# Implications of Population Growth and Wildfires on Energy Security within the Wildland-Urban Interface of California

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# Implications of Population Growth and Wildfires on Energy Security within the Wildland Urban Interface (WUI) of California

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## 1. Why Energy Security and Wildfires?

Powerlines are not widely recognized for causing a higher frequency of wildfires compared to other human ignition sources, but they contribute significantly to the total burnt acreage. These fires often occur in areas with high winds, creating conditions for tree contact. Despite proposals for underground powerlines, Electric Utility Companies (EUC) are hesitant due to the associated high costs.

The initiation of Public Service Power Shutoffs (PSPS) in 2012, prompted by the surge in wildfires and the lower cost for Electric Utility Companies (EUC), has significantly altered the landscape of energy security (Table 1). Initially, there was reluctance among EUC to undertake such a risky initiative. However, a noticeable shift occurred in 2017, reflecting an increased willingness among EUC to implement PSPS as the risk of wildfires escalated.

Energy security became a topic of discussion as PSPS events increase, and California's built environment rapidly expands as the Wildland Urban Interface(WUI), an area known for high human ignitions for wildfires, accounts for more population and land.

| | Regular | Wildfire | PSPS | Wildfire and PSPS |
|---|---|---|---|---|
| Mean | 4.25% | 6.80% | 25% | 12.59% |
| Median | 1.44% | 2.31% | 16% | 8.60% |

Table 1. Percentage of customers out of power by cause of outage; mean and median are calculated across all California counties

## 2. Data and Methods

- **Data**
  - Population data at census tract level from U.S. Census (2010-2021)
  - Power outage and customer data from Poweroutage.us
    - **2017 to 2020** (2021-2022 data in preparation)
  - **Power outage events** included in this analysis
    - At least 60 minutes long
    - More than 0.5% of total customers in the county affected (Casey et al. 2020)
  - **PSPS events** from utility companies' reports to California Public Utilities Commission (CPUC)
    - Only including events effecting more than 500 costumers.
  - 2020 version of WUI boundaries from SILVIS lab at University of Wisconsin-Madison
- **Method**
  - We used **Mann-Kendall test** to derive the population change trend from 2010 to 2021 at the census tract level
  - We connect the **number** of power outage events and the derivates (cumulative % customers out of power, customer-minutes out of power) with population trend for bi-variate mapping

## 3. Population Growth inside Wildland-Urban Interface (WUI) from 2010 to 2021

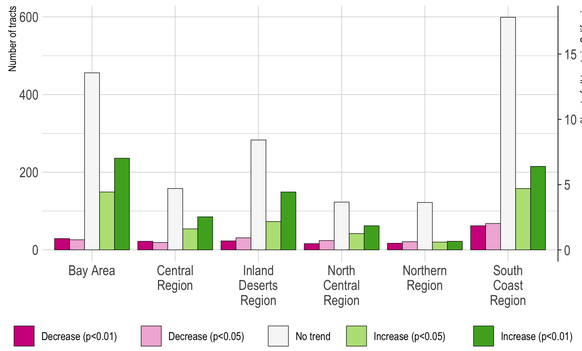



**Figure 1 (to the left)**

- In the past decade, a significant population increase happened inside California's WUI, especially the Bay Area and the South Coast Region (including Southern California) (Laszewski et al. In Review)

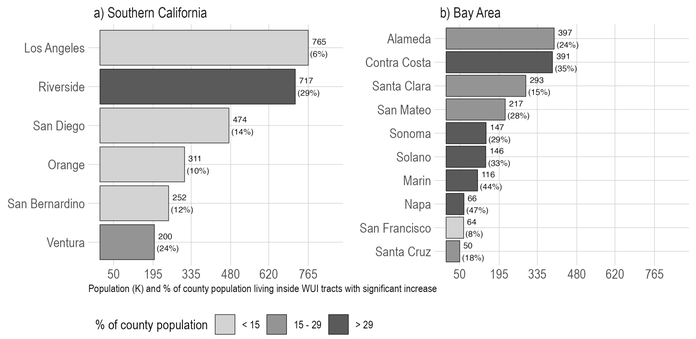



**Figure 2 (to the left)**

- Identifies the type of trends in population growth in Southern California (count is large and proportion is low and Bay Area (proportion is high and count is low)

## 4. Power Outages: Do Wildfires and PSPS make a Difference?

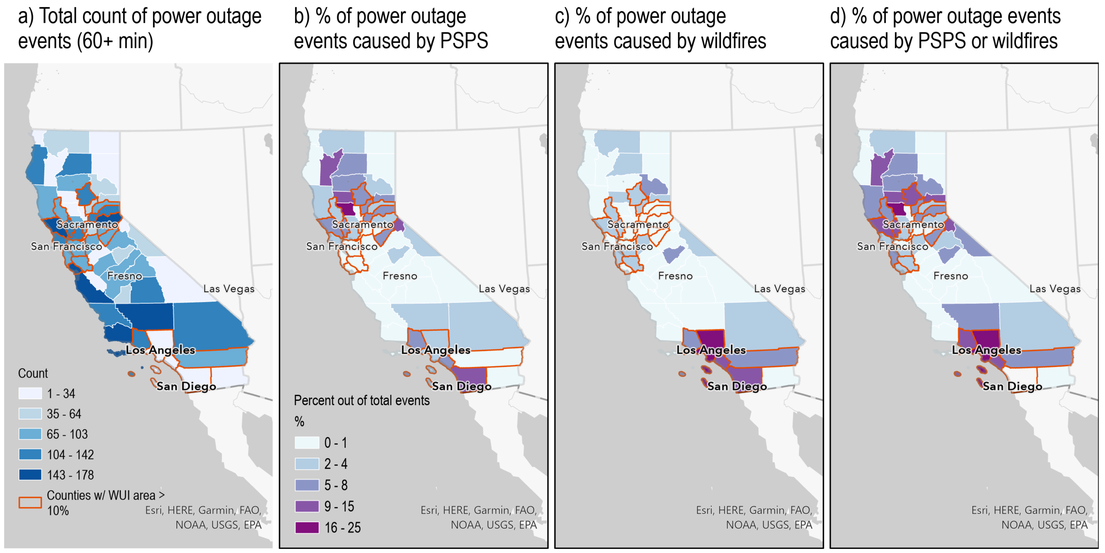
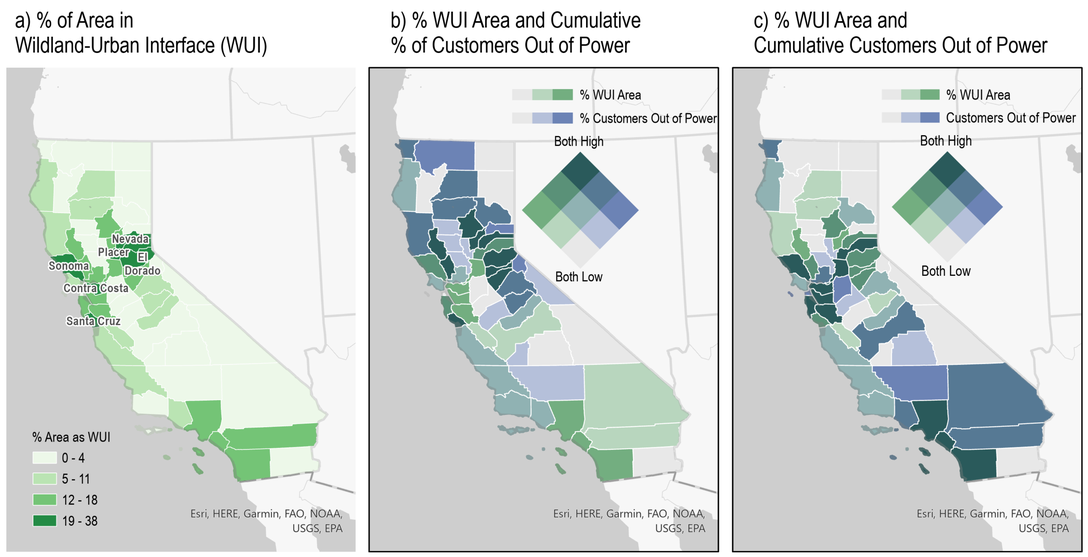



**Figure 3 (to the left)**

- Counties in the Bay Area, northern Sierra Nevada Mountains, and inland Southern California have the highest number of power outage events (**darkest blue**, Fig. 3a)
- Wildfire-induced power outages in Northern California counties are more likely to be caused by PSPS (2017-2020), while Southern California counties are more prone to power outages directly caused by wildfire (not by PSPS as a precautional measurement) (**darkest purple**, Fig. 3b)
- Counties with a high proportion of area inside WUI highly coincide with those are more prone to wildfire-induced power outages ((**darkest purple** Fig. 3d)

**Figure 4 (to the right)**

- Counties with a higher proportion of area inside WUI (**darkest green**, Fig. 4a) and a higher percentage of customers experienced a power outage event are mostly located in the rural and suburb area (**dark cyan-green**, Fig. 4b)
- Counties with a higher proportion of area inside WUI are more likely to have a **higher number** of customers experiencing a power outage during our period of study (2017-2020) (**dark cyan-green**, Fig. 4c)
- Recognize that similar trends in population of WUI are seen in the spatial distribution of % and cumulative customers out of power




## 5. Summary: Integrating WUI, Energy Security and Population

- **Significant population increase inside California WUI from 2010 to 2021** occurred, especially for the most populous counties in the San Francisco Bay Area and Southern California
  - This trend has exposed more people to heightened risk of wildfires, as well as the cascading effects of it
- **Higher change of experiencing power outages is one prime example of these cascading effects. Counties with high WUI area have**
  - Higher chance to experience a wildfire-induced power outage event
  - Higher % of customers out of power
    - Especially counties in the rural/suburb Northern California
  - More cumulative customers out of power
    - In both Northern and Southern California counties
- Next steps
  - Construct a zero-inflated negative binomial regression model to estimate the chance of experiencing a wildfire-induced power outage at the county level in California

## Reference & Acknowledgements

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