Exploring different natural disasters

Wildfires:

How might the weather event affect energy availability?

* Burned system components (ex. power lines, substations, distributed energy resources), overheating, and poor air quality affecting solar generation.
* Despite an increase in total system capacity between 2019 and 2020 in California, the wildfire season of 2020 resulted in a 13.4% decline in solar generation in the month of September [1]. In some areas in 2020, the effects of wildfire smoke on solar insolation were greater than that of cloud cover.

How might the weather event affect load demand?

* Coupled with damaged components, the remaining components may be strained to meet demand. Additionally, wildfires are frequently result in high AC load, and sometimes coupled with heat waves, too [2], [3].
* Not accounted for in REopt, but geothermal and hydroelectric generation is affected. This leads to the replacement of that generation with spot market purchases (generally fossil fuels). [4]
* Obstruct the transportation of essential fuels and operational equipment

What data is needed?

* Solar availability around wildfires events, ~30% decline [3]
* Probability of failure of generation components during wildfires?
* Energy demand around wildfire events (CAISO?)

**What data is available?**

* Load: CAISO April 2018 to present, <https://www.caiso.com/TodaysOutlook/Pages/default.aspx>
  + Can look at Camp Fire
* Solar generation: SolarAnywhere, <https://www.solaranywhere.com/products/solaranywhere-data/> (HAS SOME DATA FOR FREE)
* Solar generation: <https://midcdmz.nrel.gov/>
* Air quality: <https://aqs.epa.gov/aqsweb/airdata/download_files.html>
  + Identify a correlation between solar generation, CAISO and air quality (specifically Ozone, carbon monoxide, and Sulphur dioxide)

\*\*I think wildfires could be particularly interesting. This may be a tangent but…A simple ML model could be developed that helps plan energy systems based on historical implications of wildfires on energy generation. So, based on the anticipated size or duration of the fire input by a stakeholder (with subsequent Ozone, CO, and SO2 expectations), the solar generation will vary and the planners can understand how to best plan for these situations.

* Parameters: concentrations of Ozone, CO, SO2, size of fire, duration of fire, available solar generation, humidity
* Train on historical wildfires
* Test on hypothetical new wildfires by planners in at-risk areas

I have already done a similar project (I tried to identify a relationship between air quality and energy demand). In the end, I was semi successful. I think some of the faults were in which pollutants I chose to consider and connecting the load to the county (CAISO aggregates it). I can pull from that project and improve upon it—I wouldn’t be starting from scratch here.

Hurricanes:

How might the weather event affect energy availability?

* Natural gas and oil prices increase during landfall of Atlantic hurricanes [5]
* Limited access due to fallen debris and flooding
* Limited generation due to flooding, debris, and cloud cover
* Most of the effects occur in September and October, no damages experienced 21% of the time (79% of the time there were damages//inoperable system components). During hurricane days, 12.6% reduction in solar performance ratio (PR). During September, there is a 22.2% reduction in solar PR. [6]

How might the weather event affect load demand?

* Very unclear…
* Although more related to energy availability IMO, the EIA reported that there was a 64% decrease in energy demand during Hurricane Irma (but this is likely due to newly disconnected/down power lines) [7]
* Demand for transportation fuels increases rapidly in the days before a hurricane as people prep for evacuation

What data is needed?

* Wind and solar generation during specified events

**What data is available?**

* Solar generation: SolarAnywhere, <https://www.solaranywhere.com/products/solaranywhere-data/>
* Wind generation via ercot.com? (<https://www.ercot.com/gridinfo/generation> appears to be helpful for aggregated wind generation values but is unorganized)
* Demand: <https://www.ercot.com/gridinfo/load>

Freezes/snow storms:

How might the weather event affect energy availability?

* When a ticket on solar panels was reported, 61% of the time it was due to low or no production. Site access issues occur when the roadways are covered in snow. PR for snow days are 54.5% lower than non-snow days. It is broken down a little bit more by month in this paper [6]!
* Gas freezes [8]

How might the weather event affect load demand?

* Large surge in energy (heating) demand
* For the Texas example, an 8 GW increase in the anticipated peak demand from the reliability assessments of ERCOT [8]

What data is needed?

**What data is available?**

* Ercot.com: Especially if Texas is the case study, the wind and solar generation as well as energy demand is available
* SolarAnywhere, and ercot.com (ercot also has solar data that may be even more specific to Texas)
* Weather, NOAA: <https://www.ncdc.noaa.gov/cdo-web/datasets/NORMAL_HLY/locations/FIPS:US/detail>
* Other wind data: <https://data.nrel.gov/submissions/54>

MEWS:

Dataset for Evaluation of Extreme Weather Impacts on Uility-Scale Photovoltaic Plant Performance in the US: <https://data.openei.org/submissions/4055>

SolarAnywhere Data: <https://www.solaranywhere.com/products/solaranywhere-data/>

The primary gap in data is the probability of failure of components when faced with these threats.

Other notes that came to mind…

* Various statistical sampling methods
* Uncertainty frameworks
* Effects of generation on load (independent of storms maybe)

https://www.youtube.com/watch?v=clzfqPgLb1A