

US ELECTRIC GRID OUTAGES

Average Outage Duration

16:04:17

Total Outage Days

10,724

Total Customers Affected

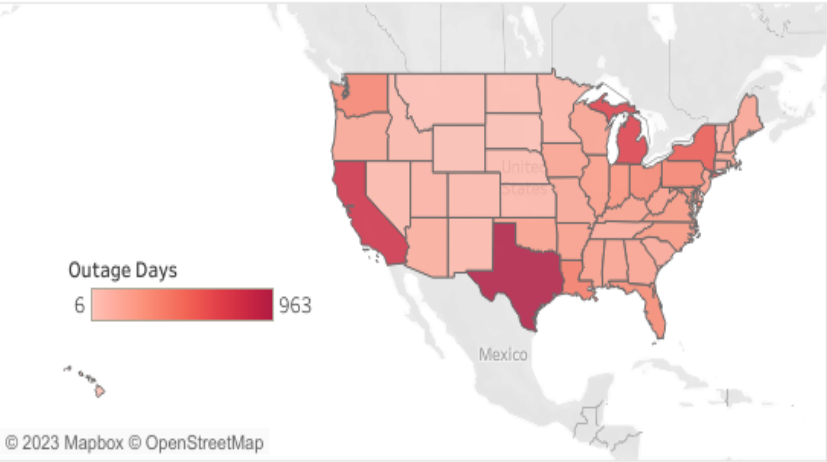
292M

Total Demand Loss (MW)

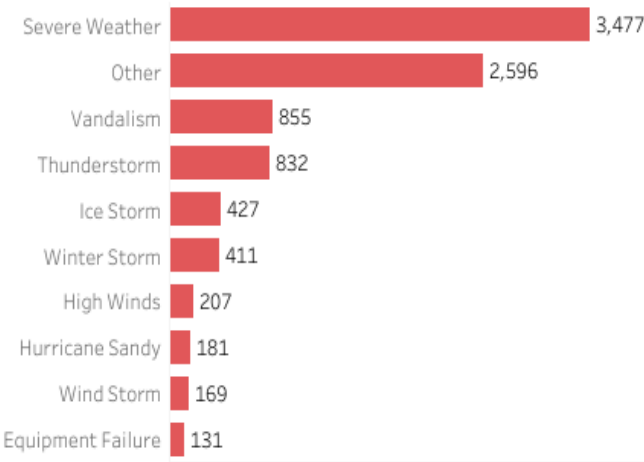
1.2M



Outage Days per State



Outage Days per Disturbance



Customers Affected vs. Demand Loss



Outage Days per Year



Outage Days per Hour



Abstract

- ▶ I played the role of a Senior Analytics Consultant for the US Department of Energy
- ▶ My task was to analyze power outage data from 2002-2023 to do the following:
 - ▶ Determine patterns and trends around power outages across the United States.
 - ▶ Quantify their impact on communities.
 - ▶ Identify possible weak points in the grid.
- ▶ The scope of my analysis was done at the state level.
 - ▶ I did not analyze any specific cities and geographic locations.
- ▶ I cleaned the raw data using Power Query.
- ▶ I built a dashboard using Tableau that summarized the following:
 - ▶ Power Outages by state, disturbance, year, and hour.
 - ▶ Customers Affected vs. Demand Loss per NERC region.
- ▶ I have uploaded all the files for this project onto my [GitHub](#).

Data-Cleaning Strategy

- ▶ I am working with unstructured data for this project.
- ▶ There were sheets for each year of outage data.
- ▶ My goal was to combine all the data in each sheet into one table.
- ▶ The tables had different column names.
 - ▶ I consolidated all the tables to the same column names and added some calculated fields.
- ▶ The table had several null values and inconsistent date formats.
 - ▶ I removed completely null rows.
 - ▶ I made the dates have consistent formats.
- ▶ I removed the extra text in all numeric values.
 - ▶ Approx, peak, etc.

Assumptions

- ▶ Some data had null and confusing values.
 - ▶ I assumed a user error in recording these power outage logs.
 - ▶ I filtered out these power outage logs to avoid any uncertainties in my analysis.
 - ▶ I assumed zero for these lost power and customers affected values.
 - ▶ I assumed “unknown” for these types of disturbances.
- ▶ Some numeric values had ranges.
 - ▶ I assumed the average value of the bounds for interval ranges.
 - ▶ I assumed the smallest value for ranges that are over a number.
 - ▶ I assumed the largest value for ranges that are under a number.
- ▶ Some areas affected had multiple locations listed.
 - ▶ To simplify my analysis, I assumed an equal distribution of the following:
 - ▶ customers affected
 - ▶ power outage wattage

Geographic Insights

- ▶ The following states experienced very long outage days.
 - ▶ Texas (963 days)
 - ▶ California (802 days)
 - ▶ New York (571 days)
 - ▶ Michigan (693 days)
 - ▶ Washington (355 days)
- ▶ Bible Belt and New England states experienced about 100 outage days on average.
- ▶ States along the Mid-West experienced less than 100 outage days on average.

Disturbance Insights

- ▶ Weather-related issues were the most frequent causes of power outages.
 - ▶ Severe Weather caused the longest outage days (3477 days).
- ▶ The following non-weather-related issues that caused significant power outages:
 - ▶ vandalism (855 days)
 - ▶ equipment failure (131 days)

Time Series Insights

- ▶ The number of outage days peaked during these years:
 - ▶ 2008 (655 days)
 - ▶ 2011 (874 days)
 - ▶ 2021 (855 days)
- ▶ The number of outage days peaked during these times:
 - ▶ 8 AM (651 days)
 - ▶ 4 PM (794 days)
 - ▶ 6 PM (770 days)

NERC Region Insights

- ▶ The customers affected and demand loss for each NERC region show a strong direct correlation (74%).
 - ▶ The total outage days tend to be larger for NERC regions with larger customer affected and demand losses.
- ▶ RFC, WECC, and SERC had the largest customers affected, demand loss, and outage days.
- ▶ SPP, RF, and MRCO had the lowest customers affected, demand loss, and outage days.

Recommendations

- ▶ Prioritize power restoration in states along the coast.
 - ▶ Hurricanes tend to land in these areas of the country.
 - ▶ According to my analysis, these areas will likely have the longest power outages.
- ▶ Prioritize power restoration during the morning and afternoon hours.
 - ▶ These hours had the longest outage days, so this is when the longest power outages will likely occur.
- ▶ Be proactive on power restoration during hurricane season.
 - ▶ The worst hurricanes made landfall during the 2008, 2011, and 2021 seasons:
 - ▶ Hurricane Ike (2008)
 - ▶ Hurricane Irene (2011)
 - ▶ Hurricane Ida (2021)
 - ▶ These hurricane seasons saw some of the longest power outage days.