How Do Wildfire Affect Our Lives?

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Sub topic : How wildfires impact energy demand and causing power outage?

Objective:

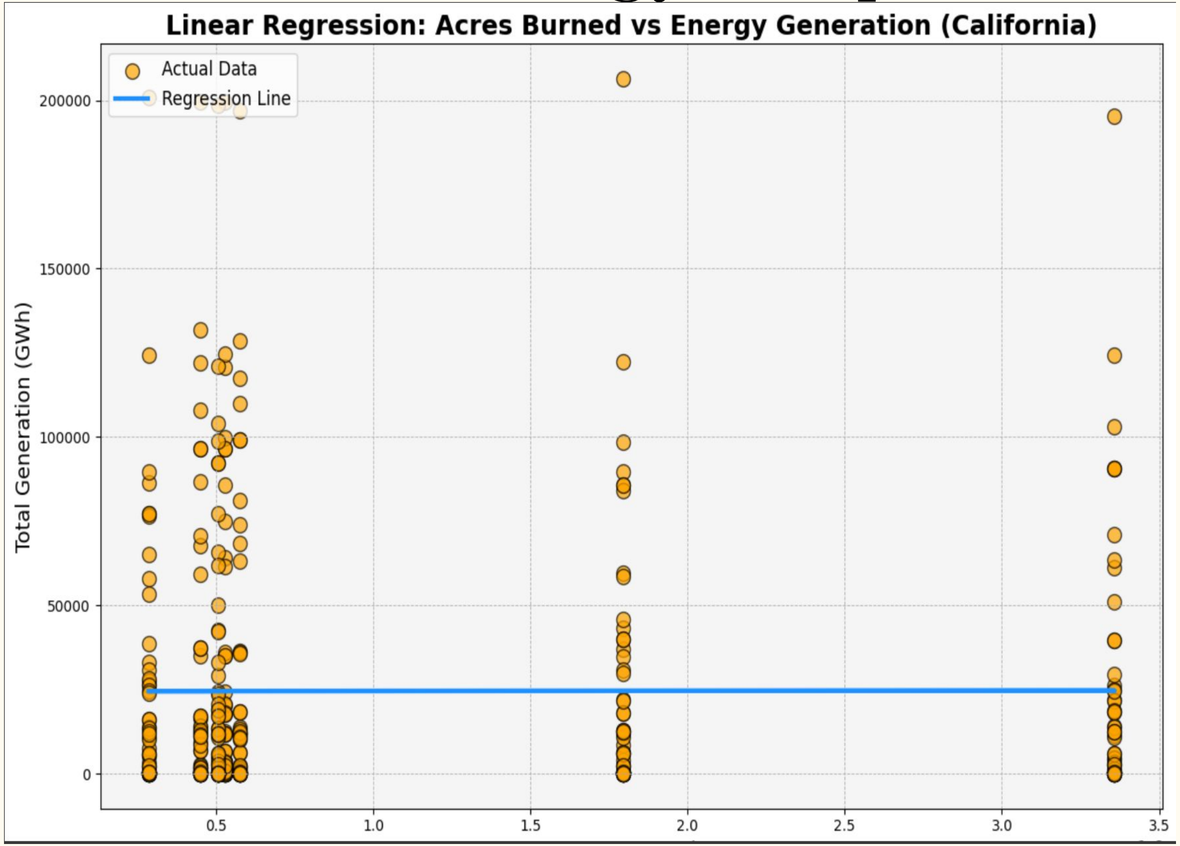
To showcase the effect of wildfires to energy generation and how it can take a toll on our growth.

Problem statement:

Wildfires have been a destructive force in our communities and have impacted us negatively. We will dive deep into the correlation between wildfires and their negative effects in our communities.

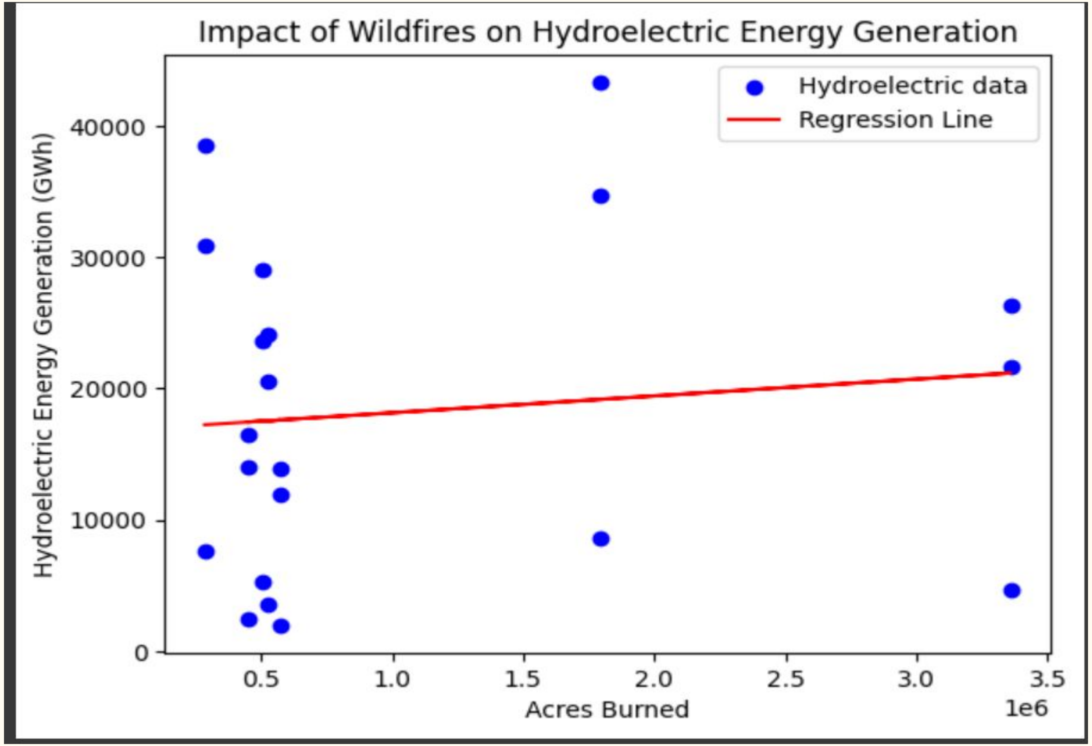
Analysis 1 - Emeka

Renewable Energy Adoption



This shows that there is little chance of energy generation in areas affected by wildfires in California. Any future outcome of energy generation cannot be determined

Renewable Energy Adoption



This shows that acres burned have a weak correlation to generating hydroelectric energy. However, the presence of outlines in this graph shows that the wildfire cannot single handedly predict the future outcome of generation in California

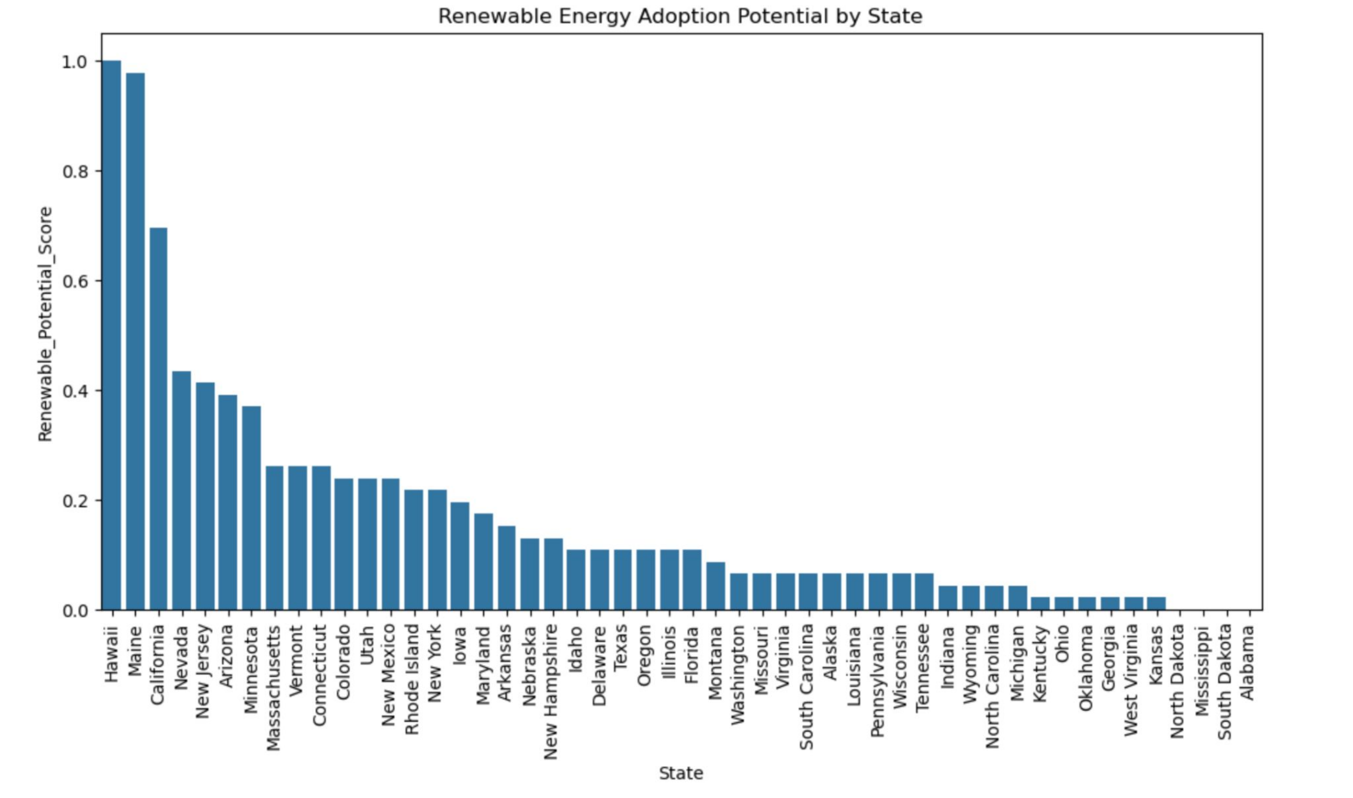
Analysis 2 - Jorge

Renewable energy and Wildfire Risk

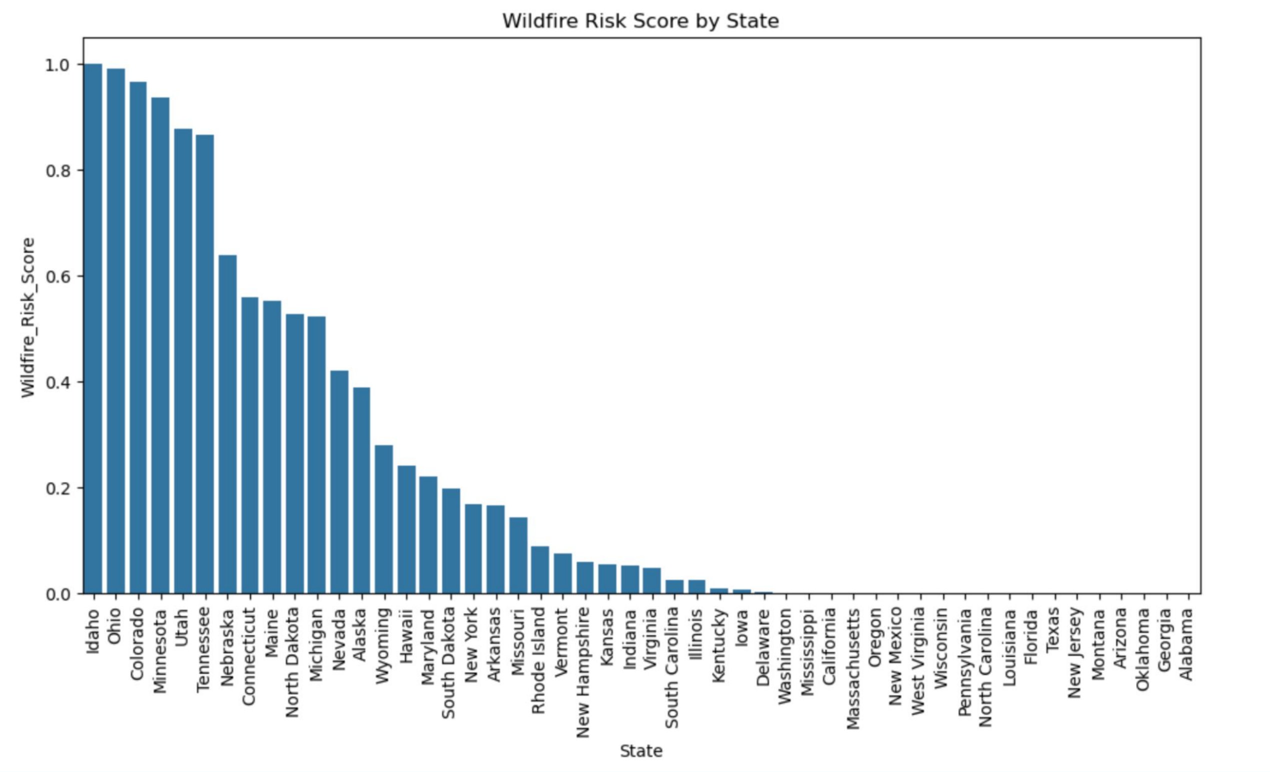
	State	Wildfire_Risk_Score	Renewable_Potential_Score
0	Wyoming	0.279148	0.043478
1	North Dakota	0.528027	0.000000
2	West Virginia	0.000000	0.021739
3	Louisiana	0.000000	0.065217
4	Alaska	0.387892	0.065217

	Rank	Annual_Emission_MMT	Population	Annual_Emmision_percapita_MT	Year_x	State-level	PowerOutages	PowerOutagesDurationHours	Year_y	Price_Cents/kWh
count	50.00000	50.000000	5.000000e+01	50.000000	50.0	50.000000	50.000000	50.00000	50.0	50.0
mean	25.50000	102.618000	6.488501e+06	20.593000	2023.0	0.079400	6.880000	158.72000	0.0	0.0
std	14.57738	112.223235	7.315430e+06	17.375121	0.0	0.100171	7.258043	178.34386	0.0	0.0
min	1.00000	5.800000	5.799940e+05	8.000000	2023.0	0.000000	0.000000	0.00000	0.0	0.0
25%	13.25000	40.650000	1.843262e+06	11.232500	2023.0	0.020000	2.000000	5.50000	0.0	0.0
50%	25.50000	77.250000	4.564632e+06	15.615000	2023.0	0.050000	5.000000	89.00000	0.0	0.0
75%	37.75000	114.650000	7.332985e+06	23.087500	2023.0	0.107500	10.750000	233.00000	0.0	0.0
max	50.00000	706.500000	3.933778e+07	104.480000	2023.0	0.460000	39.000000	740.00000	0.0	0.0

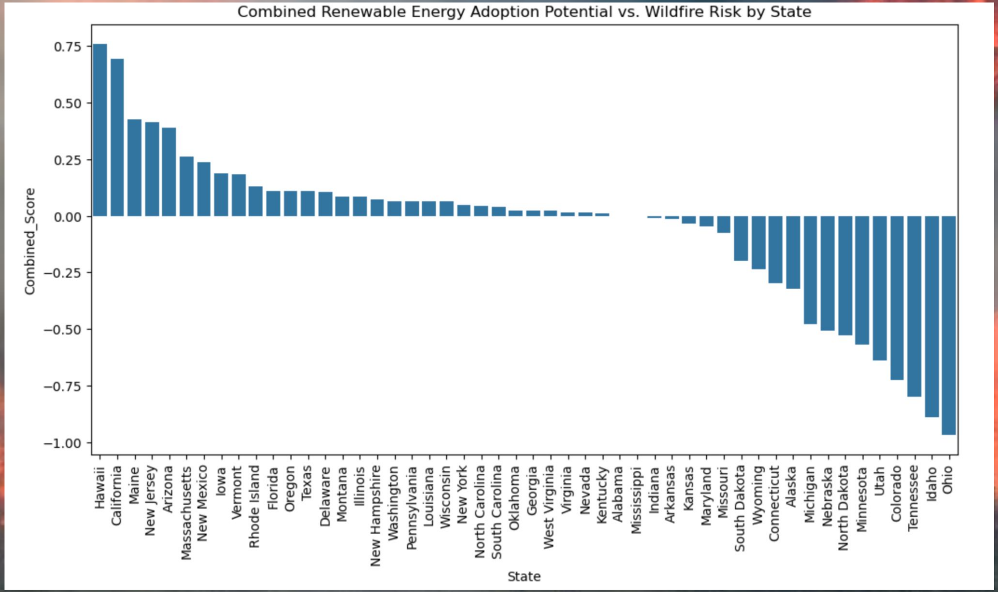
Renewable Energy Adoption



Wildfire Risks by State

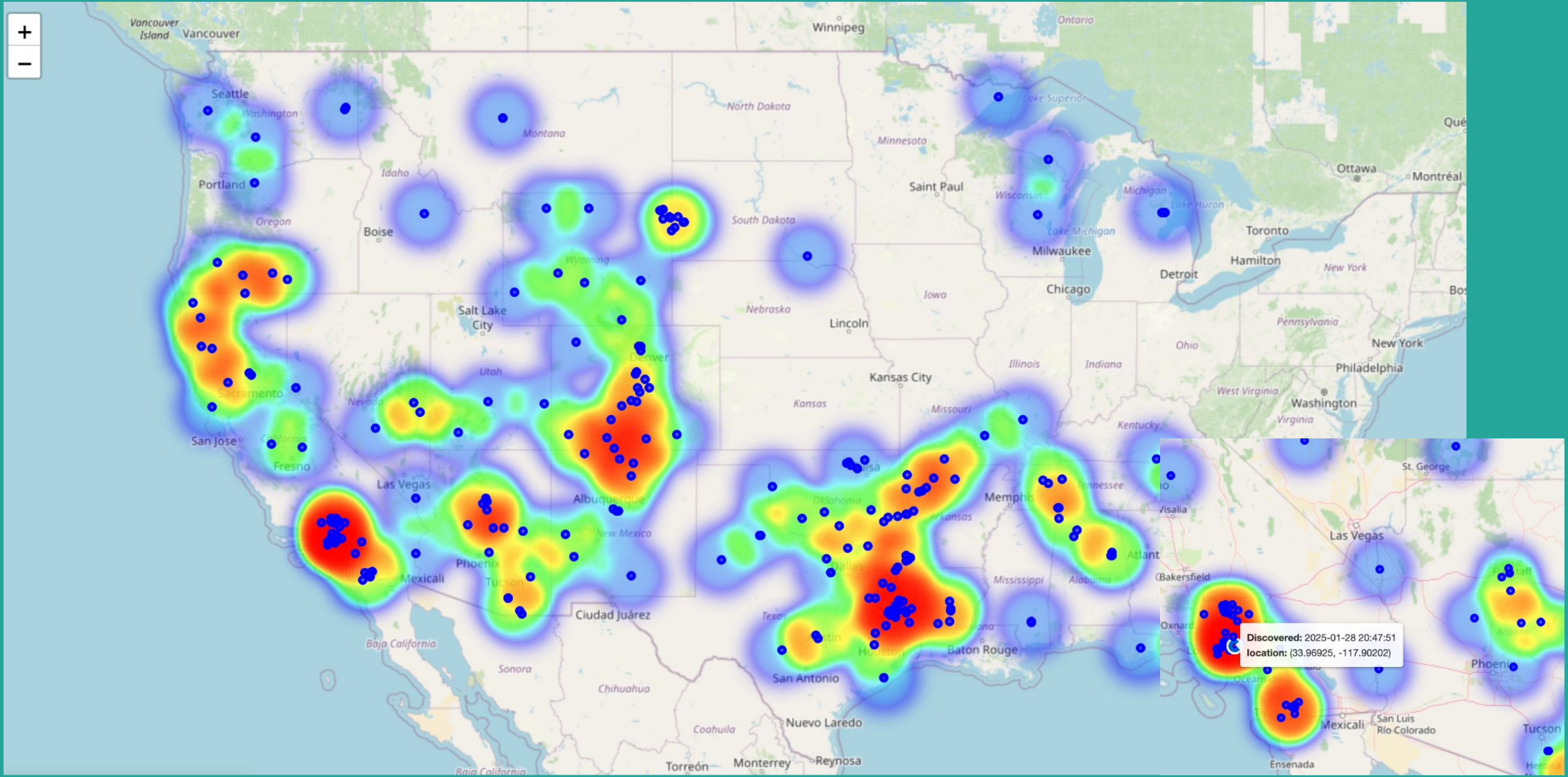


Renewable Energy VS Wildfire Risks



	State	Combined_Score	Renewable_Potential_Score	Wildfire_Risk_Score
31	Hawaii	0.760090	1.000000	0.239910
47	California	0.695652	0.695652	0.000000
35	Maine	0.425570	0.978261	0.552691
36	New Jersey	0.413043	0.413043	0.000000
33	Arizona	0.391304	0.391304	0.000000
46	Massachusetts	0.260870	0.260870	0.000000
12	New Mexico	0.239130	0.239130	0.000000
10	Iowa	0.188926	0.195652	0.006726
44	Vermont	0.185757	0.260870	0.075112
42	Rhode Island	0.129947	0.217391	0.087444

Analysis 3 - Huiyan



US Wildfire Incidents Heatmap: December 2024 to January 2025

```
                                   Predicted 0 (Natural/Undetermined)  \
Actual 0 (Natural/Undetermined)                                    59
Actual 1 (Human)                                                    0

                                   Predicted 1 (Human)
Actual 0 (Natural/Undetermined)                      0
Actual 1 (Human)                                     6
```

	Predicted 0 (Natural/Undetermined)	Predicted 1 (Human)
Actual 0 (Natural/Undetermined)	59	0
Actual 1 (Human)	0	6

```
Accuracy Score : 1.0
Classification Report
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        59
           1       1.00      1.00      1.00         6

    accuracy                           1.00        65
   macro avg       1.00      1.00      1.00        65
weighted avg       1.00      1.00      1.00        65
```

The decision tree classify wildfire incidents into:

- **Class 0:** Natural/Undetermined
- **Class 1:** Human-Caused

Majority of Wildfires Are Natural/Undetermined

- 59 out of 65 wildfires classified as **natural or undetermined**
- Less predictable and harder to control

Driven by Extreme Weather

- High temperatures
- Drought conditions
- Strong winds

Impact on Energy infrastructure

- Leads to power outage
- Increases energy system instability

Analysis 4 - Austin

Relationship between wildfire, power outage, solar adoption rate, emissions per capita.

- Energy Grid Stability
- How can we measure and predict stability across states?

Index = How Calculated

$$\mathbf{Index = (0.4 \times Solar\ Adoption) + (0.2 \times (1 - Wildfires)) + (0.2 \times (1 - Outages)) + (0.2 \times (1 - Emissions))}$$

- Solar adoption rate (higher = more stable) / 0.4 weight

- Wildfire count (more wildfires = less stable) / 0.2 weight

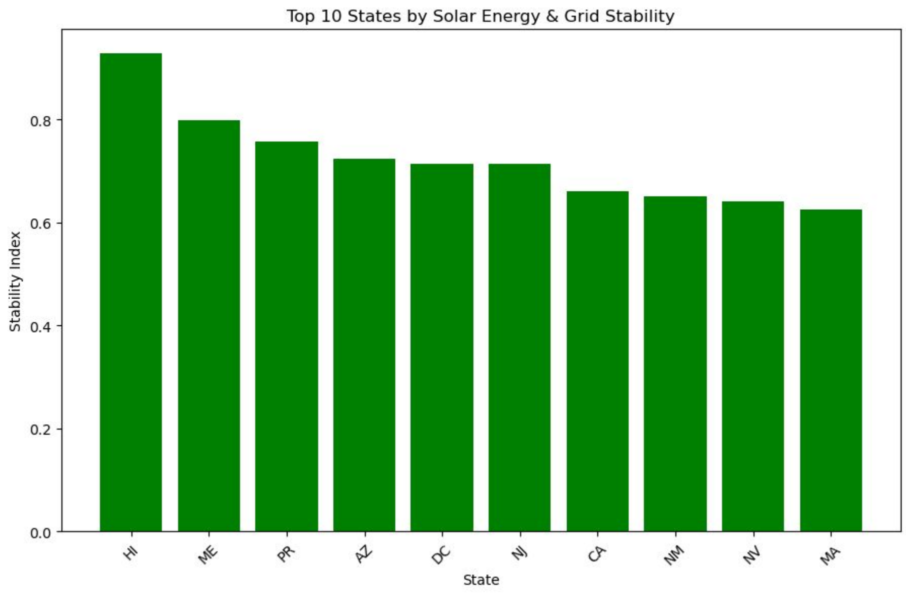
- Power outage count (more outages = less stable) / 0.2 weight

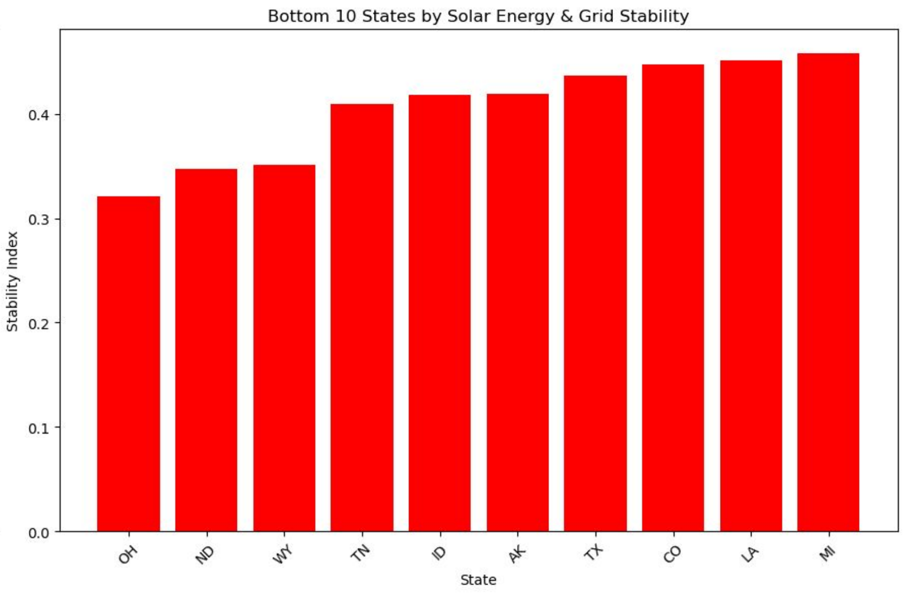
- Emissions per capita (high pollution = less stable) / 0.2 weight

Datasets used

Solar Adoption Rate, Annual Emissions, Wildfire Incidents, Power Outages
All data normalized and merged into one dataframe to create a single “index score”

Stability Index - Top & Bottom 10 States





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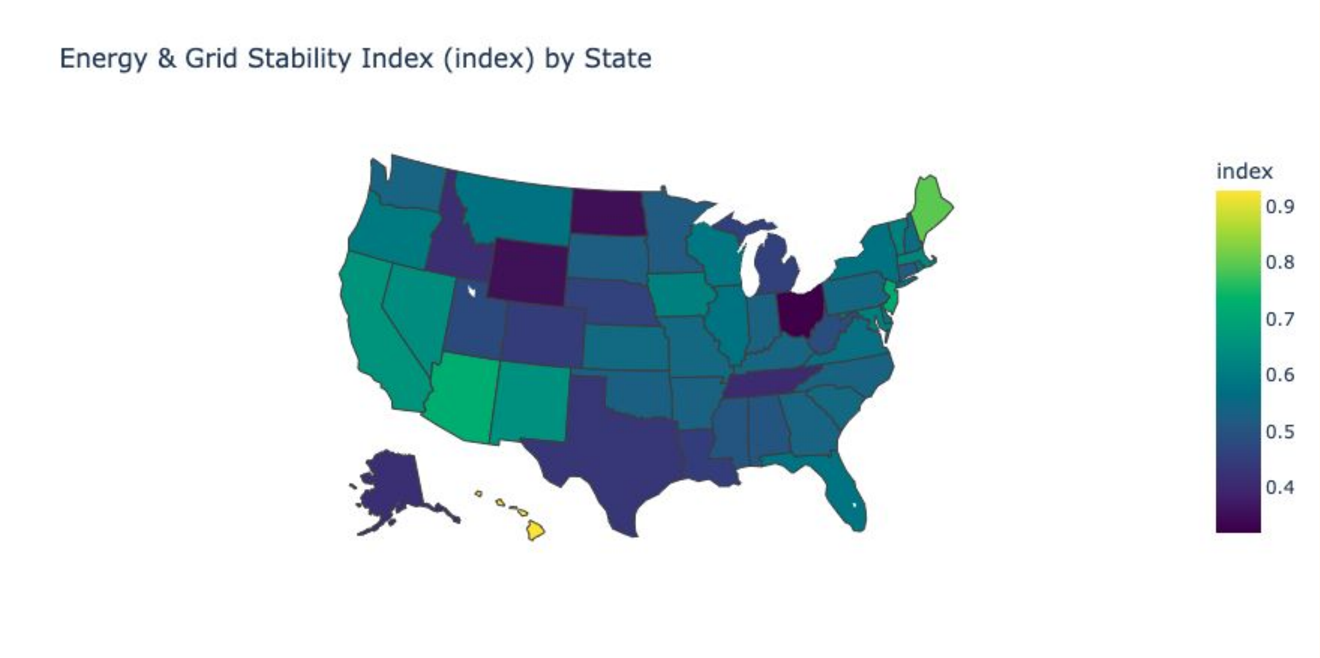
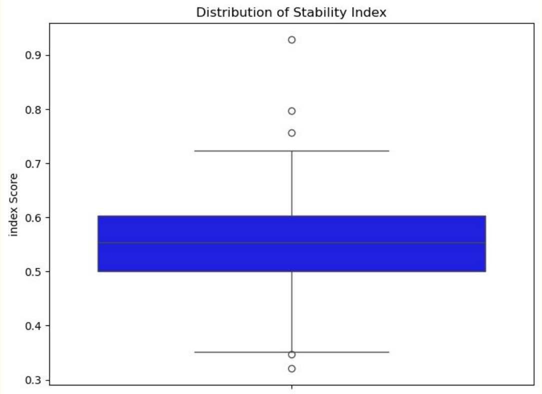
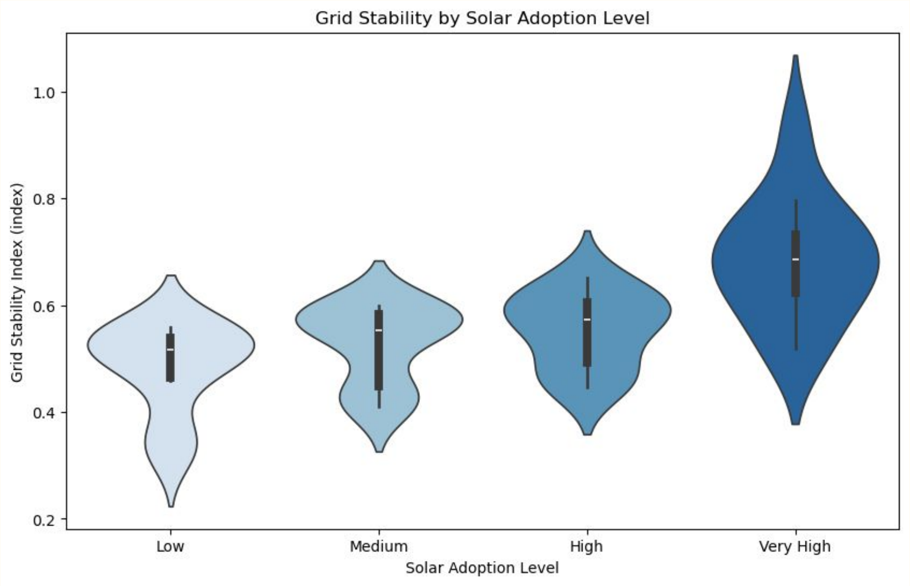




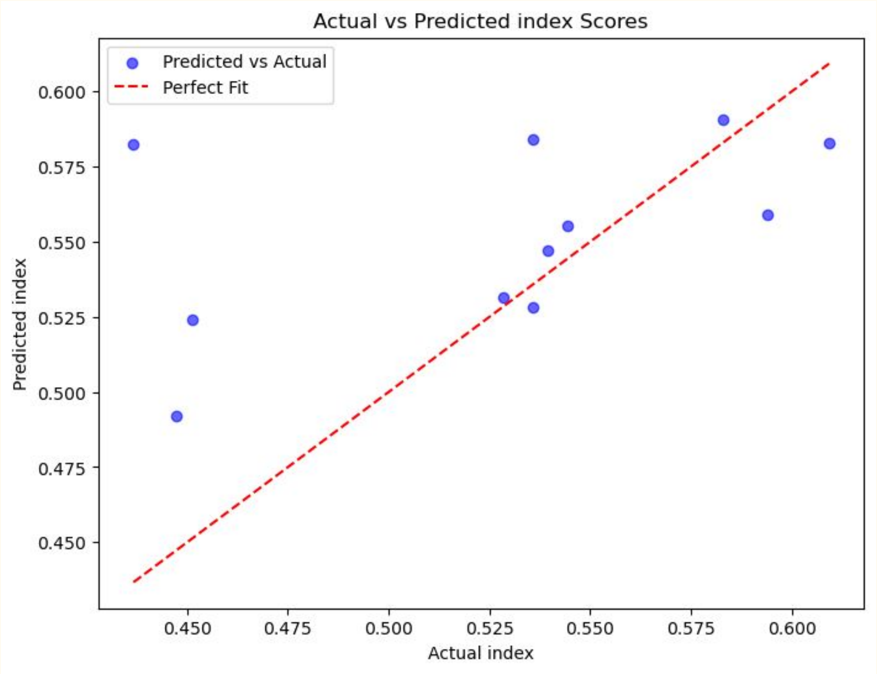
Grid Stability by Solar Adoption Level



This shows how the index is distributed among states with different levels of solar adoption.

This highlights whether higher solar adoption = more stable grid.

Random Forest - Regression Model Result



Mean Absolute Error of 0.0372

(MAE Range 0.00 - 0.05 = excellent prediction / 0.05 - 0.10 = good prediction / 0.10 - 0.20 = moderate / above 0.20 = high error)

- Scatter plot compares the model's predicted index scores against the actual scores.
- Since most points are close to the red line, our model is making accurate predictions with a low error rate of only 3.7%
- This means our model can successfully estimate a state's energy grid stability, helping predict future trends

Conclusion

Conclusion & Key Takeaways

- **Wildfires impact energy grid stability** but lack a strong direct correlation.
- **More wildfires → More outages & emissions, but not always predictable trends.**
- **Energy resilience depends on multiple complex factors.**
- **Solar adoption is a key driver of grid stability.**
- **Investing in renewables strengthens energy resilience against disruptions.**

Thank You

It has been a pleasure

Procedure

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