

Energy Production Data Between 2008 and 2018

Presented by:
Caitlin Cavanaugh
Andrew Kang

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Introduction

Data Source - EIA.gov

- US Energy Information Administration
- API used to gather information regarding key questions about energy production and costs

1) Key Data Points - State Rankings for Key Statistics

- Average Cost (Cents per Kilowatt Hour)
- Carbon Dioxide Production (lbs per Megawatt Hour)
- Total Carbon Dioxide Production (thousand metric tons)

2) Key Data Points - Generating Capacity

- Production Capability (MW)
- Energy Source
- Total Carbon Dioxide Production (thousand metric tons)



Key Questions	
Question #1	<ul style="list-style-type: none">• Which states have produced the most and the least CO2 emissions in lbs per MW hour at the start year (2008) and end year (2018)?• How do trends differ between CO2 Emissions (lbs per MW Hour) and Total CO2 Emissions (thousand metric tons)?
Question #2	<ul style="list-style-type: none">• How have energy costs changed from start year (2008) to end year (2018)? Have they increased, decreased, or stayed consistent?
Question #3	<ul style="list-style-type: none">• What are some factors that might make energy costs more expensive for different states?

A Note on Total CO2 Emissions (Thousand Metric Tons)

Key Takeaway:

Examining net emissions could obfuscate a state's efforts to decrease CO2 emissions over the time period

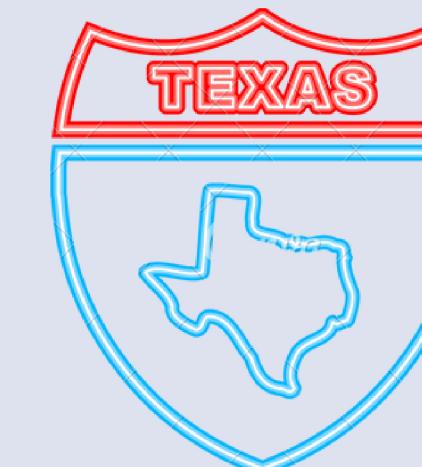
- In 2018 Texas was the #1 net carbon emitter in the United States.
- Texas is very populous and requires a large net consumption of energy, hence a large Total CO2 Emission
- When examining Texas' CO2 Emissions per MW hour against the country average, Texas falls close to the mean
- CO2 Emissions by lbs per MW Hour more accurately represents a state's CO2 Emissions

Texas Ranking in Total CO2 Emissions (thousand metric tons)

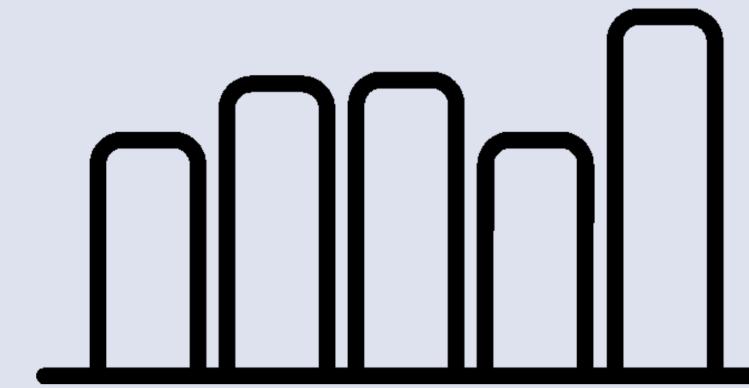
	State	Year	Energy Source	Average Price (Cents per KW Hour)	CO2 Emissions (lbs per MW Hour)	Total CO2 Emissions (thousand metric tons)
49	Texas	2008	Natural Gas		10.99	1373
49	Texas	2018	Natural Gas		8.48	1060

Texas Ranking in CO2 Emissions(lbs per MW Hour)

	State	Year	Energy Source	Average Price (Cents per KW Hour)	CO2 Emissions (lbs per MW Hour)	Total CO2 Emissions (thousand metric tons)
26	Texas	2008	Natural Gas		10.99	1373
28	Texas	2018	Natural Gas		8.48	1060



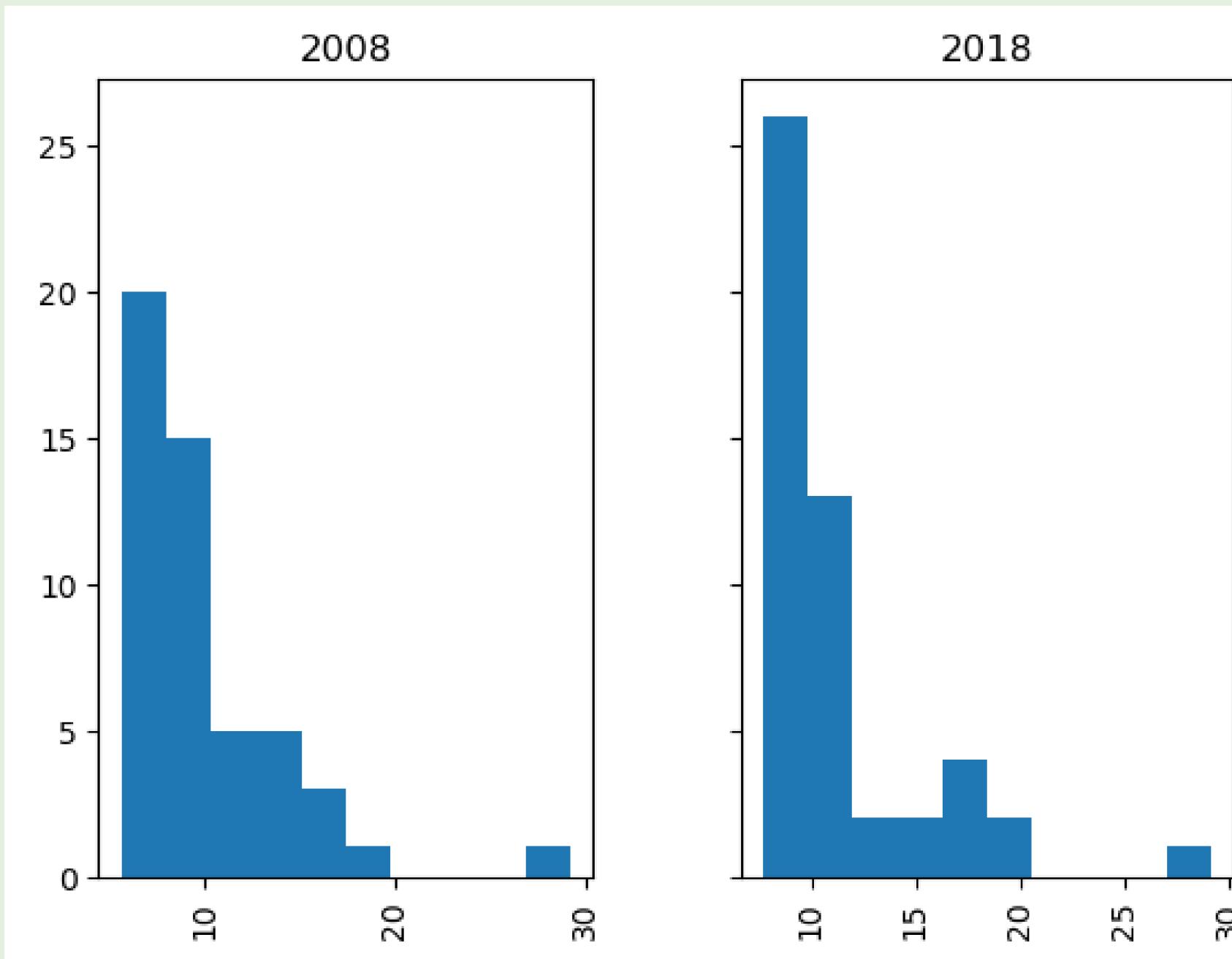
DataFrame Head of Key Statistics



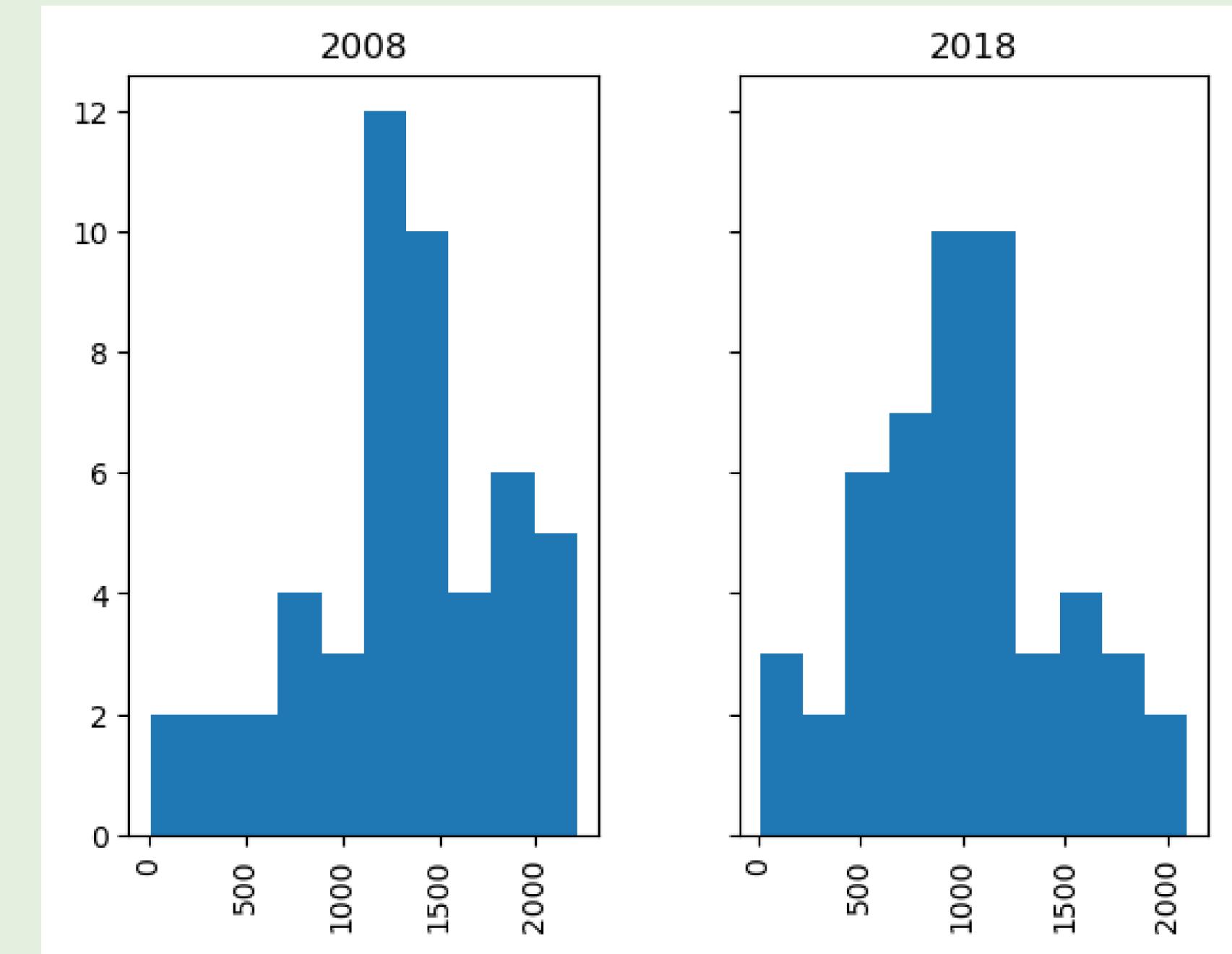
	State	2008 Average Price (Cents per KW Hour)	2018 Average Price (Cents per KW Hour)	Change in Average Price (Cents per KW Hour)	Percent Change in Average Price (Cents per KW Hour)	2008 CO2 Emissions (lbs per MW Hour)	2018 CO2 Emissions (lbs per MW Hour)	Change in CO2 Emissions (lbs per MW Hour)	Percent Change in CO2 Emissions (lbs per MW Hour)	2008 Total CO2 Emissions (thousand metric tons)	2018 Total CO2 Emissions (thousand metric tons)	Change in Total CO2 Emissions (thousand metric tons)	Percent Change in Total CO2 Emissions (thousand metric tons)
0	West Virginia	5.61	8.72	3.11	0.554367	2043	1970	-73	-0.035732	84610	60203	-24407	-0.288465
1	Wyoming	5.67	8.09	2.42	0.426808	2216	2100	-116	-0.052347	46837	44014	-2823	-0.060273
2	Idaho	5.69	8.17	2.48	0.435852	187	214	27	0.144385	1017	1766	749	0.736480
3	Kentucky	6.26	8.52	2.26	0.361022	2114	1850	-264	-0.124882	94028	66267	-27761	-0.295242
4	Utah	6.49	8.21	1.72	0.265023	1860	1595	-265	-0.142473	39381	28544	-10837	-0.275183
5	Washington	6.55	8.00	1.45	0.221374	272	201	-71	-0.261029	13686	10661	-3025	-0.221029
6	Nebraska	6.58	9.02	2.44	0.370821	1526	1519	-7	-0.004587	22460	25525	3065	0.136465
7	North Dakota	6.69	8.91	2.22	0.331839	2210	1615	-595	-0.269231	32887	31282	-1605	-0.048803
8	Missouri	6.84	9.93	3.09	0.451754	1877	1697	-180	-0.095898	77650	65623	-12027	-0.154887
9	Iowa	6.89	8.92	2.03	0.294630	1912	1189	-723	-0.378138	46137	34253	-11884	-0.257581
10	Indiana	7.09	9.75	2.66	0.375176	2118	1775	-343	-0.161945	124660	91554	-33106	-0.265570

Histograms and P-Values

Average Price (Cents per KW Hour)



CO2 Emissions (lbs per MW Hour)



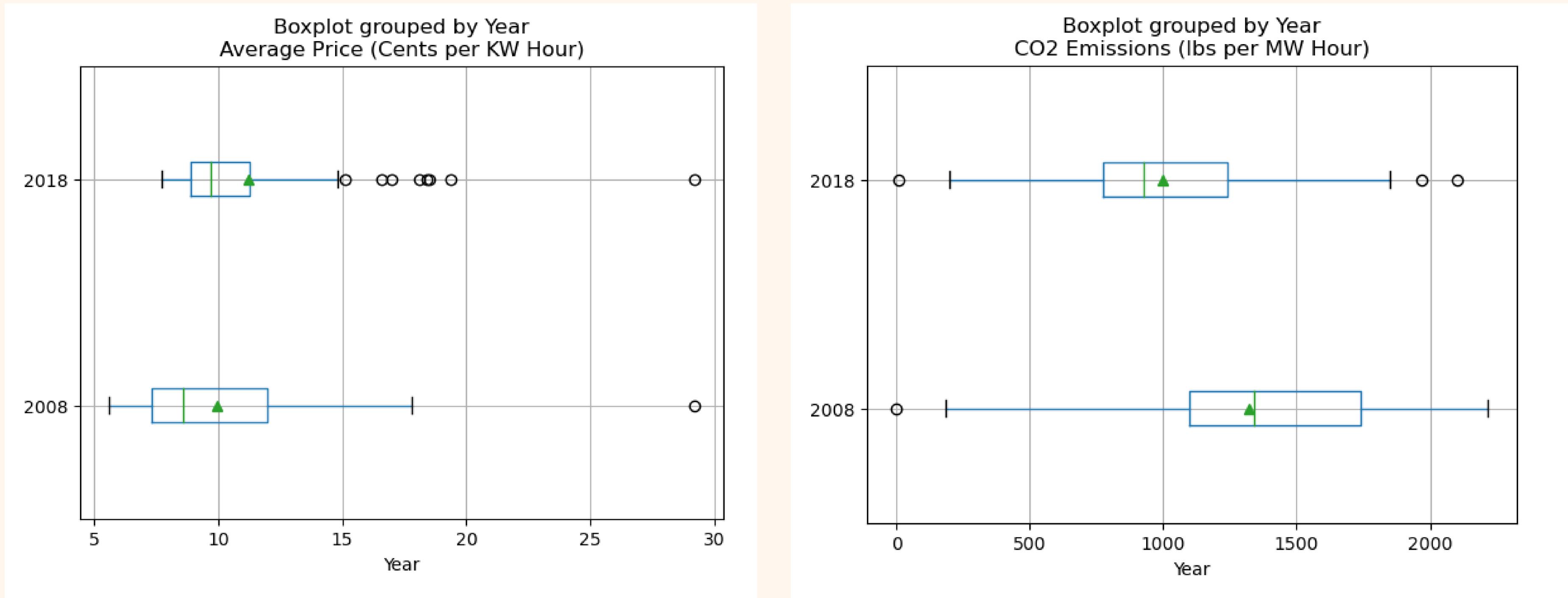
P-Values:

CO2 Emissions (lbs per MW Hour): P-Value=0.0021

Average Price (Cents per KW Hour): P-Value=0.1302

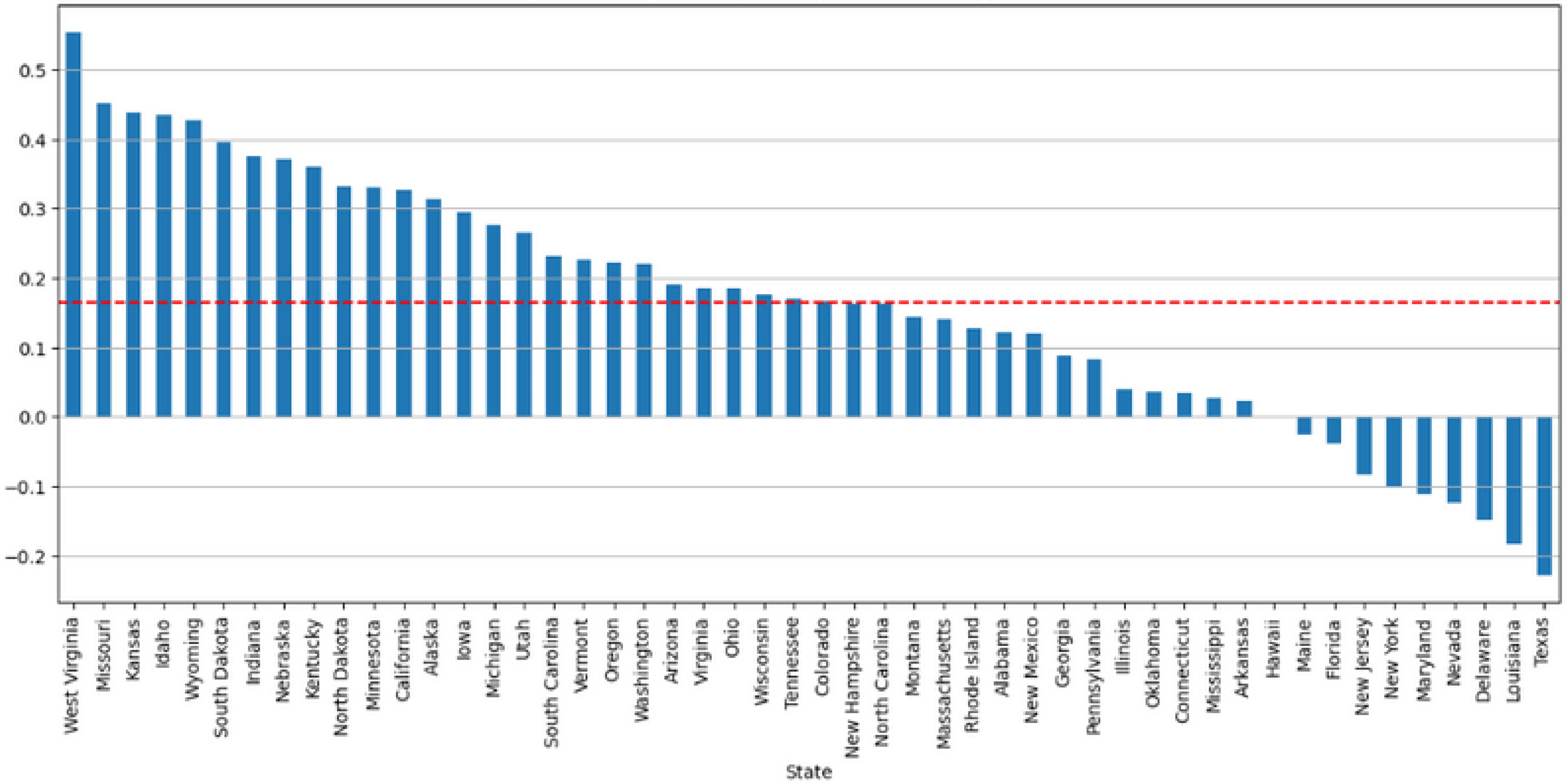
Total CO2 Emissions (thousand metric tons): P-Value=0.1528

Box Plots and Initial Stats

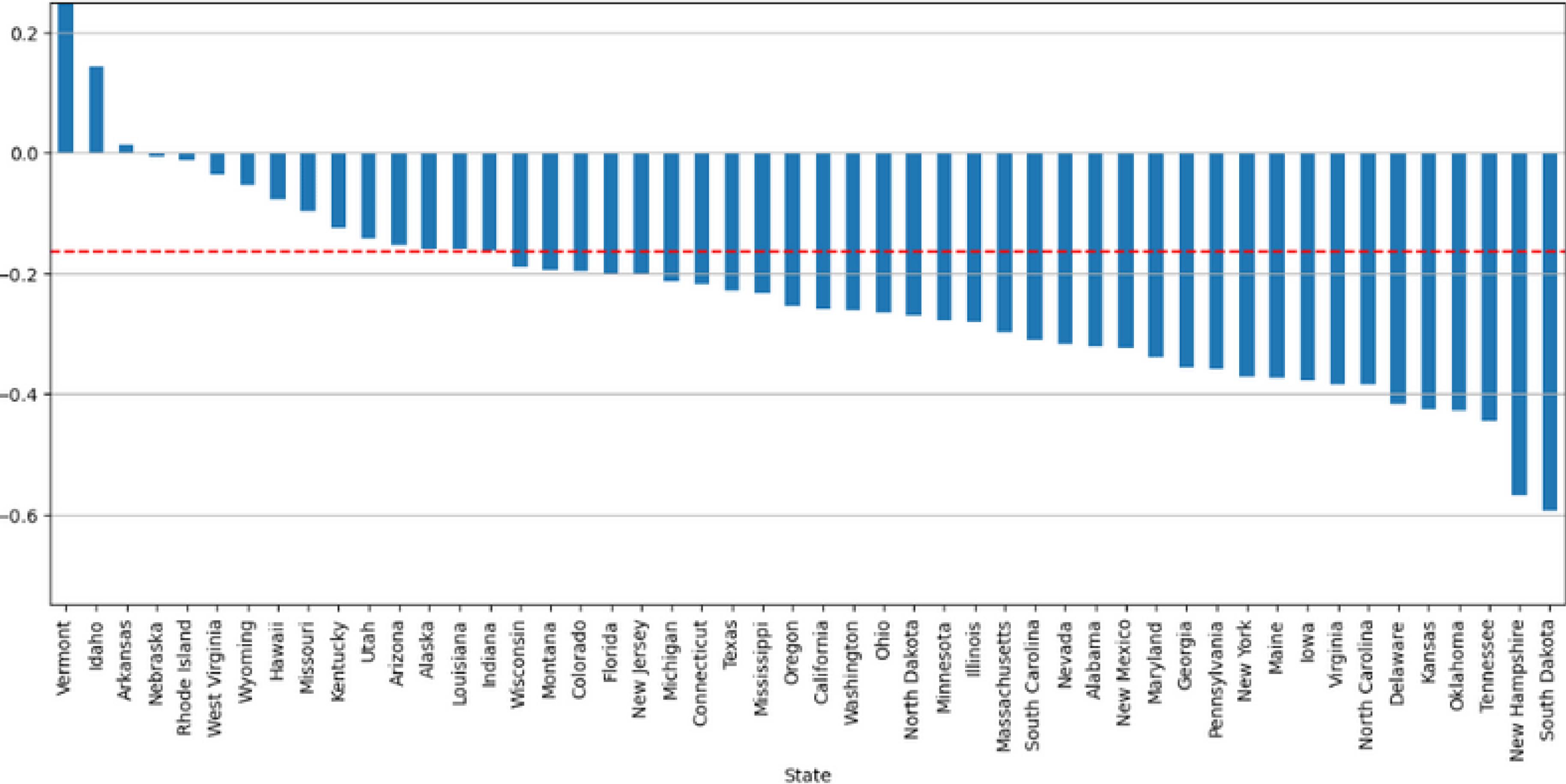


- Both box plots support the results of T-test P-Values
 - Means and medians of Average Price did not change much
 - Means and medians of CO2 Emissions had more change

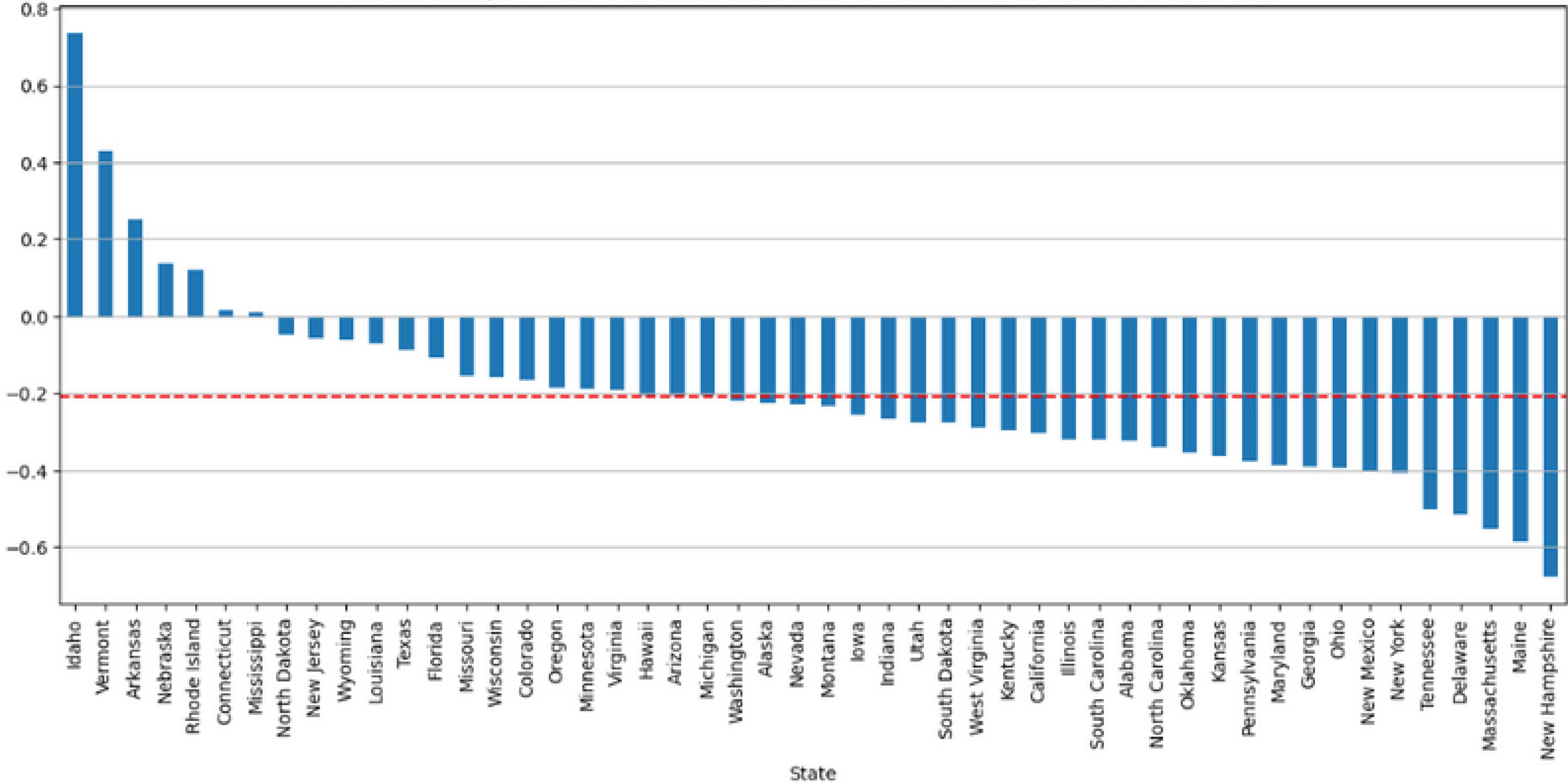
Percent Change in Average Price (Cents per KW Hour) by state from 2008-2018



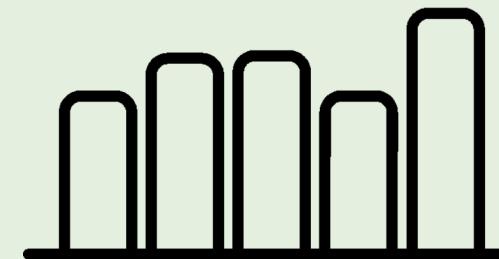
Percent Change in CO2 Emissions(lbs per MW Hour) by State from 2008-2018



Percent Change in Total CO2 Emissions(thousand metric tons) by state from 2008-2018

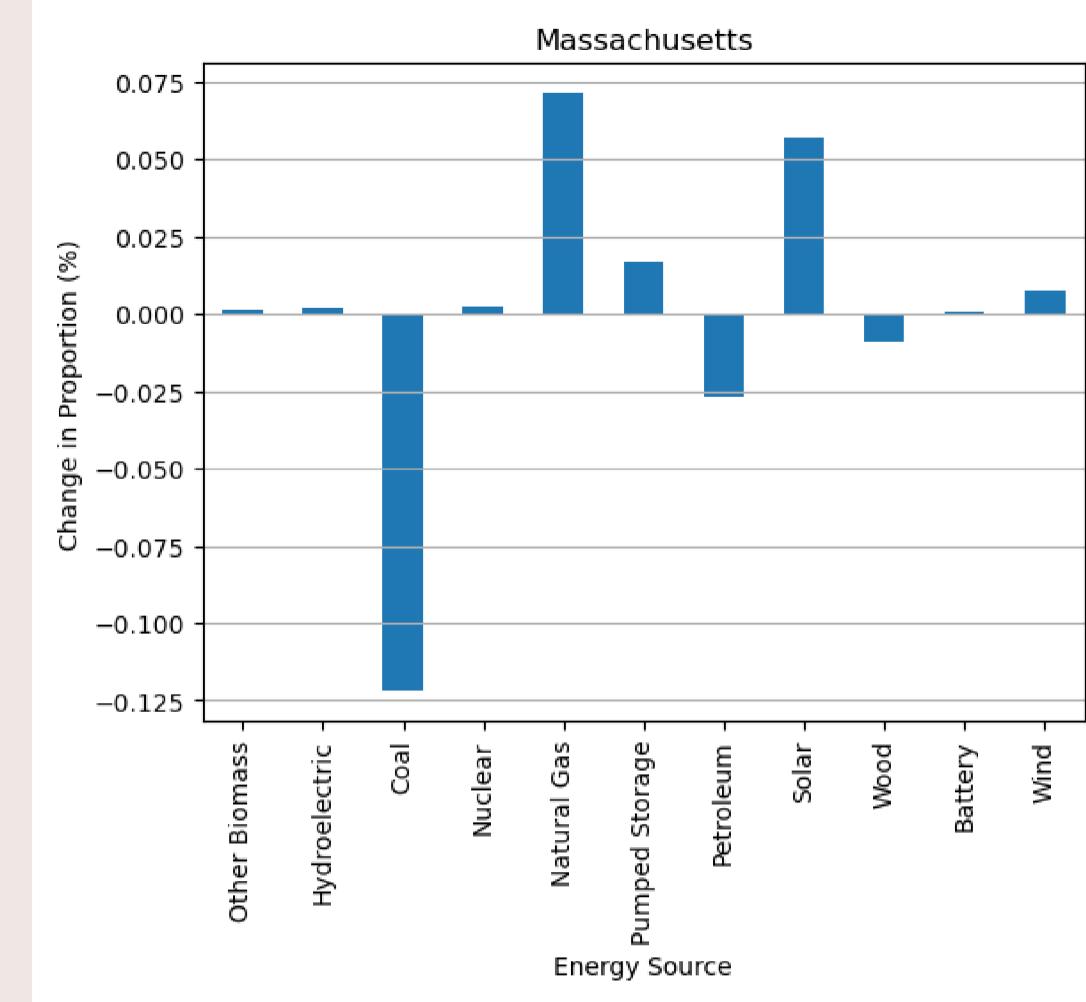
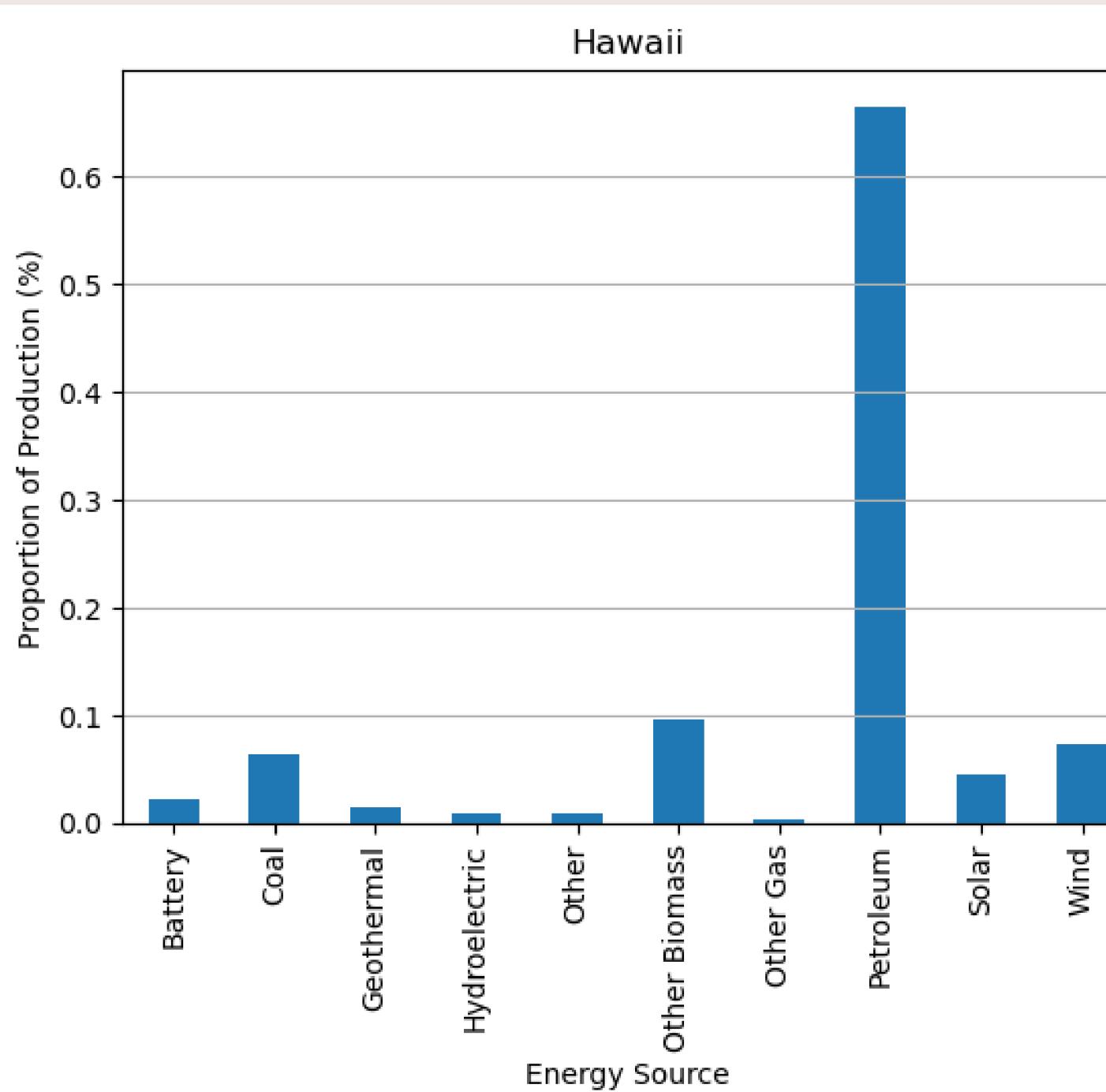


DataFrame Head of Energy Production Statistics

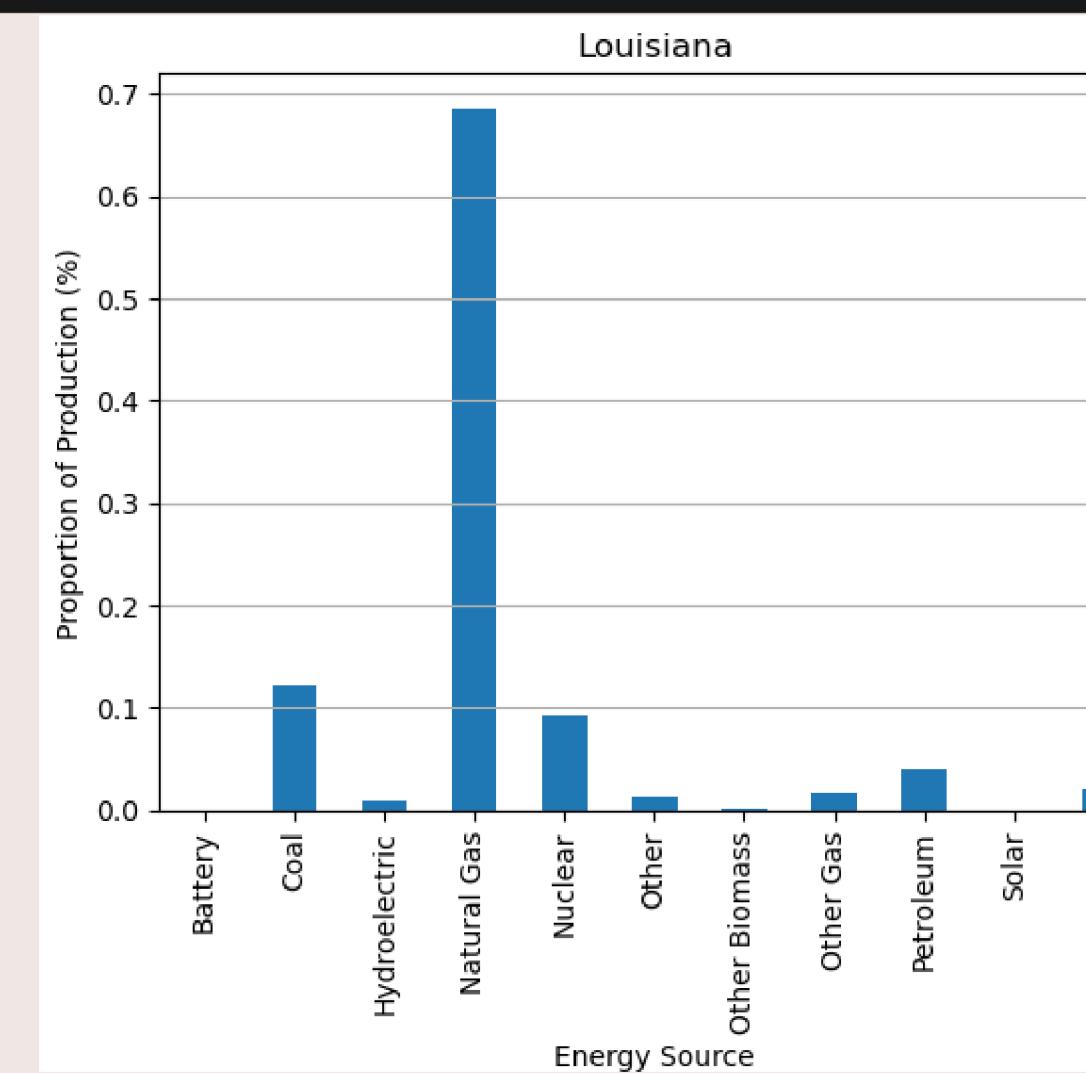


	State	Energy Source	2008 Production Capability (MW)	2018 Production Capability (MW)	Change in Production Capability (MW)	2008 Proportion of Production	2018 Proportion of Production	Percent Change in Proportion
0	Hawaii	Other Gas	9.0	6.4	-2.6	0.003694	0.002276	-0.001417
1	Hawaii	Battery	0.0	61.0	61.0	0.000000	0.021697	0.021697
2	Hawaii	Coal	180.0	180.0	0.0	0.073870	0.064025	-0.009845
3	Hawaii	Wind	63.8	205.6	141.8	0.026183	0.073131	0.046948
4	Hawaii	Other Biomass	108.6	266.9	158.3	0.044568	0.094935	0.050366
...
78	Wyoming	Wind	680.4	1487.3	806.9	0.095234	0.171484	0.076250
79	Wyoming	Coal	5931.9	6406.0	474.1	0.830275	0.738606	-0.091669
80	Wyoming	Other	11.5	12.4	0.9	0.001610	0.001430	-0.000180
81	Wyoming	Natural Gas	119.5	260.5	141.0	0.016726	0.030035	0.013309
82	Wyoming	Petroleum	6.6	5.8	-0.8	0.000924	0.000669	-0.000255

Key States



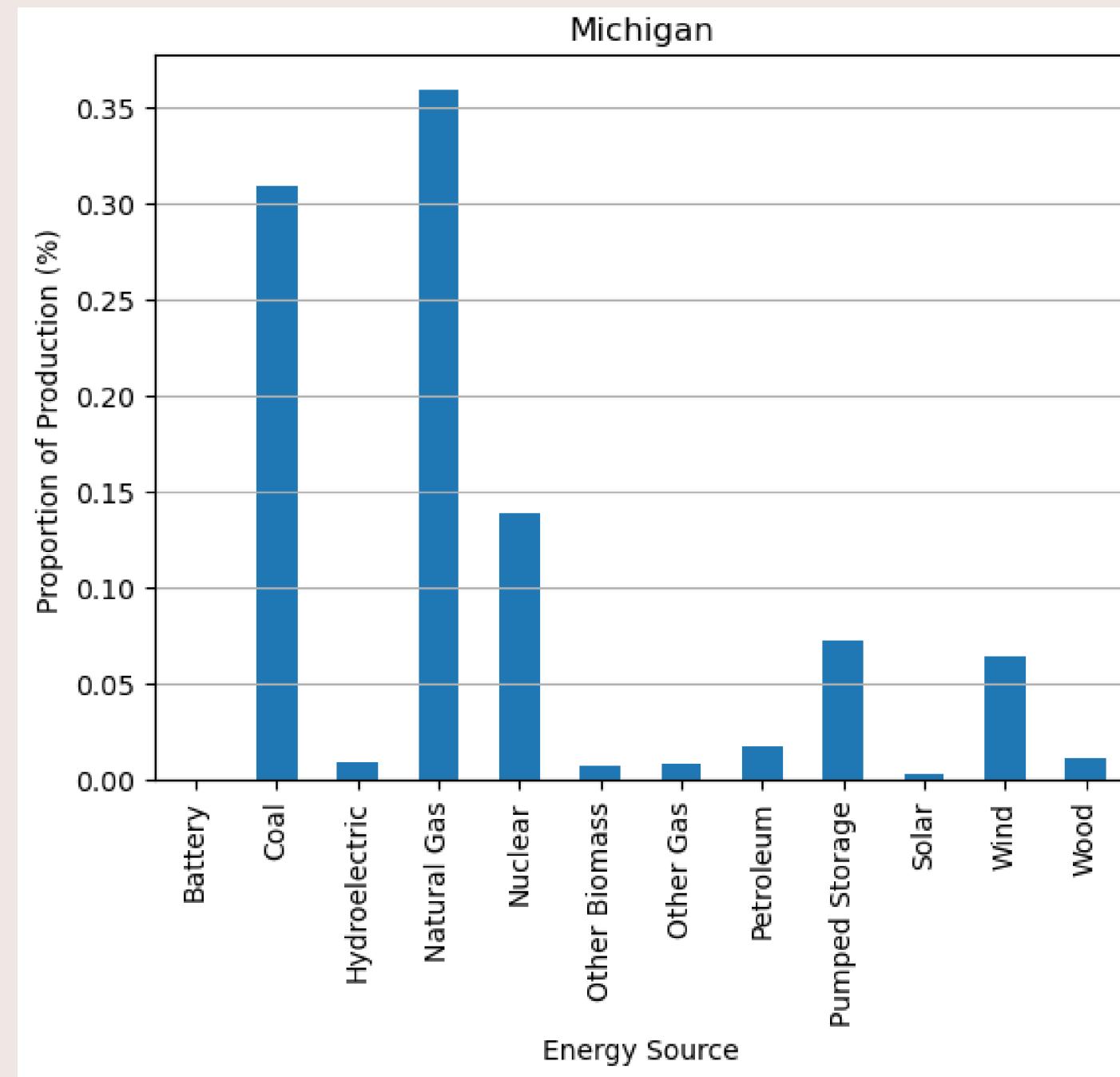
- **Massachusetts:** highest price at the upper bound of energy cost in 2008 (16.23)
 - Average Energy cost in 2018 was (18.50)



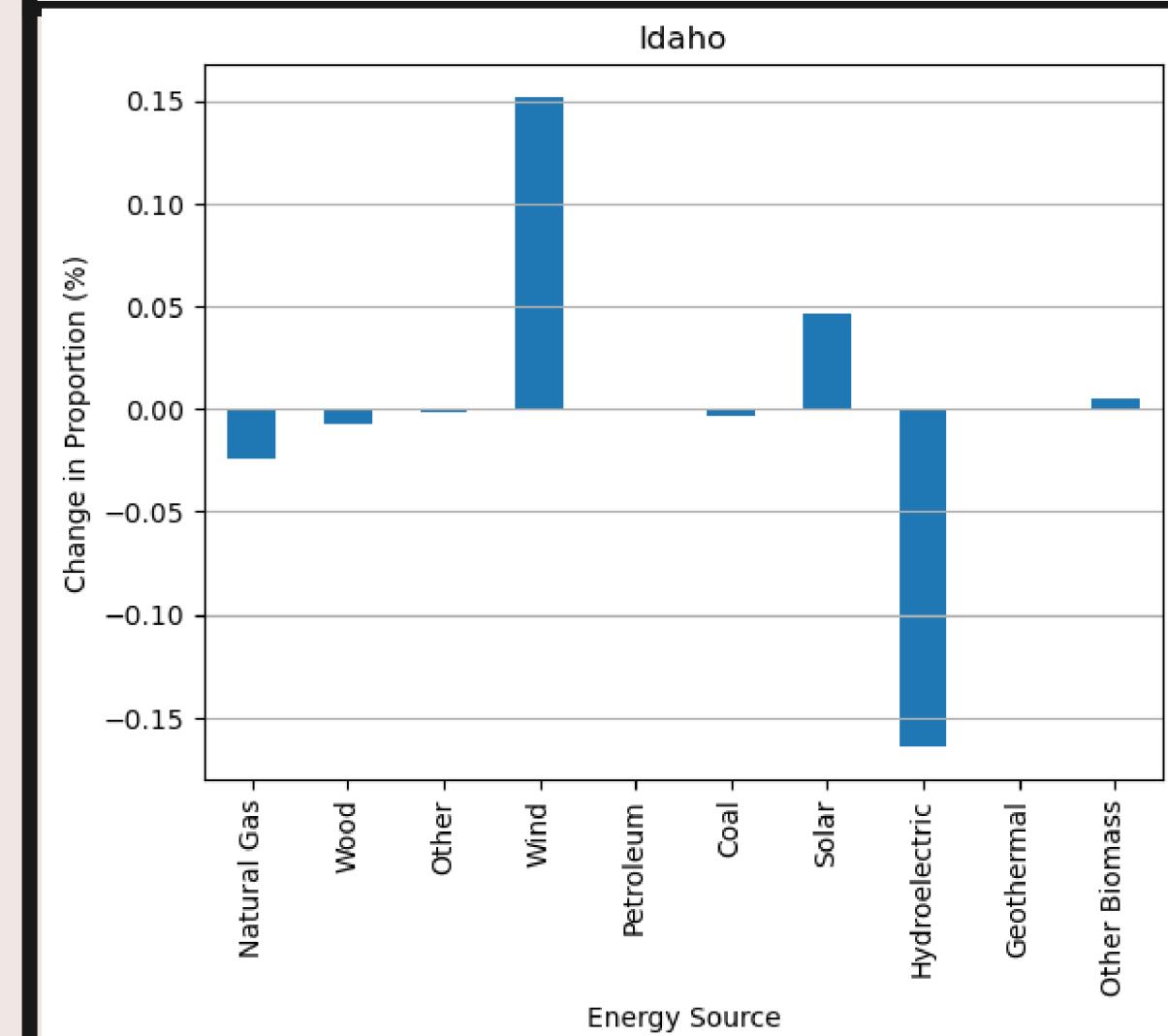
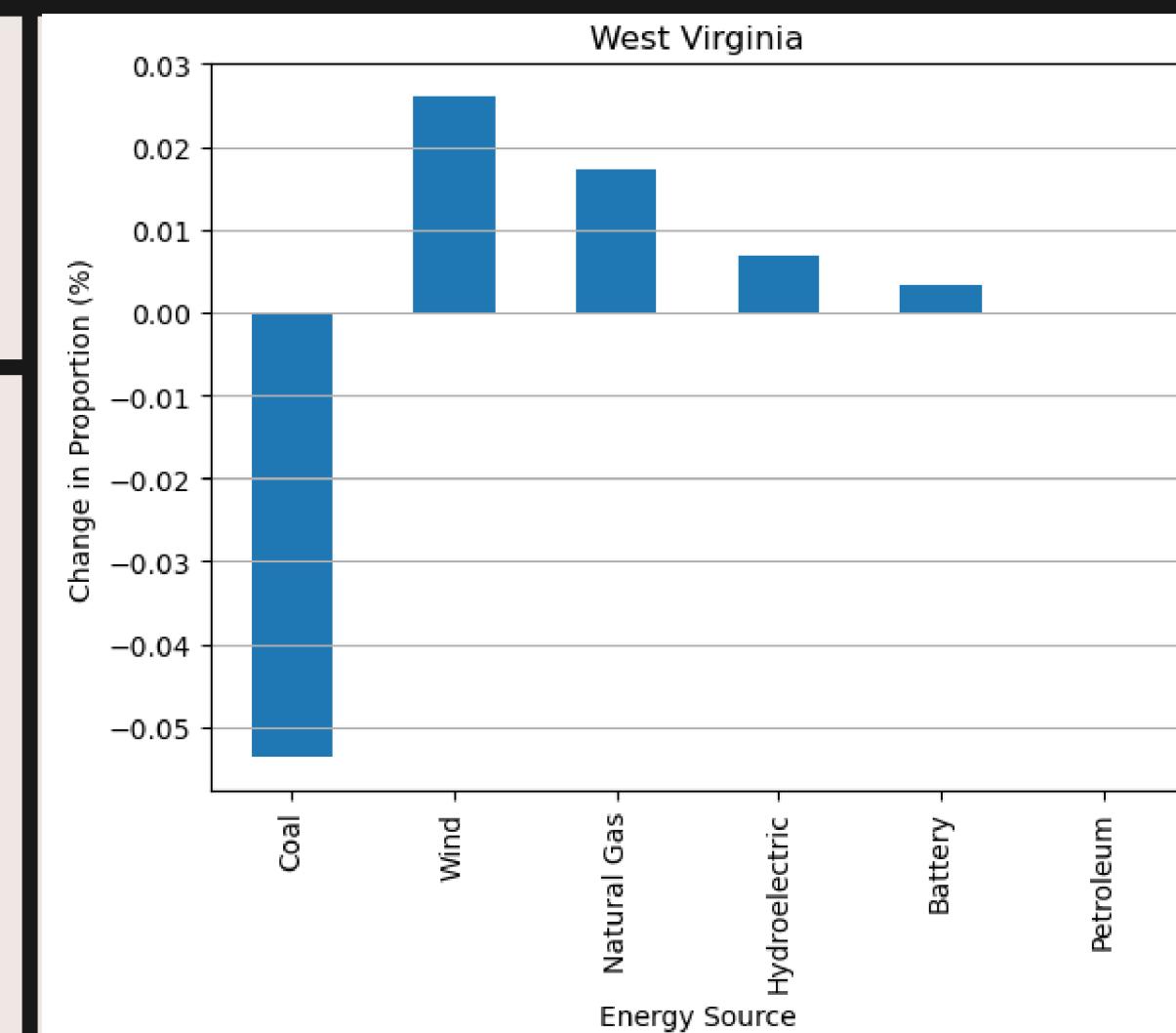
- **Louisiana:** The state with the least expensive electricity in 2018 (7.71)

- **Hawaii:** The state with the most expensive electricity in 2008 and 2018 to the point of being a possible outlier (29.20 & 29.18 respectively)

Key States(cont.)



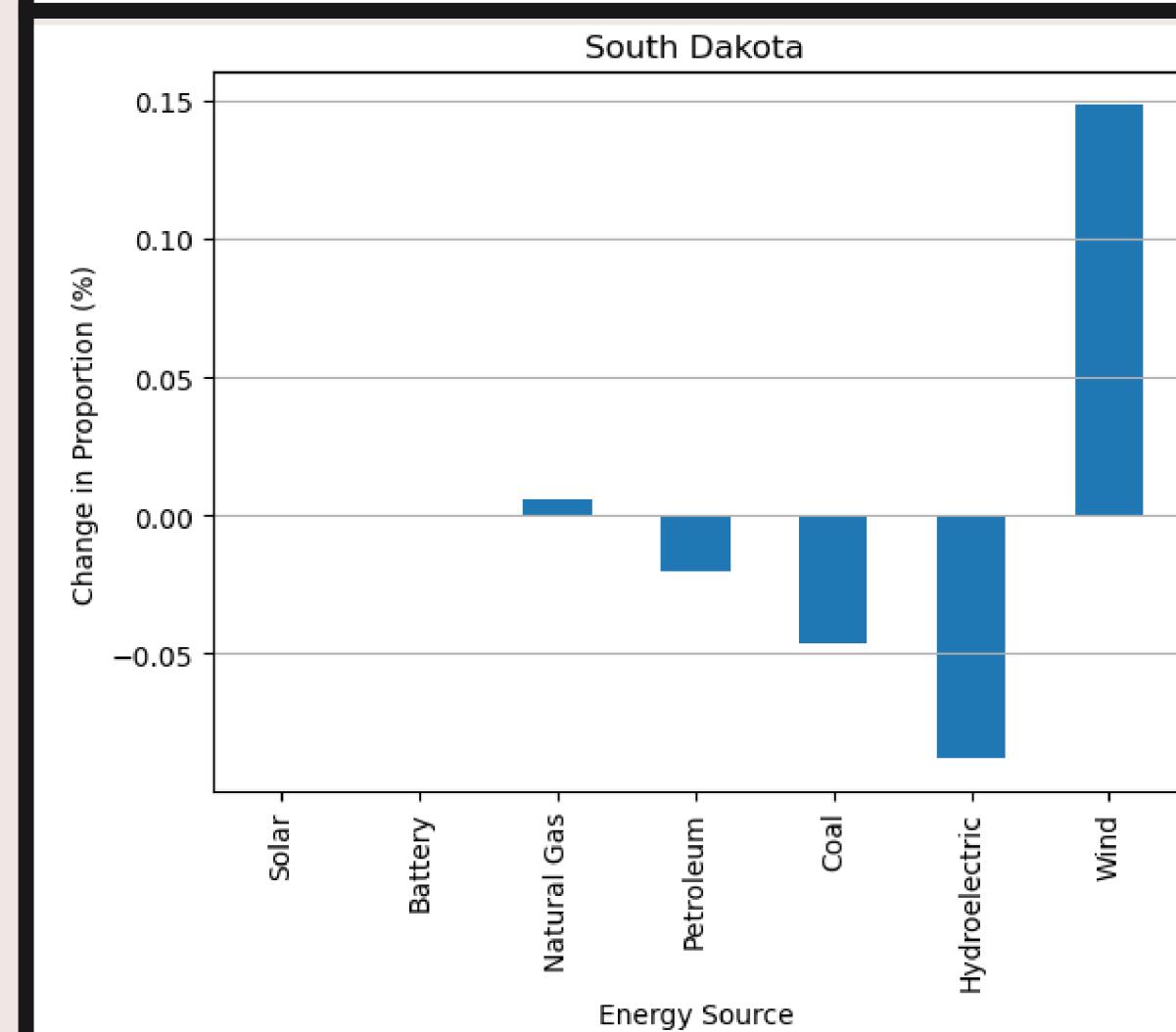
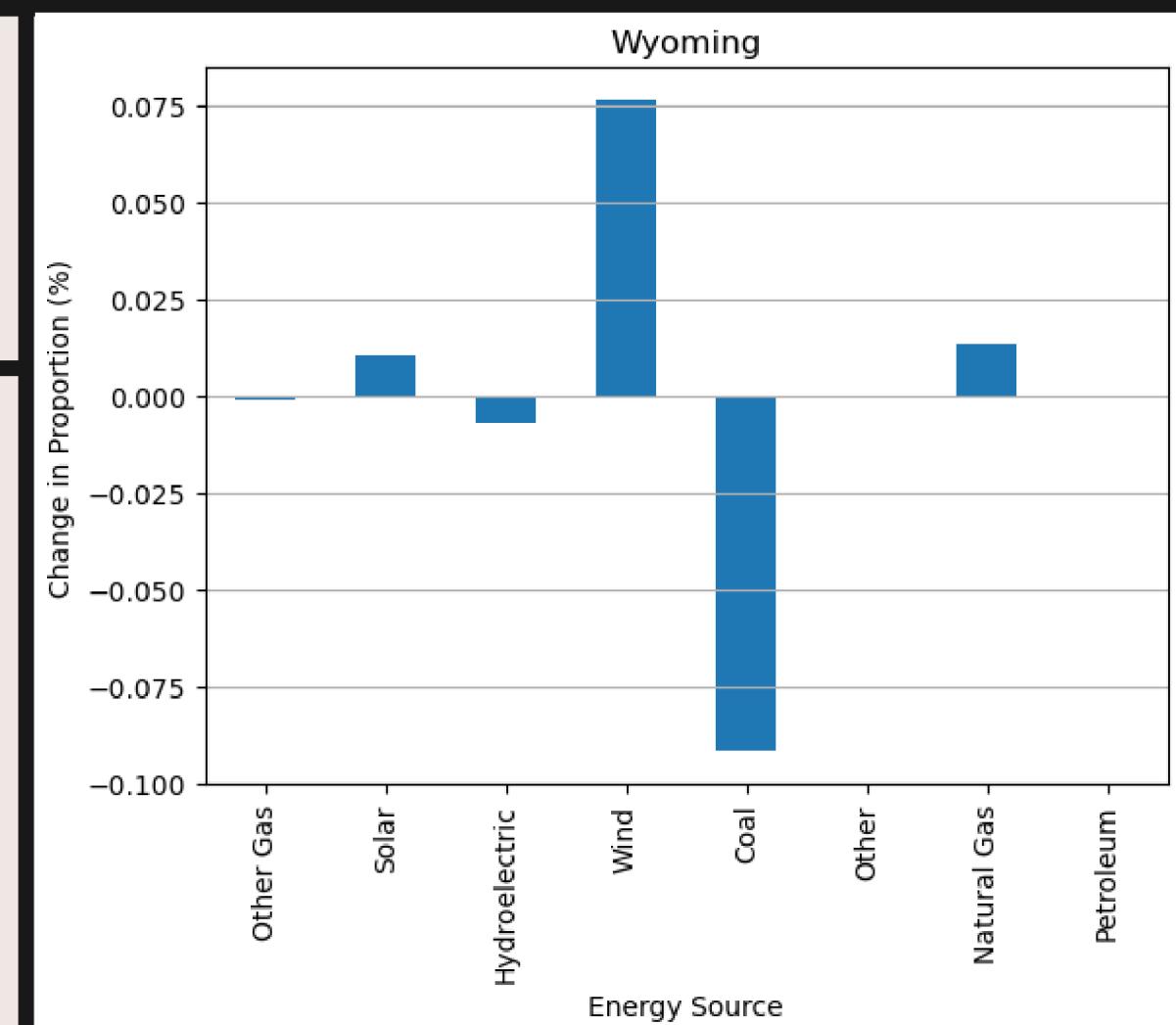
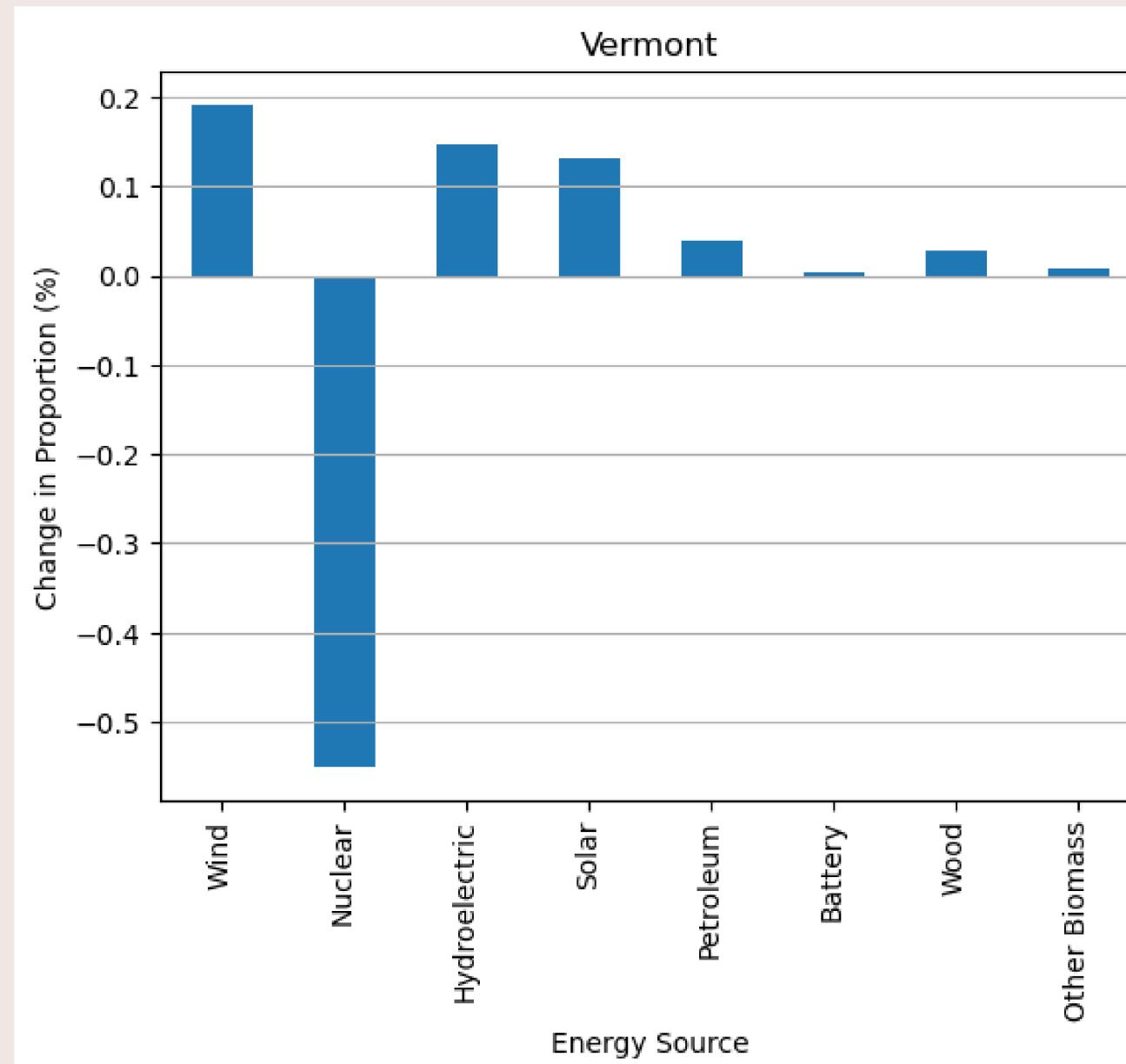
- **Michigan:** The state closest to the mean of all states in 2018 in average price per KW hour (11.40)



- **West Virginia:** Greatest percent change in average price per KW hour (+55.4%)

- **Idaho:** Greatest percent change in total CO₂ Emissions in thousand metric tons (+73.6%)

Key States(cont.)



- **Vermont:** The state with the lowest lbs of CO₂ emissions per MW Hour of energy produced in 2008 and 2018 (2 & 10 respectively)

- **Wyoming:** The state with the highest lbs of CO₂ emissions per MW Hour of energy produced in 2008 and 2018 (2216 & 2100 respectively)

- **South Dakota:** Greatest percent change in CO₂ Emissions (lbs per MW Hour) (-59.4%)
 - Vermont excepted due to being an outlier



Results and Conclusions

1.1) Which states have produced the most and the least **CO2 emissions in lbs per MW hour** at the start year (2008) and end year (2018)?

- **Vermont** with the least at both time points.
- **Wyoming** with the highest at both time points

1.2) How do trends differ between **CO2 Emissions (lbs per MW Hour)** and **Total CO2 Emissions (thousand metric tons)**?

- **Some** states have **potential relation** between the two.
 - ex: New Hampshire and Idaho are similarly positioned on their respective percent change graphs.
- **Some** states are **not as strongly related**.
 - ex: South Dakota has the largest percent decrease in CO2 emissions (lbs per MW hour) and is close to the mean in the percent change in total CO2 emissions.

2) How have energy costs changed from start year (2008) to end year (2018)? Have they increased, decreased, or stayed consistent?

- The **t-test** of average price between the two time points indicates the **change is not statistically significant** with a p-value of .13
 - However, the **average increase of 16%** is notable

3) What are some factors that might make energy costs more expensive for different states and regions?

- **Inconclusive. Findings** are cursory and **require additional investigation**, but **initial examples seem to show maintaining fossil fuel usage to be related to lower energy costs**
 - **Hawaii dropped its usage of petroleum** but essentially **had no change in energy price**
 - **Massachusetts dropped its usage of coal and increased usage of natural gas and solar energy**. Prices increased.
 - **Louisiana dropped natural gas usage for other gas and petroleum usage**, and has the least expensive energy in 2018