

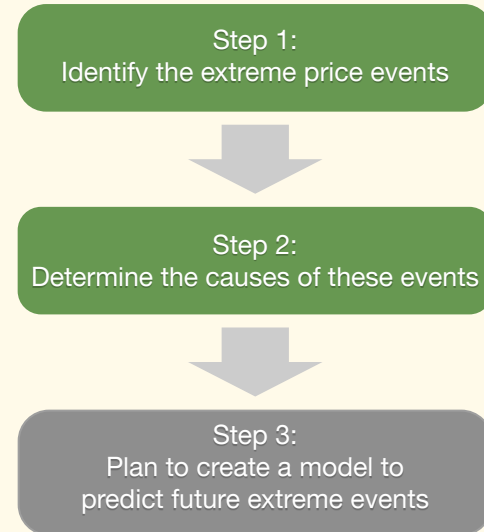
Identifying Extreme Events in Wholesale Energy Markets

Undergraduates: Cassandra Turk, Alec Ashforth
Project Manager: Paichen Li
Project Lead: Eric Butter (Tether Energy)

Goal: minimize the risk of trading electricity on California's wholesale energy market for our sponsor, Tether Energy, by creating a dataset of extreme price events and their causes

Background

California has a deregulated electricity market, allowing generators to sell electricity into the wholesale market at different prices. These prices are determined locally, at hubs known as “nodes”. The California Independent System Operator (CAISO) manages the reliability of the electrical grid, but electricity prices are still significantly more volatile than stock prices, regularly increasing and decreasing over 300%, making it risky to trade on this market.



Identifying Extreme Events

Initial Price Data

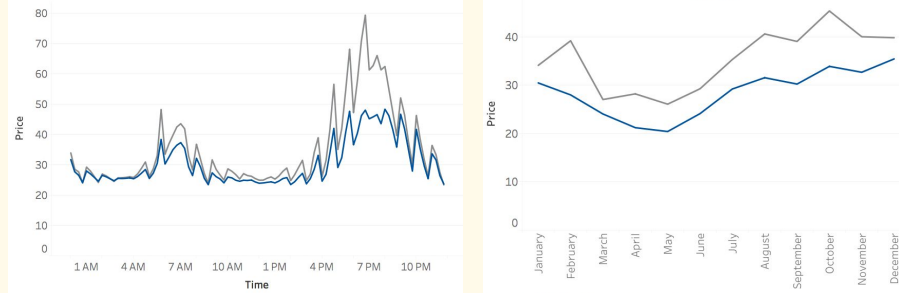
15
Minute
Intervals

2016
to
2019

400+
Nodes

What We Want

- Create a usable sized dataset of extreme events that can't be "explained" solely by month or time of day



Time of day (left) and month (right) affect electricity prices
Median (blue) and mean (grey) price plotted against month and time of day

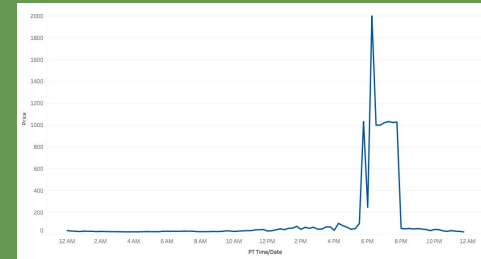
Method

- Chose dates, times, and prices that were:
 - Greater than 99.8 percentile for month and for time of day at each node
 - Less than 0.2 percentile for month and for time of day at each node
- Prioritized extreme highs by cutting off highest 90% of lows and lowest 10% of highs

Results

30927
Extreme
Prices

431
Unique
Days



Price Spike at GRIZZLY_7_N_101 on 6-20-2017

26967
Extreme
Highs

3960
Extreme
Lows

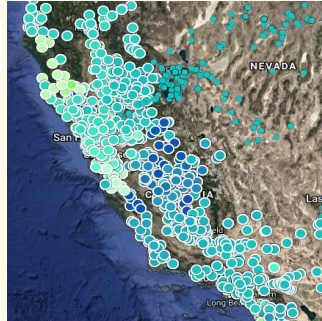
Determining the Causes

Manual Research

- Scanned through online news sources to determine causes of extreme events
 - LA Times, SF Chronicle, Bloomberg Terminal, Wikipedia, The Fresno Bee, etc.
- Found many different causes including *wildfires, floods, poor air quality, and storms*

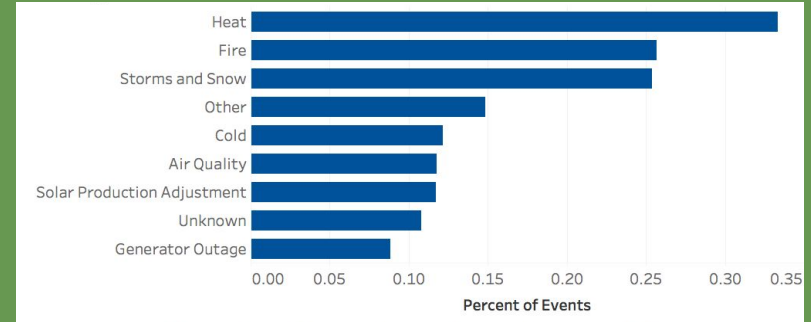
Coordinate Mapping

- Found locations of nodes to determine whether events on same day were one event or multiple



Public Datasets

- Downloaded hourly temperature data to connect *extremely hot* and *extremely cold* days to some extreme events
- Webscraped CAISO website for every planned and unplanned *generator outage* in California
- Downloaded CAISO curtailment data and found some extreme low prices were probably caused by *excessive solar or wind production*



Common explanations for extreme events
Many events have multiple explanations

Found Explanations for...

90%
of All
Extreme
Prices

95%
Extreme
High
Prices

49%
Extreme
Low Prices