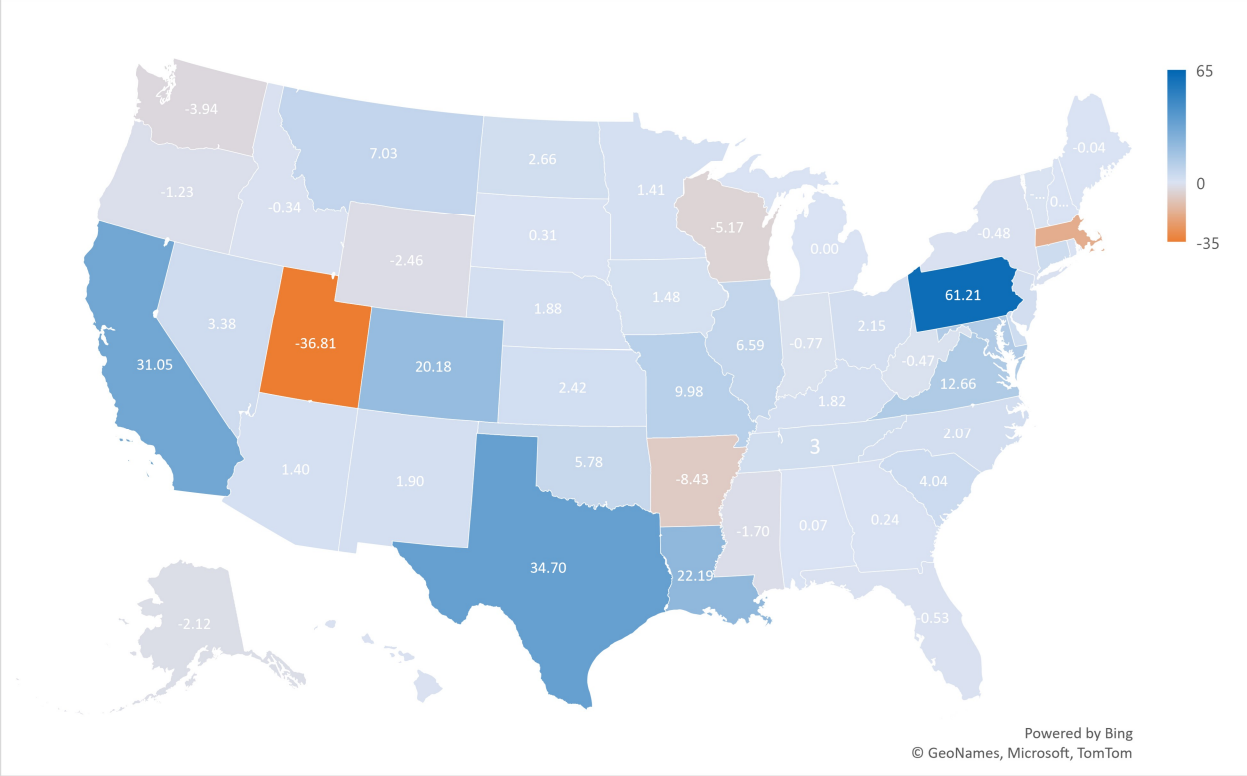
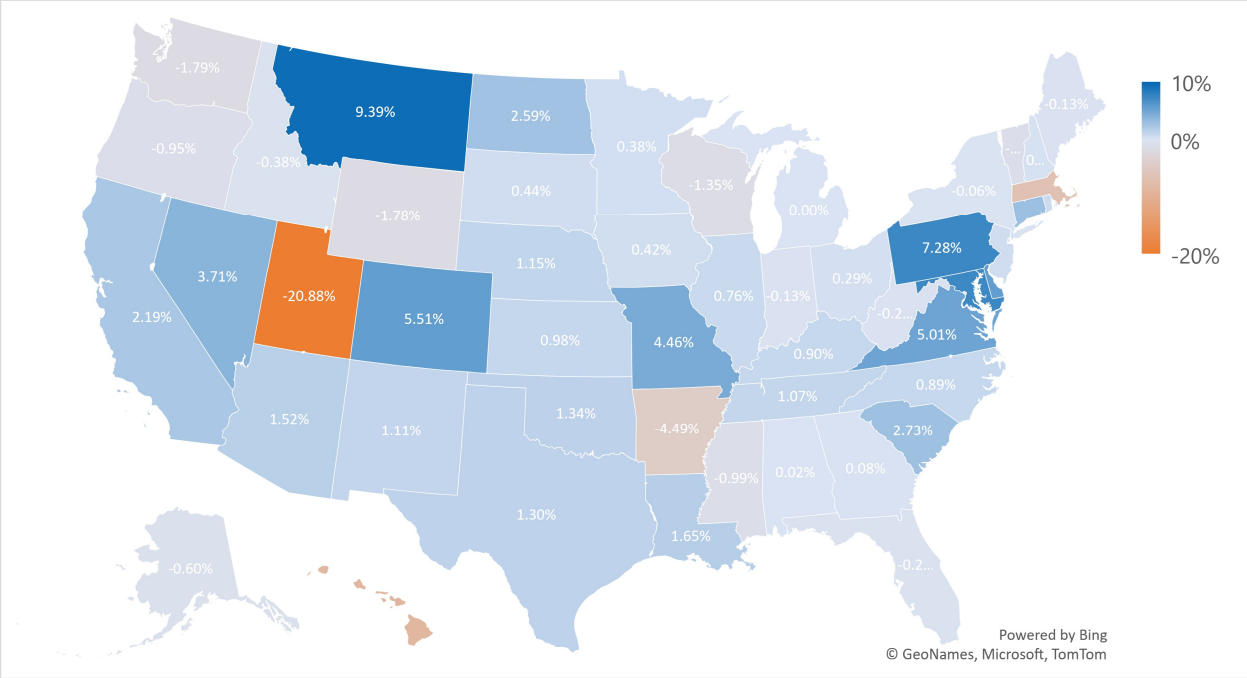


Figure 29: 2020 Unaccounted for Natural Gas as a Percentage of Sales Map



Michigan Gas Utility Performance

A notable trend in Michigan's gas utility performance can be seen in DTE Energy's and Consumers Energy's relative losses and unaccounted-for natural gas statistics. DTE reports the largest natural gas losses of any Michigan utility by far, but no unaccounted-for gas in 2020. In contrast, Consumers reports low levels of lost natural gas, but large amounts of unaccounted-for gas. It is possible that Consumers' unaccounted-for natural gas is lost natural gas, but Consumers is doing a worse job of tracking it than DTE. If this were the case, then the major discrepancy between Consumers and DTE in natural gas losses would be much smaller. However, without further research no conclusions can be made definitively.

Figure 30: 2020 Natural Gas Losses in Millions of Cubic Feet for Michigan Utilities

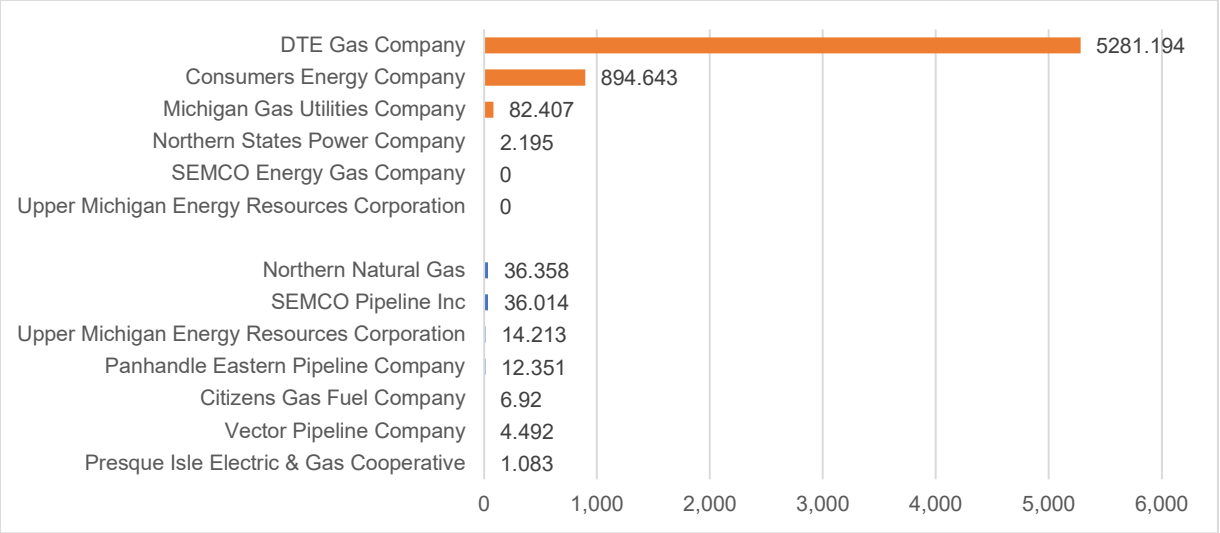
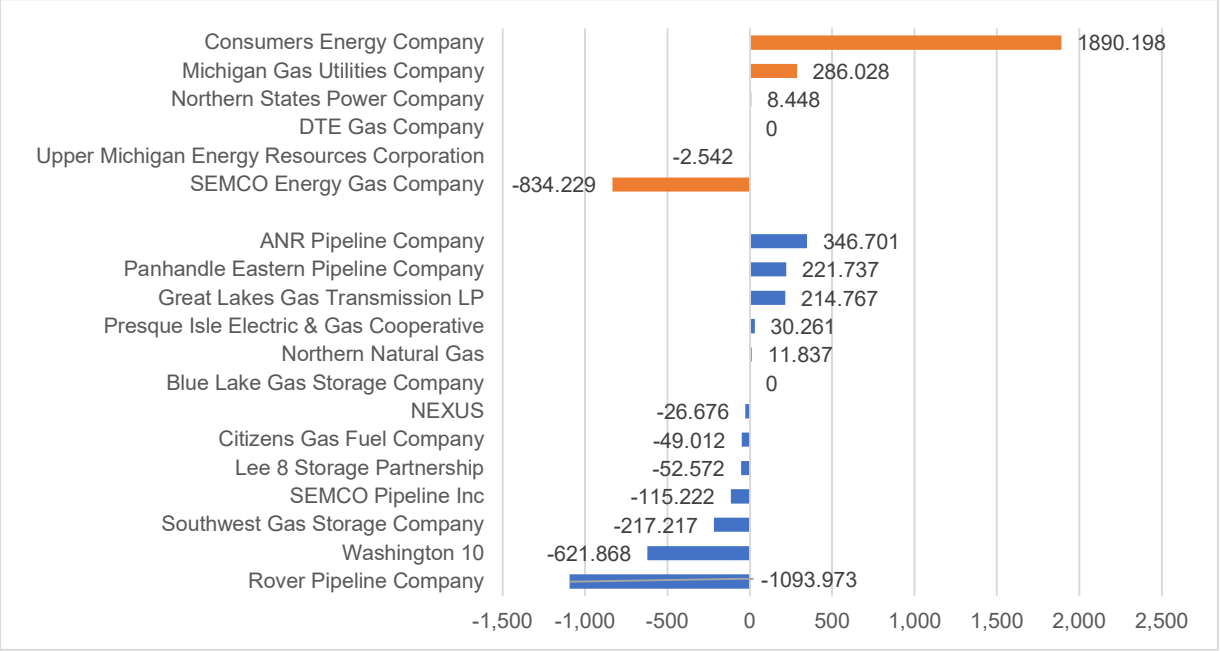


Figure 31: 2020 Unaccounted-for Natural Gas in Millions of Cubic Feet for Michigan Utilities



HOUSEHOLD ENERGY

American homes use a variety of forms of energy on a day-to-day basis. Almost every American home has access to electricity, and some homes use electricity as their exclusive source of energy as it is highly adaptable, and can be used for lighting, powering tools and electronics and cooling homes. It can also be used for household heating through resistance heat, and, increasingly, through air-source and ground-source heat pumps.

However, many homes have multiple energy sources, the most prevalent of which, after electricity, is natural gas. Natural gas is commonly used for heating homes and water, cooking and drying clothing. Beyond electricity and natural gas, Americans use a variety of other fuels as sources of heat, including propane, kerosene, fuel oil, wood and more. Given their relatively limited use compared with electricity and natural gas, this report aggregates all fuel sources other than electricity and natural gas into a category called "other heating fuels."

The *Household Energy* section of the document is broken down into the following subsections:

- Affordability
- Fuel Sources
- Residential Energy Use
- Residential Electricity Costs and Expenditures
- Residential Natural Gas Costs and Expenditures
- Residential Other Heating Fuel Costs and Expenditures

Affordability

This subsection takes a broad look at energy affordability, which we quantify through the metric of energy expenditures as a percentage of state median income. For these figures, energy expenditures refer to expenditures on all forms of energy combined, which includes electricity, natural gas and other heating fuels.

The broad trends in affordability show that some of the least affordable states are relatively low-income southern states with high electricity bills for cooling, such as Mississippi, Alabama and Georgia, as well as cold northern states with high fuel costs and use and state median incomes closer to the mean, such as Vermont and Maine (Figure 33 and Figure 35).

In 2020 Michigan rated 14th-worst on energy expenditures as a percentage of median income, five ranks worse than in 2019. In 2020 The average Michigan household spent 3.22% of its income on energy (Figure 33). In absolute terms, the average Michigan household spent 2,055 dollars on energy, making Michiganders' energy bills the 12th-highest in the nation (Figure 32), four ranks worse than in 2019.

Figure 32: 2020 Household Energy Expenditures

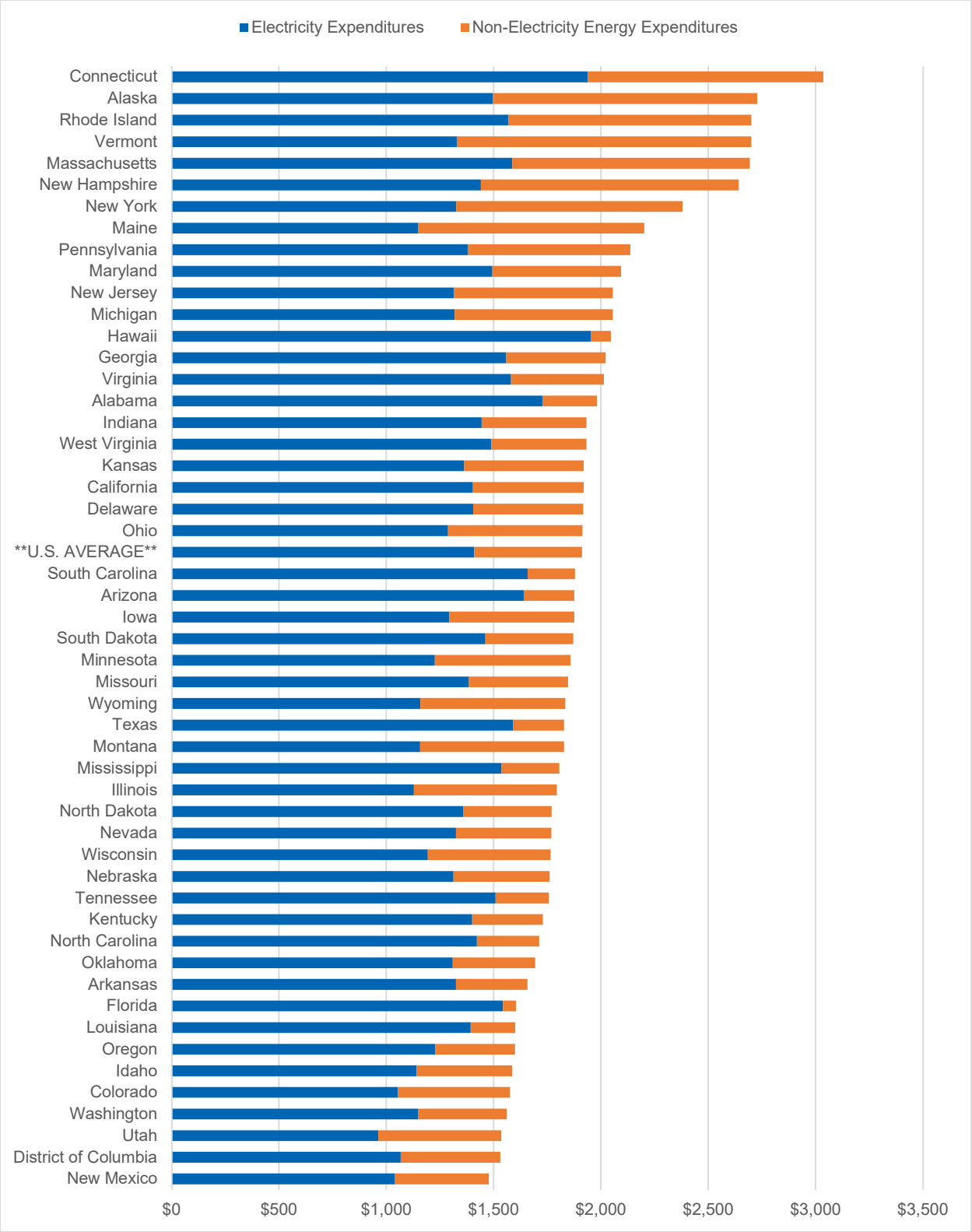


Figure 33: 2020 Household Energy Expendigures as a Percentage of Median Income

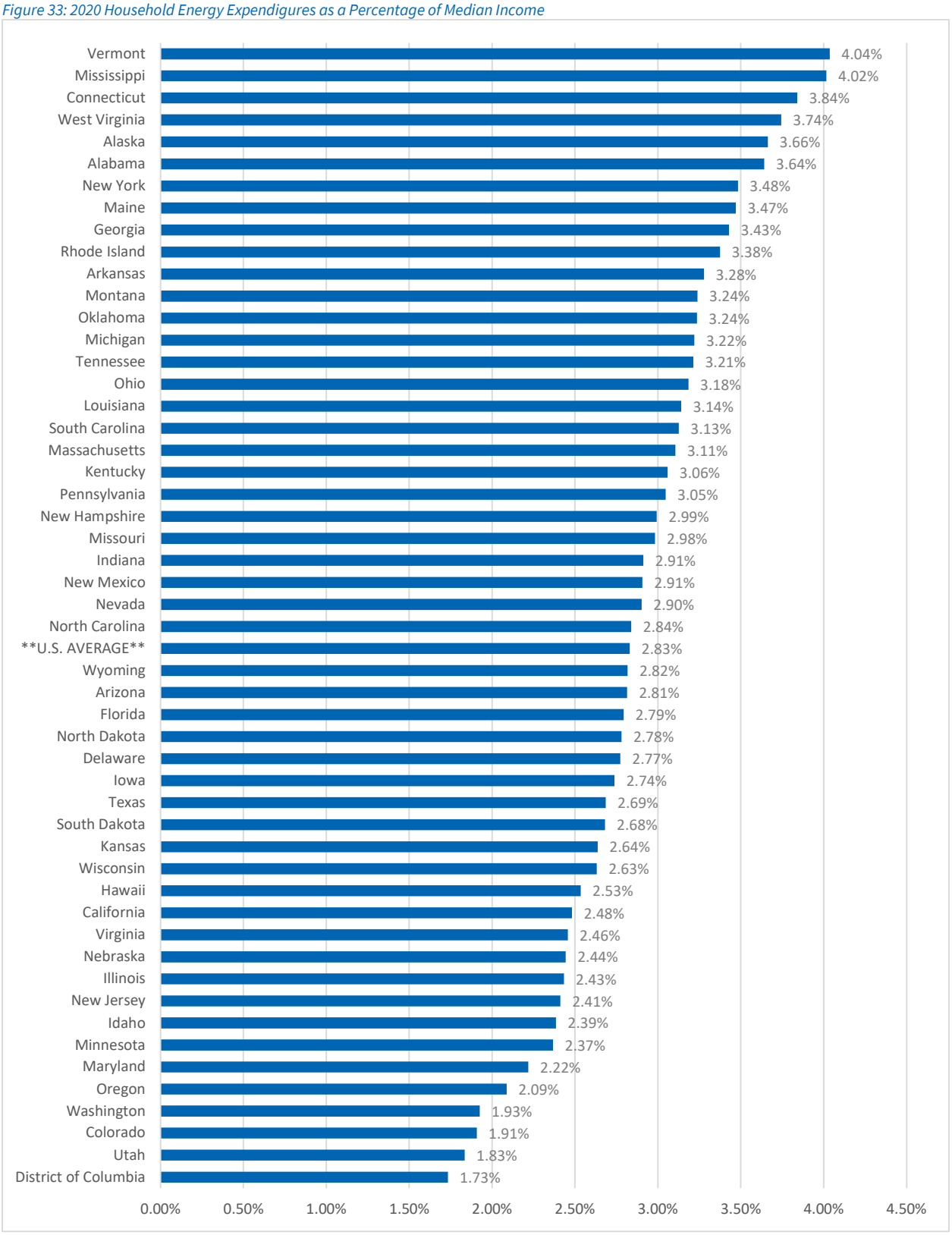


Figure 34: 2020 Household Energy Expenditures

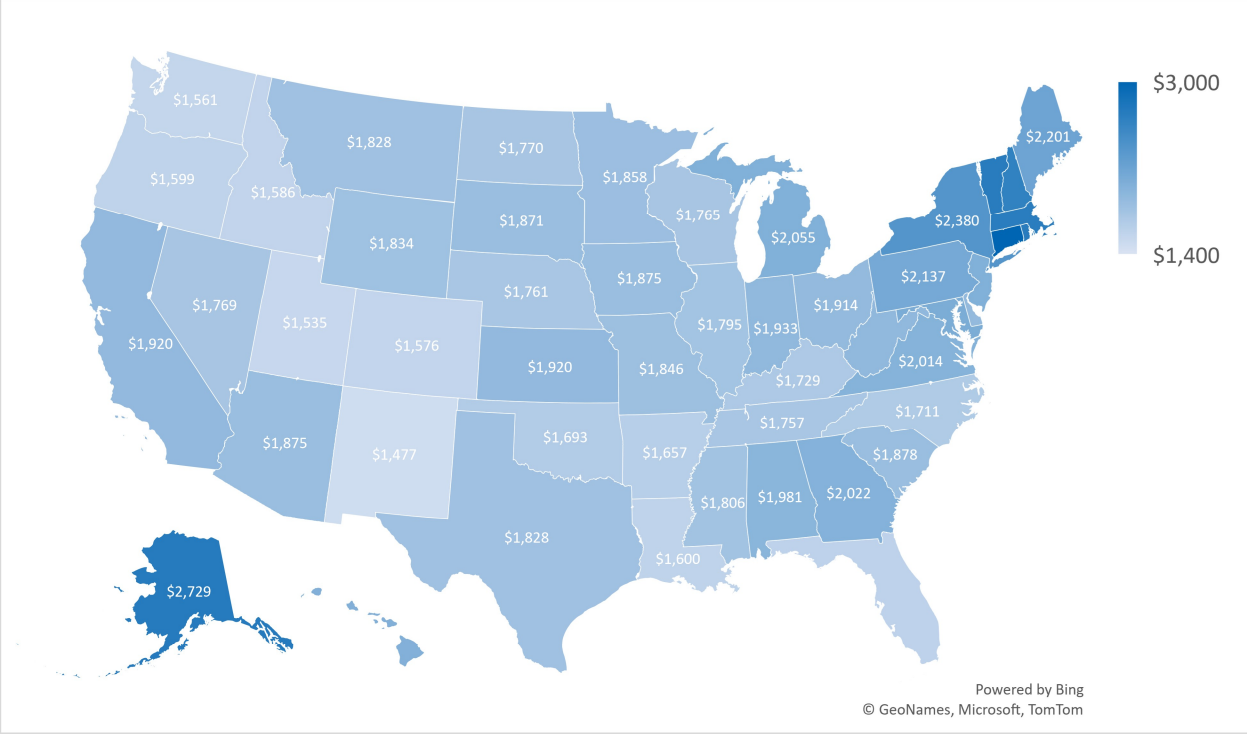
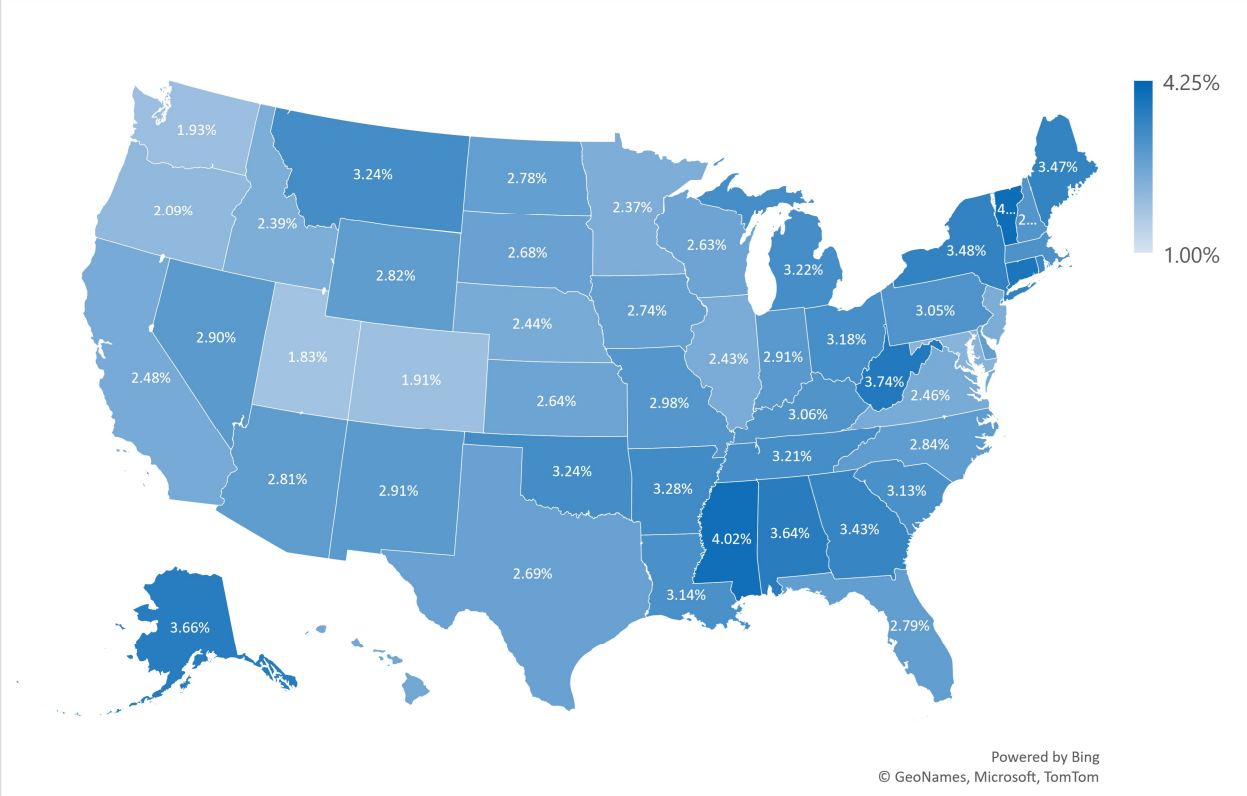


Figure 35: 2020 Household Energy Expenditures as a Percentage of Median Income



Heating Fuel Sources

The type of fuel American households use for heat, both for home heating and for other heat uses such as cooking, hot water heating and clothes drying, is dependent on factors such as geography, average daily temperature, access to infrastructure and relative fuel costs.

In recent history natural gas, and in some places, other heating fuels, are on a cost per energy unit basis more affordable than electricity for producing heat. This trend is beginning to be upended by the increasing accessibility of high-quality, low-temperature, air-source heat pumps, but for the time being, economics support the use of direct heat sources for household heating. Thus, colder, northern states are unlikely to heat with electricity, whereas southern states are generally content to use resistance electric heat, or air-source heat pumps which can easily provide enough heat for cold days in Southern states. The advantage of having only an electric hookup is the cost savings from avoiding the need for a furnace and gas or other heating fuel hookup.

Access to infrastructure, however, also drives the choice of heating fuel sources. For instance, access to natural gas distribution is a product of population density and the age of a state's infrastructure and housing stock. Given North Dakota's cold climate, one might reasonably expect that homes would heat with natural gas or other heating fuels, but a surprising 41% of North Dakotans heat with electricity (Figure 38), and fewer than half heat with natural gas, whereas nearby Minnesota has a 66% penetration of natural gas heating and a mere 18% of Minnesotans heat with electricity (Figure 38 and Figure 39). This phenomenon appears to be the product of relatively low population density in North Dakota compared to Minnesota, which has some major urban centers, making the development of natural gas infrastructure in North Dakota uneconomical for natural gas distributors.

The Northeastern US shows very few homes heating with electricity but a high penetration of other heating fuels (Figure 40). This trend is less the product of low-population density, as these Northeastern states are some of the densest, and more the product of older housing stock and infrastructure.

Most of the data in this subsection come from the EIA, but data on which fuel sources are used for home heating come from the United States Census Bureau, specifically from American Community Survey (ACS) form S2504, which gathers information on physical housing characteristics of occupied housing.

In 2020 10% of Michigan's population heated their homes with electricity, making Michigan households the 48th-most likely to be heating with electricity.

In 2020 76% of Michigan's population heated their homes with natural gas, making Michigan households the third-most likely to be heating with natural gas.

In 2020 13% of Michigan's population heated their homes with other heating fuels, making Michigan households the 23rd-most likely to be heating with other heating fuels.

Figure 36: 2020 Number of Households Heating by Fuel Type

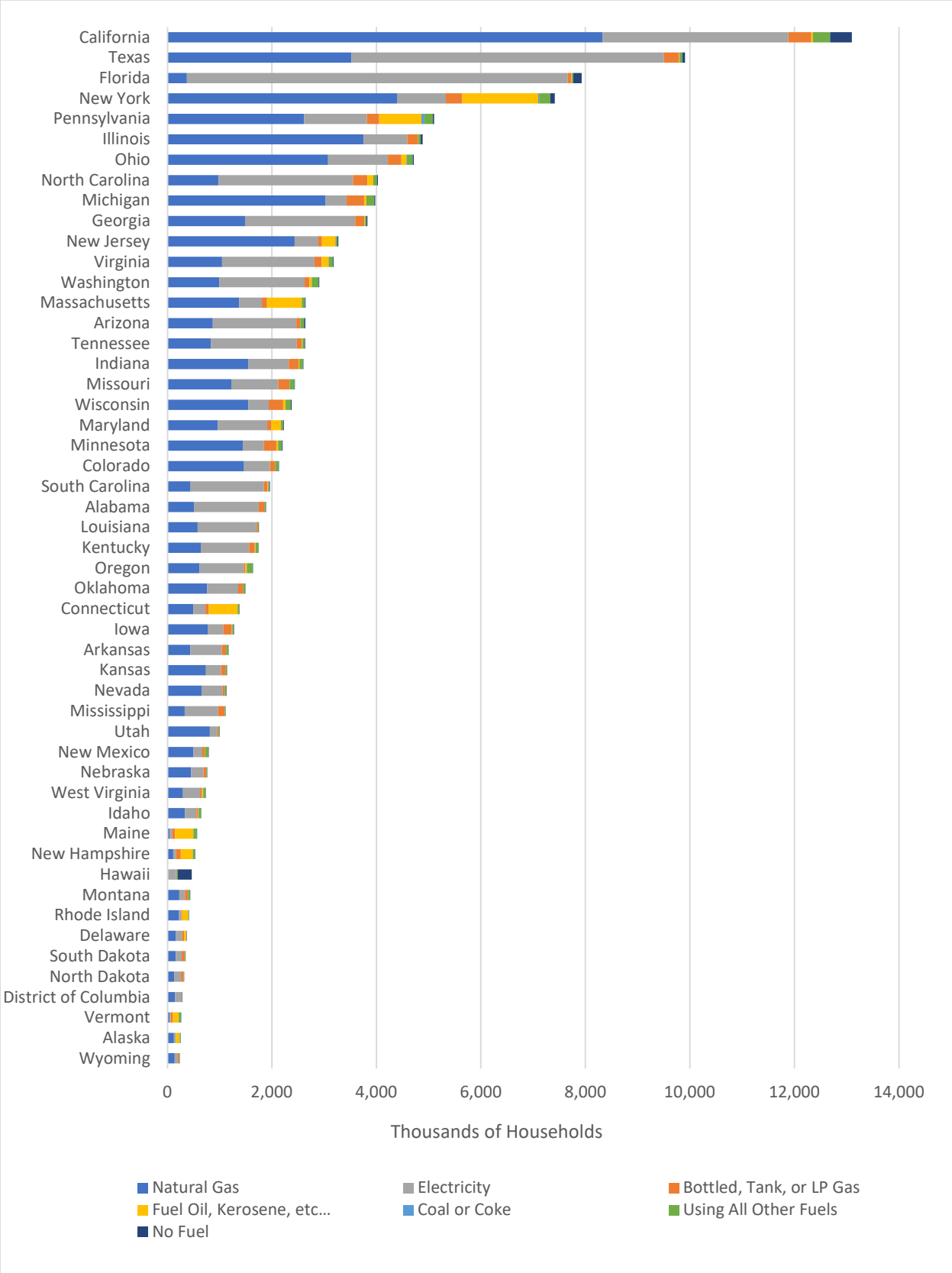


Figure 37: 2020 Percentage of Households Heating by Fuel

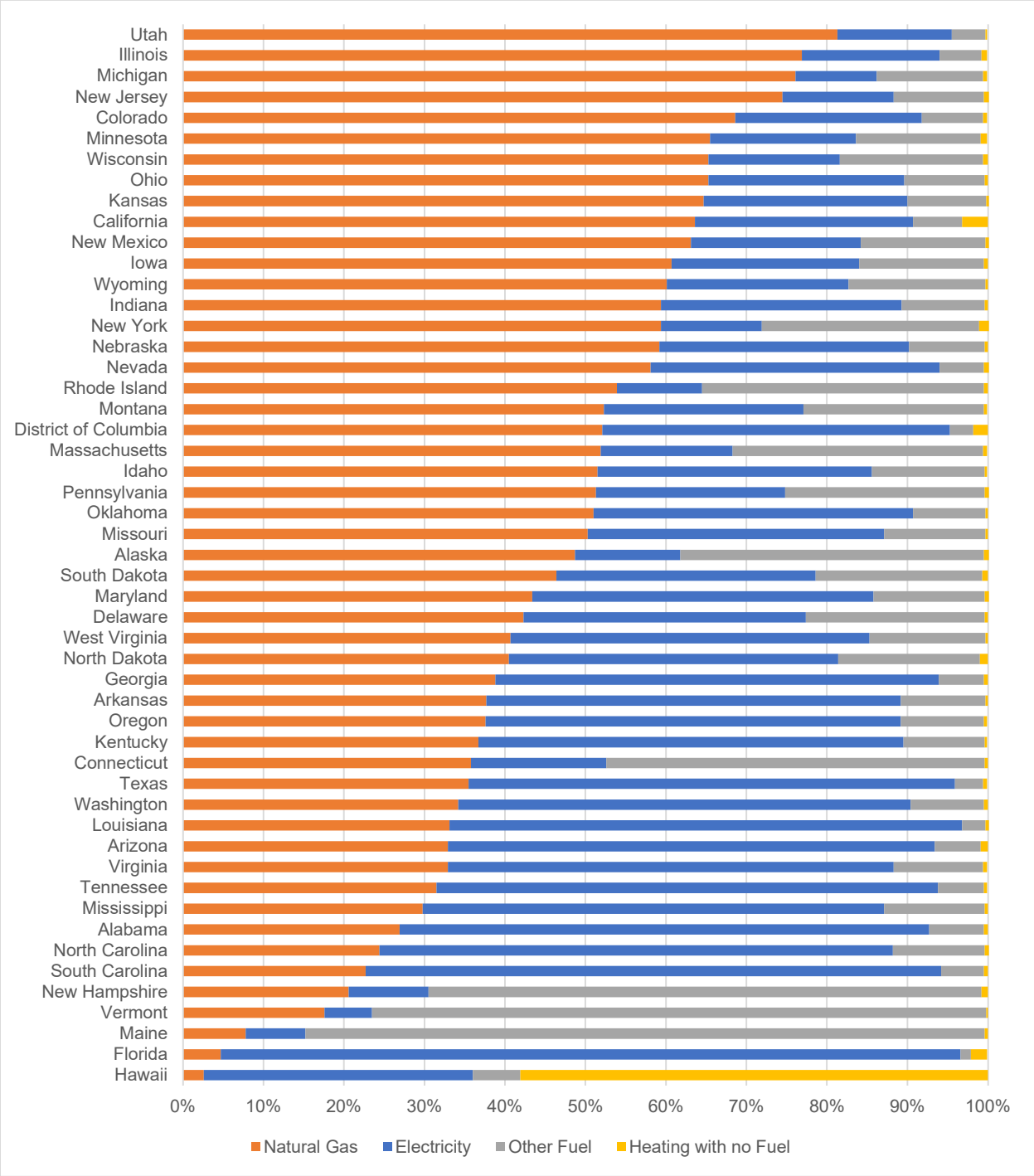


Figure 38: 2020 Percentage of Households Heating with Electricity

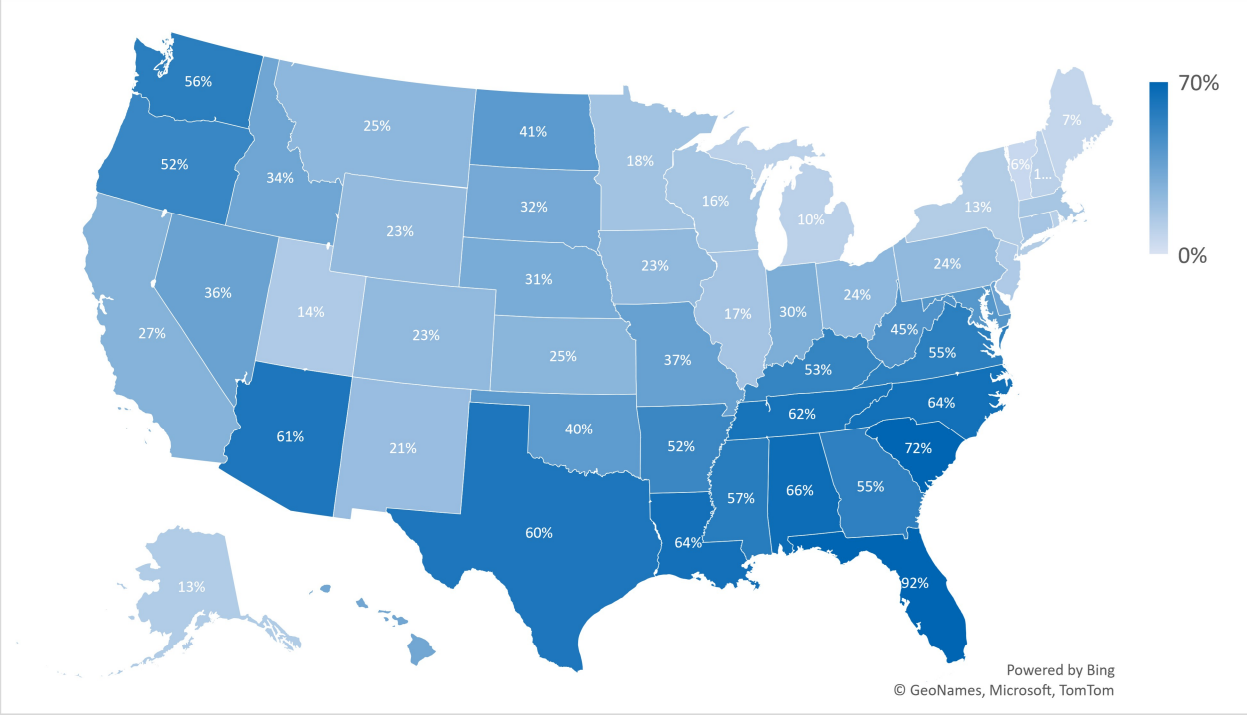


Figure 39: 2020 Percentage of Households Heating with Natural Gas

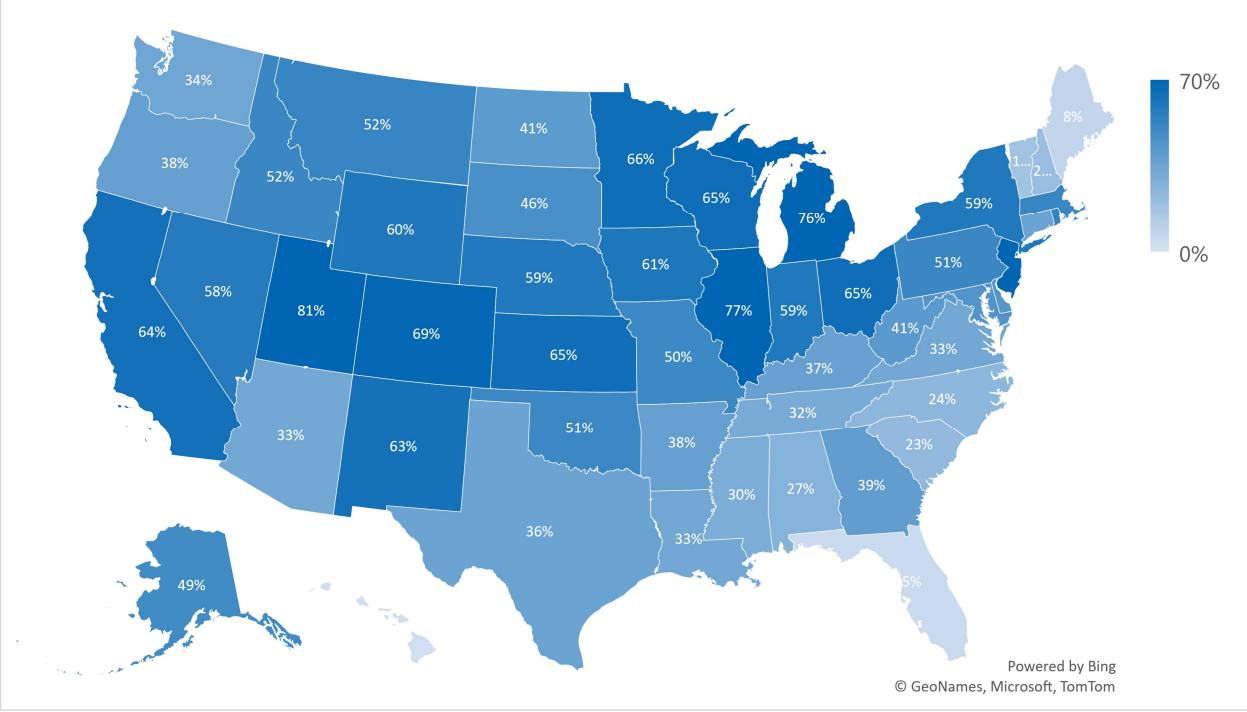
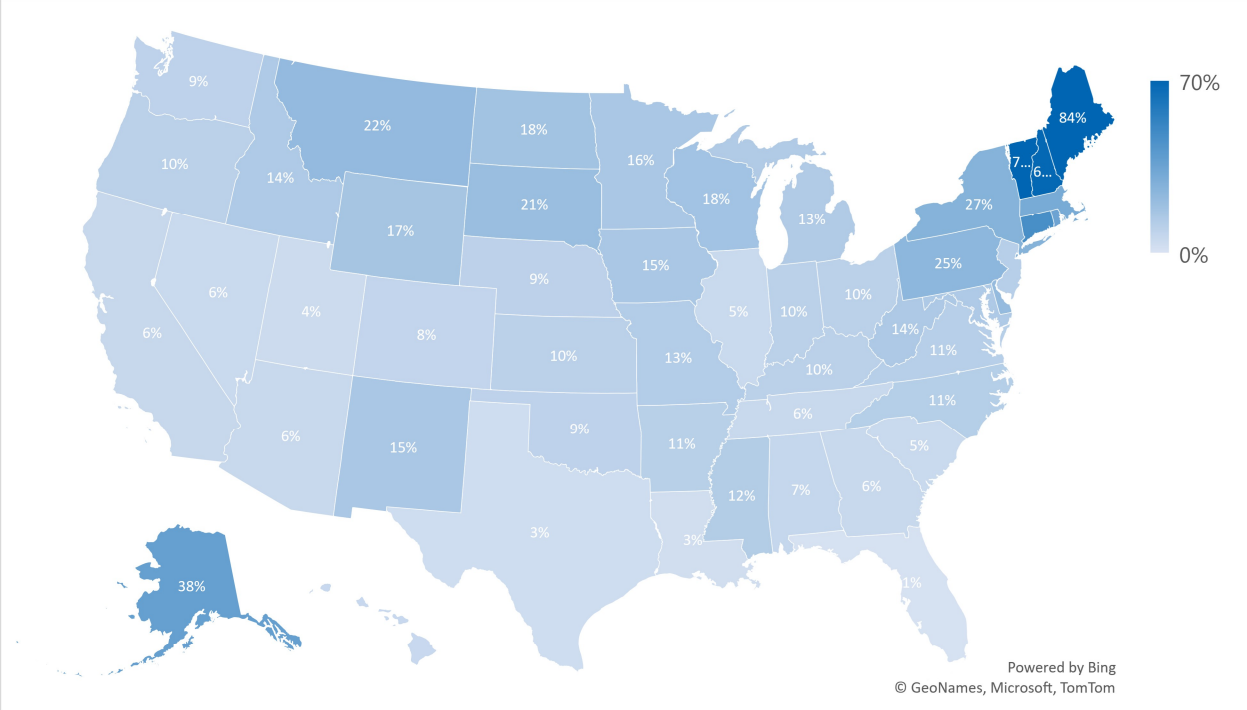


Figure 40: 2020 Percentage of Households Heating with Other Heating Fuels



Household Energy Use

This subsection shows the average residential household use of energy sources. Customers who do not use a particular source do not count toward that source's average use—if a residential property lacks a natural gas hookup, for example, that property does not affect the average natural gas use by customers in that state.

Figures for natural gas and other heating fuels are shown in both their native energy units—therms for natural gas, and MMBTU for other heating fuels—as well as in kWh. This conversion of energy units to a common unit allows for comparison of use between energy types.

The clearest trend in electricity use is that warmer southern states use more electricity than northern states (Figure 42). This use is mostly driven by air conditioning but may also be affected by the use of electricity as a sole energy source for cooking and home heating. A less intuitive trend is that high use is observed in the Dakotas. This observation tracks with the figures discussed in *Fuel Sources* above, which show that a high percentage of homes are heated with electricity in these relatively cold states (Figure 38)**.** However, the degree of electricity necessary to heat individual homes in the Dakotas may not be reflected in the values shown, as nearly every home in the Dakotas has an electricity hookup, but only 41% heat with electricity, meaning that the trend of high electricity use in these states is being driven by less than half of the states' populations. As concerns about climate change and improvements in heat pump technology drive the electrification of household heating in more northern states, alongside the proliferation of electric vehicles, we may see shifts to the macro-trends described.

Unlike electricity, with its diverse uses, homes with natural gas hook-ups or those heating with other fuels are likely to be using those fuels, at least in colder states, primarily for household heat, with the use of these fuels for cooking and hot water heating being relatively small compared to home heating.

For electricity and natural gas, the EIA gathers data on both aggregate sales to the residential sector and number of utility customers as counted by the number of meters with active hookups. Thus, household-use metrics are calculated as *residential sales/residential consumers*. Because consumers are counted by number of meters, our denominator may include second homes as well as multiple families behind one meter. Unfortunately, we currently have no way of determining the effects these potential disparities have on our calculations.

Household other heating fuels use is calculated differently. The other heating fuels category combines a variety of fuel types and data sources. Residential sector use of other heating fuels is calculated by totaling residential sector uses of distillate fuel oil, kerosene, propane and wood, which are reported in the EIA's State Energy Data System (SEDS) data sets. This total is then divided by the number of occupied housing units using other heating fuels as calculated by summing Census data (described in *Fuel Sources* above) for occupied housing units using "bottled tank of LP gas," "fuel oil, kerosene, etc.," "coal or coke" and "all other fuels" (in this document, we assume that "all other fuels" is mostly wood). Because "occupied housing units" is calculated by the Census Bureau in a way that may not correlate to "residential consumers" as reported to the EIA, the way we have calculated household use for other heating fuels does not allow for precise apples-to-apples comparisons with the use of electricity and natural gas. Furthermore, wood use complicates the other heating fuels metric as wood is sometimes purchased, and sometimes harvested or gathered by the user at no monetary cost. The EIA makes rough estimates of how much wood is paid for and how much is not. In an attempt to ensure the metrics we report are as precise as possible, we show each use metric for other heating fuels with both paid and unpaid per household use, to the extent that we can estimate it. Price and expenditures metrics are reported only for households that are purchasing wood, or another heating fuel.

In 2020 Michigan households used the third-most natural gas out of the 50 states and DC, but the 41st-most electricity and the 12th-most other heating fuels. These trends follow from Michigan's geography as a northern state that uses a lot of heating fuels in the winter, but less electricity in the summer for cooling. Over the next decades, as more Michigan homes begin to heat with efficient heat pumps, these use numbers may change to reflect high electricity demands during the winter.

Figure 41: 2020 Electricity Use per Residential Customer in Kilowatt Hours

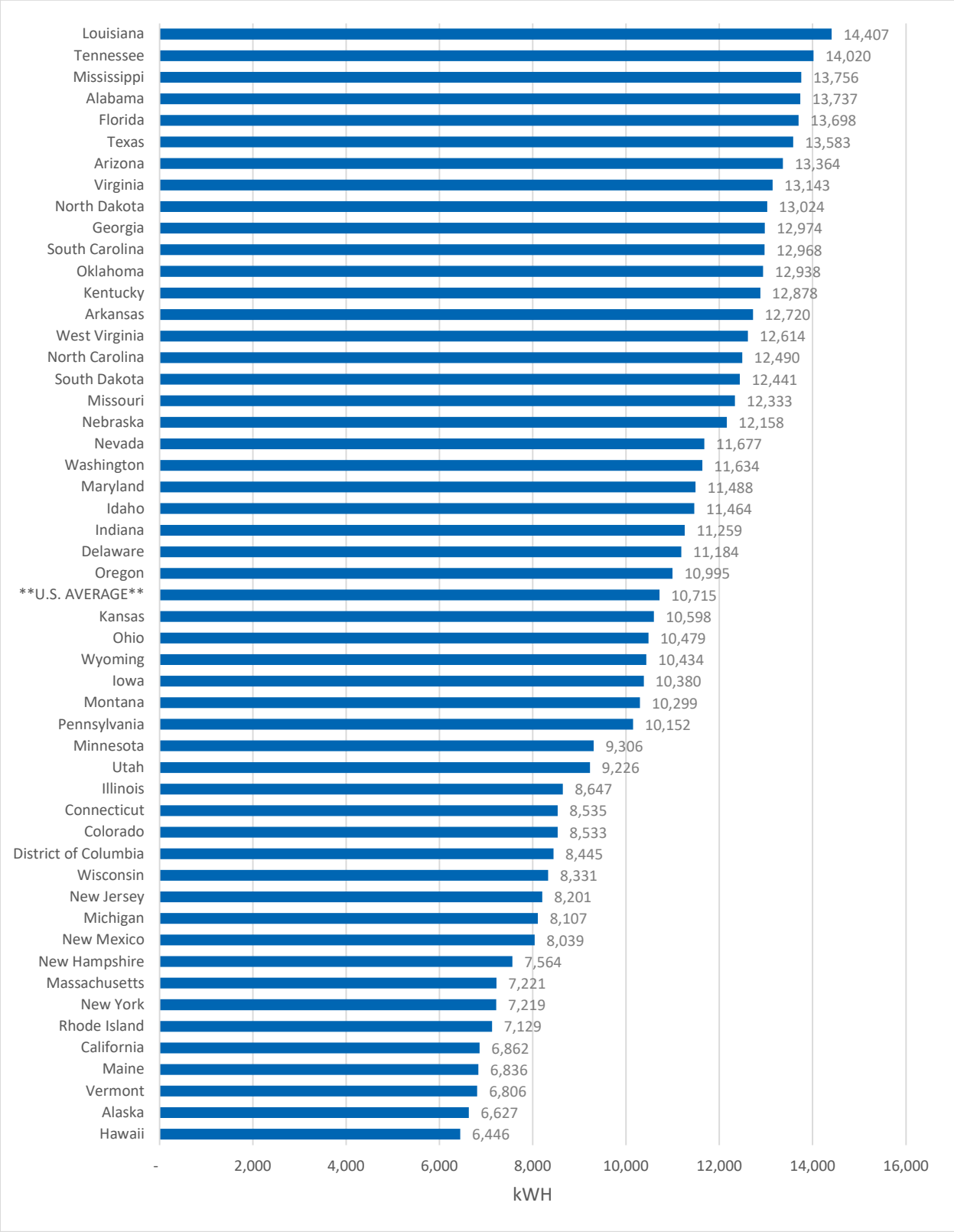


Figure 42: 2020 Electricity Use per Residential Customer in Kilowatt Hours Map

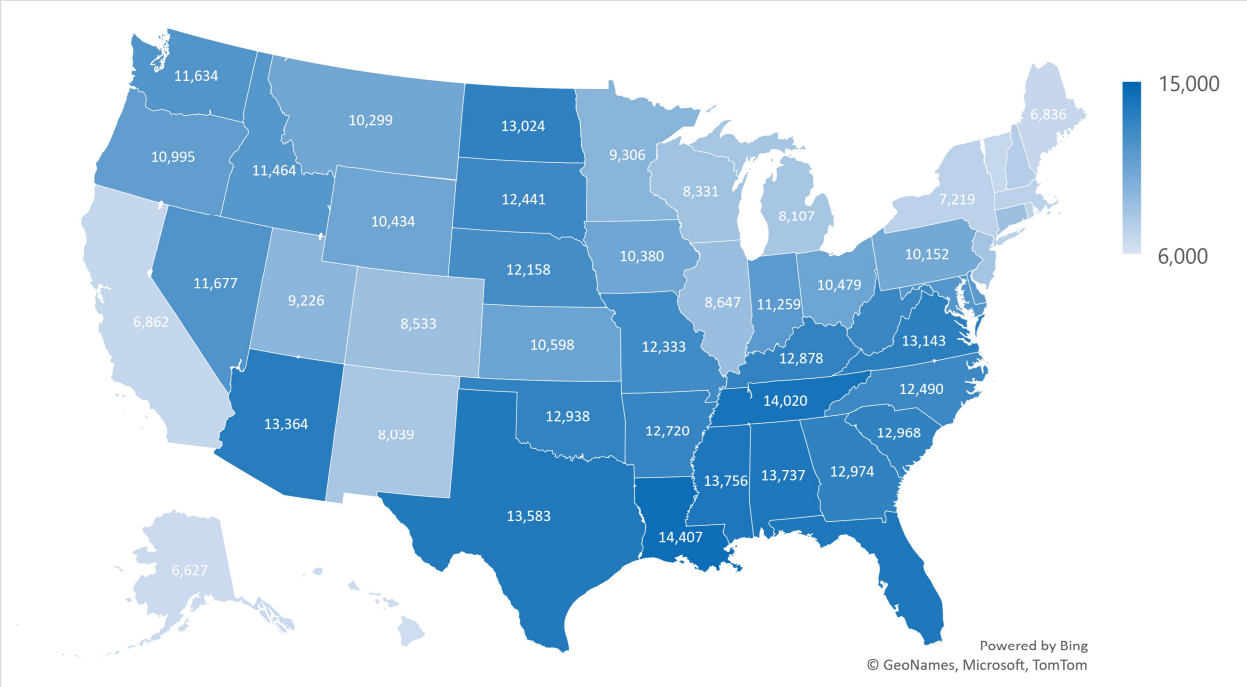


Figure 43: 2020 Natural Gas Use per Residential Customer

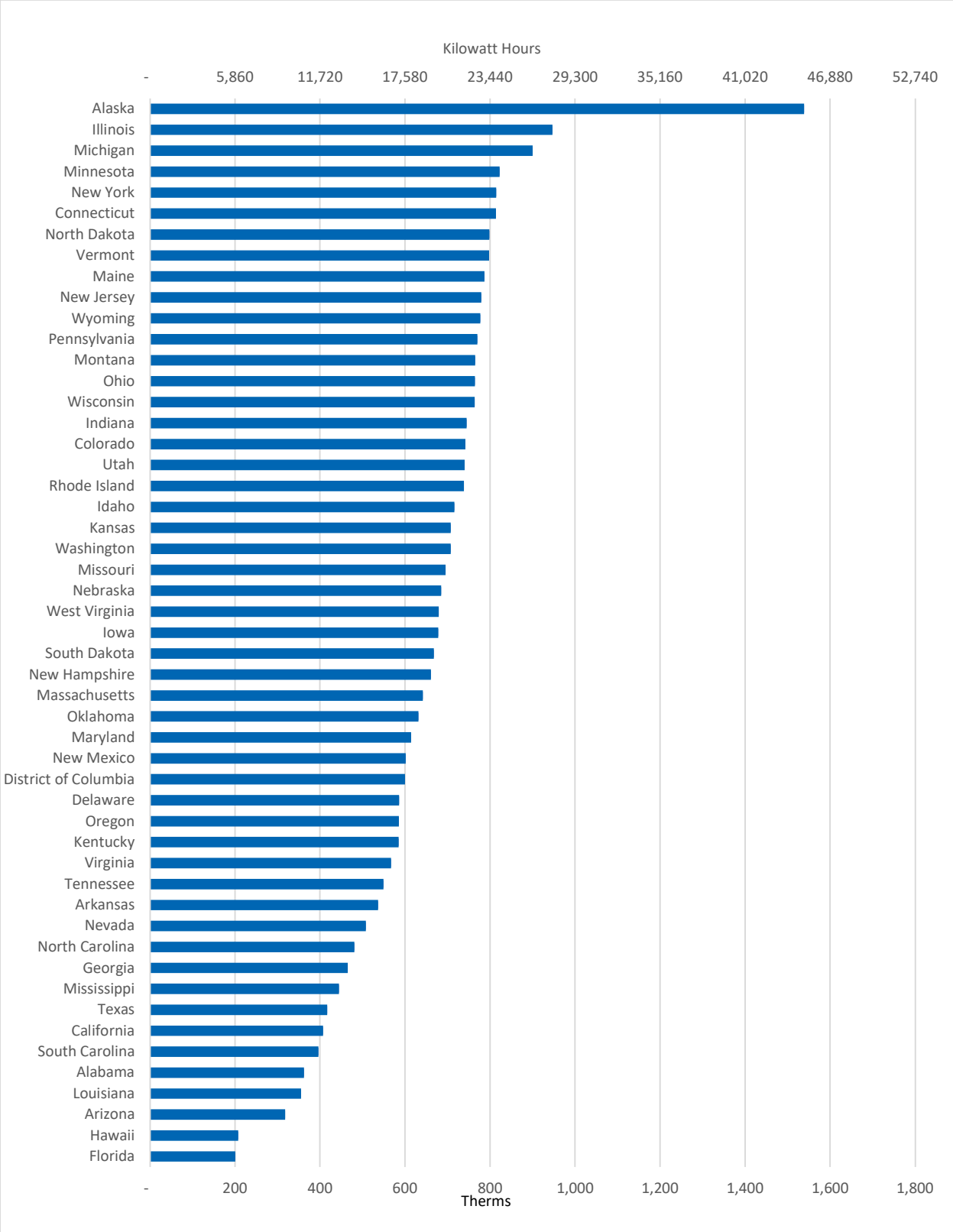


Figure 44: 2020 Natural Gas Use per Residential Customer Map in Therms Map

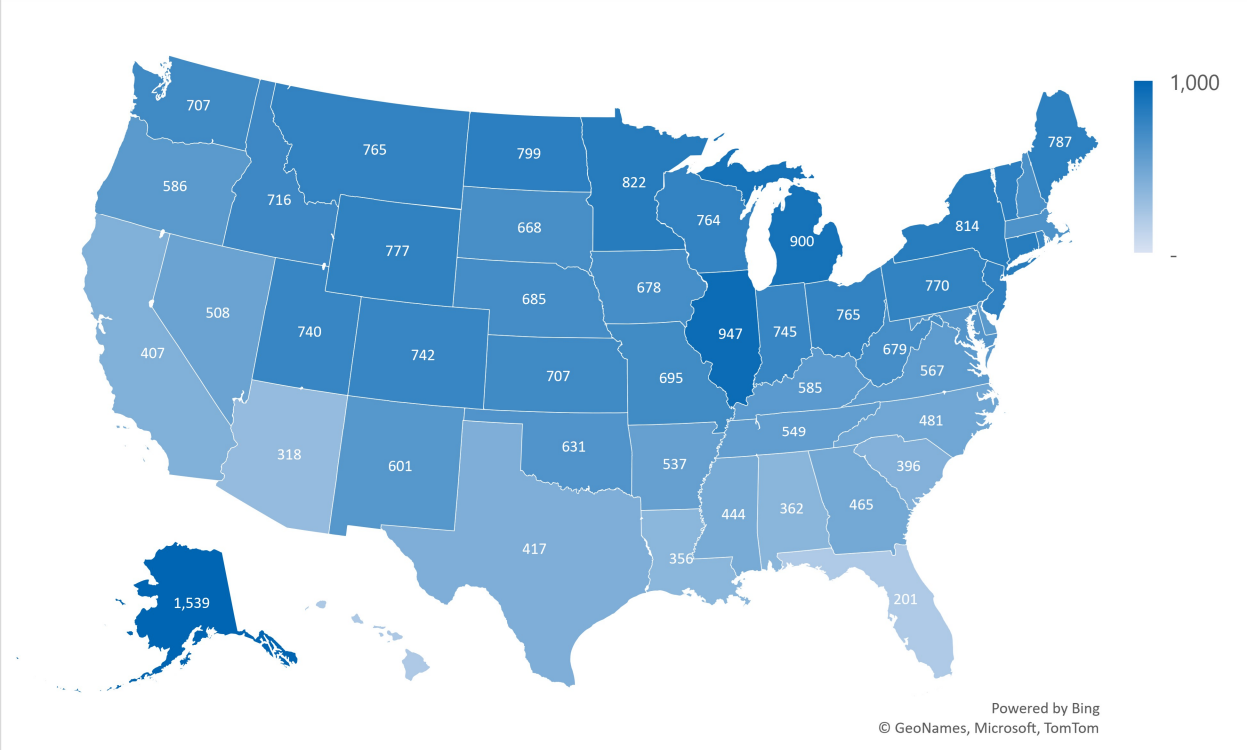


Figure 45: 2020 Natural Gas Use per Residential Customer in Kilowatt Hours Map

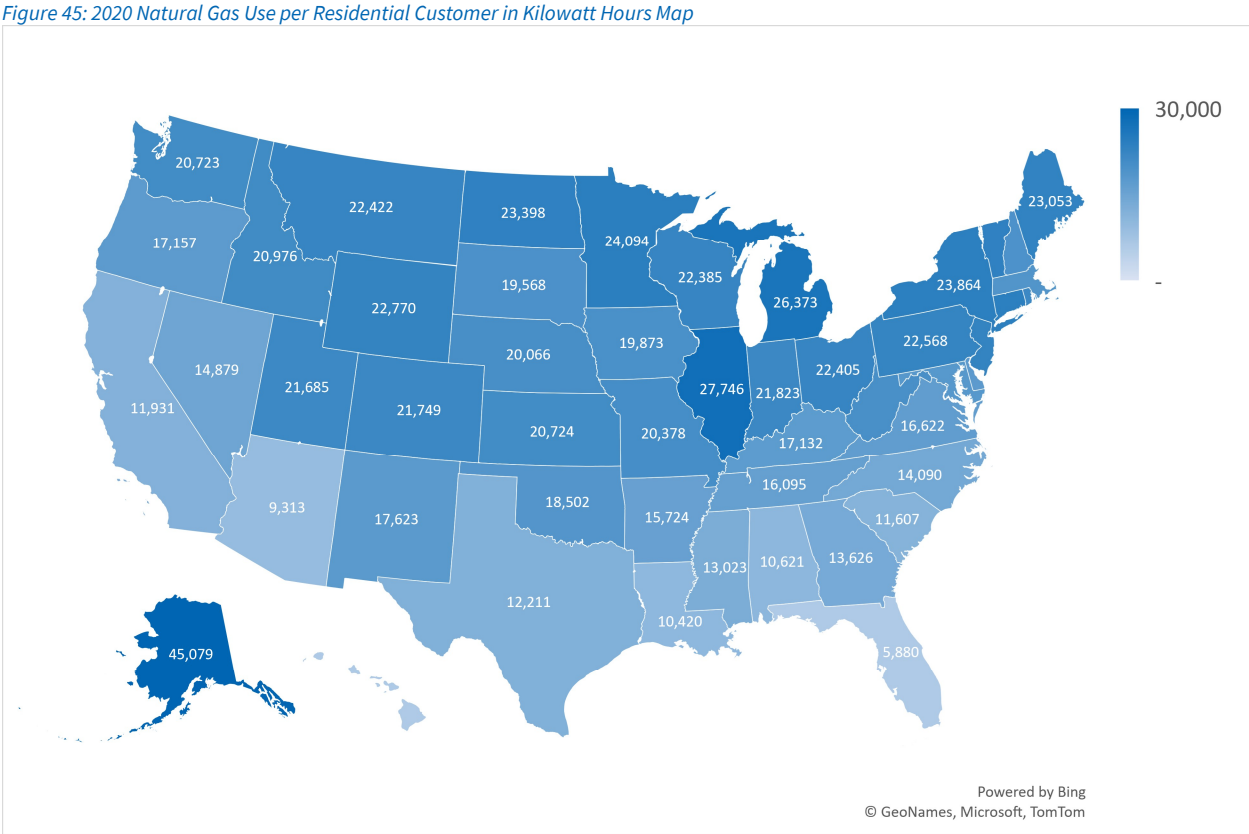


Figure 46: 2020 Other Heating Fuel Use (Paid Only) per Occupied Housing Unit

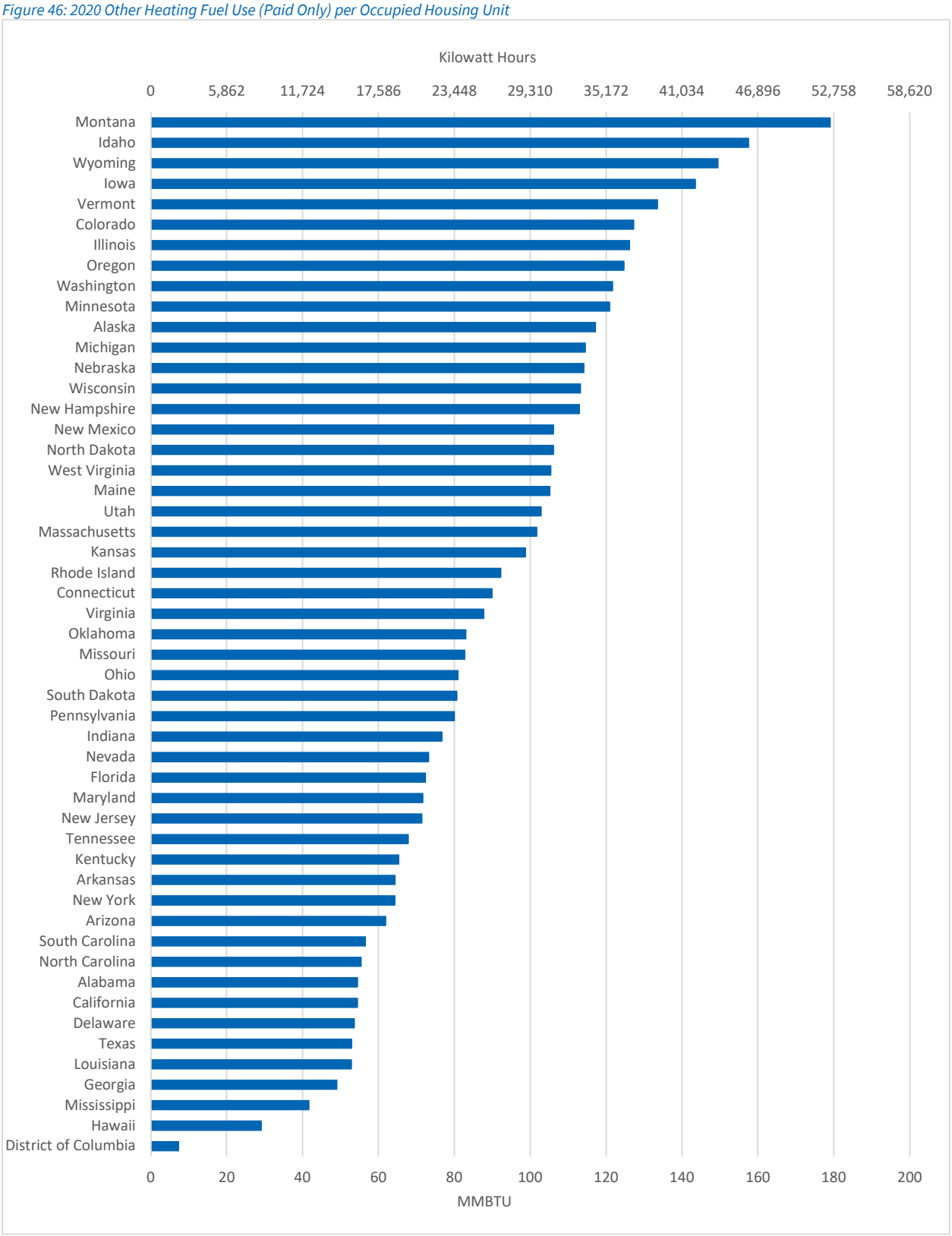


Figure 47: 2020 Other Heating Fuel Use per Occupied Housing Unit Heating with Other Heating Fuels in MMBTU (Paid Only) Map

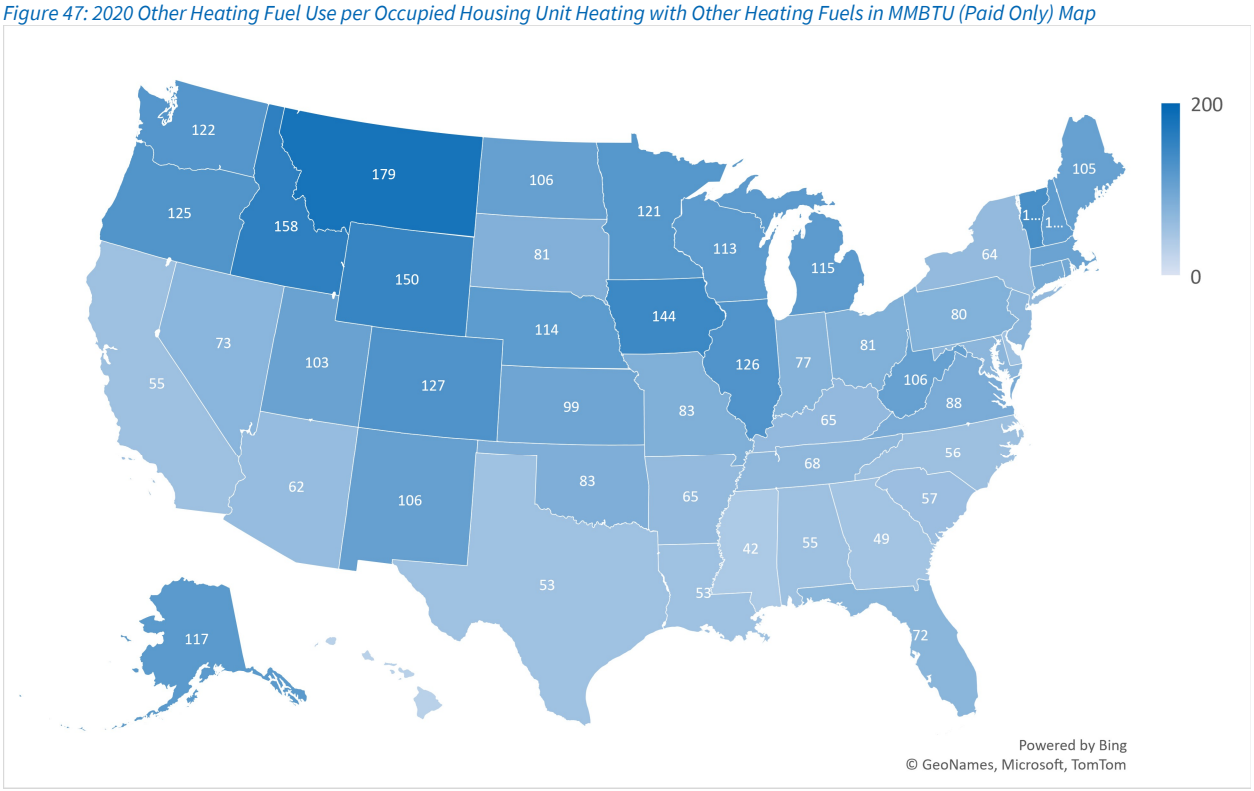


Figure 48: 2020 Other Heating Fuel Use per Occupied Housing Unit Heating with Other Heating Fuels in kWh (Paid Only) Map

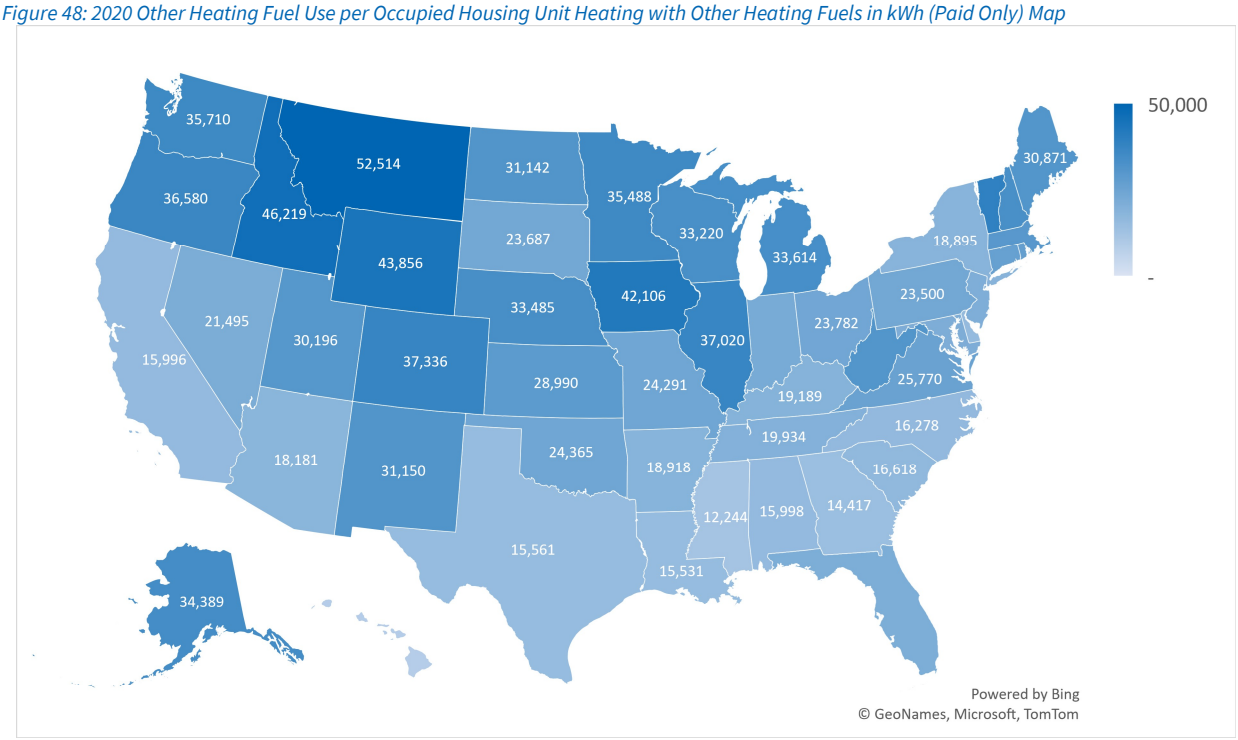


Figure 49: 2020 Other Heating Fuel Use (All Users) per Occupied Housing Unit

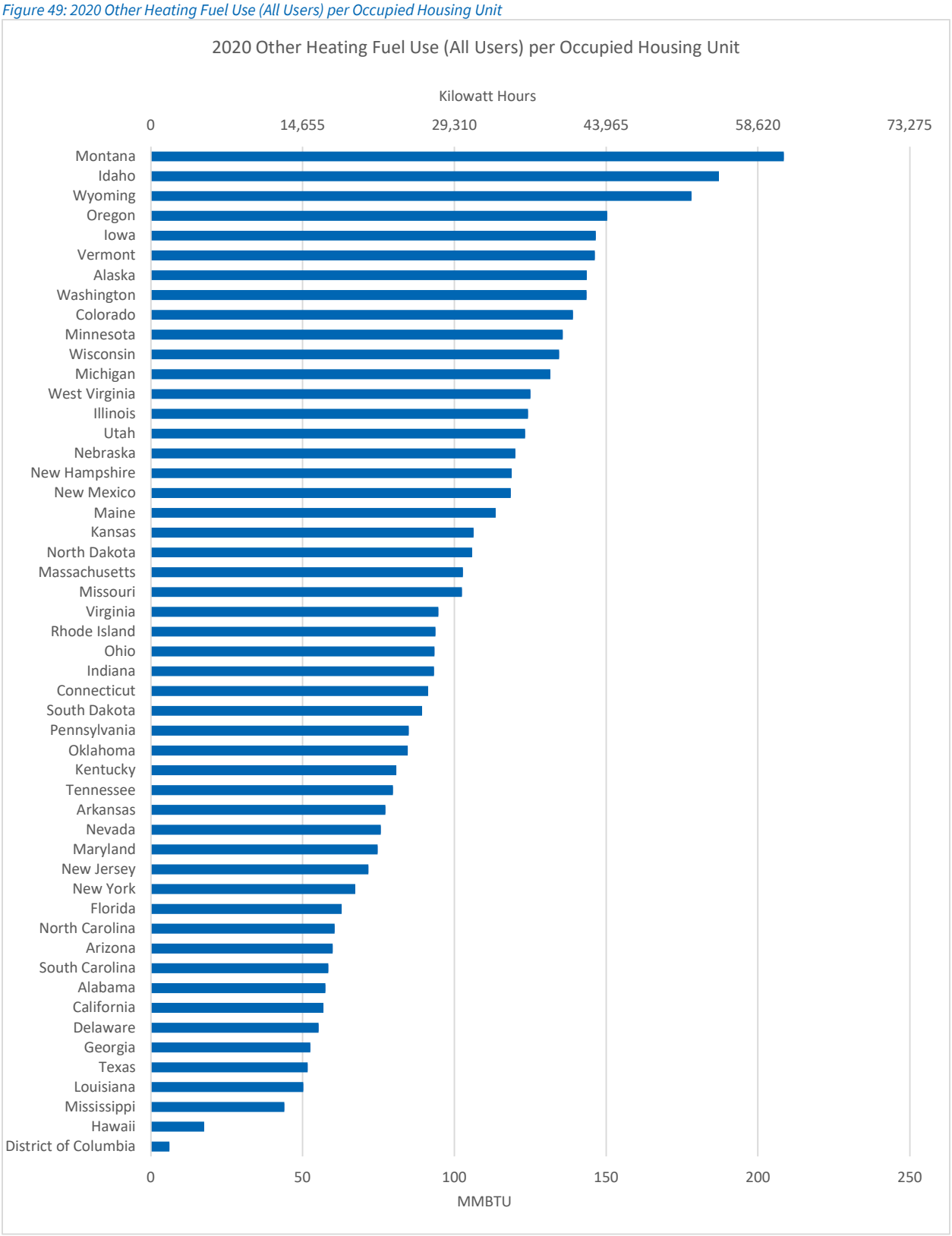


Figure 50: 2020 Other Heating Fuel Use per Occupied Housing Unit Heating with Other Heating Fuels in MMBTU (All Users) Map

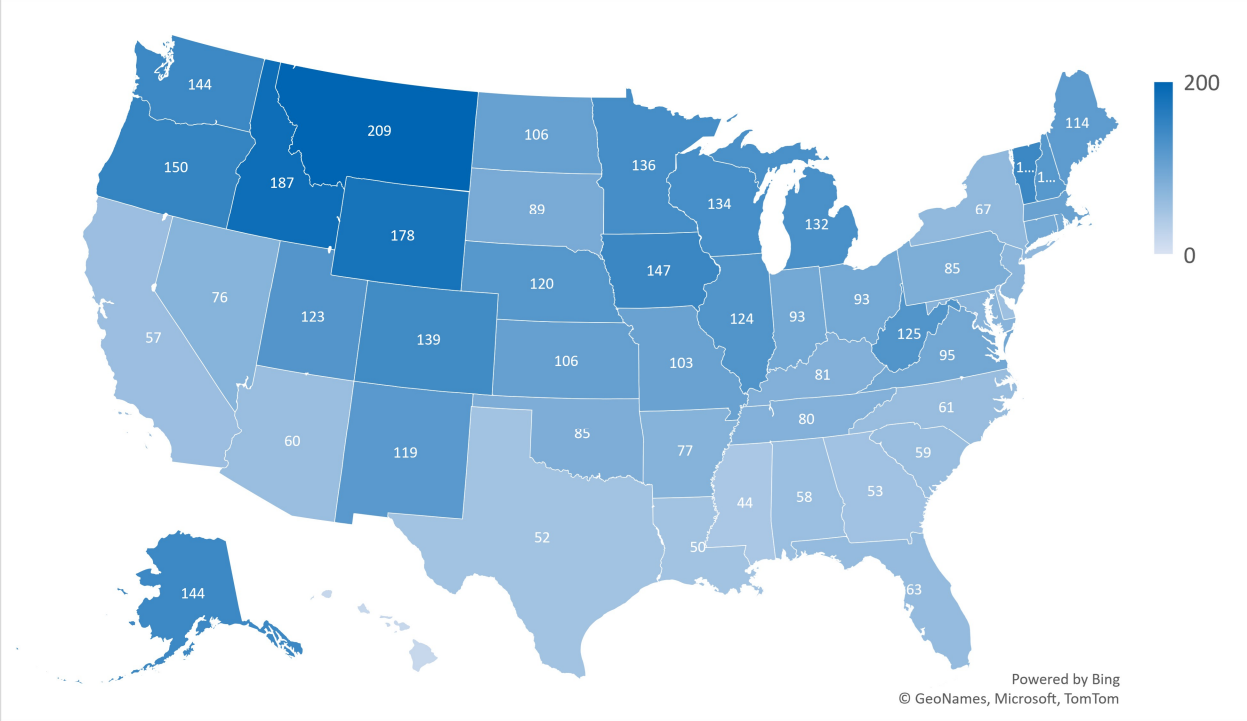
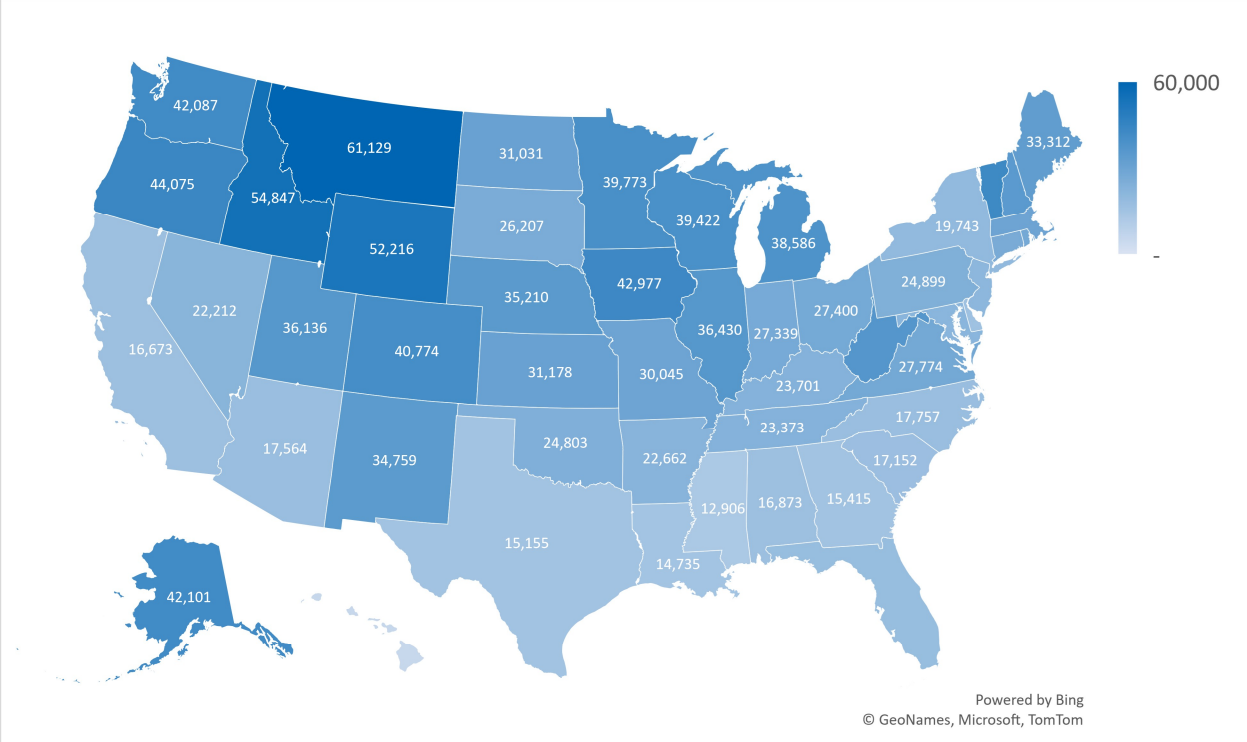


Figure 51: 2020 Other Heating Fuel Use per Occupied Housing Unit Heating with Other Heating Fuels in kWh (All Users) Map



Household Electricity Costs and Expenditures

Electricity bills often have many components: fixed monthly charges, charges based on the customer's peak rate of power usage in the billing month or previous year, a charge per kWh of electricity and others. The way utilities assign costs to these components of the bill varies across states and between utilities and classes of customers. 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 EIA collects monthly data from each utility in each state on the amount of electricity sold and the revenue from electricity by customer class. Customer classes include residential, commercial, industrial, transportation and "other," with almost all electricity delivered in most states going to the first three classes. The EIA makes these data available through its Electric Data Browser.

The figures in this section show that Michigan had the 10th-highest electricity cost in the country in 2021, higher than any of its peers in the Midwest, as is easily visible in Figure 55**.** Despite these high electricity costs, in 2020 Michiganders' yearly electricity expenditures were only the 32nd-highest in the country (Figure 52), although, in the previous year, they were 39th-highest (Figure 174). This is due to relatively low electricity use statistics in Michigan, described above in *Household Energy Use*.

Figure 52: 2020 Electricity Expenditures per Residential Customer

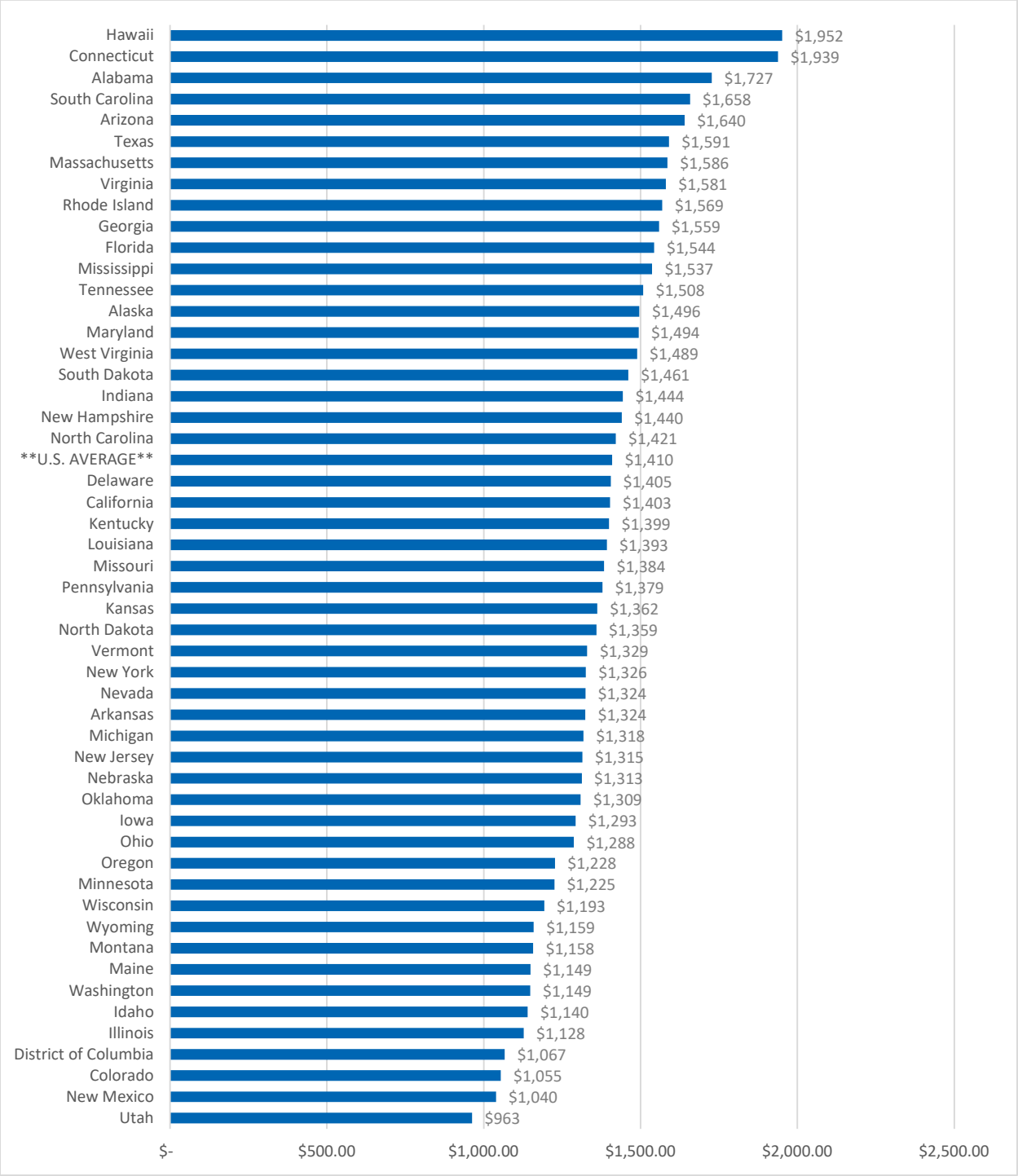


Figure 53: 2020 Electricity Expenditures per Residential Customer in Dollars Map

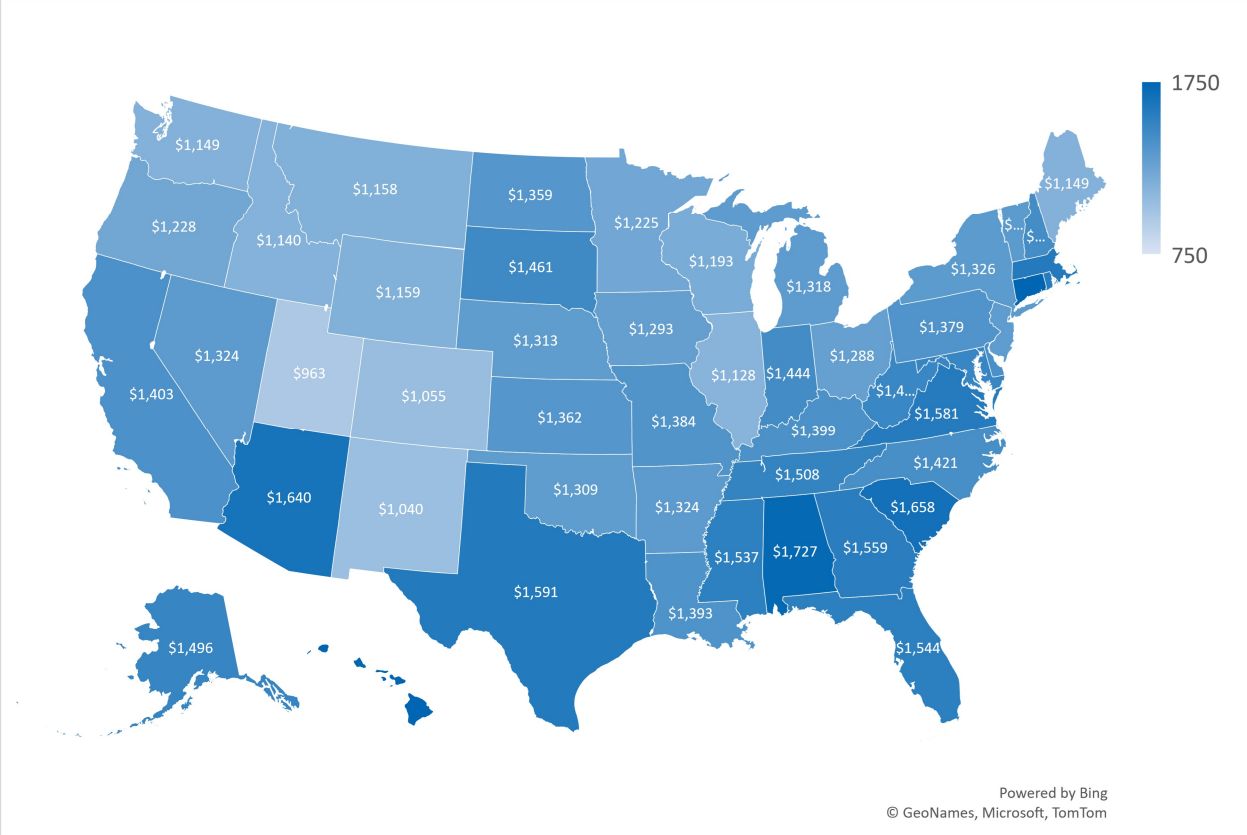


Figure 54: 2021 Cost per Kilowatt Hour of Electricity in the Residential Sector

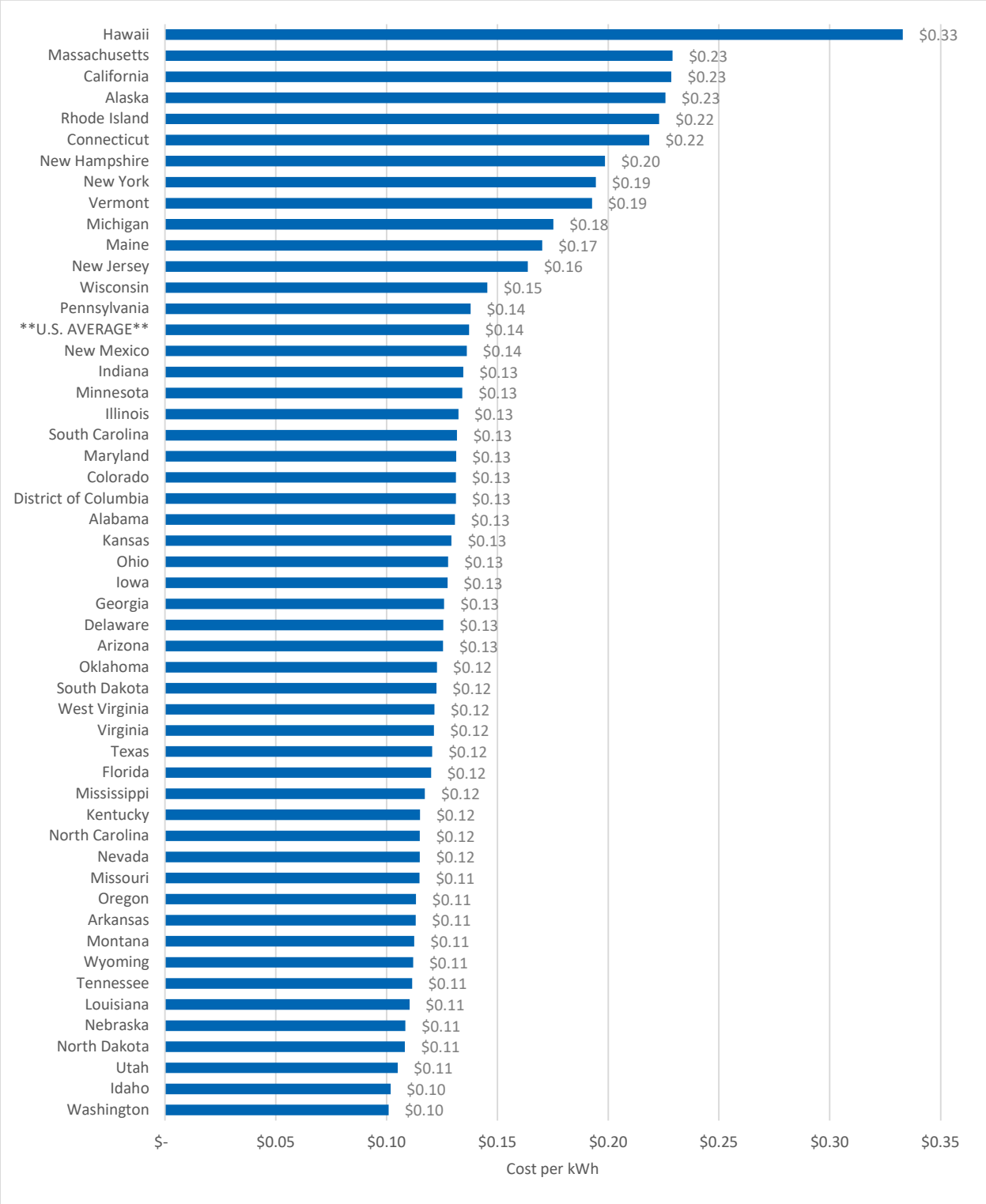
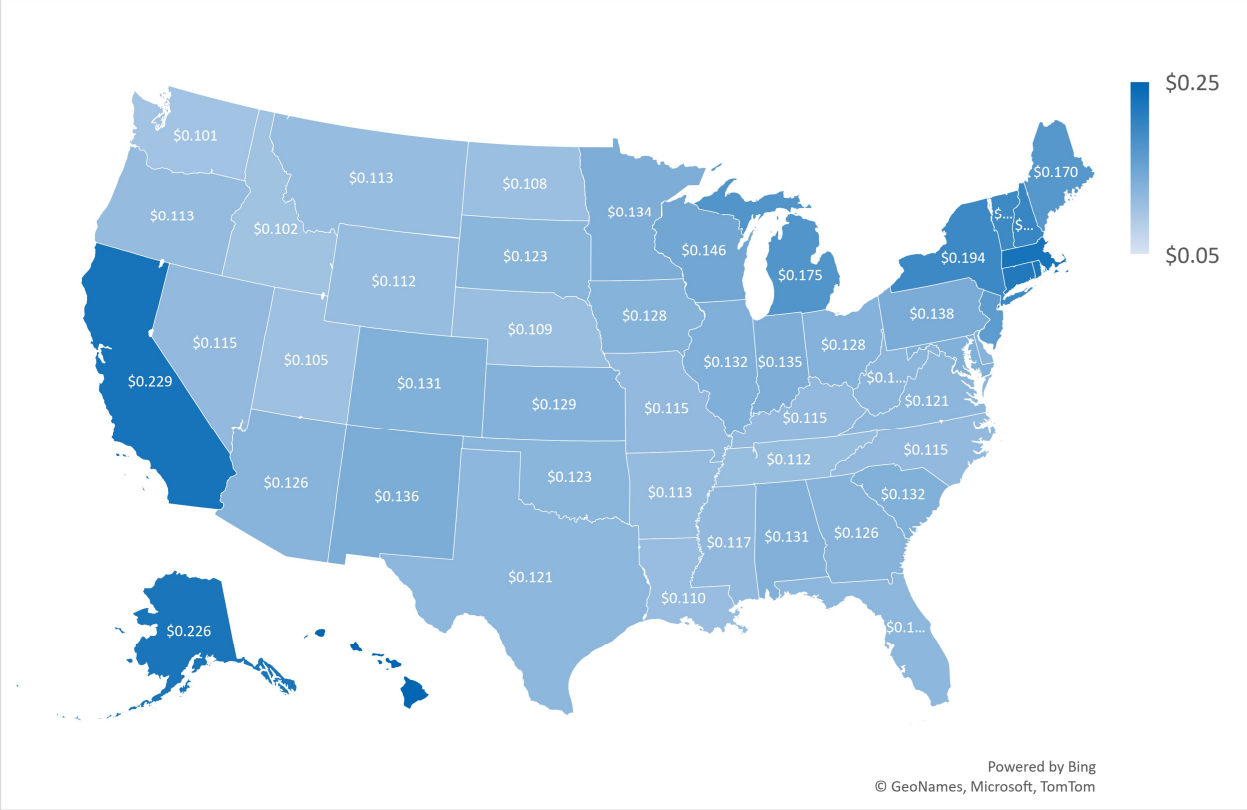


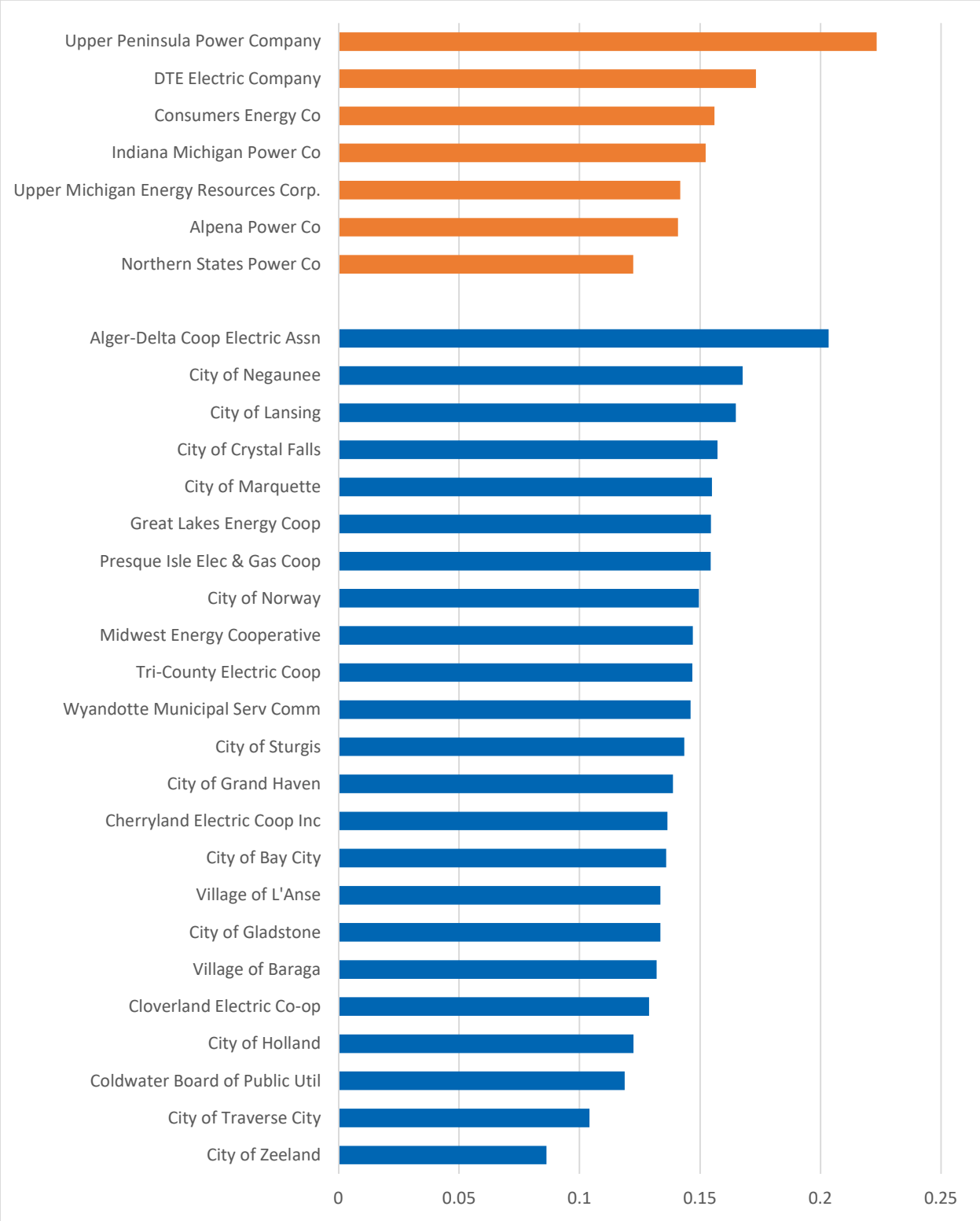
Figure 55: 2021 Cost per Kilowatt Hour of Electricity in the Residential Sector in Dollars Map



Michigan Electricity Costs

Figure 56 shows that that per kWh residential electricity costs vary from about nine cents per kWh for the City of Zeeland municipal utility to just over 22 cents per kWh for the Upper Peninsula Power Company. The most obvious trend in Michigan's residential electricity costs is that the highest cost utilities are in the Upper Peninsula. The Upper Peninsula's high electricity costs result from the high expense of distribution infrastructure in rural areas plus the relatively low amount of local generation resources. That said, most utilities in Michigan have residential electricity costs falling in a narrow range between 13 and 17 cents per kWh.

Figure 56: 2020 Cost per Kilowatt Hour of Electricity in the Residential Sector for Michigan Utilities



Household Natural Gas Costs and Expenditures

Although responsible for significant greenhouse gas emissions and other pollutants, natural gas remains an affordable and accessible fuel for water and space heating in cold climates. However, consumers are not insulated from price spikes or distribution disruptions, especially during harsh winters.

Residential consumers purchase natural gas in units called therms, which are equivalent to 100 cubic feet of natural gas. To facilitate energy cost comparisons with electricity, this section contains figures that show both therms, the unit customers see on their gas bill, and kWh, a unit generally used to measure electricity. The conversion factor from therms to kWh is 29.3 kWh to 1 therm. This allows readers to compare the absolute energy costs of these disparate energy forms. Comparing natural gas and electricity costs shows that natural gas is usually a cheaper form of energy than electricity, which helps explain why it is a more common heating fuel in climates with high heating requirements.

Although the geographies of high and low costs and expenditures are different for natural gas than for electricity, the trends that relate costs to expenditures and use follow a similar logic to electricity's. There are higher expenditures but lower costs in areas with higher use, such as colder, more northern climates where natural gas is a common heating fuel, as described in *Household Energy Use*.

Unsurprisingly, given the trends described above, household expenditures on natural gas are relatively high, the 16th-highest in the nation, but cost per therm is only the 39th-highest in the nation. Figure 58 and Figure 60 show that Michigan's costs and expenditures are about average when compared to its neighboring states, with higher expenditures than Illinois, and higher per-therm costs than Wisconsin or Illinois.

Figure 57: 2020 Natural Gas Expenditures per Residential Customer

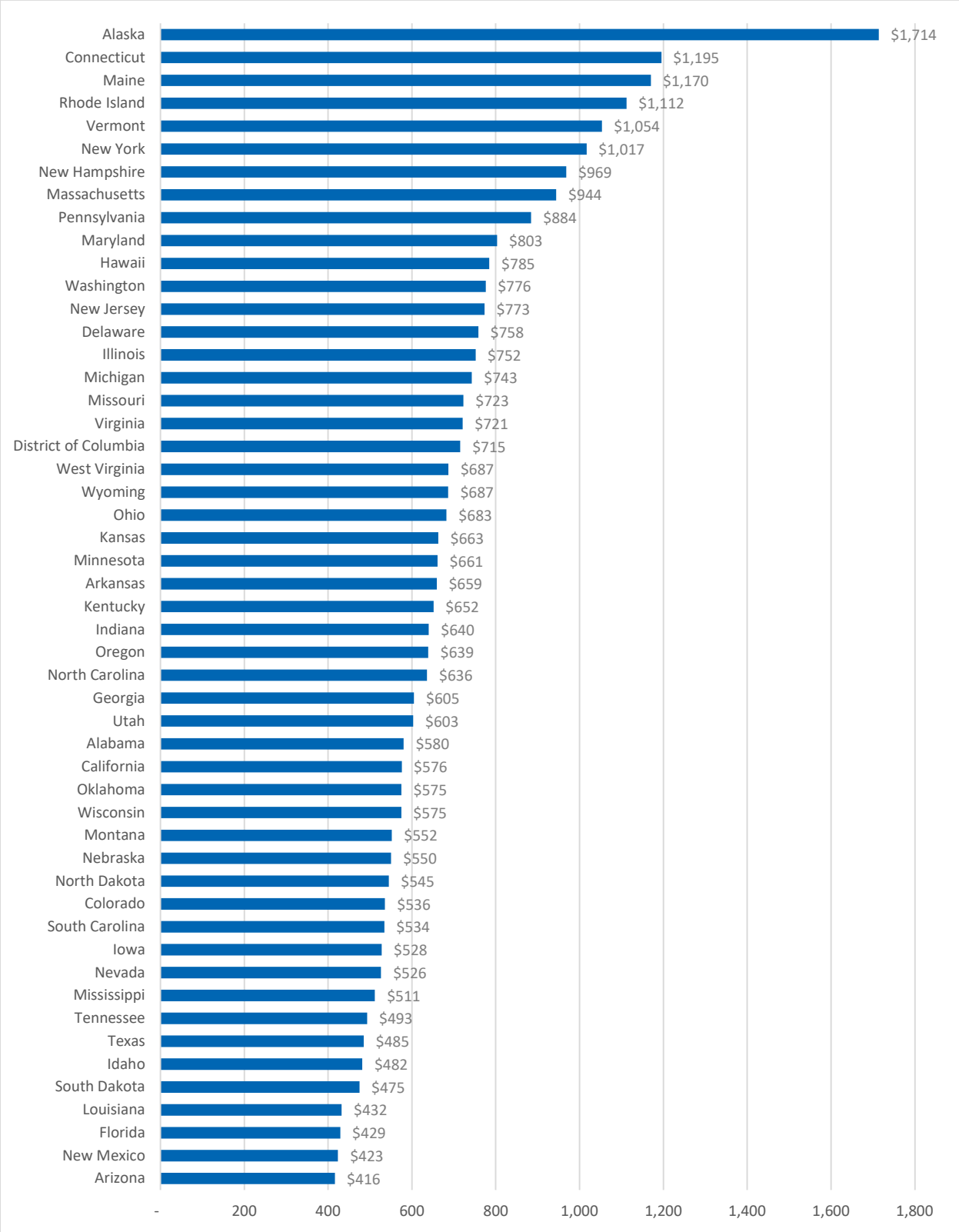


Figure 58: 2020 Natural Gas Expenditures per Residential Customer in Dollars Map

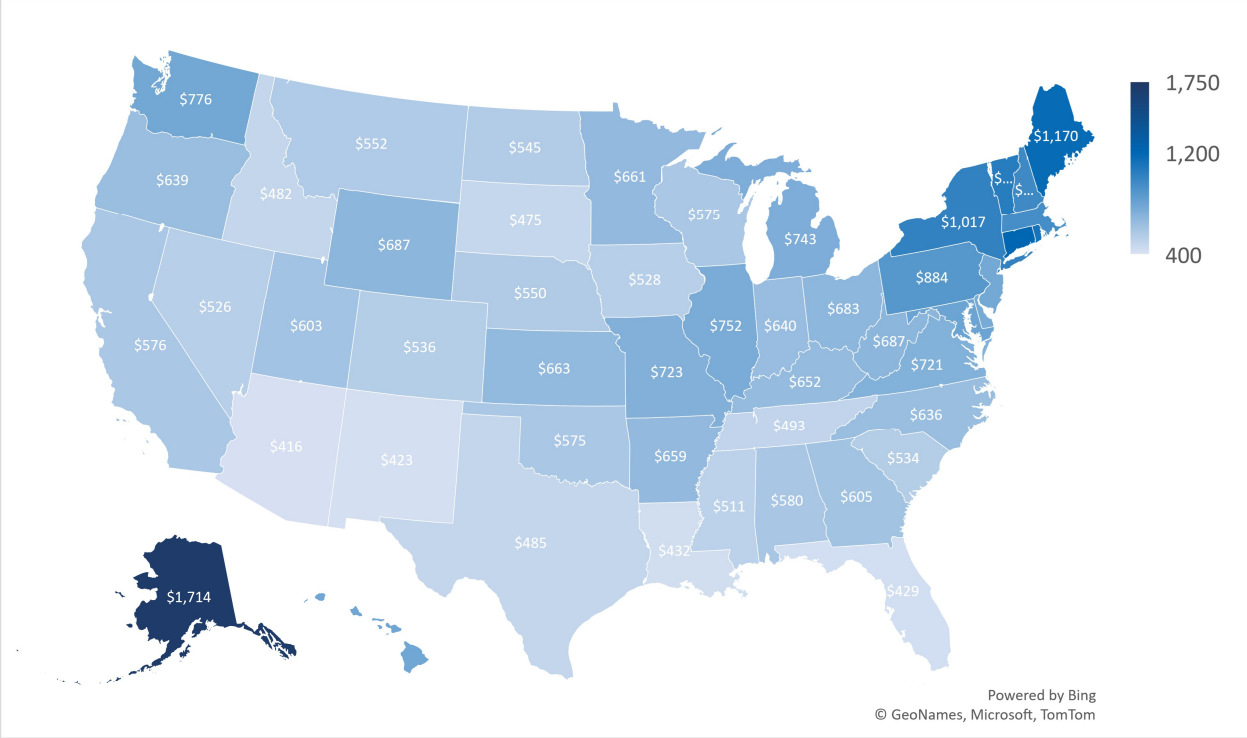


Figure 59: 2020 Cost per Therm and kWh of Natural Gas for Residential Customers

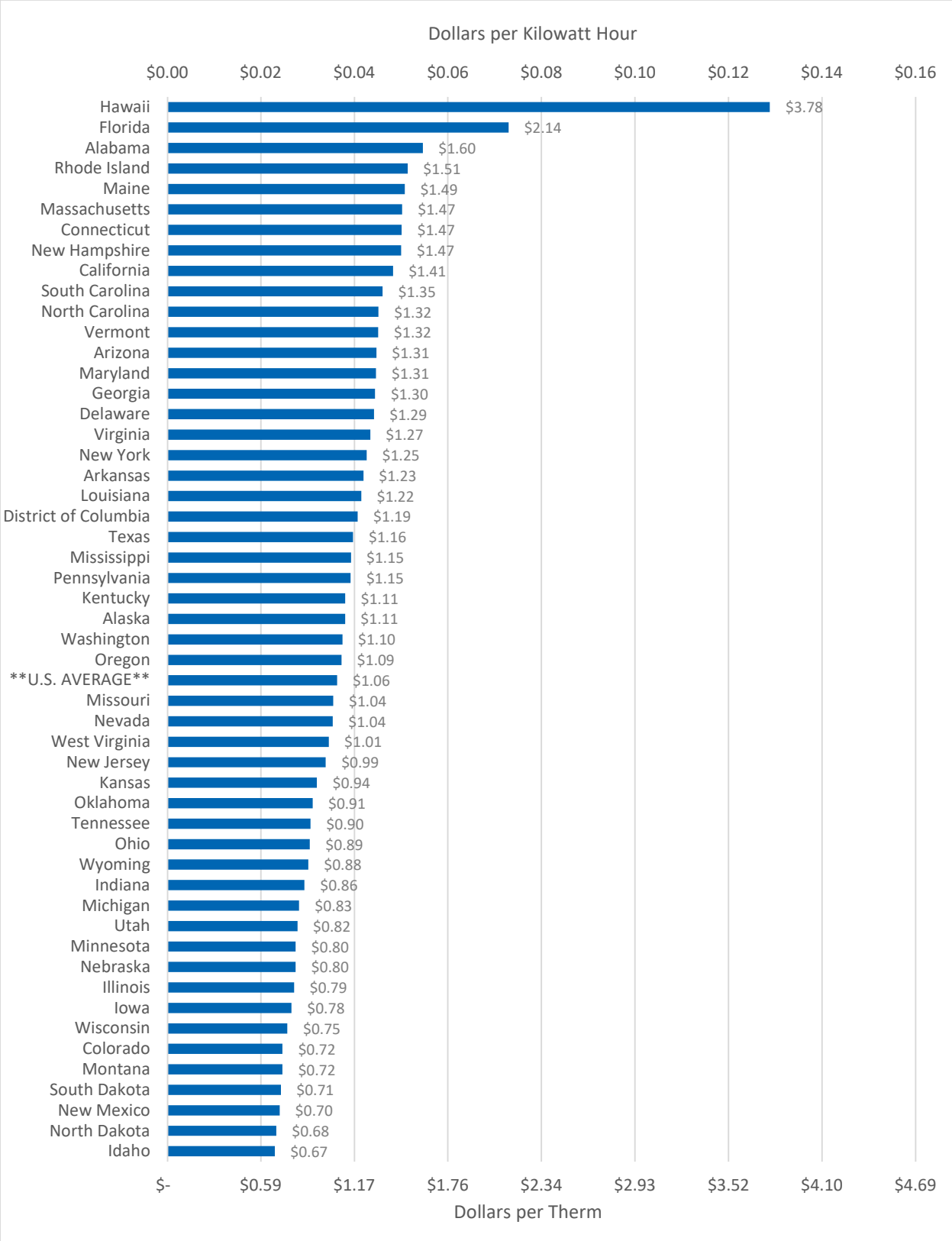


Figure 60: 2020 Cost per Therm of Natural Gas for Residential Customers in Dollars Map

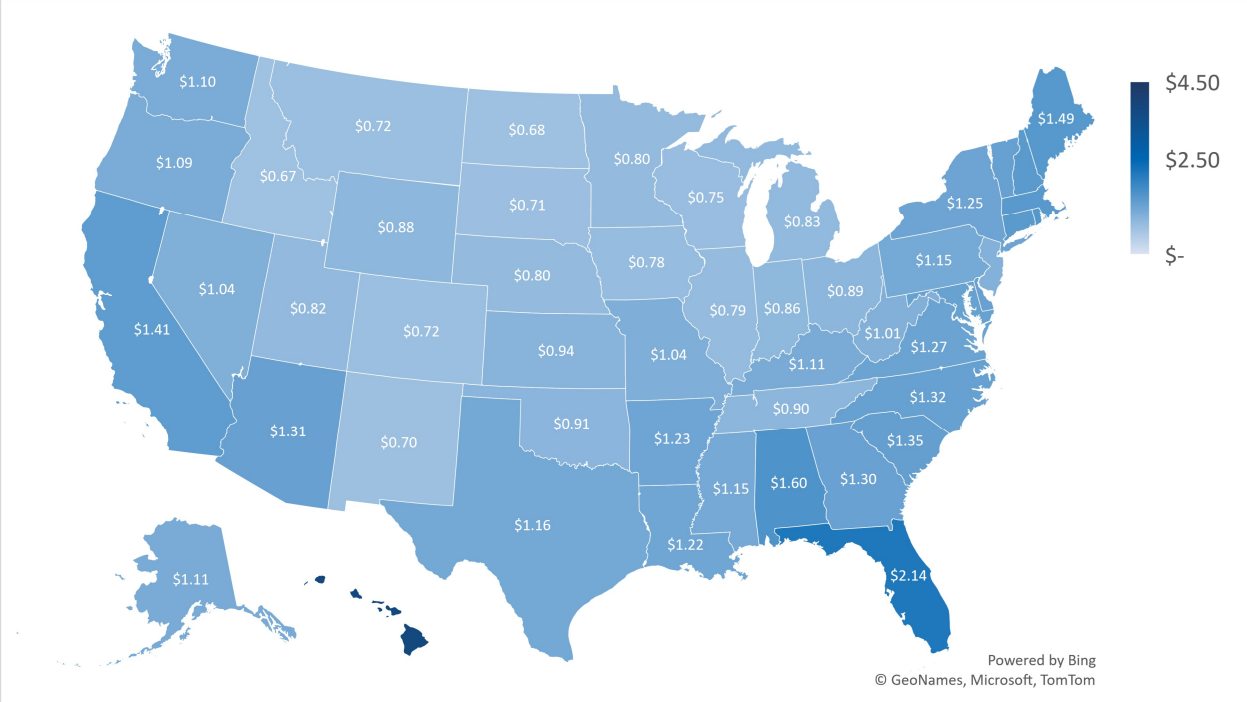
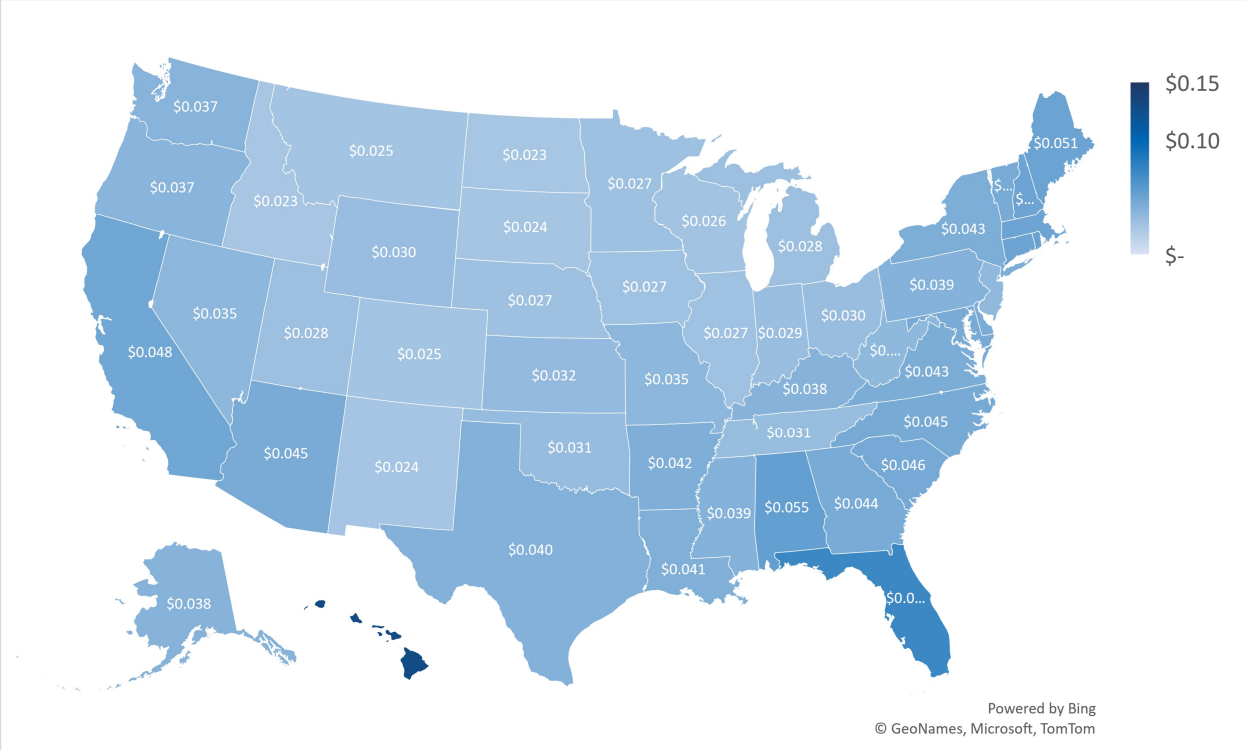


Figure 61: 2020 Cost per Kilowatt Hours of Natural Gas for Residential Customers in Dollars Map

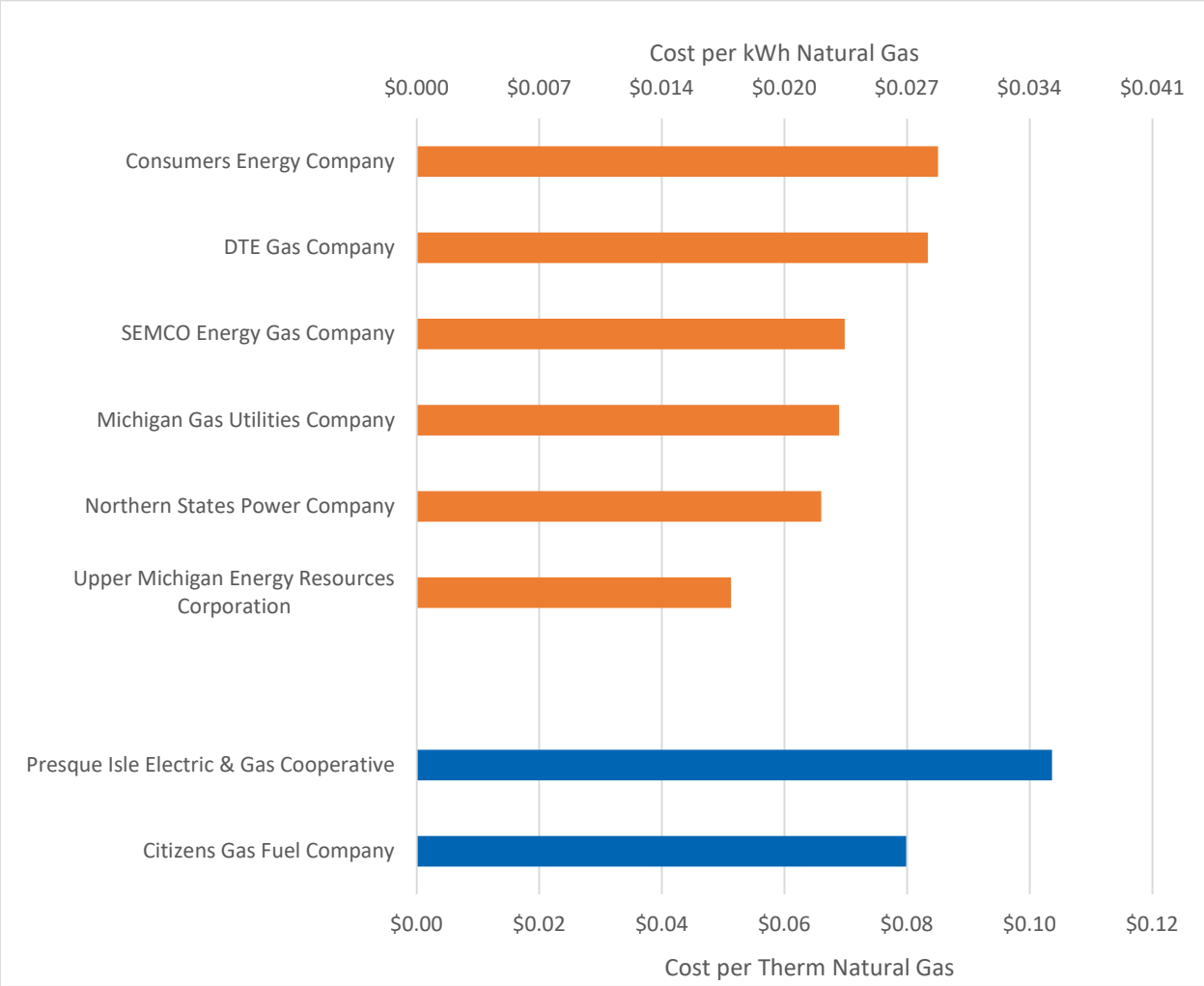


Michigan Natural Gas Costs

In 2020 the cost per therm of natural gas varied between $.51 and $.85 for Michigan's natural gas IOUs. Among all of Michigan's natural gas utilities, Presque Isle Electric & Gas Cooperative had the highest price at $1.04 per therm.

Because of the proliferation of hydraulic fracturing, natural gas costs have declined substantially for most Michigan customers over the last 10 years. Most Michigan natural gas utilities, however, saw $.01 - $.04 increases in their natural gas costs between 2019 and 2020 with the exception of Northern States Power Company, which is the only natural gas utility that saw a decline in rates between 2019 and 2020 (Figure 163).

Figure 62: 2020 Residential Natural Gas Cost for Michigan Utilities



Household Other Heating Fuels Costs and Expenditures

As described in *Household Energy Use,* "other heating fuels" references a variety of heating fuels including propane, kerosene, fuel oils, wood and more. Residential consumers purchase each of these fuels in different forms and units, but when reporting consumption of these fuels,

the EIA converts the energy embodied in those materials to a basic unit of energy measurement—MMBTU. To facilitate energy cost comparisons with electricity, this section contains figures that show both MMBTU, the unit the data were reported in, and kWh, a unit generally used to measure electricity. The conversion factor from MMBTU to kWh is 293 kWh to 1 MMBTU.

The trend in Michigan's other heating fuels costs and expenditures nearly mirror that of natural gas. Michigan ranks 14th for yearly expenditures and 33rd for per MMBTU costs. However, compared to adjacent states, Michigan has the highest expenditures other than Illinois, and the median per MMBTU costs, with higher costs than Wisconsin or Illinois, and lower costs than Ohio or Indiana (Figure 64 and Figure 66).

Figure 63: 2020 Other Heating Fuel Expenditures per Household Using and Paying for Other Heating Fuels

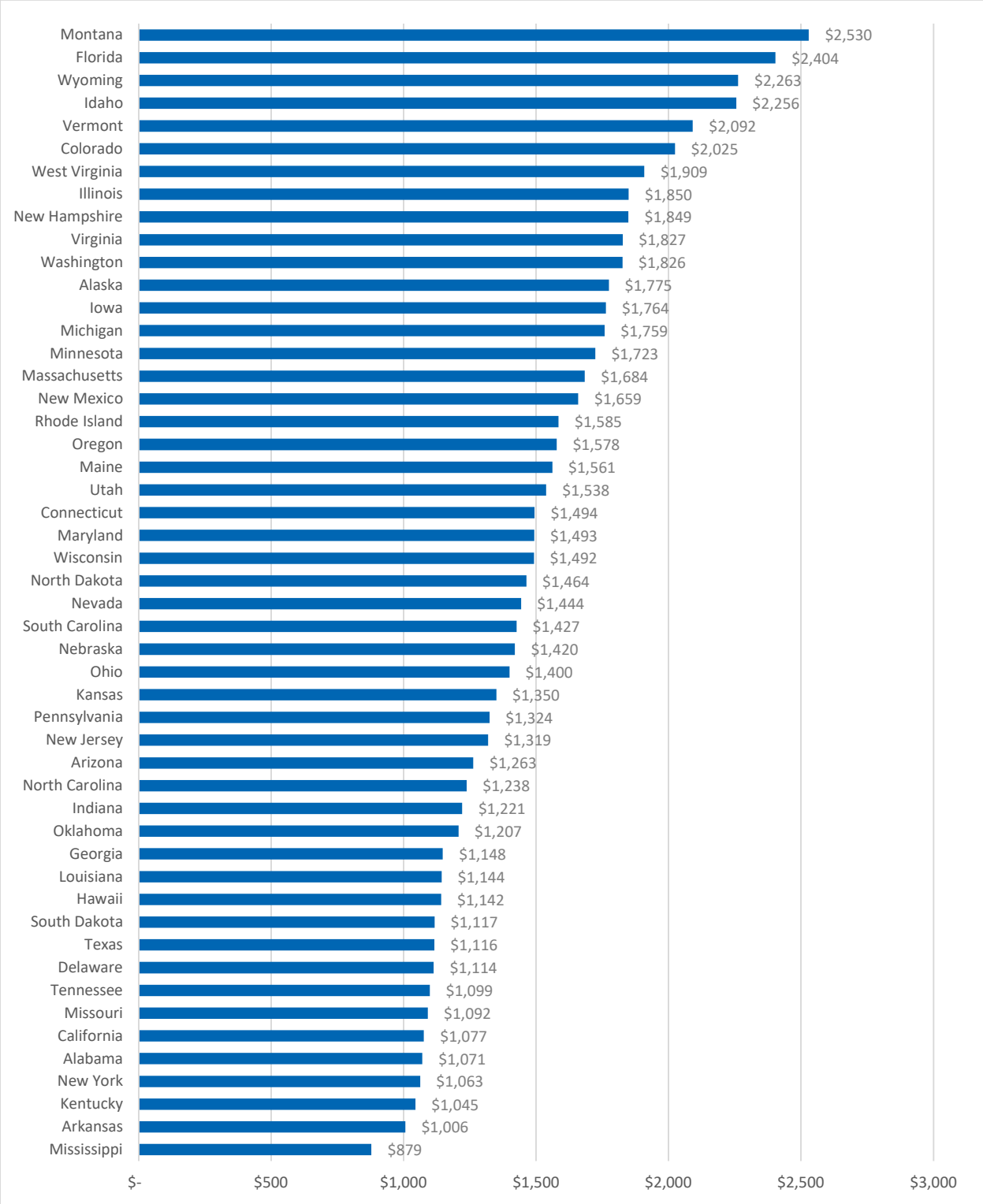


Figure 64: 2020 Other Heating Fuel Expenditures per Household Using and Paying for Other Heating Fuels Map

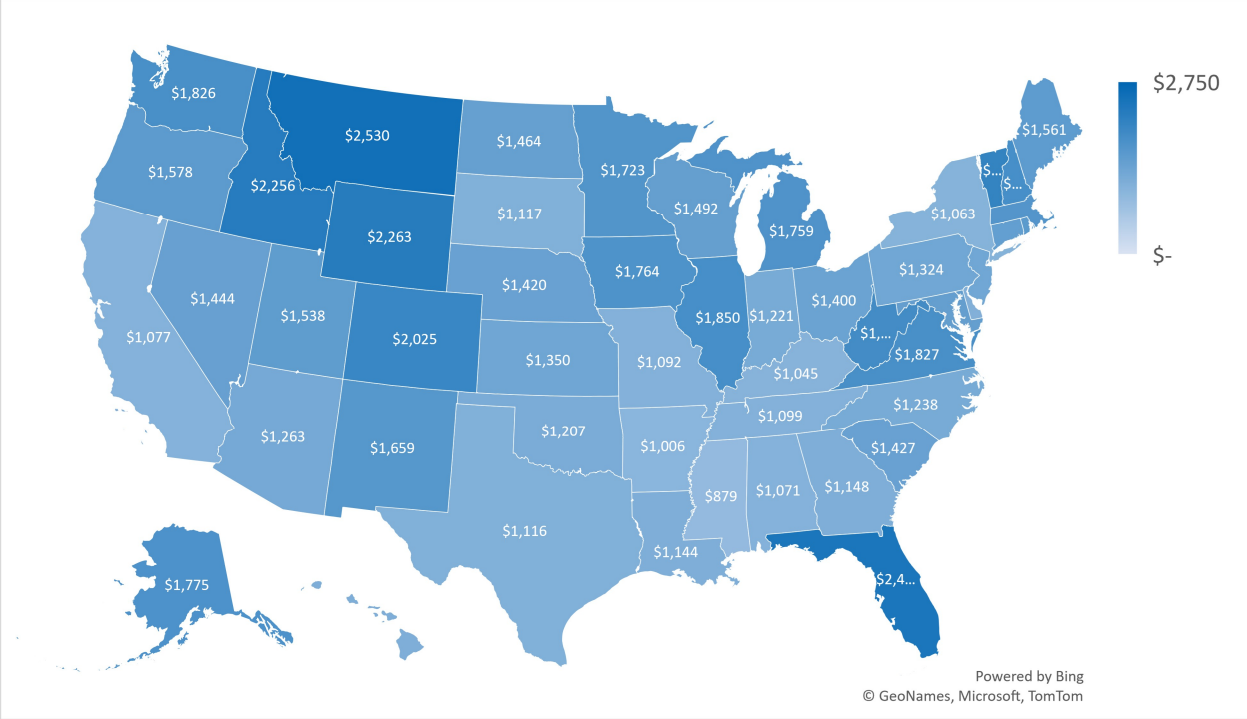


Figure 65: 2020 Residential Cost of Other Heating Fuels for Occupied Housing Units Using and Paying for Other Heating Fuels

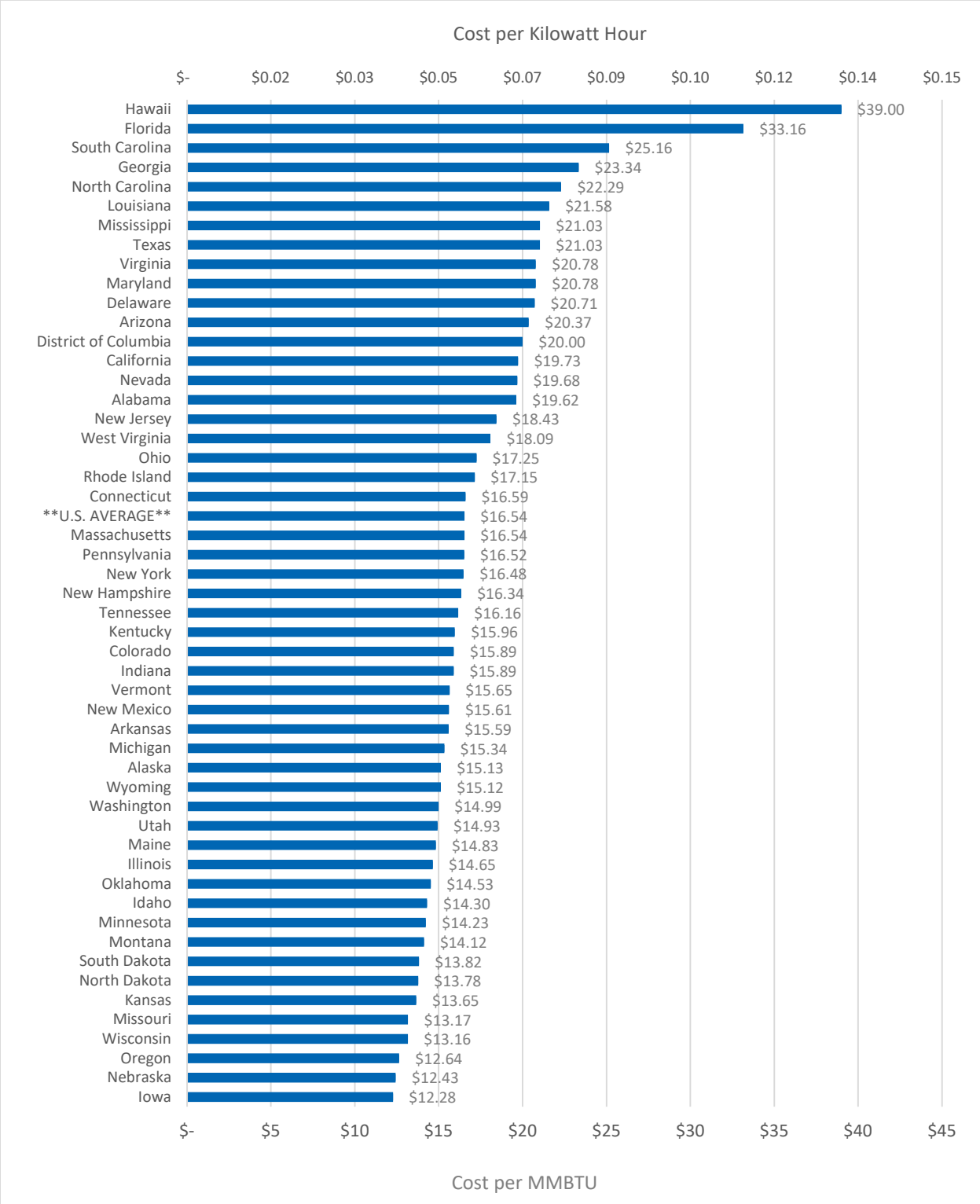


Figure 66: 2020 Residential Cost of Other Heating Fuels per MMBTU for Occupied Housing Units Using and Paying for Other Heating Fuels Map

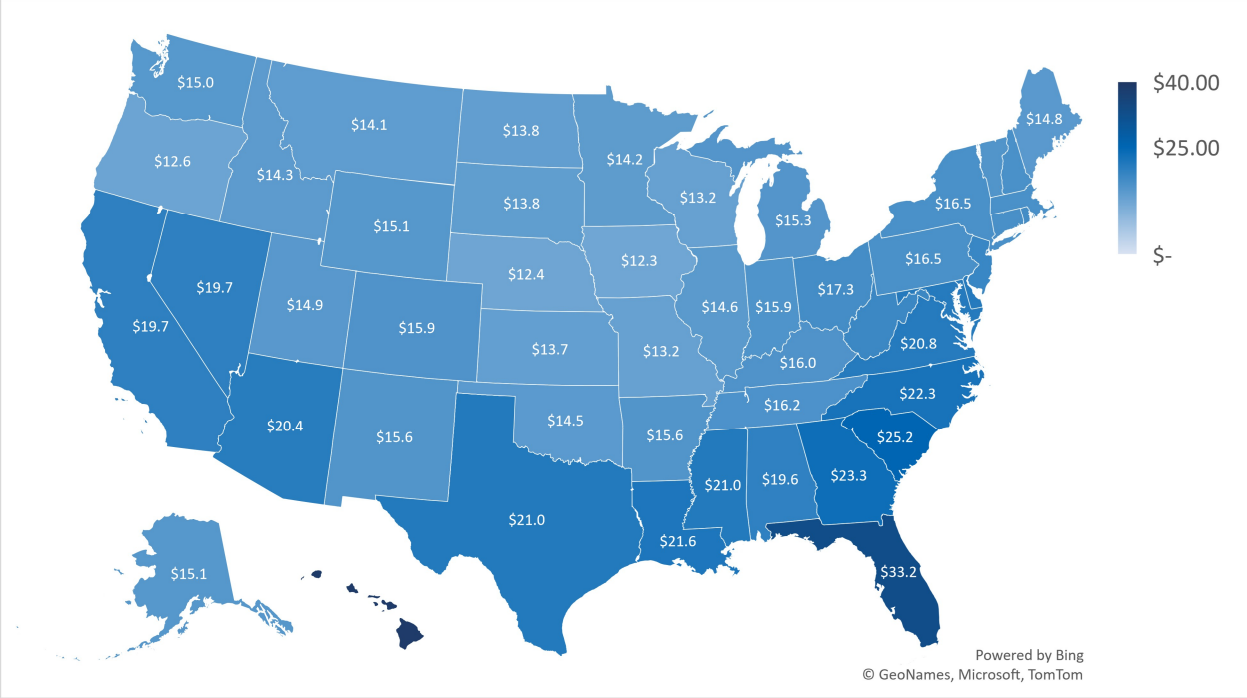
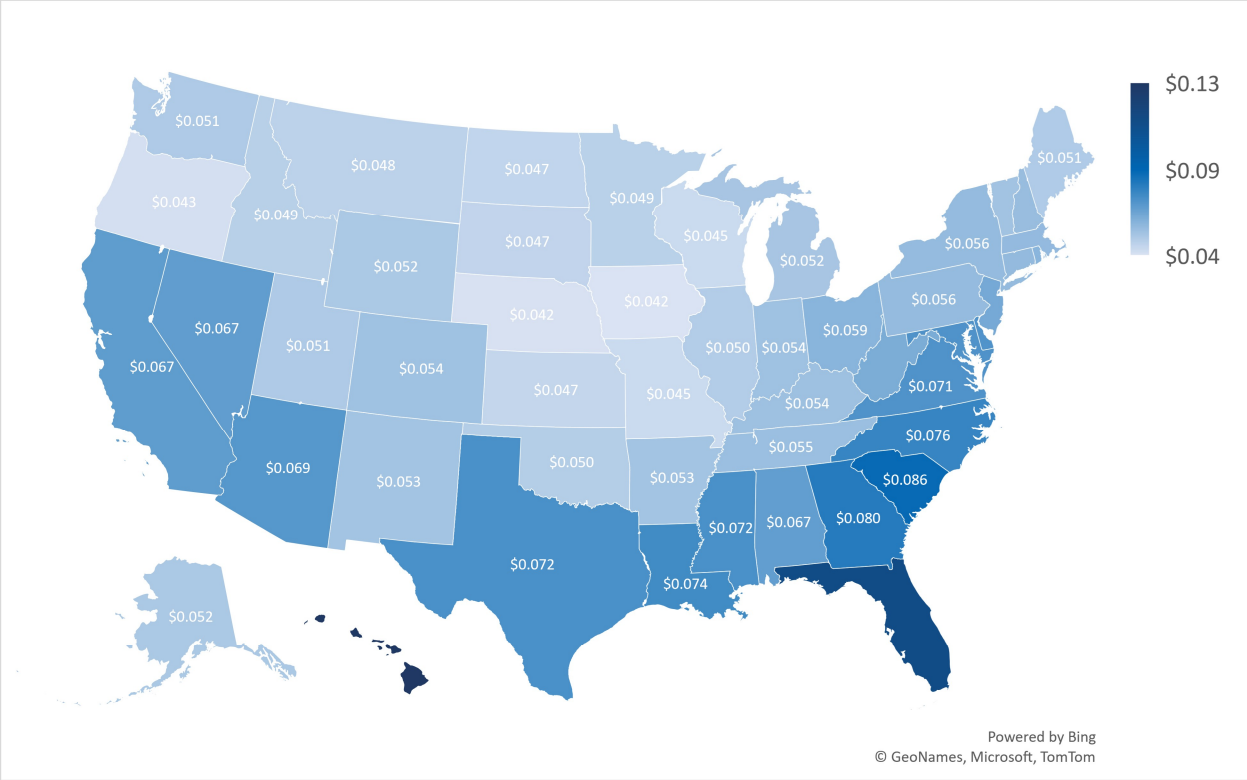


Figure 67: 2020 Residential Cost of Other Heating Fuels per kWh for Occupied Housing Units Using and Paying for Other Heating Fuels Map



NON-RESIDENTIAL COSTS

Residential, commercial and industrial customers all pay different costs for electricity and natural gas. Industrial customers generally receive the lowest rates of the customer classes because they are large users that require singular hookups. The energy costs for industrial customers can be understood in the electricity sector as primarily transmission and generations costs, and in the natural gas sector as transmission and production costs. Residential and commercial customers, on the other hand, pay for transmission, generation/production, and the construction and maintenance of distribution infrastructure. How much of these costs falls on commercial customers and how much falls on residential customers is largely a matter of policy. Looking at Figure 68 and Figure 76, there is a clear lack of uniformity in how distribution costs are shared between residential and commercial customers.

In Rhode Island, the commercial cost of electricity is negligibly higher than the industrial, and the residential sector is forced to pay for distribution infrastructure. Conversely, in many southern states, including Kentucky, Tennessee, Alabama and Mississippi, there is a large spread between commercial and industrial prices, but a very small spread between commercial and residential.

Similar trends exist in natural gas costs, although which states they exist in appear uncorrelated to where they exist for electricity. It is also worth noting that there are two instances—New York and Ohio—where industrial customers pay more than commercial customers.

Non-Residential Electricity Costs

In 2021, Michigan's 12.3 cents per kilowatt-hour price of electricity for the commercial sector is relatively high compared to other states, ranking 13th-highest. Michigan's electricity price for industrial customers was 7.8 cents per kilowatt-hour and Michigan ranked 16th in overall industrial sector electricity price. Figure 70 and Figure 72 show that Michigan's commercial and industrial sector electricity prices were the highest among its peer states, except for Minnesota, which, in 2021 had the highest industrial electricity price in the Midwest.

Figure 68: 2021 Electricity Cost per Kilowatt Hour by Sector

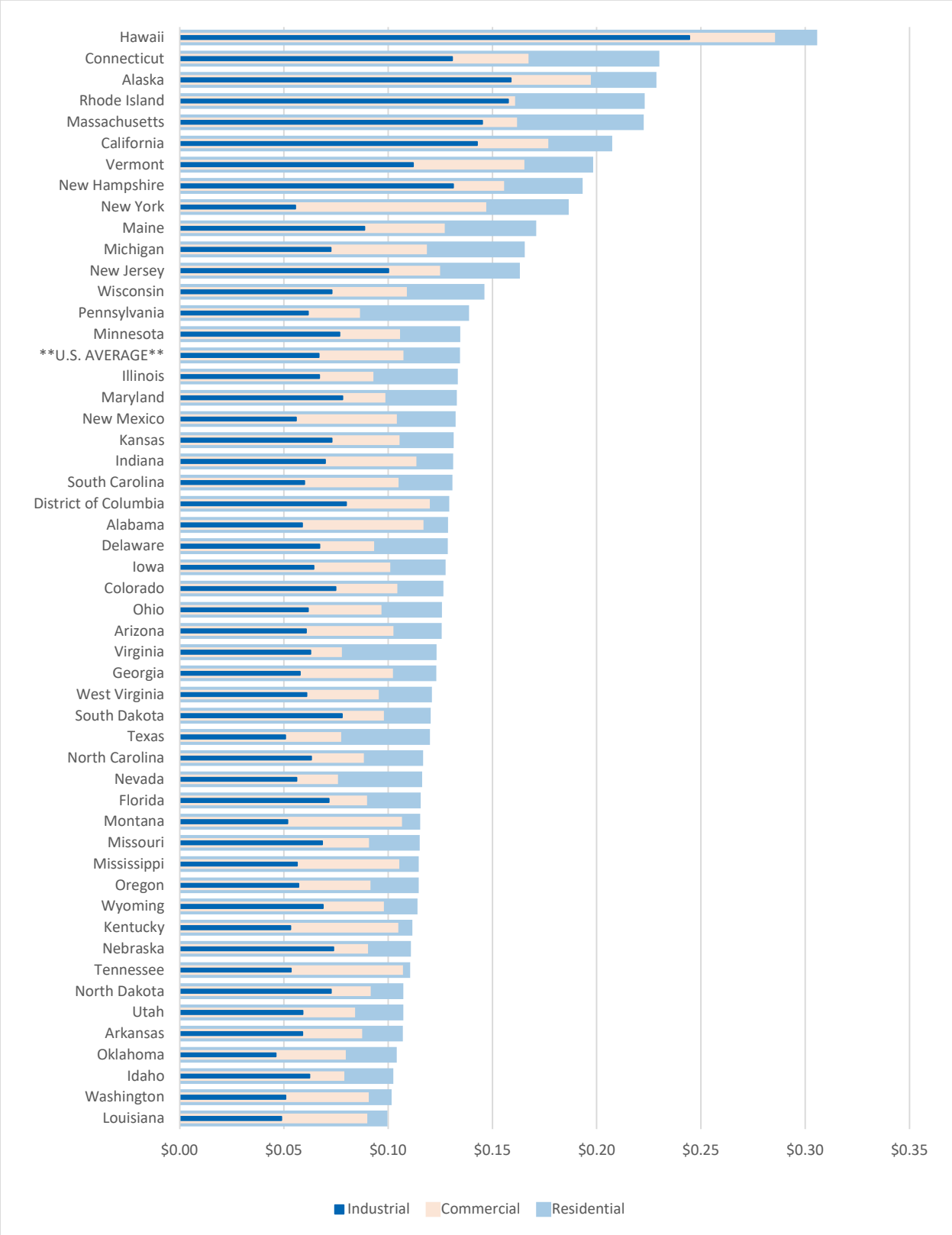


Figure 69: 2021 Cost per Kilowatt Hour of Electricity in the Commerical Sector

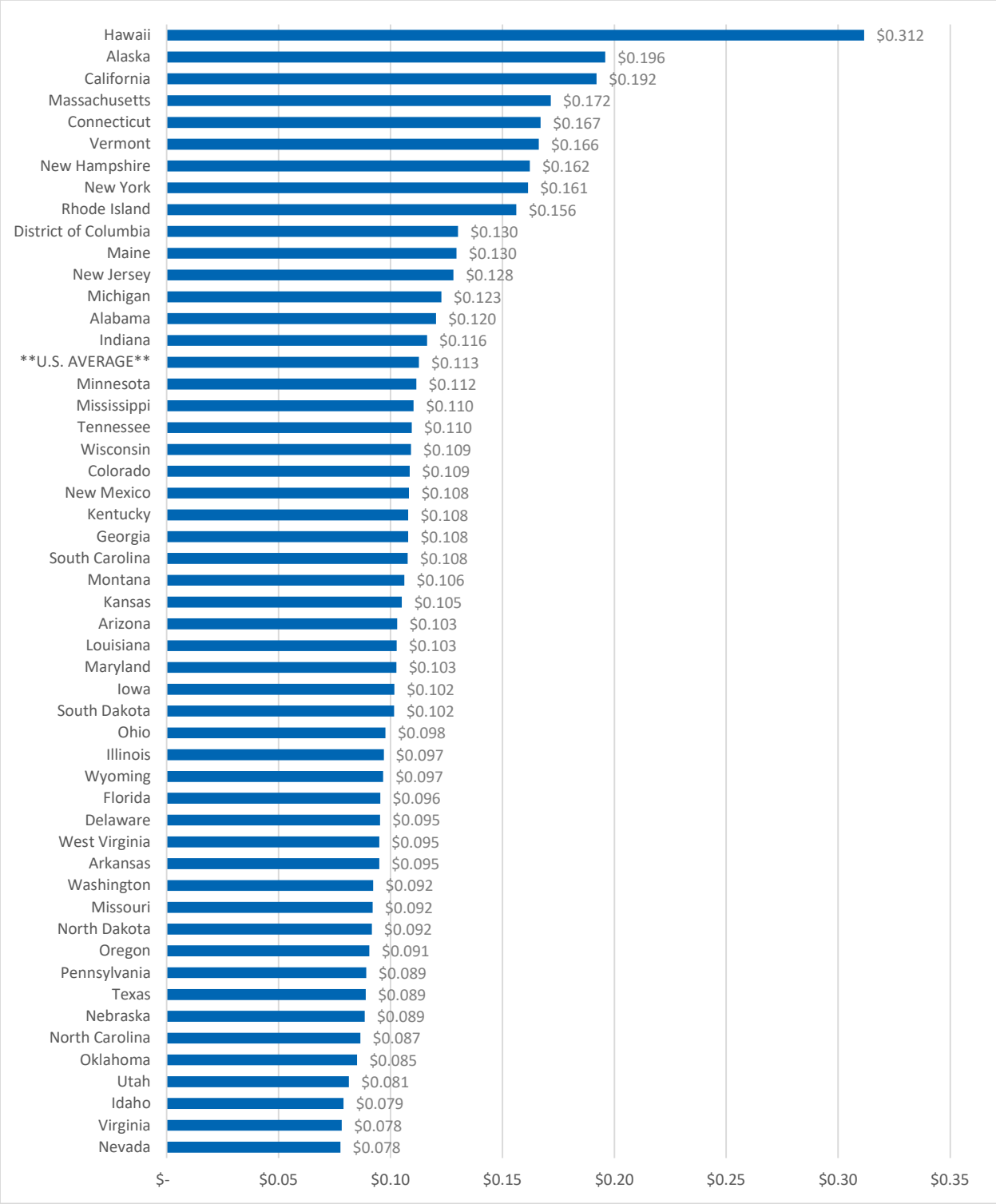


Figure 70: 2021 Cost per Kilowatt Hour of Electricity in the Commercial Sector in Dollars Map

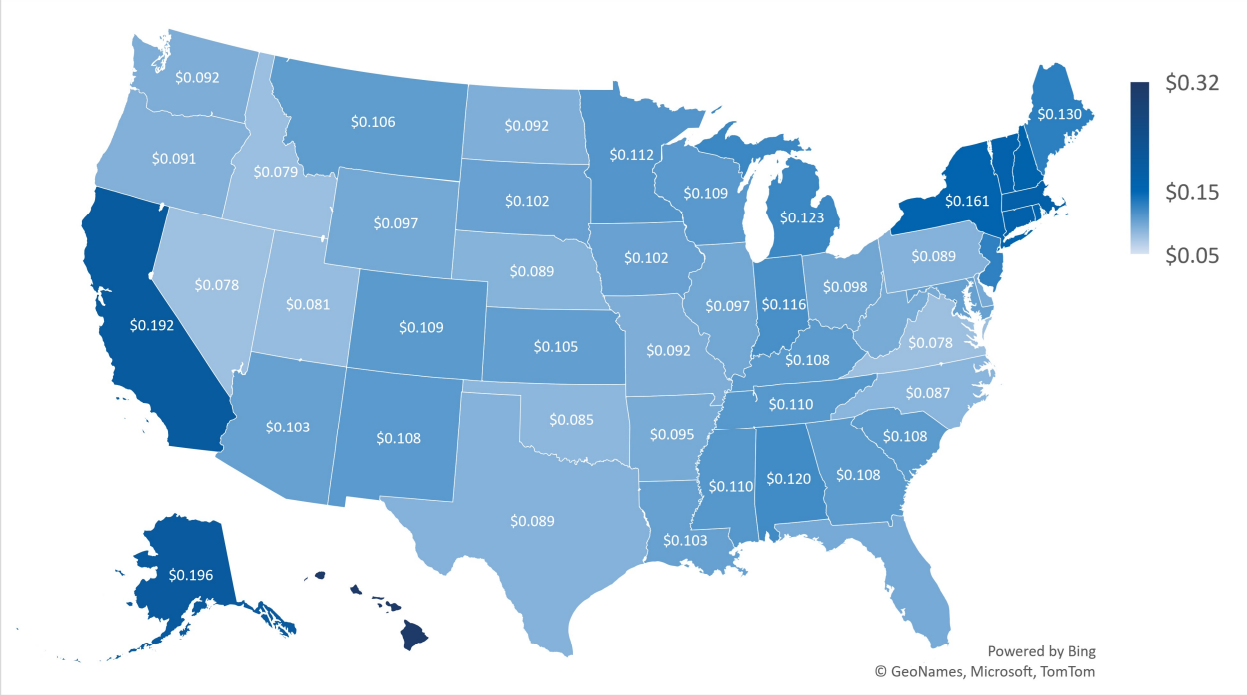


Figure 71: 2021 Cost per Kilowatt Hour of Electricity in the Industrial Sector

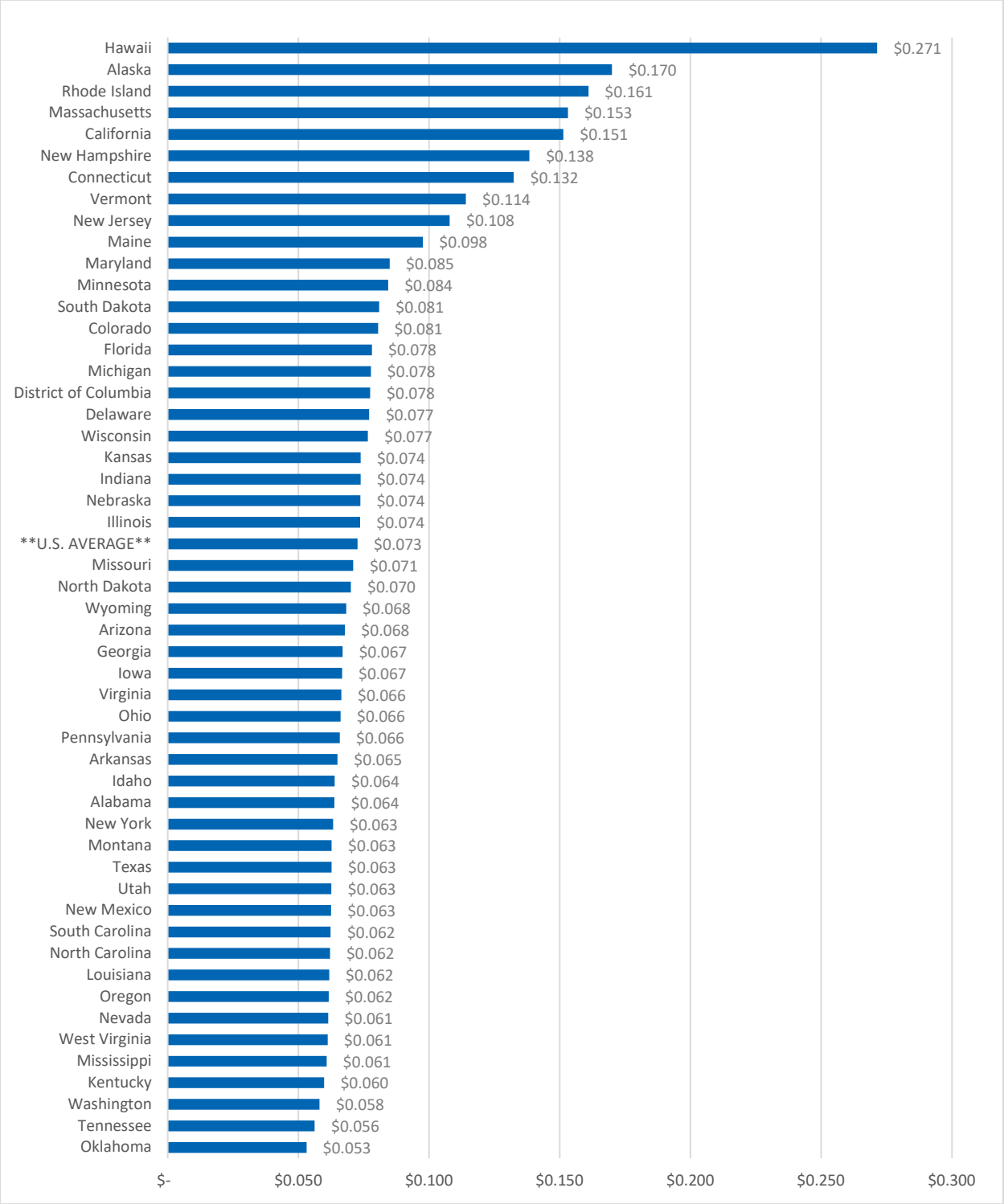
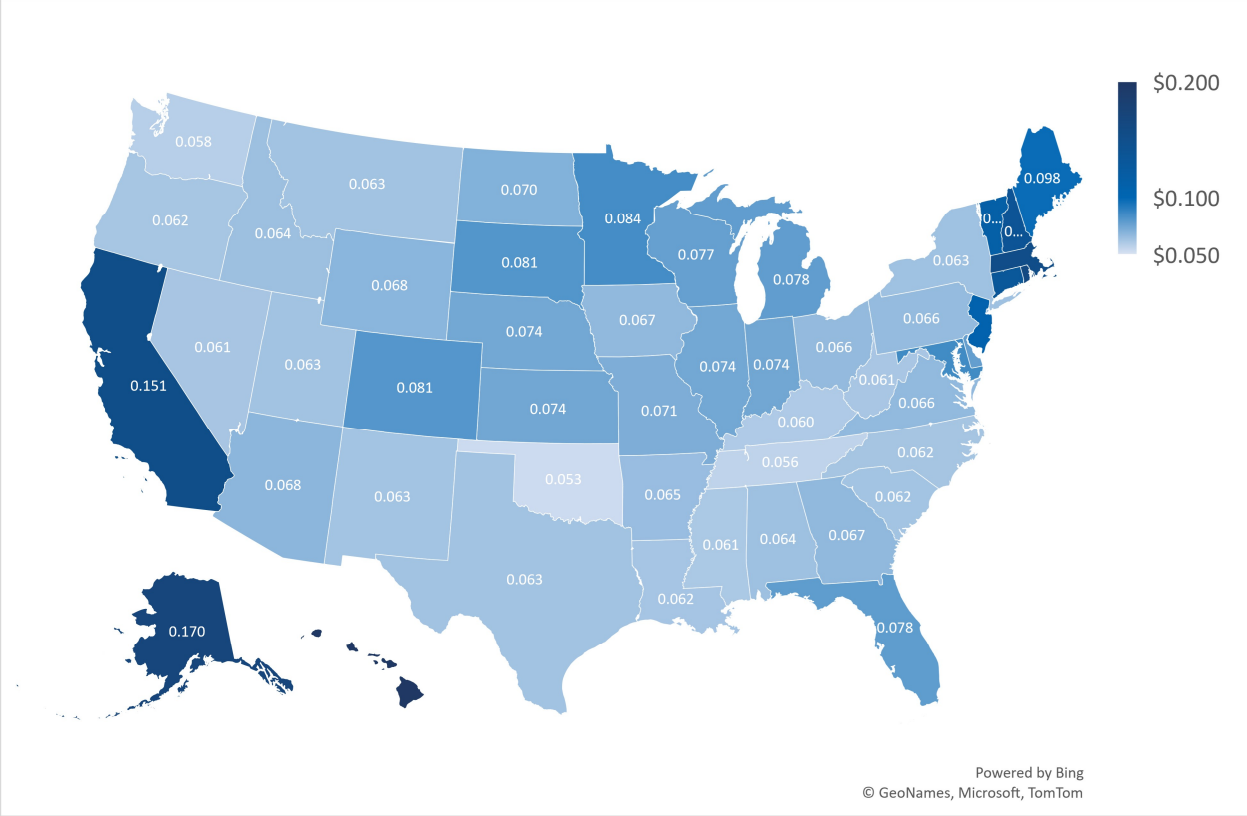


Figure 72: 2021 Cost per Kilowatt Hour of Electricity in the Industrial Sector in Dollars Map



Michigan Non-Residential Electricity Costs

Figure 73 shows the comparative pricing by sector of different utilities across Michigan. It is interesting to note that, for some smaller municipal and cooperative utilities, the normal pattern of price increasing from industrial to commercial to residential is not always the case. Although they may represent real differences in cost of service between different sectors, these discrepancies are more likely to represent the political priorities of these smaller utilities that have more pricing flexibility because of their smaller scales and institutional structures.

Figure 73: 2020 Electricity Cost by Sector for Michigan Electric Utilities

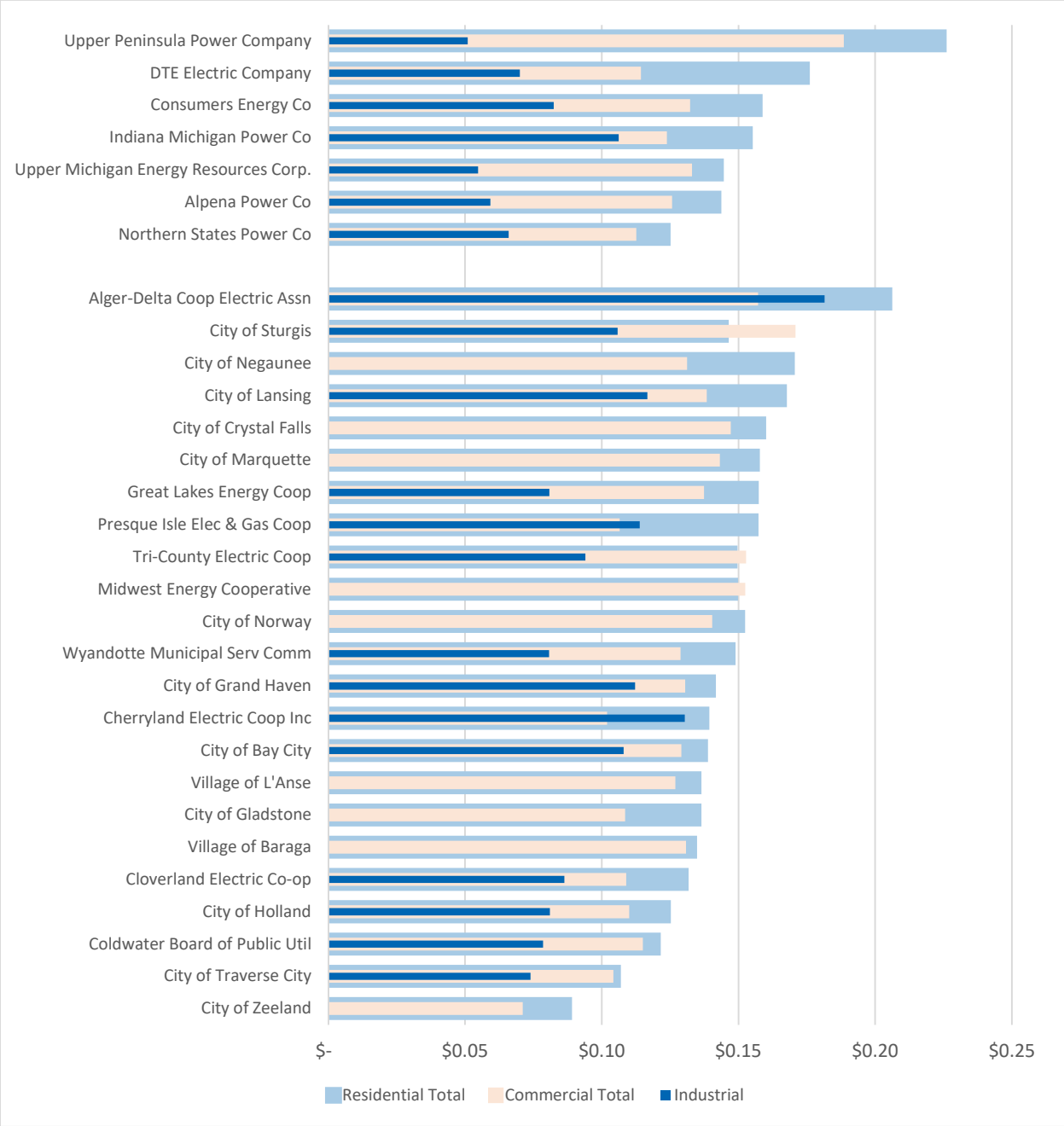


Figure 74: 2020 Cost per Kilowatt Hour of Electricity in the Commerical Sector for Michigan Utilities

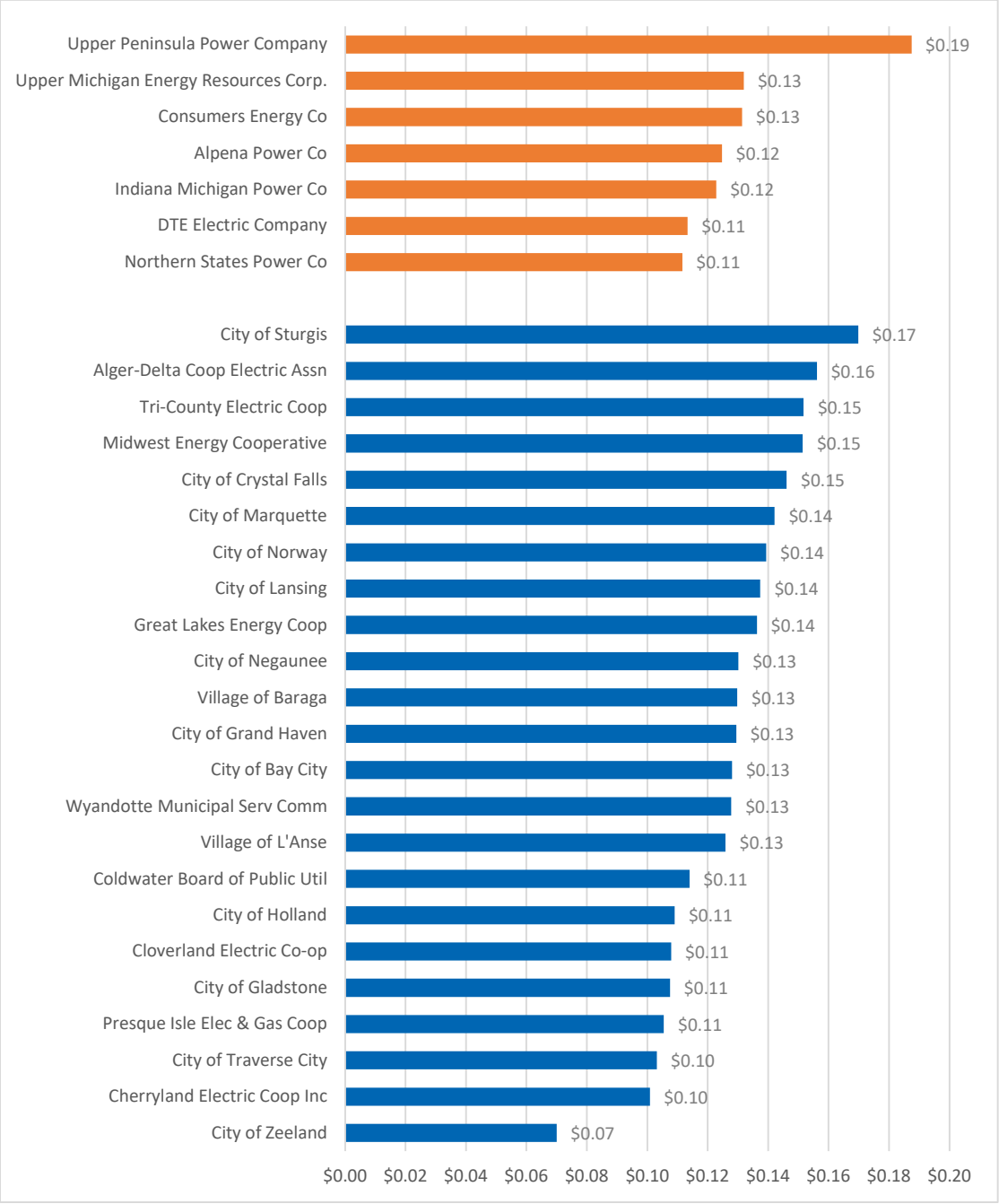
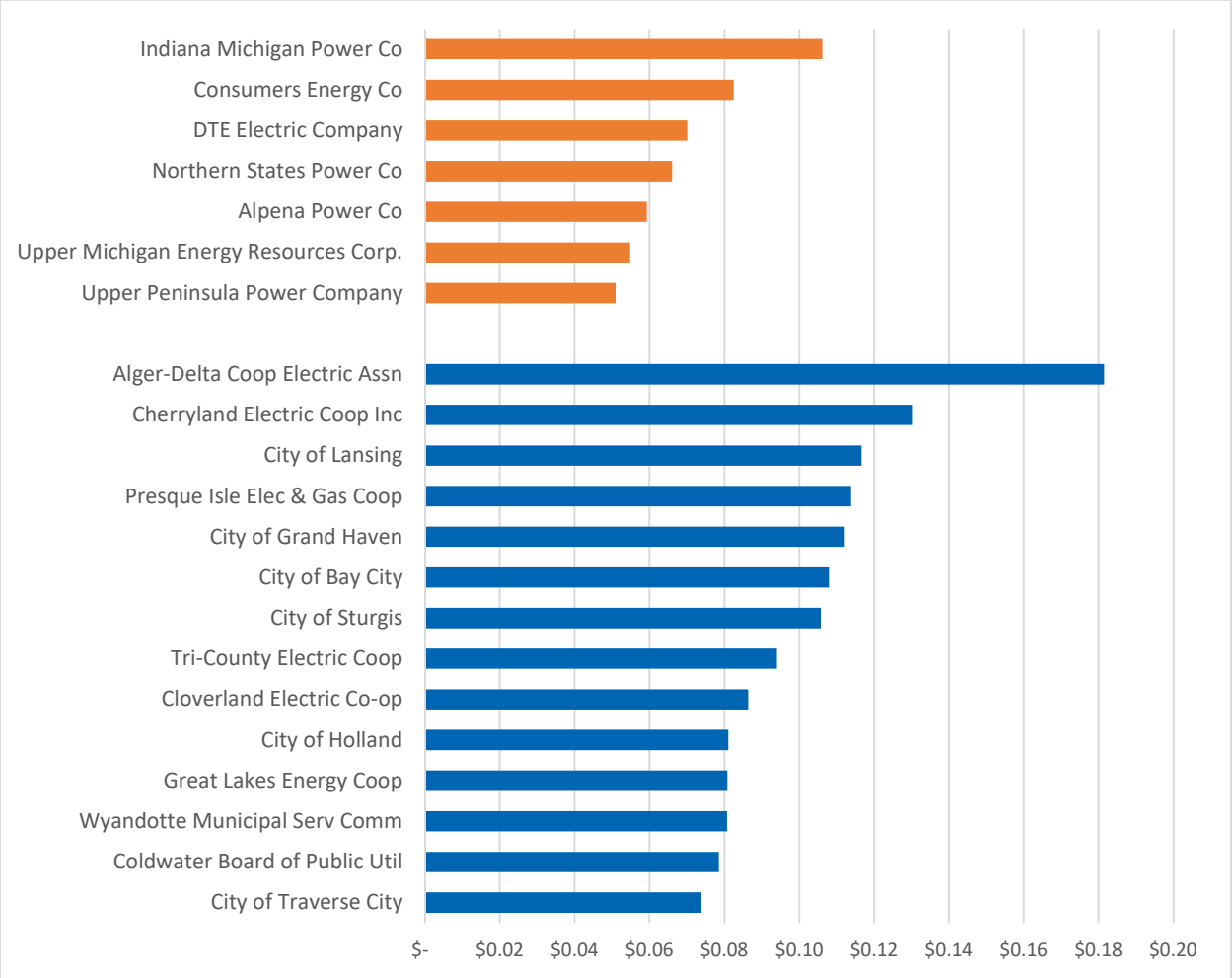


Figure 75: 2020 Cost per Kilowatt Hour of Electricity in the Industrial Sector



Non-Residential Natural Gas Costs

Michigan's 68.6 cents per therm price of natural gas for the commercial sector is relatively low compared to other states, ranking 37th-highest. Michigan's natural gas price for industrial customers was 58.5 cents per therm and Michigan ranked 18th in overall industrial sector natural gas price. Those results are notably much worse than the state's rankings for commercial and residential natural gas price. Whereas commercial and residential sector natural gas rates are driven by space heating and go down as infrastructure costs are divided up over a higher number of therms sold, in the industrial sector, natural gas price is driven by other factors, unlinked to the demand produced by space-heating. Figure 78 and Figure 80 show that Michigan's commercial sector natural gas price is comparable to that of its peer states, whereas Michigan's industrial sector natural gas price is higher than all its peers, except Ohio.

Figure 76: 2020 Cost per Therm and Kilowatt Hour of Natural Gas by Sector

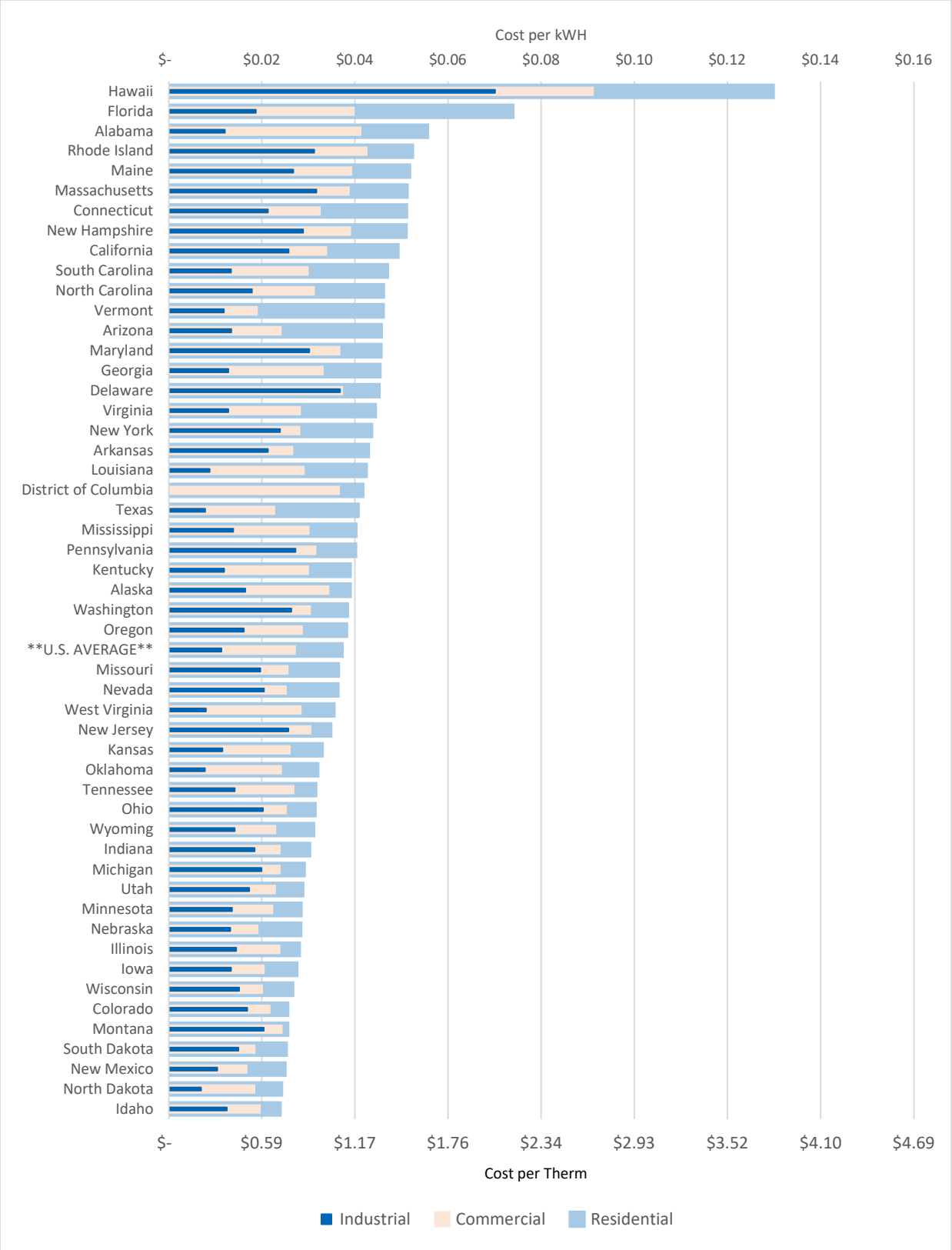


Figure 77: 2020 Cost per Therm and Kilowatt Hour of Natural Gas in the Commercial Sector

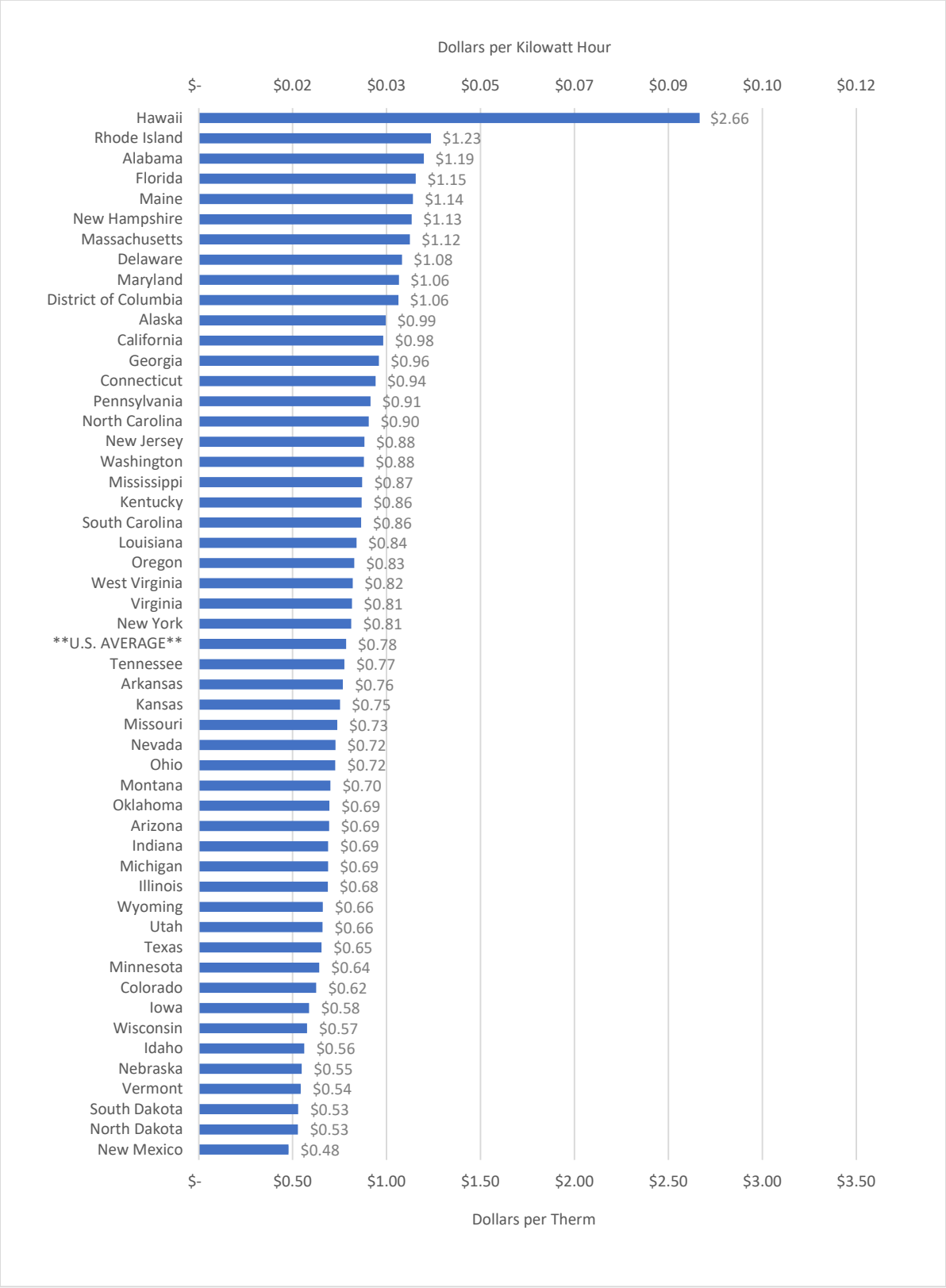


Figure 78: 2020 Cost per Therm of Natural Gas in the Commercial Sector in Dollars Map

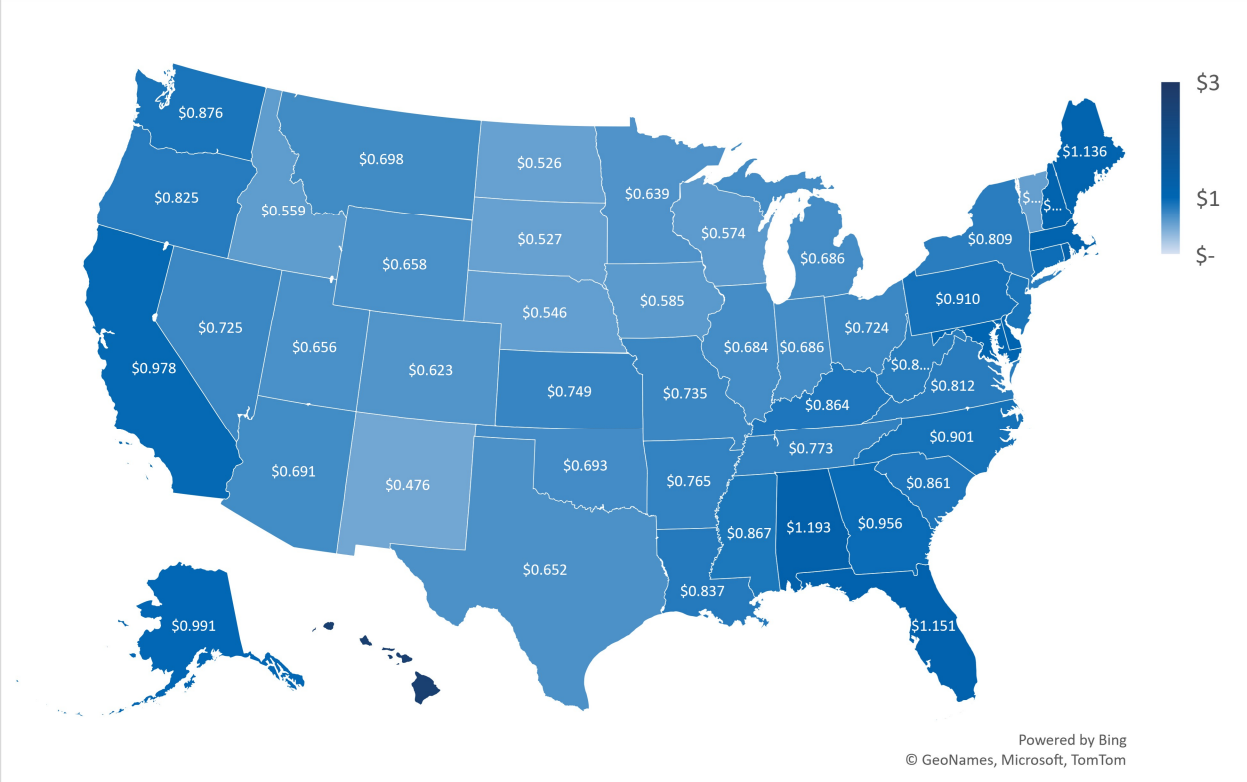


Figure 79: 2020 Cost per Therm and Kilowatt Hour of Natural Gas in the Industrial Sector

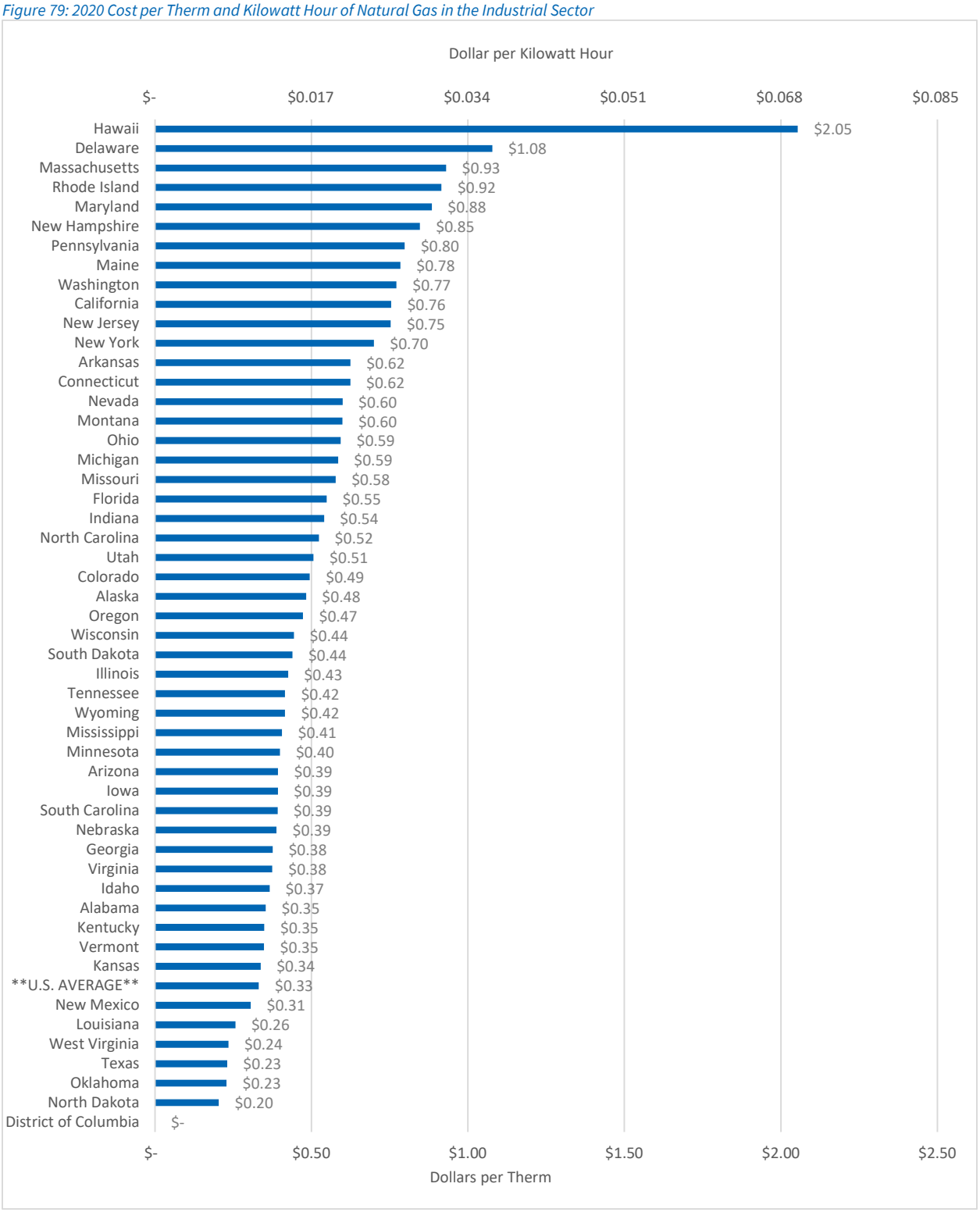
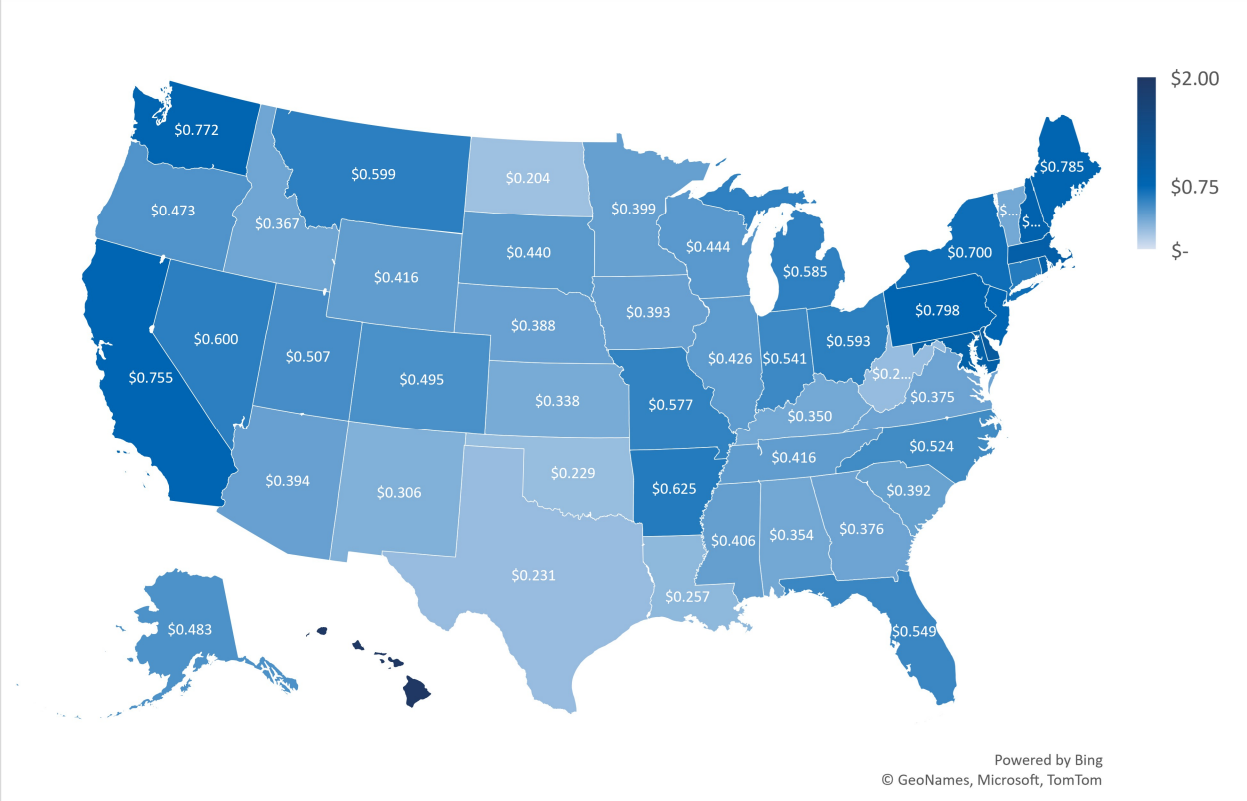


Figure 80: Cost Per Therm of Natural Gas in the Industrial Sector in Dollars Map



Michigan Non-Residential Natural Gas Costs

In 2020 sector cost per therm of natural gas for the commercial varied between $.48 and $.76 among Michigan's natural gas utilities. Like in the residential sector, natural gas prices in the commercial sector have substantially declined since 2011 for all utilities. However, between 2019 and 2020, three utilities saw increases in natural gas prices and four saw decreases, while Consumers Energy's natural gas price stayed approximately the same (Figure 164).

In the industrial sector, natural gas costs $.28 and $.67 between Michigan's natural gas utilities. Like in the residential and commercial sectors, natural gas prices in the industrial sector have substantially declined since 2011 for all utilities. Between 2019 and 2020, most of Michigan's natural gas utilities continued to see reduced costs for industrial consumers, except for Michigan's largest two utilities, Consumers Energy Company and DTE Gas Company. They had approximately the same costs between the two years, with DTE showing an approximate $.01 increase and Consumers showing a less than half penny decrease (Figure 165).

Figure 81: 2020 Natural Gas Cost by Sector for Michigan Natural Gas Utilities

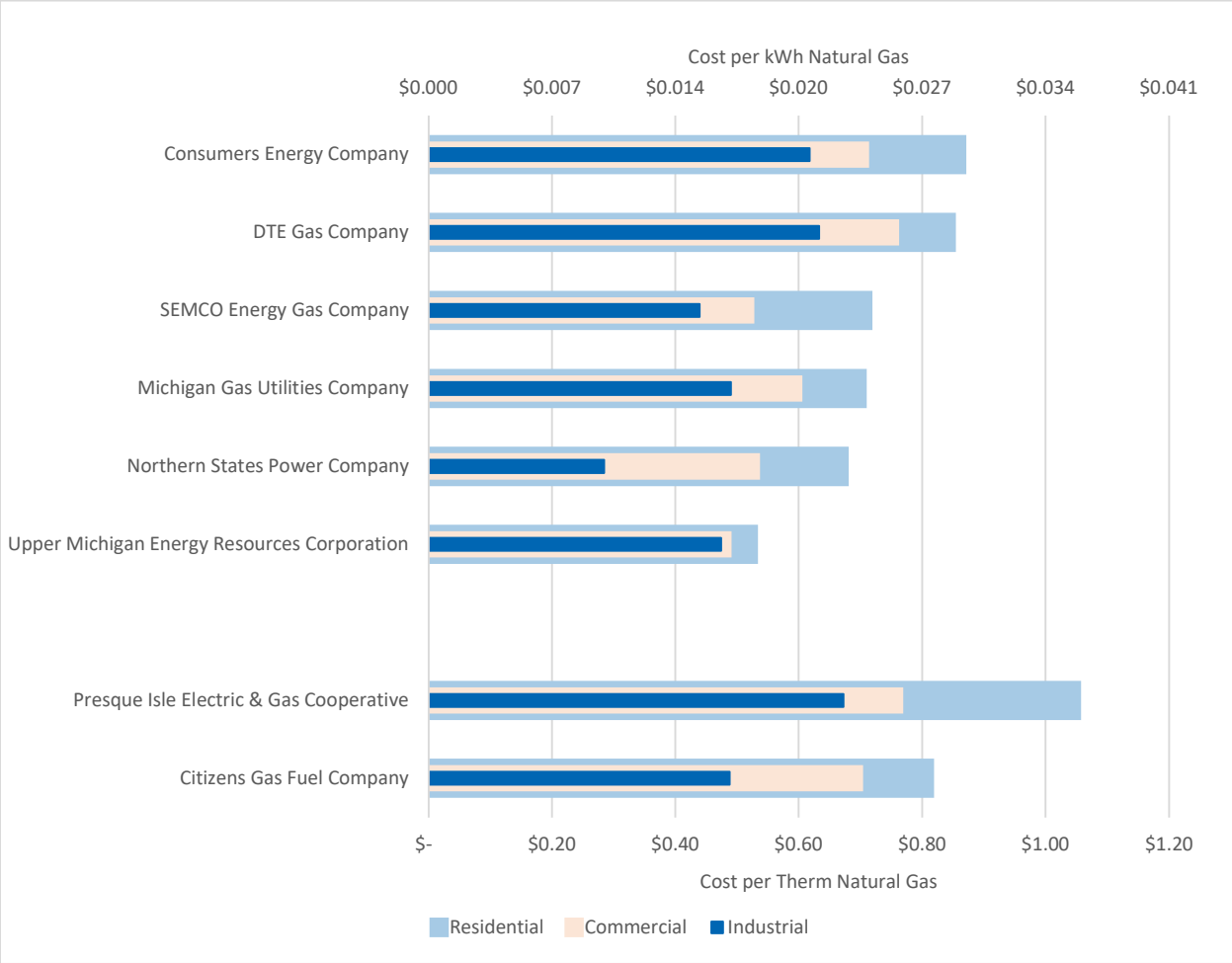


Figure 82: 2020 Commercial Natural Gas Cost for Michigan Utilities

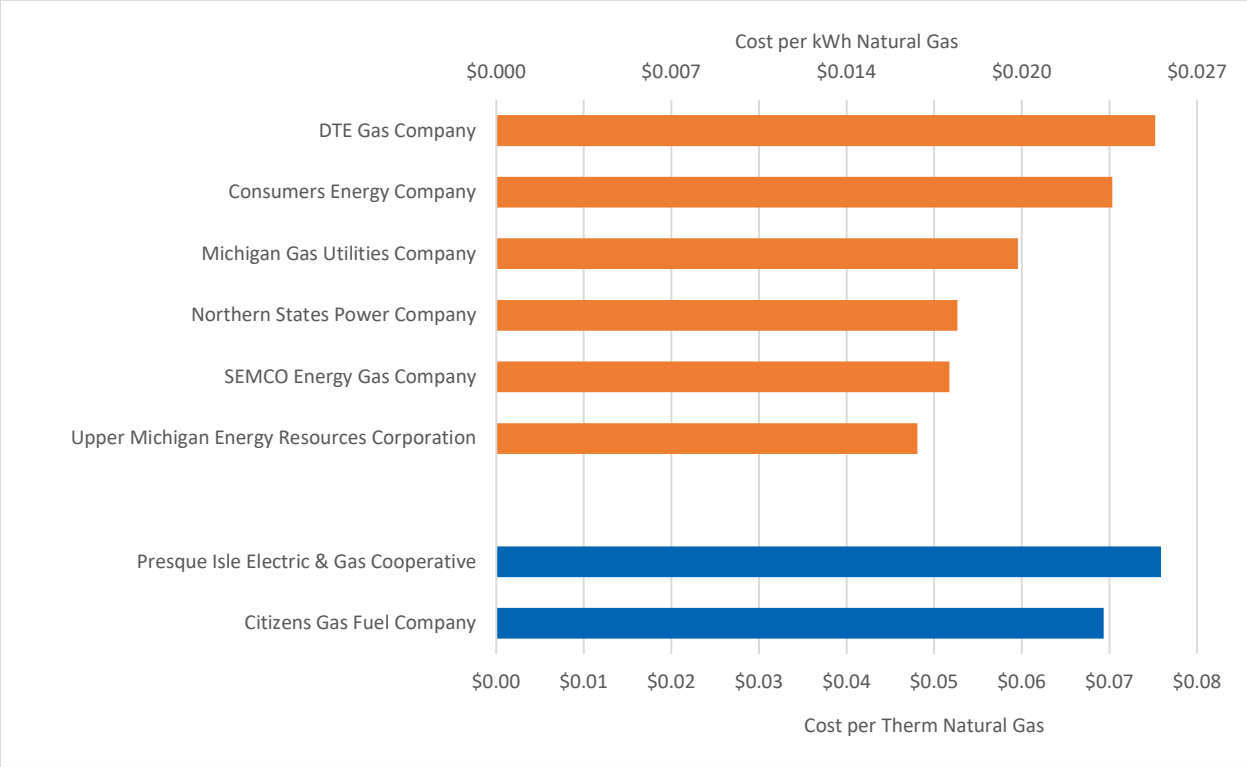
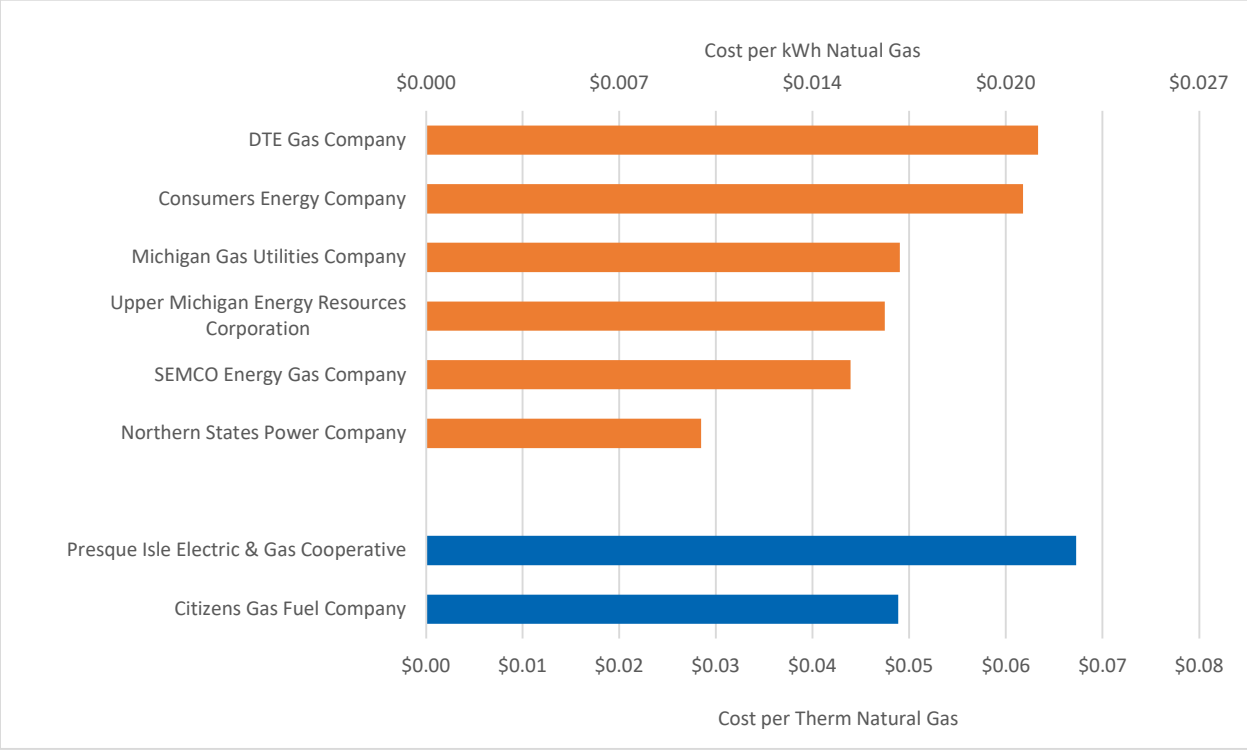


Figure 83: 2020 Industrial Natural Gas Cost for Michigan Utilities



ENERGY EFFICIENCY

Electric utilities across the country are working to reduce carbon emissions and are closing their oldest and dirtiest power plants. This trend is the result of both economic pressures and state and federal legislation. To make up for the lost electricity supply, as well as increases in load resulting from electrification, utilities are looking both to build new clean supply, and to control the demand side of the equation. From the point of view of utilities and utility regulators, a kilowatt-hour of unused electricity is the same as, and often cheaper than, the production of an additional kilowatt-hour of clean generation. The practice of intentionally reducing electricity use is called demand-side management. Energy efficiency programs are a big part of demand-side management. These energy efficiency programs come in different forms, but typical programs include weatherization programs to help improve insulation and air sealing, and programs that either provide or subsidize the replacement of older, less efficient lightbulbs and appliances, with newer, more efficient versions.

However, not all energy efficiency programs are equal, and not all utilities use them to their full potential. To get at the differences in program efficiency and deployment, we present two metrics that we have produced from data reported in utilities' Form 861 filings to the EIA. These metrics are "Cost per Kilowatt Hour of Energy Efficiency Savings," which is a measurement of how well utilities are spending their money on energy efficiency, and "Energy Efficiency Savings as a Percentage of Sales," which measures how aggressively utilities are deploying energy efficiency programs. We report these metrics for each major economic sector—residential, commercial and industrial—at the state and Michigan utility levels. While all states have some residential energy efficiency programs, two states have no commercial energy efficiency programs, and fifteen states have no industrial energy efficiency programs.

Energy Efficiency Program Costs

In 2020 Michigan had the 24th-highest cost residential energy efficiency program in the country, the 22nd-highest cost program in the commercial sector and the 10th-highest cost program in the industrial sector (although it is still lower than the U.S. average). These programs provide energy efficiency savings at $0.025/kWh for residential, $0.015/kWh for commercial and $0.019/kWh for industrial. Compared to its peer states, Michigan utilities' energy efficiency programs are the most expensive, with their residential and industrial programs being notably more expensive than peer states, and their commercial programs being only slightly higher.

Figure 84: 2020 Cost per Kilowatt Hour of Energy Efficiency Savings in the Residential Sector

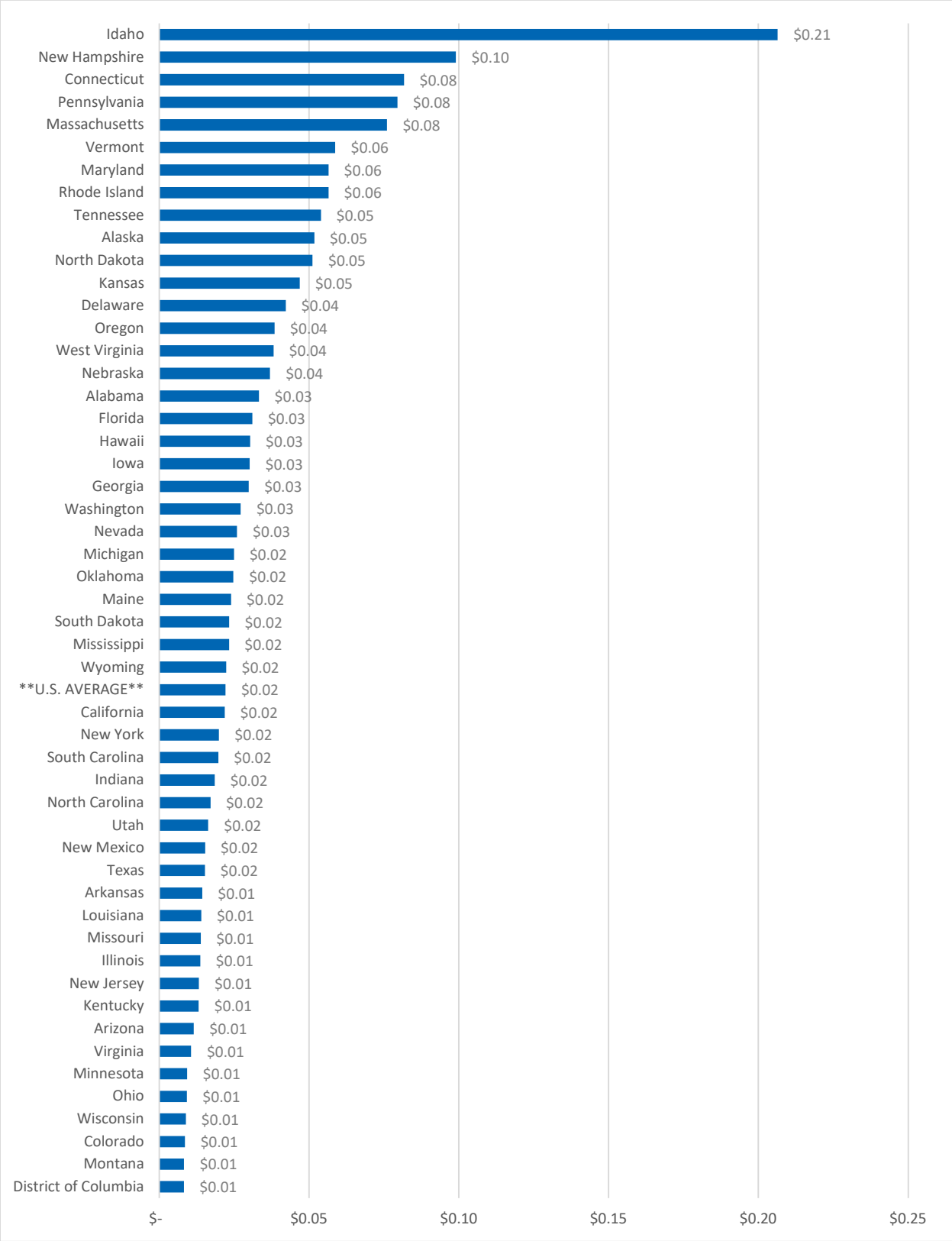


Figure 85: 2020 Cost per Kilowatt Hour of Energy Efficiency Savings in the Residential Sector Map

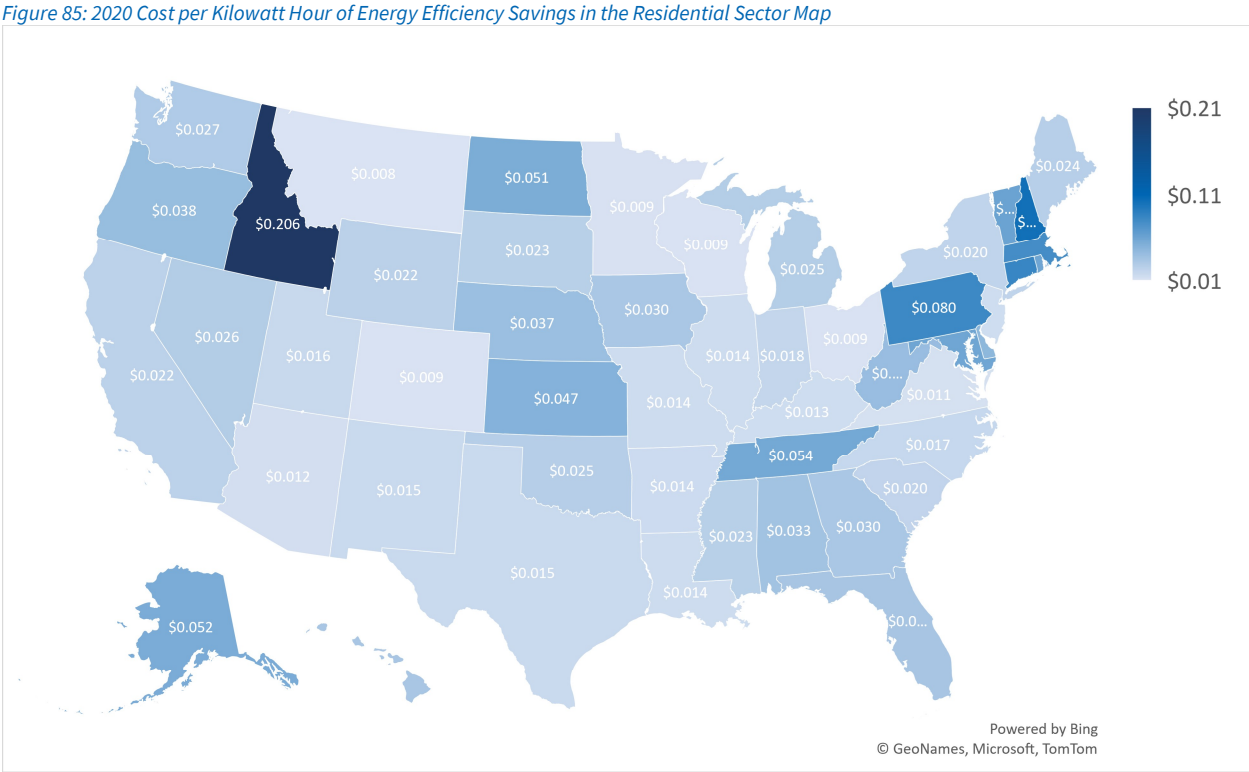


Figure 86: 2020 Cost per Kilowatt Hour of Energy Efficiency Savings in the Commercial Sector

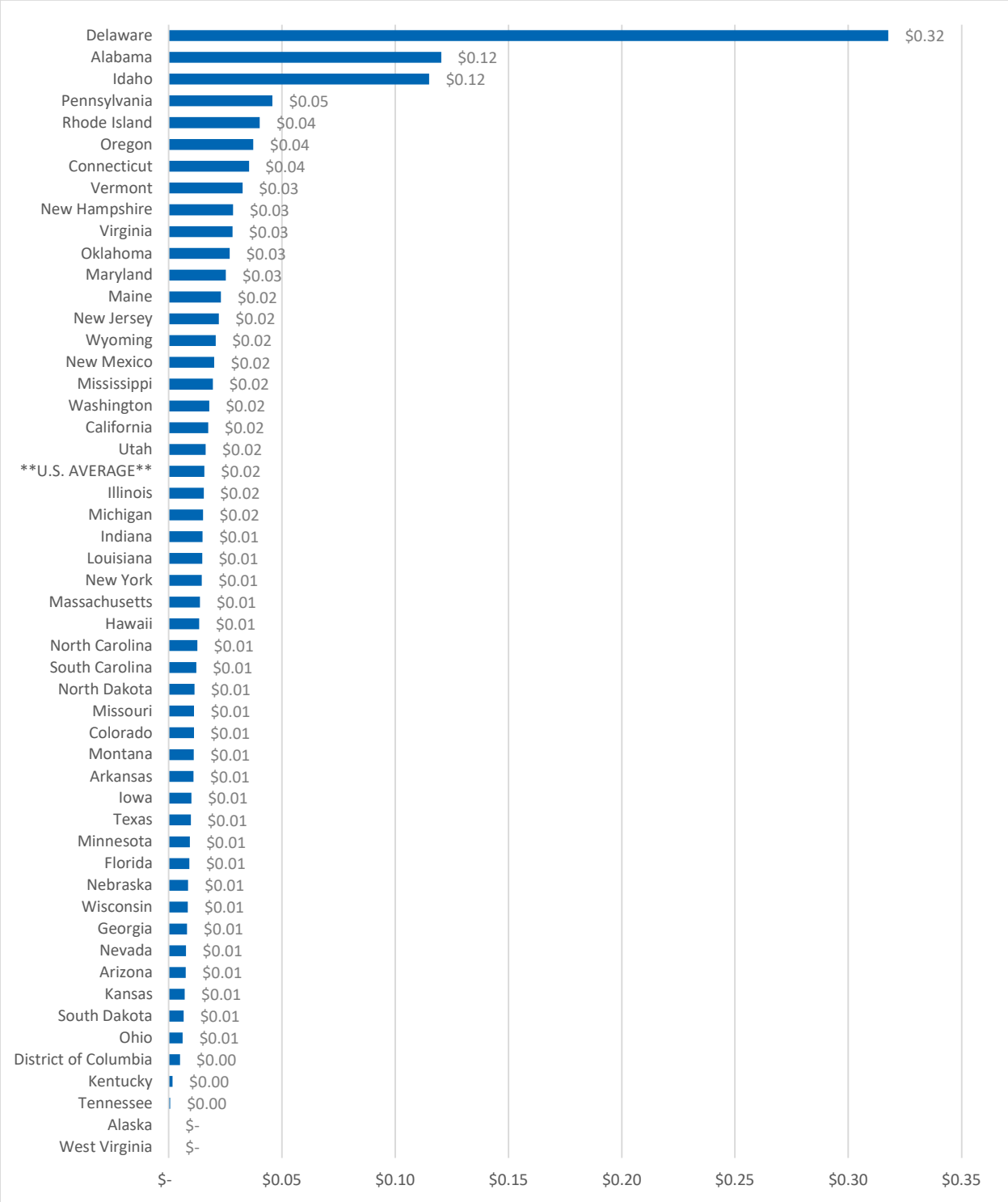


Figure 87: 2020 Cost per Kilowatt Hour of Energy Efficiency Savings in the Commercial Sector Map

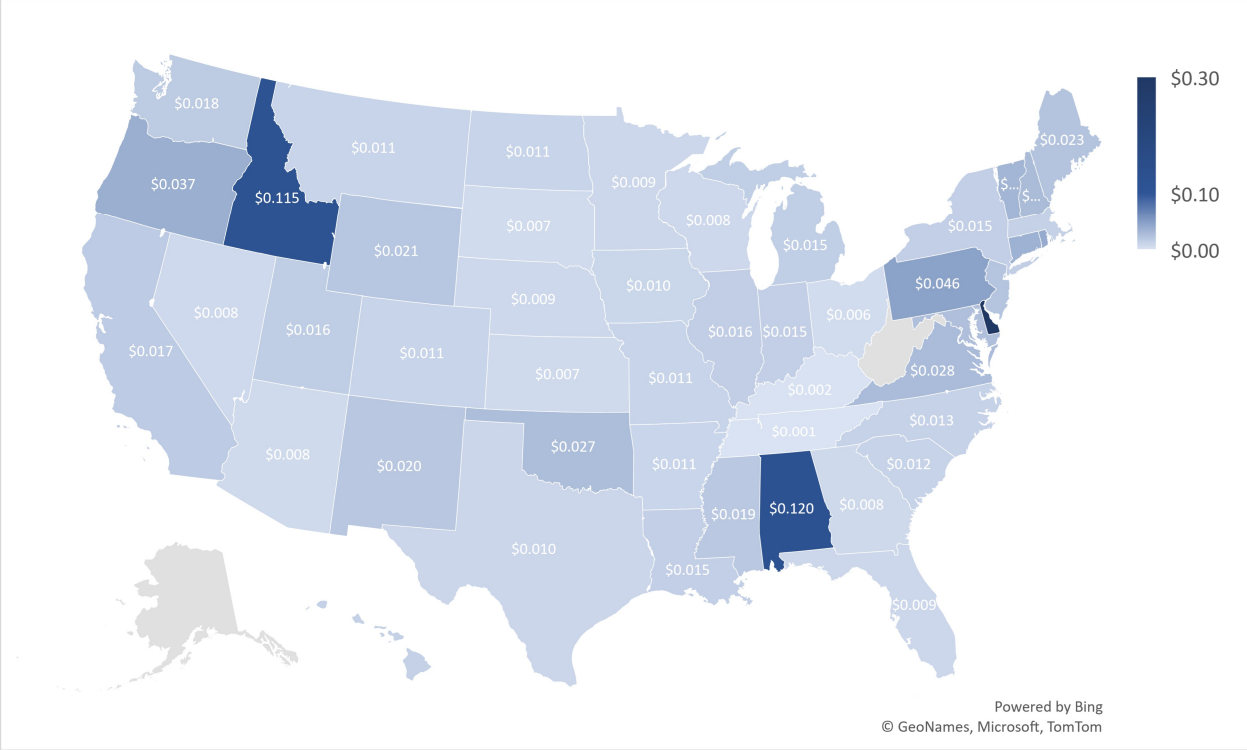


Figure 88: 2020 Cost per Kilowatt Hour of Energy Efficiency Savings in the Industrial Sector

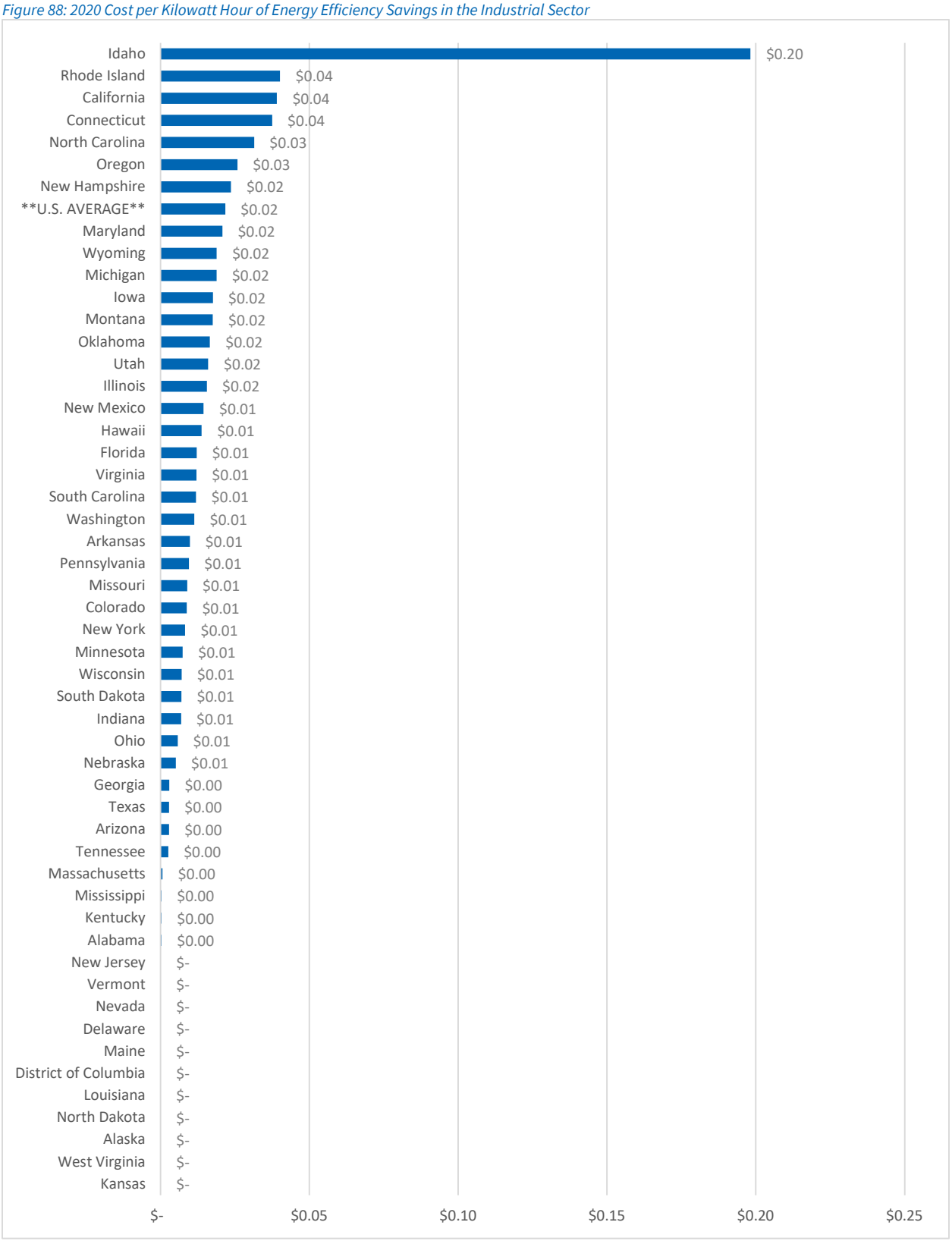
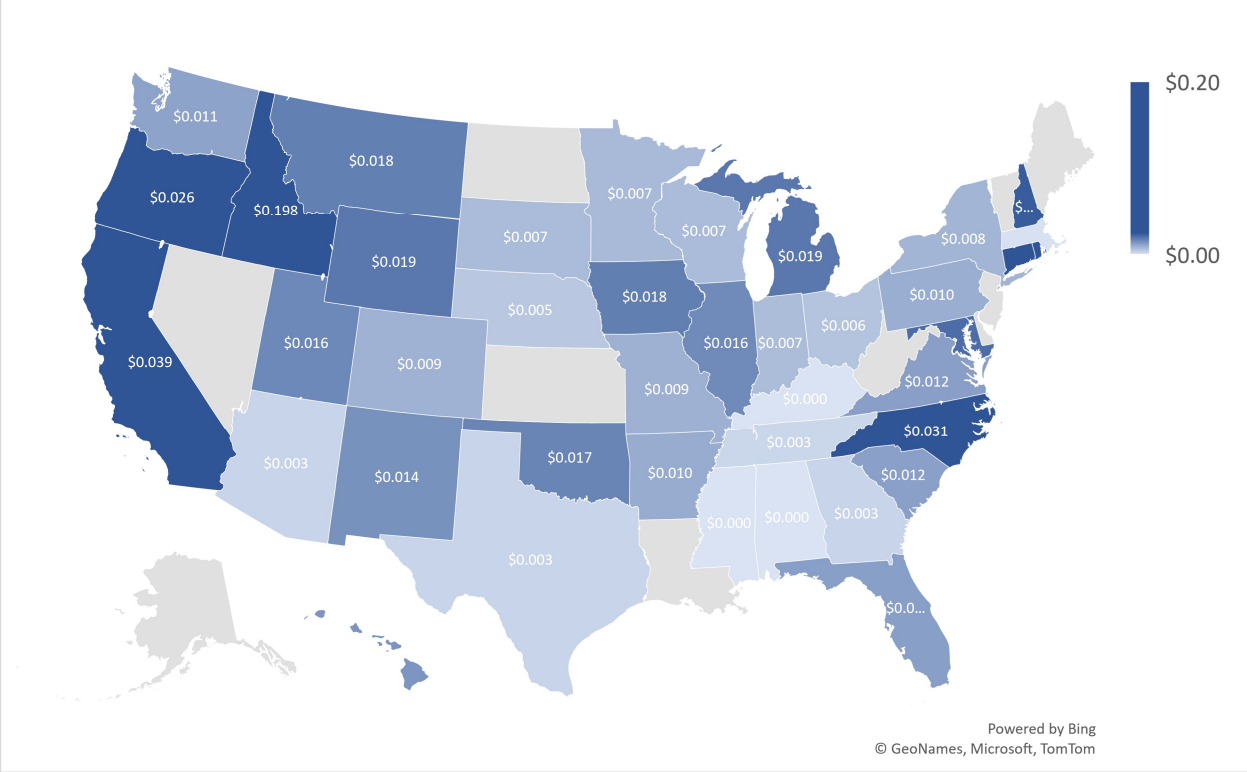


Figure 89: 2020 Cost per Kilowatt Hour of Energy Efficiency Savings in the Industrial Sector Map



Energy Efficiency Program Deployment

When looking at the figures in this section, it's important to note that, unlike most figures in this report, the longest bars at the top of the graphs represent the best performance rather than the worst performance.

As discussed above, Michigan's residential energy efficiency programs are fairly costly compared to those in other states. On the metric "Energy Efficiency Savings as a Percentage of Sales," however, Michigan utilities' residential sector programs ranked the 16th-best among all states at 1.42%, and near the middle of states in its peer group, with Ohio, Illinois and Minnesota performing better, and Indiana and Wisconsin performing worse.

Michigan performed even better with its commercial sector programs performing fifth-best among all states at 2.25% and was out-performed only by Illinois within its peer group (3 states have no commercial energy efficiency programs).

Michigan's industrial sector programs ranked 10th-best among all states at .67%, which was better than three states in Michigan's peer group—Indiana, Wisconsin and Illinois, but worse than Ohio and Wisconsin (10 states have no industrial energy efficiency programs).

Figure 90: 2020 Energy Efficiency Savings as a Percentage of Electricity Sales in the Residential Sector

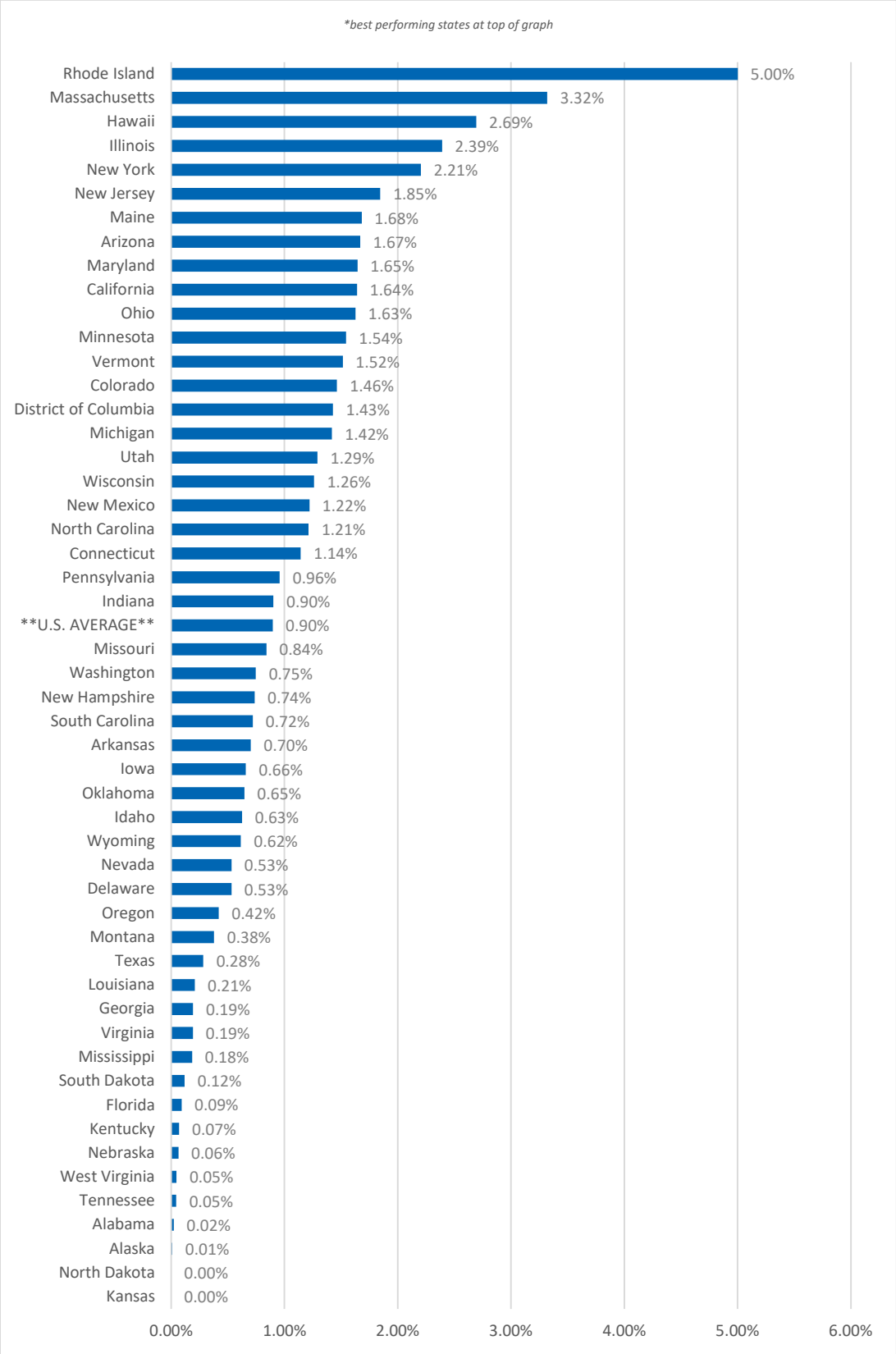


Figure 91: 2020 Energy Efficiency Savings as a Percentage of Electricity Sales in the Residential Sector Map

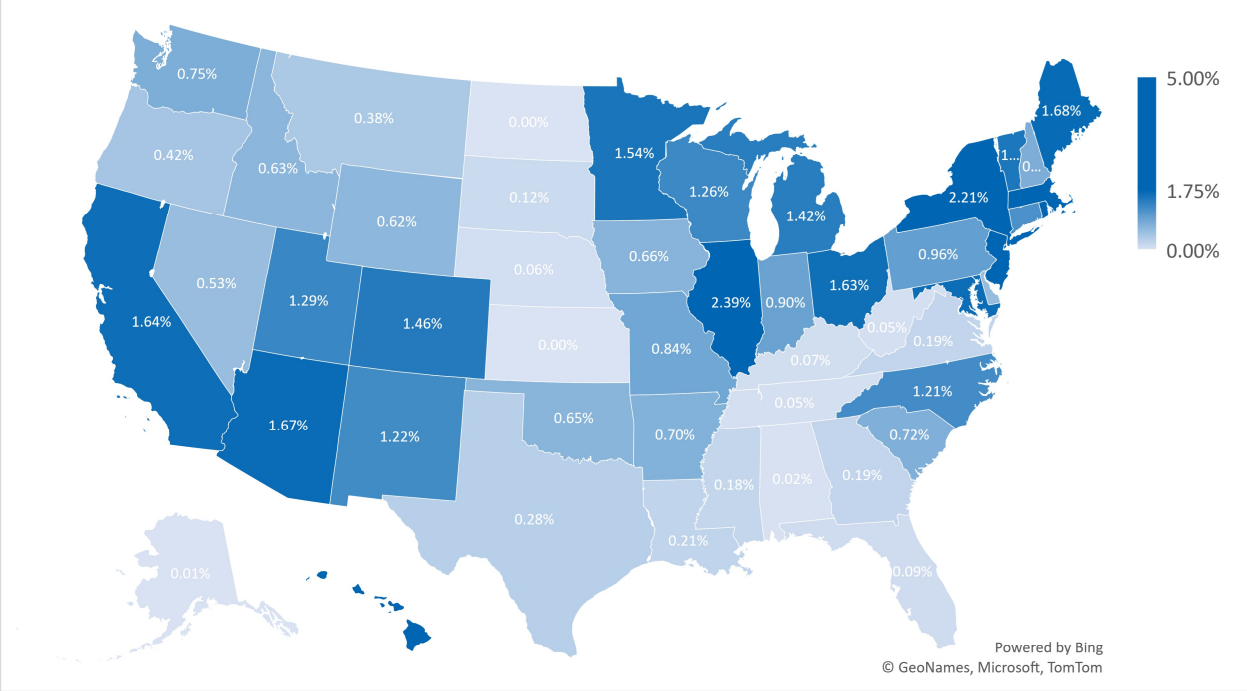


Figure 92: 2020 Energy Efficiency Savings as a Percentage of Electricity Sales in the Commercial Sector

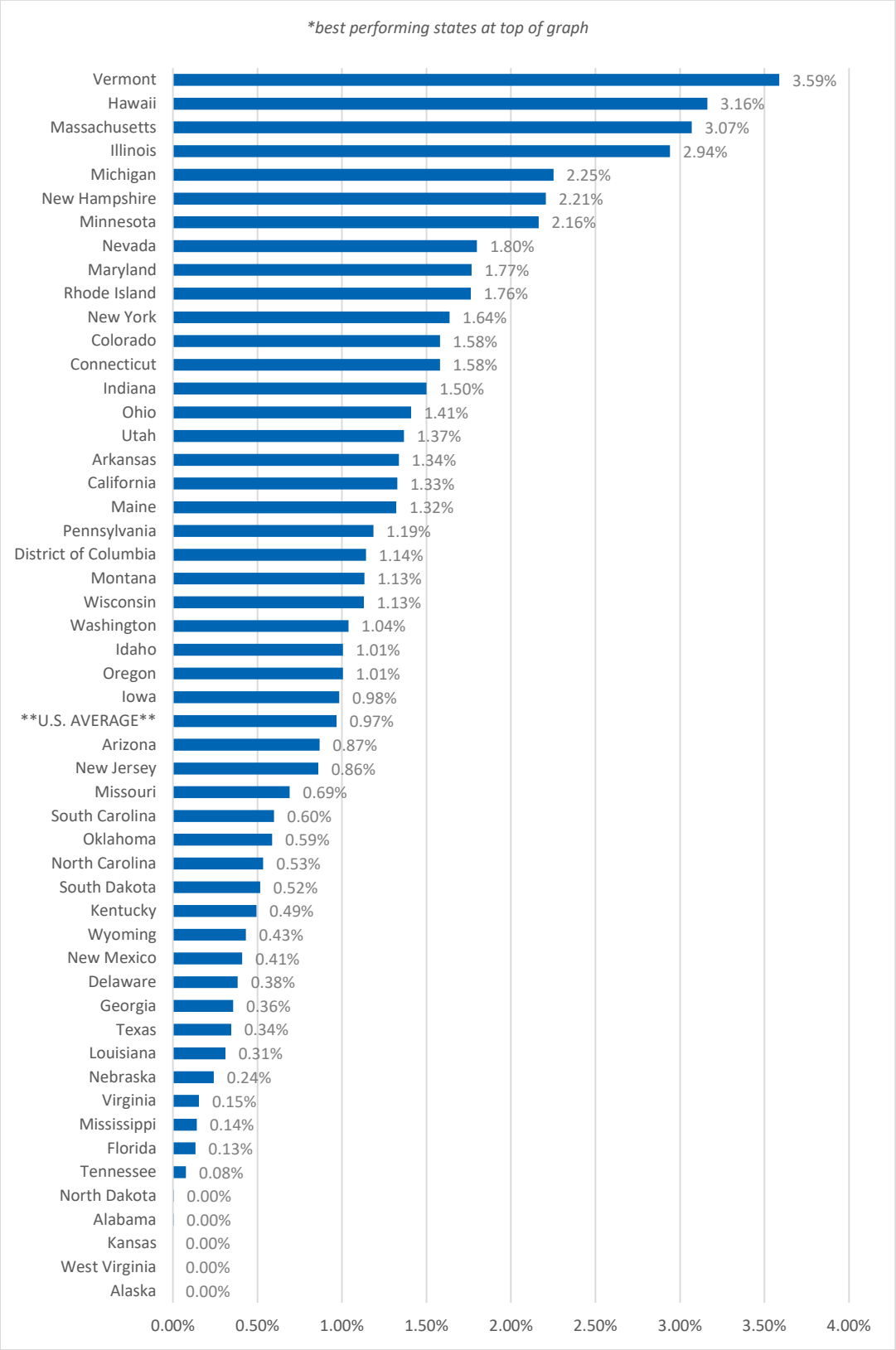


Figure 93: 2020 Energy Efficiency Savings as a Percentage of Electricity Sales in the Commercial Sector Map

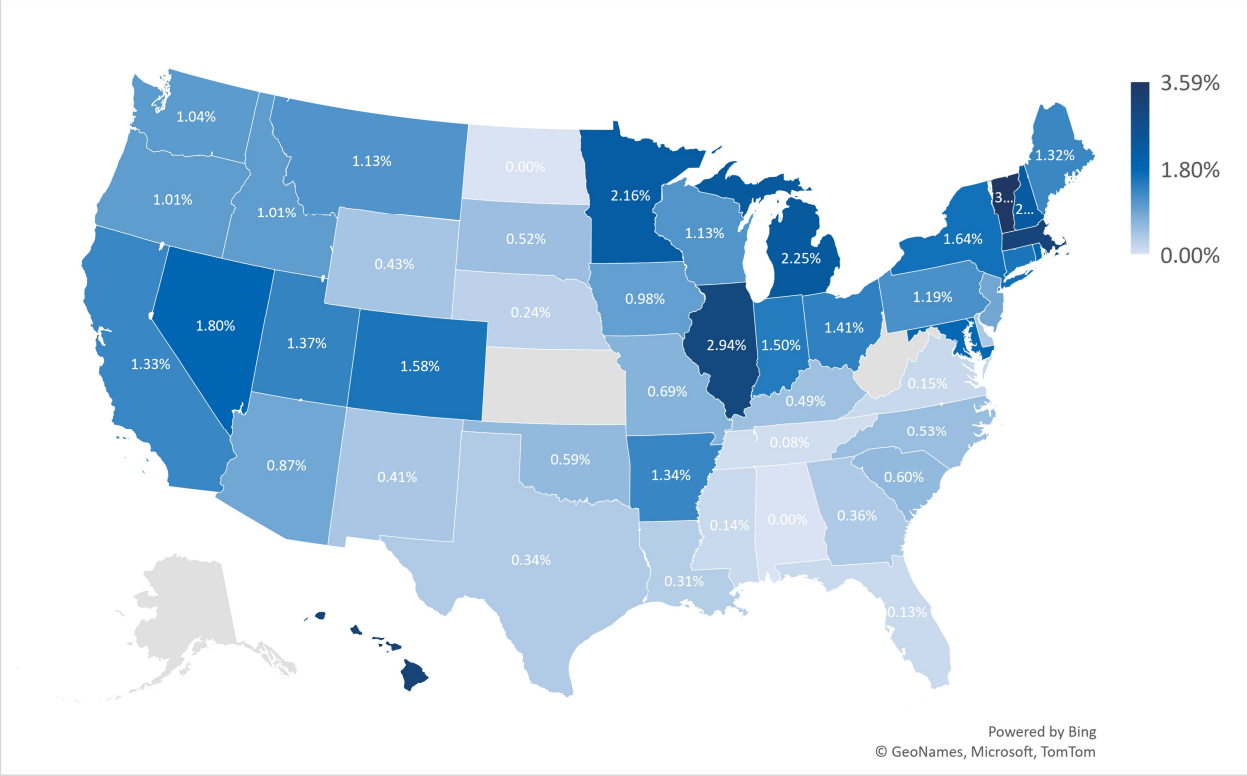


Figure 94: 2020 Energy Efficiency Savings as a Percentage of Electricity Sales in the Industrial Sector

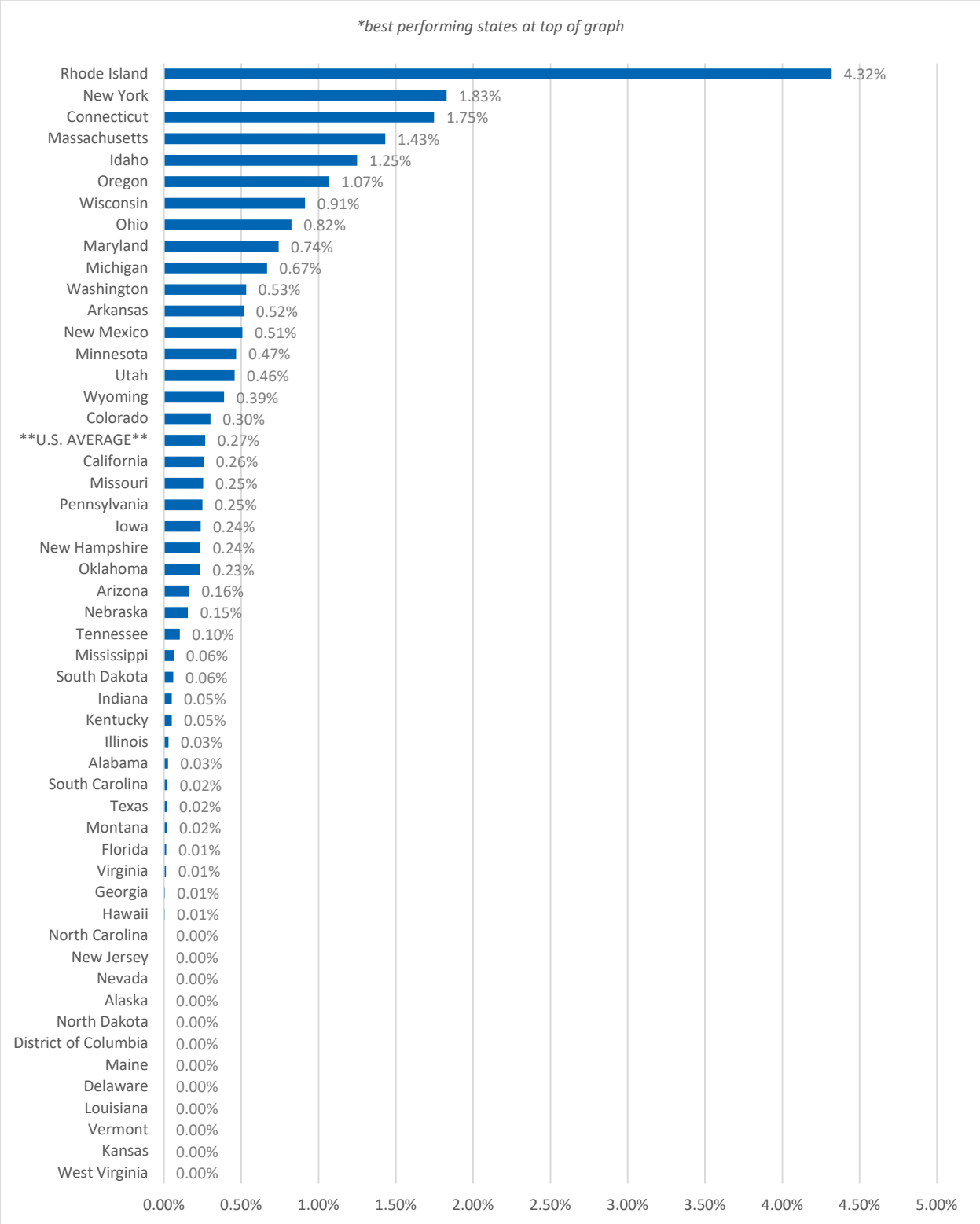
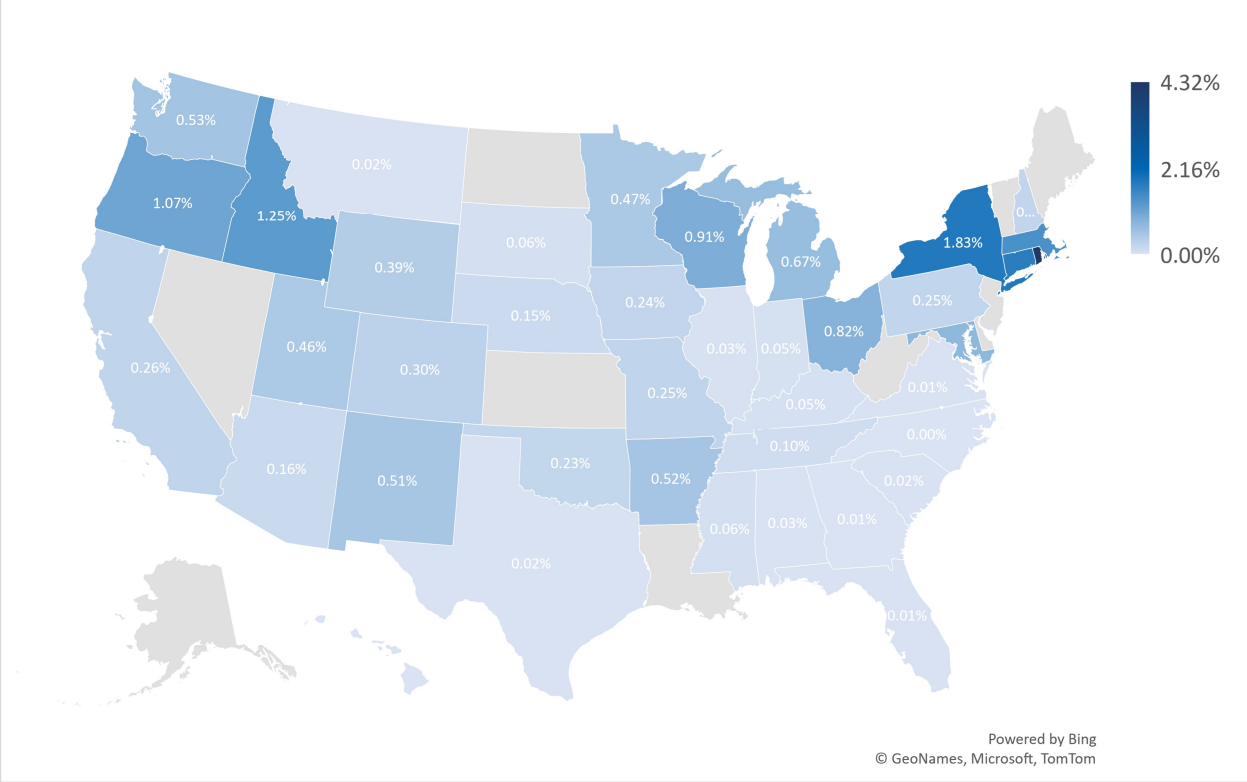


Figure 95: 2020 Energy Efficiency Savings as a Percentage of Electricity Sales in the Industrial Sector Map



Michigan Energy Efficiency Program Costs

Two of Michigan's IOUs have no residential or commercial energy efficiency program—Northern States Power Co. and Upper Michigan Energy Resources Corp. Only two of Michigan's IOUs have industrial energy efficiency programs—Consumers Energy Co. and Upper Peninsula Power Company. Michigan cooperatives and municipal utilities are not required to offer energy efficiency programs.

Michigan's IOUs run energy efficiency programs with similar cost-effectiveness, with costs ranging from $.01 to $.026 for residential energy efficiency programs Figure 96, whereas Michigan's municipal and co-op utilities run programs with cost effectiveness varying from $.015 to $.055, with most utilities towards the lower end of that range. Figure 97 and Figure 98 show similar dynamics for commercial and industrial energy efficiency programs, but with fewer participating utilities.

Figure 96: 2020 Cost per Kilowatt Hour of Energy Efficiency Savings in the Residential Sector

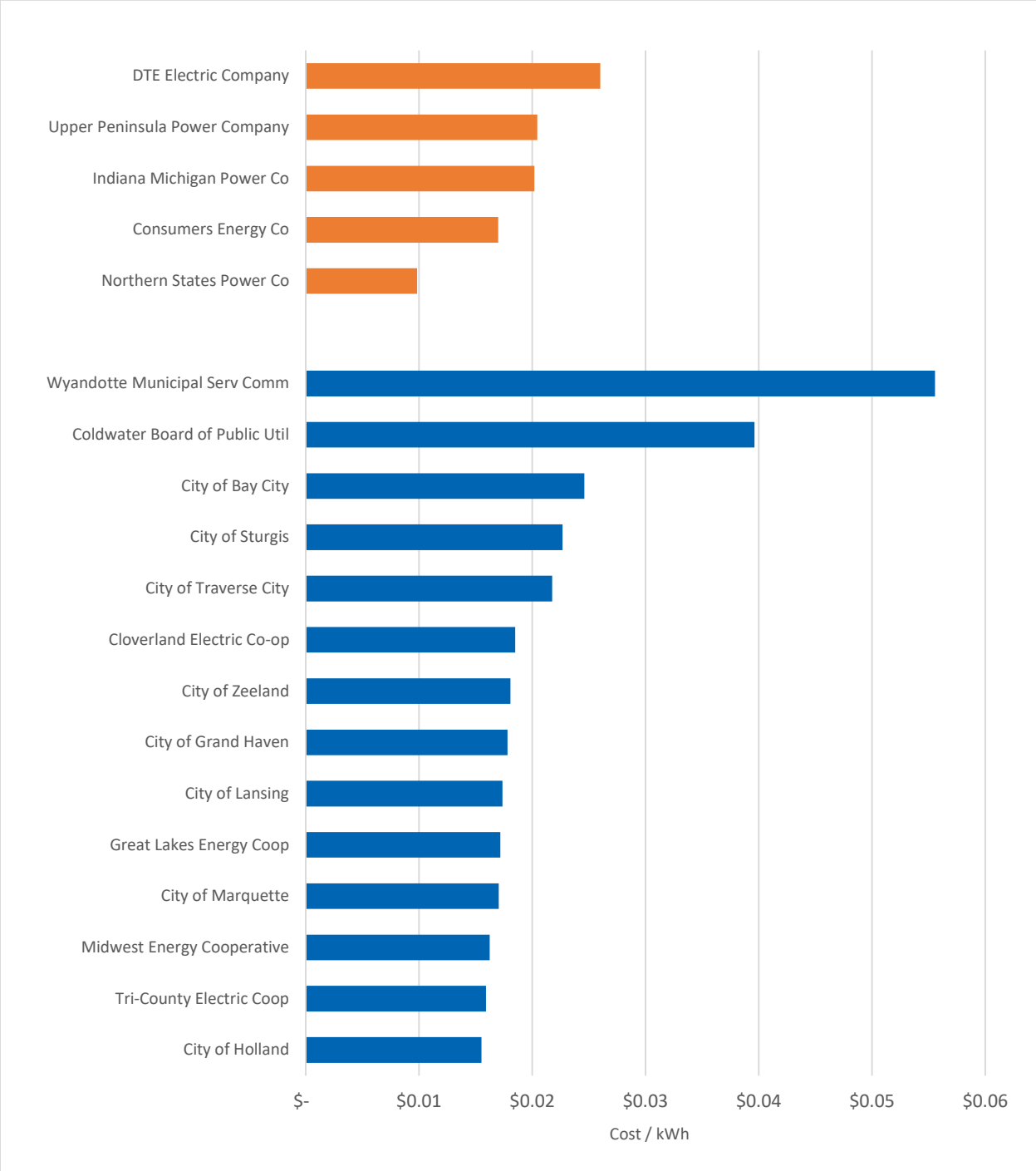


Figure 97: 2020 Cost per Kilowatt Hour of Energy Efficiency Savings in the Commercial Sector

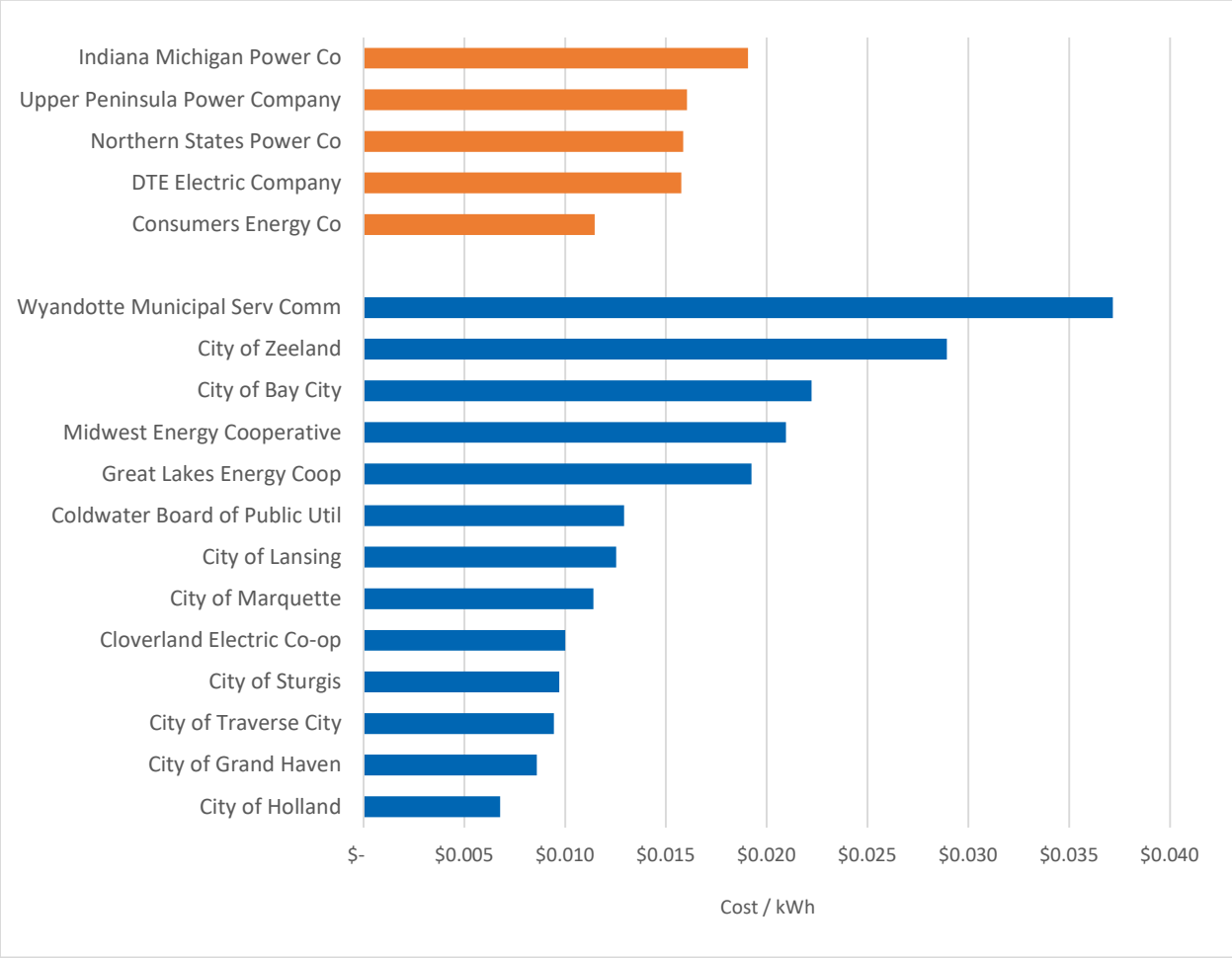
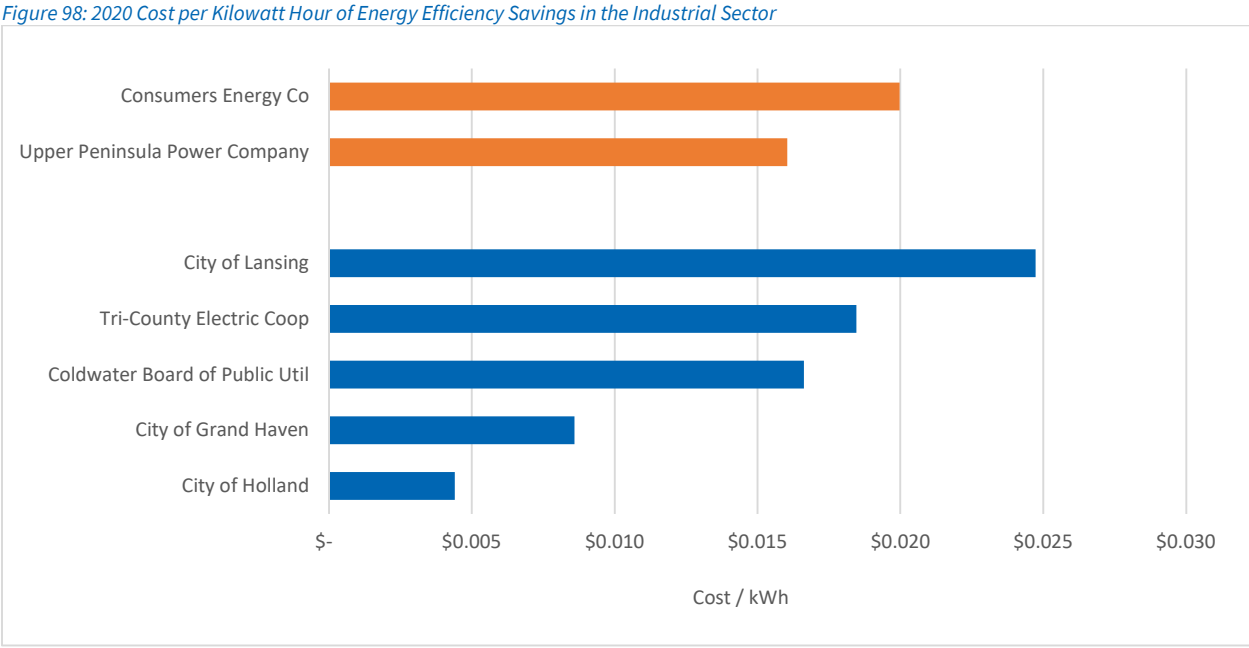


Figure 98: 2020 Cost per Kilowatt Hour of Energy Efficiency Savings in the Industrial Sector



Michigan Energy Efficiency Program Deployment

Two of Michigan's IOUs have no residential or commercial energy efficiency program—Northern States Power Co, and Upper Michigan Energy Resources Corp. Only two of Michigan's IOUs have Industrial Energy efficiency programs—Consumers Energy Co. and Upper Peninsula Power Company. Similarly, only some of Michigan's co-ops and municipal utilities have energy efficiency programs.

Northern States Power Co. and Upper Michigan Energy Resources Corp. show serious commitment to energy efficiency programs. Not only are they the only IOUs running industrial energy efficiency programs, they run the most extensive residential programs, outperforming the large utilities substantially. Upper Michigan Energy Resources Corp. also has the most extensive commercial sector program. In general, there is much greater variation in energy efficiency deployment effectiveness, as measured by energy efficiency savings as a percentage of sales, than there is in program costs.

Figure 99: 2020 Efficiency Savings as a Percentage of Electricity Sales in the Residential Sector

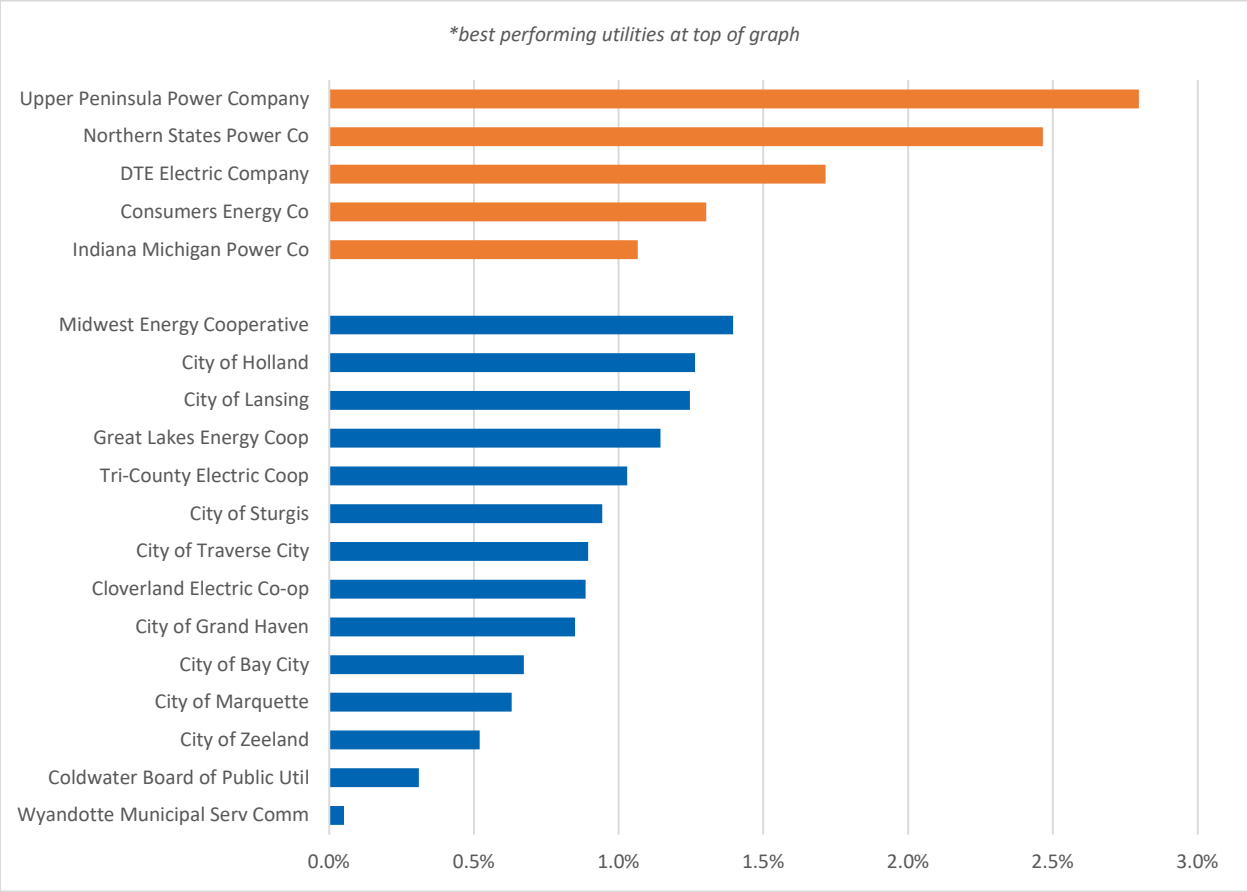


Figure 100: 2020 Efficiency Savings as a Percentage of Electricity Sales in the Commercial Sector

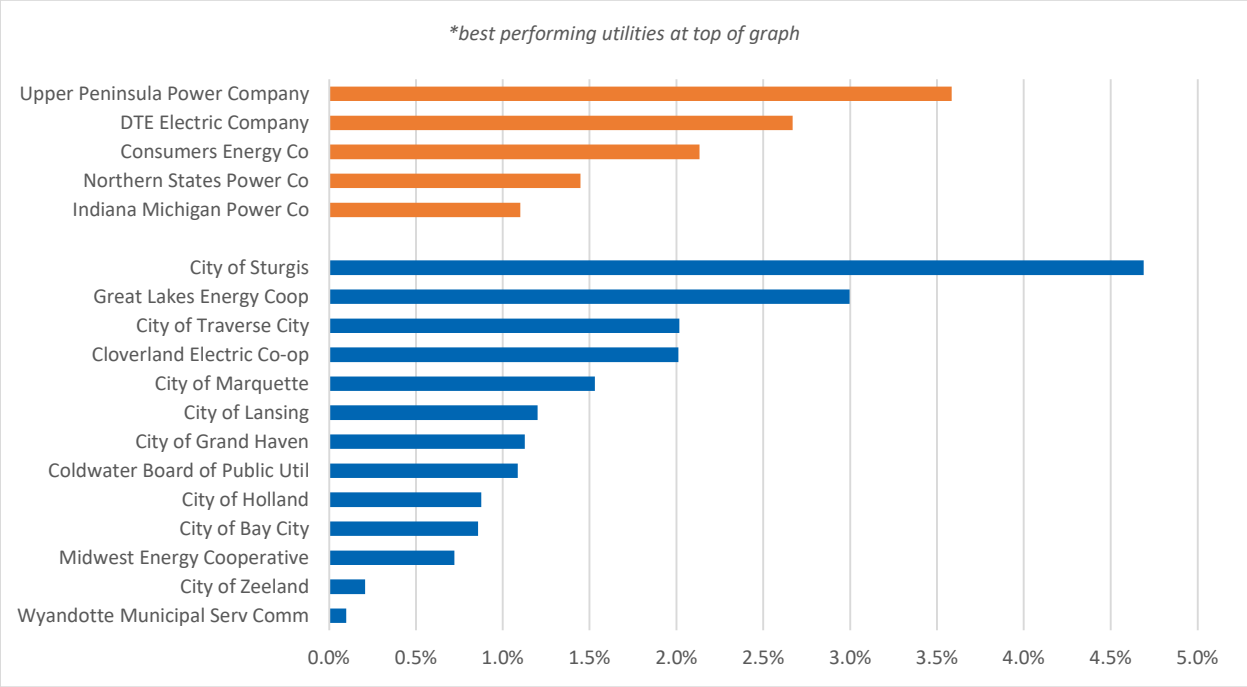
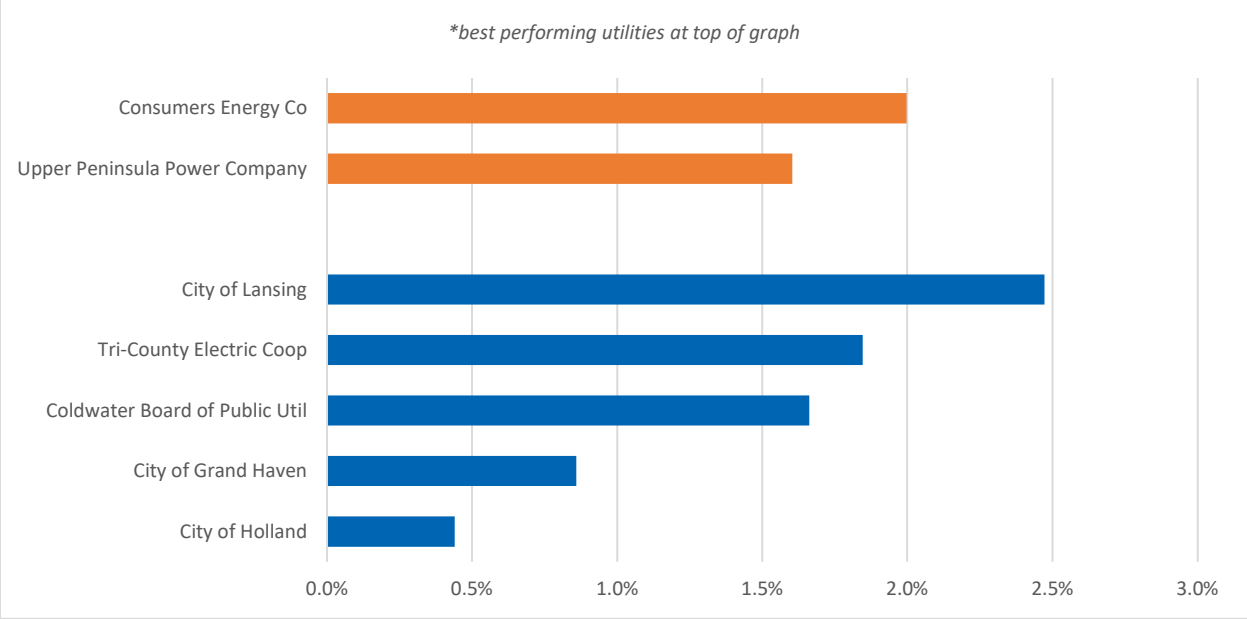


Figure 101: 2020 Efficiency Savings as a Percentage of Electricity Sales in the Industrial Sector



ELECTRICITY GENERATION

Electricity is the most important form of energy in the contemporary era because of its diverse uses—it powers our electronics and lighting, cools our homes and, most recently, fuels many of our vehicles. Unfortunately, there are externalities from electricity generation that affect both our immediate health and our environment. The mitigation of these externalities is crucial to the prevention of the worst effects of climate change. This section explores trends in the sources of and externalities from electricity generation, and comprises the following subsections:

- Generation Overview
- Electricity Sources
- Emissions from Electricity Generation
- Water Use by Electricity Generators

Generation Overview

Most states generate and use different amounts of electricity. This subsection looks at which fuels power electricity generation in states and the following subsection—*Electricity Sources*—looks at the sources that generate the electricity sold in states. Figure 102 shows eleven different forms of electricity generation for which the EIA reports data but does not include behind-the-meter or small-scale solar generation, which currently only account for small percentages of most states' energy mixes. The sources displayed are:

- Hydroelectric
- Utility-Scale Solar
- Wind
- Geothermal
- Nuclear
- Biomass
- Petroleum Coke
- Other Gases
- Coal
- Natural Gas
- Petroleum Liquids

Figure 105 and Figure 107 are maps of states' generation mixes by renewable and clean resources. Renewable resources are defined as: hydroelectric, utility-scale solar, wind, geothermal and biomass. The definition of clean resources adds nuclear to that list while excluding biomass. Biomass is included as a renewable resource because it is comprised of a variety of organic sources that can be regrown. However, biomass is not considered a clean resource because, while it is technically net zero emissions, it produces substantial emissions when burned, which may contaminate the atmosphere locally.

The data in this section comes from the EIA's SEDS databases.

At 10.4%, Michigan is in the bottom half of states for electricity generated by renewables, ranking 18th-lowest. However, because of its substantial nuclear power industry, Michigan ranks exactly in the middle of states in terms of clean energy production at 37.9%. The role of nuclear in Michigan will likely decline dramatically starting in 2022, when the Palisades nuclear plant, one of four power reactors in the state, is retired. In 2021 the largest source of generation in Michigan was coal at 31.8%, followed by nuclear at 29.4% and natural gas at 26.4%.

Figure 102: 2021 Generation Type as a Percentage of Energy Mix

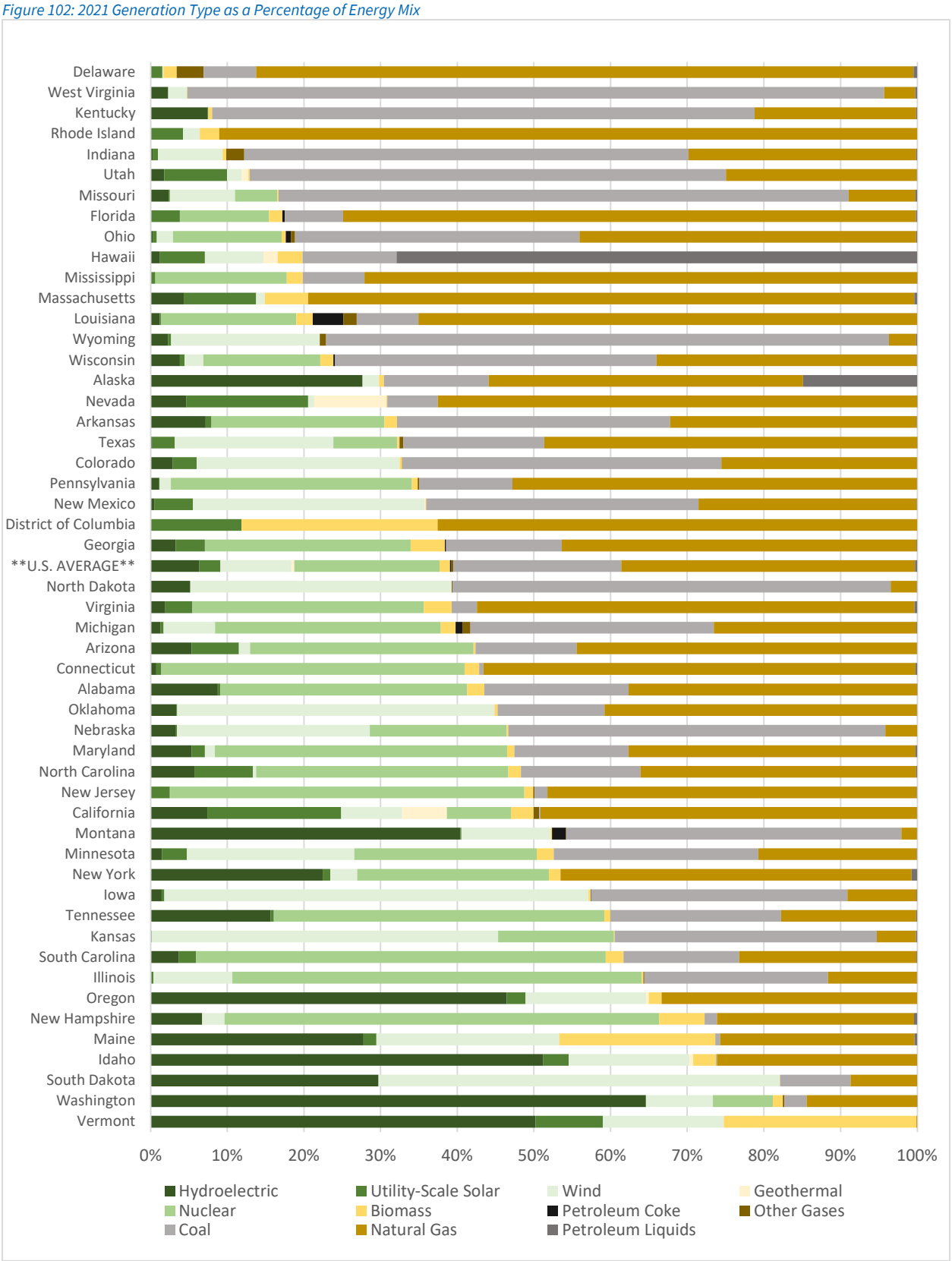


Figure 103: 2021 Fuel Source with Largest Share in Current Generation Mix

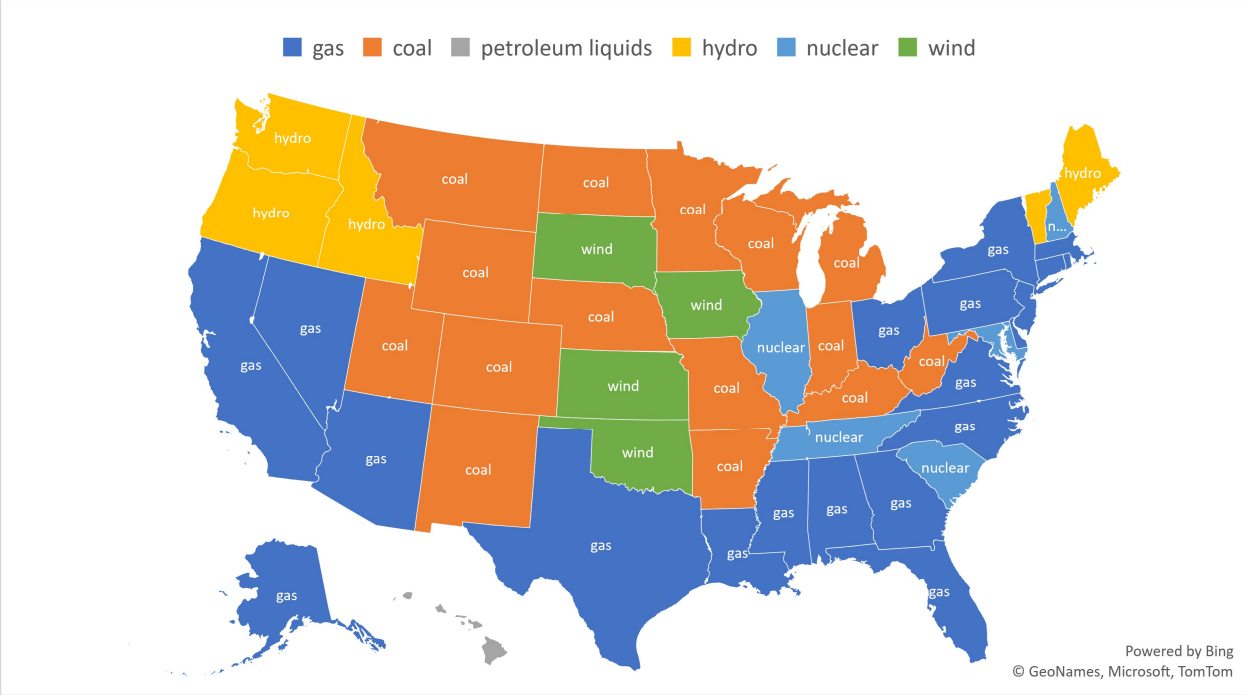


Figure 104: 2021 Percentage of Generation Produced by Renewable Resources

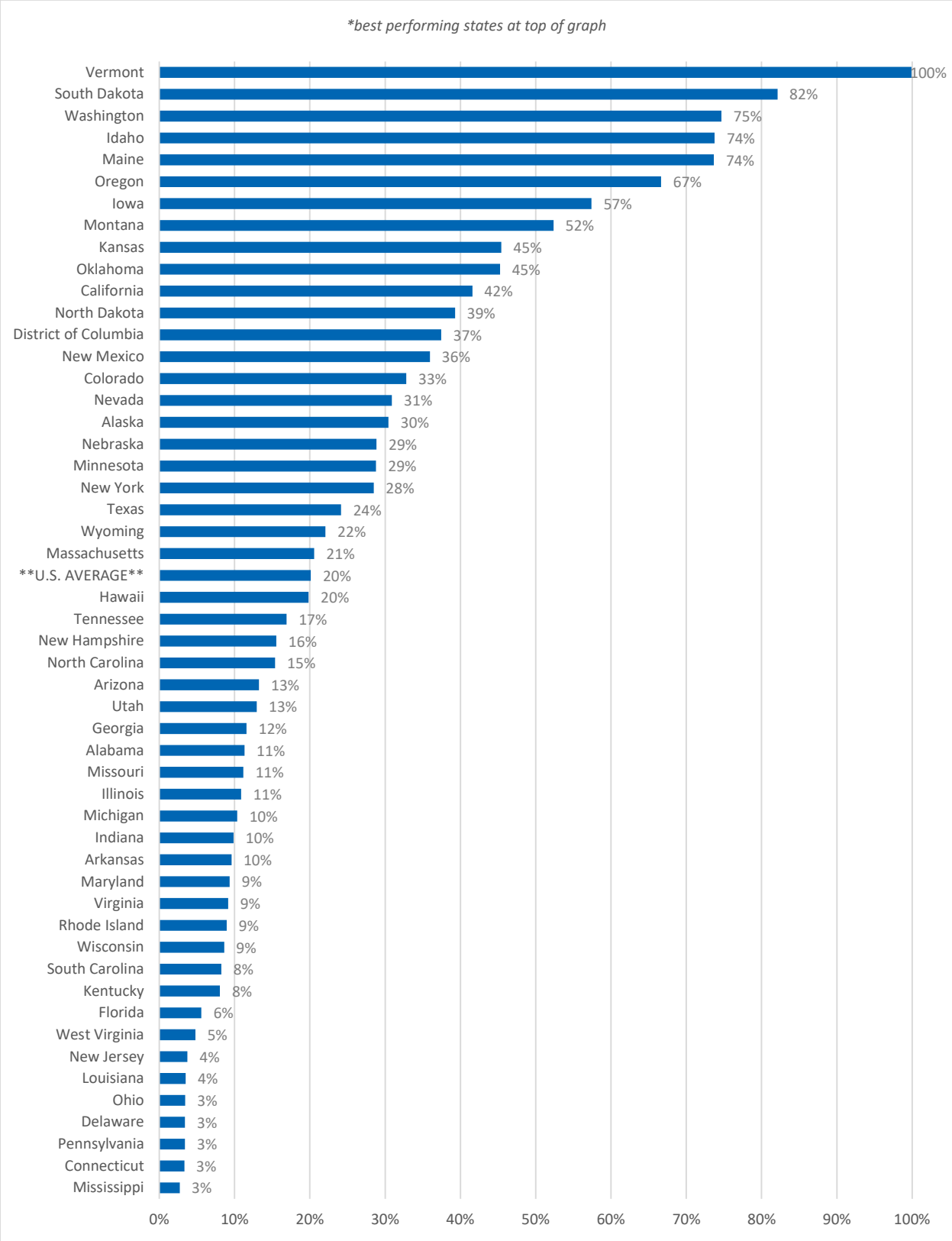


Figure 105: 2021 Percentage of Generation Produced by Renewable Resources Map

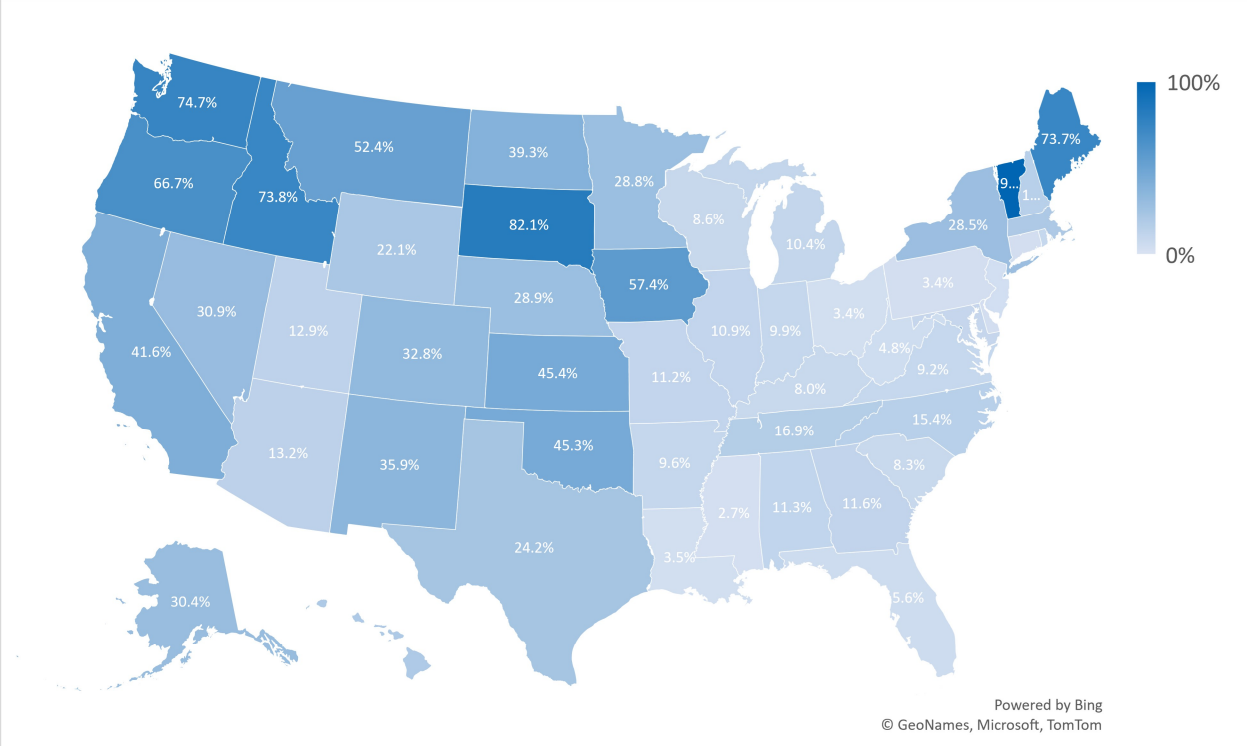


Figure 106: 2021 Percentage of Generation Produced by Clean Resources

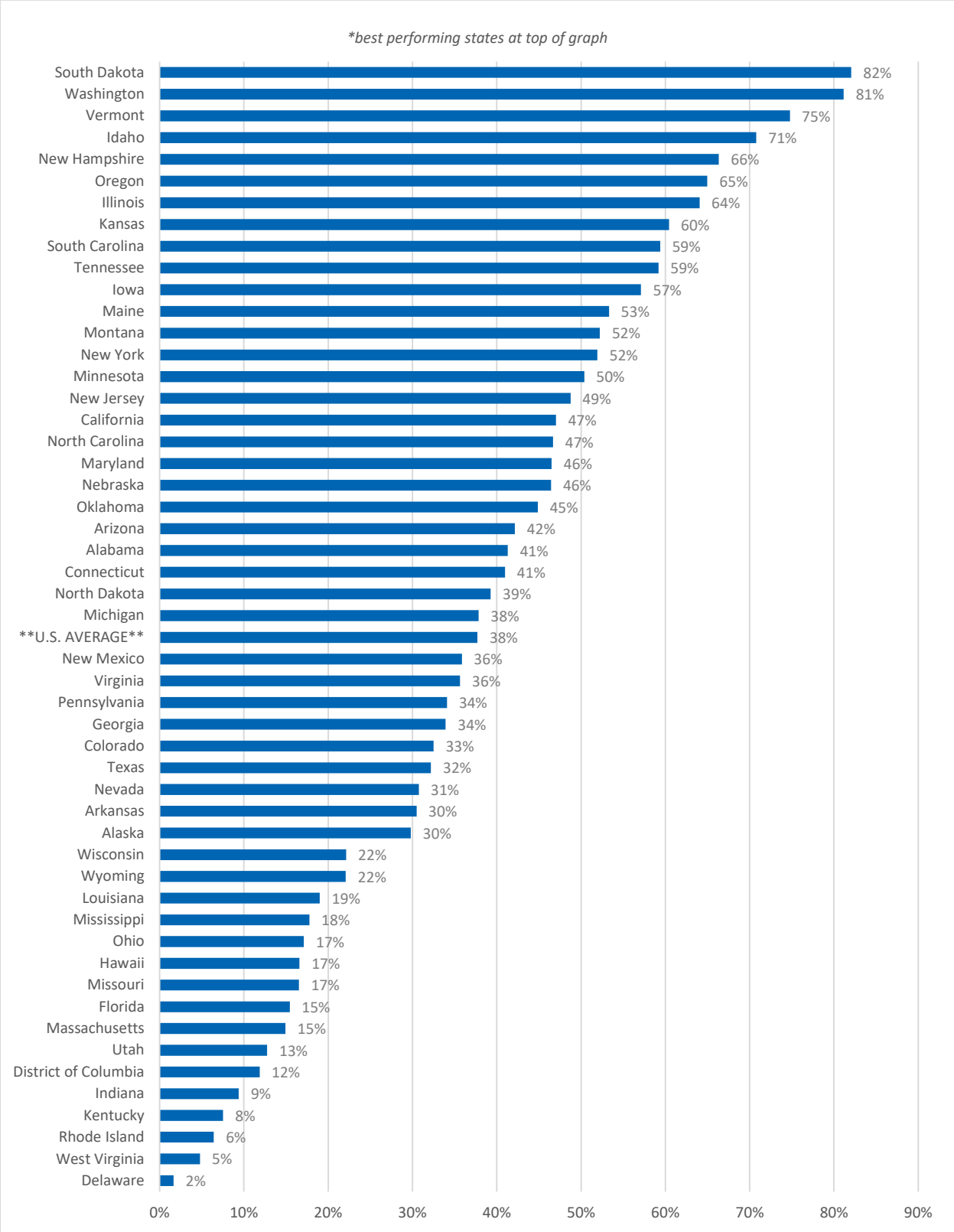
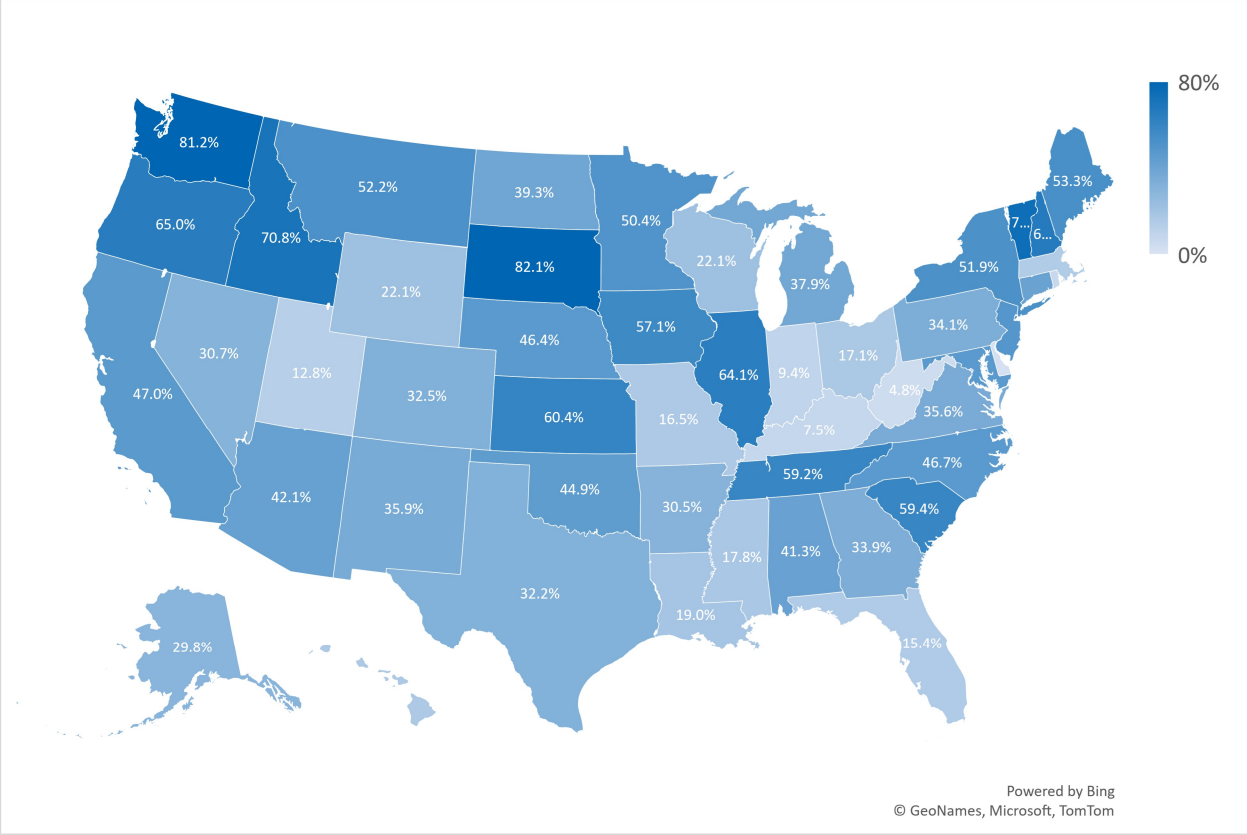


Figure 107: 2021 Percentage of Generation Produced by Clean Resources Map



Electricity Sources

The electricity grid connects states and generation resources such that at any given time a home, business or manufacturer cannot know precisely from where their electricity is coming. This section looks at the sources of electricity that power states—which states are large exporters, and which are importers.

Some states with largely clean and renewable generation mixes import electricity generated by fossil fuels from out of state to meet their energy demands. This is the case for Idaho, which, in 2021, had a 73.8% renewable generation mix, but renewable generation is only 49.3% (Figure 104 and Figure 114) 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, making it, by percentage of in-state electricity sales, the largest electricity exporter in the country (Figure 111). However, in terms of net exports, Vermont's are trivial. The largest exporter by kWh is Pennsylvania, which, in 2020, exported nearly 80 terawatt hours of electricity generated by fossil fuels, around seven times Vermont's exports (Figure 109).

Some states have legislated goals for how much electricity sold in a state must or should come from renewable or clean resources. The most rigorous of these standards are renewable portfolio standards (RPS), which mandate that a portion of a states' electricity sales *must* come from renewable resources, while less stringent are "clean energy standards," "renewable portfolio goals" and "clean energy goals." "Goals" are non-binding standards, and "clean energy" may refer to a variety of energy resources, but the largest non-renewable clean energy source is nuclear. The scale and speed of these standards and goals varies dramatically between states. The current scope of clean and renewable energy requirements is well represented in a map published in 2020 by the Database of State Incentives for Renewables and Efficiency (Figure 113).

The data in this section come from two EIA sources: the SEDS database and state electricity profiles, the latter of which provides information on state electricity disposition necessary to produce Figure 108 and Figure 114 through Figure 117**.**

Michigan had relatively low interstate electricity sales in 2020, exporting about 4 TWh, or 4% of sales. Of its peer states, Illinois was the only other net exporter of electricity, with other peer states importing 15%-20% of electricity sold in the respective state in 2020. Because renewable and nuclear generation are used as base load, under most market conditions Michigan's electricity exports are from fossil generation, which in turn means that the percentage of in-state sales provided by renewable and clean generation are higher than the percentage of generation produced by these resources at 10.8% and 38.9%, respectively (*see section overview for comparison*).

Michigan's current renewable portfolio standard is 15% by 2021. While Michigan utilities were probably producing more renewable energy in 2021 than they were in 2020 (the year reported

for above), they still may not be quite producing 15% of their sales from renewable sources. The technical legal requirement of the RPS standard is for electric utilities to “retire” an amount of Renewable Energy Credits (RECs) each year equal to 15% of their sales.

RECs can be produced by renewable generation in the out-of-state service territories of Michigan utilities, which happens with Indiana Michigan Power and some of the Upper Peninsula utilities that get power from Wisconsin. RECs can also be banked for up to five years, so if more RECs were earned than were needed in the past, those credits can be used to satisfy RPS requirements in the present. Finally, certain “bonus” RECs can be earned by utilities for using parts and labor from Michigan. These RECs are not actually attributable to renewable electricity under the reporting standards used by the EIA.

Figure 108: 2020 Electricity Sales by Generation Type and Source in Millions of Kilowatt Hours

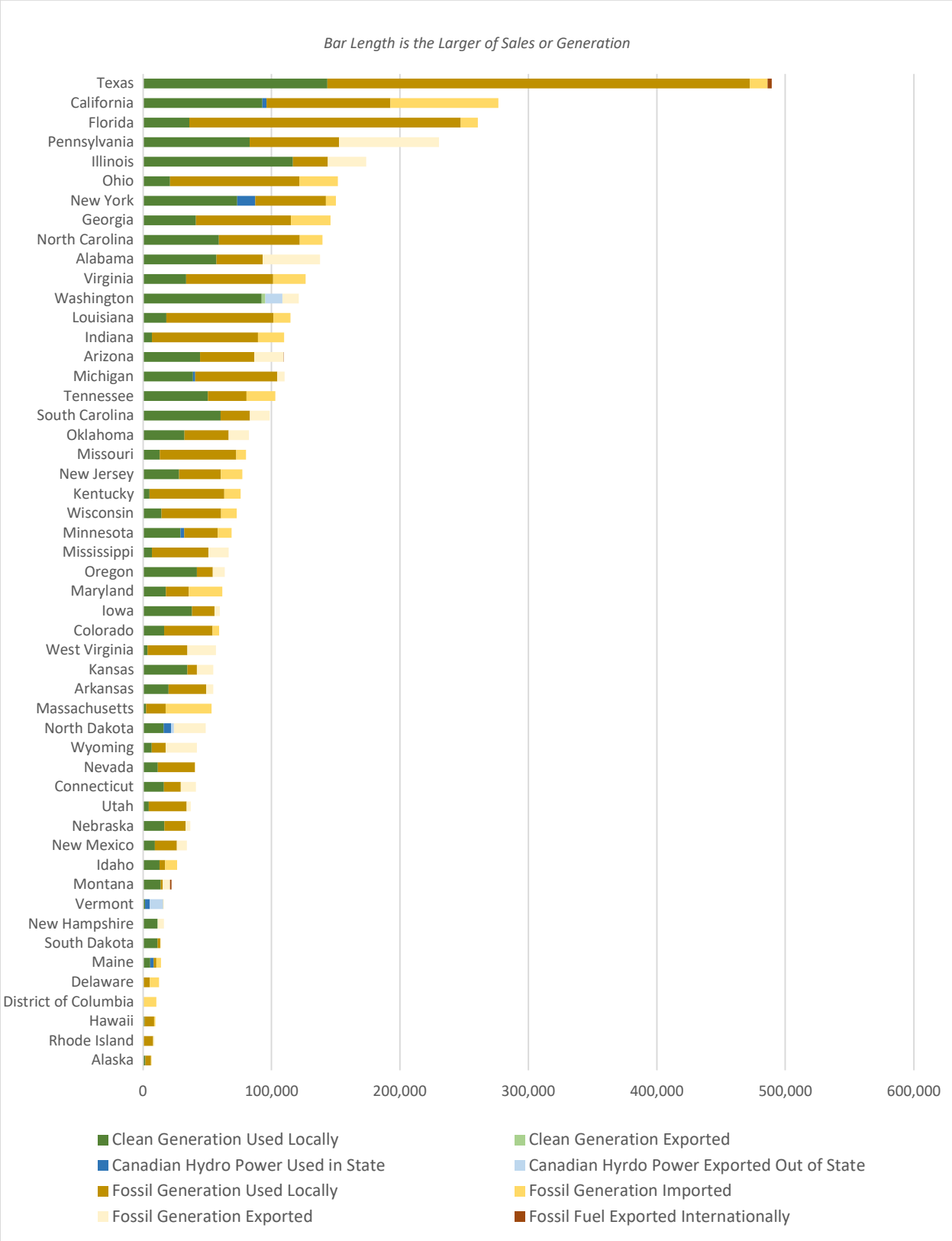


Figure 109: 2020 Interstate Imports and Exports of Electricity in Gigawatt Hours

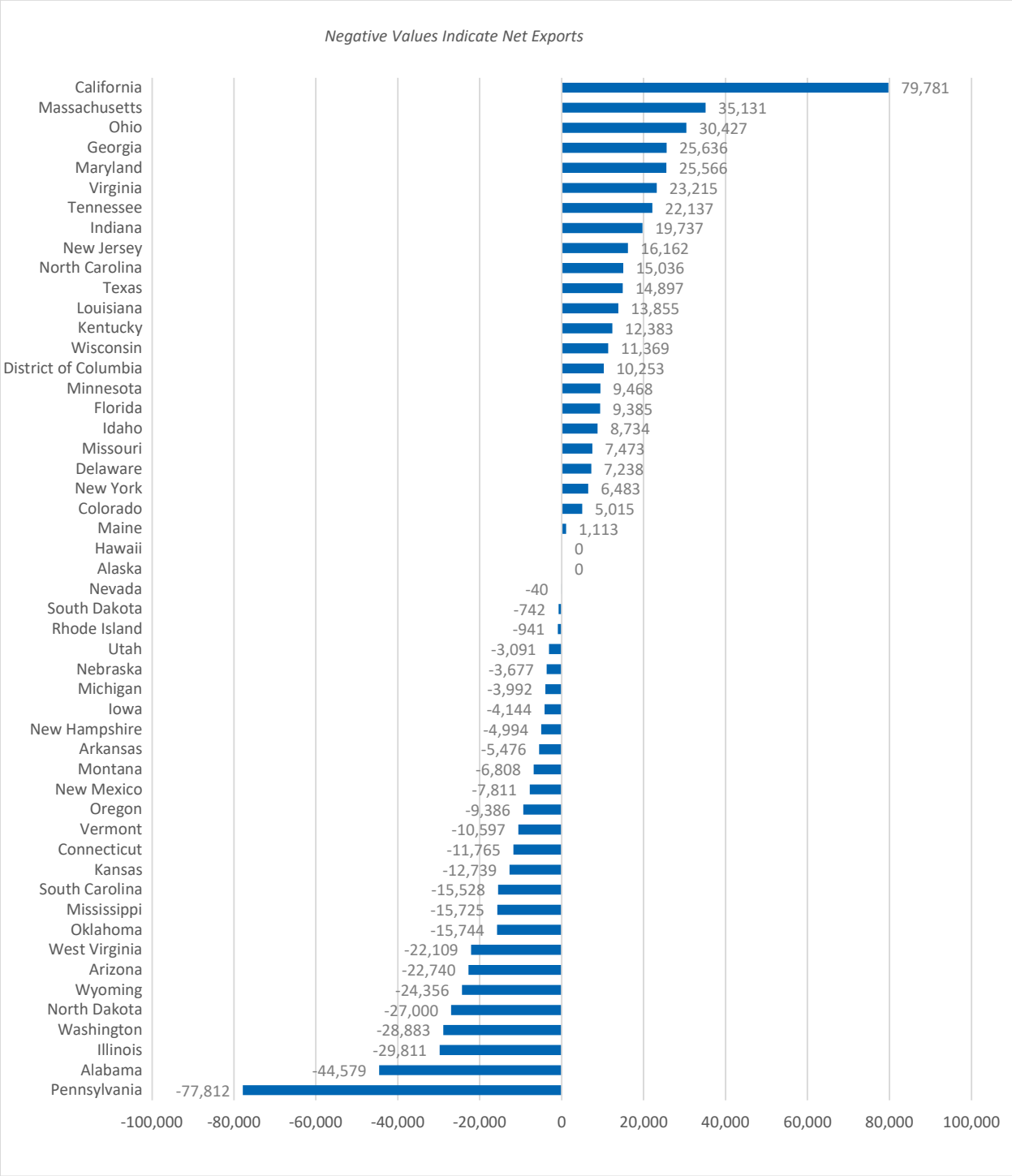


Figure 110: 2020 Interstate Imports and Exports of Electricity in Gigawatt Hours Map

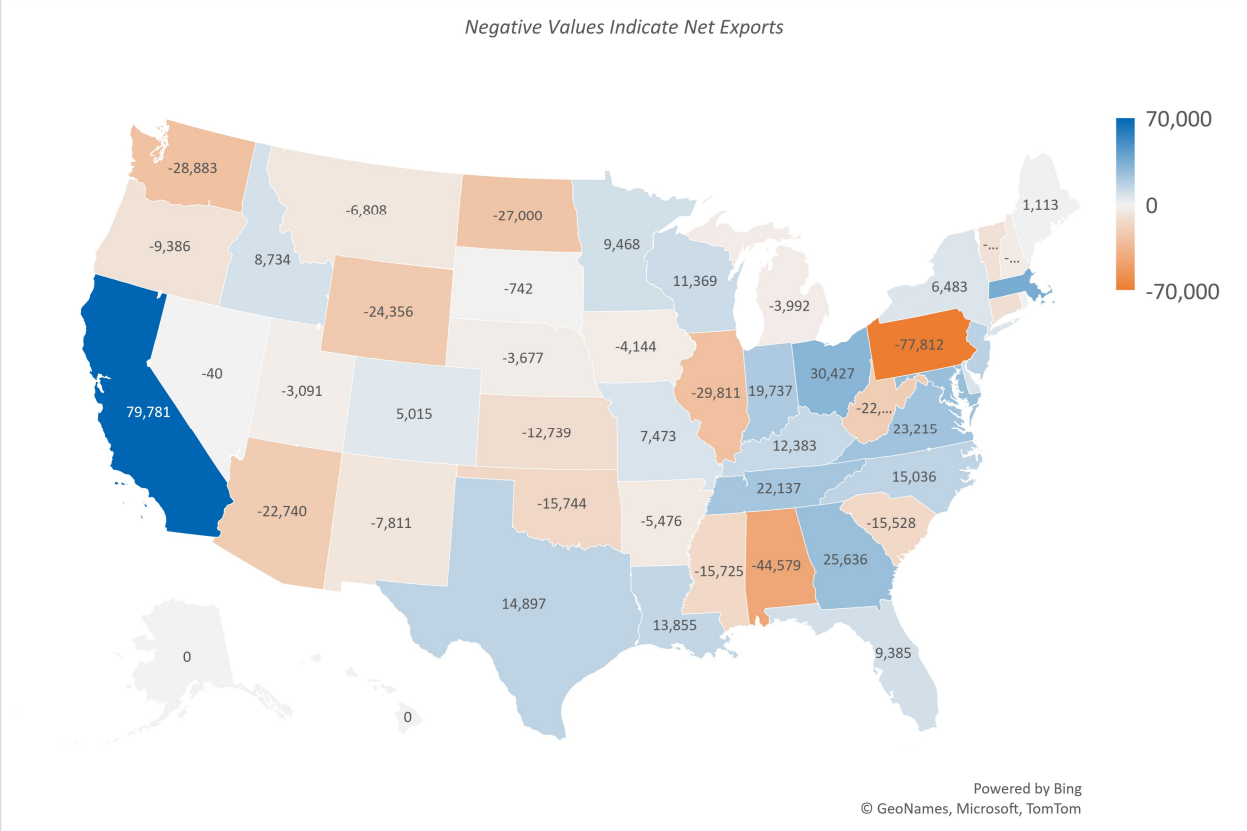


Figure 111: 2020 Interstate Imports and Exports of Electricity as a Percentage of State Sales

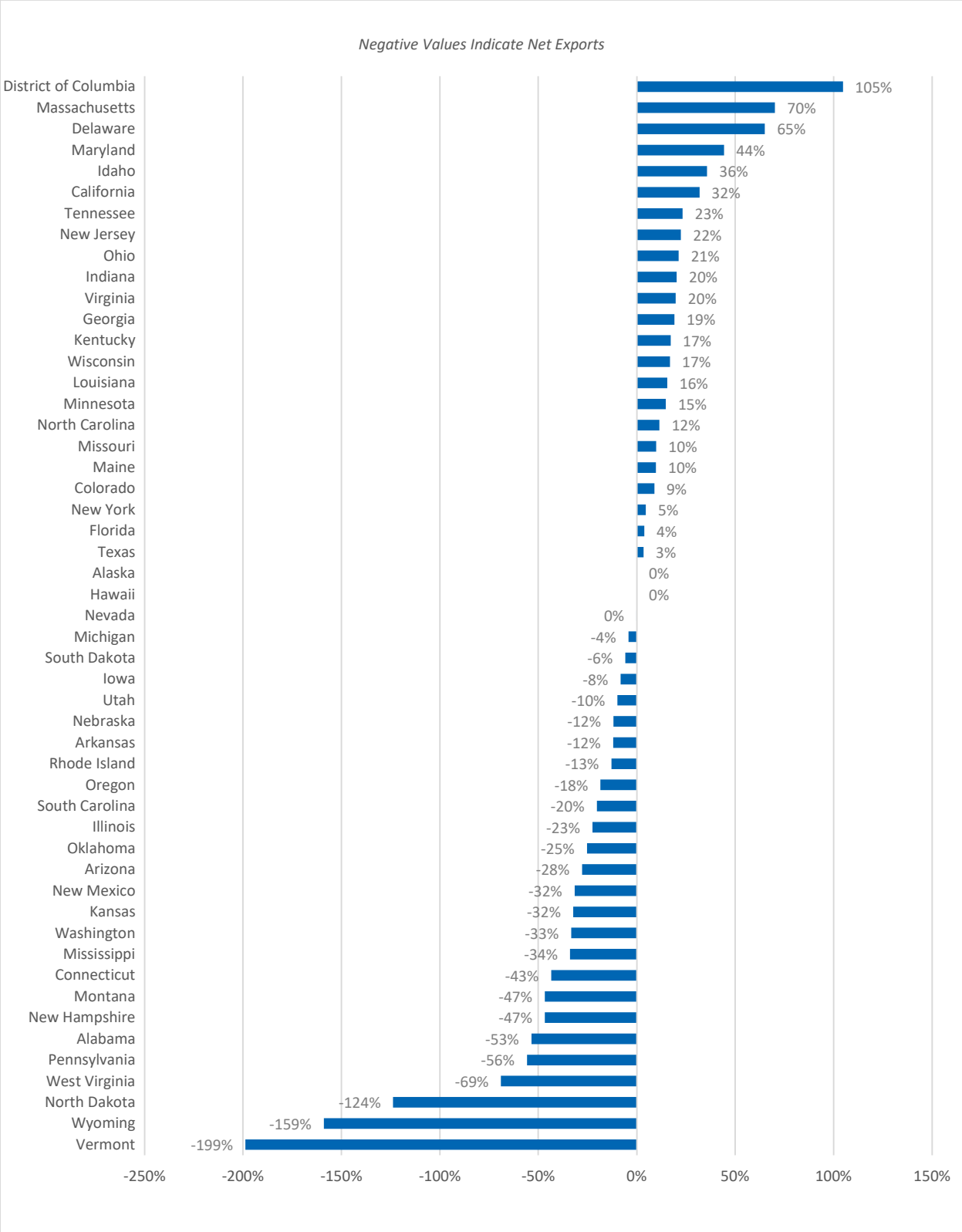


Figure 112: 2020 Interstate Imports and Exports of Electricity as a Percentage of State Sales

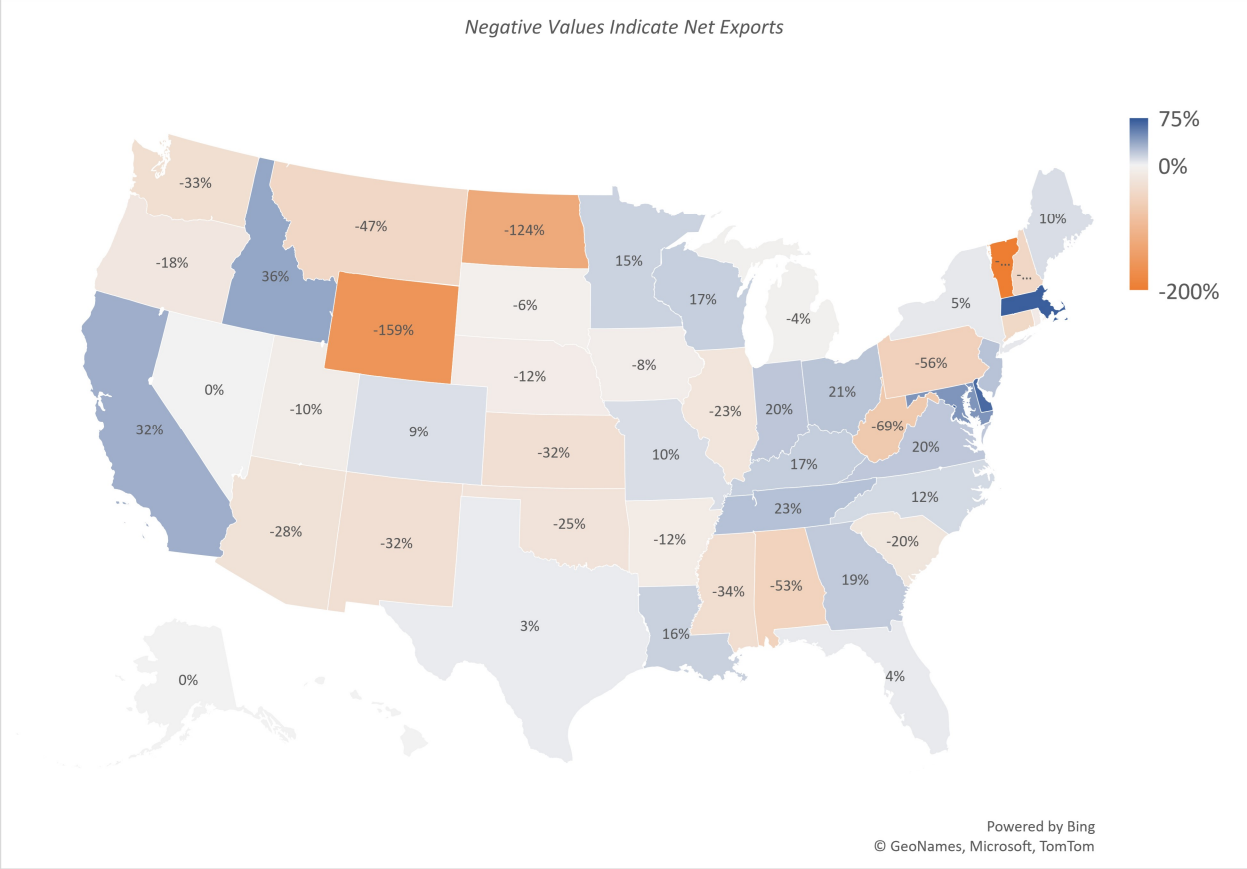
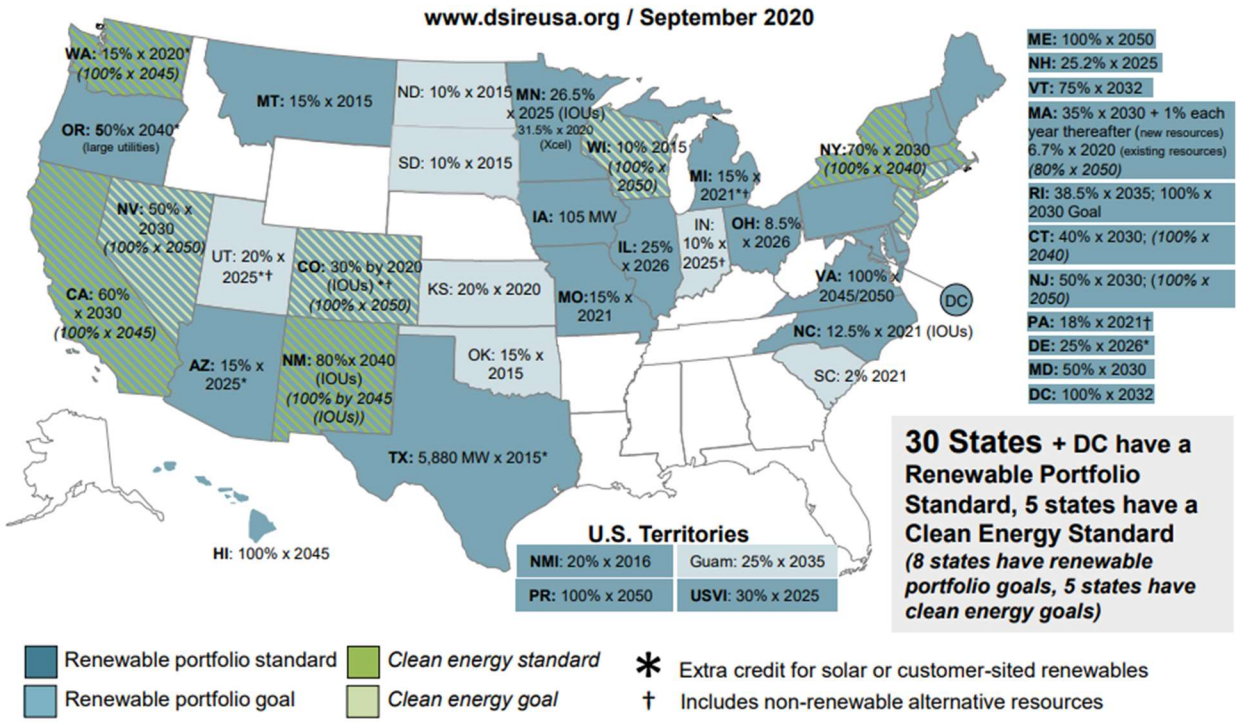


Figure 113: Renewable and Clean Energy Standards



Courtesy: DSIRE USA

Figure 114: 2020 Renewable Generation and Renewable Imports as a Percentage of State Sales

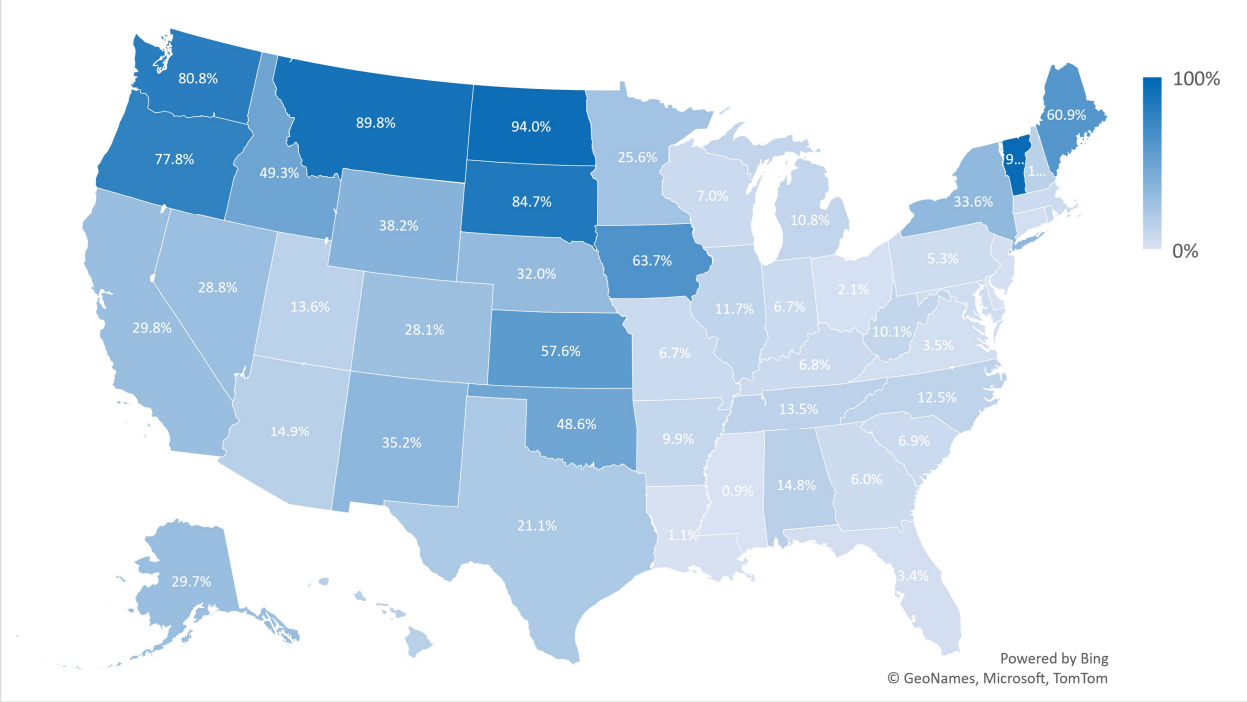


Figure 115: 2020 Clean Generation and Clean Imports as a Percentage of State Sales

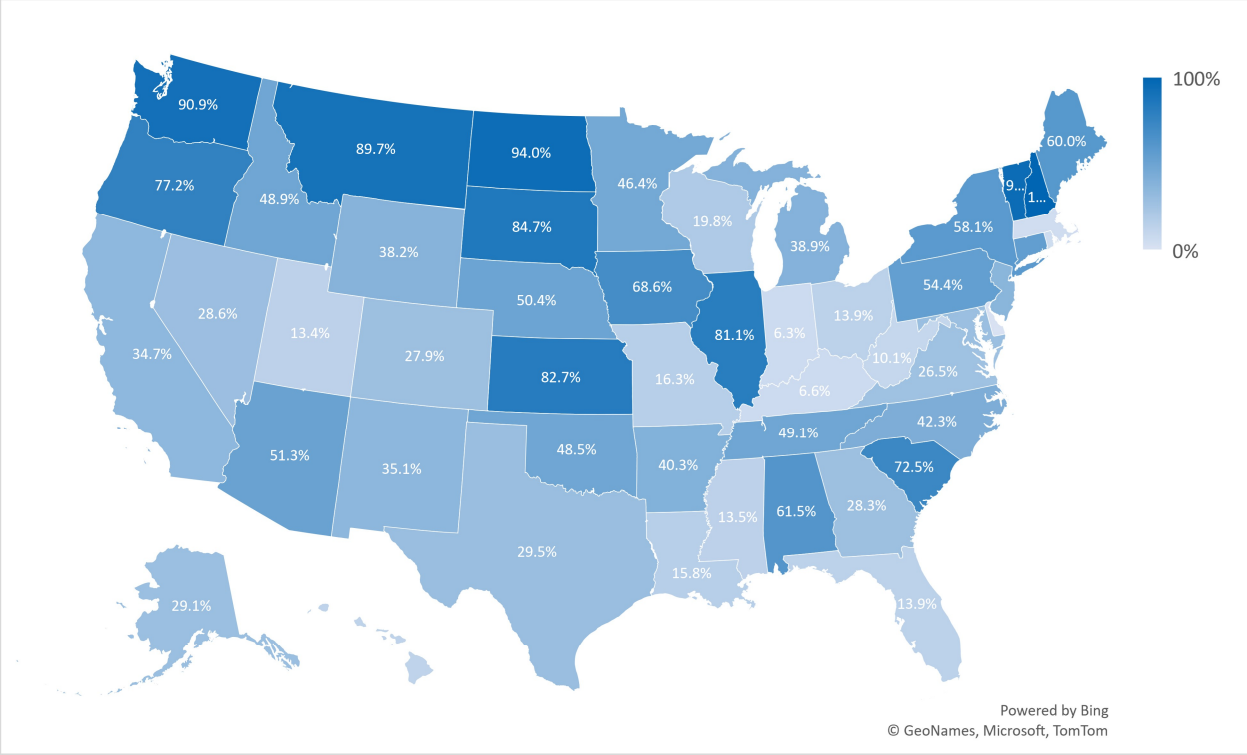


Figure 116: 2020 Fossil Generation and Fossil Imports as a Percentage of State Sales

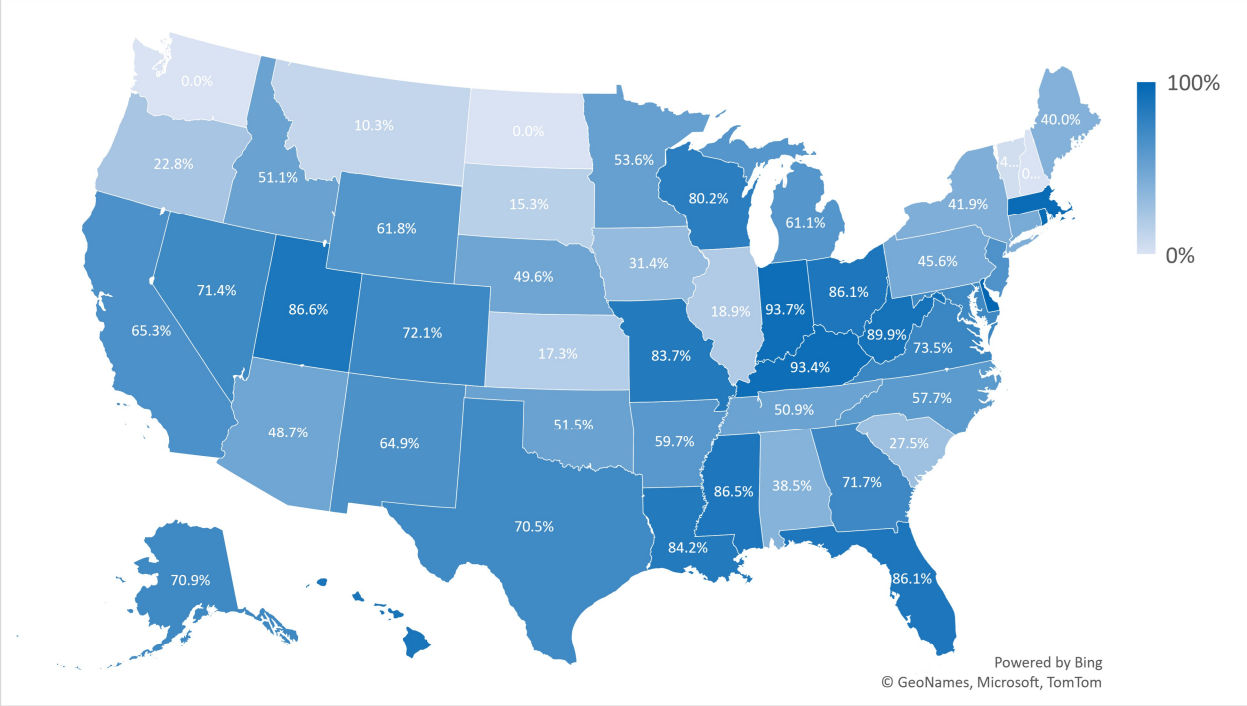
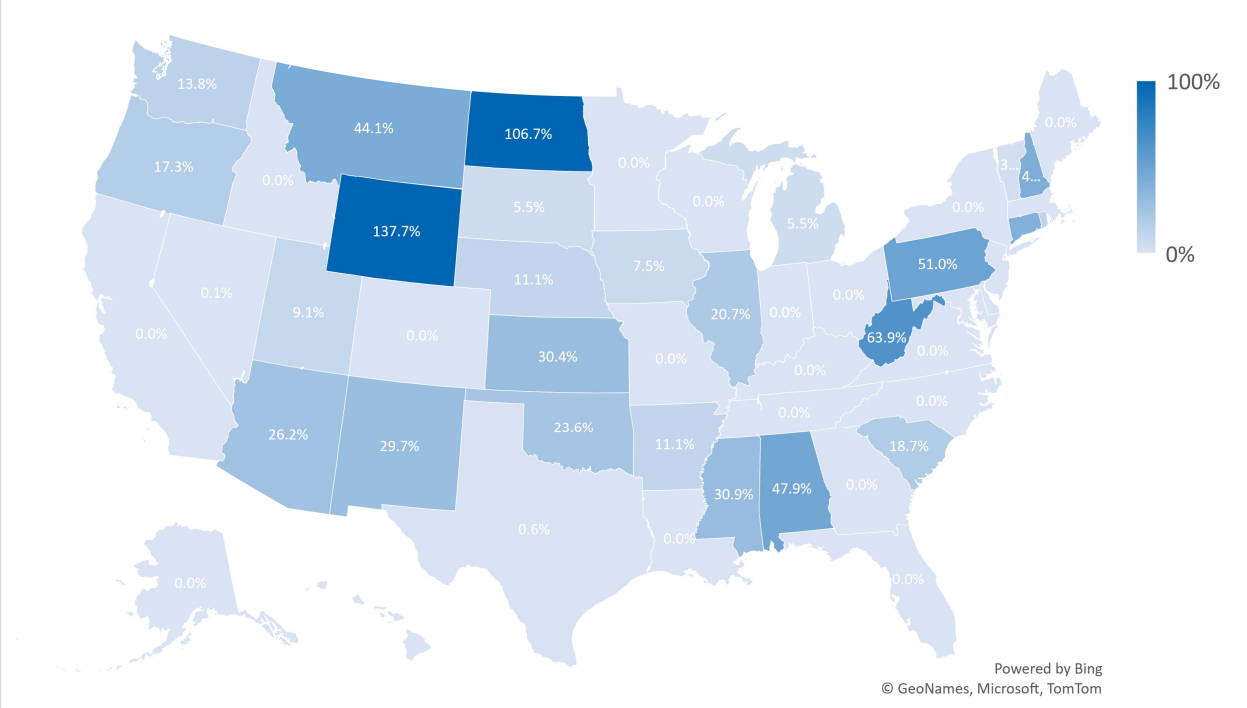


Figure 117: 2020 Exported Fossil Generation as a Percentage of State Sales



Emissions from Electricity Sources

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

- carbon dioxide (CO_2), which is the principal gas causing climate change and has deleterious effects on cognitive function
- sulfur dioxide (SO_2), which causes asthma attacks, cardiopulmonary diseases, acid rain and is a chemical precursor to formation of small particles that when breathed cause several respiratory and other problems, miscarriages and birth defects
- nitrogen oxides (NO_x), which cause respiratory problems including wheezing, asthma and other breathing difficulties and is a chemical precursor to formation of small particles and ozone in the air that also cause numerous health problems

Electric utilities report emissions of key pollutants from each power plant to the EPA, which compiles this information and makes it available to the EIA. 2020 is the most recent complete compilation currently available and can be obtained here. 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 consider emissions per unit of power generated. 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.

Carbon Dioxide

As shown in Figure 120, Michigan ranked 16th-worst among the states in carbon dioxide pollution per gigawatt-hour in 2020, with 464 metric tons emitted for every gigawatt-hour generated. This is worse than the median of all states and around the median of its six-state peer group, with only Illinois and Minnesota performing better. Michigan's carbon dioxide emissions per gigawatt-hour have declined at a trended compound annual growth rate of 3.6% from 2011-2020 (Figure 180).

Figure 118 shows that Michigan's annual carbon dioxide emissions of 49,523,270 metric tons ranked seventh-worst among the states in 2020.

Figure 118: 2020 CO_2 Emissions from the Electric Sector in Millions of Metric Tons

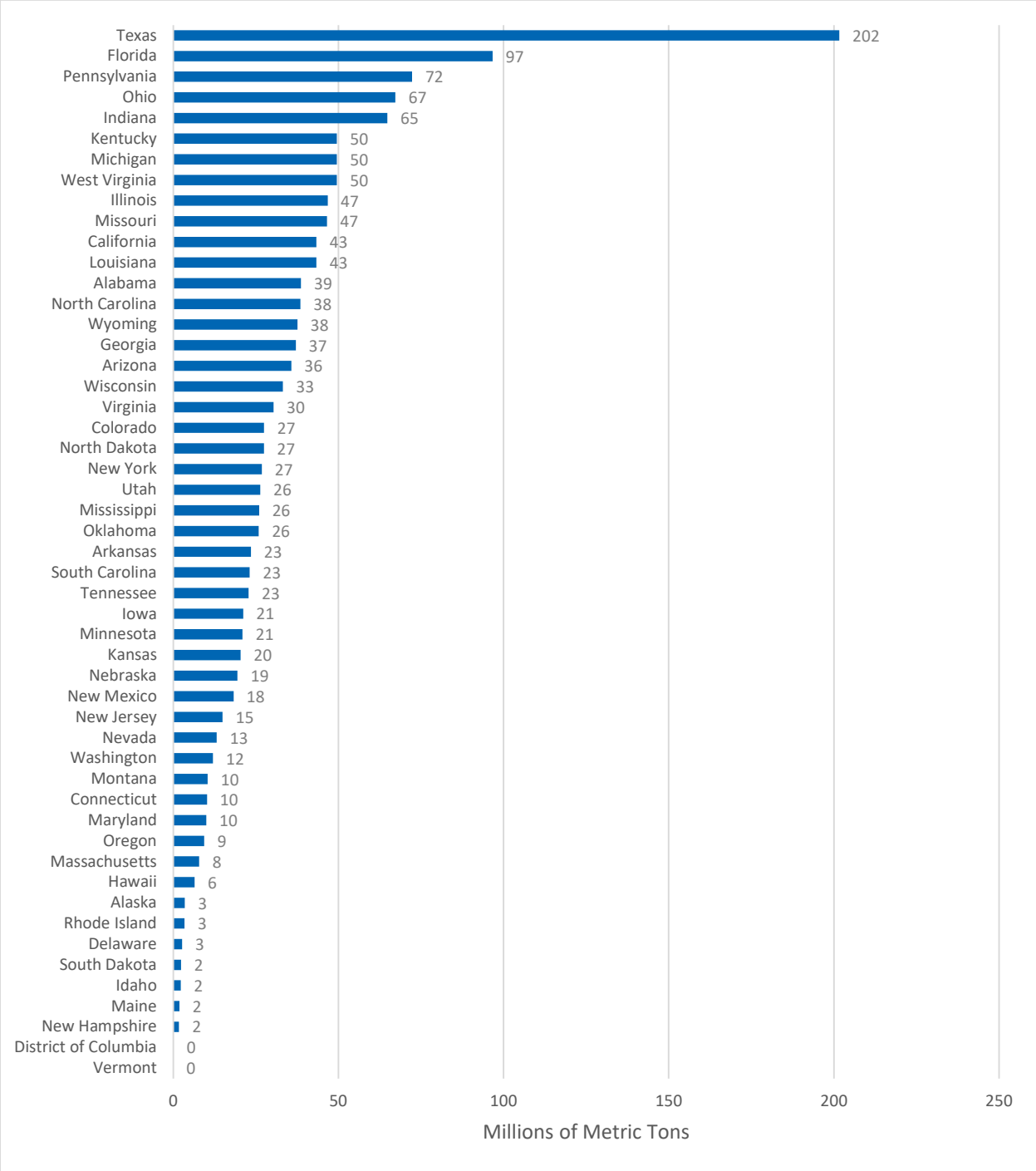


Figure 119: 2020 CO_2 Emissions from the Electric Sector in Millions of Metric Tons Map

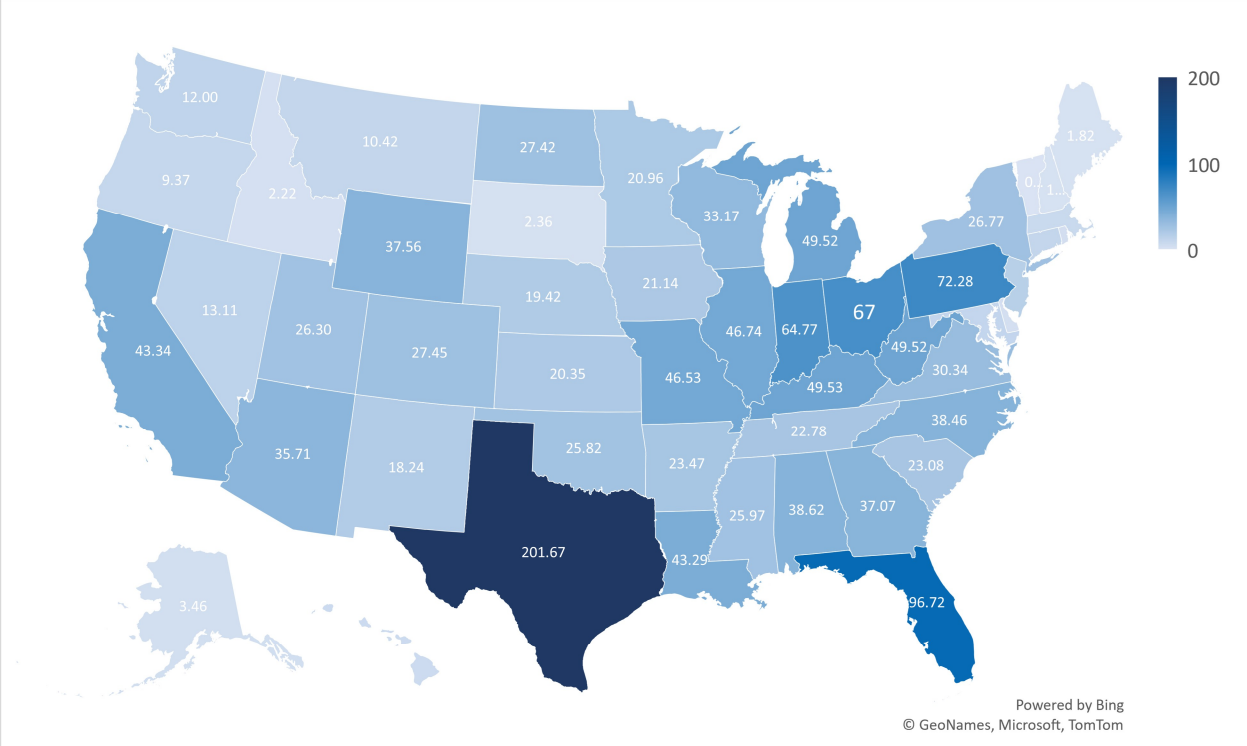


Figure 120: 2020 CO_2 Intensity in Metric Tons per Gigawatt Hour of Generation

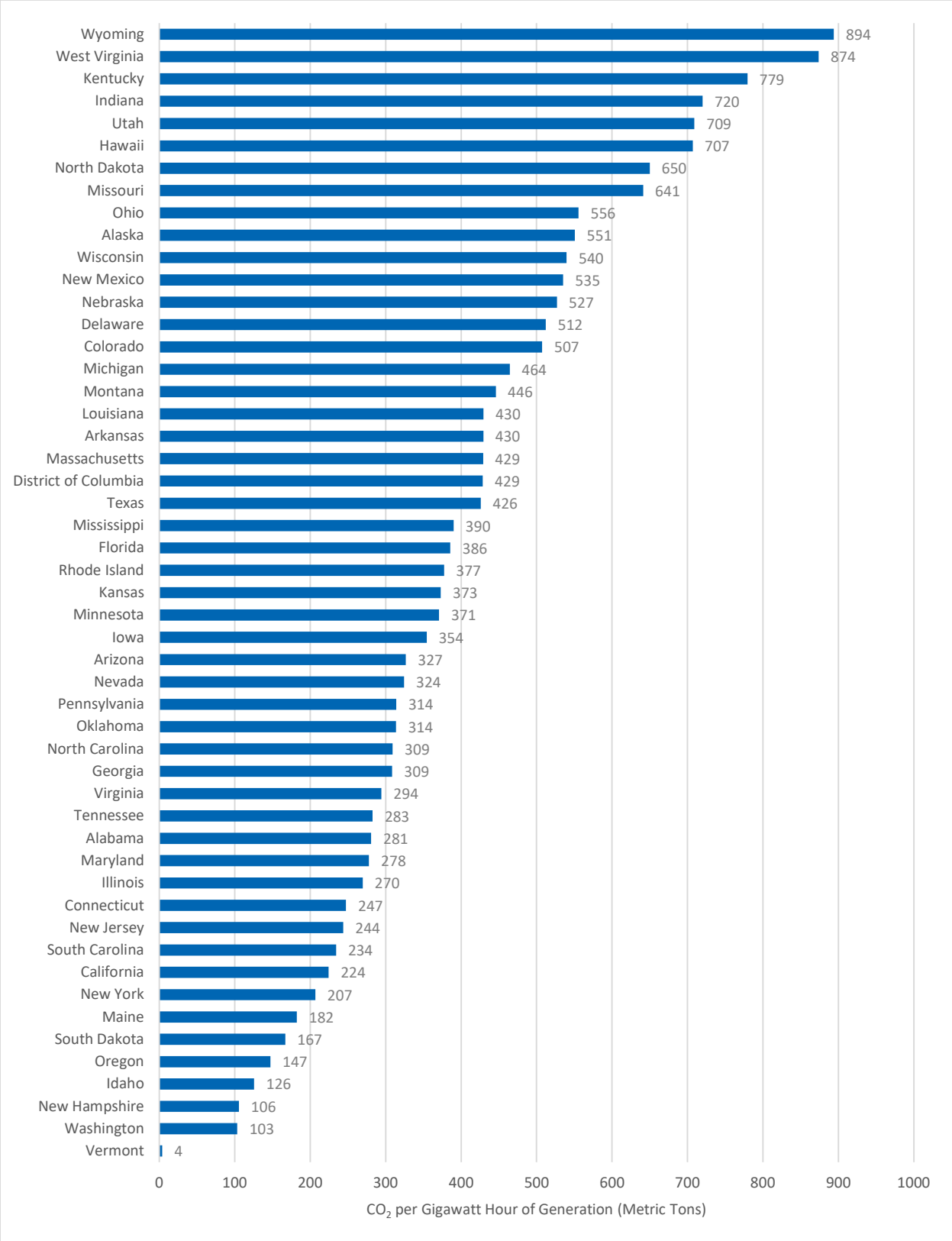
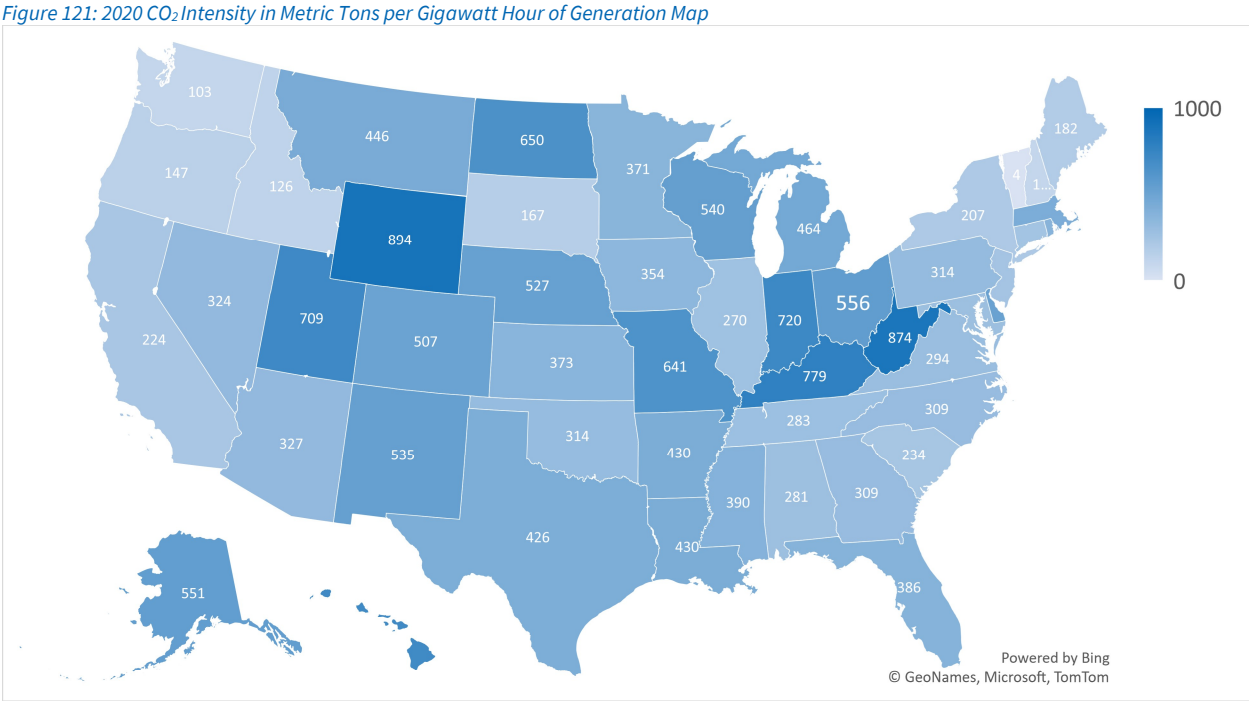


Figure 121: 2020 CO_2 Intensity in Metric Tons per Gigawatt Hour of Generation Map



Sulfur Dioxide

As shown in Figure 124, Michigan ranked 12th-worst among the states in sulfur dioxide pollution per gigawatt-hour in 2020, with 0.38 metric tons emitted for every gigawatt-hour generated. Compared to its peer group, only Ohio performed notably worse, while Indiana had similar performance. Michigan's sulfur dioxide emissions per gigawatt-hour have significantly and steadily declined since 2011 at a trended compound annual rate of 17.7% (Figure 181). However, many states have experienced larger rates of decreases over that period.

Figure 122 shows that Michigan's 2020 sulfur dioxide emissions of 40,651 metric tons ranked sixth-worst among the states, with only Illinois and Ohio emitting more sulfur dioxide among peer states.

Figure 122: 2020 SO_2 Emissions from the Electric Sector in Thousands of Metric Tons

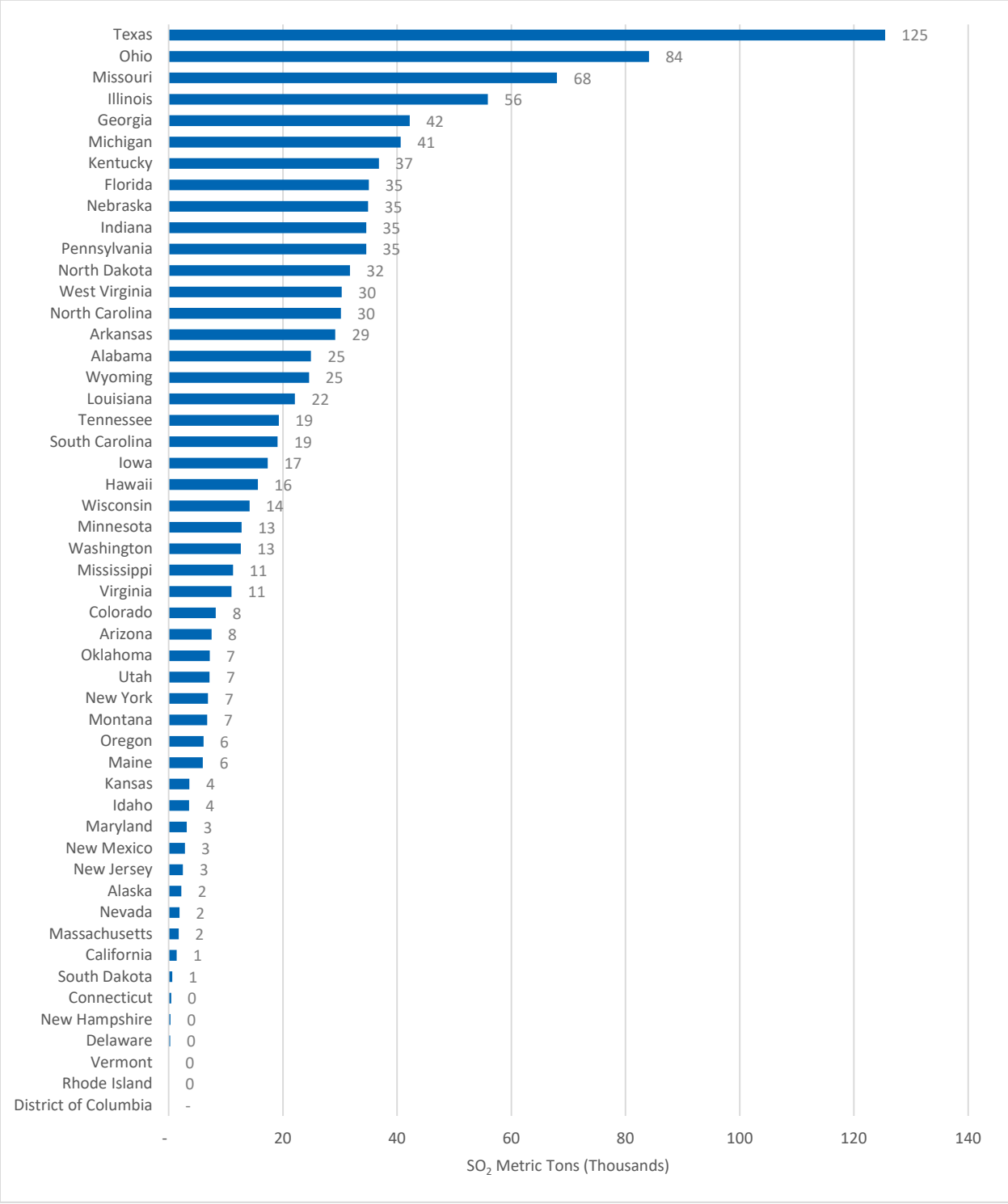


Figure 123: 2020 SO_2 Emissions from the Electric Sector in Thousands of Metric Tons Map

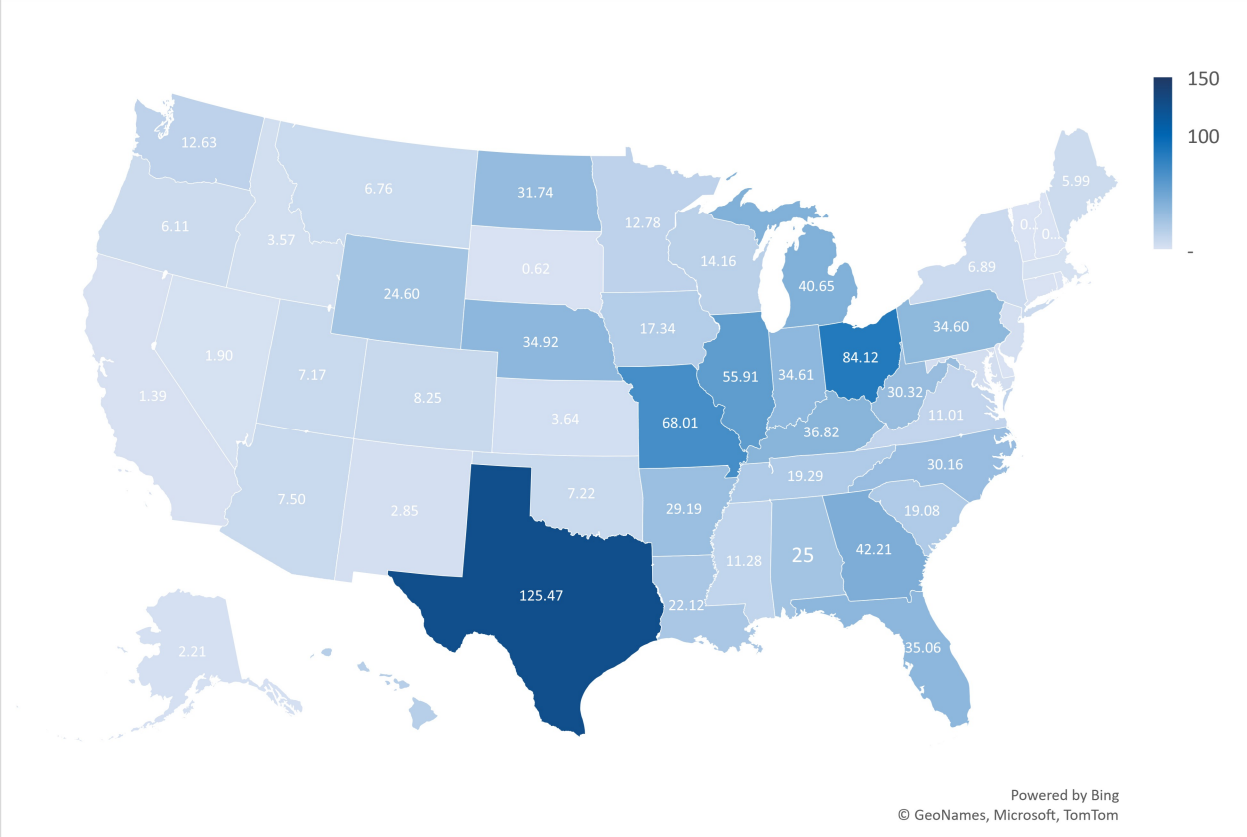


Figure 124: 2020 SO_2 Intensity in Metric Tons per Gigawatt Hour of Generation

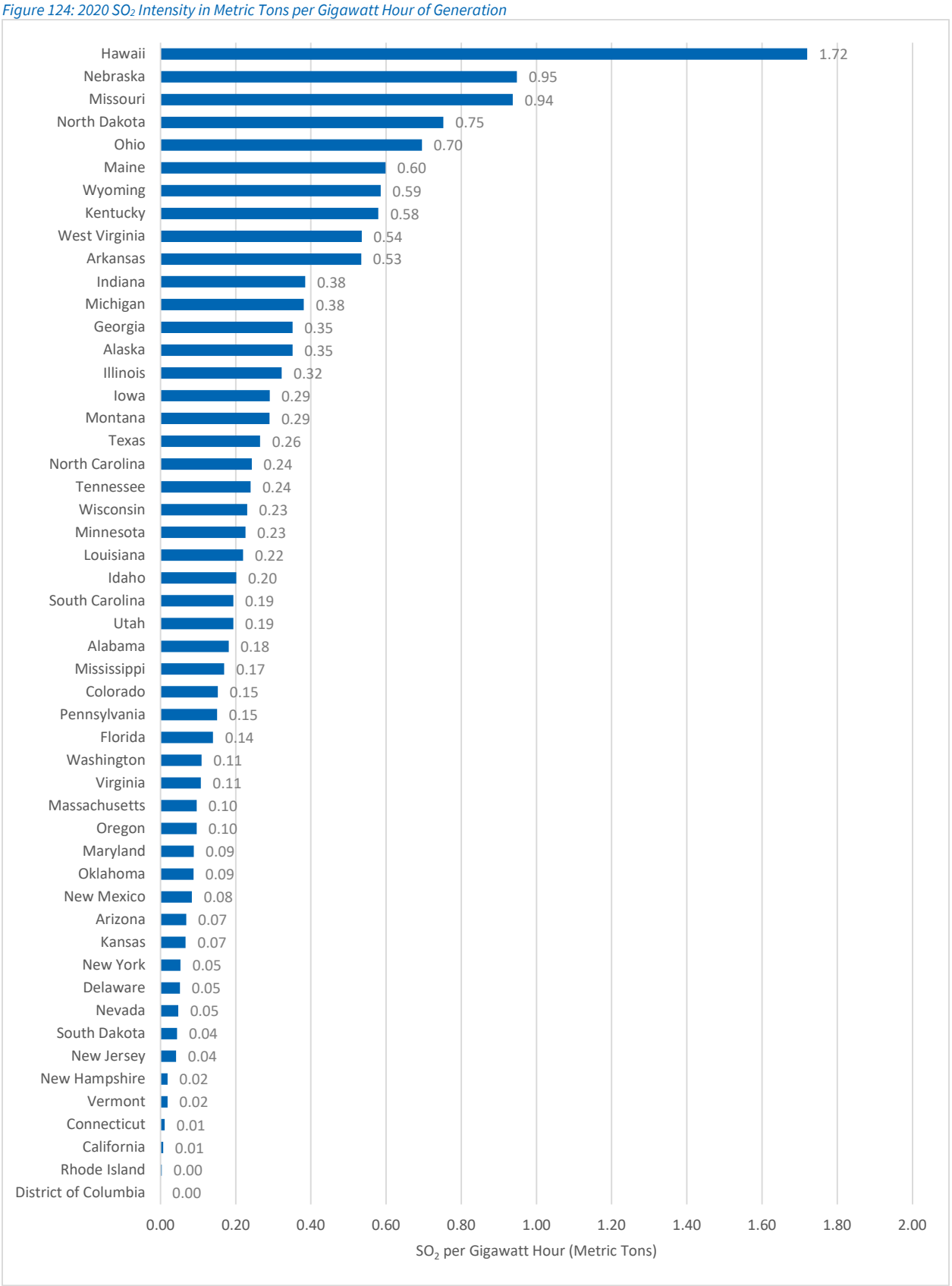
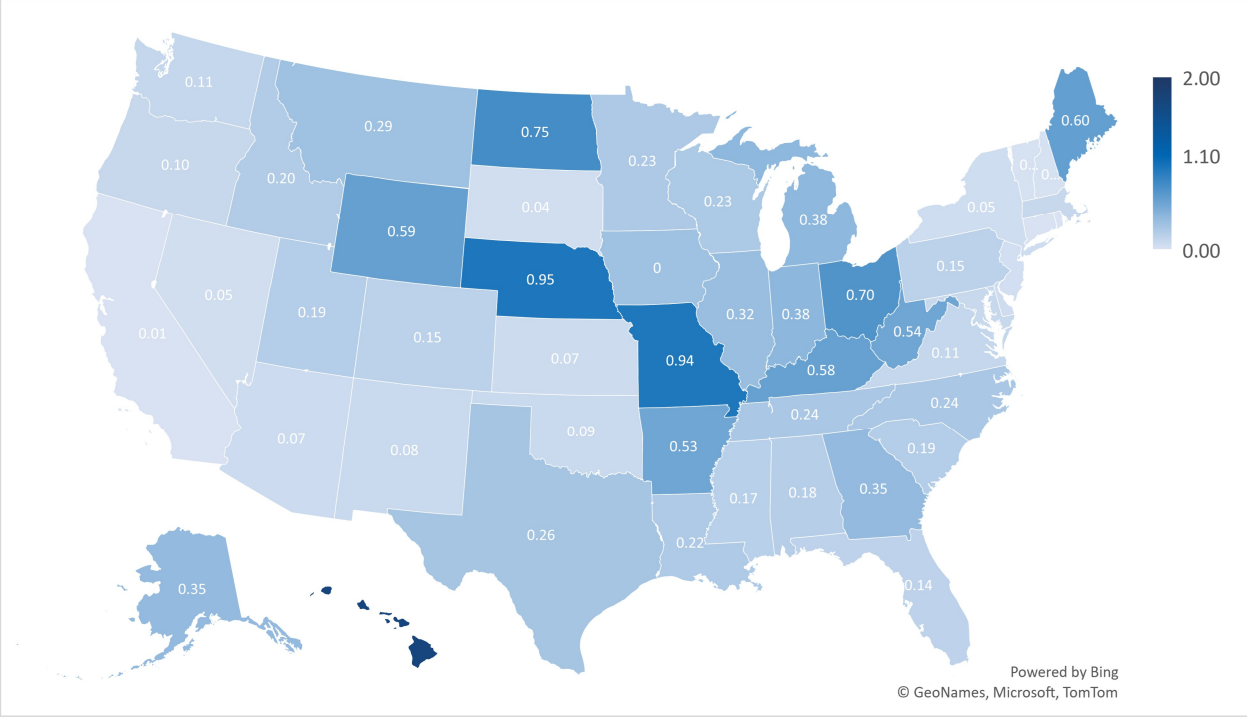


Figure 125: 2020 SO_2 Intensity in Metric Tons per Gigawatt Hour of Generation Map



Nitrogen Oxides

As shown in Figure 128, Michigan ranked 14th-worst among the states in nitrogen oxides emitted per gigawatt-hour in 2020, with 0.44 metric tons emitted for every gigawatt-hour generated. Michigan performs worse than most of its peers, except for Ohio and Indiana. Between 2011 and 2020, Michigan's trended annual rate of decline in total nitrogen oxide emissions intensity was 7.0%. (Figure 182).

As shown in Figure 126**,** Michigan utilities emitted 48,173 metric tons of nitrogen oxides in 2020, and ranks sixth-worst in total nitrogen oxide emissions. Between 2011 and 2020 Michigan's trended annual rate of decline in total nitrogen oxide emissions was 6.5%.

Figure 126: 2020 NOx Emissions from the Electric Sector in Thousands of Metric Tons

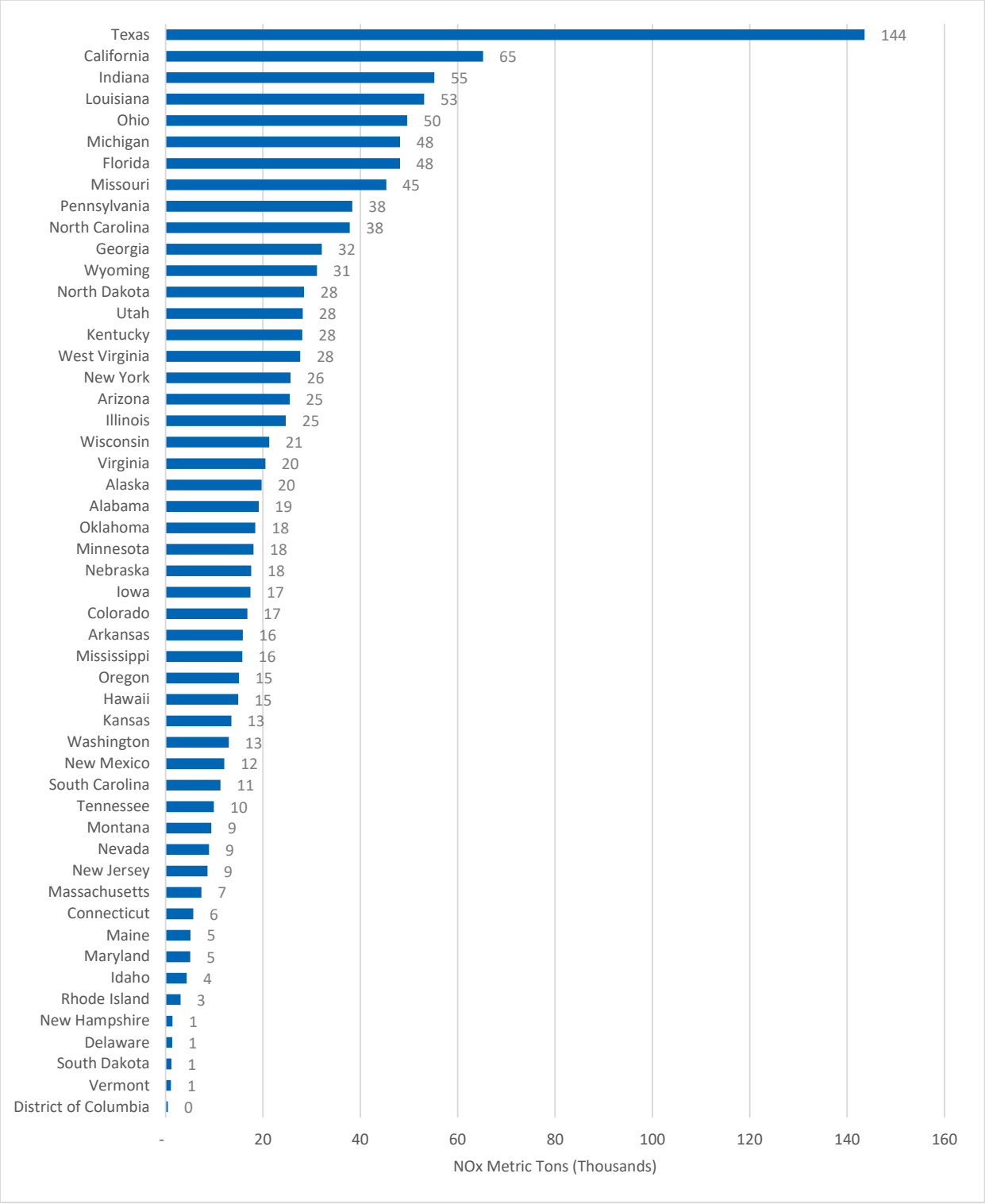


Figure 127: 2020 NOx Emissions from the Electric Sector in Thousands of Metric Tons Map

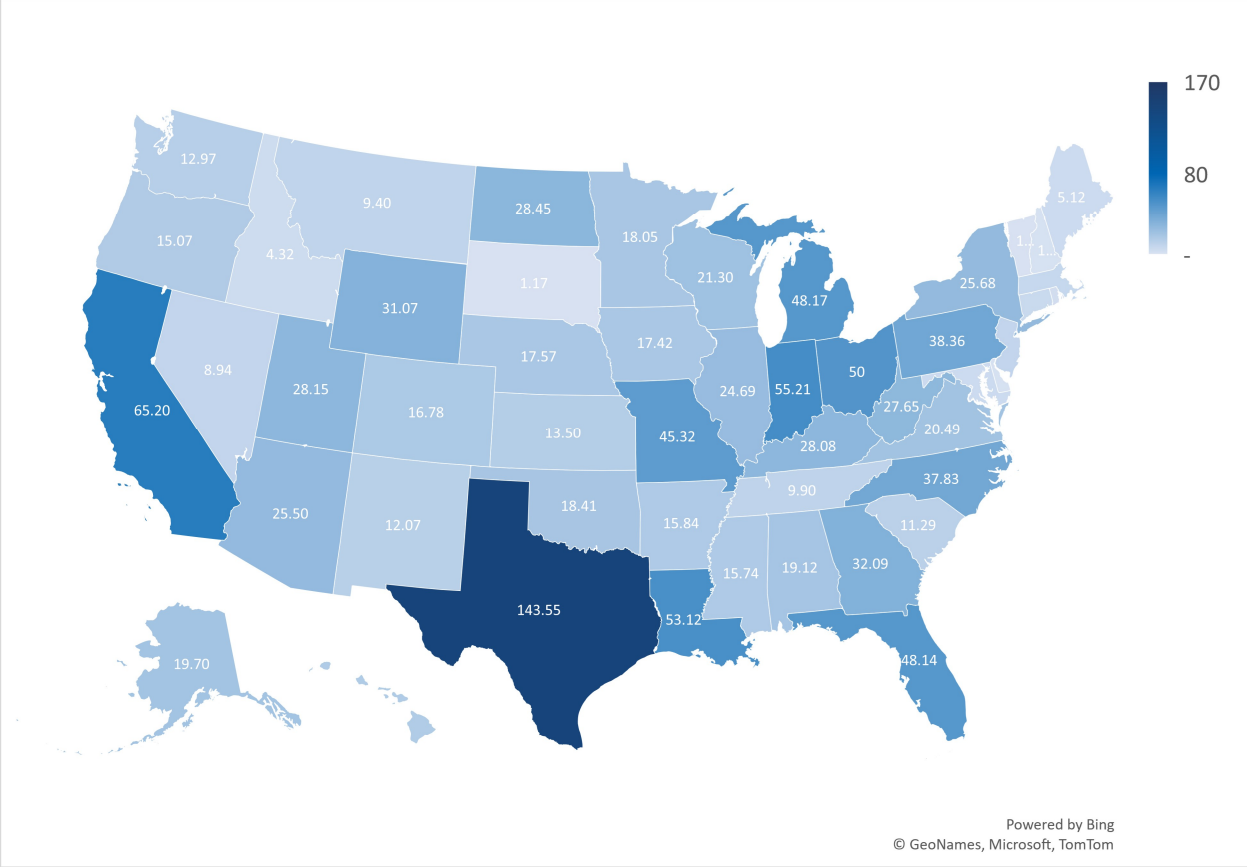


Figure 128: 2020 NOx Intesity in Metric Tons per Gigawatt Hour of Generation

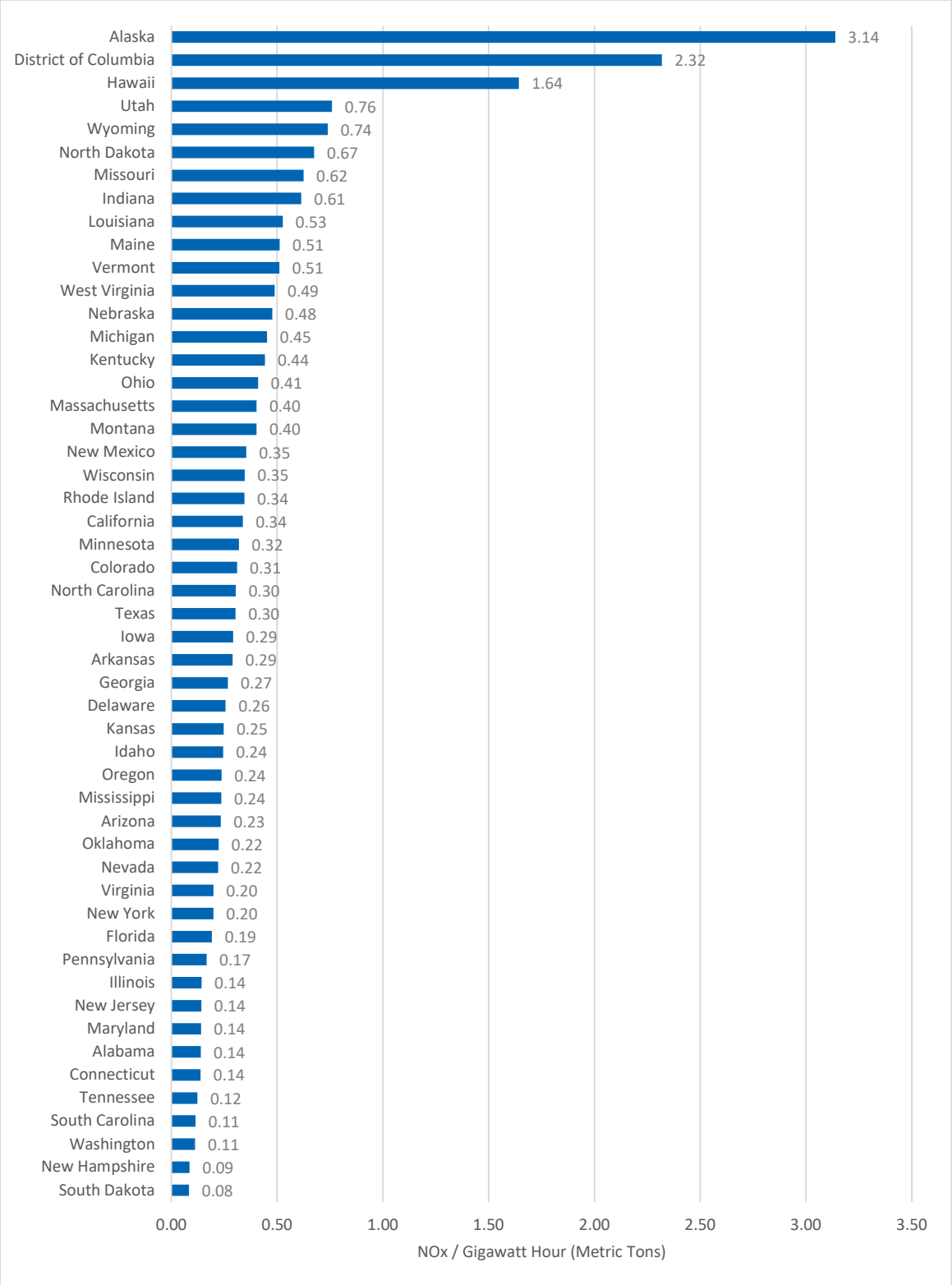
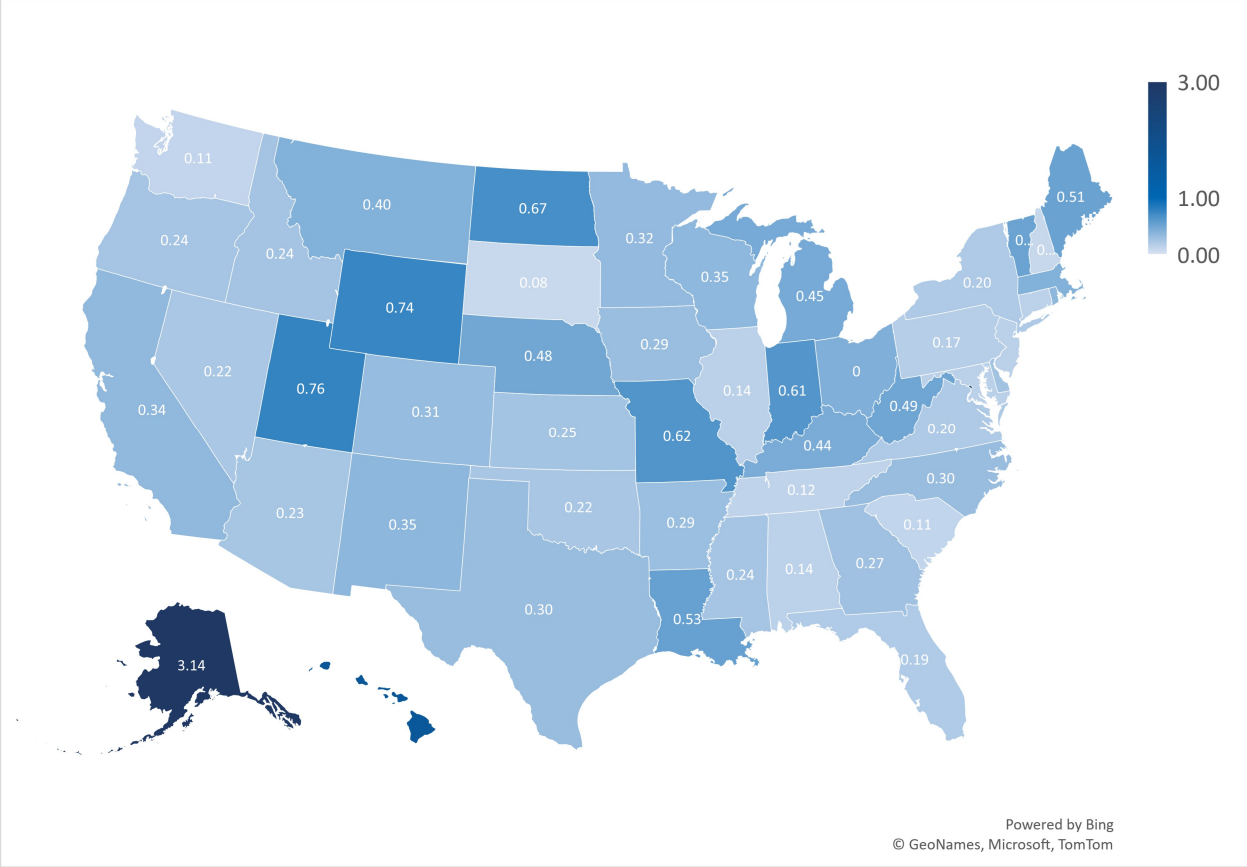


Figure 129: 2020 NOx Intensity in Metric Tons per Gigawatt Hour of Generation



Water Consumption and Withdrawals from Power Generation

Water is used in large quantities by the electricity sector, both for cooling and the production of steam to turn turbines in thermoelectric plants. The EIA's water data browser is still in its beta form, and has only recently been made available to the public.

Many thermoelectric plants require more water to run than they consume. When power plants use water for cooling, the water passes through the plant and is rereleased in the form of uncontaminated, but warmed, water, which can be harmful to aquatic ecosystems. Some power plants are designed to recycle and recondense steam, thus minimizing their total withdrawals, but increasing the proportion of water that is lost to steam. Because, as with emissions, not all power plants use water with equal efficiency, water withdrawal and consumption intensity—gallons/MWh—is a useful way of understanding the relative water efficiency of different states' electric sectors. To best understand the different forms of water use by the electric sector, this report shows water use in four ways:

- Water Withdrawal—the volume of water pulled into power plants for cooling and steam production.
- Water Consumption—the volume of water that leaves power plants in the form of steam
- Water Withdrawal Intensity—the amount of water pulled into a power plant per MWh of electricity generation
- Water Consumption Intensity—the amount of water released as steam by a power plant per MWh of electricity generation

In 2020, Michigan ranked as the fifth- and ninth-largest state for total water withdrawals and consumption for electric production, respectively, withdrawing 2,326 billions of gallons of water and consuming 31.5 billion gallons. This makes Michigan the second-largest user in its peer group, after Illinois, and the fourth-largest consumer after Illinois, Indiana and Ohio (Figure 131 and Error! Reference source not found.).

In terms of efficiency of water use, in 2020 Michigan withdrew 29 thousand gallons of water per MWh of electricity produced, making it the 13th-least efficient user. Michigan's withdrawal intensity was higher than its peer states', except for Wisconsin's. Michigan utilities' water consumption intensity is the 31st highest at 386 gallons of water consumed per MWh, making its consumption intensity lower than its peer states', except for Wisconsin's (Figure 134 and Figure 136). This dynamic of Wisconsin having the highest withdrawal intensity in the region, but the lowest consumption intensity illustrates the complicated ways in which water is used in thermal generation.

Figure 130: 2020 Water Withdrawals for Electricity Generation in Billions of Gallons

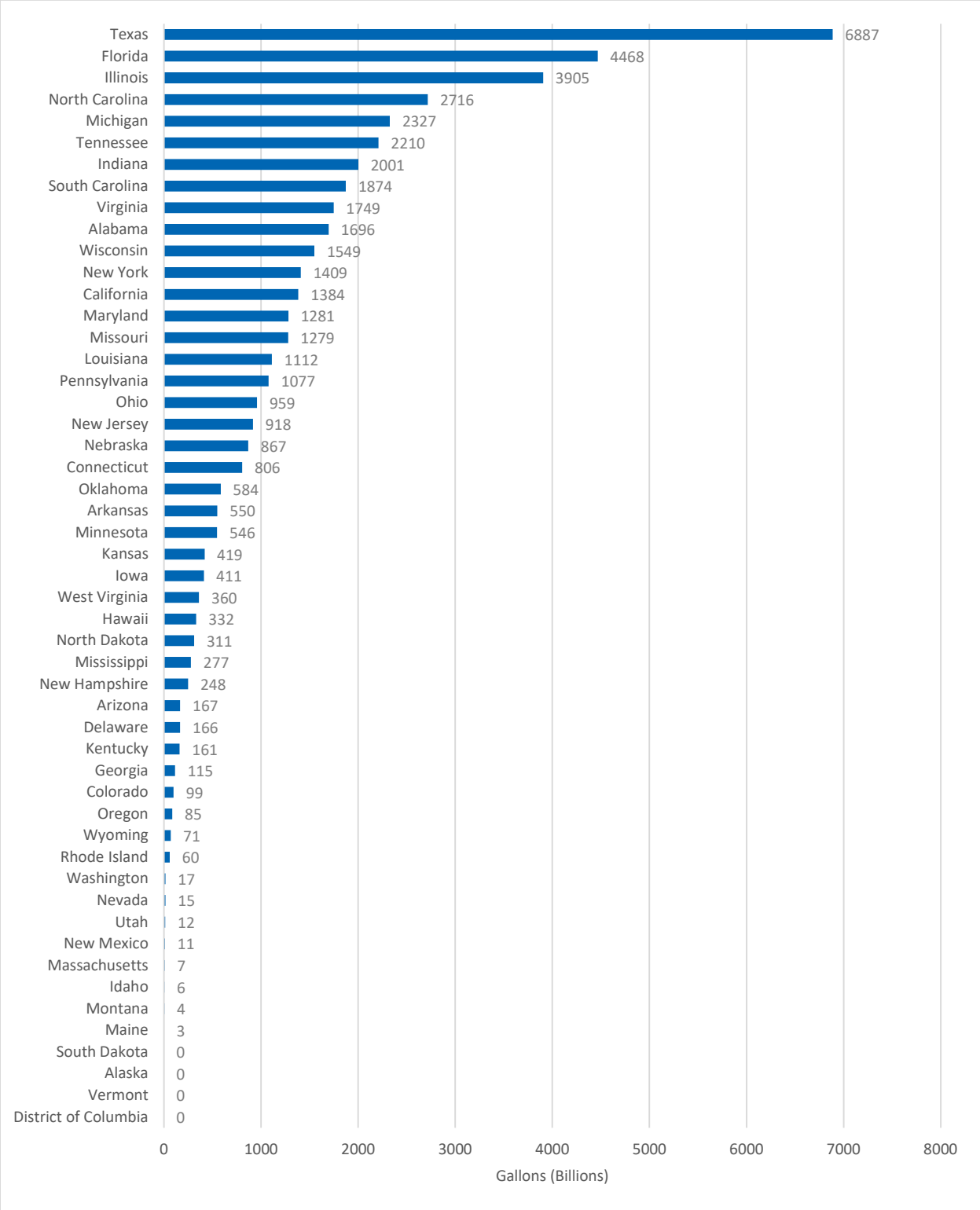


Figure 131: 2020 Water Withdrawals for Electricity Generation in Billions of Gallons Map

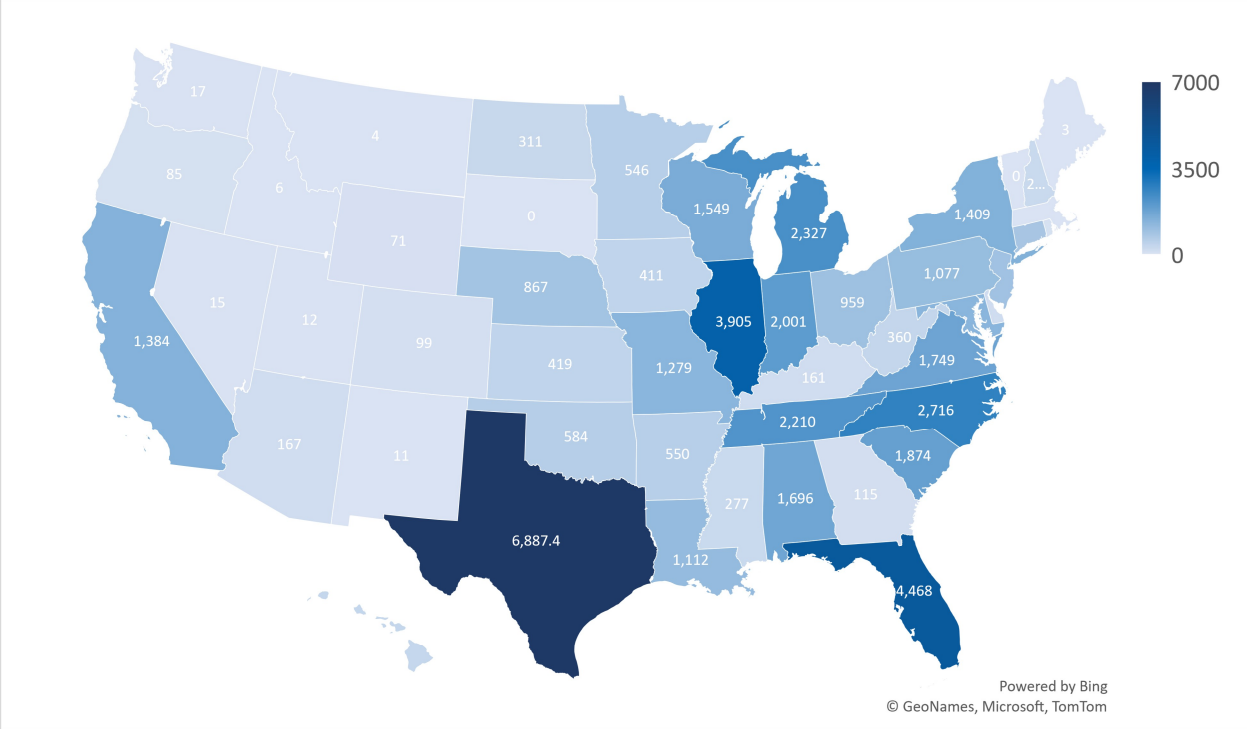


Figure 132: 2020 Water Consumption for Electricity Generation in Billions of Gallons

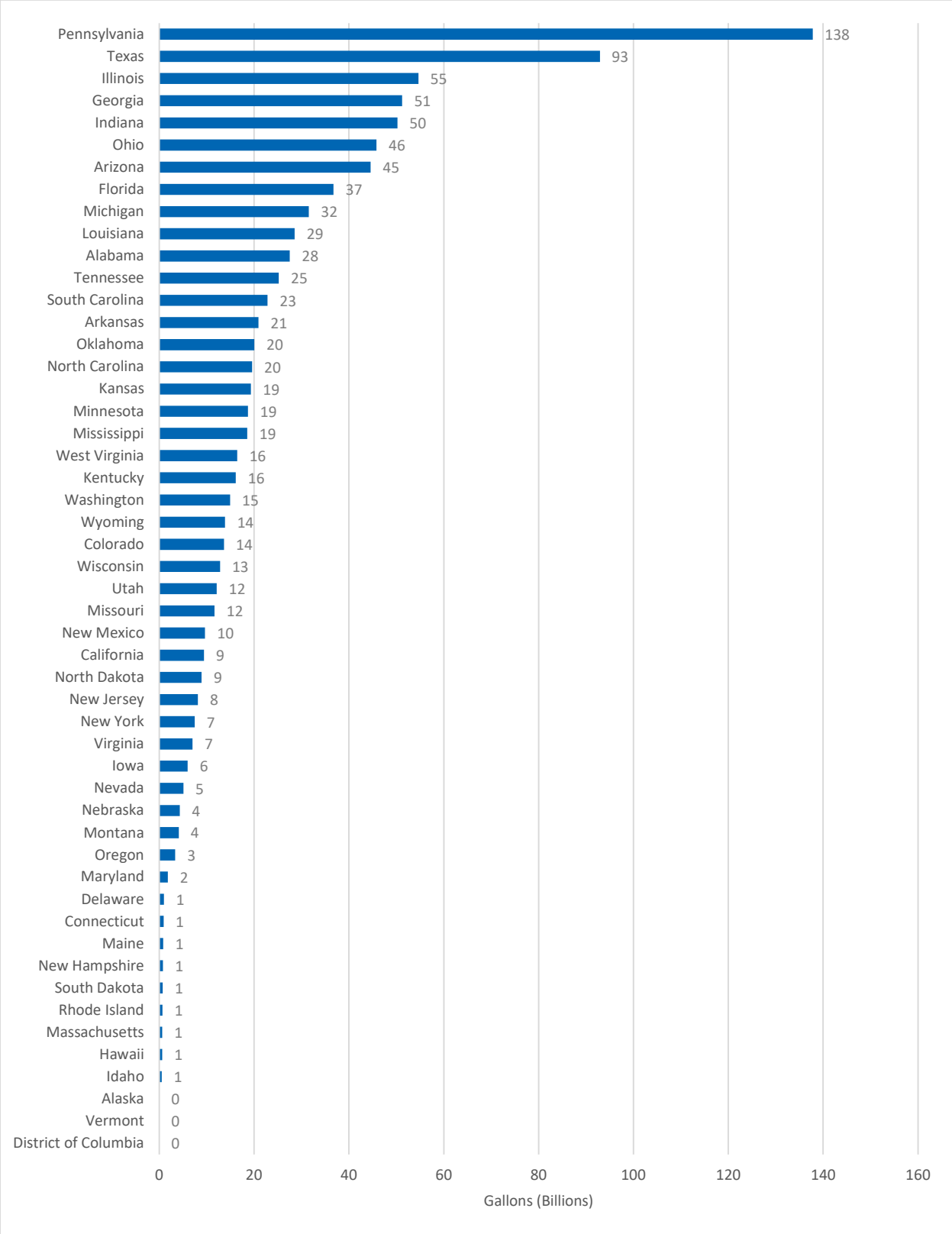


Figure 133: 2020 Water Withdrawal Intensity for Electricity Generation in Thousands of Gallons per Megawatt Hour

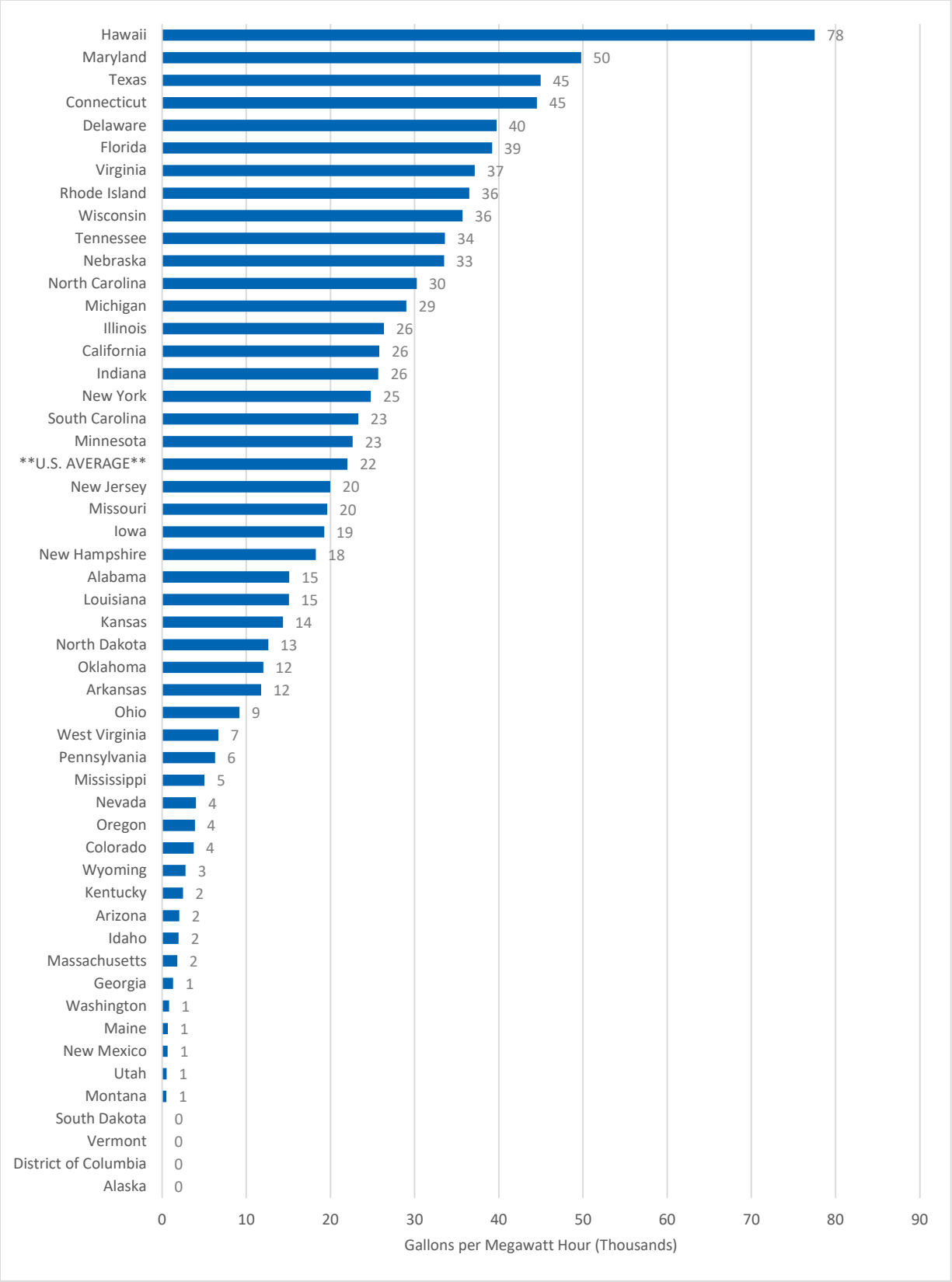


Figure 134: 2020 Water Withdrawal Intensity for Electricity Generation in Thousands of Gallons per Megawatt Hour

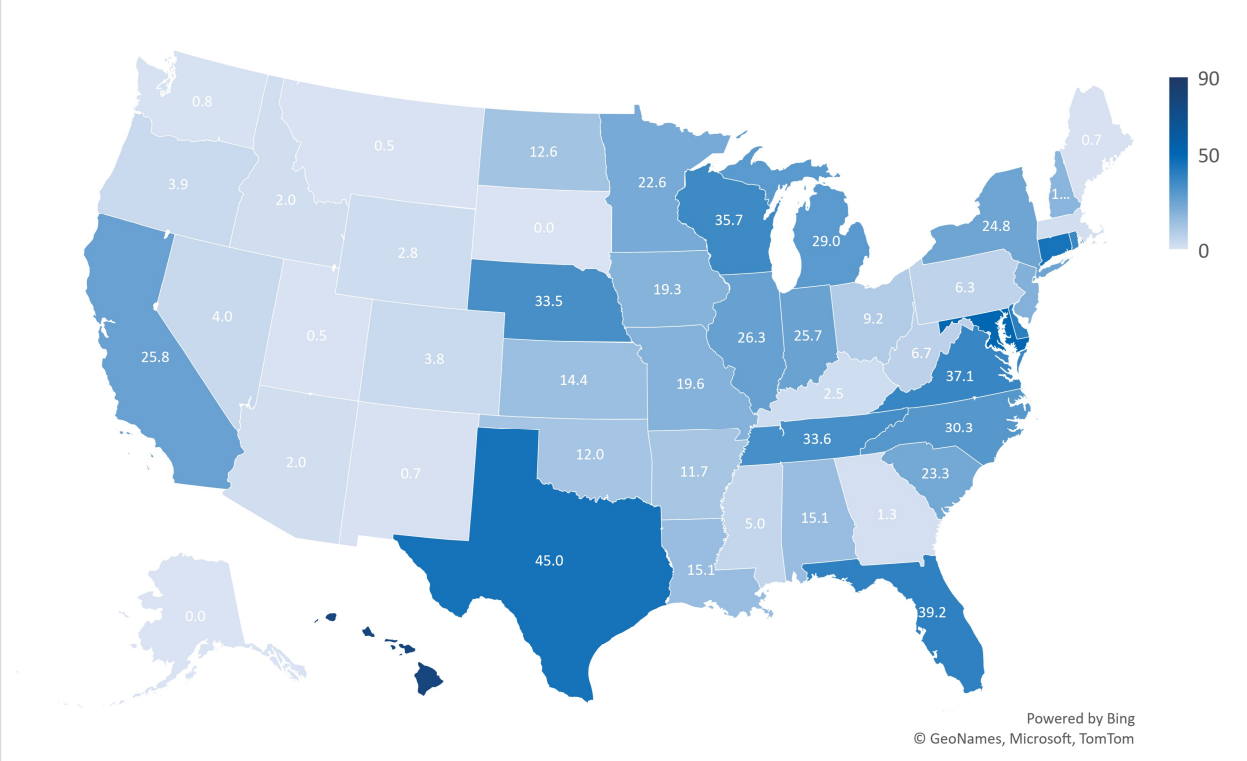


Figure 135: 2020 Water Consumption Intensity for Electricity Generation in Thousands of Gallons per Megawatt Hour

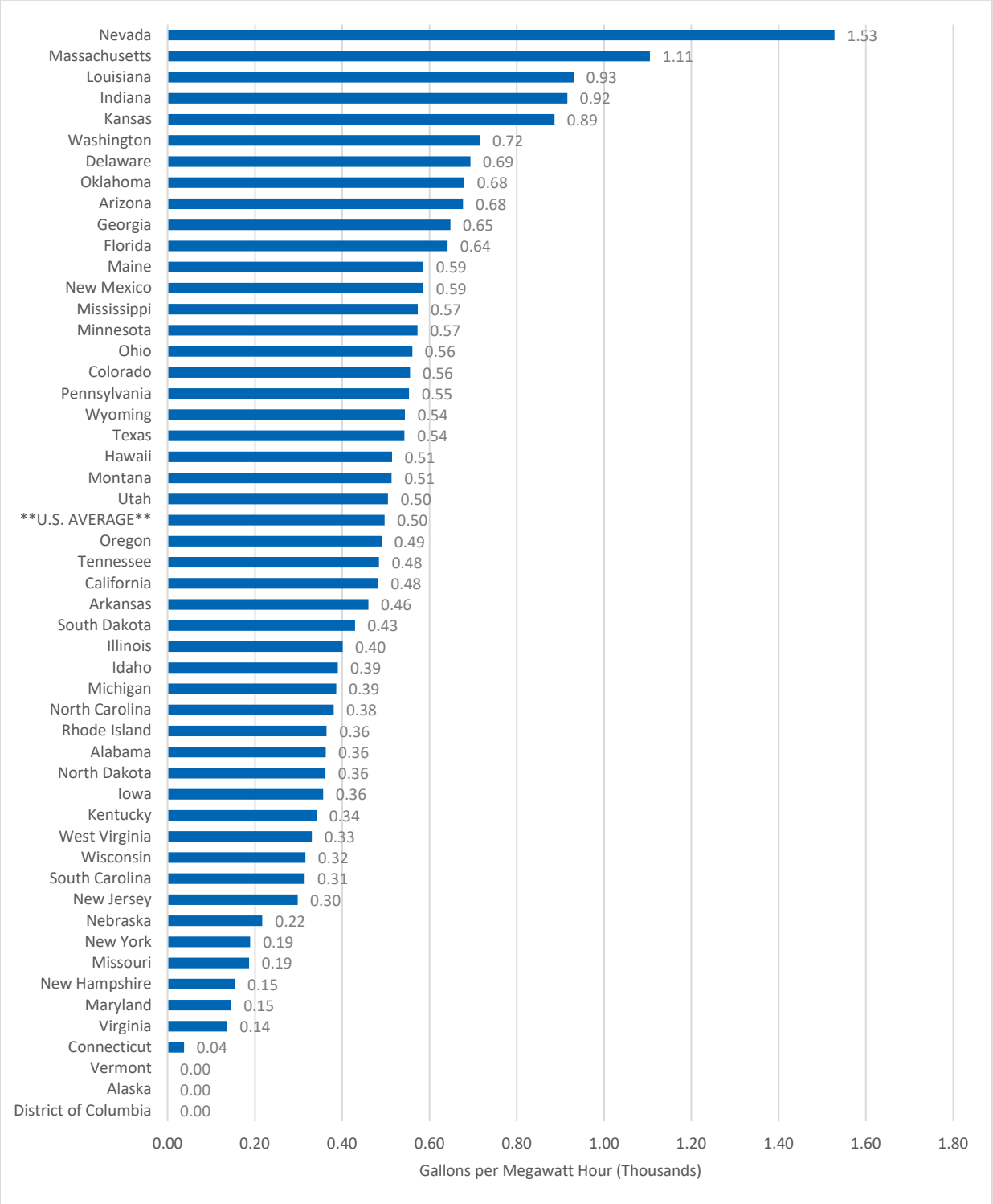
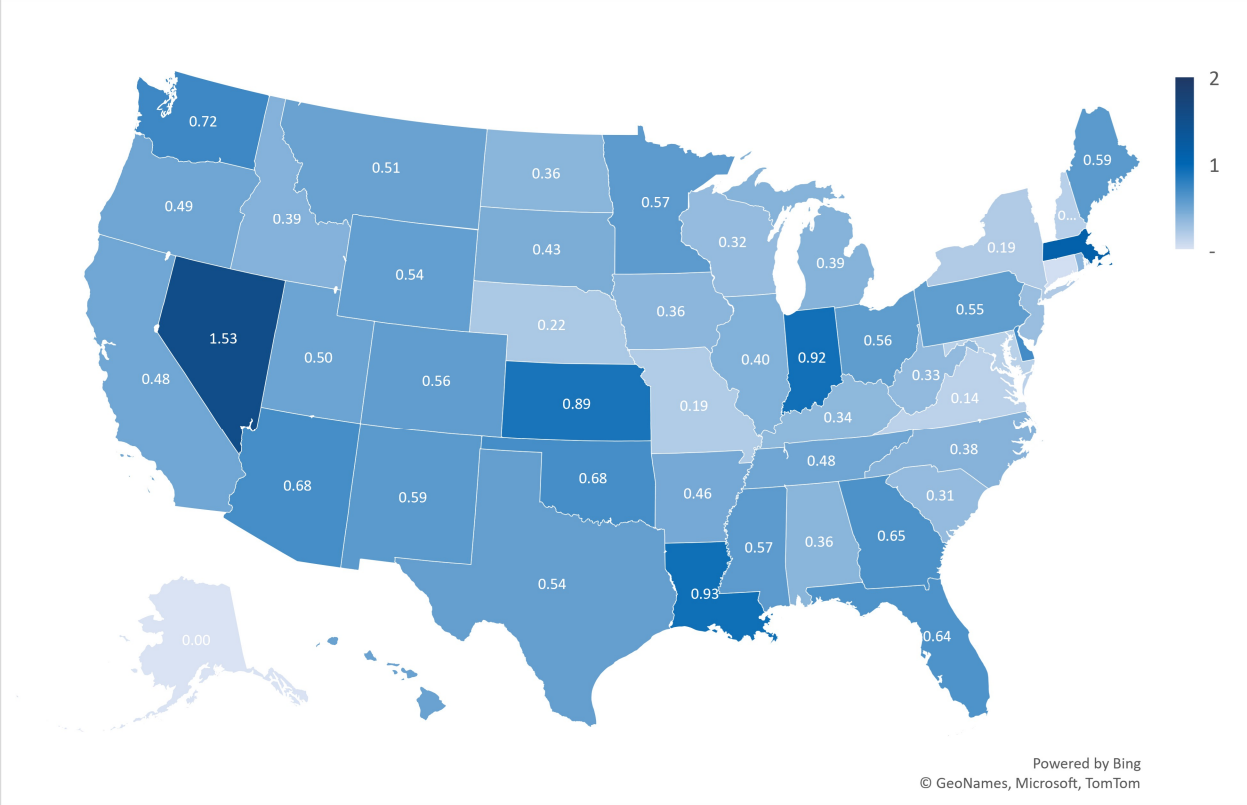


Figure 136: 2020 Water Consumption Intensity for Electricity Generation in Thousands of Gallons per Megawatt Hour



NATURAL GAS EMISSIONS

Overview

Natural gas, known also as methane, creates emissions when burned, but is itself also a potent greenhouse gas. This section looks to fill in a gap on the potential damages done to the environment from the natural gas sector. Emissions from the burning of natural gas for electricity production are reported in *Emissions from Electricity Generation* above. This section addresses the warming potential of natural gas losses by gas utilities, as reported by volume in *Gas Utility Performance,* as well as the warming potential of natural gas burned by sectors outside of the electric sector. The residential and commercial sectors burn natural gas for space and water heating, and the industrial sector burns natural gas for many other heat uses necessary for manufacturing.

Natural Gas Losses as CO_2 Equivalents

Emissions from natural gas losses are reported as CO_2 equivalents by taking natural gas loss volume, the same volume as reported above in *Gas Utility Performance,* converting it to metric tons and multiplying it by the lifetime CO_2 equivalency factor for methane. The final formula for converting methane to CO_2 equivalents is thus: *Metric Tons of CO_2 Equivalents = Losses in CF*Weight per CF methane (.035lb) * CO_2 Equivalency Factor (25)/lbs. per Metric Ton (2204.6 lbs).*

In 2020, Michigan's CO_2 equivalents from lost natural gas were the seventh-largest in the nation at 2.2 million metric tons, which is higher than all its peer states except Illinois. Looking at Figure 131 in *Gas Utility Performance,* if we assume that a substantial portion of Consumers' Energy's unaccounted-for natural gas is, in fact, leaked natural gas, the numbers in this section may not fully account for the harms of Michigan's lost natural gas.

Figure 137: 2020 CO_2 Equivalents from Lost Natural Gas in Thousands of Metric Tons

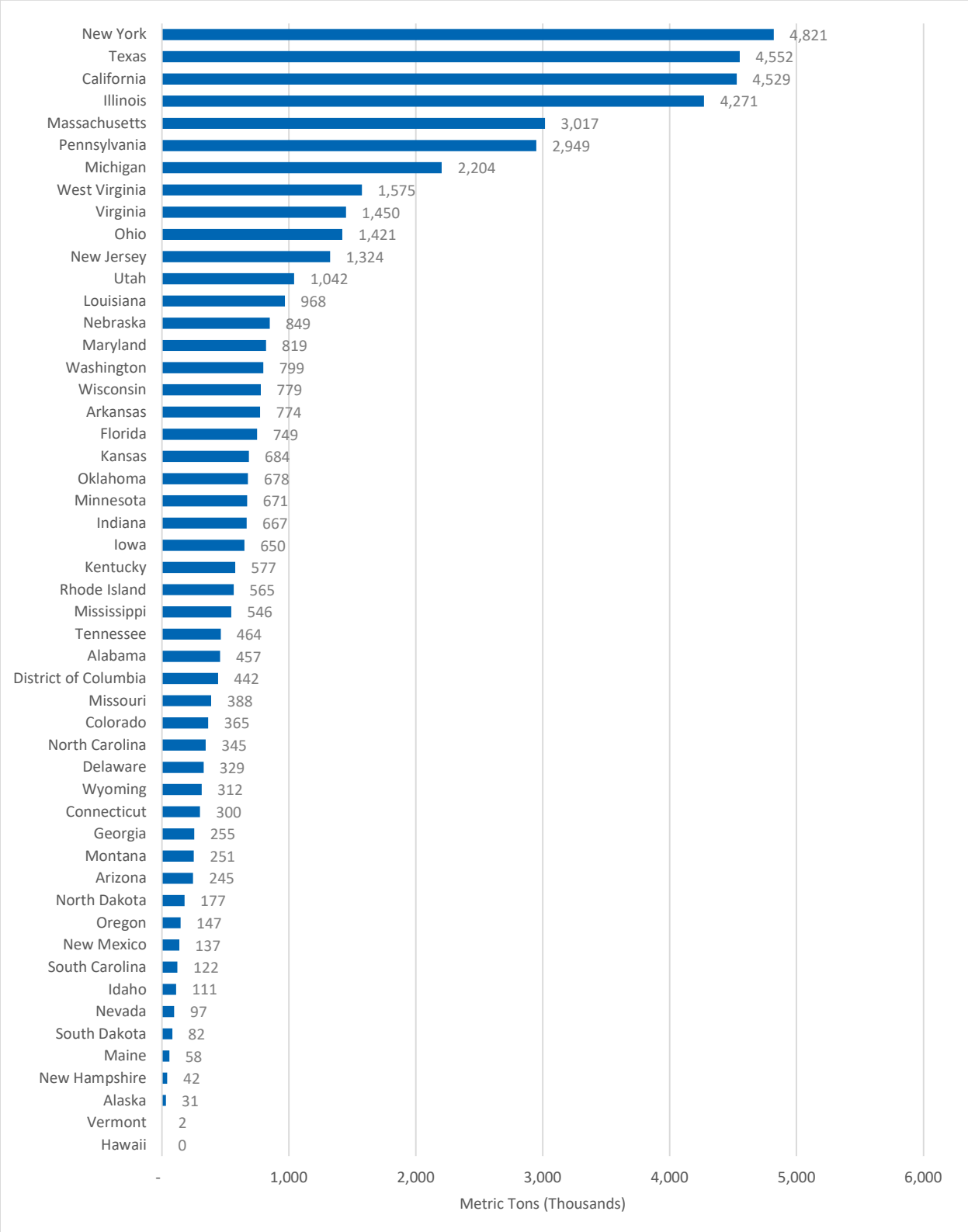
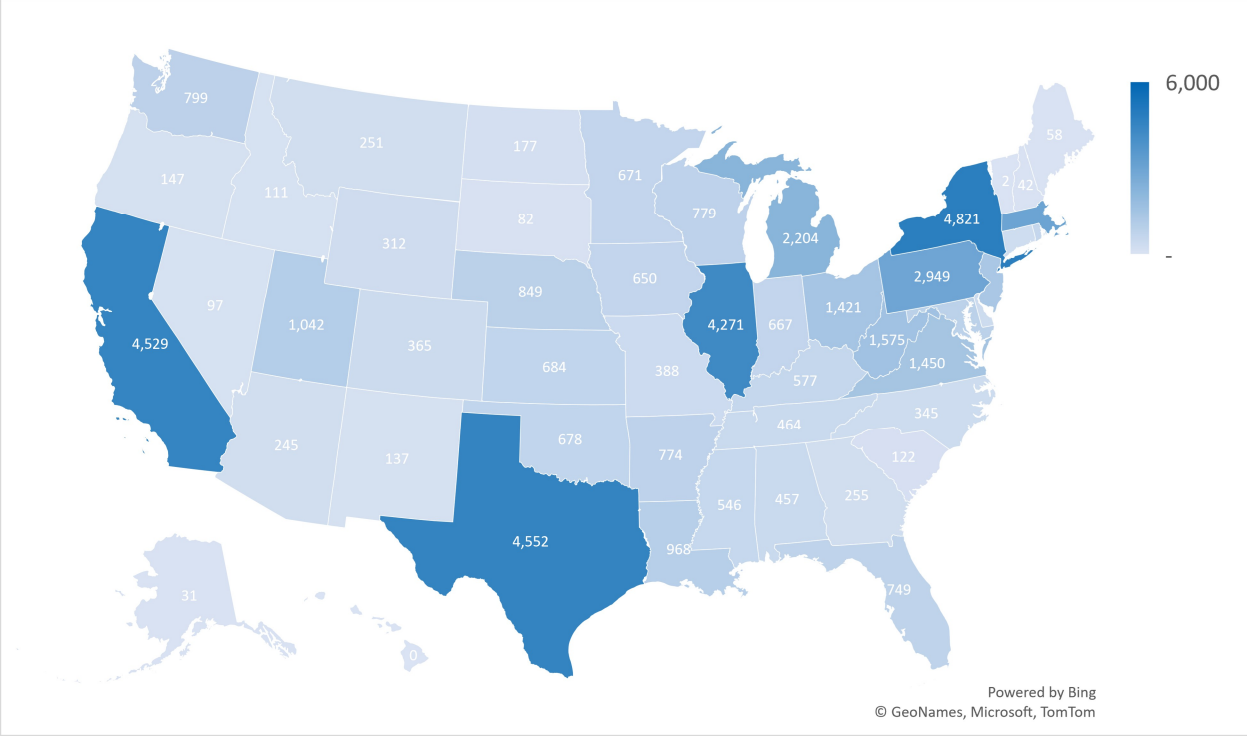


Figure 138: 2020 CO2 Equivalents from Lost Natural Gas in Thousands of Metric Tons Map



Emissions from Gas Combustion Outside the Electric Sector

Burning natural gas produces multiple emission types including CO_2, SO_2 and NO_x. There are consistent emissions factors for CO_2 and SO_2 from the burning of natural gas, but the NO_x emission factor from burning natural gas depends on the conditions under which it is burned. There is generally a higher NO_x emission factor when burning larger volumes of natural gas at higher temperatures. To compensate for this differential, the reported NO_x emissions use one factor—100lb/million CF natural gas—for residential and commercial uses, and a higher factor—190lb/million CF natural gas— for industrial uses. Unfortunately, this provides only a rough approximation of the real NO_x emissions produced by these sectors.

The natural gas consumption data used for this subsection come from the SEDS database, while the emissions factors come from the EPA.

In Michigan, just under half of non-electric sector natural gas consumption—and therefore emissions—comes from the residential sector, with the commercial and industrial sectors contributing nearly equal amounts of the other half. In 2020, Michigan was the eighth-largest producer of emissions from natural gas use in terms of CO_2 and SO_2 with emissions of 34 million and 170 metric tons, respectively (Figure 139 and Figure 141). Michigan was the ninth-largest emitter of NO_x from site use of natural gas in the country (Figure 143). In relation to its peer states, Michigan is near the middle, producing fewer CO_2, SO_2 and NO_x emissions than Ohio and Illinois.

Figure 139: 2020 CO_2 Emissions from Natural Gas Combustion in All Sectors (Except Electric) in Millions of Metric Tons

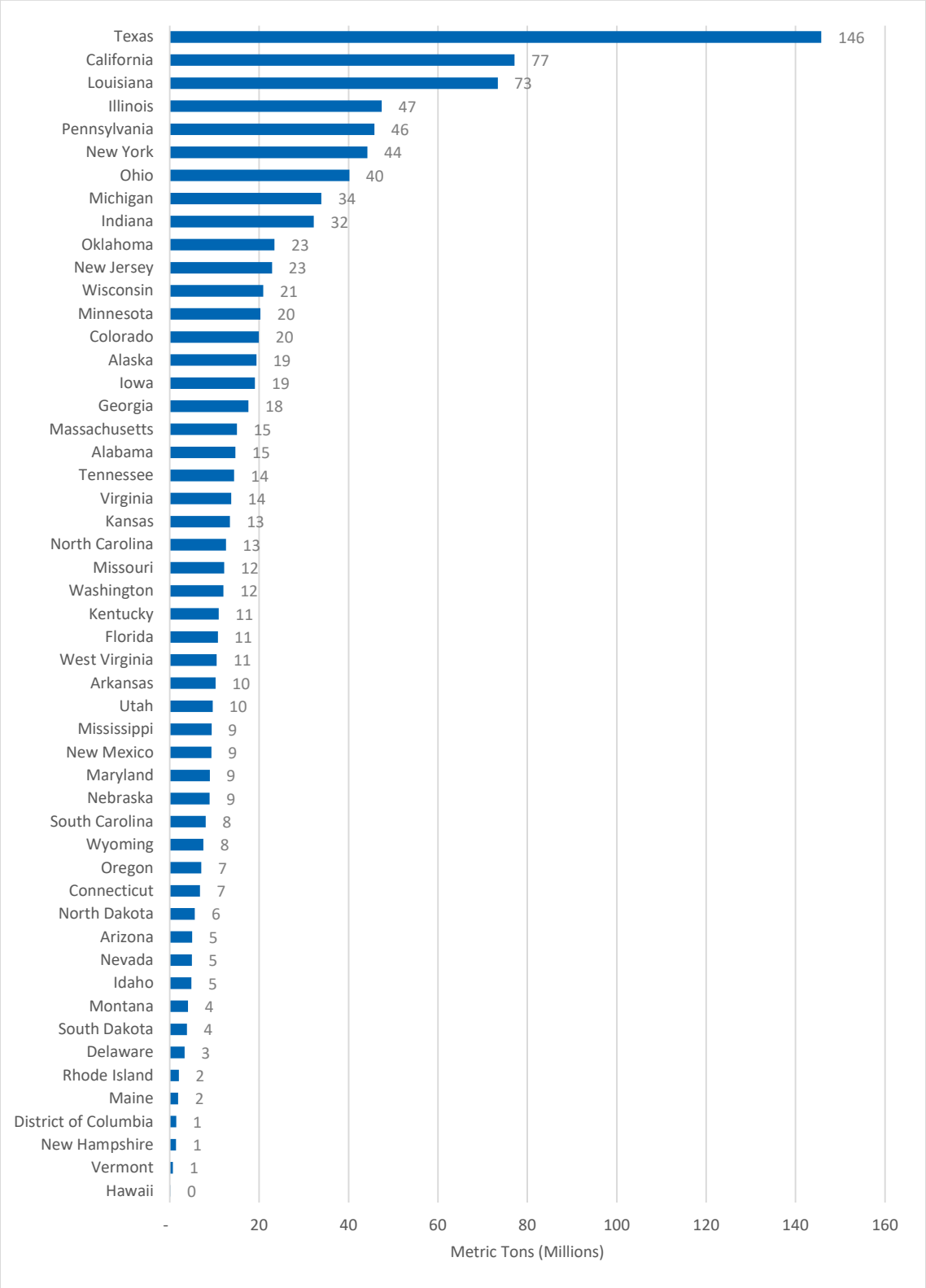


Figure 140: 2020 CO_2 Emissions from Natural Gas Combustion in All Sectors (Except Electric) in Millions of Metric Tons Map

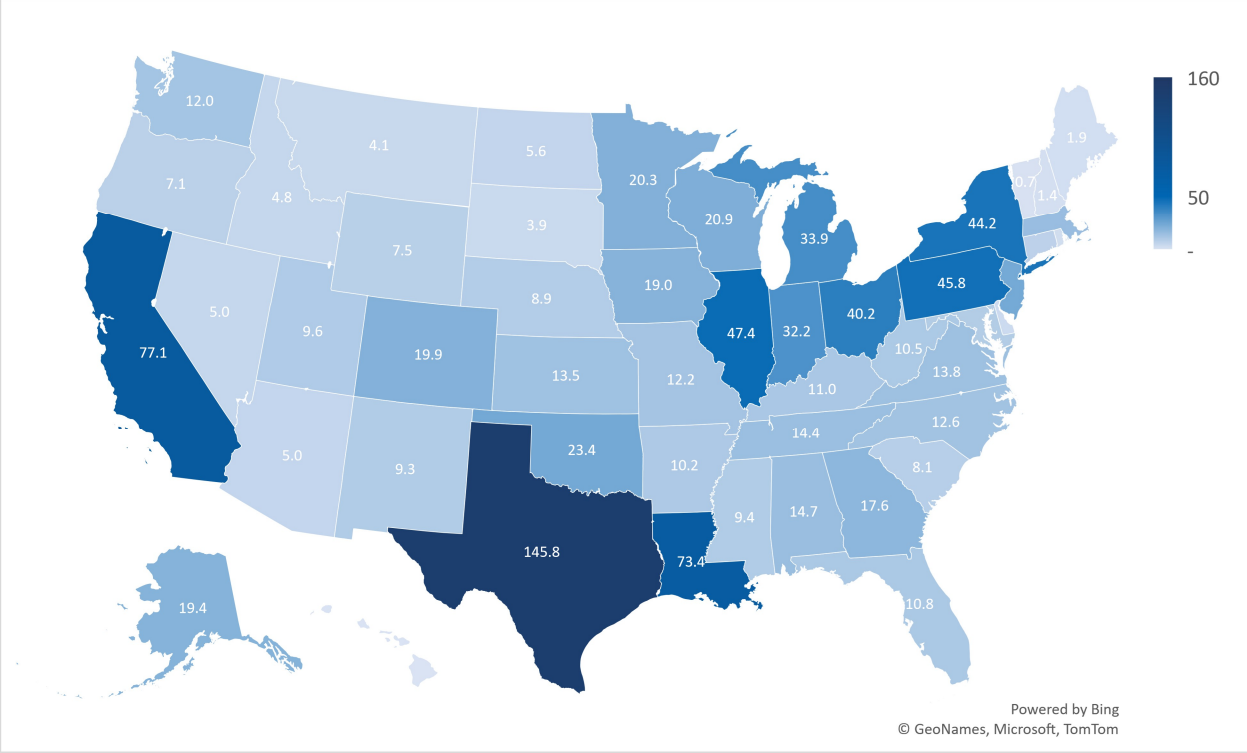


Figure 141: 2020 SO_2 Emissions from Natural Gas Combustion in All Sectors (Except Electric) in Metric Tons

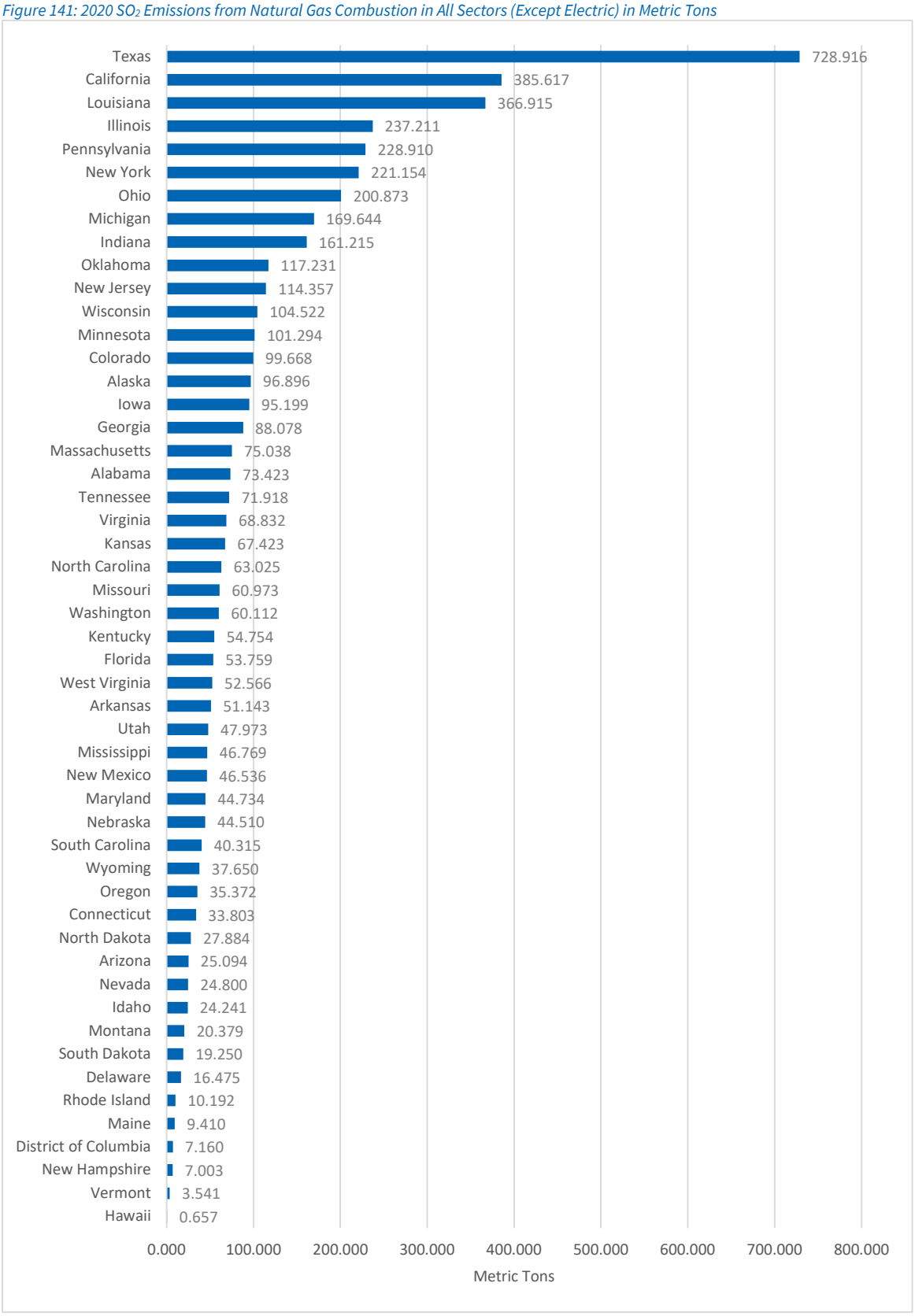


Figure 142: 2020 SO_2 Emissions from Natural Gas Combustion in All Sectors (Except Electric) in Metric Tons Map

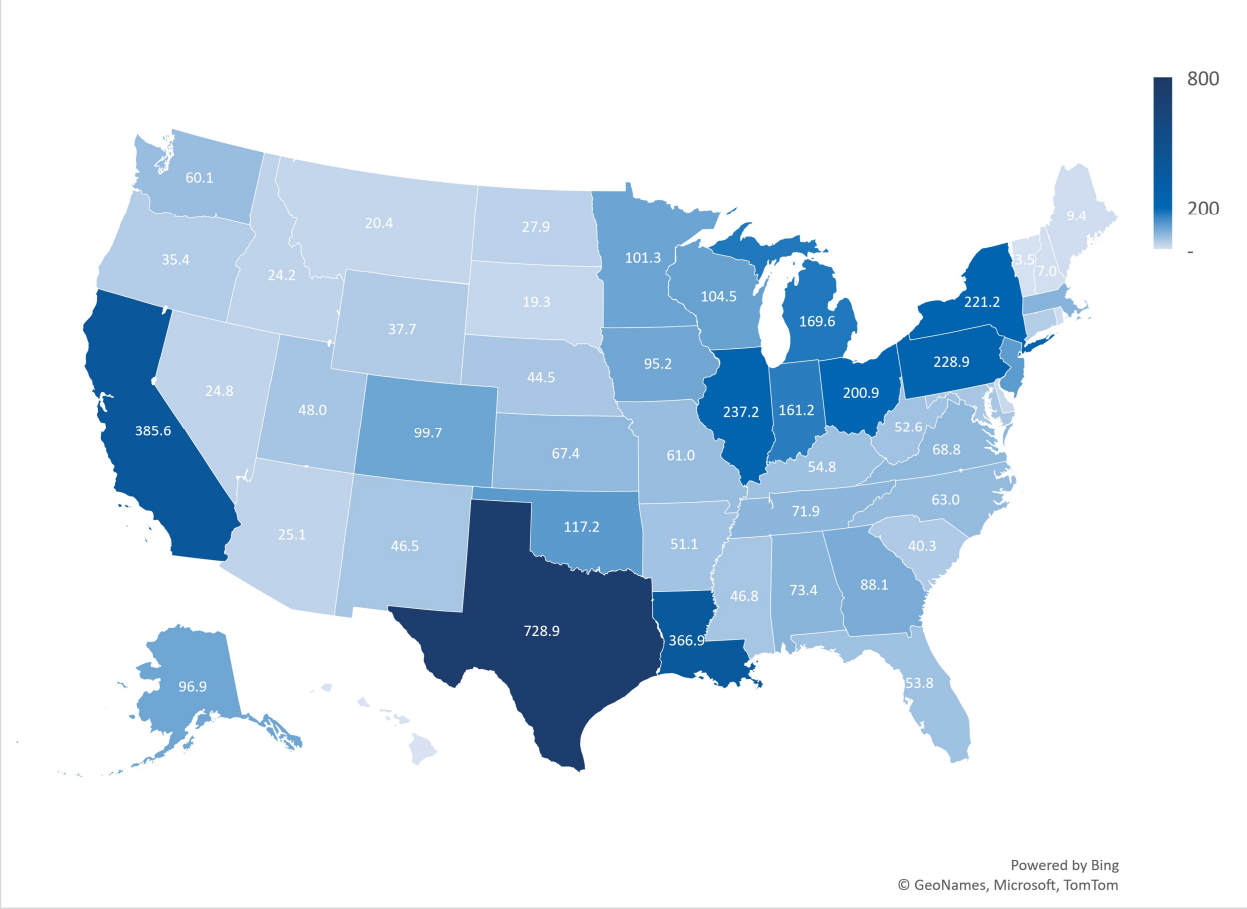


Figure 143: 2020 NOx Emissions from Natural Gas Combustion in All Sectors (Except Electric) in Thousands of Metric Tons

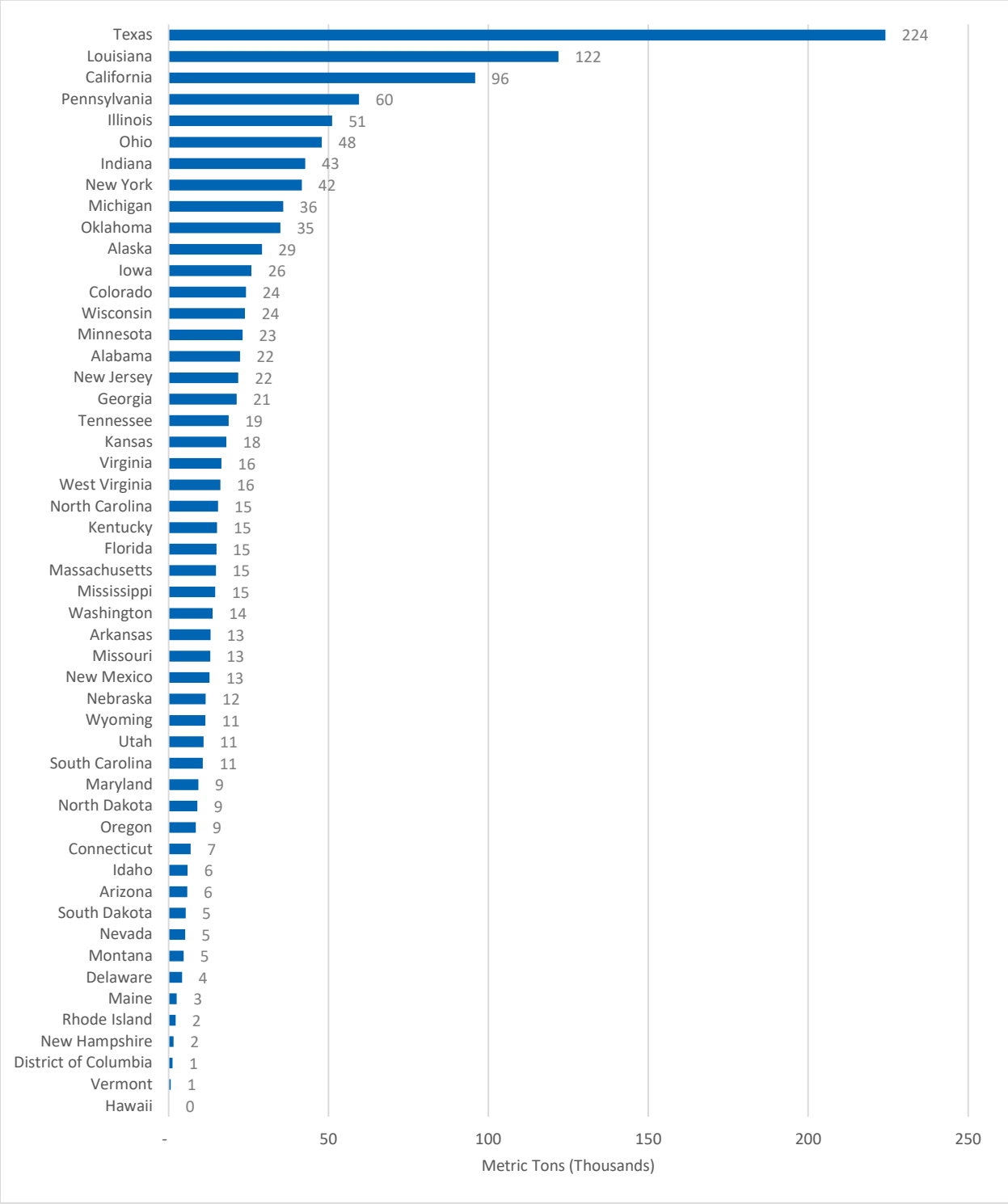
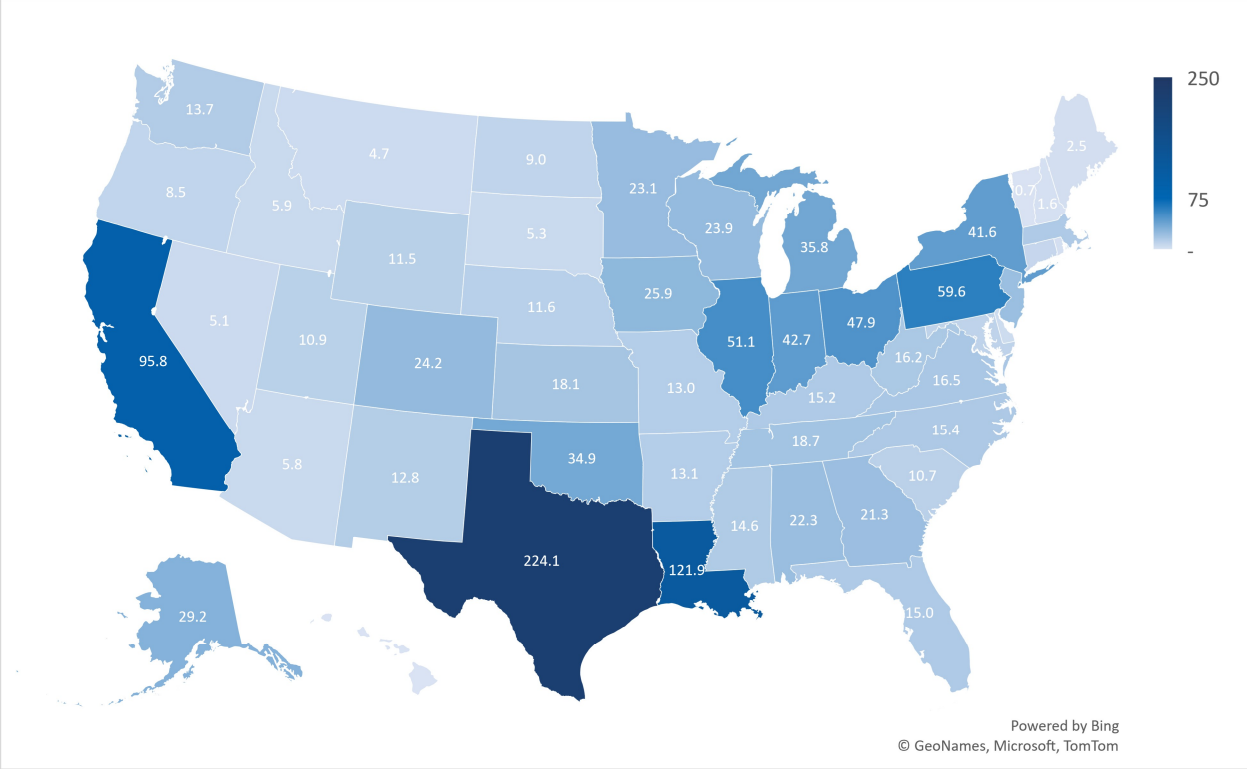


Figure 144: 2020 NOx Emissions from Natural Gas Combustion in All Sectors (Except Electric) in Thousands of Metric Tons Map



APPENDICES

Appendix A: Historical Data Tables for Michigan Utilities

Figure 145: Number of Electricity Customers

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Trend CAGR
Alpena Power Co	13,689	13,681	13,687	13,711	13,718	13,720	13,708	13,686	16,511	16,554	1.9%
Consumers Energy Co	1,571,319	1,571,873	1,573,802	1,574,243	1,577,087	1,584,318	1,594,272	1,603,125	1,836,668	1,855,672	1.7%
DTE Electric Company	1,924,607	1,925,908	1,936,236	1,943,880	1,953,735	1,966,635	1,980,906	1,992,276	2,209,021	2,226,500	1.5%
Indiana Michigan Power Co	109,162	109,019	109,111	108,929	108,947	109,017	109,725	110,179	129,283	129,886	1.7%
Northern States Power Co	7,738	7,740	7,723	7,710	7,669	7,637	7,628	7,599	8,942	8,913	1.3%
Upper Michigan Energy Resources Corp.	-	-	-	-	-	-	32,707	32,763	36,818	36,896	4.9%
Upper Peninsula Power Company	46,221	46,252	46,279	46,190	42,740	49,562	55,342	52,250	52,889	53,159	2.1%
Alger-Delta Coop Electric Assn	9,439	9,442	9,458	9,398	9,399	9,449	9,439	9,507	10,089	10,208	0.7%
Cherryland Electric Coop Inc	30,620	30,754	30,946	31,205	31,520	31,896	32,300	32,738	36,075	36,487	1.9%
City of Bay City	17,737	17,696	17,734	17,696	17,693	17,722	17,858	17,908	20,243	20,159	1.3%
City of Crystal Falls	1,373	1,358	1,323	1,339	1,344	1,344	1,350	1,336	1,603	1,603	1.6%
City of Gladstone	2,540	2,511	2,510	2,516	2,512	2,517	2,518	2,521	3,168	2,934	1.8%
City of Grand Haven	11,498	11,620	11,731	11,800	11,785	11,883	12,176	12,432	14,403	14,642	2.5%
City of Holland	23,038	23,134	23,266	23,493	23,645	23,732	23,981	24,349	29,131	29,423	2.5%
City of Lansing	82,967	82,833	83,143	83,512	83,747	83,910	84,241	84,699	98,268	99,274	1.8%
City of Marquette	14,209	14,147	14,700	14,741	14,783	14,833	14,990	14,924	17,230	17,264	2.0%
City of Negaunee	2,021	2,020	2,015	2,023	1,980	1,954	1,958	1,959	2,234	2,250	0.9%
City of Norway	1,815	1,827	1,829	1,847	1,843	1,837	1,840	1,843	2,094	2,088	1.4%
City of Sturgis	6,063	6,059	6,080	6,079	6,054	6,074	6,082	6,089	7,108	7,048	1.5%
City of Traverse City	8,660	8,775	9,014	9,171	9,202	9,396	9,098	9,709	12,599	12,812	4.0%
City of Zeeland	5,300	5,429	5,485	5,463	5,432	5,514	5,673	5,738	6,749	6,857	2.6%
Cloverland Electric Co-op	36,172	35,998	35,775	35,349	34,630	34,226	34,186	34,383	42,471	42,852	1.4%
Coldwater Board of Public Util	5,525	5,361	5,466	5,594	5,663	5,573	5,671	5,814	7,233	7,324	3.1%
Great Lakes Energy Coop	111,226	111,215	112,229	112,071	112,432	113,061	113,765	114,475	126,250	126,956	1.4%
Midwest Energy Cooperative	28,523	28,469	28,485	28,487	28,512	28,630	28,767	28,789	34,748	34,919	2.0%
Presque Isle Elec & Gas Coop	30,825	30,878	30,895	30,732	30,760	30,873	31,078	31,107	33,713	33,769	0.9%
Tri-County Electric Coop	22,361	22,314	22,292	22,247	22,241	22,267	22,334	22,388	26,105	26,349	1.6%
Village of Baraga	642	643	646	647	653	649	652	540	750	738	0.9%
Village of L'Anse	989	988	988	990	998	993	989	987	1,176	1,132	1.5%
Wyandotte Municipal Serv Comm	11,344	11,313	11,323	11,335	11,434	11,562	11,633	11,665	12,790	12,635	1.3%

Figure 146: System Average Interruption Duration Index (SAIDI) with Major Event Days in Minutes

	2013	2014	2015	2016	2017	2018	2019	2020	Trend CAGR
Alpena Power Co	-	146	229	91	131	206	96	214	0.8%
Consumers Energy Co	1,109	377	441	284	606	407	691	510	-2.2%
DTE Electric Company	583	793	277	238	1,063	485	466	352	-3.5%
Indiana Michigan Power Co	1,188	1,079	526	561	442	609	505	644	-9.0%
Northern States Power Co	-	-	157	436	348	222	106	346	-2.1%
Upper Michigan Energy Resources Corp.	-	-	-	-	551	245	723	253	-11.8%
Upper Peninsula Power Company	297	281	161	457	603	137	785	293	5.9%
Alger-Delta Coop Electric Assn	53	751	108	82	335	74	583	166	8.7%
Cherryland Electric Coop Inc	83	75	78	74	109	201	85	107	7.0%
City of Bay City	-	-	-	55	99	100	100	164	24.4%
City of Escanaba	-	89	538	27	33	33	48	-	NA
City of Grand Haven	-	67	52	155	605	209	222	73	13.2%
City of Holland	55	39	28	50	35	37	29	46	-2.6%
City of Lansing	-	166	139	305	283	92	65	51	-20.0%
City of Lowell	-	-	-	-	-	-	68	-	NA
City of Marquette	-	86	30	34	109	39	96	80	8.4%
City of Niles	-	-	-	-	-	-	90	-	NA
City of Traverse City	-	-	-	-	35	52	64	55	16.6%
City of Zeeland	-	-	40	6	27	33	27	67	23.6%
Cloverland Electric Co-op	350	608	879	436	871	760	2,040	437	9.8%
Coldwater Board of Public Util	37	61	33	82	69	77	64	159	16.6%
Great Lakes Energy Coop	340	250	912	256	335	874	729	486	10.0%
Hillsdale Board of Public Wks	-	-	-	66	76	59	127	-	NA
Midwest Energy Cooperative	1,069	587	107	371	563	385	404	377	-5.7%
Ontonagon County R E A	-	-	-	-	-	-	1,041	-	NA
Presque Isle Elec & Gas Coop	317	196	1,367	442	883	951	659	872	16.4%
Thumb Electric Coop of Mich	-	-	-	-	-	-	549	-	NA
Tri-County Electric Coop	1,057	724	281	519	232	303	270	228	-17.6%
Wyandotte Municipal Serv Comm	25	55	24	19	1	17	1	75	-18.4%

Figure 147: System Average Interruption Duration Index (SAIDI) without Major Event Days in Minutes

	2013	2014	2015	2016	2017	2018	2019	2020	Trend CAGR
Upper Michigan Energy Resources Corp.	-	-	-	-	149	146	238	222	18.4%
Alpena Power Co	-	64	97	91	66	92	96	89	3.6%
Northern States Power Co	-	-	157	283	135	130	100	244	-2.7%
DTE Electric Company	180	189	187	180	196	177	202	142	-1.7%
Indiana Michigan Power Co	268	287	311	373	304	314	332	240	-0.3%
Consumers Energy Co	218	168	177	207	161	201	233	195	1.2%
Upper Peninsula Power Company	248	248	122	165	176	137	212	206	-2.0%
Alger-Delta Coop Electric Assn	52	476	107	75	73	74	56	166	-4.3%
Cherryland Electric Coop Inc	83	75	78	74	69	158	75	71	1.2%
City of Bay City	-	-	-	55	99	100	100	99	12.5%
City of Grand Haven	275	-	-	155	6	5	13	17	NA
City of Holland	35	28	18	19	21	22	29	28	-0.8%
City of Lansing	-	81	43	113	68	60	46	46	-7.7%
City of Lowell	-	-	-	-	-	-	32	-	NA
City of Marquette	50	86	21	34	109	17	36	17	-12.8%
City of Niles	-	-	-	-	-	-	90	-	NA
City of Traverse City	-	-	-	-	35	52	64	55	16.6%
City of Zeeland	-	-	40	6	27	33	27	38	13.8%
Cloverland Electric Co-op	284	254	210	352	208	208	325	335	2.2%
Great Lakes Energy Coop	177	136	175	160	178	159	176	212	2.9%
Hillsdale Board of Public Wks	-	-	-	-	-	-	54	-	NA
Midwest Energy Cooperative	462	291	107	371	452	329	303	308	1.1%
Ontonagon County R E A	-	-	-	-	-	-	442	-	NA
Presque Isle Elec & Gas Coop	180	196	227	275	288	259	279	253	5.6%
Thumb Electric Coop of Mich	-	-	-	-	-	-	269	-	NA
Tri-County Electric Coop	259	243	179	179	139	249	156	159	-5.7%

Figure 148: System Average Frequency Interruption Index (SAIFI) with Major Event Days in Number of Outages

	2013	2014	2015	2016	2017	2018	2019	2020	Trend CAGR
Alpena Power Co	-	1.00	1.50	1.20	1.20	1.90	0.90	1.10	0.5%
Consumers Energy Co	2.00	1.10	1.18	1.15	1.31	1.30	1.58	1.35	-1.0%
DTE Electric Company	1.10	1.22	1.00	0.99	1.39	1.36	1.37	1.29	4.4%
Indiana Michigan Power Co	1.82	1.69	1.74	1.91	2.01	1.78	2.13	1.43	2.7%
Northern States Power Co	-	-	1.00	2.34	1.32	1.09	0.68	2.41	-14.2%
Upper Michigan Energy Resources Corp.	-	-	-	-	1.85	1.16	2.15	2.71	7.8%
Upper Peninsula Power Company	2.00	1.85	1.30	2.10	2.20	1.16	2.48	2.30	0.9%
Alger-Delta Coop Electric Assn	0.28	1.67	1.09	0.40	0.99	0.33	0.70	0.93	-2.0%
Cherryland Electric Coop Inc	0.57	0.61	0.73	0.68	0.82	1.34	0.89	0.78	11.4%
City of Bay City	-	-	-	0.52	0.62	1.15	0.82	1.03	21.8%
City of Escanaba	1.03	0.64	0.95	0.19	0.32	0.26	0.52	-	-16.2%
City of Grand Haven	-	0.80	0.44	2.06	2.09	2.08	1.20	0.80	21.2%
City of Holland	0.57	0.57	0.40	0.46	0.49	0.38	0.41	0.52	-5.5%
City of Lansing	-	0.89	1.08	1.67	1.04	0.72	1.08	1.42	-2.0%
City of Lowell	-	-	-	-	-	-	0.55	-	0.0%
City of Marquette	-	1.22	0.40	0.50	0.93	0.40	0.71	0.83	-5.8%
City of Niles	-	-	-	-	-	-	0.84	-	0.0%
City of Traverse City	-	-	-	-	0.43	0.66	0.62	0.57	19.6%
City of Zeeland	-	-	1.03	0.54	1.17	0.53	0.89	0.69	-3.1%
Cloverland Electric Co-op	1.92	2.84	2.07	2.43	3.17	2.85	4.51	2.76	11.3%
Coldwater Board of Public Util	0.56	0.92	0.70	1.67	1.02	2.50	1.33	1.10	19.5%
Great Lakes Energy Coop	1.85	1.48	2.27	1.82	2.07	2.44	2.72	2.57	7.6%
Hillsdale Board of Public Wks	-	-	-	2.41	0.89	1.58	2.30	-	4.4%
Midwest Energy Cooperative	3.00	2.23	0.99	1.87	2.80	2.20	2.00	1.90	-0.7%
Ontonagon County R E A	-	-	-	-	-	-	3.13	-	0.0%
Presque Isle Elec & Gas Coop	1.38	1.32	2.30	1.81	2.75	2.65	2.15	2.50	11.0%
Thumb Electric Coop of Mich	-	-	-	-	-	-	2.02	-	0.0%
Tri-County Electric Coop	2.06	2.53	1.68	1.79	1.52	1.98	1.52	1.61	-5.2%
Wyandotte Municipal Serv Comm	0.28	0.40	0.03	0.20	0.00	0.08	0.01	0.40	NA

Figure 149: System Average Frequency Interruption Index (SAIFI) without Major Event Days in Number of Outages

	2013	2014	2015	2016	2017	2018	2019	2020	Trend CAGR
Alpena Power Co	-	64.00	96.70	91.00	65.80	91.90	96.30	89.20	4.6%
Consumers Energy Co	218.00	168.40	177.00	207.00	160.90	200.90	233.34	194.70	1.7%
DTE Electric Company	180.00	189.00	187.00	180.00	196.00	177.19	202.38	141.88	1.0%
Indiana Michigan Power Co	268.00	286.90	310.60	373.00	303.50	313.50	332.20	239.80	2.9%
Northern States Power Co	-	-	156.53	283.17	135.46	130.04	99.85	244.01	-15.4%
Upper Michigan Energy Resources Corp.	-	-	-	-	149.00	146.00	238.00	222.00	26.4%
Upper Peninsula Power Company	248.00	248.00	121.90	164.90	176.10	136.90	211.50	206.20	-4.5%
Alger-Delta Coop Electric Assn	51.74	476.20	107.40	75.20	72.66	74.24	55.85	165.80	-12.9%
Cherryland Electric Coop Inc	83.00	74.53	77.87	74.27	68.70	158.20	74.91	70.94	3.9%
City of Bay City	-	-	-	55.42	99.23	99.97	99.99	99.43	19.5%
City of Grand Haven	275.00	-	-	154.86	5.76	5.49	13.23	17.28	NA
City of Holland	35.00	28.38	18.18	18.95	20.85	21.87	29.08	28.33	-3.3%
City of Lansing	-	81.00	43.40	112.78	67.95	59.88	45.76	45.76	-6.6%
City of Lowell	-	-	-	-	-	-	31.63	-	0.0%
City of Marquette	50.00	85.60	21.37	33.68	108.99	16.58	36.14	16.86	-9.0%
City of Niles	-	-	-	-	-	-	90.03	-	0.0%
City of Traverse City	-	-	-	-	35.29	52.29	64.28	54.91	NA
City of Zeeland	-	-	39.51	5.90	27.29	33.50	27.07	37.64	10.3%
Cloverland Electric Co-op	284.00	254.00	209.50	352.40	207.70	208.10	324.80	334.80	0.0%
Great Lakes Energy Coop	177.00	136.20	175.04	160.19	177.97	159.46	176.10	212.30	1.1%
Hillsdale Board of Public Wks	-	-	-	-	-	-	54.13	-	0.0%
Midwest Energy Cooperative	462.00	291.39	107.23	371.30	452.00	329.40	303.00	308.20	1.5%
Ontonagon County R E A	-	-	-	-	-	-	442.20	-	0.0%
Presque Isle Elec & Gas Coop	180.00	195.53	227.49	275.00	288.10	259.20	278.90	252.90	7.8%
Thumb Electric Coop of Mich	-	-	-	-	-	-	269.02	-	0.0%
Tri-County Electric Coop	259.00	243.00	179.00	179.00	139.00	249.00	156.00	159.00	-6.0%

Figure 150: Customer Average Interruption Duration Index (CAIDI) with Major Event Days in Minutes

	2013	2014	2015	2016	2017	2018	2019	2020	Trend CAGR
Alpena Power Co	-	146	153	76	109	109	107	194	-6.1%
Consumers Energy Co	555	342	373	247	462	314	437	379	-2.4%
DTE Electric Company	530	650	277	241	765	358	340	274	-5.2%
Indiana Michigan Power Co	655	640	302	294	219	342	237	451	-15.2%
Northern States Power Co	-	-	157	186	264	204	155	144	0.7%
Upper Michigan Energy Resources Corp.	-	-	-	-	298	211	336	93	6.3%
Upper Peninsula Power Company	149	152	124	218	274	118	316	127	9.6%
Alger-Delta Coop Electric Assn	190.79	449.46	99.45	204.00	339.01	222.96	837.35	178.71	16.4%
Cherryland Electric Coop Inc	146	121	107	110	134	150	96	137	-2.2%
City of Bay City	-	-	-	106	160	87	122	160	-2.0%
City of Escanaba	-	139	566	144	102	127	92	-	-17.8%
City of Grand Haven	-	84	119	75	289	100	185	92	14.7%
City of Holland	97	68	71	108	71	99	71	88	-0.8%
City of Lansing	-	187	129	183	272	128	61	36	-13.9%
City of Lowell	-	-	-	-	-	-	123	-	0.0%
City of Marquette	-	70	75	67	118	98	135	96	14.2%
City of Niles	-	-	-	-	-	-	107	-	0.0%
City of Traverse City	-	-	-	-	82	79	105	96	12.9%
City of Zeeland	-	-	38.36	10.93	23.40	63.44	30.48	96.74	13.9%
Cloverland Electric Co-op	182	214	424	179	275	267	452	158	10.2%
Coldwater Board of Public Util	66	66	46	49	67	31	48	145	-7.3%
Great Lakes Energy Coop	183.78	169.04	401.91	140.70	161.72	358.10	268.15	189.23	6.4%
Hillsdale Board of Public Wks	-	-	-	27	86	37	55	-	13.7%
Midwest Energy Cooperative	356	263	108	199	201	175	202	198	-6.6%
Ontonagon County R E A	-	-	-	-	-	-	333	-	0.0%
Presque Isle Elec & Gas Coop	230	148	595	244	321	358	306	349	7.4%
Thumb Electric Coop of Mich	-	-	-	-	-	-	272	-	0.0%
Tri-County Electric Coop	513	286	167	290	153	153	178	142	-14.9%
Wyandotte Municipal Serv Comm	89	138	800	96	199	212	75	187	-3.7%

Figure 151: Customer Average Interruption Duration Index (CAIDI) without Major Event Days in Minutes

	2013	2014	2015	2016	2017	2018	2019	2020	Trend CAGR
Alpena Power Co	-	107	88	76	82	92	107	99	0.7%
Consumers Energy Co	218	184	180	206	181	198	208	188	0.0%
DTE Electric Company	244	249	205	197	198	170	178	140	-6.0%
Indiana Michigan Power Co	207	221	212	217	174	208	194	221	-1.8%
Northern States Power Co	-	-	157	134	159	183	151	108	2.5%
Upper Michigan Energy Resources Corp.	-	-	-	-	152	160	159	87	2.2%
Upper Peninsula Power Company	124	139	111	127	135	118	119	116	-0.9%
Alger-Delta Coop Electric Assn	-	331	99	188	74	223	477	179	10.0%
Cherryland Electric Coop Inc	146	121	107	110	121	132	88	114	-4.3%
City of Bay City	-	-	-	106	160	87	122	157	-2.0%
City of Grand Haven	163	-	-	75	89	88	121	107	NA
City of Holland	75	57	57	79	89	88	71	58	4.0%
City of Lansing	-	98	89	108	105	103	49	35	-8.4%
City of Lowell	-	-	-	-	-	-	109	-	0.0%
City of Marquette	73.86	70.16	71.23	67.09	117.57	80.12	144.56	75.59	10.4%
City of Niles	-	-	-	-	-	-	107	-	0.0%
City of Traverse City	-	-	-	-	82.07	78.75	104.53	96.34	12.9%
City of Zeeland	-	-	38	11	23	63	30	58	13.9%
Cloverland Electric Co-op	163.22	126.37	126.20	156.62	129.01	114.34	142.46	124.93	-2.1%
Great Lakes Energy Coop	120	114	130	110	119	113	112	123	-1.2%
Midwest Energy Cooperative	231	156	108	199	181	157	178	171	-0.9%
Ontonagon County R E A	-	-	-	-	-	-	202	-	0.0%
Presque Isle Elec & Gas Coop	172	148	172	191	191	174	219	168	4.1%
Thumb Electric Coop of Mich	-	-	-	-	-	-	187	-	0.0%
Tri-County Electric Coop	162	109	120	123	104	132	127	112	-1.8%

Figure 152: Natural Gas Losses in Thousands of Cubic Feet

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Trend CAGR
Consumers Energy Company	842,416	812,797	863,854	913,618	875,184	884,583	870,501	953,027	969,860	894,643	1.3%
DTE Gas Company	3,800,000	3,800,000	1,400,000	1,600,000	1,653,000	1,557,000	4,379,714	3,711,115	7,742,053	5,281,194	10.0%
Michigan Gas Utilities Company	107,084	65,824	130,116	142,509	96,181	103,547	97,065	108,341	110,623	82,407	-0.4%
Northern States Power Company	3,082	1,959	3,955	4,076	2,542	2,914	2,723	2,925	2,862	2,195	-1.8%
Upper Michigan Energy Resources Corporation	1,321	3,939	7,239	15,936	14,290	15,211	15,217	16,875	16,987	14,213	NA
Aurora Gas Company	877	518	1,008	1,177	873	848	786	393	-	-	NA
Blue Lake Gas Storage Company	-	-	-	-	-	-	-	-	500,000	-	NA
Citizens Gas Fuel Company	23,802	2,334	12,049	13,456	8,668	8,586	8,462	9,086	9,101	6,920	-2.6%
Northern Natural Gas	28,990	35,128	39,047	43,928	46,690	42,299	37,655	37,170	56,448	36,358	2.8%
Panhandle Eastern Pipeline Company	51,681	35,319	56,177	46,500	27,822	33,256	30,814	29,002	30,426	12,351	-10.5%
Presque Isle Electric & Gas Cooperative	2,356	578	719	848	746	688	737	983	1,182	1,083	-0.6%
SEMCO Pipeline Inc	27,839	25,611	26,053	20,304	13,032	26,667	29,822	40,387	40,814	36,014	6.0%
Vector Pipeline Company	27,342	16,191	86,782	15,877	25,077	17,449	80,798	18,751	14,166	4,492	-11.6%

Figure 153: Unaccounted for Natural Gas in Thousands of Cubic Feet

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Consumers Energy Company	(1,397,989)	1,586,413	3,931,908	2,068,374	2,591,118	1,986,957	370,570	5,601,307	2,994,474	1,890,198
DTE Gas Company	9,550,191	4,019,087	4,019,123	5,048,994	3,687,637	(8,656)	737	-	-	-
Michigan Gas Utilities Company	778,430	(341,119)	23,437	(448,673)	(296,444)	(117,986)	(182,430)	(285,168)	(529,500)	286,028
Northern States Power Company	(12,809)	(23,833)	(791)	22,690	5,154	28,564	14,275	(30,120)	9,215	8,448
SEMCO Energy Gas Company	376,460	(10,990)	87,152	59,652	(119,755)	330,056	(81,614)	(282,932)	-	(834,229)
Upper Michigan Energy Resources Corporation	14,122	25,299	24,486	23,695	(15,577)	(19,892)	11,362	721	(1,963)	(2,542)
ANR Pipeline Company	(207,121)	101,255	285,091	283,110	336,607	280,126	514,147	440,707	-	346,701
Blue Lake Gas Storage Company	-	-	-	-	-	-	-	-	(500,000)	-
Citizens Gas Fuel Company	(63,963)	6,539	1,820	(174,140)	(11,828)	105,426	(11,215)	(66,452)	97,522	(49,012)
Great Lakes Gas Transmission LP	470,948	582,697	814,314	254,289	1,173,536	1,145,507	228,391	71,616	-	214,767
Lee 8 Storage Partnership	(52,618)	(40,139)	(58,875)	(41,083)	(59,065)	(44,269)	(41,400)	(225,210)	-	(52,572)
NEXUS	-	-	-	-	-	-	-	71,438	-	(26,676)
Northern Natural Gas	12,618	14,243	14,720	7,486	(7,226)	5,251	11,894	(1,310)	13,461	11,837
Panhandle Eastern Pipeline Company	(39,619)	729	(123,187)	(276,287)	(291,035)	(72,461)	188,892	153,070	1,098,457	221,737
Presque Isle Electric & Gas Cooperative	13,988	(2,547)	30,385	47,917	10,551	19,574	19,015	(4,083)	34,011	30,261
Rover Pipeline Company	-	-	-	-	-	-	-	(125,844)	-	(1,093,973)
SEMCO Pipeline Inc	(251,581)	(64,734)	(120,755)	(116,887)	(54,746)	(71,679)	(52,726)	(107,183)	(107,610)	(115,222)
Southwest Gas Storage Company	(390,776)	(270,981)	(373,011)	(518,469)	(388,323)	(267,286)	(301,035)	(266,957)	-	(217,217)
Washington 10	-	(989,642)	(621,230)	(847,318)	(830,653)	(489,958)	(575,464)	(636,497)	-	(621,868)

Figure 154: Cost per Kilowatt Hour of Electricity in the Residential Sector

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Trend CAGR
Alpena Power Co	$0.141	$0.138	$0.140	$0.136	$0.138	$0.133	$0.139	$0.142	$0.146	$0.141	0.3%
Consumers Energy Co	$0.134	$0.137	$0.144	$0.149	$0.146	$0.154	$0.159	$0.159	$0.159	$0.156	1.9%
DTE Electric Company	$0.137	$0.150	$0.154	$0.146	$0.145	$0.156	$0.155	$0.156	$0.161	$0.173	1.8%
Indiana Michigan Power Co	$0.086	$0.097	$0.100	$0.100	$0.107	$0.110	$0.113	$0.126	$0.135	$0.152	5.7%
Northern States Power Co	$0.101	$0.109	$0.110	$0.121	$0.123	$0.123	$0.126	$0.119	$0.123	$0.122	1.9%
Upper Michigan Energy Resources Corp.	$-	$-	$-	$-	$-	$-	$0.148	$0.145	$0.141	$0.142	-1.6%
Upper Peninsula Power Company	$0.183	$0.194	$0.205	$0.225	$0.229	$0.235	$0.243	$0.218	$0.220	$0.223	2.0%
Alger-Delta Coop Electric Assn	$0.203	$0.213	$0.206	$0.208	$0.209	$0.207	$0.206	$0.206	$0.206	$0.203	-0.1%
Cherryland Electric Coop Inc	$0.125	$0.137	$0.136	$0.135	$0.136	$0.138	$0.139	$0.138	$0.146	$0.136	0.9%
City of Bay City	$0.104	$0.105	$0.108	$0.117	$0.117	$0.124	$0.131	$0.130	$0.130	$0.136	3.2%
City of Crystal Falls	$0.149	$0.154	$0.153	$0.152	$0.158	$0.155	$0.159	$0.158	$0.157	$0.157	0.6%
City of Gladstone	$0.148	$0.149	$0.125	$0.133	$0.121	$0.117	$0.130	$0.134	$0.133	$0.134	-0.9%
City of Grand Haven	$0.125	$0.134	$0.135	$0.136	$0.154	$0.147	$0.140	$0.140	$0.142	$0.139	1.0%
City of Holland	$0.099	$0.103	$0.106	$0.110	$0.111	$0.117	$0.124	$0.120	$0.121	$0.122	2.5%
City of Lansing	$0.117	$0.128	$0.132	$0.136	$0.148	$0.147	$0.148	$0.146	$0.158	$0.165	3.3%
City of Marquette	$0.093	$0.100	$0.104	$0.111	$0.119	$0.138	$0.171	$0.173	$0.167	$0.155	7.6%
City of Negaunee	$0.181	$0.157	$0.159	$0.160	$0.171	$0.176	$0.176	$0.172	$0.165	$0.168	0.3%
City of Norway	$0.128	$0.136	$0.134	$0.138	$0.144	$0.149	$0.150	$0.150	$0.152	$0.150	1.9%
City of Sturgis	$0.119	$0.120	$0.124	$0.115	$0.128	$0.128	$0.139	$0.142	$0.142	$0.144	2.5%
City of Traverse City	$0.098	$0.096	$0.099	$0.118	$0.113	$0.108	$0.108	$0.108	$0.105	$0.104	0.8%
City of Zeeland	$0.085	$0.087	$0.089	$0.094	$0.091	$0.086	$0.086	$0.086	$0.086	$0.086	-0.3%
Cloverland Electric Co-op	$0.114	$0.114	$0.110	$0.117	$0.118	$0.126	$0.128	$0.127	$0.129	$0.129	1.9%
Coldwater Board of Public Util	$0.117	$0.121	$0.123	$0.127	$0.116	$0.117	$0.124	$0.115	$0.114	$0.119	-0.4%
Great Lakes Energy Coop	$0.138	$0.149	$0.151	$0.153	$0.152	$0.150	$0.151	$0.151	$0.157	$0.155	0.8%
Midwest Energy Cooperative	$0.140	$0.149	$0.148	$0.151	$0.160	$0.162	$0.156	$0.139	$0.154	$0.147	0.3%
Presque Isle Elec & Gas Coop	$0.145	$0.156	$0.164	$0.160	$0.160	$0.160	$0.162	$0.159	$0.153	$0.154	0.2%
Tri-County Electric Coop	$0.126	$0.135	$0.138	$0.140	$0.139	$0.139	$0.144	$0.146	$0.149	$0.147	1.5%
Village of Baraga	$0.123	$0.124	$0.132	$0.127	$0.126	$0.214	$0.131	$0.132	$0.132	$0.132	1.0%
Village of L'Anse	$0.123	$0.130	$0.135	$0.137	$0.146	$0.139	$0.145	$0.136	$0.126	$0.134	0.5%
Wyandotte Municipal Serv Comm	$0.128	$0.142	$0.149	$0.146	$0.145	$0.146	$0.147	$0.143	$0.147	$0.146	0.7%

Figure 155: Cost per Kilowatt Hour of Electricity in the Commercial Sector

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Trend CAGR
Alpena Power Co	$0.121	$0.123	$0.124	$0.119	$0.119	$0.113	$0.119	$0.123	$0.128	$0.125	0.3%
Consumers Energy Co	$0.112	$0.116	$0.122	$0.126	$0.123	$0.123	$0.127	$0.129	$0.132	$0.131	1.6%
DTE Electric Company	$0.103	$0.114	$0.113	$0.105	$0.099	$0.100	$0.103	$0.105	$0.108	$0.113	0.0%
Indiana Michigan Power Co	$0.087	$0.092	$0.093	$0.092	$0.096	$0.098	$0.102	$0.110	$0.117	$0.123	3.7%
Northern States Power Co	$0.090	$0.096	$0.098	$0.110	$0.114	$0.112	$0.117	$0.108	$0.110	$0.112	2.2%
Upper Michigan Energy Resources Corp.	$-	$-	$-	$-	$-	$-	$0.142	$0.137	$0.132	$0.132	-2.5%
Upper Peninsula Power Company	$0.146	$0.147	$0.157	$0.169	$0.165	$0.158	$0.170	$0.147	$0.167	$0.187	1.7%
Alger-Delta Coop Electric Assn	$0.153	$0.156	$0.156	$0.148	$0.158	$0.154	$0.156	$0.159	$0.159	$0.156	0.3%
Cherryland Electric Coop Inc	$0.098	$0.102	$0.105	$0.106	$0.101	$0.103	$0.105	$0.097	$0.103	$0.101	-0.1%
City of Bay City	$0.097	$0.098	$0.102	$0.111	$0.112	$0.114	$0.124	$0.124	$0.124	$0.128	3.4%
City of Crystal Falls	$0.132	$0.128	$0.126	$0.135	$0.135	$0.136	$0.138	$0.145	$0.144	$0.146	1.5%
City of Gladstone	$0.118	$0.102	$0.123	$0.137	$0.105	$0.102	$0.114	$0.122	$0.115	$0.108	-0.4%
City of Grand Haven	$0.150	$0.146	$0.153	$0.153	$0.136	$0.134	$0.128	$0.129	$0.130	$0.129	-2.2%
City of Holland	$0.085	$0.087	$0.092	$0.095	$0.101	$0.105	$0.108	$0.102	$0.106	$0.109	2.8%
City of Lansing	$0.103	$0.113	$0.116	$0.117	$0.128	$0.128	$0.130	$0.125	$0.133	$0.137	2.7%
City of Marquette	$0.083	$0.090	$0.095	$0.101	$0.108	$0.126	$0.156	$0.157	$0.150	$0.142	7.8%
City of Negaunee	$0.117	$0.118	$0.116	$0.122	$0.132	$0.133	$0.134	$0.131	$0.128	$0.130	1.5%
City of Norway	$0.124	$0.130	$0.123	$0.124	$0.143	$0.143	$0.134	$0.134	$0.134	$0.139	1.1%
City of Sturgis	$0.145	$0.141	$0.147	$0.144	$0.153	$0.154	$0.161	$0.166	$0.166	$0.170	2.1%
City of Traverse City	$0.098	$0.100	$0.102	$0.119	$0.112	$0.106	$0.107	$0.106	$0.103	$0.103	0.3%
City of Zeeland	$0.087	$0.089	$0.093	$0.096	$0.092	$0.086	$0.086	$0.085	$0.082	$0.070	-2.0%
Cloverland Electric Co-op	$0.105	$0.106	$0.101	$0.106	$0.104	$0.111	$0.105	$0.106	$0.106	$0.108	0.3%
Coldwater Board of Public Util	$0.113	$0.117	$0.119	$0.124	$0.103	$0.096	$0.105	$0.101	$0.105	$0.114	-1.2%
Great Lakes Energy Coop	$0.113	$0.119	$0.128	$0.130	$0.130	$0.129	$0.130	$0.132	$0.136	$0.136	1.7%
Midwest Energy Cooperative	$0.084	$0.086	$0.091	$0.094	$0.088	$0.097	$0.099	$0.111	$0.133	$0.151	6.0%
Presque Isle Elec & Gas Coop	$0.108	$0.111	$0.114	$0.111	$0.110	$0.109	$0.111	$0.110	$0.102	$0.105	-0.6%
Tri-County Electric Coop	$0.141	$0.148	$0.149	$0.156	$0.152	$0.150	$0.151	$0.155	$0.155	$0.152	0.6%
Village of Baraga	$0.131	$0.131	$0.132	$0.121	$0.122	$0.192	$0.126	$0.130	$0.130	$0.130	0.2%
Village of L'Anse	$0.113	$0.123	$0.128	$0.127	$0.132	$0.122	$0.130	$0.121	$0.125	$0.126	0.5%
Wyandotte Municipal Serv Comm	$0.159	$0.154	$0.155	$0.157	$0.124	$0.123	$0.124	$0.125	$0.128	$0.128	-3.0%

Figure 156: Cost per Kilowatt Hour of Electricity in the Industrial Sector

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Trend CAGR
Alpena Power Co	$0.064	$0.063	$0.064	$0.067	$0.061	$0.059	$0.062	$0.065	$0.062	$0.059	-0.6%
Consumers Energy Co	$0.081	$0.083	$0.090	$0.088	$0.080	$0.077	$0.082	$0.080	$0.081	$0.082	-0.5%
DTE Electric Company	$0.071	$0.078	$0.078	$0.075	$0.067	$0.065	$0.067	$0.067	$0.067	$0.070	-1.4%
Indiana Michigan Power Co	$0.071	$0.077	$0.078	$0.077	$0.080	$0.084	$0.086	$0.090	$0.098	$0.106	4.0%
Northern States Power Co	$0.069	$0.069	$0.070	$0.076	$0.073	$0.069	$0.074	$0.063	$0.063	$0.066	-1.0%
Upper Michigan Energy Resources Corp.	$-	$-	$-	$-	$-	$-	$0.067	$0.065	$0.051	$0.055	-8.2%
Upper Peninsula Power Company	$0.058	$0.053	$0.057	$0.075	$0.058	$0.091	$0.067	$0.051	$0.054	$0.051	-0.9%
Alger-Delta Coop Electric Assn	$-	$-	$0.137	$0.143	$0.136	$0.133	$0.132	$0.175	$0.190	$0.182	5.1%
Cherryland Electric Coop Inc	$-	$-	$0.131	$0.134	$0.130	$0.129	$0.137	$0.127	$0.137	$0.130	0.1%
City of Bay City	$0.081	$0.087	$0.091	$0.098	$0.095	$0.100	$0.108	$0.105	$0.107	$0.108	3.1%
City of Grand Haven	$0.092	$0.094	$0.096	$0.096	$0.113	$0.112	$0.109	$0.110	$0.111	$0.112	2.4%
City of Holland	$0.074	$0.075	$0.076	$0.080	$0.082	$0.086	$0.088	$0.081	$0.080	$0.081	1.2%
City of Lansing	$0.084	$0.095	$0.097	$0.098	$0.106	$0.104	$0.106	$0.103	$0.111	$0.117	2.9%
City of Sturgis	$0.091	$0.090	$0.092	$0.097	$0.099	$0.100	$0.104	$0.107	$0.105	$0.106	2.1%
City of Traverse City	$0.075	$0.076	$0.079	$0.096	$0.082	$0.080	$0.078	$0.074	$0.074	$0.074	-0.8%
Cloverland Electric Co-op	$0.079	$0.078	$0.072	$0.079	$0.081	$0.083	$0.082	$0.082	$0.083	$0.086	1.2%
Coldwater Board of Public Util	$0.087	$0.084	$0.081	$0.083	$0.073	$0.073	$0.080	$0.073	$0.072	$0.079	-1.7%
Great Lakes Energy Coop	$0.073	$0.077	$0.084	$0.086	$0.084	$0.082	$0.082	$0.082	$0.081	$0.081	0.7%
Presque Isle Elec & Gas Coop	$0.107	$0.117	$0.120	$0.116	$0.114	$0.112	$0.115	$0.114	$0.107	$0.114	-0.2%
Tri-County Electric Coop	$0.093	$0.101	$0.097	$0.098	$0.097	$0.096	$0.094	$0.092	$0.094	$0.094	-0.4%
Wyandotte Municipal Serv Comm	$0.100	$0.106	$0.097	$0.099	$0.094	$0.094	$0.085	$0.078	$0.079	$0.081	-3.4%

Figure 157: Cost per Kilowatt Hour of Energy Efficiency Savings in the Residential Sector

	2013	2014	2015	2016	2017	2018	2019	2020	Trend CAGR
Consumers Energy Co	$0.021	$0.024	$0.019	$0.016	$0.020	$0.020	$0.016	$0.017	-4.1%
DTE Electric Company	$0.105	$0.113	$0.118	$0.020	$0.020	$0.020	$0.023	$0.026	-29.6%
Indiana Michigan Power Co	$0.019	$0.013	$0.014	$0.018	$0.013	$0.021	$0.015	$0.020	1.1%
Northern States Power Co	$-	$-	$-	$-	$-	$0.015	$0.017	$0.010	15.1%
Upper Peninsula Power Company	$-	$-	$-	$-	$-	$0.036	$0.030	$0.020	-16.0%
Cherryland Electric Coop Inc	$0.062	$0.043	$0.036	$-	$-	$-	$-	$-	NA
City of Bay City	$0.190	$0.014	$0.016	$0.016	$0.018	$0.025	$0.019	$0.025	-18.3%
City of Charlevoix	$-	$-	$-	$-	$-	$-	$0.030	$-	0.0%
City of Escanaba	$0.103	$0.139	$0.013	$0.010	$0.024	$0.043	$0.015	$-	-23.4%
City of Grand Haven	$-	$-	$0.014	$0.011	$0.010	$0.019	$0.028	$0.018	21.5%
City of Holland	$0.014	$0.013	$0.018	$0.010	$0.007	$0.016	$0.007	$0.016	-8.0%
City of Lansing	$0.019	$0.017	$0.021	$0.022	$0.027	$0.028	$0.018	$0.017	3.3%
City of Lowell	$-	$-	$-	$-	$-	$-	$0.001	$-	0.0%
City of Marquette	$0.146	$0.157	$0.017	$0.011	$0.027	$0.042	$0.022	$0.017	-24.3%
City of Marshall	$0.043	$0.007	$0.015	$0.001	$0.023	$0.014	$0.009	$-	-9.3%
City of Niles	$12.750	$0.011	$0.028	$0.014	$0.014	$0.020	$0.041	$-	NA
City of Sebewaing	$-	$-	$-	$-	$-	$-	$0.034	$-	0.0%
City of Stephenson	$-	$-	$-	$-	$-	$-	$0.017	$-	0.0%
City of Sturgis	$0.013	$0.008	$-	$-	$0.009	$0.025	$0.037	$0.023	NA
City of Traverse City	$0.172	$0.022	$0.008	$0.026	$0.017	$0.010	$0.019	$0.022	-23.5%
City of Wakefield	$-	$-	$-	$-	$-	$-	$0.000	$-	0.0%
City of Zeeland	$-	$-	$-	$-	$0.021	$0.015	$0.023	$0.018	4.1%
Cloverland Electric Co-op	$-	$0.060	$0.014	$0.013	$0.024	$0.031	$0.031	$0.019	-0.8%
Coldwater Board of Public Util	$-	$0.030	$0.042	$0.020	$0.076	$0.060	$0.041	$0.040	12.0%
Great Lakes Energy Coop	$0.103	$0.152	$0.018	$0.016	$0.018	$0.026	$0.021	$0.017	-25.9%
Midwest Energy Cooperative	$-	$0.075	$0.096	$0.023	$0.076	$0.042	$0.015	$0.016	-23.4%
Thumb Electric Coop of Mich	$-	$-	$-	$-	$-	$0.017	$0.017	$-	-0.1%
Tri-County Electric Coop	$0.129	$0.012	$0.018	$0.014	$0.022	$0.022	$0.018	$0.016	-14.6%
Village of Paw Paw	$-	$-	$-	$-	$-	$-	$0.032	$-	0.0%
Village of Union City	$-	$-	$-	$-	$-	$-	$0.054	$-	0.0%
Wyandotte Municipal Serv Comm	$0.075	$0.054	$0.016	$0.038	$0.038	$0.008	$0.005	$0.056	NA

Figure 158: Cost per Kilowatt Hour of Energy Efficiency Savings in the Commerical Sector

	2013	2014	2015	2016	2017	2018	2019	2020	Trend CAGR
Consumers Energy Co	$0.015	$0.008	$0.013	$0.012	$0.016	$0.017	$0.017	$0.011	6.9%
DTE Electric Company	$0.110	$0.149	$0.114	$0.014	$0.012	$0.012	$0.014	$0.016	NA
Indiana Michigan Power Co	$0.014	$0.009	$0.009	$0.010	$0.011	$0.009	$0.010	$0.019	-2.5%
Northern States Power Co	$-	$-	$-	$-	$-	$0.005	$0.010	$0.016	NA
Upper Peninsula Power Company	$-	$-	$-	$-	$-	$0.010	$0.012	$0.016	21.8%
Cherryland Electric Coop Inc	$0.018	$0.021	$0.052	$-	$-	$-	$-	$-	
City of Bay City	$0.125	$0.010	$0.010	$0.008	$0.005	$0.010	$0.012	$0.022	
City of Charlevoix	$-	$-	$-	$-	$-	$-	$0.007	$-	0.0%
City of Escanaba	$0.140	$0.117	$0.011	$0.009	$0.013	$0.009	$0.012	$-	NA
City of Grand Haven	$-	$-	$0.009	$0.006	$0.007	$0.006	$0.006	$0.009	-7.9%
City of Holland	$0.008	$0.009	$0.006	$0.005	$0.004	$0.004	$0.004	$0.007	-14.2%
City of Lansing	$0.013	$0.017	$0.012	$0.009	$0.014	$0.014	$0.014	$0.013	0.2%
City of Lowell	$-	$-	$-	$-	$-	$-	$0.004	$-	0.0%
City of Marquette	$0.113	$0.134	$0.010	$0.010	$0.017	$0.008	$0.013	$0.011	NA
City of Marshall	$-	$0.004	$0.006	$0.000	$0.014	$0.005	$0.008	$-	26.5%
City of Niles	$0.051	$0.012	$0.007	$0.007	$0.007	$0.009	$0.011	$-	-17.0%
City of Sebewaing	$-	$-	$-	$-	$-	$-	$0.030	$-	0.0%
City of Stephenson	$-	$-	$-	$-	$-	$-	$0.018	$-	0.0%
City of Sturgis	$-	$-	$-	$-	$0.006	$0.008	$0.008	$0.010	16.8%
City of Traverse City	$0.130	$0.012	$0.009	$0.006	$0.009	$0.009	$0.004	$0.009	NA
City of Wakefield	$-	$-	$-	$-	$-	$-	$0.001	$-	0.0%
City of Zeeland	$-	$-	$-	$-	$0.008	$0.009	$0.011	$0.029	12.5%
Cloverland Electric Co-op	$-	$0.000	$0.012	$0.012	$0.022	$0.013	$0.013	$0.010	NA
Coldwater Board of Public Util	$-	$0.008	$0.005	$0.029	$0.018	$0.011	$0.009	$0.013	7.3%
Great Lakes Energy Coop	$0.118	$0.119	$0.012	$0.012	$0.014	$0.017	$0.017	$0.019	-28.9%
Midwest Energy Cooperative	$-	$0.036	$0.057	$0.011	$0.022	$0.010	$0.018	$0.021	-20.1%
Thumb Electric Coop of Mich	$-	$-	$-	$-	$-	$0.011	$0.009	$-	-17.0%
Village of Paw Paw	$-	$-	$-	$-	$-	$-	$0.016	$-	0.0%
Village of Union City	$-	$-	$-	$-	$-	$-	$0.076	$-	0.0%
Wyandotte Municipal Serv Comm	$0.014	$0.016	$0.040	$0.013	$0.013	$0.008	$0.009	$0.037	-12.7%

Figure 159: Cost per Kilowatt Hour of Energy Efficiency Savings in the Industrial Sector

	2013	2014	2015	2016	2017	2018	2019	2020	Trend CAGR
Consumers Energy Co	$0.015	$0.008	$0.013	$0.012	$0.016	$0.017	$0.017	$0.020	6.9%
Upper Peninsula Power Company	$-	$-	$-	$-	$-	$0.010	$0.012	$0.016	21.8%
City of Grand Haven	$-	$-	$0.009	$0.006	$0.007	$0.006	$0.006	$0.009	-7.9%
City of Holland	$0.007	$0.008	$0.005	$0.004	$0.004	$0.004	$0.004	$0.004	-11.9%
City of Lansing	$0.013	$0.017	$0.012	$0.009	$0.014	$0.014	$0.011	$0.025	-2.4%
City of Marshall	$0.050	$-	$-	$0.000	$0.015	$0.005	$0.008	$-	NA
City of Sebewaing	$-	$-	$-	$-	$-	$-	$0.030	$-	0.0%
City of Sturgis	$0.039	$0.042	$-	$-	$-	$-	$-	$-	NA
Coldwater Board of Public Util	$-	$0.009	$0.008	$0.003	$0.011	$0.004	$0.005	$0.017	-9.7%
Tri-County Electric Coop	$0.087	$0.013	$0.011	$0.013	$0.016	$0.019	$0.017	$0.018	-12.2%

Figure 160: Energy Savings as a Percentage of Electricity Sales in the Residential Sector

	2013	2014	2015	2016	2017	2018	2019	2020	Trend CAGR
Consumers Energy Co	1.6%	1.5%	1.1%	1.2%	1.4%	1.3%	1.5%	1.3%	-0.5%
DTE Electric Company	2.2%	2.2%	2.0%	1.8%	2.7%	2.0%	2.1%	1.7%	-0.3%
Indiana Michigan Power Co	1.2%	1.2%	1.4%	1.5%	1.7%	0.9%	1.1%	1.1%	-2.6%
Northern States Power Co	0.0%	0.0%	0.0%	0.0%	0.0%	1.1%	1.2%	2.5%	10.0%
Upper Peninsula Power Company	0.0%	0.0%	0.0%	0.0%	0.0%	0.9%	1.5%	2.8%	NA
Cherryland Electric Coop Inc	0.3%	0.5%	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%	NA
City of Bay City	0.9%	1.6%	1.4%	1.0%	1.1%	0.7%	0.9%	0.7%	-6.3%
City of Charlevoix	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.6%	0.0%	0.0%
City of Escanaba	1.1%	1.1%	0.8%	1.6%	0.9%	0.3%	0.6%	0.0%	-12.9%
City of Grand Haven	0.0%	0.0%	1.0%	1.4%	1.2%	0.6%	0.5%	0.9%	-19.2%
City of Holland	0.9%	1.2%	1.0%	1.2%	1.3%	1.2%	1.2%	1.3%	5.2%
City of Lansing	1.2%	1.4%	1.2%	1.1%	1.2%	0.7%	1.2%	1.2%	-4.9%
City of Lowell	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.9%	0.0%	0.0%
City of Marquette	1.1%	0.8%	0.6%	1.1%	0.9%	0.4%	0.4%	0.6%	-11.9%
City of Marshall	0.7%	0.7%	0.7%	0.5%	0.8%	0.6%	0.7%	0.0%	-0.9%
City of Niles	0.0%	0.8%	0.4%	1.4%	0.8%	0.5%	0.4%	0.0%	NA
City of Sebewaing	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.9%	0.0%	0.0%
City of Stephenson	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.1%	0.0%	0.0%
City of Sturgis	0.5%	0.7%	0.0%	0.0%	1.7%	0.4%	0.6%	0.9%	NA
City of Traverse City	0.9%	1.0%	1.1%	0.4%	0.4%	0.6%	0.5%	0.9%	-13.5%
City of Wakefield	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
City of Zeeland	0.0%	0.0%	0.0%	0.0%	0.6%	0.8%	0.6%	0.5%	-4.6%
Cloverland Electric Co-op	0.0%	1.0%	0.9%	1.4%	1.0%	0.7%	0.7%	0.9%	-8.0%
Coldwater Board of Public Util	0.0%	0.6%	0.4%	0.8%	0.2%	0.3%	0.5%	0.3%	-6.0%
Great Lakes Energy Coop	1.3%	0.9%	0.6%	1.3%	1.0%	0.9%	1.0%	1.1%	-0.9%
Midwest Energy Cooperative	0.0%	2.9%	0.8%	1.2%	0.9%	0.6%	1.2%	1.4%	-14.6%
Thumb Electric Coop of Mich	0.0%	0.0%	0.0%	0.0%	0.0%	1.2%	1.3%	0.0%	3.3%
Tri-County Electric Coop	1.2%	1.2%	0.8%	1.4%	1.0%	0.9%	1.1%	1.0%	-1.6%
Village of Paw Paw	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.0%	0.0%	0.0%
Village of Union City	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.9%	0.0%	0.0%
Wyandotte Municipal Serv Comm	0.4%	0.6%	0.7%	0.2%	0.2%	0.2%	0.3%	0.1%	-11.7%

Figure 161: Energy Savings as a Percentage of Electricity Sales in the Commercial Sector

	2013	2014	2015	2016	2017	2018	2019	2020	Trend CAGR
Consumers Energy Co	1.6%	1.6%	1.1%	1.1%	1.9%	2.1%	2.0%	2.1%	6.7%
DTE Electric Company	1.4%	1.8%	1.6%	1.7%	1.8%	2.0%	2.0%	2.7%	5.4%
Indiana Michigan Power Co	2.4%	2.2%	2.3%	1.8%	2.4%	2.9%	2.3%	1.1%	1.8%
Northern States Power Co	0.0%	0.0%	0.0%	0.0%	0.0%	1.7%	2.0%	1.4%	17.3%
Upper Peninsula Power Company	0.0%	0.0%	0.0%	0.0%	0.0%	1.9%	2.1%	3.6%	6.7%
Cherryland Electric Coop Inc	2.2%	2.8%	1.4%	0.0%	0.0%	0.0%	0.0%	0.0%	NA
City of Bay City	1.4%	1.5%	1.6%	1.7%	3.2%	1.5%	1.2%	0.9%	0.6%
City of Charlevoix	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.8%	0.0%	0.0%
City of Escanaba	2.8%	2.0%	2.7%	2.9%	3.3%	3.2%	1.9%	0.0%	-0.1%
City of Grand Haven	0.0%	0.0%	1.2%	1.7%	1.7%	1.4%	1.6%	1.1%	3.4%
City of Holland	1.0%	1.0%	1.2%	1.2%	1.9%	1.2%	1.9%	0.9%	10.3%
City of Lansing	1.3%	1.0%	1.5%	1.3%	1.3%	1.0%	1.4%	1.2%	1.1%
City of Lowell	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.4%	0.0%	0.0%
City of Marquette	1.4%	1.0%	1.1%	1.2%	0.9%	1.5%	1.7%	1.5%	4.4%
City of Marshall	0.0%	1.8%	1.8%	1.7%	2.1%	2.3%	1.6%	0.0%	1.1%
City of Niles	4.3%	2.3%	2.5%	1.8%	2.5%	1.5%	0.9%	0.0%	-18.0%
City of Sebewaing	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.3%	0.0%	0.0%
City of Stephenson	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.0%	0.0%	0.0%
City of Sturgis	0.0%	0.0%	0.0%	0.0%	6.5%	3.3%	5.1%	4.7%	-11.3%
City of Traverse City	1.6%	2.1%	1.6%	3.2%	1.7%	1.6%	3.4%	2.0%	6.7%
City of Wakefield	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.3%	0.0%	0.0%
City of Zeeland	0.0%	0.0%	0.0%	0.0%	4.4%	5.1%	4.2%	0.2%	-2.0%
Cloverland Electric Co-op	0.0%	1.5%	1.5%	1.5%	0.7%	1.5%	1.5%	2.0%	-1.3%
Coldwater Board of Public Util	0.0%	1.2%	1.5%	1.1%	1.1%	2.5%	2.1%	1.1%	13.0%
Great Lakes Energy Coop	5.0%	3.6%	3.2%	3.7%	2.3%	3.3%	3.8%	3.0%	-4.8%
Midwest Energy Cooperative	0.0%	3.6%	1.3%	1.0%	1.2%	1.6%	1.0%	0.7%	-14.1%
Thumb Electric Coop of Mich	0.0%	0.0%	0.0%	0.0%	0.0%	1.0%	1.0%	0.0%	2.4%
Village of Paw Paw	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%
Village of Union City	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.3%	0.0%	0.0%
Wyandotte Municipal Serv Comm	9.7%	4.4%	1.1%	1.2%	1.4%	0.9%	0.6%	0.1%	NA

Figure 162: Energy Savings as a Percentage of Electricity Sales in the Industrial Sector

	2013	2014	2015	2016	2017	2018	2019	2020	Trend CAGR
Consumers Energy Co	1.54%	0.83%	1.31%	1.18%	1.57%	1.67%	1.70%	2.00%	6.9%
Upper Peninsula Power Company	0.00%	0.00%	0.00%	0.00%	0.00%	1.02%	1.24%	1.60%	21.8%
City of Grand Haven	0.00%	0.00%	0.90%	0.65%	0.69%	0.57%	0.64%	0.86%	-7.9%
City of Holland	0.68%	0.80%	0.50%	0.42%	0.35%	0.43%	0.35%	0.44%	-11.9%
City of Lansing	1.28%	1.67%	1.17%	0.89%	1.43%	1.35%	1.09%	2.47%	-2.4%
City of Marshall	5.01%	0.00%	0.00%	0.00%	1.45%	0.53%	0.80%	0.00%	NA
City of Sebewaing	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.95%	0.00%	0.0%
City of Sturgis	3.94%	4.16%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	NA
Coldwater Board of Public Util	0.00%	0.92%	0.75%	0.32%	1.14%	0.35%	0.55%	1.66%	-9.7%
Tri-County Electric Coop	8.74%	1.30%	1.06%	1.31%	1.60%	1.95%	1.73%	1.85%	-12.2%

Figure 163: Cost per Therm of Natural Gas in the Residential Sector

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Trend CAGR
Consumers Energy Company	$1.09	$1.04	$0.94	$0.95	$0.89	$0.81	$0.83	$0.82	$0.83	$0.85	-3.0%
DTE Gas Company	$1.03	$0.99	$0.91	$0.92	$0.90	$0.88	$0.89	$0.85	$0.82	$0.83	-2.2%
Michigan Gas Utilities Company	$0.99	$0.79	$0.76	$0.82	$0.73	$0.70	$0.77	$0.71	$0.67	$0.69	-3.0%
Northern States Power Company	$0.71	$0.66	$0.68	$0.79	$0.83	$0.68	$0.73	$0.71	$0.75	$0.66	0.0%
SEMCO Energy Gas Company	$0.85	$0.81	$0.77	$0.90	$0.77	$0.72	$0.74	$0.70	$0.69	$0.70	-2.4%
Upper Michigan Energy Resources Corporation	$0.73	$0.64	$0.67	$0.74	$0.77	$0.57	$0.61	$0.54	$0.55	$0.51	-3.7%
Aurora Gas Company	$1.25	$1.16	$1.13	$1.08	$1.03	$1.19	$0.97	$1.08	$-	$-	
Citizens Gas Fuel Company	$0.96	$1.00	$0.99	$0.95	$0.99	$0.77	$0.80	$0.82	$0.76	$0.80	-3.2%
Presque Isle Electric & Gas Cooperative	$1.31	$1.30	$1.22	$1.15	$1.18	$1.17	$1.08	$1.06	$1.03	$1.04	-2.8%

Figure 164: Cost per Therm of Natural Gas in the Commercial Sector

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Trend CAGR
Consumers Energy Company	$0.92	$0.83	$0.77	$0.82	$0.73	$0.66	$0.68	$0.69	$0.70	$0.70	-2.9%
DTE Gas Company	$0.98	$0.94	$0.88	$0.89	$0.86	$0.83	$0.81	$0.76	$0.73	$0.75	-3.1%
Michigan Gas Utilities Company	$0.92	$0.74	$0.71	$0.79	$0.67	$0.61	$0.67	$0.63	$0.59	$0.60	-3.9%
Northern States Power Company	$0.63	$0.57	$0.61	$0.72	$0.73	$0.57	$0.61	$0.60	$0.62	$0.53	-1.1%
SEMCO Energy Gas Company	$0.72	$0.65	$0.64	$0.78	$0.63	$0.57	$0.59	$0.57	$0.56	$0.52	-3.4%
Upper Michigan Energy Resources Corporation	$0.71	$0.61	$0.65	$0.73	$0.75	$0.55	$0.59	$0.55	$0.53	$0.48	-3.7%
Aurora Gas Company	$1.24	$1.16	$1.13	$1.08	$1.02	$1.01	$0.98	$0.99	$-	$-	
Citizens Gas Fuel Company	$0.88	$0.88	$0.90	$0.89	$0.88	$0.67	$0.72	$0.72	$0.67	$0.69	-3.6%
Presque Isle Electric & Gas Cooperative	$1.10	$1.03	$0.94	$0.89	$0.91	$0.87	$0.82	$0.81	$0.78	$0.76	-3.8%

Figure 165: Cost per Therm of Natural Gas in the Industrial Sector

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Trend CAGR
Consumers Energy Company	$0.86	$0.76	$0.71	$0.77	$0.67	$0.59	$0.60	$0.61	$0.62	$0.62	-3.5%
DTE Gas Company	$0.87	$0.84	$0.79	$1.13	$0.82	$0.60	$0.69	$0.64	$0.62	$0.63	-4.6%
Michigan Gas Utilities Company	$0.84	$0.66	$0.72	$0.72	$0.63	$0.54	$0.55	$0.51	$0.51	$0.49	-5.5%
Northern States Power Company	$0.48	$0.38	$0.44	$0.58	$0.47	$0.37	$0.39	$0.41	$0.34	$0.28	-4.3%
SEMCO Energy Gas Company	$0.64	$0.60	$0.60	$0.77	$0.54	$0.53	$0.56	$0.54	$0.56	$0.44	-3.3%
Upper Michigan Energy Resources Corporation	$0.68	$0.58	$0.61	$0.68	$0.74	$0.56	$0.57	$0.49	$0.58	$0.47	-3.1%
Citizens Gas Fuel Company	$0.68	$0.63	$0.64	$0.73	$0.57	$0.50	$0.55	$0.56	$0.52	$0.49	-3.57%
Presque Isle Electric & Gas Cooperative	$0.95	$0.88	$0.82	$0.77	$0.78	$0.88	$0.72	$0.75	$0.73	$0.67	-3.0%

Appendix B: Historical Data Tables

Appendix B.1: Reliability

Figure 166: Historical System Average Interruption Duration Index (SAIDI) with Major Event Days in Minutes by State

State	2013	2014	2015	2016	2017	2018	2019	2020	Rank	Trend CAGR
Alabama	230	197	209	174	316	308	174	1,743	5	20%
Alaska	358	253	597	195	153	335	280	268	33	-4%
Arizona	74	84	90	86	91	115	86	72	50	1%
Arkansas	251	212	303	397	395	323	438	708	9	14%
California	98	103	118	117	233	195	587	267	34	24%
Colorado	127	83	109	164	228	113	181	134	40	6%
Connecticut	79	86	104	174	291	656	236	2,643	3	53%
Delaware	158	169	190	149	154	136	102	272	31	0%
District of Columbia	124	96	112	115	58	109	77	44	51	-10%
Florida	82	92	85	337	2,381	310	88	189	37	15%
Georgia	138	235	241	420	1,042	373	152	510	14	12%
Hawaii	145	262	266	126	252	191	195	119	43	-4%
Idaho	255	240	459	201	311	174	167	325	22	-3%
Illinois	184	195	169	135	120	143	116	331	21	1%
Indiana	226	234	242	250	211	286	261	280	30	3%
Iowa	122	164	97	117	119	127	123	1,759	4	24%
Kansas	244	139	265	168	365	155	240	107	46	-5%
Kentucky	227	283	200	192	194	406	203	282	29	2%
Louisiana	253	196	312	378	378	276	472	3,624	1	31%
Maine	16	474	102	535	2,493	665	908	1,725	6	67%
Maryland	112	236	124	120	116	337	141	120	42	1%
Massachusetts	427	124	91	145	275	813	250	319	24	11%
Michigan	785	551	350	268	779	443	555	411	18	-3%
Minnesota	359	120	154	302	129	127	150	128	41	-9%
Mississippi	178	184	297	282	557	268	519	1,497	7	28%
Missouri	304	126	167	204	264	150	255	153	38	-2%
Montana	161	139	287	154	215	143	169	271	32	3%
Nebraska	128	120	87	90	154	188	84	113	44	0%
Nevada	66	74	107	96	114	126	87	73	49	3%
New Hampshire	189	725	105	192	1,113	509	292	499	15	11%
New Jersey	166	112	261	137	86	510	248	965	8	24%
New Mexico	149	82	122	136	141	138	170	148	39	5%
New York	86	67	87	107	227	406	171	408	19	28%
North Carolina	228	440	210	823	265	1,762	288	418	17	9%
North Dakota	113	81	104	120	87	94	107	101	47	0%
Ohio	217	170	172	173	248	242	305	283	28	8%
Oklahoma	611	109	824	317	290	176	335	2,922	2	15%
Oregon	167	277	200	285	313	113	265	311	25	3%
Pennsylvania	139	400	157	126	177	518	249	334	20	10%
Rhode Island	783	54	342	169	728	595	236	548	13	10%
South Carolina	111	755	224	1,647	373	470	327	324	23	5%
South Dakota	1,100	107	126	216	95	92	295	97	48	-15%
Tennessee	129	185	219	208	482	200	268	588	11	17%
Texas	182	188	269	211	481	167	291	433	16	10%
Utah	190	187	200	190	139	125	146	575	12	6%
Vermont	7	741	204	352	874	898	444	256	36	40%
Virginia	449	176	201	237	190	507	310	309	26	3%
Washington	155	303	550	224	271	270	300	262	35	2%
West Virginia	542	663	815	743	691	740	755	604	10	1%
Wisconsin	143	139	105	136	204	123	356	113	45	5%
Wyoming	369	193	187	193	216	135	164	290	27	-4%

Figure 167: System Average Interruption Duration Index (SAIDI) without Major Event Days in Minutes

State	2013	2014	2015	2016	2017	2018	2019	2020	Rank	Trend CAGR
Alabama	114	122	122	115	116	121	120	127	19	1%
Alaska	222	195	162	181	137	193	184	246	3	1%
Arizona	55	52	55	58	51	61	67	64	48	3%
Arkansas	207	203	213	208	178	210	222	205	7	0%
California	84	86	93	99	103	102	104	104	29	3%
Colorado	82	78	82	82	78	85	84	83	39	1%
Connecticut	55	86	70	92	68	76	200	65	47	6%
Delaware	129	114	115	103	83	74	74	85	38	-8%
District of Columbia	124	82	112	115	58	53	55	39	51	-14%
Florida	74	84	77	82	78	77	74	73	44	-1%
Georgia	87	90	106	122	121	123	128	133	17	6%
Hawaii	116	117	117	96	104	152	113	97	31	-1%
Idaho	172	183	263	170	247	145	144	181	8	-3%
Illinois	84	92	89	81	73	73	74	57	49	-5%
Indiana	107	115	120	126	131	142	147	125	22	3%
Iowa	77	93	86	92	95	93	90	88	34	1%
Kansas	111	106	127	132	131	109	117	92	33	-1%
Kentucky	146	158	116	137	120	147	149	125	21	-1%
Louisiana	98	111	152	179	184	206	208	216	5	12%
Maine	4	83	87	264	238	273	214	245	4	55%
Maryland	111	85	109	105	86	95	91	81	41	-3%
Massachusetts	83	82	74	113	91	99	96	168	9	8%
Michigan	199	179	178	193	179	185	211	167	10	0%
Minnesota	87	75	78	88	73	87	81	86	37	1%
Mississippi	117	147	187	180	201	212	222	211	6	8%
Missouri	88	90	93	83	96	94	113	95	32	2%
Montana	139	124	141	128	162	118	127	141	16	0%
Nebraska	54	66	52	54	70	74	62	69	46	3%
Nevada	51	61	55	74	88	77	77	55	50	4%
New Hampshire	123	122	94	141	151	152	217	122	23	5%
New Jersey	123	79	65	86	71	88	87	87	35	-1%
New Mexico	98	75	99	101	111	123	132	119	25	6%
New York	43	46	77	83	72	79	79	80	42	9%
North Carolina	111	118	127	146	146	162	146	144	15	4%
North Dakota	88	78	81	98	64	95	74	83	40	-1%
Ohio	112	130	141	128	143	151	146	129	18	2%
Oklahoma	109	101	177	149	138	127	139	144	14	3%
Oregon	82	106	101	101	111	93	104	104	28	2%
Pennsylvania	99	100	99	101	109	119	128	108	27	3%
Rhode Island	57	54	64	69	59	65	68	69	45	3%
South Carolina	97	97	119	120	118	137	106	120	24	3%
South Dakota	171	100	103	80	76	74	107	73	43	-8%
Tennessee	92	105	121	157	133	139	161	148	13	7%
Texas	105	112	137	129	133	114	122	164	12	4%
Utah	176	148	156	106	115	127	115	101	30	-7%
Vermont	2	212	204	270	247	262	170	256	2	49%
Virginia	135	141	146	163	140	188	182	165	11	4%
Washington	97	115	110	111	132	115	106	127	20	2%
West Virginia	418	450	458	439	452	513	471	468	1	2%
Wisconsin	75	71	69	77	78	79	93	86	36	3%
Wyoming	169	178	166	150	191	118	130	111	26	-6%

Figure 168: System Average Interruption Frequency Index (SAIFI) in Number of Power Outages per Customer with Major Event Days

State	2013	2014	2015	2016	2017	2018	2019	2020	Rank	Trend CAGR
Alabama	3.15	3.20	1.71	1.57	1.97	1.52	1.41	2.38	5	-7%
Alaska	6.12	2.38	2.56	2.30	1.71	3.14	2.19	2.19	7	-8%
Arizona	0.83	0.85	2.92	0.84	0.89	0.94	0.89	0.82	47	-4%
Arkansas	1.78	1.78	1.98	2.03	2.05	1.77	1.93	1.83	14	0%
California	0.87	0.93	0.92	1.03	1.28	0.95	1.26	1.08	37	4%
Colorado	1.08	0.90	1.01	1.14	1.19	0.97	1.08	1.00	40	0%
Connecticut	0.69	0.74	0.70	1.06	0.95	1.25	0.97	1.83	15	12%
Delaware	1.46	1.42	1.52	1.35	1.13	1.03	0.98	1.51	21	-3%
District of Columbia	0.88	0.69	0.69	0.82	0.55	0.64	0.59	0.40	51	-8%
Florida	1.12	1.18	1.12	1.37	2.01	1.13	1.03	1.17	34	0%
Georgia	1.34	1.50	1.53	1.51	2.43	1.56	1.38	1.96	11	3%
Hawaii	2.13	2.31	2.99	1.89	2.09	1.96	2.05	1.22	33	-7%
Idaho	1.64	1.28	1.75	1.38	1.72	1.20	1.24	1.59	19	-2%
Illinois	1.11	1.13	1.11	1.02	0.93	0.92	0.93	0.92	46	-3%
Indiana	1.20	1.26	1.26	1.30	1.26	1.46	1.50	1.29	32	2%
Iowa	0.97	1.20	0.96	1.05	1.00	1.01	1.08	1.49	22	3%
Kansas	1.57	1.35	2.26	1.41	1.48	1.17	1.37	0.95	45	-6%
Kentucky	1.81	1.91	1.34	1.46	1.35	1.78	1.61	1.35	27	-3%
Louisiana	2.44	2.35	2.27	2.12	2.29	2.10	2.17	3.23	2	2%
Maine	2.89	10.92	1.87	2.69	3.07	2.80	2.53	3.86	1	-5%
Maryland	4.15	1.26	1.09	1.09	0.97	1.30	1.05	0.96	44	-12%
Massachusetts	1.13	0.96	0.79	0.99	1.09	1.55	1.22	1.30	29	5%
Michigan	1.52	2.55	2.22	1.15	1.41	1.37	1.53	1.38	24	-5%
Minnesota	1.65	1.44	0.97	1.21	0.94	1.02	0.99	1.04	38	-6%
Mississippi	1.45	1.51	1.85	1.93	2.19	1.76	2.10	2.51	3	7%
Missouri	1.12	1.09	1.06	1.04	1.19	0.97	1.30	1.00	41	0%
Montana	1.36	1.13	1.75	1.26	1.58	1.28	1.33	1.36	25	0%
Nebraska	0.99	1.28	0.71	0.67	0.88	1.09	0.65	0.79	49	-4%
Nevada	0.72	0.70	0.73	0.84	0.90	0.98	0.81	0.72	50	2%
New Hampshire	2.17	2.26	1.38	1.54	2.30	2.17	1.43	1.82	16	-2%
New Jersey	1.34	0.95	0.99	1.15	0.93	1.42	1.19	1.58	20	4%
New Mexico	1.06	0.85	3.38	1.75	1.29	1.15	1.20	1.01	39	-3%
New York	0.65	0.69	0.67	0.78	0.84	1.01	0.88	0.98	42	6%
North Carolina	2.20	1.49	1.34	1.79	1.33	2.17	1.44	1.70	17	-1%
North Dakota	0.87	0.88	1.08	0.96	0.88	0.91	0.87	0.97	43	0%
Ohio	1.18	1.22	1.21	1.18	1.35	1.41	1.47	1.36	26	3%
Oklahoma	1.82	1.05	1.67	1.58	1.43	1.33	1.53	2.11	9	3%
Oregon	0.79	1.29	1.21	1.31	1.41	0.92	1.00	1.14	35	1%
Pennsylvania	0.97	1.22	0.99	1.07	1.11	1.43	1.31	1.30	31	4%
Rhode Island	1.26	0.76	1.23	1.21	1.19	1.57	1.40	1.97	10	9%
South Carolina	1.80	1.82	1.44	2.39	1.59	1.75	1.48	1.47	23	-3%
South Dakota	1.84	0.92	0.97	1.16	1.06	1.08	1.58	1.10	36	-1%
Tennessee	2.98	1.75	1.98	2.05	1.77	1.90	2.15	2.14	8	-2%
Texas	1.54	1.43	2.05	1.60	1.67	1.39	1.67	2.22	6	3%
Utah	1.65	1.36	1.43	1.31	1.06	1.02	1.00	1.32	28	-5%
Vermont	2.22	2.20	1.67	1.86	2.41	2.62	1.98	1.90	12	0%
Virginia	2.89	1.37	1.41	1.53	1.36	1.82	1.73	1.63	18	-3%
Washington	1.05	1.52	1.70	1.17	1.32	1.21	1.17	1.30	30	-1%
West Virginia	2.29	2.37	2.42	2.35	2.33	2.65	2.80	2.44	4	2%
Wisconsin	0.77	0.83	1.32	0.97	0.91	0.81	1.09	0.80	48	0%
Wyoming	1.79	1.47	1.46	1.49	1.66	1.27	1.49	1.84	13	0%

Figure 169: System Average Interruption Frequency Index (SAIFI) in Number of Power Outages per Customer without Major Event Days

State	2013	2014	2015	2016	2017	2018	2019	2020	Rank	Trend CAGR
Alabama	2.88	2.92	1.24	1.16	1.08	1.18	1.10	1.13	14	-13%
Alaska	2.31	2.03	1.83	1.93	1.83	2.60	1.59	2.22	1	-1%
Arizona	0.63	0.59	1.28	0.61	0.58	0.61	0.77	0.77	43	0%
Arkansas	1.57	1.55	1.75	1.68	1.45	1.48	1.51	1.43	9	-2%
California	0.82	0.85	0.83	0.93	0.90	0.85	0.88	0.88	38	1%
Colorado	1.00	0.88	0.90	0.91	0.87	0.90	0.86	0.85	41	-2%
Connecticut	0.59	0.74	0.65	0.91	0.68	0.71	0.88	0.66	47	2%
Delaware	1.28	1.18	1.29	1.16	0.99	0.86	0.86	0.95	28	-6%
District of Columbia	0.88	0.64	0.69	0.82	0.55	0.54	0.49	0.37	51	-10%
Florida	1.03	1.11	1.05	1.07	1.04	0.97	0.94	0.95	27	-2%
Georgia	1.16	1.14	1.26	1.34	1.18	1.26	1.24	1.36	10	2%
Hawaii	1.60	1.84	1.71	1.34	1.20	1.69	1.19	1.11	16	-6%
Idaho	1.39	1.14	1.43	1.21	1.65	1.09	1.14	1.21	12	-2%
Illinois	0.85	0.95	0.94	0.83	0.75	0.78	0.76	0.65	48	-4%
Indiana	0.96	1.02	1.02	1.03	1.00	1.13	1.17	1.00	25	1%
Iowa	0.85	0.99	0.92	0.94	0.91	0.94	0.95	0.85	40	0%
Kansas	1.25	1.20	1.75	1.23	1.19	0.99	1.03	0.89	36	-6%
Kentucky	1.45	1.50	1.13	1.26	1.10	1.27	1.38	1.10	18	-2%
Louisiana	1.43	1.53	1.80	1.77	1.71	1.84	1.65	1.72	5	2%
Maine	1.98	2.46	1.82	2.17	2.18	2.04	1.68	2.12	3	-1%
Maryland	4.37	1.00	1.04	1.02	0.86	0.97	0.88	0.80	42	-14%
Massachusetts	0.89	0.83	0.74	0.91	0.58	0.92	0.84	1.01	24	1%
Michigan	0.92	0.89	0.96	1.01	0.99	1.05	1.16	1.08	20	3%
Minnesota	1.30	1.27	0.81	0.86	0.76	0.88	0.80	0.90	34	-5%
Mississippi	1.23	1.29	1.59	1.72	1.56	1.63	1.62	1.49	7	3%
Missouri	0.82	0.93	0.92	0.77	0.83	0.84	1.02	0.85	39	1%
Montana	1.27	1.13	1.45	1.14	1.36	1.18	1.24	1.06	22	-1%
Nebraska	0.52	0.69	0.55	0.54	0.67	0.71	0.55	0.56	50	0%
Nevada	0.57	0.63	0.56	0.73	0.81	0.81	0.77	0.58	49	3%
New Hampshire	1.30	1.58	1.35	1.38	1.53	1.27	1.25	1.09	19	-3%
New Jersey	1.22	0.87	0.83	0.98	0.87	0.96	0.94	0.94	30	-1%
New Mexico	0.94	0.82	1.56	1.39	1.08	1.09	1.08	0.93	31	0%
New York	0.59	0.61	0.64	0.70	0.62	0.65	0.63	0.68	46	1%
North Carolina	1.89	1.03	1.11	1.13	1.13	1.15	1.11	1.21	13	-3%
North Dakota	0.94	1.03	0.92	0.97	0.76	0.89	0.82	0.95	26	-2%
Ohio	0.95	1.11	1.14	1.06	1.13	1.17	1.14	1.07	21	1%
Oklahoma	1.03	1.00	1.11	1.26	1.12	1.13	1.15	1.10	17	1%
Oregon	0.65	0.86	0.71	0.78	0.87	0.80	0.75	0.75	44	1%
Pennsylvania	0.90	0.92	0.89	0.96	0.94	1.02	1.03	0.93	32	1%
Rhode Island	0.72	0.76	0.94	0.97	0.78	1.00	1.02	0.95	29	4%
South Carolina	1.72	1.11	1.15	1.21	1.11	1.22	1.00	1.12	15	-4%
South Dakota	1.06	0.69	0.85	0.90	0.97	0.91	1.09	0.90	35	2%
Tennessee	2.77	1.46	1.69	1.88	1.43	1.69	1.79	1.57	6	-4%
Texas	1.20	1.16	1.44	1.26	1.28	1.09	1.12	1.49	8	1%
Utah	1.29	1.19	1.26	0.97	0.95	1.02	0.94	0.88	37	-5%
Vermont	1.95	1.50	1.75	1.84	1.90	1.93	1.46	1.93	4	0%
Virginia	1.20	1.21	1.23	1.33	1.16	1.39	1.34	1.32	11	2%
Washington	0.81	0.98	0.84	0.79	0.94	0.83	0.78	0.91	33	0%
West Virginia	1.71	2.13	2.15	2.10	2.06	2.35	2.35	2.16	2	3%
Wisconsin	0.66	0.67	1.07	0.70	0.62	0.70	0.76	0.70	45	0%
Wyoming	1.56	1.47	1.42	1.36	1.62	1.19	1.28	1.02	23	-5%

Figure 170: Customer Average Interruption Duration Index (CAIDI) with Major Event Days in Minutes

State	2013	2014	2015	2016	2017	2018	2019	2020	Rank	Trend CAGR
Alabama	163	132	120	109	158	187	122	659	5	14%
Alaska	151	111	207	83	104	117	138	158	34	0%
Arizona	87	103	289	99	98	111	92	84	51	-4%
Arkansas	160	150	158	198	189	179	220	359	11	10%
California	116	110	125	115	173	189	371	234	23	16%
Colorado	270	87	104	128	138	104	175	143	39	-1%
Connecticut	115	117	149	169	298	515	243	1,385	1	35%
Delaware	110	127	128	115	145	143	109	213	25	5%
District of Columbia	141	139	164	140	104	170	131	110	45	-3%
Florida	78	81	77	254	1,157	167	85	136	41	10%
Georgia	102	135	137	245	442	150	105	255	18	7%
Hawaii	79	91	89	74	115	95	116	100	49	4%
Idaho	137	128	178	138	150	139	123	182	30	1%
Illinois	237	181	152	151	128	155	122	358	12	1%
Indiana	192	283	289	319	161	188	171	218	24	-4%
Iowa	130	137	98	110	117	124	114	1,137	3	20%
Kansas	162	104	163	116	209	124	182	105	46	-1%
Kentucky	107	127	123	123	133	242	118	161	33	6%
Louisiana	91	71	146	178	161	131	223	1,081	4	31%
Maine	5	114	43	194	861	240	366	452	9	68%
Maryland	94	187	114	110	115	259	127	122	43	3%
Massachusetts	371	125	111	145	248	519	208	246	19	6%
Michigan	511	450	296	234	559	319	356	301	13	-4%
Minnesota	320	115	162	201	151	118	134	113	44	-9%
Mississippi	105	85	147	135	210	131	208	509	8	20%
Missouri	265	130	156	183	215	149	189	152	36	-2%
Montana	121	120	172	117	125	102	114	174	31	1%
Nebraska	168	198	204	218	161	163	123	147	38	-5%
Nevada	110	94	122	104	125	144	97	101	48	0%
New Hampshire	95	376	95	125	475	237	194	274	16	10%
New Jersey	125	115	183	109	87	297	172	534	7	17%
New Mexico	142	89	113	86	96	109	129	149	37	3%
New York	147	138	155	145	229	609	197	639	6	22%
North Carolina	171	509	202	364	189	687	195	245	20	1%
North Dakota	146	112	101	109	94	99	124	101	47	-3%
Ohio	184	138	137	141	184	169	206	203	26	4%
Oklahoma	443	221	869	205	189	138	240	1,244	2	2%
Oregon	237	208	195	271	245	137	213	288	14	0%
Pennsylvania	140	294	157	117	153	352	189	240	21	5%
Rhode Island	622	71	278	140	615	379	169	279	15	1%
South Carolina	110	295	205	1,183	217	264	204	203	27	2%
South Dakota	566	167	635	243	94	93	165	96	50	-20%
Tennessee	85	177	108	109	255	106	123	269	17	9%
Texas	120	120	166	122	236	110	159	163	32	4%
Utah	133	136	142	149	126	120	137	422	10	9%
Vermont	3	333	117	183	347	325	220	132	42	38%
Virginia	256	123	138	148	137	244	172	186	29	1%
Washington	143	189	300	175	191	204	232	188	28	2%
West Virginia	232	279	321	300	280	270	275	237	22	-1%
Wisconsin	200	170	102	151	200	150	285	141	40	2%
Wyoming	186	132	125	124	110	101	103	156	35	-4%

Figure 171: Customer Average Interruption Duration Index (CAIDI) without Major Event Days in Minutes

State	2013	2014	2015	2016	2017	2018	2019	2020	Rank	Trend CAGR
Alabama	97	107	96	98	108	101	106	111	27	1%
Alaska	100	106	95	88	81	80	129	150	4	4%
Arizona	122	91	83	95	98	86	95	79	49	-3%
Arkansas	128	159	122	123	121	135	144	139	6	0%
California	106	102	112	109	111	110	118	117	20	2%
Colorado	219	83	90	88	88	93	101	106	29	-5%
Connecticut	105	117	107	108	100	107	211	97	36	3%
Delaware	101	100	90	94	88	93	90	94	39	-1%
District of Columbia	141	128	164	140	104	98	112	105	30	-5%
Florida	78	91	75	79	79	80	81	78	50	0%
Georgia	75	76	80	86	95	93	99	95	38	4%
Hawaii	80	67	70	78	86	90	99	90	44	4%
Idaho	113	116	135	137	140	128	112	139	7	1%
Illinois	147	99	103	120	95	92	93	85	47	-5%
Indiana	108	207	118	154	123	121	123	124	15	-2%
Iowa	99	96	92	98	104	99	95	104	31	1%
Kansas	89	89	96	104	99	98	101	97	37	1%
Kentucky	94	95	90	103	101	109	100	104	32	2%
Louisiana	79	82	87	101	107	112	131	126	13	8%
Maine	2	29	39	119	110	133	129	115	21	59%
Maryland	93	86	104	103	100	98	101	99	35	1%
Massachusetts	93	100	102	124	501	109	114	152	3	7%
Michigan	222	207	185	192	181	175	182	156	2	-4%
Minnesota	112	88	97	103	98	97	99	92	41	-1%
Mississippi	88	98	111	105	109	121	129	124	14	5%
Missouri	112	121	128	106	115	107	108	109	28	-1%
Montana	111	107	97	107	114	99	99	128	11	1%
Nebraska	123	137	149	174	98	95	106	113	24	-4%
Nevada	90	89	93	94	99	94	93	94	40	1%
New Hampshire	114	89	87	102	103	116	173	114	23	5%
New Jersey	102	85	74	82	77	86	85	85	46	-1%
New Mexico	103	88	107	89	98	107	115	127	12	4%
New York	105	120	148	129	134	137	145	115	22	2%
North Carolina	109	320	164	127	127	140	131	118	18	-5%
North Dakota	92	79	94	92	77	103	91	84	48	0%
Ohio	114	119	121	119	122	124	124	118	19	1%
Oklahoma	116	225	301	121	125	116	131	128	10	-6%
Oregon	125	124	142	136	141	130	139	142	5	1%
Pennsylvania	109	108	108	104	116	114	121	113	25	1%
Rhode Island	80	71	69	71	76	65	67	73	51	-1%
South Carolina	100	89	132	132	102	111	103	103	33	0%
South Dakota	157	331	577	105	83	93	91	87	45	-18%
Tennessee	70	150	80	93	104	85	94	92	42	0%
Texas	80	89	111	97	97	95	98	102	34	2%
Utah	138	124	128	110	120	121	115	113	26	-2%
Vermont	1	139	117	149	129	137	116	132	9	49%
Virginia	106	109	113	118	117	129	131	122	17	3%
Washington	119	120	127	133	138	132	133	137	8	2%
West Virginia	234	204	204	201	211	210	196	209	1	-1%
Wisconsin	123	106	79	112	121	113	122	122	16	2%
Wyoming	101	120	116	96	102	86	93	90	43	-3%

Appendix B.2: Household Energy Costs

Figure 172: Yearly Household Energy Expenditures in Dollars

State	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Rank	Trend CAGR
Alabama	$2,062	$1,898	$1,963	$2,095	$1,984	$1,982	$1,961	$2,117	$2,085	$1,981	16	0.3%
Alaska	$2,934	$2,963	$2,782	$2,715	$2,726	$2,580	$2,902	$2,839	$2,807	$2,729	2	-0.5%
Arizona	$1,726	$1,696	$1,739	$1,719	$1,757	$1,742	$1,776	$1,830	$1,774	$1,875	24	0.9%
Arkansas	$1,706	$1,586	$1,712	$1,747	$1,690	$1,572	$1,573	$1,748	$1,663	$1,657	42	-0.1%
California	$1,495	$1,460	$1,529	$1,514	$1,527	$1,556	$1,671	$1,682	$1,724	$1,920	20	2.6%
Colorado	$1,637	$1,568	$1,685	$1,727	$1,582	$1,519	$1,535	$1,578	$1,610	$1,576	47	-0.5%
Connecticut	$3,260	$3,174	$3,327	$3,528	$3,225	$2,751	$2,890	$3,280	$3,173	$3,036	1	-0.9%
Delaware	$2,425	$2,227	$2,214	$2,346	$2,271	$2,030	$1,991	$2,142	$2,033	$1,917	21	-2.1%
District of Columbia	$1,932	$1,788	$1,887	$1,976	$2,050	$1,671	$1,723	$1,826	$1,724	$1,531	50	-1.9%
Florida	$1,637	$1,542	$1,521	$1,629	$1,641	$1,537	$1,578	$1,606	$1,618	$1,604	43	0.2%
Georgia	$2,099	$1,955	$2,001	$2,170	$2,025	$2,025	$2,006	$2,066	$2,055	$2,022	14	0.0%
Hawaii	$2,611	$2,650	$2,455	$2,434	$1,931	$1,781	$1,908	$2,128	$2,127	$2,046	13	-3.1%
Idaho	$1,591	$1,535	$1,763	$1,676	$1,622	$1,596	$1,747	$1,658	$1,657	$1,586	46	0.2%
Illinois	$1,922	$1,713	$1,797	$2,073	$1,762	$1,740	$1,775	$1,899	$1,863	$1,795	33	-0.1%
Indiana	$1,894	$1,764	$1,913	$2,070	$1,860	$1,819	$1,859	$2,049	$1,999	$1,933	17	0.6%
Iowa	$1,925	$1,744	$1,939	$2,098	$1,743	$1,740	$1,806	$2,034	$1,989	$1,875	25	0.3%
Kansas	$1,955	$1,812	$1,997	$2,157	$1,922	$1,912	$1,942	$2,168	$1,981	$1,920	19	0.3%
Kentucky	$1,762	$1,625	$1,764	$1,923	$1,757	$1,721	$1,693	$1,851	$1,826	$1,729	39	0.3%
Louisiana	$1,726	$1,475	$1,681	$1,765	$1,659	$1,584	$1,594	$1,712	$1,672	$1,600	44	0.0%
Maine	$2,502	$2,323	$2,413	$2,572	$2,384	$2,131	$2,278	$2,627	$2,585	$2,201	8	-0.3%
Maryland	$2,410	$2,224	$2,414	$2,568	$2,400	$2,253	$2,178	$2,285	$2,169	$2,094	10	-1.4%
Massachusetts	$2,690	$2,531	$2,692	$2,960	$2,695	$2,359	$2,564	$2,978	$2,879	$2,693	5	0.5%
Michigan	$2,112	$1,975	$2,113	$2,208	$1,957	$1,953	$1,943	$2,107	$2,041	$2,055	12	-0.3%
Minnesota	$1,829	$1,674	$1,907	$2,131	$1,738	$1,720	$1,832	$2,012	$1,925	$1,858	27	0.6%
Mississippi	$1,943	$1,749	$1,908	$2,112	$1,936	$1,771	$1,782	$1,990	$1,934	$1,806	32	-0.2%
Missouri	$1,931	$1,798	$1,963	$2,056	$1,899	$1,831	$1,849	$2,077	$1,961	$1,846	28	0.1%
Montana	$1,908	$1,703	$1,779	$1,880	$1,771	$1,672	$1,877	$1,896	$1,973	$1,828	31	0.5%
Nebraska	$1,797	$1,677	$1,872	$1,928	$1,703	$1,669	$1,713	$1,867	$1,819	$1,761	37	0.0%
Nevada	$1,755	$1,743	$1,765	$1,830	$1,845	$1,671	$1,576	$1,738	$1,721	$1,769	35	-0.4%
New Hampshire	$2,708	$2,486	$2,743	$3,157	$2,843	$2,539	$2,770	$3,090	$2,941	$2,641	6	0.6%
New Jersey	$2,395	$2,195	$2,291	$2,275	$2,093	$1,945	$1,949	$2,108	$2,093	$2,055	11	-1.6%
New Mexico	$1,497	$1,427	$1,530	$1,549	$1,444	$1,375	$1,423	$1,476	$1,461	$1,477	51	-0.3%
New York	$2,634	$2,553	$2,634	$2,839	$2,498	$2,192	$2,302	$2,643	$2,498	$2,380	7	-1.1%
North Carolina	$1,829	$1,730	$1,814	$1,927	$1,834	$1,744	$1,662	$1,854	$1,805	$1,711	40	-0.4%
North Dakota	$1,938	$1,726	$1,964	$2,172	$1,728	$1,652	$1,781	$1,917	$1,980	$1,770	34	-0.4%
Ohio	$2,079	$1,915	$2,018	$2,202	$2,024	$1,918	$1,921	$2,088	$2,007	$1,914	22	-0.4%
Oklahoma	$1,882	$1,698	$1,811	$1,907	$1,759	$1,707	$1,736	$1,856	$1,816	$1,693	41	-0.4%
Oregon	$1,625	$1,553	$1,615	$1,613	$1,536	$1,523	$1,648	$1,582	$1,612	$1,599	45	0.0%
Pennsylvania	$2,467	$2,261	$2,405	$2,582	$2,339	$2,153	$2,214	$2,449	$2,295	$2,137	9	-1.0%
Rhode Island	$2,667	$2,670	$2,850	$3,013	$2,871	$2,362	$2,409	$3,013	$2,805	$2,701	3	-0.1%
South Carolina	$1,886	$1,796	$1,866	$2,057	$1,958	$1,971	$1,922	$1,996	$1,960	$1,878	23	0.4%
South Dakota	$1,797	$1,673	$1,874	$1,988	$1,731	$1,732	$1,819	$1,973	$1,978	$1,871	26	0.9%
Tennessee	$1,938	$1,729	$1,804	$1,982	$1,836	$1,789	$1,738	$1,961	$1,877	$1,757	38	-0.2%
Texas	$1,954	$1,770	$1,874	$1,973	$1,896	$1,765	$1,717	$1,855	$1,870	$1,828	30	-0.5%
Utah	$1,542	$1,535	$1,671	$1,608	$1,576	$1,595	$1,620	$1,565	$1,520	$1,535	49	-0.2%
Vermont	$2,884	$2,796	$3,028	$3,192	$2,778	$2,517	$2,739	$3,052	$2,901	$2,700	4	-0.5%
Virginia	$2,121	$1,981	$2,076	$2,170	$2,060	$1,925	$1,923	$2,139	$2,099	$2,014	15	-0.2%
Washington	$1,613	$1,533	$1,562	$1,487	$1,447	$1,470	$1,646	$1,544	$1,571	$1,561	48	0.1%
West Virginia	$1,848	$1,775	$1,894	$1,909	$1,824	$1,902	$1,810	$1,996	$1,919	$1,932	18	0.7%
Wisconsin	$1,875	$1,716	$1,874	$2,084	$1,734	$1,688	$1,736	$1,817	$1,820	$1,765	36	-0.5%
Wyoming	$1,846	$1,680	$1,829	$1,926	$1,748	$1,765	$1,964	$1,933	$1,923	$1,834	29	0.7%

Figure 173: Residential Energy Expenditures as a Percentage of Median Income

State	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Rank	Trend CAGR
Alabama	4.8%	4.4%	4.7%	5.0%	4.5%	4.2%	3.9%	4.2%	3.7%	3.6%	6	-3.0%
Alaska	5.1%	4.7%	4.5%	4.0%	3.6%	3.4%	3.7%	4.1%	3.6%	3.7%	5	-3.3%
Arizona	3.5%	3.6%	3.4%	3.5%	3.4%	3.1%	3.0%	2.9%	2.5%	2.8%	29	-3.6%
Arkansas	4.1%	4.1%	4.3%	3.9%	3.9%	3.4%	3.2%	3.5%	3.0%	3.3%	11	-3.5%
California	2.8%	2.6%	2.7%	2.5%	2.4%	2.3%	2.4%	2.4%	2.2%	2.5%	39	-1.7%
Colorado	2.8%	2.7%	2.7%	2.8%	2.4%	2.2%	2.0%	2.2%	2.2%	1.9%	49	-4.2%
Connecticut	5.0%	4.9%	4.9%	5.0%	4.4%	3.6%	3.9%	4.5%	3.6%	3.8%	3	-3.5%
Delaware	4.4%	4.5%	4.2%	4.1%	3.9%	3.5%	3.1%	3.3%	2.7%	2.8%	32	-5.9%
District of Columbia	3.5%	2.7%	3.1%	2.9%	2.9%	2.4%	2.1%	2.1%	1.9%	1.7%	51	-7.1%
Florida	3.6%	3.3%	3.2%	3.5%	3.4%	3.0%	3.0%	2.9%	2.8%	2.8%	30	-2.8%
Georgia	4.6%	4.1%	4.2%	4.4%	4.0%	3.8%	3.5%	3.7%	3.6%	3.4%	9	-2.9%
Hawaii	4.4%	4.7%	4.0%	3.4%	3.0%	2.5%	2.6%	2.7%	2.4%	2.5%	38	-7.4%
Idaho	3.4%	3.2%	3.4%	3.1%	3.1%	2.8%	2.9%	2.8%	2.5%	2.4%	44	-3.6%
Illinois	3.8%	3.3%	3.1%	3.8%	2.9%	2.8%	2.7%	2.7%	2.5%	2.4%	42	-4.6%
Indiana	4.3%	3.8%	3.8%	4.3%	3.6%	3.2%	3.2%	3.4%	3.0%	2.9%	24	-4.0%
Iowa	3.8%	3.3%	3.5%	3.6%	2.9%	2.9%	2.8%	3.0%	3.0%	2.7%	33	-3.1%
Kansas	4.2%	3.6%	3.9%	4.0%	3.5%	3.4%	3.4%	3.4%	2.7%	2.6%	36	-4.5%
Kentucky	4.4%	4.0%	4.2%	4.5%	4.1%	3.8%	3.4%	3.4%	3.3%	3.1%	20	-3.9%
Louisiana	4.2%	3.8%	4.2%	4.2%	3.6%	3.8%	3.7%	3.4%	3.2%	3.1%	17	-3.1%
Maine	5.0%	4.7%	4.8%	5.0%	4.7%	4.2%	4.3%	4.5%	3.9%	3.5%	8	-3.4%
Maryland	3.5%	3.1%	3.7%	3.4%	3.3%	3.1%	2.7%	2.7%	2.3%	2.2%	46	-5.2%
Massachusetts	4.2%	4.0%	4.3%	4.7%	4.0%	3.3%	3.4%	3.4%	3.3%	3.1%	19	-3.8%
Michigan	4.3%	3.9%	4.3%	4.2%	3.6%	3.4%	3.4%	3.5%	3.2%	3.2%	14	-3.5%
Minnesota	3.2%	2.7%	3.1%	3.2%	2.5%	2.4%	2.6%	2.8%	2.4%	2.4%	45	-2.8%
Mississippi	4.7%	4.8%	4.7%	5.9%	4.8%	4.3%	4.1%	4.7%	4.3%	4.0%	2	-2.0%
Missouri	4.2%	3.6%	3.9%	3.6%	3.2%	3.3%	3.3%	3.4%	3.2%	3.0%	23	-2.9%
Montana	4.7%	3.8%	4.0%	3.7%	3.4%	2.9%	3.3%	3.3%	3.3%	3.2%	12	-3.5%
Nebraska	3.2%	3.2%	3.5%	3.4%	2.8%	2.8%	2.9%	2.8%	2.5%	2.4%	41	-3.5%
Nevada	3.7%	3.7%	3.9%	3.7%	3.5%	3.0%	2.7%	2.8%	2.4%	2.9%	26	-4.7%
New Hampshire	4.1%	3.7%	3.8%	4.3%	3.8%	3.3%	3.7%	3.8%	3.4%	3.0%	22	-2.4%
New Jersey	3.8%	3.3%	3.7%	3.5%	3.1%	2.8%	2.7%	2.8%	2.4%	2.4%	43	-5.1%
New Mexico	3.6%	3.3%	3.6%	3.3%	3.2%	2.8%	3.1%	3.1%	2.8%	2.9%	25	-2.5%
New York	5.2%	5.4%	4.9%	5.2%	4.3%	3.6%	3.7%	3.9%	3.5%	3.5%	7	-5.3%
North Carolina	4.0%	4.2%	4.4%	4.1%	3.6%	3.2%	3.4%	3.5%	3.0%	2.8%	27	-4.4%
North Dakota	3.4%	3.1%	3.7%	3.6%	3.0%	2.7%	3.0%	2.9%	2.8%	2.8%	31	-2.7%
Ohio	4.7%	4.3%	4.3%	4.4%	3.8%	3.6%	3.2%	3.4%	3.1%	3.2%	16	-4.8%
Oklahoma	3.9%	3.5%	4.1%	4.0%	3.7%	3.4%	3.3%	3.4%	3.1%	3.2%	13	-2.5%
Oregon	3.2%	3.0%	2.9%	2.7%	2.5%	2.6%	2.6%	2.3%	2.2%	2.1%	47	-4.3%
Pennsylvania	4.9%	4.4%	4.5%	4.7%	3.9%	3.5%	3.6%	3.8%	3.3%	3.0%	21	-4.8%
Rhode Island	5.4%	4.8%	4.9%	5.1%	5.2%	3.8%	3.7%	4.8%	4.0%	3.4%	10	-4.1%
South Carolina	4.7%	4.0%	4.3%	4.6%	4.2%	3.6%	3.5%	3.5%	3.2%	3.1%	18	-4.4%
South Dakota	3.8%	3.4%	3.4%	3.7%	3.1%	3.0%	3.2%	3.3%	3.1%	2.7%	35	-2.7%
Tennessee	4.6%	4.0%	4.2%	4.5%	3.9%	3.5%	3.1%	3.5%	3.3%	3.2%	15	-4.0%
Texas	4.0%	3.4%	3.5%	3.7%	3.4%	3.0%	2.9%	3.1%	2.8%	2.7%	34	-3.9%
Utah	2.8%	2.6%	2.7%	2.5%	2.4%	2.4%	2.3%	2.0%	1.8%	1.8%	50	-4.7%
Vermont	5.6%	5.0%	5.5%	5.3%	4.7%	4.1%	4.3%	4.4%	3.9%	4.0%	1	-3.9%
Virginia	3.4%	3.1%	3.1%	3.3%	3.3%	2.9%	2.7%	2.8%	2.6%	2.5%	40	-3.2%
Washington	2.8%	2.5%	2.6%	2.5%	2.2%	2.1%	2.3%	1.9%	1.9%	1.9%	48	-4.2%
West Virginia	4.4%	4.1%	4.7%	4.8%	4.3%	4.3%	3.9%	3.9%	3.6%	3.7%	4	-2.4%
Wisconsin	3.6%	3.2%	3.4%	3.6%	3.1%	2.8%	2.7%	2.9%	2.7%	2.6%	37	-3.4%
Wyoming	3.4%	2.9%	3.3%	3.5%	2.9%	3.1%	3.3%	3.1%	3.0%	2.8%	28	-1.2%

Figure 174: Yearly Household Electricity Expenditures in Dollars

State	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Rank	Trend CAGR
Alabama	1,709	1,623	1,636	1,743	1,710	1,747	1,711	1,807	1,805	1,727	3	1%
Alaska	1,373	1,403	1,375	1,390	1,436	1,438	1,534	1,507	1,527	1,496	14	1%
Arizona	1,423	1,438	1,474	1,446	1,496	1,502	1,541	1,576	1,513	1,640	5	1%
Arkansas	1,275	1,250	1,304	1,304	1,323	1,289	1,268	1,360	1,314	1,324	32	0%
California	1,004	1,055	1,092	1,095	1,135	1,142	1,218	1,235	1,223	1,403	22	3%
Colorado	961	971	1,019	1,005	1,001	1,006	990	1,007	997	1,055	49	1%
Connecticut	1,609	1,521	1,585	1,729	1,838	1,706	1,680	1,841	1,809	1,939	2	2%
Delaware	1,594	1,535	1,467	1,515	1,574	1,524	1,461	1,469	1,430	1,405	21	-1%
District of Columbia	1,204	1,062	1,086	1,103	1,311	1,185	1,158	1,212	1,171	1,067	48	0%
Florida	1,561	1,481	1,458	1,558	1,586	1,480	1,517	1,537	1,556	1,544	11	0%
Georgia	1,574	1,473	1,496	1,610	1,554	1,570	1,517	1,573	1,582	1,559	10	0%
Hawaii	2,433	2,438	2,284	2,251	1,825	1,665	1,792	2,018	2,019	1,952	1	-3%
Idaho	990	1,050	1,180	1,146	1,140	1,139	1,205	1,150	1,126	1,140	46	1%
Illinois	1,090	1,046	962	1,065	1,079	1,102	1,076	1,140	1,108	1,128	47	1%
Indiana	1,242	1,259	1,325	1,387	1,338	1,380	1,368	1,481	1,449	1,444	18	2%
Iowa	1,127	1,134	1,204	1,194	1,182	1,238	1,231	1,311	1,296	1,293	37	2%
Kansas	1,256	1,274	1,294	1,355	1,327	1,408	1,376	1,496	1,359	1,362	27	1%
Kentucky	1,298	1,279	1,355	1,436	1,377	1,412	1,370	1,483	1,441	1,399	23	1%
Louisiana	1,450	1,260	1,440	1,483	1,440	1,390	1,386	1,474	1,448	1,393	24	0%
Maine	961	933	950	1,007	1,041	1,038	1,046	1,156	1,206	1,149	44	3%
Maryland	1,646	1,548	1,640	1,676	1,679	1,698	1,574	1,604	1,535	1,494	15	-1%
Massachusetts	1,115	1,122	1,212	1,283	1,431	1,365	1,402	1,574	1,511	1,586	7	4%
Michigan	1,088	1,146	1,163	1,134	1,123	1,220	1,169	1,243	1,203	1,318	33	2%
Minnesota	1,070	1,081	1,158	1,167	1,108	1,161	1,171	1,240	1,188	1,225	40	1%
Mississippi	1,571	1,470	1,578	1,695	1,647	1,511	1,505	1,664	1,630	1,537	12	0%
Missouri	1,301	1,294	1,382	1,398	1,390	1,400	1,387	1,521	1,414	1,384	25	1%
Montana	1,020	1,019	1,066	1,043	1,068	1,067	1,137	1,118	1,145	1,158	43	2%
Nebraska	1,151	1,206	1,280	1,276	1,223	1,266	1,259	1,311	1,297	1,313	35	1%
Nevada	1,249	1,327	1,319	1,388	1,398	1,266	1,228	1,346	1,282	1,324	31	0%
New Hampshire	1,227	1,186	1,232	1,303	1,379	1,331	1,379	1,467	1,441	1,440	19	2%
New Jersey	1,380	1,309	1,297	1,268	1,320	1,303	1,229	1,275	1,261	1,315	34	-1%
New Mexico	883	895	919	934	951	912	950	973	960	1,040	50	1%
New York	1,339	1,274	1,358	1,424	1,336	1,255	1,239	1,343	1,243	1,326	30	0%
North Carolina	1,417	1,409	1,446	1,513	1,506	1,457	1,368	1,502	1,479	1,421	20	0%
North Dakota	1,182	1,186	1,318	1,361	1,259	1,275	1,313	1,375	1,371	1,359	28	1%
Ohio	1,258	1,263	1,285	1,351	1,347	1,334	1,274	1,378	1,298	1,288	38	0%
Oklahoma	1,387	1,291	1,326	1,370	1,330	1,338	1,323	1,407	1,367	1,309	36	0%
Oregon	1,134	1,126	1,159	1,168	1,155	1,161	1,239	1,188	1,204	1,228	39	1%
Pennsylvania	1,384	1,281	1,316	1,365	1,399	1,400	1,374	1,440	1,386	1,379	26	1%
Rhode Island	1,037	1,033	1,098	1,201	1,374	1,308	1,269	1,453	1,459	1,569	9	5%
South Carolina	1,620	1,580	1,618	1,773	1,729	1,753	1,690	1,730	1,737	1,658	4	1%
South Dakota	1,161	1,184	1,299	1,313	1,304	1,350	1,381	1,454	1,447	1,461	17	3%
Tennessee	1,587	1,476	1,491	1,593	1,542	1,547	1,480	1,648	1,588	1,508	13	0%
Texas	1,678	1,539	1,600	1,649	1,632	1,525	1,470	1,580	1,609	1,591	6	0%
Utah	847	944	994	954	971	991	980	927	908	963	51	0%
Vermont	1,118	1,153	1,170	1,192	1,144	1,144	1,140	1,210	1,166	1,329	29	1%
Virginia	1,510	1,485	1,504	1,560	1,567	1,526	1,494	1,639	1,626	1,581	8	1%
Washington	1,061	1,062	1,087	1,046	1,052	1,087	1,185	1,120	1,134	1,149	45	1%
West Virginia	1,271	1,274	1,277	1,298	1,339	1,513	1,432	1,520	1,463	1,489	16	2%
Wisconsin	1,109	1,114	1,143	1,139	1,131	1,153	1,136	1,165	1,146	1,193	41	1%
Wyoming	987	1,024	1,090	1,087	1,094	1,136	1,165	1,139	1,158	1,159	42	2%

Figure 175: Average Price per Kilowatt Hour in the Residential Sector in Cents

State	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Rank	Trend CAGR
Alabama	11.4	11.3	11.5	11.7	12.0	12.6	12.2	12.5	12.6	13.1	23	2%
Alaska	17.9	18.1	19.1	19.8	20.3	21.3	21.9	22.9	22.6	22.6	4	3%
Arizona	11.3	11.7	11.9	12.1	12.2	12.4	12.8	12.4	12.3	12.6	29	1%
Arkansas	9.3	9.6	9.5	9.8	9.9	10.3	9.8	9.8	10.4	11.3	42	2%
California	15.3	16.2	16.3	17.0	17.4	18.3	18.8	19.2	20.4	22.9	3	4%
Colorado	11.5	11.9	12.2	12.1	12.1	12.2	12.2	12.2	12.4	13.1	21	1%
Connecticut	17.3	17.6	19.8	20.9	20.0	20.3	21.2	21.9	22.7	21.9	6	3%
Delaware	13.6	13.0	13.3	13.4	13.4	13.4	12.5	12.6	12.6	12.6	28	-1%
District of Columbia	12.3	12.6	12.7	13.0	12.3	12.9	12.8	13.0	12.6	13.1	21	0%
Florida	11.4	11.3	11.9	11.6	11.0	11.6	11.5	11.7	11.3	12.0	35	0%
Georgia	11.2	11.5	11.7	11.5	11.5	11.9	11.5	11.8	12.0	12.6	27	1%
Hawaii	37.3	37.0	37.0	29.6	27.5	29.5	32.5	32.1	30.3	33.3	1	-2%
Idaho	8.7	9.3	9.7	9.9	10.0	10.0	10.2	9.9	9.9	10.2	50	1%
Illinois	11.4	10.6	11.9	12.5	12.5	13.0	12.8	13.0	13.0	13.2	18	2%
Indiana	10.5	11.0	11.5	11.6	11.8	12.3	12.3	12.6	12.8	13.5	16	2%
Iowa	10.8	11.0	11.2	11.6	11.9	12.3	12.2	12.5	12.5	12.8	26	2%
Kansas	11.2	11.6	12.2	12.3	13.1	13.3	13.4	12.7	12.9	12.9	24	1%
Kentucky	9.4	9.8	10.2	10.2	10.5	10.9	10.6	10.8	10.9	11.5	37	2%
Louisiana	8.4	9.4	9.6	9.3	9.3	9.7	9.6	9.8	9.7	11.0	46	2%
Maine	14.7	14.4	15.3	15.6	15.8	16.0	16.8	17.9	16.8	17.0	11	2%
Maryland	12.8	13.3	13.6	13.8	14.2	14.0	13.3	13.1	13.0	13.1	20	0%
Massachusetts	14.9	15.8	17.4	19.8	19.0	20.1	21.6	21.9	22.0	22.9	2	5%
Michigan	14.1	14.6	14.5	14.4	15.2	15.4	15.5	15.7	16.3	17.5	10	2%
Minnesota	11.4	11.8	12.0	12.1	12.7	13.0	13.1	13.0	13.2	13.4	17	2%
Mississippi	10.3	10.8	11.3	11.3	10.5	11.1	11.1	11.3	11.2	11.7	36	1%
Missouri	10.2	10.6	10.6	11.2	11.2	11.6	11.3	11.1	11.2	11.5	40	1%
Montana	10.1	10.3	10.2	10.9	10.9	11.0	11.0	11.1	11.2	11.3	43	1%
Nebraska	10.0	10.3	10.4	10.6	10.8	11.0	10.7	10.8	10.8	10.9	47	1%
Nevada	11.8	11.9	12.9	12.8	11.4	12.0	11.9	12.0	11.3	11.5	38	-1%
New Hampshire	16.1	16.3	17.5	18.5	18.4	19.2	19.7	20.1	19.0	19.9	7	2%
New Jersey	15.8	15.7	15.8	15.8	15.7	15.7	15.4	15.9	16.0	16.4	12	0%
New Mexico	11.4	11.7	12.3	12.5	12.0	12.9	12.7	12.5	12.9	13.6	15	2%
New York	17.6	18.8	20.1	18.5	17.6	18.0	18.5	17.9	18.4	19.4	8	0%
North Carolina	10.9	11.0	11.1	11.3	11.0	10.9	11.1	11.4	11.4	11.5	38	0%
North Dakota	9.1	9.1	9.2	9.6	10.2	10.3	10.3	10.3	10.4	10.8	48	2%
Ohio	11.8	12.0	12.5	12.8	12.5	12.6	12.6	12.4	12.3	12.8	25	0%
Oklahoma	9.5	9.7	10.0	10.1	10.2	10.6	10.3	10.2	10.1	12.3	30	2%
Oregon	9.8	9.9	10.5	10.7	10.7	10.7	11.0	11.0	11.2	11.3	41	2%
Pennsylvania	12.8	12.8	13.3	13.6	13.9	14.2	13.9	13.8	13.6	13.8	14	1%
Rhode Island	14.4	15.2	17.2	19.3	18.6	18.3	20.6	21.7	22.0	22.3	5	5%
South Carolina	11.8	12.0	12.5	12.6	12.7	13.0	12.4	13.0	12.8	13.2	19	1%
South Dakota	10.1	10.3	10.5	11.1	11.5	11.8	11.6	11.6	11.7	12.3	31	2%
Tennessee	10.1	10.0	10.3	10.3	10.4	10.7	10.7	10.9	10.8	11.2	45	1%
Texas	11.0	11.4	11.9	11.6	11.0	11.0	11.2	11.8	11.7	12.1	34	1%
Utah	9.9	10.4	10.7	10.9	11.0	11.0	10.4	10.4	10.4	10.5	49	0%
Vermont	17.0	17.1	17.5	17.1	17.4	17.7	18.0	17.7	19.5	19.3	9	1%
Virginia	11.1	10.8	11.1	11.4	11.4	11.6	11.7	12.1	12.0	12.1	33	1%
Washington	8.5	8.7	8.7	9.1	9.5	9.7	9.8	9.7	9.9	10.1	51	2%
West Virginia	9.9	9.5	9.3	10.1	11.4	11.6	11.2	11.3	11.8	12.2	32	3%
Wisconsin	13.2	13.6	13.7	14.1	14.1	14.4	14.0	14.2	14.3	14.6	13	1%
Wyoming	9.9	10.2	10.5	11.0	11.1	11.4	11.3	11.2	11.1	11.2	44	1%

Figure 176: Yearly Household Natural Gas Expenditures in Dollars

State	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Rank	Trend CAGR
Alabama	$714	$582	$708	$741	$601	$514	$546	$679	$611	$580	32	-2%
Alaska	$1,460	$1,473	$1,366	$1,278	$1,392	$1,335	$1,609	$1,527	$1,474	$1,714	1	2%
Arizona	$506	$476	$471	$469	$490	$441	$419	$430	$444	$416	51	-2%
Arkansas	$701	$563	$666	$721	$695	$548	$602	$743	$669	$659	25	0%
California	$475	$404	$439	$418	$411	$441	$483	$468	$538	$576	33	3%
Colorado	$652	$577	$633	$695	$591	$516	$545	$556	$611	$536	39	-2%
Connecticut	$1,212	$1,118	$1,161	$1,330	$1,157	$1,059	$1,184	$1,281	$1,298	$1,195	2	1%
Delaware	$1,015	$851	$895	$943	$879	$689	$739	$863	$779	$758	14	-3%
District of Columbia	$926	$777	$952	$1,055	$906	$687	$814	$841	$837	$715	19	-2%
Florida	$439	$383	$407	$451	$389	$399	$399	$451	$430	$429	49	0%
Georgia	$636	$515	$532	$732	$606	$552	$583	$681	$651	$605	30	1%
Hawaii	$1,062	$1,010	$1,084	$958	$792	$721	$770	$888	$880	$785	11	-3%
Idaho	$669	$558	$618	$573	$539	$530	$563	$486	$482	$482	46	-3%
Illinois	$899	$727	$917	$1,124	$778	$740	$810	$861	$848	$752	15	-1%
Indiana	$733	$616	$723	$831	$695	$574	$635	$715	$699	$640	27	-1%
Iowa	$724	$592	$728	$852	$588	$544	$608	$682	$625	$528	41	-2%
Kansas	$761	$598	$808	$875	$678	$616	$687	$785	$722	$663	23	-1%
Kentucky	$692	$576	$694	$799	$698	$600	$649	$699	$706	$652	26	0%
Louisiana	$499	$381	$465	$536	$438	$397	$420	$485	$455	$432	48	0%
Maine	$891	$1,006	$1,160	$1,473	$1,461	$1,084	$1,189	$1,441	$1,376	$1,170	3	3%
Maryland	$836	$760	$847	$937	$828	$728	$809	$833	$829	$803	10	0%
Massachusetts	$1,133	$925	$1,072	$1,256	$1,114	$934	$1,068	$1,314	$1,285	$944	8	1%
Michigan	$1,041	$858	$944	$1,023	$847	$736	$759	$804	$802	$743	16	-3%
Minnesota	$771	$603	$785	$985	$690	$625	$688	$796	$747	$661	24	-1%
Mississippi	$521	$425	$509	$610	$513	$462	$470	$548	$511	$511	43	0%
Missouri	$918	$732	$853	$918	$809	$695	$738	$838	$810	$723	17	-1%
Montana	$738	$591	$651	$733	$576	$510	$595	$595	$604	$552	36	-2%
Nebraska	$686	$521	$659	$714	$590	$495	$577	$678	$594	$550	37	-1%
Nevada	$560	$480	$494	$497	$531	$477	$422	$444	$513	$526	42	-1%
New Hampshire	$1,048	$885	$1,008	$1,273	$1,237	$936	$1,010	$1,162	$1,158	$969	7	1%
New Jersey	$947	$799	$913	$878	$720	$650	$727	$798	$820	$773	13	-2%
New Mexico	$549	$503	$562	$571	$494	$450	$471	$458	$456	$423	50	-3%
New York	$1,085	$931	$1,033	$1,121	$962	$852	$1,012	$1,142	$1,113	$1,017	6	0%
North Carolina	$685	$603	$709	$755	$618	$593	$634	$693	$671	$636	29	0%
North Dakota	$706	$548	$670	$803	$608	$506	$581	$624	$621	$545	38	-2%
Ohio	$891	$792	$851	$981	$789	$693	$744	$802	$813	$683	22	-2%
Oklahoma	$687	$587	$689	$744	$646	$570	$618	$658	$670	$575	34	-1%
Oregon	$796	$701	$716	$683	$645	$632	$685	$604	$625	$639	28	-2%
Pennsylvania	$1,020	$881	$993	$1,093	$941	$790	$898	$1,011	$977	$884	9	-1%
Rhode Island	$1,145	$993	$1,144	$1,277	$1,208	$993	$1,070	$1,317	$1,241	$1,112	4	1%
South Carolina	$602	$518	$609	$666	$559	$530	$547	$620	$555	$534	40	-1%
South Dakota	$652	$519	$651	$736	$534	$479	$529	$573	$556	$475	47	-2%
Tennessee	$630	$494	$615	$718	$577	$477	$508	$607	$554	$493	44	-2%
Texas	$471	$409	$490	$584	$497	$449	$481	$550	$505	$485	45	1%
Utah	$713	$619	$705	$682	$638	$644	$652	$641	$609	$603	31	-1%
Vermont	$1,338	$1,262	$1,317	$1,330	$1,290	$1,125	$1,094	$1,202	$1,155	$1,054	5	-2%
Virginia	$840	$719	$816	$906	$792	$663	$744	$811	$792	$721	18	-1%
Washington	$973	$871	$860	$746	$749	$714	$823	$719	$724	$776	12	-2%
West Virginia	$800	$714	$778	$852	$770	$637	$628	$771	$707	$687	20	-2%
Wisconsin	$757	$621	$730	$927	$629	$582	$626	$654	$649	$575	35	-2%
Wyoming	$740	$614	$707	$763	$676	$623	$691	$682	$679	$687	21	0%

Figure 177: Residential Natural Gas Price per Therm in Dollars

State	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Rank	Trend CAGR
Alabama	$1.51	$1.62	$1.55	$1.46	$1.41	$1.41	$1.61	$1.52	$1.56	$1.60	3	0%
Alaska	$0.88	$0.85	$0.89	$0.91	$0.96	$0.98	$1.05	$1.10	$1.11	$1.11	26	3%
Arizona	$1.50	$1.58	$1.39	$1.72	$1.70	$1.53	$1.58	$1.54	$1.35	$1.31	13	-1%
Arkansas	$1.15	$1.18	$1.05	$1.04	$1.16	$1.12	$1.30	$1.18	$1.11	$1.23	19	1%
California	$0.99	$0.91	$0.99	$1.15	$1.14	$1.18	$1.25	$1.23	$1.30	$1.41	9	4%
Colorado	$0.83	$0.83	$0.79	$0.89	$0.83	$0.74	$0.81	$0.77	$0.78	$0.72	46	-1%
Connecticut	$1.38	$1.42	$1.33	$1.41	$1.25	$1.29	$1.40	$1.39	$1.46	$1.47	7	1%
Delaware	$1.54	$1.52	$1.37	$1.32	$1.26	$1.19	$1.28	$1.26	$1.21	$1.29	16	-2%
District of Columbia	$1.31	$1.21	$1.25	$1.31	$1.20	$1.09	$1.25	$1.18	$1.28	$1.19	21	-1%
Florida	$1.82	$1.83	$1.85	$1.90	$1.93	$2.03	$2.12	$2.13	$2.17	$2.14	2	2%
Georgia	$1.57	$1.62	$1.46	$1.45	$1.46	$1.46	$1.69	$1.40	$1.49	$1.30	15	-1%
Hawaii	$5.53	$5.29	$4.91	$4.75	$4.01	$3.65	$3.89	$4.35	$4.41	$3.78	1	-4%
Idaho	$0.88	$0.83	$0.81	$0.85	$0.86	$0.81	$0.77	$0.71	$0.65	$0.67	51	-3%
Illinois	$0.88	$0.83	$0.82	$0.96	$0.80	$0.79	$0.88	$0.82	$0.80	$0.79	43	-1%
Indiana	$0.95	$0.89	$0.84	$0.90	$0.89	$0.79	$0.89	$0.87	$0.87	$0.86	38	-1%
Iowa	$0.95	$0.95	$0.90	$1.00	$0.85	$0.81	$0.93	$0.89	$0.82	$0.78	44	-2%
Kansas	$0.99	$1.01	$1.02	$1.06	$1.02	$0.99	$1.10	$1.02	$0.92	$0.94	33	-1%
Kentucky	$1.04	$1.02	$0.98	$1.06	$1.09	$1.01	$1.16	$1.06	$1.09	$1.11	25	1%
Louisiana	$1.14	$1.15	$1.08	$1.09	$1.08	$1.14	$1.30	$1.17	$1.15	$1.22	20	1%
Maine	$1.42	$1.59	$1.52	$1.69	$1.68	$1.38	$1.46	$1.63	$1.61	$1.49	5	0%
Maryland	$1.21	$1.22	$1.17	$1.22	$1.20	$1.15	$1.30	$1.18	$1.26	$1.31	14	1%
Massachusetts	$1.38	$1.32	$1.35	$1.45	$1.30	$1.25	$1.33	$1.55	$1.47	$1.47	6	1%
Michigan	$1.05	$1.00	$0.91	$0.93	$0.88	$0.82	$0.84	$0.82	$0.81	$0.83	39	-3%
Minnesota	$0.89	$0.80	$0.82	$0.99	$0.88	$0.80	$0.85	$0.87	$0.81	$0.80	41	-1%
Mississippi	$0.95	$0.96	$0.90	$0.95	$0.97	$1.01	$1.18	$1.04	$1.08	$1.15	23	2%
Missouri	$1.20	$1.23	$1.09	$1.08	$1.16	$1.09	$1.18	$1.04	$1.04	$1.04	29	-1%
Montana	$0.88	$0.81	$0.82	$0.91	$0.82	$0.73	$0.76	$0.73	$0.71	$0.72	47	-2%
Nebraska	$0.88	$0.87	$0.84	$0.88	$0.89	$0.80	$0.90	$0.85	$0.79	$0.80	42	-1%
Nevada	$1.07	$1.01	$0.94	$1.14	$1.18	$1.02	$0.88	$0.92	$0.95	$1.04	30	-1%
New Hampshire	$1.47	$1.37	$1.38	$1.63	$1.62	$1.43	$1.46	$1.54	$1.58	$1.47	8	1%
New Jersey	$1.18	$1.11	$1.09	$0.97	$0.83	$0.83	$0.91	$0.91	$0.97	$0.99	32	-2%
New Mexico	$0.91	$0.87	$0.89	$1.01	$0.86	$0.81	$0.92	$0.79	$0.64	$0.70	49	-3%
New York	$1.37	$1.30	$1.25	$1.25	$1.12	$1.08	$1.20	$1.24	$1.26	$1.25	18	-1%
North Carolina	$1.26	$1.22	$1.18	$1.19	$1.16	$1.13	$1.33	$1.21	$1.29	$1.32	11	1%
North Dakota	$0.81	$0.74	$0.74	$0.89	$0.82	$0.72	$0.76	$0.72	$0.70	$0.68	50	-2%
Ohio	$1.08	$0.99	$0.95	$1.02	$0.95	$0.90	$0.97	$0.91	$0.96	$0.89	36	-1%
Oklahoma	$1.03	$1.11	$0.97	$1.01	$1.02	$1.06	$1.14	$0.93	$0.94	$0.91	34	-1%
Oregon	$1.18	$1.12	$1.08	$1.17	$1.25	$1.17	$1.06	$1.07	$1.00	$1.09	28	-1%
Pennsylvania	$1.25	$1.20	$1.16	$1.18	$1.10	$1.02	$1.14	$1.13	$1.17	$1.15	24	-1%
Rhode Island	$1.53	$1.43	$1.46	$1.51	$1.42	$1.38	$1.40	$1.57	$1.54	$1.51	4	0%
South Carolina	$1.29	$1.33	$1.26	$1.27	$1.26	$1.26	$1.45	$1.35	$1.31	$1.35	10	1%
South Dakota	$0.86	$0.84	$0.82	$0.93	$0.83	$0.76	$0.82	$0.77	$0.73	$0.71	48	-2%
Tennessee	$1.02	$1.00	$0.94	$1.01	$0.96	$0.92	$1.03	$0.95	$0.95	$0.90	35	-1%
Texas	$1.02	$1.06	$1.05	$1.12	$1.06	$1.17	$1.36	$1.14	$1.06	$1.16	22	1%
Utah	$0.84	$0.87	$0.86	$0.95	$0.97	$0.91	$0.91	$0.90	$0.78	$0.82	40	-1%
Vermont	$1.62	$1.67	$1.59	$1.47	$1.46	$1.42	$1.41	$1.37	$1.31	$1.32	12	-3%
Virginia	$1.27	$1.24	$1.17	$1.21	$1.16	$1.09	$1.23	$1.17	$1.26	$1.27	17	0%
Washington	$1.23	$1.19	$1.14	$1.06	$1.18	$1.08	$1.06	$1.03	$0.98	$1.10	27	-2%
West Virginia	$1.09	$1.08	$1.00	$1.02	$1.05	$0.93	$0.94	$0.98	$0.99	$1.01	31	-1%
Wisconsin	$0.98	$0.93	$0.87	$1.05	$0.85	$0.81	$0.84	$0.80	$0.77	$0.75	45	-3%
Wyoming	$0.87	$0.84	$0.83	$0.93	$0.93	$0.85	$0.90	$0.86	$0.81	$0.88	37	0%

Figure 178: Other Heating Fuel Expenditures per Household Using and Paying for Other Heating Fuels in Dollars

State	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Rank	Trend CAGR
Alabama	$1,345	$981	$1,218	$1,541	$1,074	$981	$1,118	$1,430	$1,300	$1,071	46	0%
Alaska	$2,677	$2,763	$2,544	$2,465	$2,217	$1,775	$2,064	$2,070	$1,905	$1,775	12	-5%
Arizona	$2,097	$1,211	$1,516	$1,823	$1,194	$1,202	$1,305	$1,615	$1,614	$1,263	33	-2%
Arkansas	$1,700	$1,312	$1,787	$1,950	$1,205	$892	$939	$1,259	$1,211	$1,006	49	-6%
California	$2,379	$1,774	$1,761	$1,765	$1,226	$1,198	$1,284	$1,451	$1,421	$1,077	45	-6%
Colorado	$3,065	$2,664	$3,111	$3,334	$2,236	$2,089	$2,278	$2,611	$2,554	$2,025	6	-4%
Connecticut	$2,580	$2,669	$2,897	$2,887	$2,192	$1,518	$1,768	$2,258	$2,089	$1,494	22	-6%
Delaware	$1,958	$1,637	$1,914	$2,207	$1,686	$1,202	$1,355	$1,688	$1,569	$1,114	42	-5%
District of Columbia	$579	$3,307	$2,573	$2,781	$2,337	$278	$248	$2,161	$198	$149	51	-23%
Florida	$3,516	$2,621	$2,821	$3,237	$2,124	$2,511	$3,041	$3,358	$2,725	$2,404	2	-1%
Georgia	$1,674	$1,834	$1,422	$1,891	$1,300	$1,253	$1,161	$1,494	$1,349	$1,148	37	-4%
Hawaii	$5,180	$6,760	$3,854	$4,828	$2,086	$2,257	$1,913	$1,484	$1,439	$1,142	39	-18%
Idaho	$2,659	$2,157	$2,766	$2,550	$2,387	$2,112	$2,911	$2,911	$3,160	$2,256	4	1%
Illinois	$2,580	$1,942	$2,431	$2,625	$1,561	$1,331	$1,599	$1,994	$2,150	$1,850	8	-3%
Indiana	$2,403	$1,583	$1,831	$2,161	$1,268	$1,136	$1,296	$1,654	$1,565	$1,221	35	-5%
Iowa	$2,275	$1,569	$1,847	$2,496	$1,256	$1,037	$1,298	$2,047	$2,123	$1,764	13	-1%
Kansas	$2,081	$1,562	$1,713	$2,342	$1,452	$1,079	$1,332	$1,684	$1,634	$1,350	30	-3%
Kentucky	$2,315	$1,489	$1,755	$2,251	$1,407	$1,002	$955	$1,258	$1,645	$1,045	48	-6%
Louisiana	$1,929	$1,351	$1,537	$1,968	$1,134	$1,029	$1,251	$1,557	$1,524	$1,144	38	-3%
Maine	$2,260	$2,035	$2,219	$2,388	$2,035	$1,703	$1,912	$2,172	$2,049	$1,561	20	-3%
Maryland	$2,426	$2,104	$2,482	$2,986	$2,191	$1,367	$1,473	$2,058	$1,699	$1,493	23	-6%
Massachusetts	$2,707	$2,595	$2,816	$3,303	$2,324	$1,643	$1,995	$2,414	$2,364	$1,684	16	-4%
Michigan	$2,333	$1,797	$2,390	$3,085	$1,984	$1,820	$2,072	$2,595	$2,353	$1,759	14	-1%
Minnesota	$2,183	$1,703	$2,026	$2,760	$1,582	$1,382	$1,931	$2,144	$2,085	$1,723	15	-1%
Mississippi	$1,619	$1,131	$1,392	$1,876	$1,020	$1,054	$1,055	$1,262	$1,172	$879	50	-4%
Missouri	$1,740	$1,359	$1,605	$2,108	$1,157	$985	$1,086	$1,498	$1,512	$1,092	44	-4%
Montana	$3,136	$2,312	$2,346	$2,951	$2,742	$2,336	$2,928	$2,998	$3,336	$2,530	1	1%
Nebraska	$2,568	$1,631	$2,077	$2,527	$1,353	$1,255	$1,285	$1,681	$1,805	$1,420	28	-5%
Nevada	$2,474	$1,773	$2,238	$2,079	$1,636	$1,425	$1,775	$1,764	$1,601	$1,444	26	-4%
New Hampshire	$2,216	$1,982	$2,325	$2,899	$2,213	$1,889	$2,166	$2,556	$2,330	$1,849	9	-1%
New Jersey	$2,227	$2,175	$2,392	$2,774	$1,917	$1,310	$1,485	$2,079	$2,011	$1,319	32	-5%
New Mexico	$2,245	$1,964	$2,362	$2,380	$1,695	$1,742	$1,803	$2,047	$2,185	$1,659	17	-2%
New York	$1,557	$1,885	$1,693	$1,950	$1,523	$1,118	$1,236	$1,745	$1,674	$1,063	47	-3%
North Carolina	$1,816	$1,395	$1,634	$1,979	$1,541	$1,265	$1,271	$1,756	$1,583	$1,238	34	-2%
North Dakota	$3,049	$2,131	$2,547	$3,503	$1,686	$1,365	$1,732	$2,123	$2,637	$1,464	25	-5%
Ohio	$2,241	$1,712	$1,943	$2,333	$1,534	$1,448	$1,783	$2,069	$1,931	$1,400	29	-2%
Oklahoma	$1,524	$1,180	$1,501	$1,926	$1,158	$963	$1,292	$1,436	$1,379	$1,207	36	-2%
Oregon	$2,116	$1,879	$2,179	$2,366	$1,673	$1,510	$1,923	$2,284	$2,334	$1,578	19	-1%
Pennsylvania	$2,233	$2,145	$2,443	$2,768	$1,955	$1,556	$1,718	$2,179	$1,833	$1,324	31	-5%
Rhode Island	$2,715	$3,021	$3,353	$3,367	$2,627	$1,620	$1,667	$2,746	$2,149	$1,585	18	-6%
South Carolina	$1,796	$1,385	$1,515	$2,113	$1,361	$1,421	$1,743	$1,981	$1,595	$1,427	27	0%
South Dakota	$1,833	$1,450	$1,627	$1,924	$1,066	$1,011	$1,193	$1,522	$1,610	$1,117	40	-3%
Tennessee	$1,813	$1,069	$1,352	$2,143	$1,314	$1,069	$1,217	$1,680	$1,513	$1,099	43	-2%
Texas	$1,826	$1,386	$1,718	$2,055	$1,491	$1,521	$1,423	$1,580	$1,752	$1,116	41	-3%
Utah	$2,217	$1,973	$2,187	$2,021	$1,727	$1,734	$2,633	$2,835	$2,747	$1,538	21	1%
Vermont	$2,600	$2,479	$2,921	$3,076	$2,548	$2,147	$2,543	$2,889	$2,723	$2,092	5	-1%
Virginia	$2,624	$2,077	$2,525	$2,620	$2,003	$1,553	$1,642	$2,227	$2,044	$1,827	10	-3%
Washington	$2,484	$1,958	$2,156	$2,323	$1,627	$1,700	$2,359	$2,327	$2,546	$1,826	11	0%
West Virginia	$2,702	$2,403	$3,445	$3,141	$2,019	$1,573	$1,417	$1,934	$1,942	$1,909	7	-6%
Wisconsin	$2,016	$1,489	$1,845	$2,572	$1,460	$1,212	$1,462	$1,695	$1,879	$1,492	24	-2%
Wyoming	$3,362	$2,447	$2,559	$3,242	$2,222	$2,454	$3,464	$3,569	$2,813	$2,263	3	0%

Figure 179: Residential Price per MMBTU of Other Heating Fuel for Occupied Housing Units Using and Paying for Other Heating Fuels

State	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Rank	Trend CAGR
Alabama	$23.52	$21.89	$21.12	$23.92	$21.41	$20.55	$23.97	$24.77	$22.07	$19.62	16	0%
Alaska	$25.97	$27.17	$26.40	$26.05	$17.40	$14.52	$16.96	$19.09	$18.35	$15.13	34	-6%
Arizona	$30.10	$27.43	$26.89	$30.63	$21.93	$21.66	$25.09	$25.85	$22.61	$20.37	12	-3%
Arkansas	$20.53	$19.51	$19.31	$21.46	$17.09	$15.79	$18.57	$18.91	$17.00	$15.59	32	-2%
California	$26.92	$25.41	$24.32	$26.08	$21.90	$20.97	$24.17	$25.33	$22.18	$19.73	14	-2%
Colorado	$23.15	$22.13	$21.74	$24.52	$17.66	$16.78	$19.28	$20.42	$18.11	$15.89	28	-3%
Connecticut	$25.72	$28.66	$27.76	$27.48	$19.30	$17.24	$19.73	$21.13	$19.76	$16.59	21	-5%
Delaware	$27.10	$28.19	$26.90	$28.33	$22.57	$20.70	$22.83	$24.53	$23.00	$20.71	11	-3%
District of Columbia	$25.46	$29.63	$28.64	$28.00	$19.72	$16.52	$19.19	$20.88	$23.33	$20.00	13	-4%
Florida	$26.70	$25.34	$23.25	$25.81	$35.74	$35.52	$39.52	$40.64	$36.24	$33.16	2	5%
Georgia	$23.52	$24.07	$21.81	$24.68	$24.92	$24.63	$27.42	$28.08	$25.66	$23.34	4	1%
Hawaii	$47.16	$46.05	$43.36	$49.51	$43.27	$42.01	$46.89	$48.82	$43.56	$39.00	1	-1%
Idaho	$24.68	$23.70	$23.45	$25.38	$15.45	$14.34	$17.16	$17.65	$16.60	$14.30	41	-6%
Illinois	$20.36	$18.32	$18.12	$22.11	$15.68	$14.16	$17.42	$17.98	$16.21	$14.65	39	-3%
Indiana	$23.89	$21.38	$20.74	$24.32	$16.33	$15.49	$18.78	$19.45	$17.55	$15.89	29	-4%
Iowa	$19.86	$17.20	$16.59	$21.91	$12.96	$10.56	$13.60	$14.59	$13.66	$12.28	51	-5%
Kansas	$20.32	$18.05	$17.66	$22.50	$14.82	$13.14	$16.53	$17.12	$15.30	$13.65	46	-4%
Kentucky	$21.69	$19.64	$18.71	$21.45	$16.72	$15.24	$16.69	$18.37	$18.44	$15.96	27	-2%
Louisiana	$26.81	$24.28	$23.15	$27.06	$23.37	$22.84	$27.03	$27.76	$24.45	$21.58	6	-1%
Maine	$23.26	$25.43	$23.95	$24.29	$16.26	$14.80	$16.75	$18.59	$17.45	$14.83	38	-5%
Maryland	$26.72	$28.38	$27.44	$28.01	$21.31	$19.64	$22.11	$23.66	$23.43	$20.78	10	-3%
Massachusetts	$25.48	$28.38	$27.53	$27.33	$19.30	$17.11	$19.01	$20.88	$19.94	$16.54	22	-5%
Michigan	$23.46	$22.00	$21.55	$25.30	$17.15	$15.86	$18.25	$19.18	$16.99	$15.34	33	-4%
Minnesota	$21.63	$19.73	$19.73	$24.02	$15.19	$13.08	$16.35	$16.77	$15.58	$14.23	42	-4%
Mississippi	$26.39	$24.27	$23.58	$27.86	$23.62	$22.50	$26.80	$27.22	$23.84	$21.03	7	-1%
Missouri	$18.23	$17.05	$16.72	$20.26	$14.14	$12.24	$15.29	$16.18	$14.85	$13.17	47	-3%
Montana	$22.67	$21.32	$20.82	$23.82	$15.87	$14.37	$17.16	$17.34	$16.30	$14.12	43	-5%
Nebraska	$19.19	$16.37	$16.44	$20.38	$12.53	$11.30	$14.26	$14.71	$13.29	$12.43	50	-4%
Nevada	$29.15	$27.32	$27.05	$29.96	$22.22	$20.87	$24.46	$23.69	$21.50	$19.68	15	-4%
New Hampshire	$23.56	$25.60	$24.65	$25.69	$18.44	$17.34	$18.56	$19.96	$18.51	$16.34	25	-5%
New Jersey	$25.24	$27.52	$26.07	$26.36	$20.89	$19.03	$21.38	$22.85	$21.86	$18.43	17	-3%
New Mexico	$24.39	$23.46	$22.95	$25.21	$17.82	$16.73	$19.17	$19.34	$17.15	$15.61	31	-5%
New York	$25.58	$27.82	$26.97	$27.20	$18.67	$16.70	$19.12	$21.09	$19.55	$16.48	24	-5%
North Carolina	$27.51	$25.95	$25.55	$27.59	$21.68	$19.95	$23.90	$25.74	$24.28	$22.29	5	-2%
North Dakota	$21.19	$18.71	$19.62	$24.15	$13.81	$11.35	$15.26	$15.91	$15.44	$13.78	45	-5%
Ohio	$25.37	$24.04	$23.71	$25.92	$18.82	$18.32	$22.03	$22.71	$20.42	$17.25	19	-3%
Oklahoma	$20.31	$18.36	$18.09	$22.28	$15.40	$14.01	$17.56	$17.69	$15.89	$14.53	40	-3%
Oregon	$21.04	$21.67	$20.84	$21.49	$14.41	$12.58	$14.54	$16.14	$15.00	$12.64	49	-6%
Pennsylvania	$25.04	$27.53	$26.34	$26.49	$18.66	$16.77	$18.78	$20.08	$19.31	$16.52	23	-5%
Rhode Island	$25.77	$28.90	$27.88	$27.64	$19.20	$17.36	$19.37	$21.65	$20.12	$17.15	20	-5%
South Carolina	$28.20	$26.87	$26.23	$29.65	$26.50	$26.05	$29.89	$30.75	$27.43	$25.16	3	0%
South Dakota	$20.77	$18.57	$18.08	$23.05	$13.52	$11.60	$15.16	$15.82	$15.01	$13.82	44	-4%
Tennessee	$23.53	$20.73	$20.27	$25.18	$17.23	$15.50	$19.10	$19.77	$18.09	$16.16	26	-3%
Texas	$26.49	$24.64	$24.11	$28.02	$23.60	$22.71	$26.54	$27.23	$24.03	$21.03	8	-1%
Utah	$24.96	$23.47	$23.08	$26.10	$16.70	$15.28	$19.37	$19.68	$18.02	$14.93	37	-5%
Vermont	$23.36	$25.34	$24.35	$24.63	$17.24	$16.14	$18.45	$19.16	$17.80	$15.65	30	-5%
Virginia	$26.42	$26.29	$26.10	$26.52	$20.67	$19.31	$21.75	$23.07	$22.21	$20.78	9	-3%
Washington	$23.62	$23.35	$22.34	$23.56	$16.43	$14.94	$17.54	$18.55	$17.28	$14.99	36	-5%
West Virginia	$19.13	$19.41	$19.87	$19.31	$18.36	$16.32	$17.75	$19.21	$18.58	$18.09	18	-1%
Wisconsin	$20.15	$18.23	$18.00	$22.63	$13.63	$11.95	$14.87	$15.42	$14.33	$13.16	48	-5%
Wyoming	$25.14	$23.28	$22.85	$26.52	$16.49	$15.97	$19.14	$20.01	$17.87	$15.12	35	-5%

Appendix B.3: Emissions Intensity in the Electric Sector

Figure 180: CO_2 Intensity in Metric Tons per Gigawatt Hour of Generation

State	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Rank	Trend CAGR
Alabama	489	452	445	453	423	406	380	387	356	281	37	-4.7%
Alaska	633	620	580	589	585	547	544	543	572	551	10	-1.5%
Arizona	495	472	488	478	444	409	413	418	384	327	29	-3.9%
Arkansas	586	557	619	605	515	525	548	564	505	430	19	-2.5%
California	239	298	287	289	282	239	216	223	203	224	43	-3.3%
Colorado	768	760	744	714	714	663	663	627	602	507	15	-3.9%
Connecticut	243	249	245	251	241	235	228	243	238	247	40	-0.3%
Delaware	596	577	608	555	524	500	484	512	504	512	14	-2.2%
District of Columbia	872	921	740	716	662	622	553	540	633	429	21	-6.7%
Florida	516	503	489	492	471	463	451	441	403	386	24	-3.0%
Georgia	572	483	470	497	460	451	430	424	397	309	34	-4.7%
Hawaii	755	728	723	730	727	729	726	735	753	707	6	-0.2%
Idaho	50	76	128	98	119	117	102	97	125	126	48	6.6%
Illinois	505	478	482	478	435	386	385	384	342	270	39	-5.8%
Indiana	897	870	905	907	856	839	828	807	759	720	4	-2.3%
Iowa	778	728	691	691	618	556	529	540	470	354	28	-7.2%
Kansas	774	713	683	639	601	541	437	459	410	373	26	-8.0%
Kentucky	942	953	951	944	915	902	864	841	819	779	3	-2.2%
Louisiana	594	582	571	548	522	496	511	497	480	430	18	-3.1%
Maine	272	247	262	257	252	222	186	195	174	182	45	-5.1%
Maryland	565	547	529	547	504	500	392	407	333	278	38	-7.1%
Massachusetts	431	403	448	415	418	398	385	367	396	429	20	-0.9%
Michigan	635	628	637	602	594	523	520	530	490	464	16	-3.6%
Minnesota	614	540	570	573	532	498	482	484	426	371	27	-4.5%
Mississippi	452	445	429	436	389	418	404	412	379	390	23	-1.7%
Missouri	858	823	855	862	813	798	811	806	735	641	8	-2.3%
Montana	565	576	612	584	619	593	564	554	588	446	17	-1.6%
Nebraska	755	774	756	668	635	630	630	690	634	527	13	-3.1%
Nevada	462	424	431	451	378	365	345	353	349	324	30	-3.8%
New Hampshire	256	223	174	177	183	131	113	128	108	106	49	-9.4%
New Jersey	261	247	244	270	260	272	240	252	266	244	41	-0.2%
New Mexico	816	796	795	765	760	705	685	564	580	535	12	-4.8%
New York	271	263	246	248	236	233	200	211	188	207	44	-3.7%
North Carolina	530	496	452	457	419	401	379	370	361	309	33	-5.1%
North Dakota	851	856	864	834	841	790	724	734	697	650	7	-3.1%
Ohio	828	736	746	734	687	686	668	619	568	556	9	-3.9%
Oklahoma	688	631	628	628	547	472	438	400	331	314	32	-8.7%
Oregon	113	121	159	139	155	136	127	137	177	147	47	2.4%
Pennsylvania	517	492	479	462	424	395	371	358	338	314	31	-5.5%
Rhode Island	412	410	454	408	414	407	391	400	393	377	25	-1.1%
South Carolina	376	354	302	341	309	289	272	291	251	234	42	-4.5%
South Dakota	243	285	319	281	202	232	229	231	227	167	46	-4.2%
Tennessee	561	537	479	521	505	503	453	359	332	283	36	-6.7%
Texas	614	590	594	582	541	521	530	482	450	426	22	-3.9%
Utah	831	824	840	804	803	741	740	725	724	709	5	-2.0%
Vermont	4	2	2	2	6	6	7	5	3	4	51	7.3%
Virginia	490	413	451	437	413	395	345	351	309	294	35	-5.1%
Washington	71	60	110	107	106	90	95	91	137	103	50	4.8%
West Virginia	914	915	908	908	917	902	886	895	889	874	2	-0.5%
Wisconsin	731	646	723	717	681	630	659	634	560	540	11	-2.8%
Wyoming	949	957	966	953	970	947	947	954	930	894	1	-0.5%

Figure 181: SO_2 Intensity in Metric Tons per Gigawatt Hour of Generation

State	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Rank	Trend CAGR
Alabama	1.25	0.97	0.87	0.93	0.77	0.35	0.25	0.26	0.22	0.18	27	-20.8%
Alaska	0.40	0.39	0.59	0.58	0.60	0.50	0.39	0.42	0.48	0.35	14	-1.6%
Arizona	0.27	0.18	0.19	0.18	0.14	0.11	0.11	0.13	0.10	0.07	39	-11.4%
Arkansas	1.31	1.29	1.34	1.32	0.97	0.90	0.92	0.87	0.74	0.53	10	-8.8%
California	0.01	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	49	-10.8%
Colorado	0.83	0.74	0.69	0.48	0.41	0.33	0.26	0.19	0.19	0.15	29	-18.3%
Connecticut	0.03	0.20	0.09	0.05	0.03	0.02	0.02	0.02	0.01	0.01	48	-21.4%
Delaware	1.28	0.28	0.26	0.10	0.10	0.05	0.07	0.09	0.05	0.05	42	-25.3%
District of Columbia	3.27	-	-	-	-	0.07	-	-	-	-	51	NA
Florida	0.51	0.46	0.48	0.50	0.32	0.25	0.23	0.22	0.16	0.14	31	-14.3%
Georgia	1.90	1.22	0.93	0.77	0.52	0.39	0.37	0.37	0.37	0.35	13	-16.9%
Hawaii	1.57	1.39	1.77	1.66	1.94	1.79	1.73	1.53	1.82	1.72	1	1.2%
Idaho	0.29	0.34	0.39	0.35	0.27	0.24	0.21	0.21	0.19	0.20	24	-6.8%
Illinois	1.04	0.87	0.91	0.84	0.71	0.52	0.42	0.43	0.47	0.32	15	-12.0%
Indiana	2.84	2.26	2.25	2.34	1.51	0.82	0.59	0.55	0.43	0.38	11	-22.2%
Iowa	1.80	1.69	1.71	1.21	0.77	0.58	0.53	0.53	0.43	0.29	16	-18.9%
Kansas	0.79	0.67	0.56	0.58	0.28	0.14	0.10	0.10	0.09	0.07	40	-26.8%
Kentucky	2.30	1.90	1.93	2.04	1.46	0.90	0.75	0.67	0.67	0.58	8	-15.9%
Louisiana	1.12	1.04	1.09	0.84	0.64	0.54	1.14	1.04	0.37	0.22	23	-12.1%
Maine	0.77	0.55	0.86	0.76	0.91	0.61	0.53	0.65	0.70	0.60	6	-2.1%
Maryland	1.17	1.07	1.05	0.99	0.86	0.66	0.46	0.42	0.22	0.09	36	-22.2%
Massachusetts	0.58	0.42	0.34	0.20	0.15	0.11	0.09	0.09	0.09	0.10	34	-19.7%
Michigan	2.16	1.99	2.04	1.47	1.21	0.82	0.68	0.64	0.64	0.38	12	-17.7%
Minnesota	0.99	0.63	0.63	0.62	0.48	0.41	0.37	0.39	0.27	0.23	22	-13.2%
Mississippi	0.94	0.79	1.51	1.66	0.51	0.19	0.19	0.19	0.18	0.17	28	-23.3%
Missouri	2.00	1.48	1.56	1.55	1.37	1.18	1.15	1.15	1.04	0.94	3	-6.9%
Montana	0.60	0.54	0.55	0.43	0.45	0.41	0.41	0.38	0.42	0.29	17	-6.1%
Nebraska	1.88	1.69	1.64	1.47	1.48	1.29	1.32	1.47	1.12	0.95	2	-5.9%
Nevada	0.15	0.12	0.19	0.26	0.12	0.06	0.05	0.08	0.11	0.05	43	-12.2%
New Hampshire	1.12	0.11	0.17	0.14	0.10	0.05	0.04	0.08	0.03	0.02	46	-27.6%
New Jersey	0.08	0.06	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	45	-5.8%
New Mexico	0.42	0.41	0.45	0.34	0.32	0.23	0.24	0.10	0.11	0.08	38	-18.1%
New York	0.38	0.23	0.21	0.21	0.16	0.14	0.12	0.08	0.06	0.05	41	-18.3%
North Carolina	0.77	0.63	0.51	0.45	0.41	0.36	0.31	0.28	0.28	0.24	19	-11.7%
North Dakota	2.44	2.19	1.47	1.31	1.15	1.14	0.90	0.88	0.76	0.75	4	-12.4%
Ohio	4.54	2.73	2.29	2.40	1.76	1.10	0.91	0.84	0.74	0.70	5	-18.9%
Oklahoma	1.21	0.95	0.99	1.02	0.80	0.63	0.54	0.37	0.10	0.09	37	-24.4%
Oregon	0.23	0.22	0.27	0.16	0.15	0.13	0.11	0.09	0.12	0.10	35	-10.6%
Pennsylvania	1.38	1.08	1.11	1.22	0.94	0.46	0.32	0.31	0.22	0.15	30	-22.5%
Rhode Island	0.01	0.00	0.18	0.01	0.01	0.01	0.01	0.01	0.01	0.00	50	-12.8%
South Carolina	0.85	0.67	0.45	0.41	0.27	0.24	0.19	0.18	0.21	0.19	25	-15.8%
South Dakota	0.85	1.01	1.38	1.14	0.45	0.07	0.07	0.07	0.07	0.04	44	-34.7%
Tennessee	1.70	1.14	0.98	1.02	1.04	0.61	0.51	0.33	0.28	0.24	20	-19.4%
Texas	0.93	0.81	0.80	0.72	0.55	0.51	0.58	0.43	0.30	0.26	18	-12.6%
Utah	0.55	0.51	0.51	0.49	0.37	0.29	0.27	0.21	0.22	0.19	26	-12.4%
Vermont	0.01	0.01	0.01	0.01	0.03	0.03	0.03	0.02	0.01	0.02	47	10.3%
Virginia	1.29	0.79	0.80	0.81	0.36	0.29	0.21	0.18	0.14	0.11	33	-24.5%
Washington	0.16	0.17	0.11	0.11	0.11	0.10	0.09	0.09	0.18	0.11	32	-2.5%
West Virginia	1.24	1.13	1.12	1.15	0.84	0.55	0.49	0.62	0.55	0.54	9	-10.6%
Wisconsin	2.02	1.53	1.49	1.21	0.82	0.43	0.38	0.35	0.26	0.23	21	-23.0%
Wyoming	1.63	0.88	0.86	0.83	0.82	0.75	0.74	0.61	0.63	0.59	7	-8.0%

Figure 182: NOx Intensity in Metric Tons per Gigawatt Hour of Generation

State	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Rank	Trend CAGR
Alabama	0.41	0.34	0.34	0.38	0.34	0.25	0.21	0.22	0.18	0.14	45	-10.6%
Alaska	2.51	2.45	2.46	2.38	3.06	3.32	3.21	3.03	3.30	3.14	1	3.8%
Arizona	0.49	0.41	0.45	0.43	0.38	0.33	0.33	0.34	0.30	0.23	35	-6.6%
Arkansas	0.67	0.59	0.69	0.69	0.52	0.51	0.51	0.39	0.34	0.29	28	-8.9%
California	0.41	0.42	0.39	0.37	0.37	0.35	0.33	0.34	0.31	0.34	22	-2.8%
Colorado	0.99	0.86	0.85	0.75	0.67	0.53	0.46	0.35	0.35	0.31	24	-12.9%
Connecticut	0.18	0.33	0.23	0.23	0.18	0.16	0.17	0.15	0.13	0.14	46	-6.8%
Delaware	0.64	0.33	0.30	0.33	0.28	0.22	0.21	0.25	0.23	0.26	30	-7.6%
District of Columbia	1.85	2.86	2.03	1.97	4.22	4.46	4.43	4.27	3.10	2.32	2	5.5%
Florida	0.37	0.38	0.36	0.36	0.32	0.30	0.29	0.24	0.21	0.19	40	-7.5%
Georgia	0.60	0.41	0.42	0.42	0.37	0.32	0.33	0.33	0.31	0.27	29	-6.7%
Hawaii	1.87	1.81	2.10	1.77	1.72	1.64	1.64	1.63	1.74	1.64	3	-1.8%
Idaho	0.17	0.28	0.45	1.21	0.79	0.30	0.28	0.23	0.24	0.24	32	-3.9%
Illinois	0.37	0.31	0.28	0.26	0.22	0.19	0.20	0.20	0.18	0.14	42	-8.8%
Indiana	0.98	0.94	1.00	1.00	0.93	0.88	0.71	0.66	0.61	0.61	8	-6.1%
Iowa	0.78	0.73	0.71	0.67	0.54	0.49	0.47	0.45	0.39	0.29	27	-9.6%
Kansas	0.90	0.73	0.58	0.53	0.41	0.36	0.31	0.34	0.30	0.25	31	-12.6%
Kentucky	0.87	0.83	0.88	0.89	0.74	0.68	0.60	0.57	0.55	0.44	15	-7.2%
Louisiana	0.74	0.72	0.73	0.67	0.65	0.62	0.73	0.74	0.59	0.53	9	-2.5%
Maine	0.50	0.44	0.62	0.59	0.69	0.53	0.54	0.53	0.52	0.51	10	0.0%
Maryland	0.61	0.58	0.56	0.49	0.40	0.35	0.31	0.27	0.18	0.14	44	-14.7%
Massachusetts	0.37	0.39	0.42	0.40	0.36	0.32	0.28	0.31	0.36	0.40	17	-1.5%
Michigan	0.75	0.75	0.73	0.66	0.54	0.47	0.45	0.45	0.44	0.45	14	-7.0%
Minnesota	0.78	0.68	0.65	0.61	0.49	0.43	0.43	0.43	0.36	0.32	23	-9.1%
Mississippi	0.51	0.43	0.42	0.39	0.23	0.24	0.24	0.24	0.24	0.24	34	-8.8%
Missouri	0.64	0.72	0.77	0.80	0.53	0.68	0.56	0.59	0.54	0.62	7	-2.7%
Montana	0.58	0.58	0.71	0.62	0.64	0.58	0.54	0.58	0.62	0.40	18	-2.6%
Nebraska	1.15	0.84	0.77	0.62	0.59	0.55	0.57	0.59	0.53	0.48	13	-7.4%
Nevada	0.38	0.34	0.37	0.40	0.25	0.25	0.23	0.26	0.27	0.22	37	-5.8%
New Hampshire	0.26	0.21	0.23	0.18	0.14	0.11	0.11	0.15	0.10	0.09	50	-10.7%
New Jersey	0.20	0.21	0.21	0.20	0.16	0.15	0.13	0.13	0.14	0.14	43	-5.6%
New Mexico	1.50	1.51	1.49	1.29	1.30	1.08	1.03	0.49	0.42	0.35	19	-15.7%
New York	0.31	0.30	0.30	0.29	0.25	0.24	0.22	0.22	0.20	0.20	39	-5.4%
North Carolina	0.42	0.46	0.45	0.43	0.40	0.37	0.38	0.37	0.35	0.30	25	-3.7%
North Dakota	1.37	1.27	1.26	1.21	1.13	0.94	0.76	0.75	0.70	0.67	6	-8.5%
Ohio	0.90	0.70	0.67	0.71	0.62	0.55	0.55	0.48	0.42	0.41	16	-7.7%
Oklahoma	1.03	0.81	0.70	0.58	0.39	0.34	0.32	0.28	0.22	0.22	36	-16.3%
Oregon	0.16	0.14	0.21	0.19	0.26	0.20	0.19	0.18	0.24	0.24	33	4.1%
Pennsylvania	0.65	0.59	0.60	0.58	0.48	0.40	0.23	0.22	0.20	0.17	41	-15.6%
Rhode Island	0.30	0.27	0.16	0.15	0.14	0.14	0.24	0.23	0.24	0.34	21	2.0%
South Carolina	0.29	0.23	0.18	0.20	0.18	0.16	0.15	0.15	0.13	0.11	48	-8.3%
South Dakota	0.78	0.93	1.03	0.88	0.31	0.09	0.10	0.10	0.10	0.08	51	-28.4%
Tennessee	0.36	0.33	0.26	0.27	0.28	0.27	0.23	0.15	0.14	0.12	47	-10.8%
Texas	0.49	0.45	0.47	0.43	0.38	0.37	0.37	0.36	0.34	0.30	26	-4.9%
Utah	1.42	1.25	1.33	1.20	1.13	0.87	0.85	0.78	0.79	0.76	4	-7.5%
Vermont	0.10	0.09	0.10	0.10	0.31	0.30	0.24	0.22	0.52	0.51	11	22.5%
Virginia	0.66	0.51	0.47	0.48	0.41	0.34	0.29	0.30	0.23	0.20	38	-11.6%
Washington	0.13	0.10	0.14	0.13	0.13	0.12	0.12	0.12	0.15	0.11	49	0.4%
West Virginia	0.70	0.66	0.72	0.82	0.78	0.63	0.54	0.55	0.52	0.49	12	-4.5%
Wisconsin	0.73	0.62	0.61	0.59	0.50	0.43	0.43	0.40	0.35	0.35	20	-8.1%
Wyoming	1.29	0.99	0.96	0.90	0.92	0.84	0.80	0.80	0.76	0.74	5	-4.9%

Appendix C: Non-Transportation Energy Use

Figure 183: 2020 Electricity Used in Residential Sector in Terawatt Hours

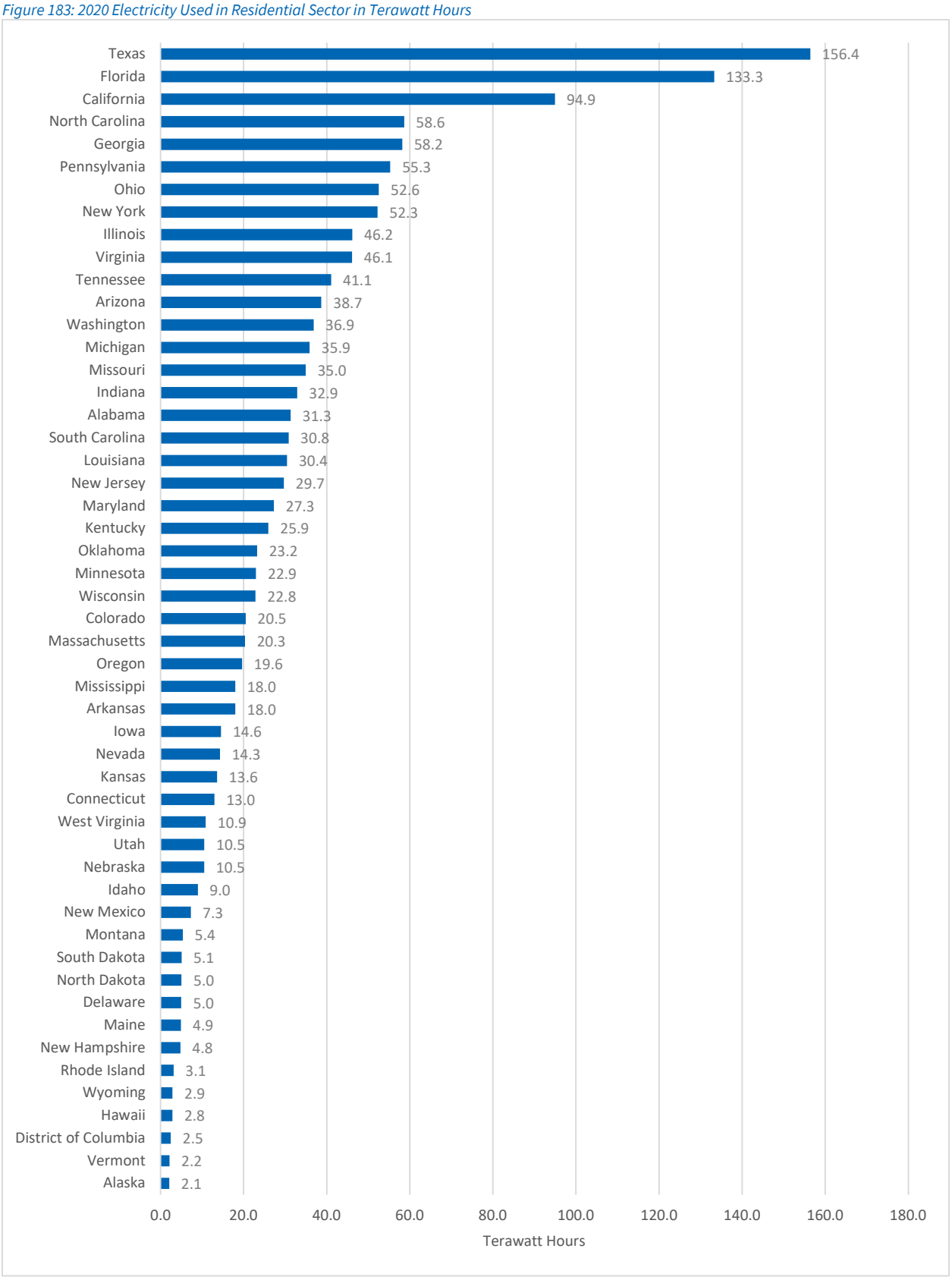


Figure 184: 2020 Electricity Used in the Residential Sector in Terawatt Hours Map

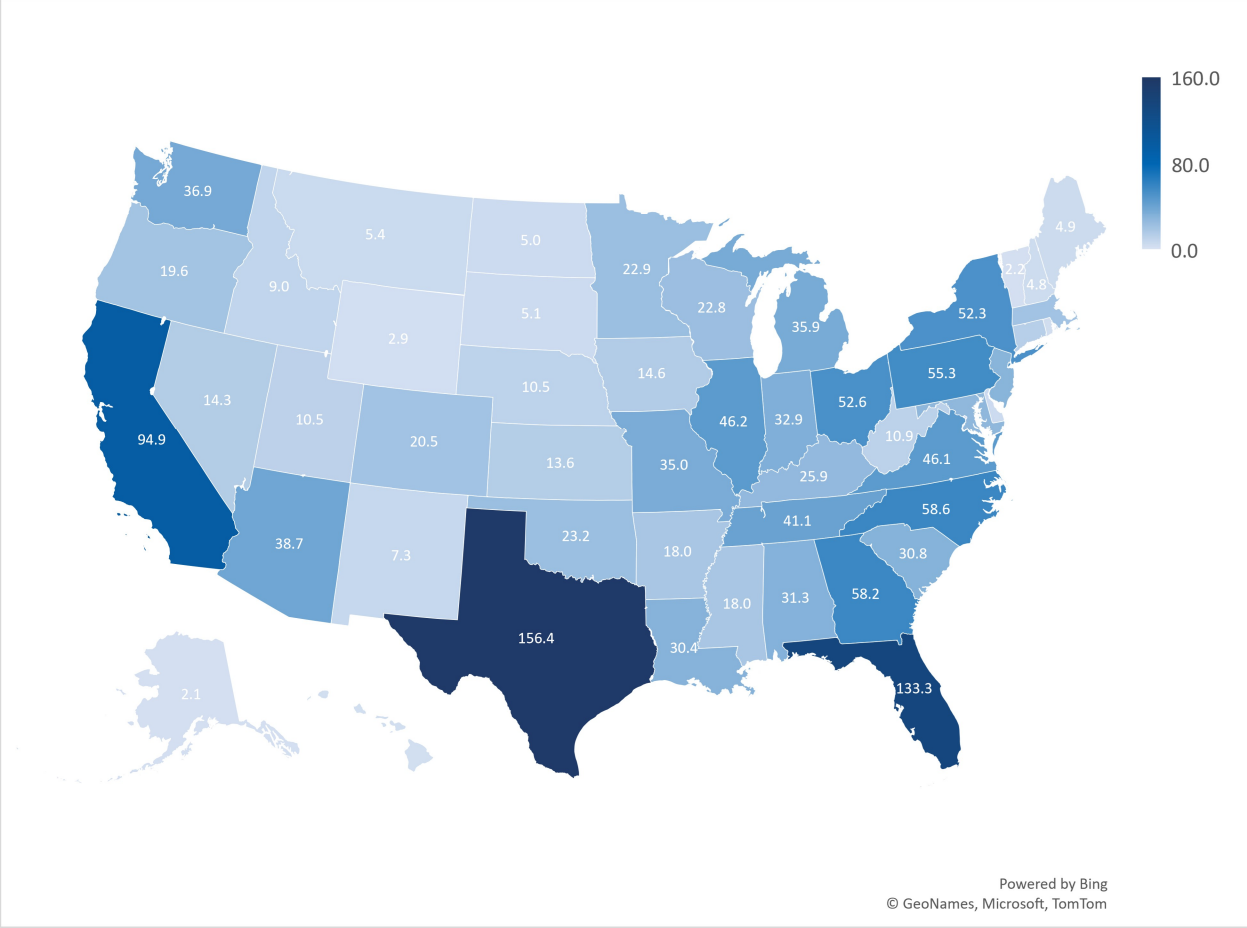


Figure 185: 2020 Natural Gas Consumed by the Residential Sector

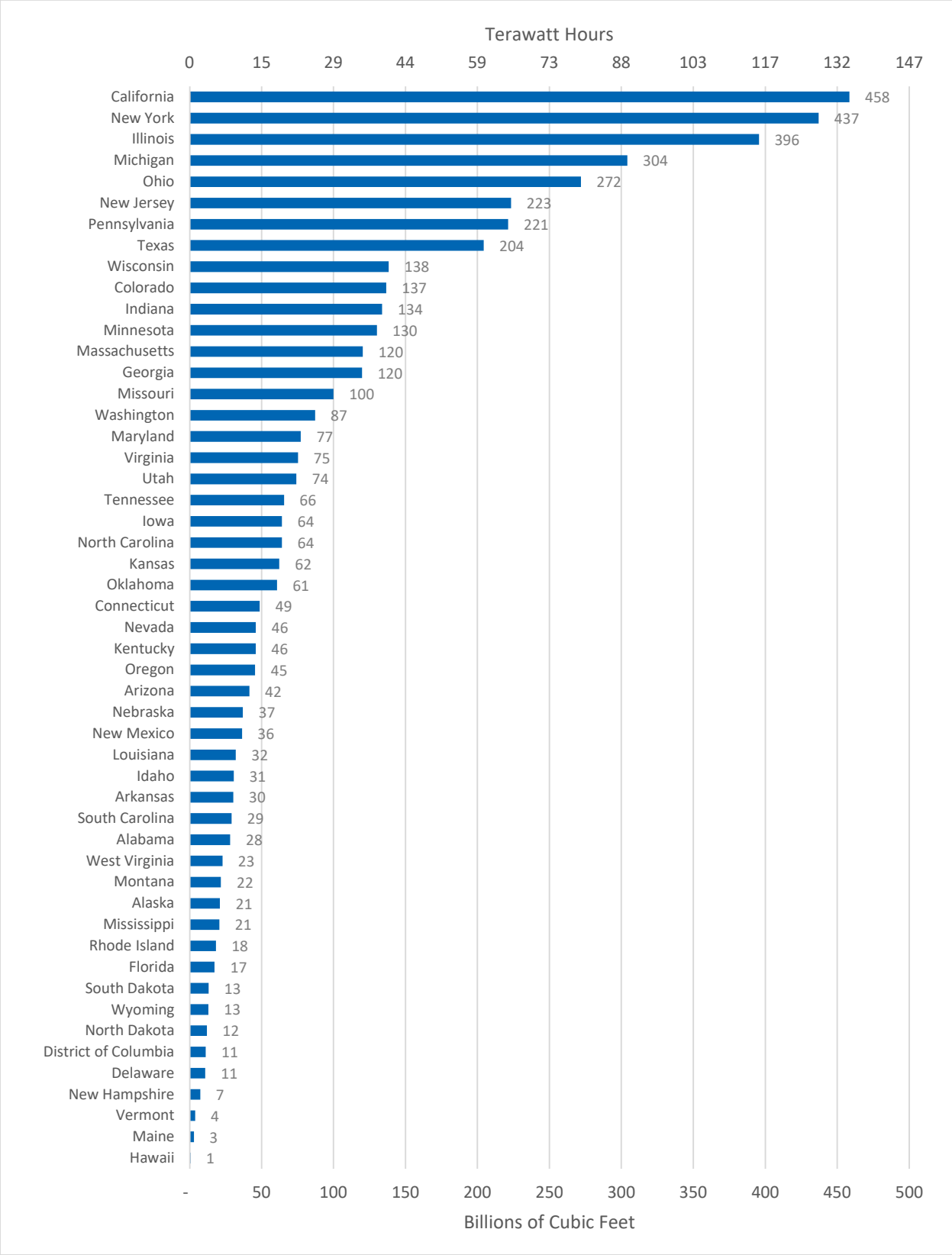


Figure 186: 2020 Natural Gas Consumed by the Residential Sector in Billions of Cubic Feet Map

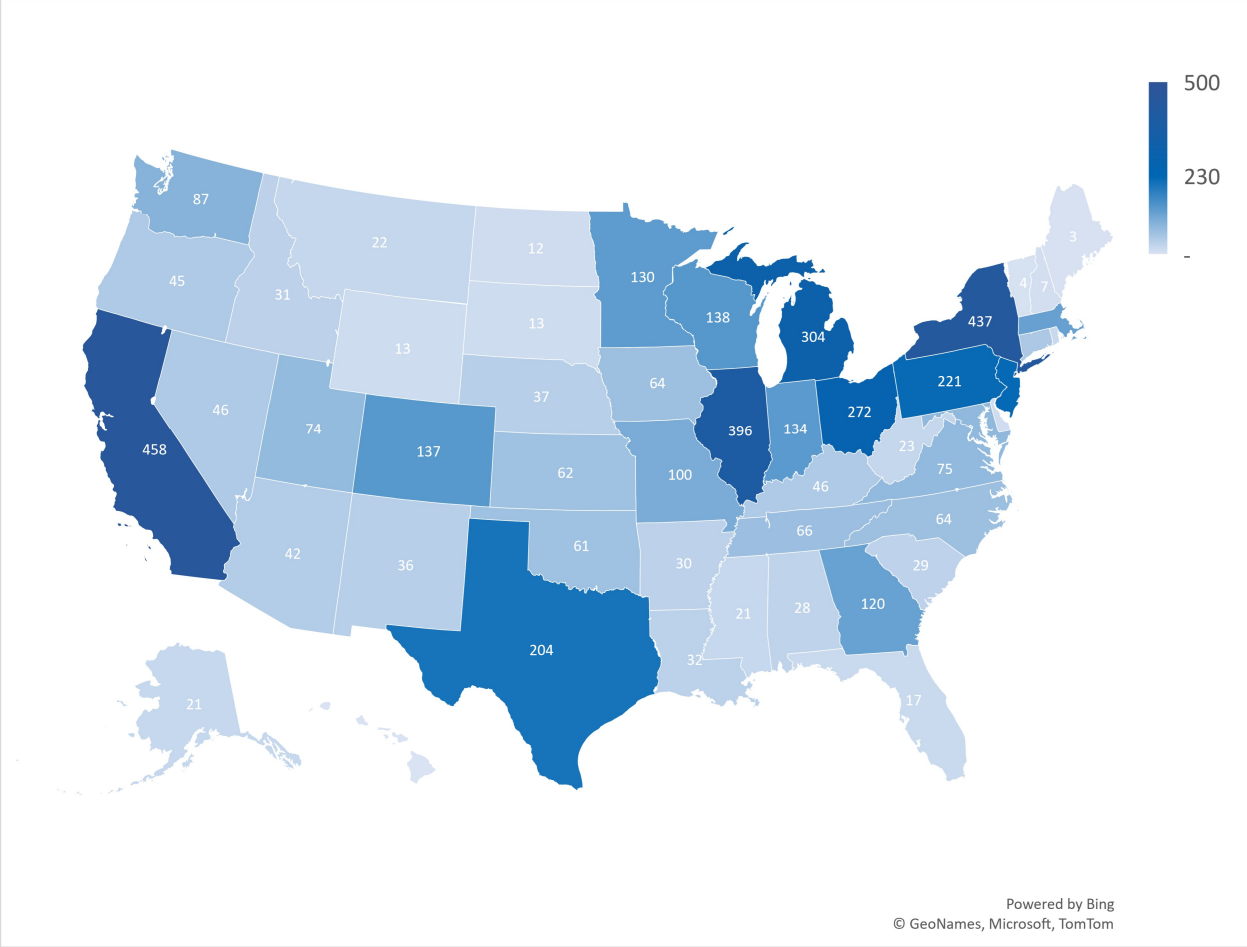


Figure 187: 2020 Other Heating Fuel Use by the Residential Sector

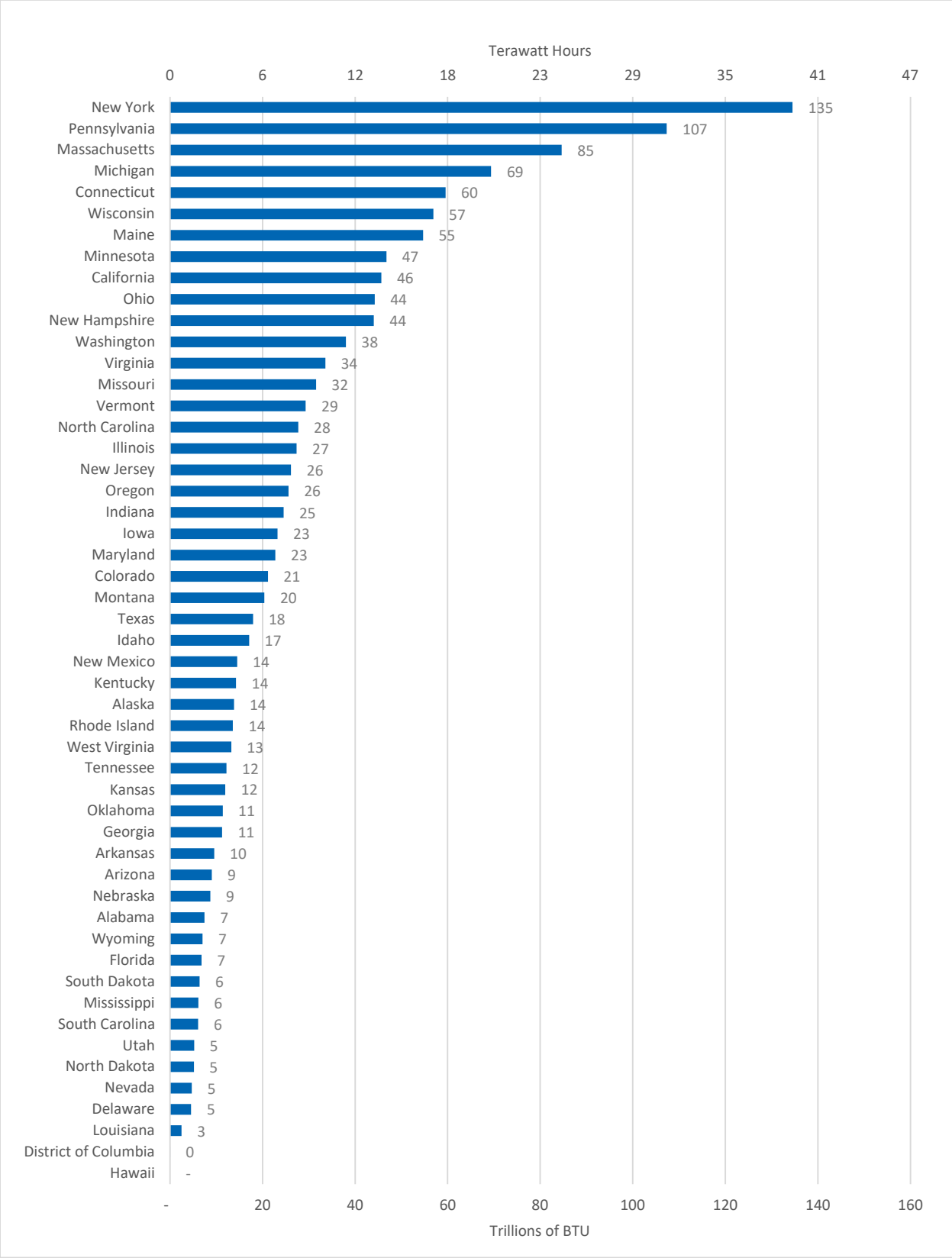


Figure 188: 2020 Other Heating Fuel Use by the Residential Sector in Trillions of BTU

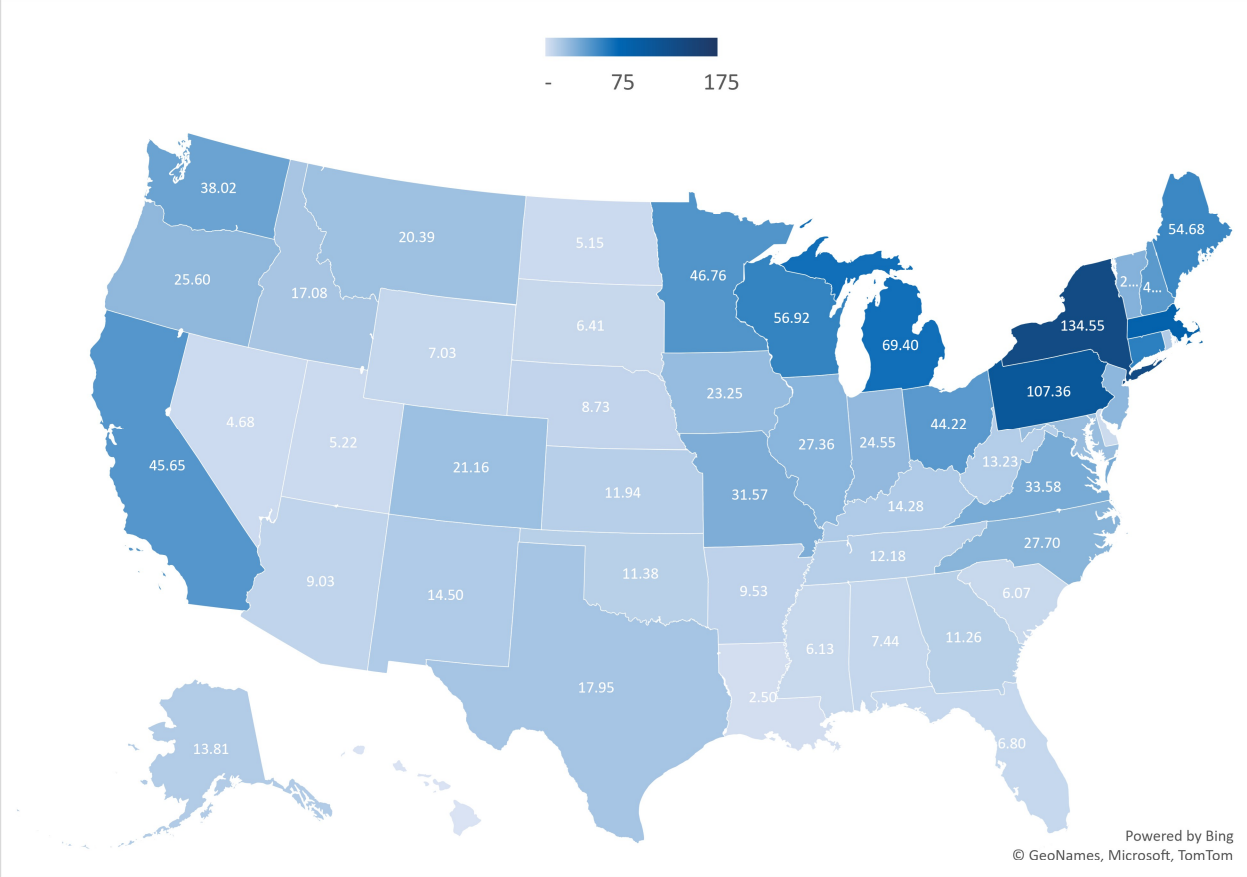


Figure 189: 2020 Electricity Used in Commercial Sector in Terawatt Hours

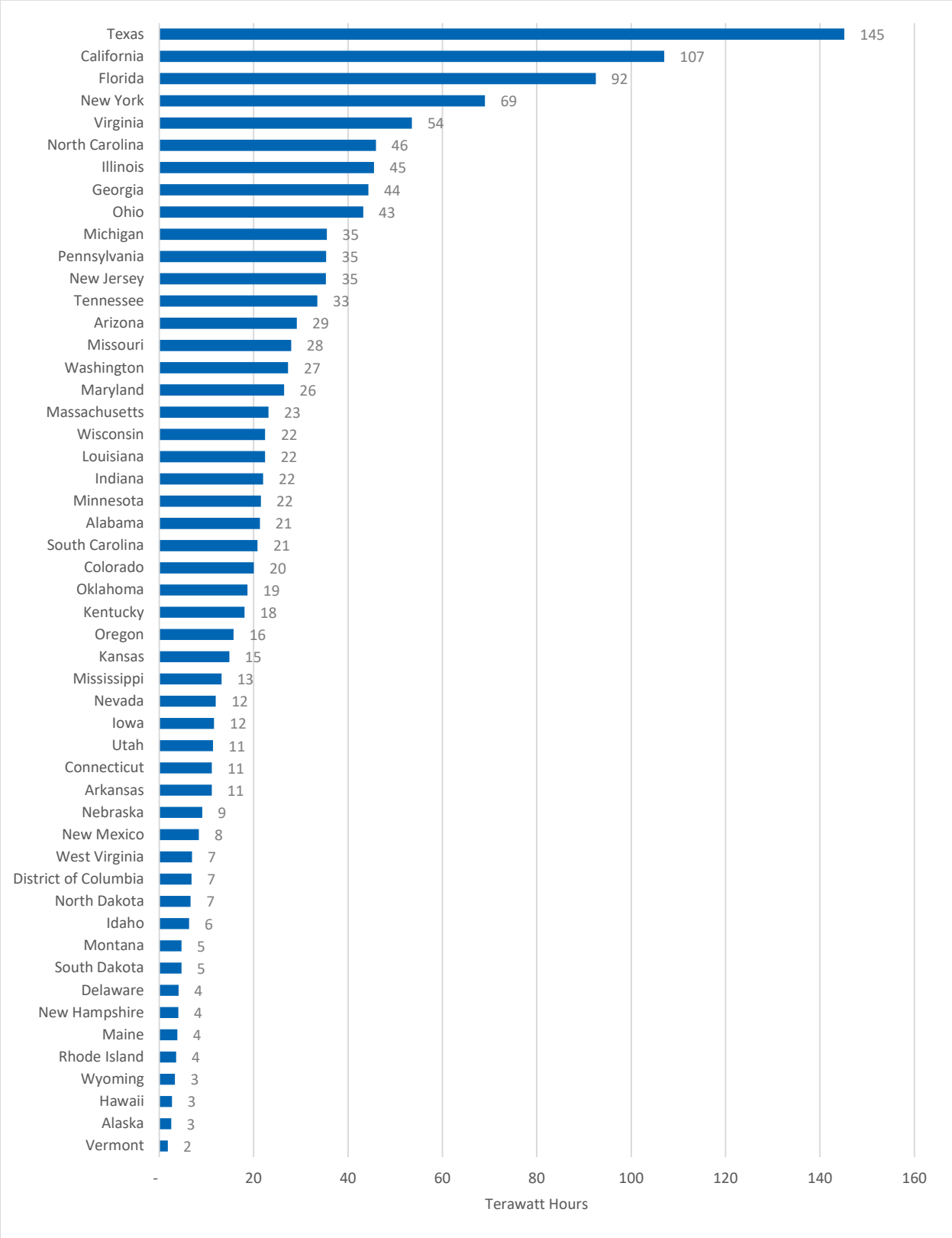


Figure 190: 2020 Electricity Used in the Commercial Sector in Terawatt Hours Map

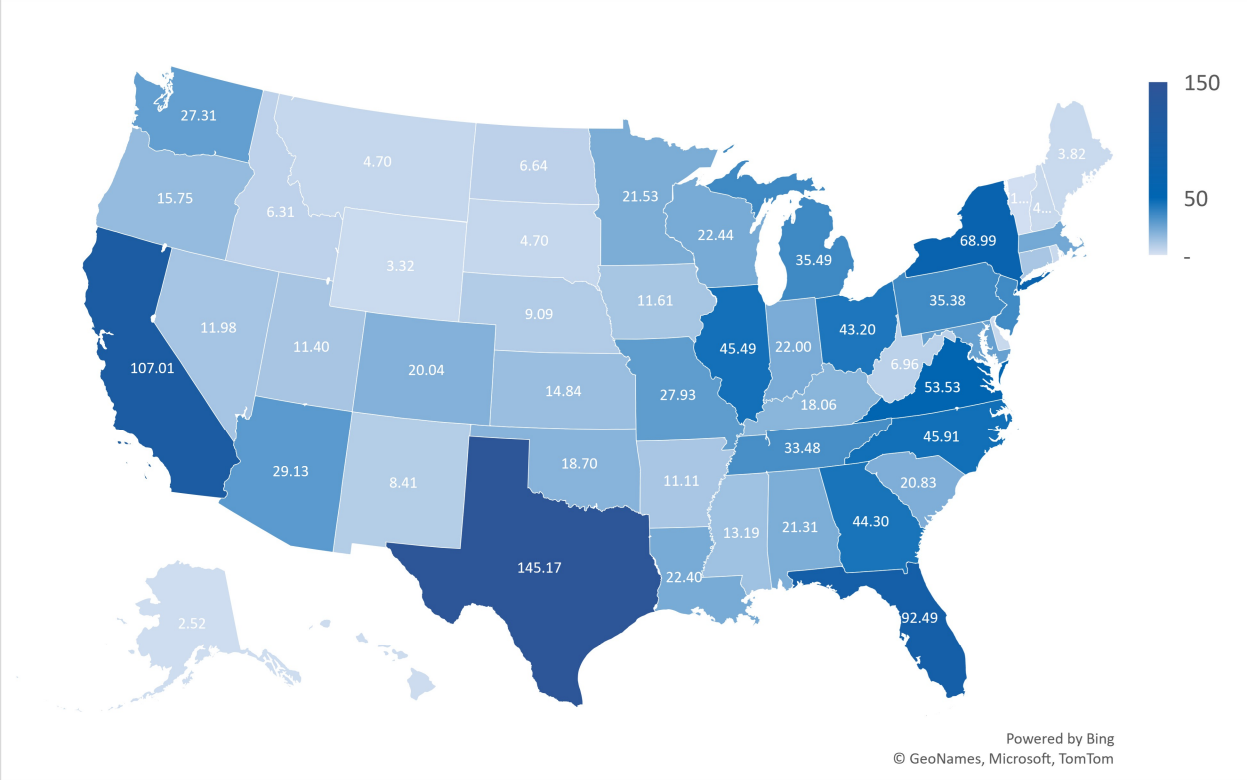


Figure 191: 2020 Natural Gas Consumed by the Commercial Sector

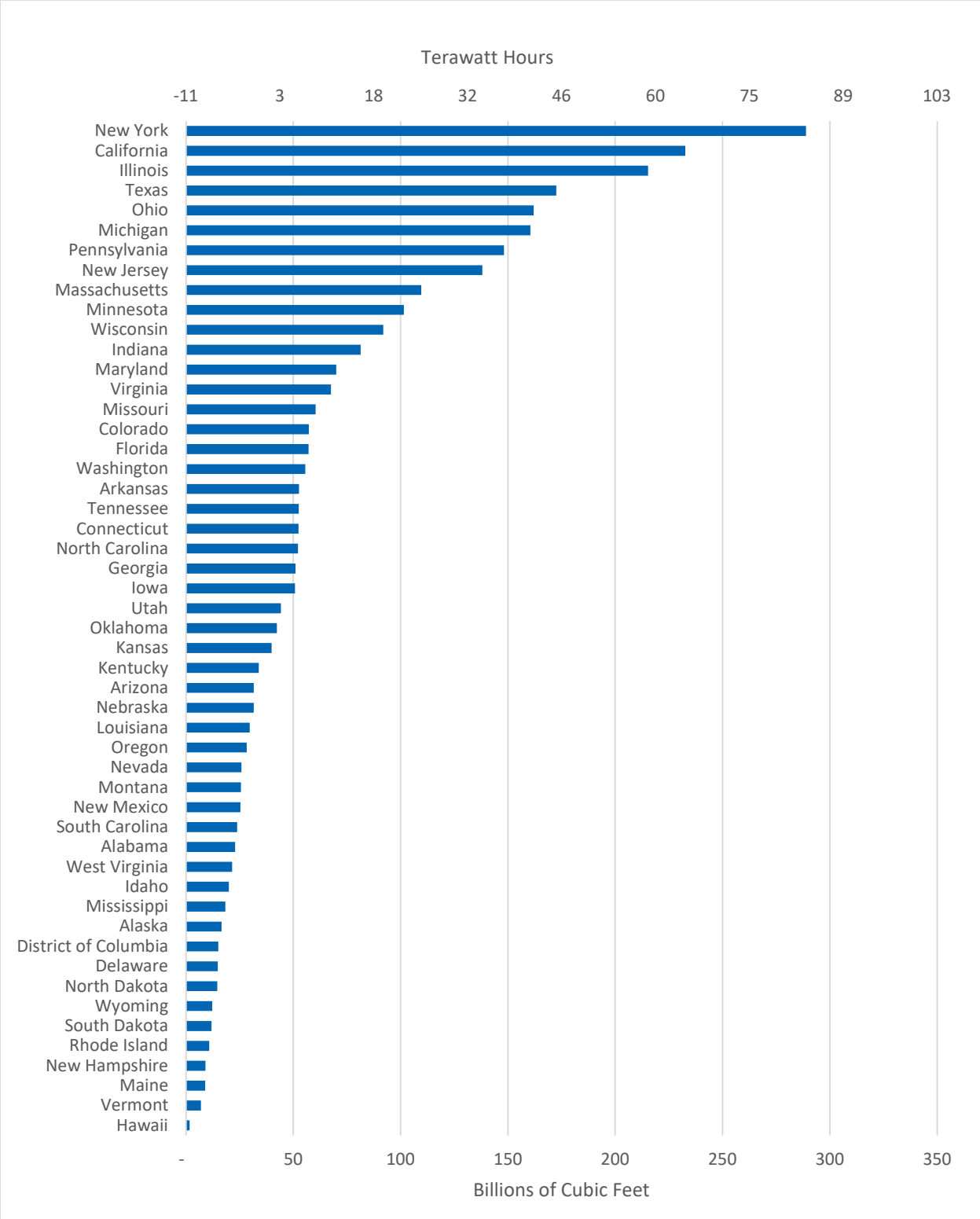


Figure 192: 2020 Natural Gas Consumed by the Commercial Sector in Billions of Cubic Feet

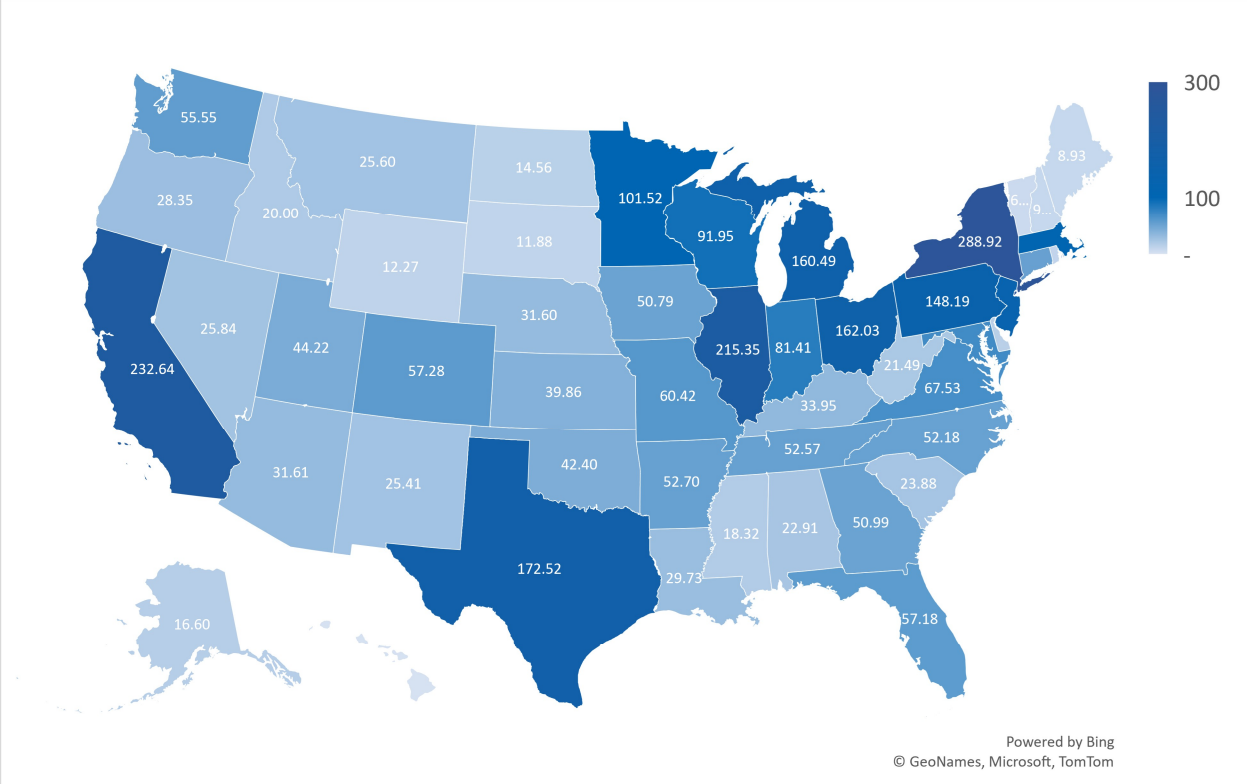


Figure 193: 2020 Other Heating Fuel Use by the Commercial Sector

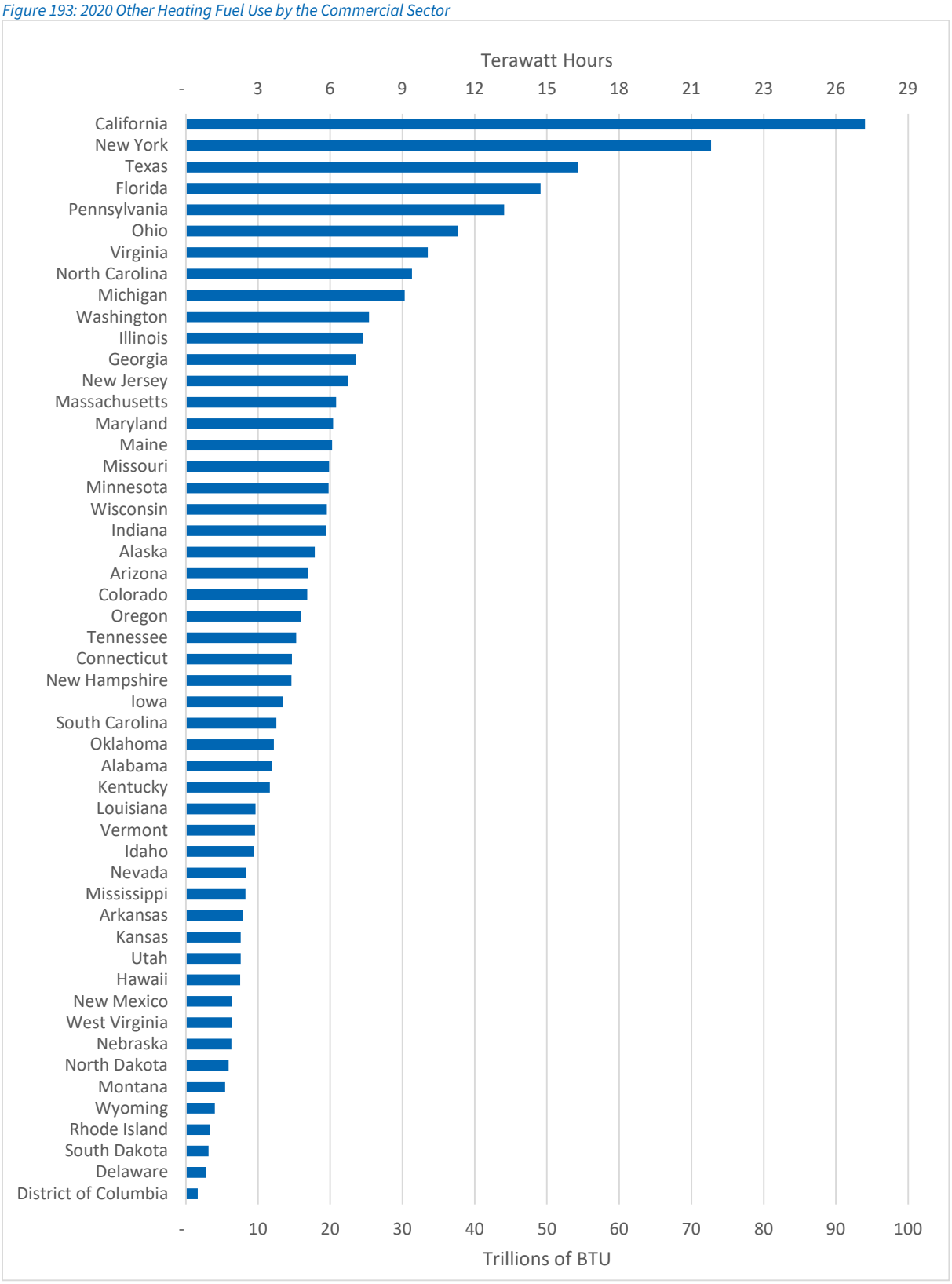


Figure 194: 2020 Other Heating Fuel Use by the Commercial Sector in Trillions of BTU

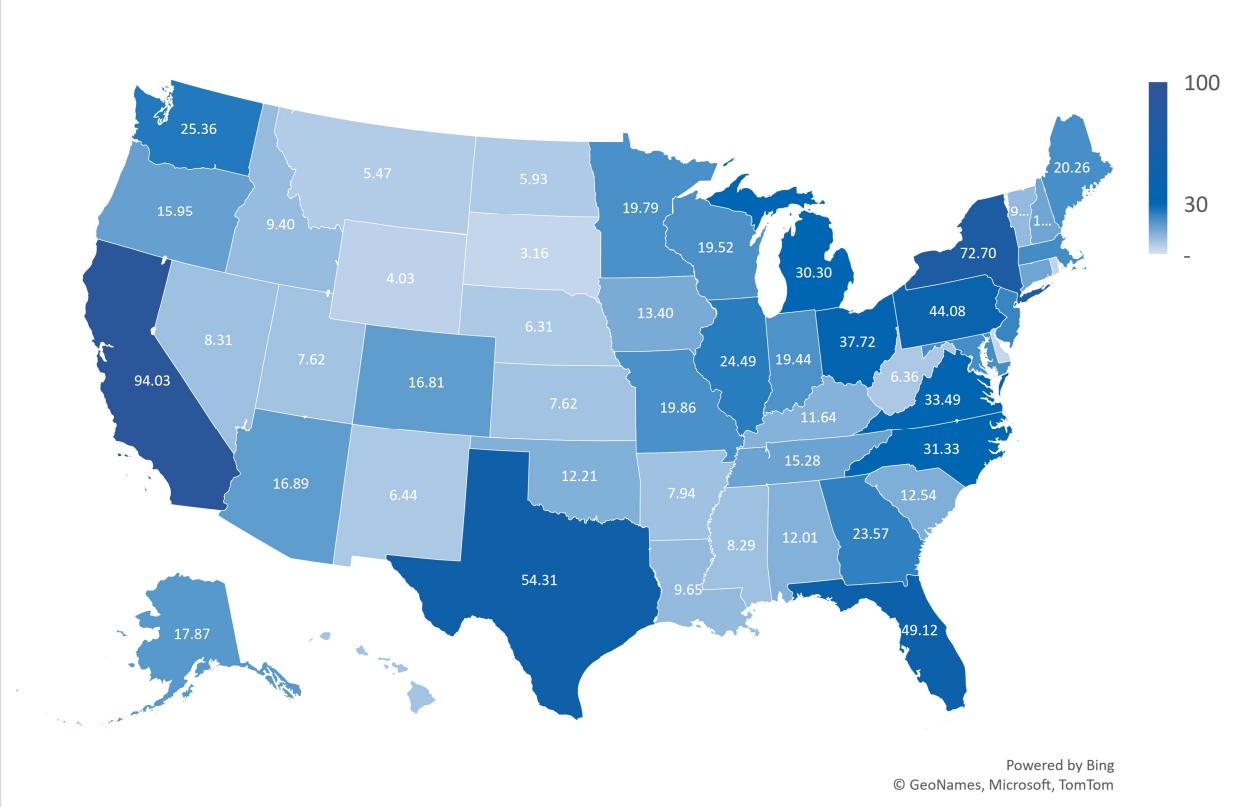


Figure 195: 2020 Electricity Used in the Industrial Sector in Terawatt Hours

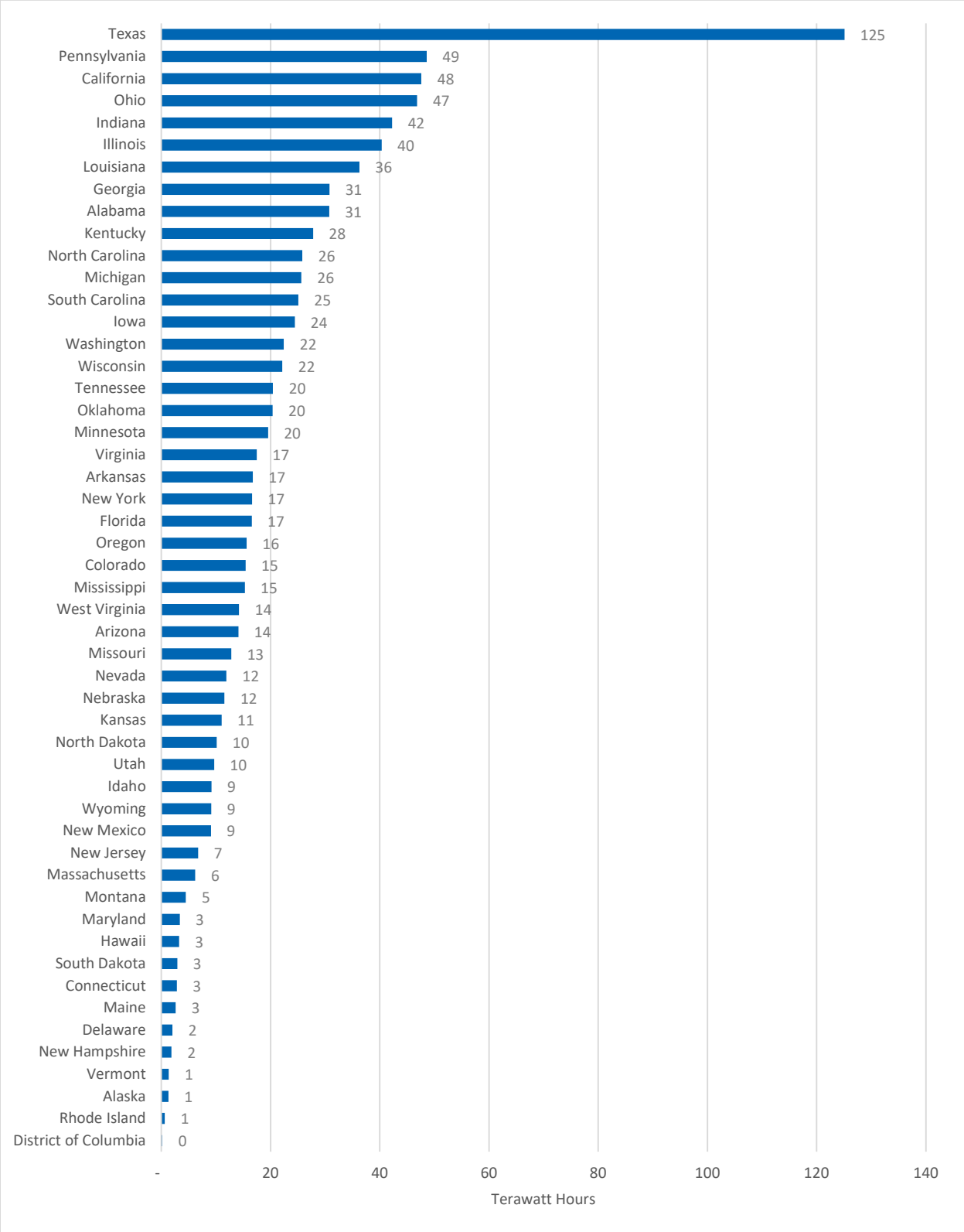


Figure 196: 2020 Electricity Used in the Industrial Sector in Terawatt Hours

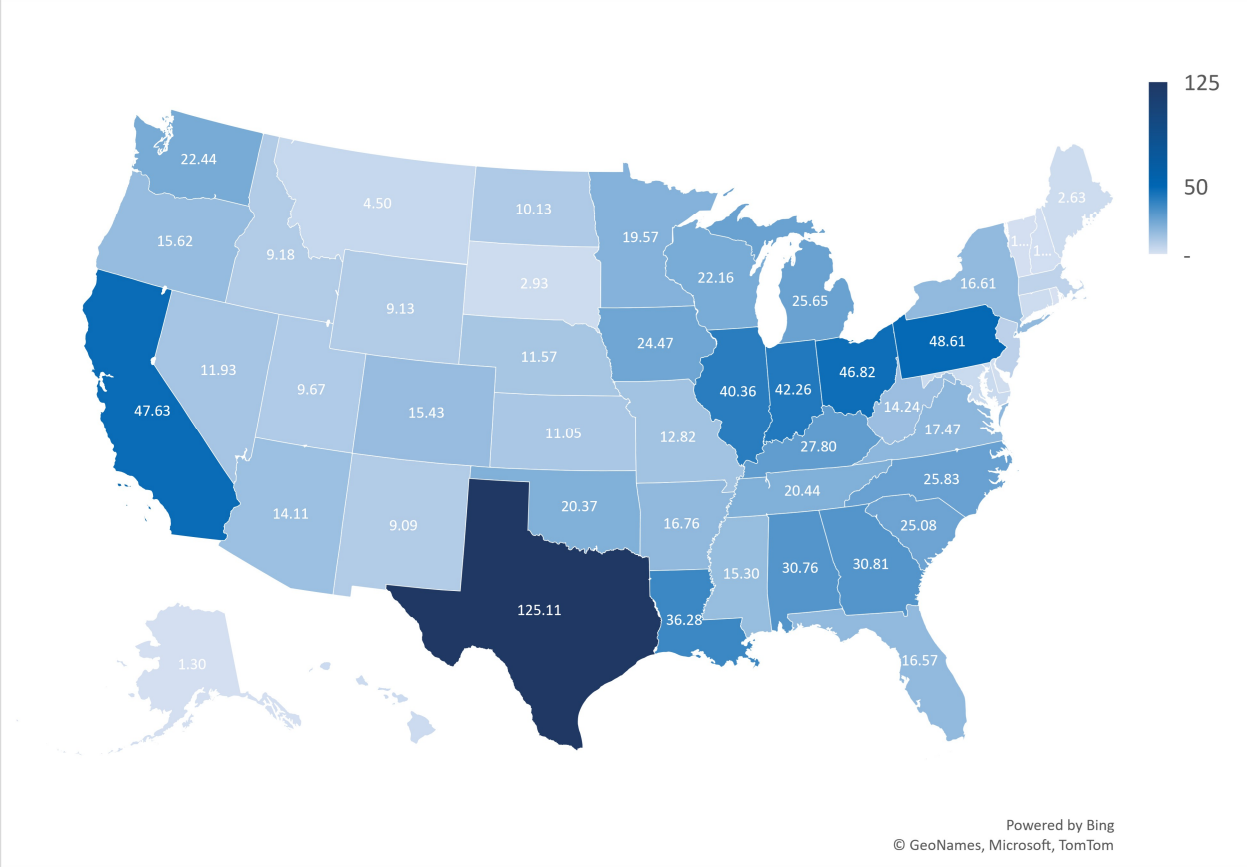


Figure 197: 2020 Natural Gas Consumed by the Industrial Sector

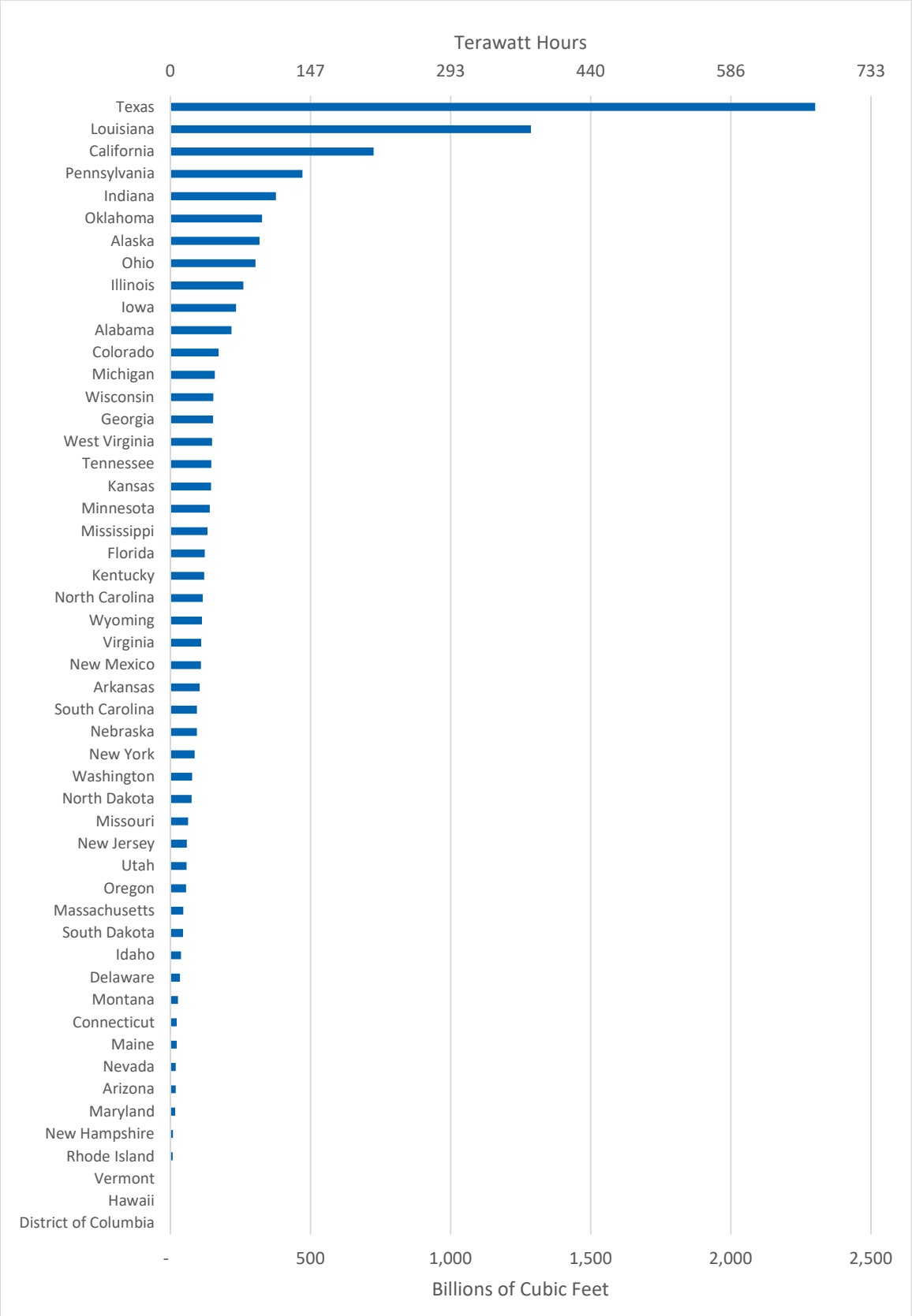


Figure 198: 2020 Natural Gas Consumed by the Industrial Sector in Billions of Cubic Feet

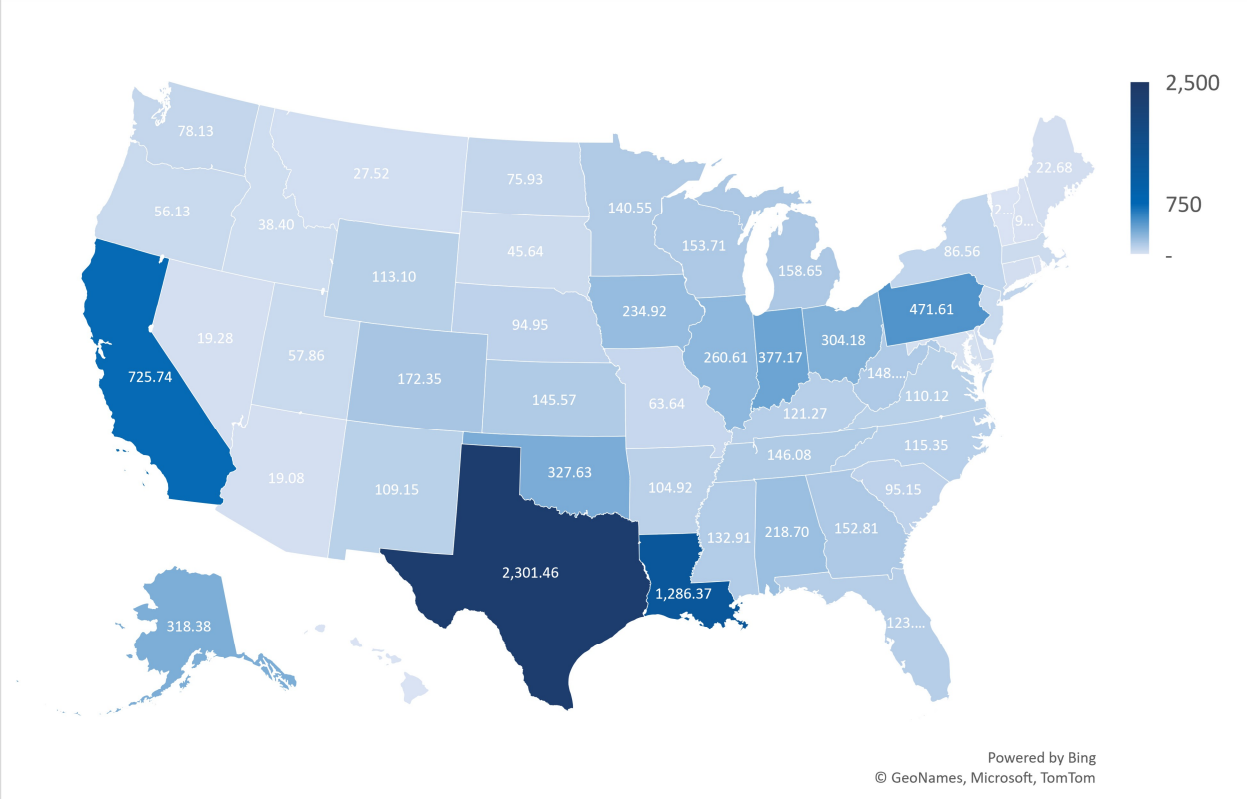


Figure 199: 2020 Other Heating Fuel Use by the Industrial Sector

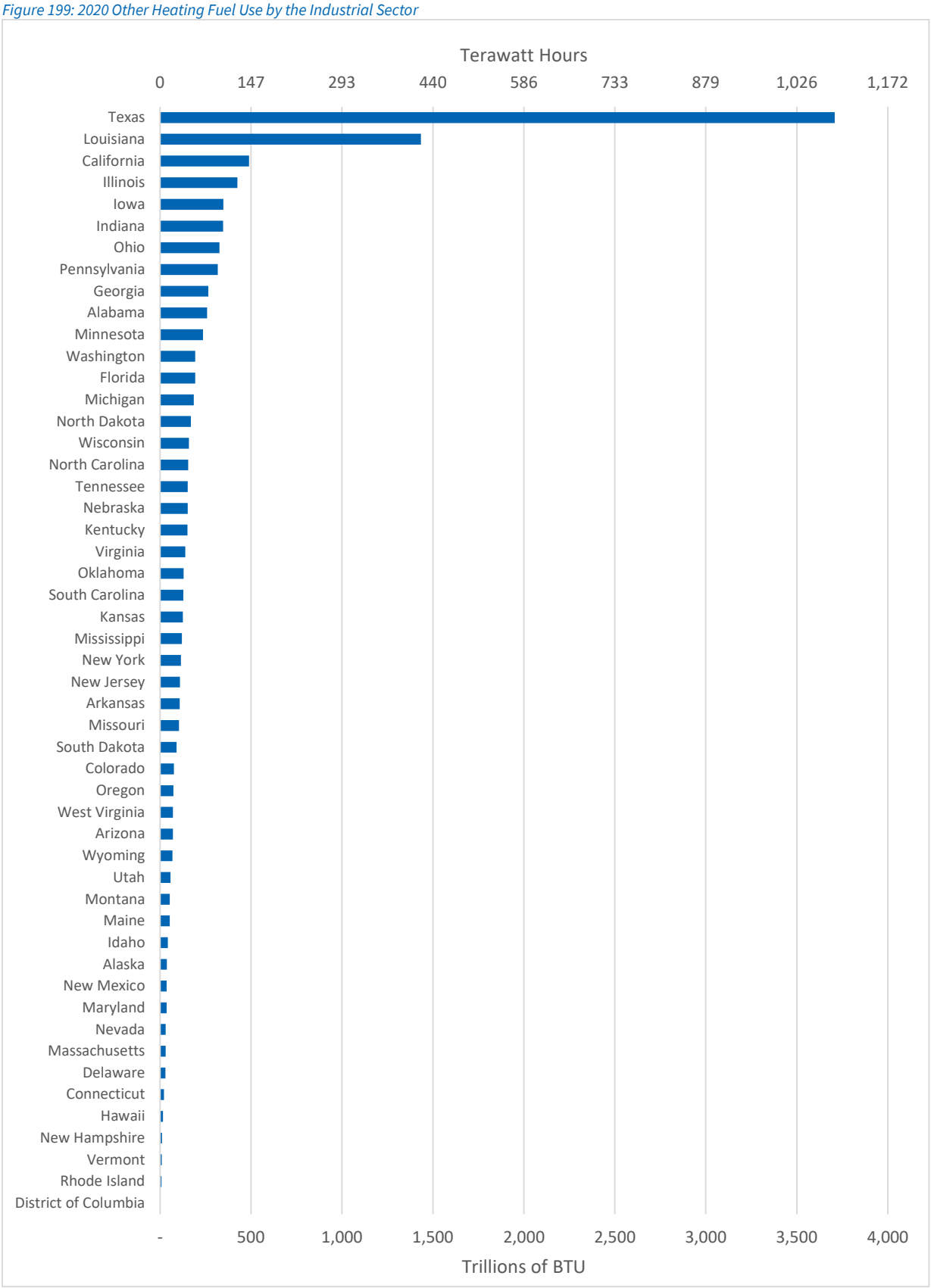


Figure 200: 2020 Other Heating Fuel Use by the Industrial Sector in Trillions of BTU