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

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OXFORD, OH • EST. 1809

GH23D-0931

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 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

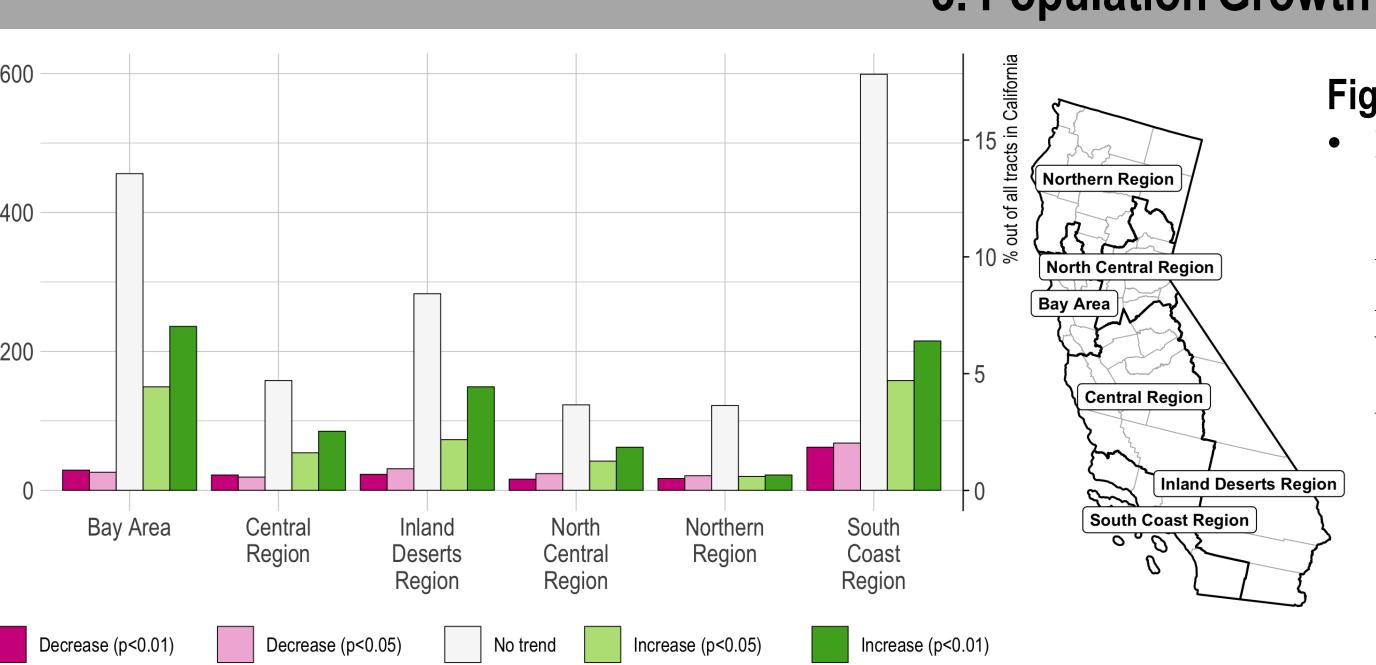
• Data

- 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

- 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, customerminutes out of power) with population trend for bi-variate

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



b) % of power outage

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)

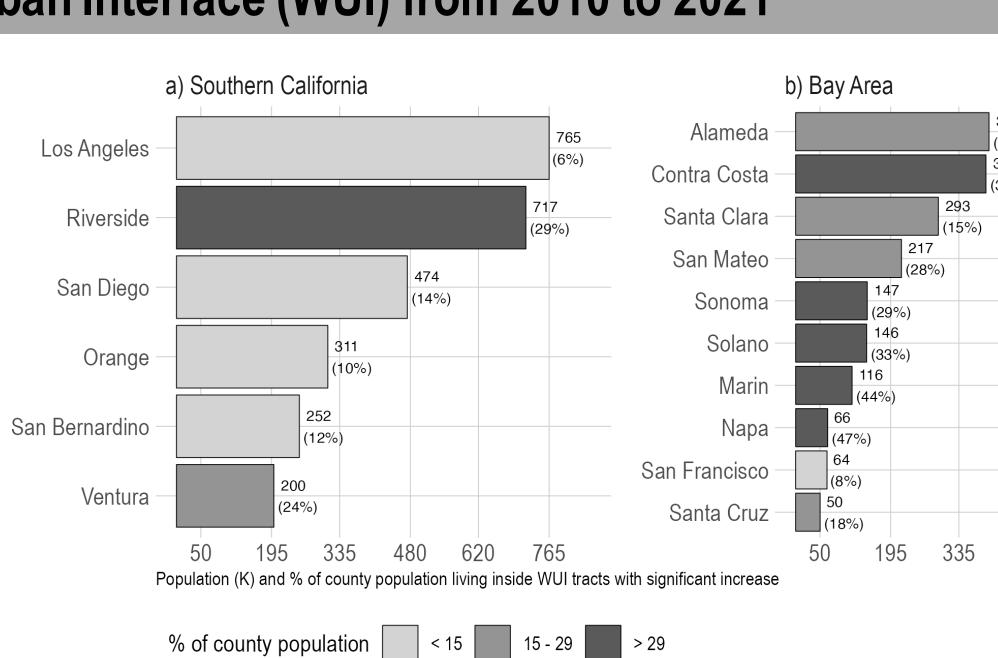


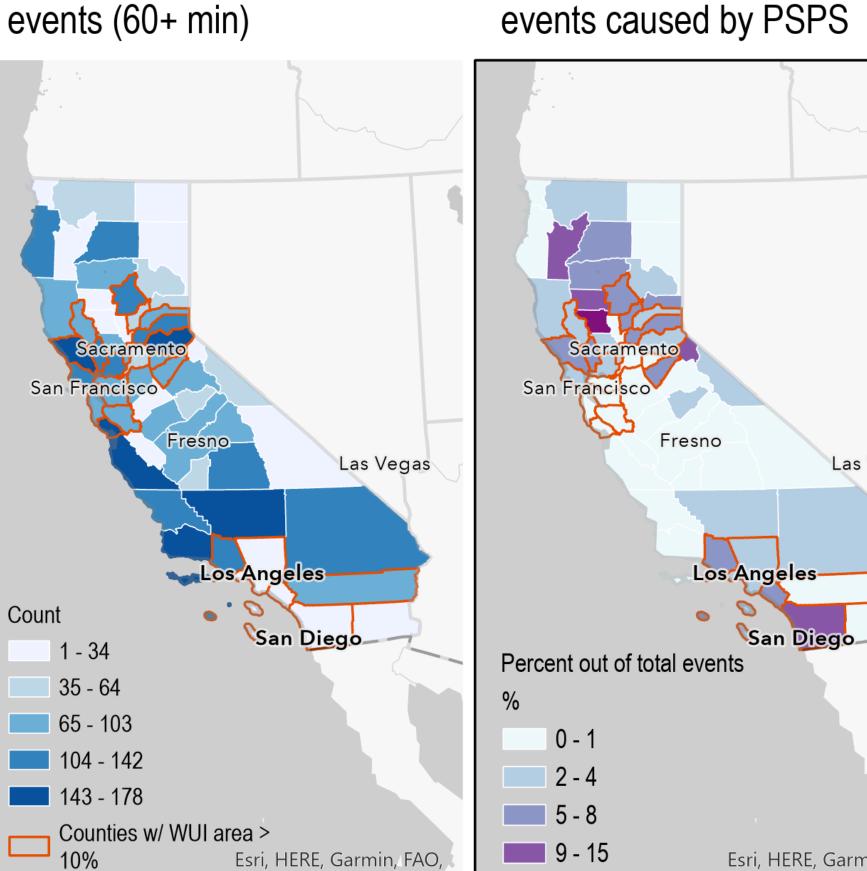
Figure 2 (to the left)

• 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)

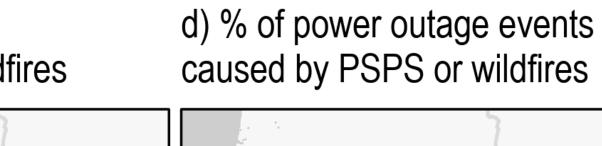
4. Power Outages: Do Wildfires and PSPS make a Difference?

Los Angeles

a) Total count of power outage events (60+ min)



c) % of power outage events caused by wildfires



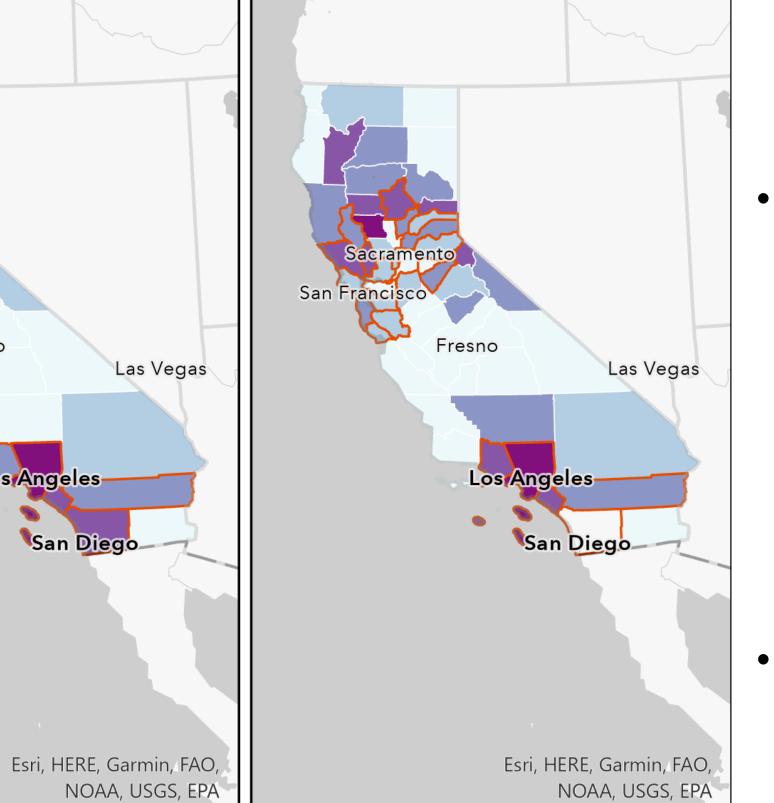
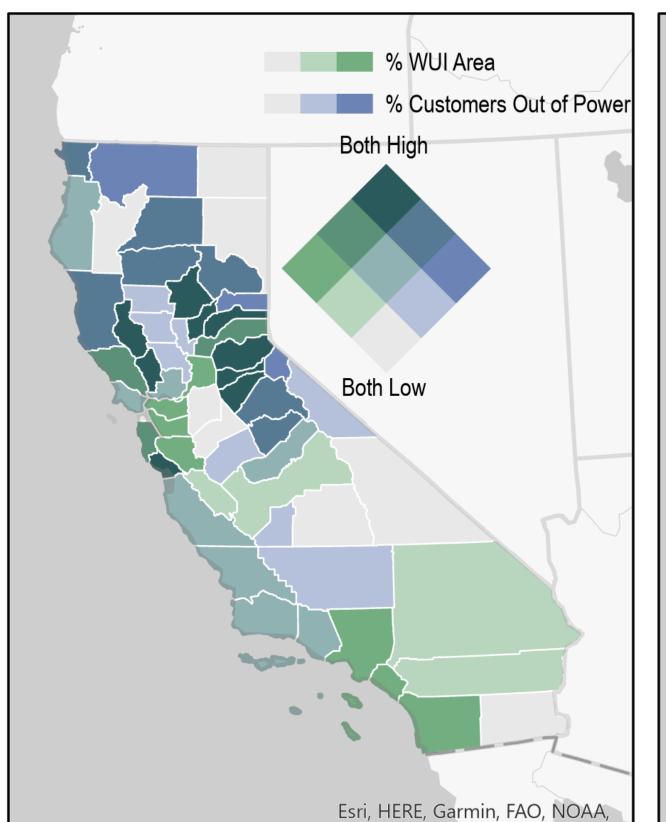


Figure 3 (to the left)

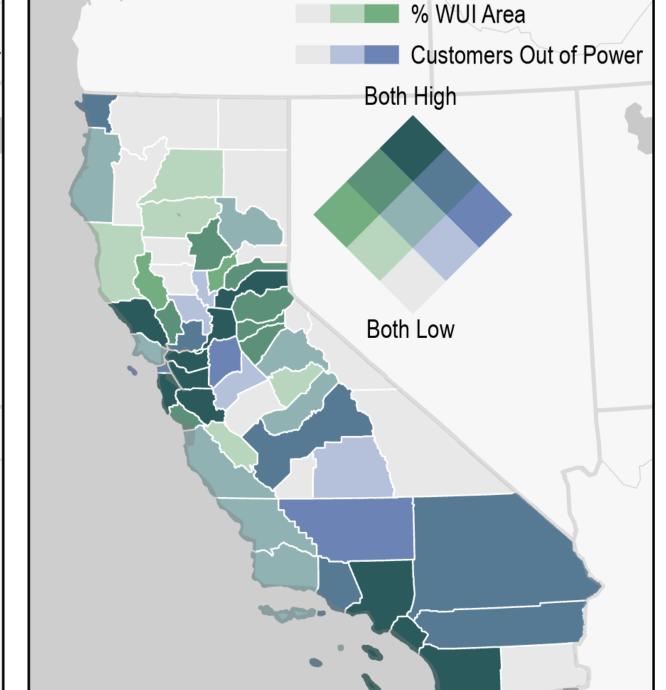
- Counties in the Bay Area, northern Sierra Nevada Mountains, and inland Southern California have the highest number of power outage events (darkest blue, Fig. 3a)
- Wildfire-induced power outages in Northern California counties are more likely to be caused by PSPS (2017-2020), while Southern California 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 wildfireinduced power outages (darkest purple Fig. 3d)

c) % WUI Area and **Cumulative Customers Out of Power**



b) % WUI Area and Cumulative

% of Customers Out of Power



Esri, HERE, Garmin, FAO, NOAA,

California • This trend has exposed more people to

the San Francisco Bay Area and Southern

5. Summary: Integrating WUI, Energy

Security and Population

California WUI from 2010 to 2021 occurred,

especially for the most populous counties in

• Significant population increase inside

- 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 wildfireinduced 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

Casey, J. A., Fukurai, M., Hernández, D., Balsari, S., & Kiang, M. V. (2020). Power outages and community health: a narrative review. Current environmental health reports, 7, 371-

Laszewski, S., Jia, S., Viner, J., Ho, W., Hoover, B., Kim, S. H., Kafatos, M. (In Review) Yearly population data at census tract level revealed that more people are now living in highly fire-prone zones in California, USA.

We thank Chapman University Grand Challenges Initiative and Miami University College of Arts and Science for its financial, administrative, and intellectual support. We also thank Dr. Brian Hoover (Farallon Institute), Dr. Gregory Goldsmith, Dr. Seung Hee Kim, and Prof. Menas Kafatos (Chapman University) for their advising, encouragement, and support as well as Jessica Viner, Wesley Ho, Liz Lyon, Pionnah Gregorio, Justin Ewoldt for their participation and help during early research conceptualization and data preparation. We thank Hannah Waler, Jacob Lewis, Ruilin Rao, Dr. Byran Smucker, and Dr. Michael O'Connell from Dept. Stats at Miami University for their help in data analysis.



- We used Mann-Kendall test to derive the population change
- mapping

Figure 4 (to the right)

9 - 15

16 - 25

Esri, HERE, Garmin, FAO,

a) % of Area in

% Area as WUI

0 - 4

12 - 18

19 - 38

5 - 11

Wildland-Urban Interface (WUI)

NOAA, USGS, EPA

• 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 cyangreen, Fig. 4b)

NOAA, USGS, EPA

- 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

