Wildfire-mitigating power shut-offs promote household-level adaptation but not climate policy support

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Wildfire-mitigating power shut-offs promote household-level adaptation but not climate policy support

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Abstract

Unmitigated climate change threatens to disrupt energy systems, for example through weather- and wildfire-induced electricity shortages. Public responses to these energy crises have the potential to shape decarbonization trajectories. Here, we estimate the attitudinal and behavioral effects of Californian power shut-offs in 2019, intended to reduce wildfire ignition risks. We use a geographically targeted survey to compare residents living within outage zones to matched residents in similar neighborhoods who retained their electricity. Outage experience increased respondent intentions to purchase gas or diesel generators and home battery systems, but reduced intentions to purchase electric vehicles. Respondents blamed outages on their utility, not local, state, or federal governments. However, outages did not change climate policy preferences, including willingness-to-pay for either wildfire or climate-mitigating reforms. Our findings show that, in reaction to some climate-linked disruptions, individuals may undertake adaptive responses that, collectively, could exacerbate future climate risks.

Climate change is already exposing the public to damaging extreme weather and natural disasters (Reidmiller et al., 2019). These lived experiences may reshape individual and political incentives to address climate change (Howe et al., 2019): exposure to high temperatures (Egan and Mullin, 2012; Zaval et al., 2014; Bergquist and Warshaw, 2019), wildfires (Hamilton et al., 2016; Hazlett and Mildenberger, 2020), hurricanes (Shao and Goidel, 2016), and flooding (Spence et al., 2011; Demski et al., 2017; Albright and Crow, 2019) have sometimes increased public climate concerns and pro-climate behaviors. However, climate change will also indirectly threaten transportation, wastewater, and energy infrastructure (Hummel et al., 2018; Burillo et al., 2019; Chester et al., 2020). For example, extreme weather has already undermined grid reliability and energy provision in places like South Australia in 2016, California in 2019, and Texas in 2021. We still know little about public responsiveness to such climate-linked disruptions. Because the causal chain linking climate change to the public's lived experiences during infrastructure crises is more indirect, people may not associate their experience with climate change (Levy et al., 2018). In turn, these climate impacts are less likely to shape public support for climate mitigation and adaptation policies.

Pre-emptive power outages, also termed public safety power shutoffs (PSPSs), are one increasingly common disruption to energy infrastructure. PSPSs are intended to reduce wildfire ignition risks and are likely to become more frequent in fire-prone landscapes like California as climate change intensifies wildfire hazards (Gonzalez et al., 2018). PSPS events can be widespread and affect large populations. In Fall 2019, one of the California's major utilities, Pacific Gas and Electric (PG&E), conducted a series of widespread PSPS outages in Northern California. During an initial shut-off from October 9 through 12, PG&E "de-energized" over 730,000 customers across 35 counties.[1] Another 177,000 customers were de-energized during a second event between October 23 and October 25,[2] followed by two successive outage events beginning on October 26 and 29 that impacted another 941,000 customers.[3]

Here, we report the results from a new, high spatial resolution survey of Californians fielded in the immediate aftermath of these widespread outage events. Unlike traditional surveys that rarely achieve geographic resolution below the ZIP code, we use a mail-to-web recruitment strategy that allows fine-grained spatial control (see Methods for details). Briefly, we used the spatial boundaries released by PG&E to generate a sample of addresses subject to at least one outage during October 2019, oversamples of addresses within 1km inside or outside the outage boundaries, and targeted samples of non-outage addresses that were otherwise similar to outage zone addresses. We visualize this sampling frame as Figure 1. All sampled addresses were mailed a letter inviting resident participation in a web-based survey in the second week of November, and then sent a postcard reminder in the first week of December. In total, we received complete survey responses from 890 Californian households (see SI Figure A1 for map of respondents' addresses).

Our data allows us to describe the experiences of the average respondent in the outage zone.

[1] PG&E. 2019. "AMENDED PG&E Public Safety Power Shutoff (PSPS) Report to the CPUC, October 9-12, 2019 De-Energization Event." Available online at https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/News_Room/NewsUpdates/2019/PGE\%20Public\%20Safety\%20Power\%20Shutoff\%20Oct.\%209-12\%20Report_Amended.pdf. The utility also de-energized 11,300 customers in the North Sierra foothills which are not captured by our sampling frame. See PG&E. 2019. "PG&E Public Safety Power Shutoff (PSPS) Report to the CPUC October 5-6, 2019 De-Energization Event. Available online at https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/News_Room/NewsUpdates/2019/PGE\%20Public\%20Safety\%20Power\%20Shutoff\%20Oct.\%205-6\%20Report.pdf

[2] PG&E. 2019. "PG&E Public Safety Power Shutoff (PSPS) Report to the CPUC October 23-25, 2019 De-Energization Event." Available online at https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/News_Room/NewsUpdates/2019/PGE\%20Public\%20Safety\%20Power\%20Shutoff\%20Oct.\%2023-25,\%202019\%20Report.pdf

[3] PG&E. 2019. "PG&E Public Safety Power Shutoff (PSPS) Report to the CPUC October 26 & 29, 2019 De-Energization Event." Available online at https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/News_Room/NewsUpdates/2019/Nov.\%201\%202019\%20PGE\%20ESRB-8\%20Repor\%20for\%20Oct.\%2026\%2029\%202019.pdf

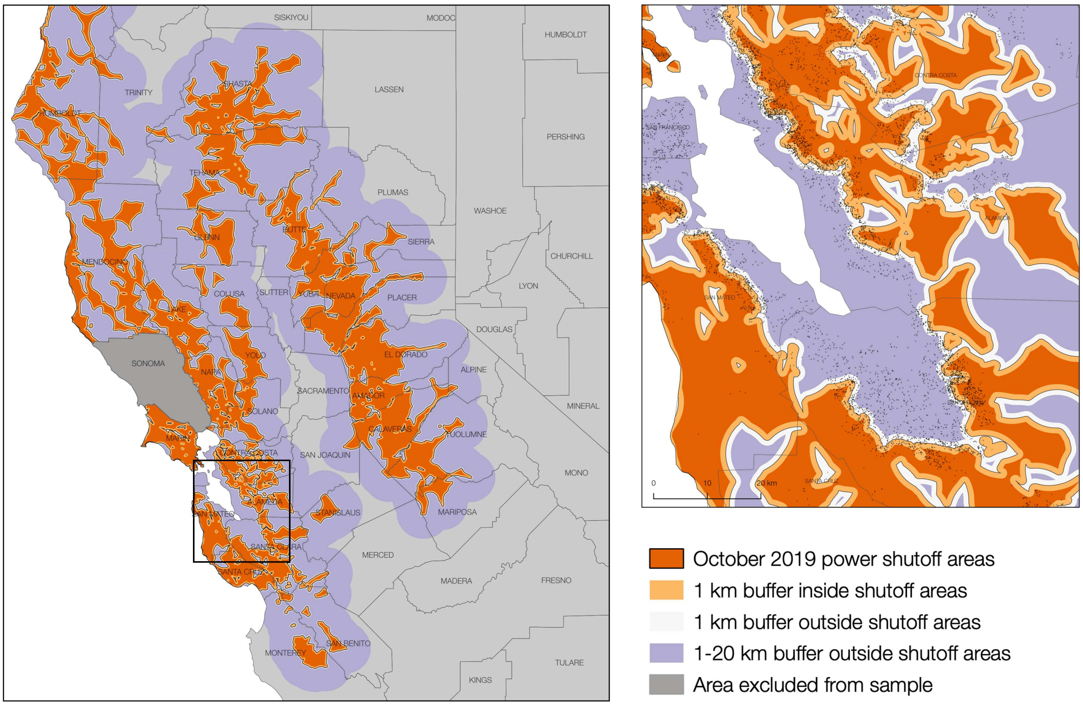

Figure 1: *Left*: Survey sampling zones associated with Public Safety Power Shut-offs events in Northern California, Fall 2019, see Methods for details. *Right*: Inset map with dots illustrating addresses selected for sampling in the East San Francisco Bay Area.

We can also exploit spatial variation in the distribution of PG&E power outages to evaluate how exposure to energy infrastructure disruption shaped the public's adaptive behaviors and climate attitudes. In general, the boundaries of PSPSs are a function of local transmission networks that remain opaque to most residents. Because transmission networks play a negligible role in structuring where people choose to live, we can estimate the effect of outage exposure on public attitudes by matching respondents within outage zones with otherwise similar respondents just outside outage zones. Overall, we find that outage experience increased respondent intentions to purchase gas or diesel generators and home battery systems, but reduced intentions to purchase electric vehicles. At the same time, outages did not change climate policy preferences, including willingness-to-pay for either wildfire or climate-mitigating reforms. Broadly, our findings suggest that, in reaction to some climate-linked disruptions, individuals may undertake adaptive responses that, collectively, can exacerbate future climate risks.

Respondent experiences with October 2019 PSPS events

Survey respondents in the outage zones reported significant disruptions from October 2019 PSPS events, with 44 percent reporting power losses for three or more days. These experiences were

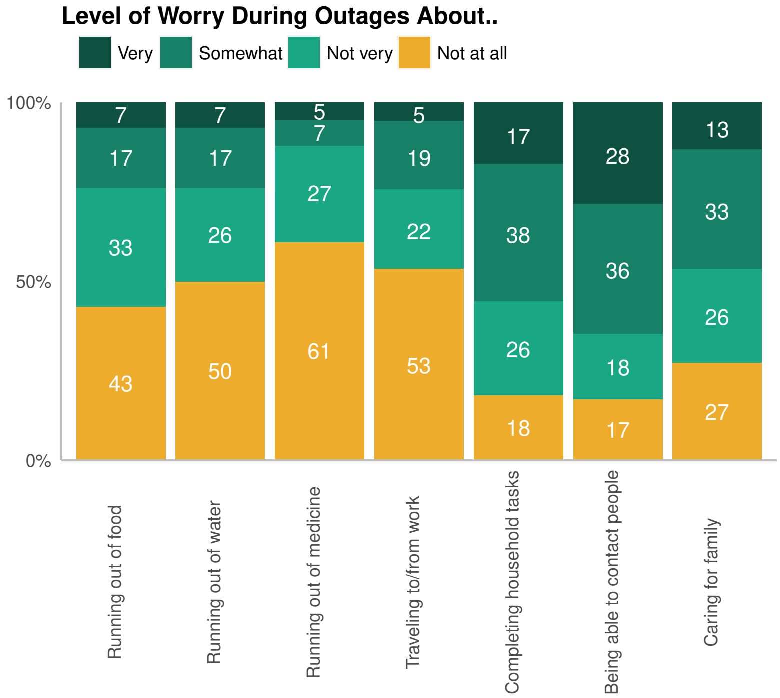

Figure 2: Outage-impacted respondent concerns during the October 2019 PSPS outages in Northern California.

consequential. Majorities of outage-impacted respondents were worried about being able to contact people (64%) and complete household tasks (55%), and 46% were worried about caring for family (Figure 2).

In our survey, we asked respondents why they thought the electricity was shut off, using an open-ended text field. 426 respondents offered responses (see Methods for coding details). Overall, 53 percent mentioned weather as a cause, generally either wind or wildfire. 28 percent mentioned some negligence or corruption on the part of PG&E (this included comments expressing that PG&E was only concerned with reducing their own liability), while 9 percent referred to PG&E safety efforts. Just 1 percent of respondents referred to government negligence or corruption. Only 4 respondents (less than 1 percent) mentioned climate change.

Most respondents in outage areas took preparatory actions in advance of the PSPS events. 64 percent reported buying additional food, and 65 percent reported buying gasoline. 50 percent reported buying flashlights, candles or rechargeable batteries.Most respondents who experienced power shutoffs stayed in their own homes (78%), even if their power was shut off over night. Few stayed with friends or relatives (4%) or at a hotel or a motel (2%). 155 respondents answered an optional question asking how much money they spent on preparations. The average reported amount was \$327, with responses ranging from a low of \$0 to a high of \$5000.

In sum, respondents self-reported that the PSPSs had psychological and economic effects on their households. We now evaluate whether these experiences shaped respondent's behavioral intentions and climate attitudes. Simple comparisons between individuals exposed and not exposed to outages would likely produce biased estimates; respondents "treated" with outages may differ systematically from non-exposed respondents, including as a result of differences in neighborhood characteristics.[4] Accordingly, we combine our spatially targeted sampling with matching algorithms to match treated respondents with similar unexposed households to estimate the causal effect of outage exposure (see Methods for details).

The effects of outage experience on behavioral intentions

We first consider behavioral intentions related to adaptation. Here, we examine whether respondents planned to take the following actions over the subsequent year:[5] 1) change home landscaping to reduce wildfire risk, 2) upgrade home building materials to reduce wildfire risk, 3) install a home battery system, 4) install gas or diesel backup generation, 5) move, 6) purchase additional food and water supplies to prepare for future shutoffs, 7) and install solar panels.[6] We also asked respondents whether they thought the next car they purchased would be an electric vehicle (EV) which is, instead, a mitigation behavior that could help reduce the risk of future climate-related hazards. The perceived benefits of EVs might also be affected by reliability of electric service. In the outage-exposed area, 50 percent of respondents reported plans to purchase additional food and water, 24 percent reported plans to install backup generation, and another 19 percent reported plans to change home landscaping. On the other hand, just 4 percent reported plans to upgrade home building materials, 9 percent reported plans to install a home battery system, and 7 percent reported plans to install solar panels.

When we compare average household-level adaptation outcomes between matched respondents inside and outside outage areas, we find that outage exposure shaped certain adaptation outcomes, but not others.[7] As demonstrated by Figure 3, exposure to an outage had the strongest effect on respondents' plans for installing a backup gas or diesel generator; individuals exposed

[4]While outage boundaries may be exogenous, topographical differences still create differences between neighborhood types, property values and other characteristics within 1km of outage boundaries.

[5]We excluded respondents who had already taken the activities prior to outage onset.

[6]We recognize that the ability to take these actions can depend on home ownership and income. Since the great majority of the sample owned their homes (86 percent), we were unable to estimate heterogeneous effects by home ownership. We also do not find statistically significant differences in adaptation behaviors by income (see SI Section 3).

[7]We present differences in means in the matched sample in the main text, with estimates from covariate-adjusted OLS regression in the SI Section 2.

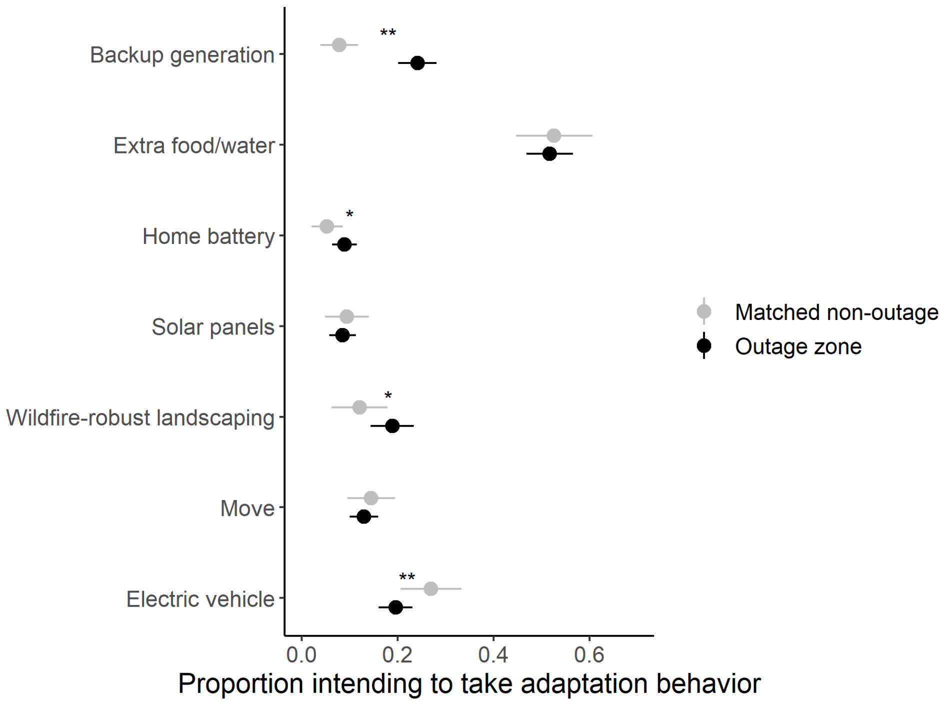

Figure 3: **Effect of outage exposure on household-level adaptation and purchasing intentions.** Figure presents proportion of matched respondents in outage and non-outage zones stating their intention to adopt a given behavior. Bars are 95 percent confidence intervals. Stars represent significance of difference-in-means between outage and non-outage sample for given behavior; **p<.05 ; *p<.1.

to outages were 16 percentage points [SE=.03, p<.01] more likely to plan generator installation. Outage-exposed respondents were also more likely to say they planned to install a home battery system, but only by 4 percentage points [SE=.02, p<.1]. In addition, outage-exposed respondents were 7 percentage points more likely to report that they planned to change their home landscaping to reduce wildfire risk [SE=.04, p<.1]. Finally, outage-exposed respondents were 7 percentage points less likely to report that they planned to purchase an EV as their next car [SE=.04, p<.05]. We do not find statistically significant effects for other household-level adaptations including building upgrades, plans for rooftop solar installations, plans to move, or preparing for future outages by buying additional food and water. On balance, we find that outage-exposed respondents tended to focus on their individual-level adaptive needs. Collectively, at least some of these behaviors (an increase in fossil fuel generator purchases and a decrease in EV purchases) might inadvertently exacerbate the climate risks that contribute to power outage events. Respondent openness to installing home battery systems suggests one potential countervailing measure that might support climate change mitigation.

Figure 4 presents estimates of the effect of outages on these behaviors, splitting the sample

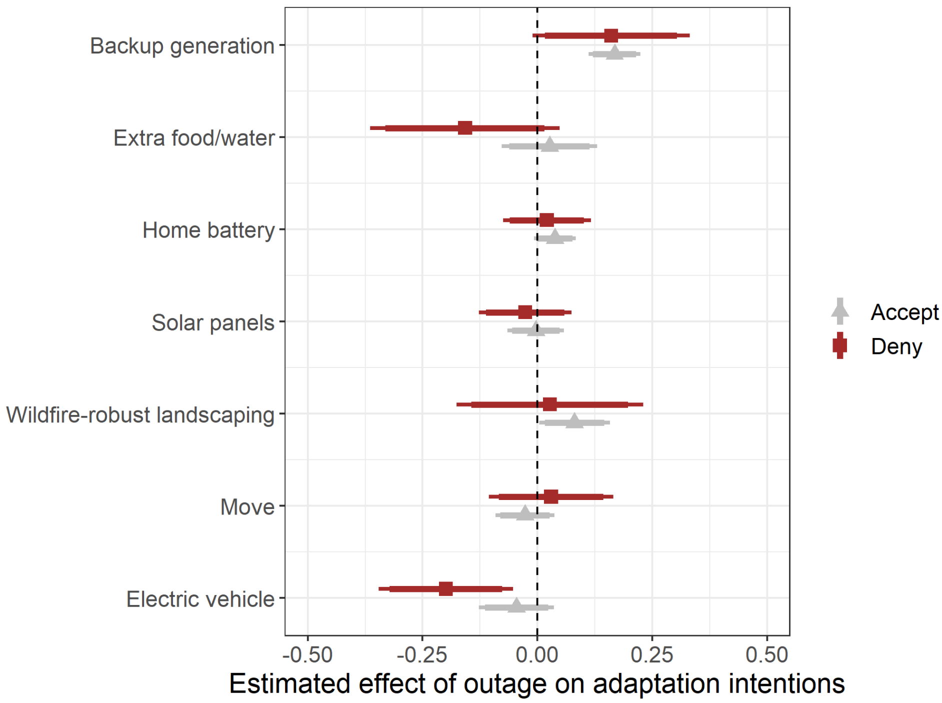

Figure 4: **Heterogeneous effects of outage exposure on adaptation by respondent acceptance of climate science.** Figure presents estimated effect of outage exposure on adaptation intentions among respondents who accept that global warming is caused mostly by human activities (n=547), and those who do not (n=128), all within the matched sample. Bars provide 95 percent confidence intervals.

by whether respondents accept that global warming is caused mostly by human activities. We generally do not find major differences in the effects of outages conditional whether respondents accept climate science. The one exception is with respect to electric vehicle uptake, where we find that the negative effect of outage exposure on EV uptake is concentrated among those who deny anthropogenic global warming. We do not find significant differences in adaptive responses to outages by partisan identification (see SI Section 3).

The effects of outage experience on utility and government trust

Our second set of outcomes concern respondents' attitudes with respect to electric utilities and government officials. Since outage decisions were made by electric utilities (principally, in this case, PG&E), we would suspect that being exposed to outages might affect respondents' attitudes towards their electricity providers. We measured respondents' trust in their electric utility, the degree to which respondents held their utility responsible for power shut-offs, whether they held PG&E liable for damages from their equipment, and whether they thought PG&E's corporate governance should be restructured as part of its bankruptcy proceeding. Overall, respondents held negative attitudes toward their utility provider. The average level of trust (across outage-exposed and non-outage areas) was "somewhat," more than half of respondents felt that PG&E was "completely" responsible for the shut-offs, and 80 percent agreed that PG&E is liable for wildfire damage caused by their equipment. Just 23 percent of respondents felt that PG&E should continue to operate as a privately-owned utility.

These attitudes were amplified by outage exposure. As shown in Figure 5, outage-exposed individuals reported statistically significantly lower levels of trust towards their electric provider than individuals in the control group. 43 percent of outage-exposed respondents reported they completely distrusted their utility, compared to 29 percent in the non-outage-exposed area [SE=.04, $p<.01$]. They also were more likely, by nearly half a standard deviation, to hold their electric utility responsible for causing the planned power shut-offs. 70 percent of outage-exposed respondents reported that the utility was completely responsible, compared to 58 percent elsewhere [SE=.04, $p<.01$]. However, we do not find that outage exposure was causally associated with respondents agreeing that utilities should be liable for the damage from wildfires caused by their equipment, nor with respondents advocating for a major restructuring in PG&E's corporate governance. These latter results may stem from limited variation in the outcome measure (even in non-outage-exposed areas, 79 percent of respondents reported holding PG&E liable, and 77 percent advocated for a major restructuring).

The strong effects of outage exposure on electric utility attitudes contrasted with minimal overall effects on attitudes towards politicians. In Figure 6, we do not find evidence that exposure affected overall attitudes towards former President Trump, California Governor Gavin Newsom, or local politicians. However, when we split the sample by partisan identification, we find some evidence that outage exposure affected politician approval among political Independents. Independents exposed to outages had lower approval of California Governor Newsom [13 points on 100 point scale, SE=5.32, $p<.05$], and higher approval of (then) President Trump [17 points on 100 point scale, SE=5.62, $p<.01$]. Democrats exposed to outages had slightly lower approval of Trump [3 points on 100 point scale, SE=1.46, $p<.1$].

The effects outage experience on climate attitudes

Our final set of outcome measures relate to climate attitudes, including willingness-to-pay for climate- and wildfire-mitigating policies. As shown in Figure 7, outage exposure was not associated with differences in policy views on clean energy and climate policies like achieving net zero emissions by 2035 and implementing a Clean Energy Standard. Exposure was also not

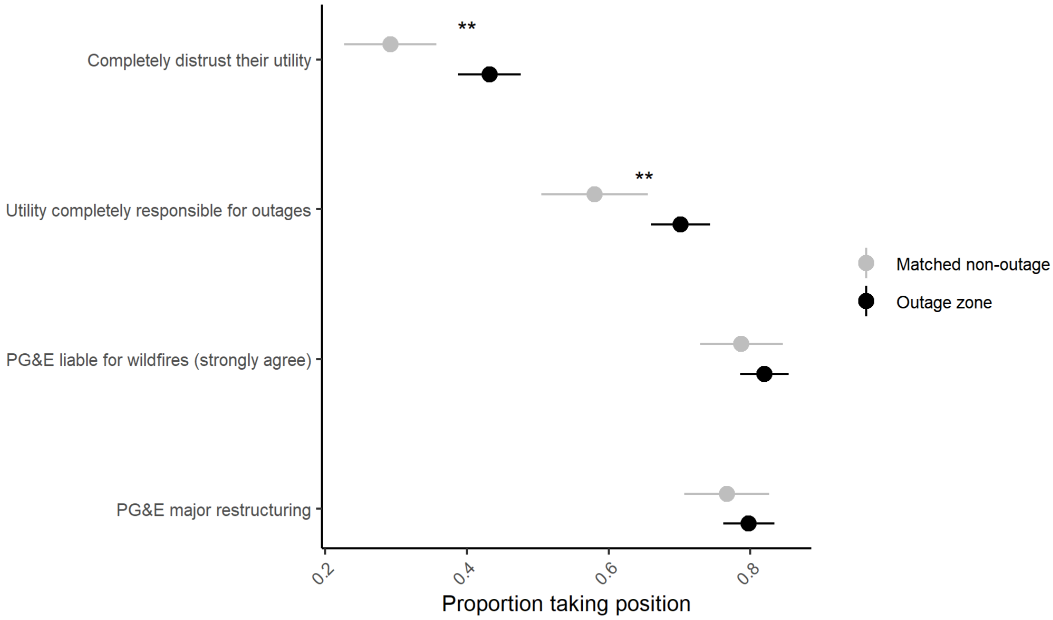

Figure 5: **Effect of outage exposure on attitudes towards utilities.** Figure presents proportion of matched respondents in outage and non-outage zones who take stated position with respect to their electric utilities, primarily PG&E. Stars represent significance of difference-in-means between outage and non-outage sample for given behavior; **p<.05.

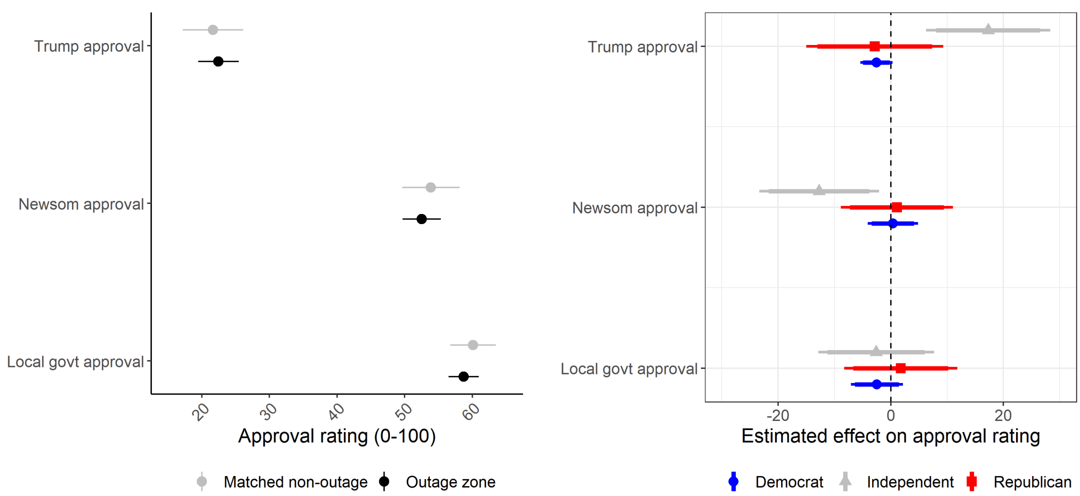

Figure 6: **Effect of outage exposure on politician approval ratings.**. *Left*: Average politician approval rating for matched respondents in outage zones and non-outage zones. *Right*: Estimated effect of outage exposure on approval ratings in matched sample by partisan identity. Bars are 95 percent confidence intervals.

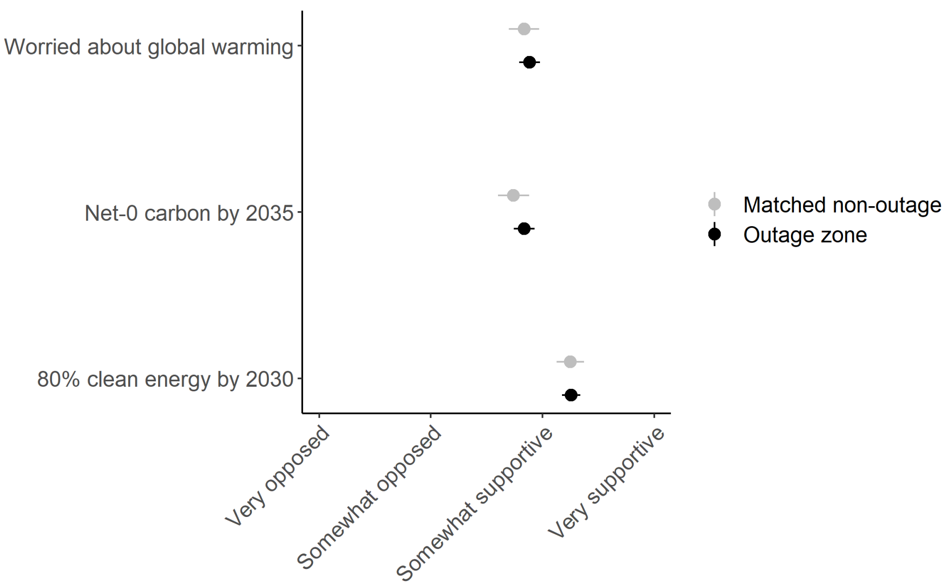

Figure 7: **Effect of outage exposure on policy and global warming attitudes.** Figure presents average policy views for matched respondents in outage and non-outage zones. For worried about global warming outcome, the opposed position corresponds to less worried. Bars are 95 percent confidence intervals.

associated with increased concern about global warming.[8]

In addition to evaluating the degree to which outage exposure affected behaviors and attitudes, we also leveraged the survey to evaluate respondents' willingness to pay (both financially and in terms of days without power) to reduce fire risk and make the electricity system more stable in California (see Methods for details). First, we estimated that the median respondent was willing to live without electricity for 6.7 days a year to reduce fire risk– 6.6 days in the outage area and 6.9 days outside it (no statistically significant difference). We also estimate that the median respondent would be willing to pay a surcharge of just $4.19 per month to avoid future planned power shutoffs– $2.19 in the outage area and $7.89 outside. Again, this difference was not statistically significant due to large standard errors in the willingness to pay analysis. This contrasted with a high willingness to pay, $49.35 per month, to bury power lines underground to improve overall system stability and resilience ($50.22 in the outage area, $47.73 outside it, no statistically significant difference).

[8]For policy attitudes, unlike politician approval ratings, we do not find significant heterogeneous effects by partisan identification.

Discussion

Public safety power shut offs (PSPSs) are becoming frequent in California, and represent a class of indirect climate-linked energy system disruptions that impact public welfare across the world. Our results suggest that California households were not well-prepared for the power outages, but the experience of the outage catalyzed adaptive behaviors like installing back-up power. By contrast, outage exposure did not encourage behaviors that might mitigate climate change, or broadly shift climate change attitudes. These results are, for the most part, robust to a number of alternative specifications that we present in our supplementary materials. These include adjusting by a set of covariates (SI Section 2), including matched Southern California respondents in the sample (SI Section 4), and excluding respondents within 1000-meters from the spatial outage boundary (SI Section 5). One exception is the finding that outage exposure reduced intention to purchase an EV, which weakens in some alternative specifications.

Broadly, public responses to these power outages reflected households' short-term and proximate needs– maintaining power and reducing fire risk– rather efforts to climate change, a systemic but indirect driver of the energy system disruption. Moreover, outage-exposed respondents tended to blame their utility, who made the proximate decision to implement the outages, rather than the politicians who could potentially be held accountable for the policies that may reduce climate change risk through mitigation and adaptation. Our findings trouble assumptions that individuals will change their attitude and behaviors if simply informed about the ways that climate change will personally affect them or if they experience a climate-related hazard event, particularly when - as was the case with the 2019 Californian outages - climate change was not portrayed as a major event driver. Efforts to decarbonize our energy systems cannot assume that all climate-linked disruptions will mobilize the public in support of clean energy reforms.

Methods

Our data collection protocol began with creating a spatially disaggregated sampling frame that allowed us to target individuals who experienced at least one PSPS as well as groups of otherwise similar residents. During the Fall 2019 PSPS events, we collected spatial polygon files publicly shared online by PG&E for each successive shut-off event. We intersected all outage polygons to define the spatial extent of Californians who were projected to experience one or more PSPS events in the PG&E service area during October and November 2019. We also recorded the number of overlapping projected outages experienced in each part of the service area.

We then defined a series of additional spatial zones using buffering methods. First, we defined a spatial zone containing all areas within California located between 0 and 1 km *inside* the projected outage zone boundaries. Second, we defined a spatial zone containing all areas located between 0 and 1 km *outside* the outage zone boundaries. Third, we defined a spatial zone containing all areas located between 1 and 20 km *outside* the outage zone boundaries. For all zones, we excluded Sonoma county because active wildfires and evacuations associated with 2019 Kincade fire remained in effect in Sonoma County during our survey period. Figure 1 illustrates these different spatial zones that structure our survey sampling frame.

Using the WorldPop gridded 100 meter population dataset as a probability surface, we generated 1 million points within Northern California county boundaries, weighted by population distribution. This point dataset simulated a random sample of the population within our target counties. For every point, we extracted its CalFire fire threat zone from CalFire gridded data (https://frap.fire.ca.gov/mapping/gis-data/) as well as its census tract ID. We then subset this Northern California point sample layer by clipping to each of our four spatial zones: 1) 0-1 km buffer outside outage boundaries, 2) 0-1 km buffer inside outage boundaries, 3) 1-20 km buffer outside outage boundaries, 4) actual outage boundaries. This created four point sample layers for geocoding. Within each layer, we randomly sampled 6000 points. Then, using the Google reverse geocoding API (via the ggmap package (Kahle and Wickham, 2013)), we reverse geocoded the coordinates of each sample point in all four layers. Reverse geocoding produced a street address (if available) for each point and a label indicating whether the address was a "premise" (Google's label for a dwelling unit). We then subset reverse geocoded points to only those with street addresses identified as premises and removed duplicates. Finally, we randomly subset 3000 addresses in each zone, except for the full outage zone, where we selected 6000 addresses to sample. In Figure 1 we also visualize local-scale sampling points in the East Bay Area.

We also generated a list of control addresses in Southern California that were as closely matched as possible to addresses in our sample within 1 km inside and 1km outside the outage boundaries. First, we prepared a map of Southern California counties (San Luis Obispo, Santa Barbara, Ventura, Los Angeles, San Bernardino, Orange, Riverside, San Diego, Imperial). Again using the WorldPop gridded 100 meter population dataset as a probability surface, we generated 500,000 points within these county boundaries, weighted by population distribution. Third, we took all sample addresses from Northern California living within 0-1km area outside and the 0-1km area inside the outage boundary; we calculated the proportions of population within each census tract within each fire threat zone. Using entropy balancing (via the eBal package in R), we generated weights for every Southern California census tract so that the weighted average of all Southern California tracts on a variety of socio-demographic characteristics matched to the distribution of tract attributes in our Northern California sample. We generated weights based on the following characteristics: percent of census tracts that were unzoned, or under low, medium, high, and very high threat per CalFire threat zones; propensity scores for tract-level wildfire occurrence between 2000 and 2017, and between 2008 and 2017; average household size; unemployment rate; percent of tract residents who are homeowners; percent who are married; percent with bachelors degree or higher; percent who speak English as first language; percent below poverty level; percent veterans; percent with jobs in management, business, science, and arts; percent with jobs in service sector; percent firefighters or working protective services; percent working in farm, fishing or forestry; percent white; percent Hispanic; percent Black; percent who drive alone to work; percent who use public transit; and percent who work in-state. We then randomly sampled, with replacement, from these census tracts, using the entropy balance weights as sampling weights. This produced a list of census tracts. We then randomly sampled points within each census tract in this list, and reverse geocoded these points as before. We included the first 3000 addresses identified as premises.

Overall, this sampling process resulted in a list of 18000 addresses: a representative sample of 6000 addresses from within the PSPS outage zone, a representative sample of 3000 addresses from 0 to 1 km inside the outage boundary, a representative sample of 3000 addresses from 0 to 1km outside the outage boundary, a representative sample of 3000 addresses from 1 to 20 km outside the outage boundary, and a sample of 3000 Southern California addresses matched to Northern California sample addresses within 1km inside or outside the outage boundary.

On November 14, 2019, we mailed a customized letter to each of these 18000 addresses, inviting one resident from each household to participate in an online survey on California's electricity system (see SI Figure A14 for example recruitment letter). Each letter contained a customized URL so that we could identify the spatial location for every survey response. Respondents who completed our survey received a $5 digital gift card by email that they could redeem at dozens of different online retailers, or that they could donate to a charity of their choice. As a result of our initial letter, we received 565 complete survey responses. On December 3rd, we sent a follow-up letter to all individuals who had not completed the survey, again inviting them to participate. This generated an additional 325 survey responses. In total, we received 890 complete response, a 4.94% response rate. In Table 1 we show response rates across sampling zones, with observed elevated response rates in areas that had experienced a PSPS event. We

Zone	All Outage	Inside 0-1 km	Outside 0-1 km	Outside 1-20 km	Southern Cal.
Response Rate	5.73	5.03	4.97	3.87	4.33
Observations	495	151	149	116	130

Table 1: Survey response rates and sample size by spatial sampling zone

provide the full text of our survey instrument as SI Section 7.

Among our sample of respondents located within the outage zones released by PG&E, 85% reported experiencing at least one recent power outage. Of those respondents, the majority (57%) reported experiencing more than one outage. Among respondents who experienced an outage, a majority were without power for three or more days.

Respondents living in an outage zone differed systematically from respondents who were not exposed to outages, as demonstrated by Table 2. This may be a function of topography, where distances of 1km from the outage boundary in Northern California include stark differences in urban (low-lying) vs. suburban and periurban neighborhoods (hillside) across the Bay Area. In particular, those exposed to outages were more likely to identify as Democrats, were more liberal, were more likely to identify as female, and were older. As a result, we should suspect underlying differences in attitudes and behaviors when making naive, direct comparisons between these groups.

To address these possible underlying variations between treated untreated groups, we used a matching algorithm to construct a plausible control group and estimate the effect of exposure to outages (Dehejia and Wahba 2002, 1999). Specifically, we leveraged genetic matching (Diamond and Sekhon 2012) via the *Matchit* package in R to identify a set of individuals that were not exposed to outages that are otherwise comparable to the individuals exposed to outages.[9] In this way, our spatially resolved sampling helps us to identify high quality likely matches for treated respondents; likewise, the quasi-arbitrary nature of outage boundaries reduces somewhat the risk of persistent unobserved confounders. The matching algorithm identified 678 respondents (of 890 in the full sample) for whom we were able to achieve balance on key covariates. 485 resided in areas that spatial data provided by PG&E indicate were exposed to outages, while 193 resided in areas that were, according to the PG&E data, unaffected. This is reflected in survey responses to questions about respondents' experience of power outages. In total, 66 percent of respondents

[9] An alternative approach is to compare individuals on either side of the boundary between outage-exposed and non-outage areas through a geographic regression discontinuity design (Keele and Titiunik 2015). If the boundary is randomly placed, we would expect, within a small geographic window around the boundary, no systematic differences between treatment and control groups. The problem with this approach in our case is imprecision in the spatial data specifying the outage-exposed areas. Only 25 percent of respondents living between 0 and 1000 meters on the inside of an outage zone reported exposure to planned outages– while 12 percent of respondents living between 0 and 1000 meters on the outside of an outage zone reported exposure. Given this imprecision, the matching design provides much greater leverage for estimating the effect of outages exposure.

Table 2: Covariate balance between treatment and control groups in overall and matched samples

	Overall sample			Matched sample		
	Treated mean	Control mean	P-value (t-test)	Treated mean	Control mean	P-value (t-test)
Party ID	2.248	2.57	0.002	2.241	2.301	0.648
	(0.066)	(0.082)		(0.067)	(0.111)	
Ideology	3.431	3.681	0.015	3.437	3.466	0.817
	(0.066)	(0.077)		(0.067)	(0.107)	
Educational attainment	4.526	4.457	0.289	4.522	4.435	0.321
	(0.042)	(0.051)		(0.042)	(0.076)	
Age	55.491	53.453	0.064	55.544	51.857	0.006
	(0.69)	(0.831)		(0.699)	(1.124)	
Income	2.639	2.648	0.893	2.648	2.736	0.265
	(0.15)	(0.158)		(0.149)	(0.221)	
Female	0.505	0.398	0.001	0.505	0.477	0.504
	(0.022)	(0.025)		(0.023)	(0.036)	
Married	0.675	0.62	0.092	0.676	0.658	0.651
	(0.021)	(0.024)		(0.021)	(0.034)	
Employed	0.562	0.595	0.318	0.563	0.617	0.199
	(0.022)	(0.025)		(0.023)	(0.035)	
Non English at home	0.238	0.281	0.151	0.237	0.311	0.057
	(0.019)	(0.023)		(0.019)	(0.033)	
Smoke level	2.473	2.349	0.054	2.478	2.534	0.484
	(0.045)	(0.046)		(0.045)	(0.065)	
Observations	495	395		485	193	

Notes: Ideology was measured using a standard 7-point Likert scale (1 is most conservative, 7 most liberal). Education was measured on a 5-point scale (less than high school, high school diploma or GED, some college, associates degree, bachelors degree of higher). Income was measured using a 4-point scale (less than \$40,000, \$40,000 to \$100,000, \$100,000 to \$250,000, over \$250,000). Smoke level is 4-point measure of degree to which smoke has made air quality in respondents' community worse since beginning of October, 2019.

in the matched treatment group reported that they experienced a planned outage, compared to just 11 percent of respondents in the matched control group.[10]

Table 2 presents summary statistics on the individuals in the full sample and the matched sample. While respondent age and whether respondents speak a language other than income at home are unbalanced in the matched sample, that results are robust to adjusting by these (and other) covariates (see SI Secton 2) suggests these imbalances are not driving estimated effects.

Throughout, we estimate the effect of outage exposure by estimating a simple linear model among respondents in the matched sample:

$$y_i = \beta_1 T_i + \beta_2 X_i + \alpha + \varepsilon_i \tag{1}$$

[10]The measurement error reduces the precision of our estimates, making it more difficult to detect treatment effects, but does not produce bias. Lack of precision in outage maps, combined with uncertainty of the accuracy of survey responses, makes it difficult to establish the ground truth of outage experiences.

Respondents are indexed by i. T_i denotes outage exposure and X_i is a matrix of demographic covariates measured the respondent level. α is an intercept, and ε_i represents standard errors.[11] Discussion of covariates included, and estimates from covariate-adjusted models, are provided in SI Section 2. Throughout, all statistical tests are two-side.

In addition to using the survey for causal inference, we also leveraged the survey to gain insights about the public's understanding of reasons for the planned electricity outages. For respondents who had reported experiencing a shutoff, we asked: “In a few words, why do you think your electricity was shut off?” For respondents who did not report that their own electricity was shut off, but that electricity of other homes in their communities was shut off, we asked: “In a few words, why do you think the electricity of other homes in your community was shut off?” 426 respondents offered answers to the open-ended question. We first conducted an analysis of the most common words used. The five most common words were “fire” (177 times), “wind” (129), “PG&E” (125), “power” (91), and ‘high"”(91). From this preliminary analysis, and from inspecting the first 100 responses, we generated five non-unique (e.g. a single response can fall into multiple) keys for responses: weather and fire risk; PG&E taking action to protect public safety; negligence or corruption on the part of PG&E; government negligence or corruption; and uncertainty as to what caused the shutoffs. We discuss the proportion of responses that fell into each category in the main text.

In the main text, we also report median respondent willingness to pay (both financially and in terms of days without power) to reduce fire risk and make the electricity system more stable. To estimate willingness-to-live without electricity to reduce fire risk, asked respondents: “Would you be willing to live without electricity for X days each year to reduce the risk of wildfires in California?” We randomly assigned X from among 1, 2, 3, 4, 5, 7, 10, 14, and 21, and used the function *sbchoice* from the package *DCchoice* in *R* to compute median willingness-to-pay. We conducted similar analysis for the other willingness-to-pay items. To estimate willingness-to-pay a surcharge to reduce future planned power shutoffs, we asked: “Would you be willing to pay a surcharge of $X every month on your electricity bill to avoid future planned power shutoffs?” We randomly assigned X from among 1, 2, 5, 7.5, 10, 15, 20, 30, 40, 50, 75, 100, 150, and 250. To estimate willingness-to-pay to bury power lines underground, we asked: "How much would you support burying power lines in California if it cost you $X more per month on your utility bill for the next 10 years?" [12] For this question, we randomly assigned X from among 1, 2, 5,

[11] We exclude income from the covariates in regression adjustment because high missingness reduces sample size considerably. Table 2 indicates balance on income.

[12] We provided more detail in a prior vignette: “A number of different policy ideas are being discussed to try to make the electricity system in California more stable. One idea is to bury power lines underground. This

10, 25, 50, 75, 100, 110.

This study was reviewed and approved by the University of California Office of Research as Protocol 22-19-0808.

Data availability

Data and replication scripts that support the findings of the study will be deposited in the Harvard Dataverse repository to accompany publication of this article, available at [URL TO BE ADDED].

Statement of Contributions

MM and PH jointly participated in all stages of this study, including design, data collection, analysis, and writing. SM participated in analysis and writing. LS and ML participated in design, data collection and writing.

Financial Competing Interests Statement

The authors declare they have no financial interests in this research.

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would likely cost $3 million per mile. Currently, California has over 175,000 miles of overhead power lines. This means that burying all California power lines would cost over $525 billion dollars, more than twice the state's total annual budget for all government spending."

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Supplementary Information

1 Distribution of completed survey responses

Figure A1 visualizes the distribution of complete survey responses received. (See Methods in the main text for a detailed elaboration of sampling strategy).

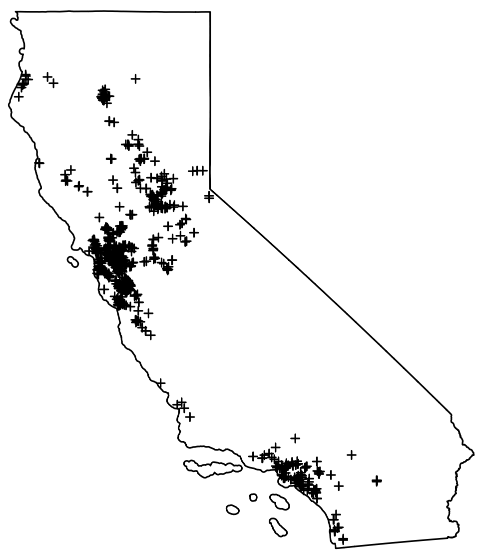

Figure A1: Locations of all complete survey responses

2 Robustness to covariate adjustment in matched sample

In the main paper, we present the difference in means within the matched sample between treatment (outage zones) and control (non-outage zones) groups for key outcomes. Here, we present estimates from OLS regression with the outcome on the left-hand side, and treatment (outage zone) and a matrix of covariates on the right-hand side (see Equation 1 above). Overall, we recover consistent results when we include covariates in the analyses.

The following covariates were included: age, gender, education, ideology, income, partisanship, whether employed, whether a language other than English is spoken at home, and whether there were children in the household. Education was measured on a 5-point scale (less than high school, high school diploma or GED, some college, associates degree, bachelors degree of higher). Ideology was measured using a standard 7-point Likert scale. Income was measured using a 4-point scale (less than $40,000, $40,000 to $100,000, $100,000 to $250,000, over $250,000).

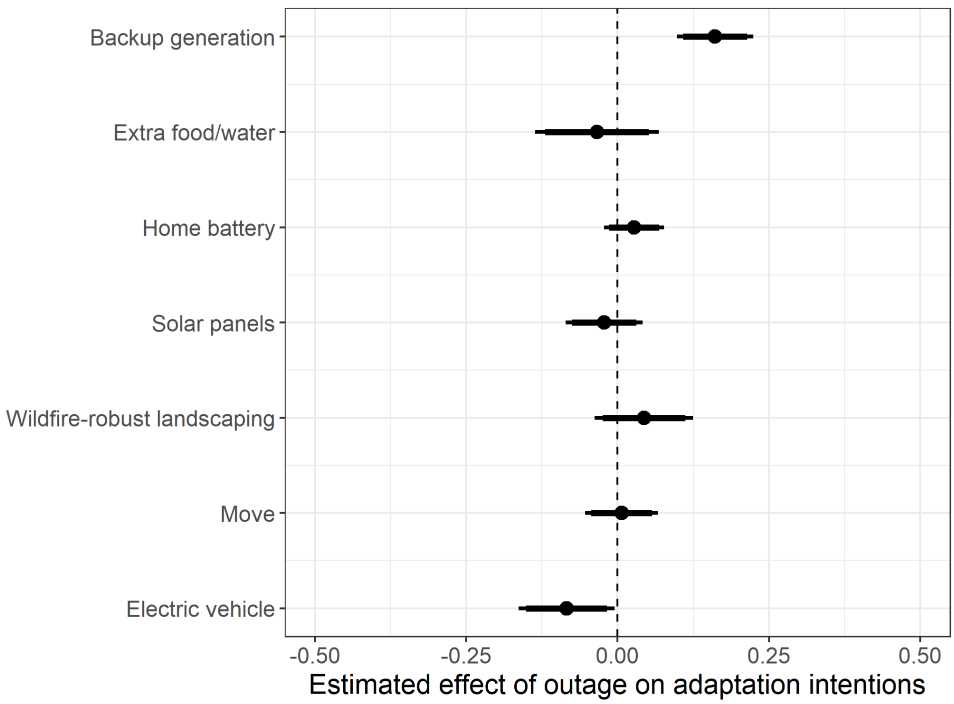

Figure A2: **Covariate-adjusted estimates of effect of outage exposure on household-level adaptation and purchasing intentions.** Estimates from OLS regression on matched sample. Bars are 95 percent confidence intervals.

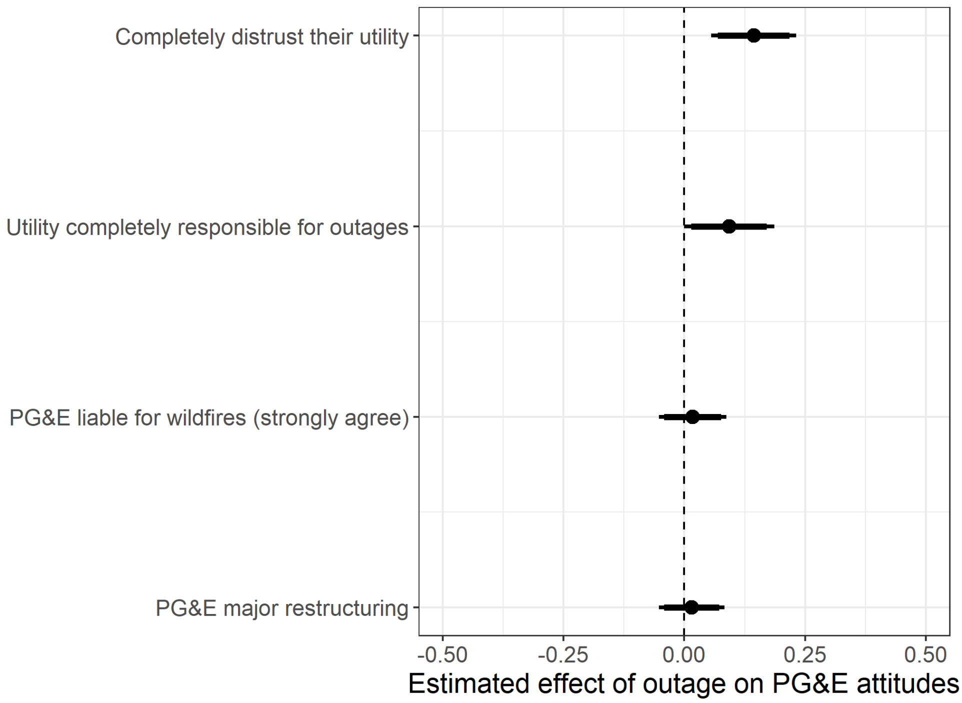

Figure A3: **Estimated effects of outage exposure on attitudes towards utilities.** Estimates from OLS regression on matched sample. Bars are 95 percent confidence intervals.

3 Heterogeneous treatment effects

This section presents a number of analyses of heterogeneous effects of exposure to outages based on respondent-level covariates (e.g. income, partisanship). We first explore heterogeneous treatment effects of outage exposure on household-level adaptation. Figure A4 presents analysis of individual-level adaptation responses to outage exposure by income, recognizing that income may moderate the ability of respondents to adapt. However, we do not estimate heterogeneous treatment effects when we split the sample into two income groups (over / under \$100K).

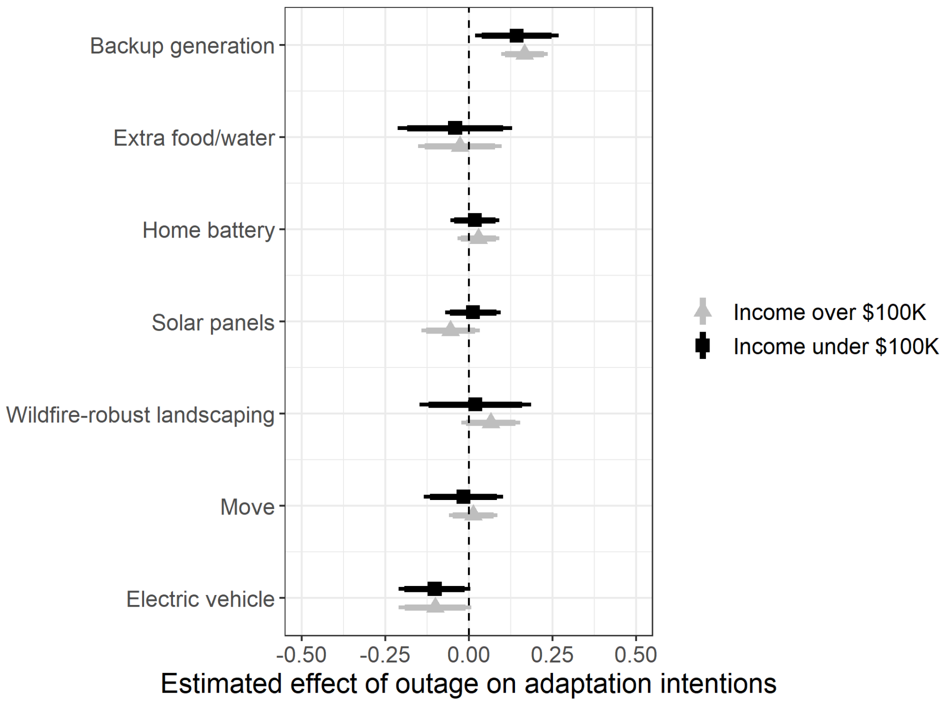

Figure A4: **Estimated effects of outage exposure on adaptation, by income**. Bars are 95 percent confidence intervals.

We also, as demonstrated by Figure A5, do not estimate significant heterogeneous effects of outage exposure on adaptation responses by partisan identity.

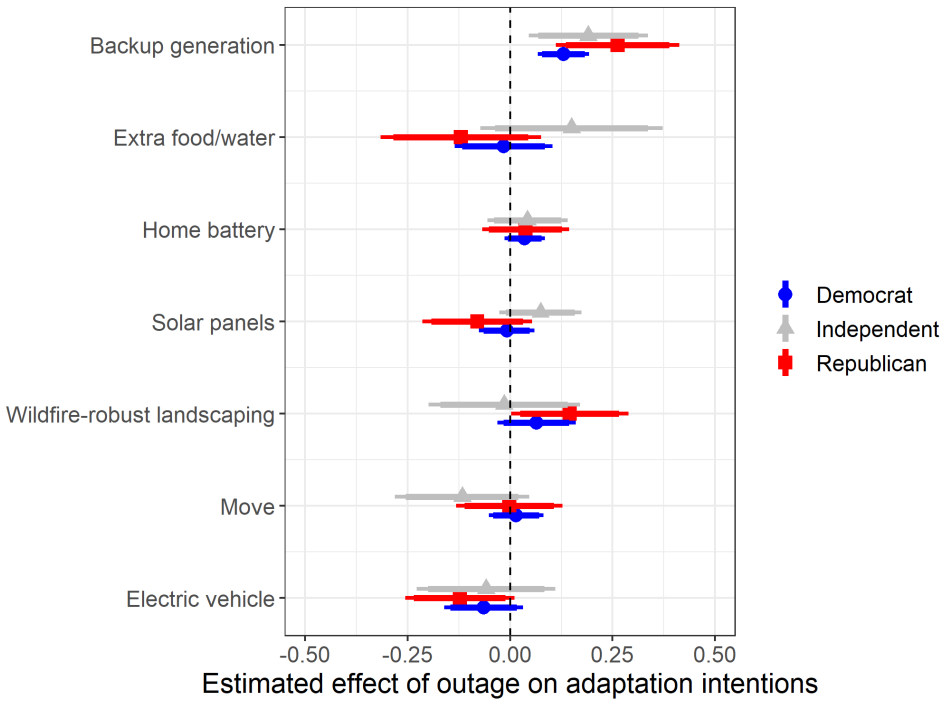

Figure A5: **Estimated effects of outage exposure on adaptation, by partisan identity**. Estimates from OLS regression on matched sample. Bars are 95 percent confidence intervals.

Household-level adaptation might also plausibly depend on distance from outage zones for those in the control group, and relatedly, whether respondents have a close friend or family member who was exposed to outages. However, Figure A6 indicates no statistically significant differences among those in the control group by distance to the outage zone (splitting the control group by the median distance to the outage zone). And Figure A7 indicates no statistically significant differences among control respondents by whether they have a friend or family who was exposed to outages.

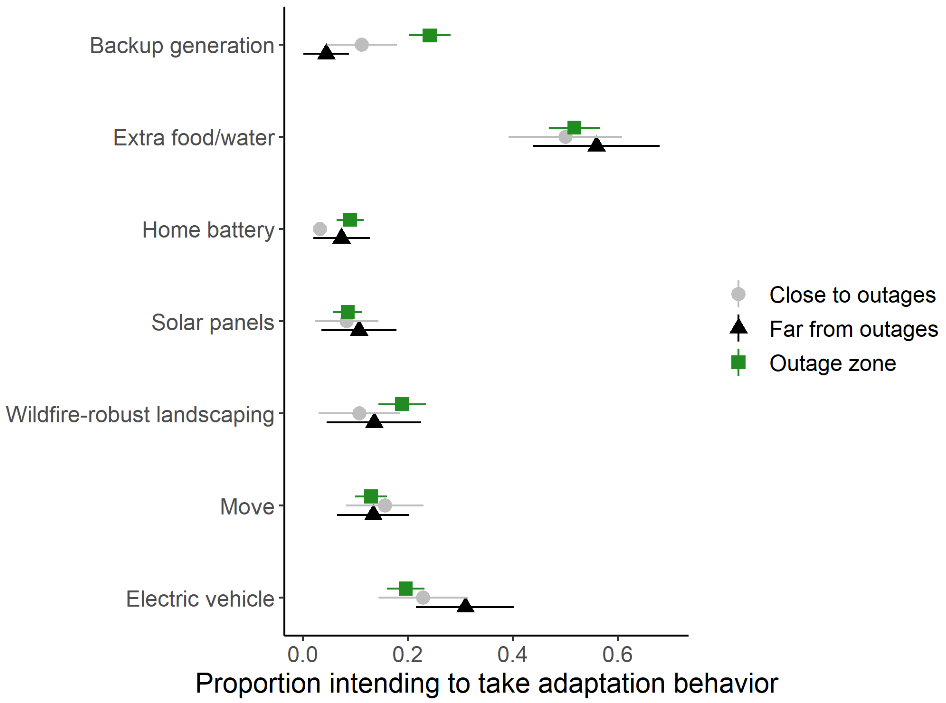

Figure A6: **Adaptation intentions by distance to outage zone**. Far from outages indicates more than 1048 meters (median distance in the control group). Estimated proportions drawn from matched sample. Bars are 95 percent confidence intervals.

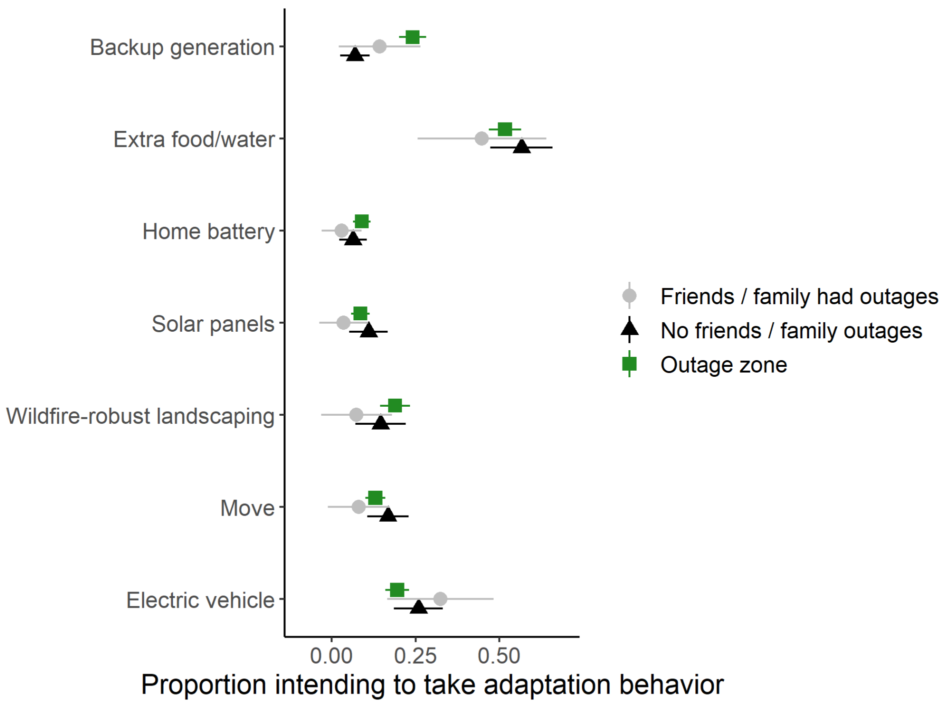

Figure A7: **Adaptation intentions by whether friends or family exposed to outages**. Estimated proportions drawn from matched sample. Bars are 95 percent confidence intervals.

On the other hand, Figure A8 indicates that household-level adaptation did depend on the length of outage exposure. In particular, those exposed to longer outages were more likely to express an intention to install backup gas or diesel generation. They were also more likely to report plans to change home landscaping to reduce wildfire risk, and less likely to report that they planned to purchase an EV as their next car.

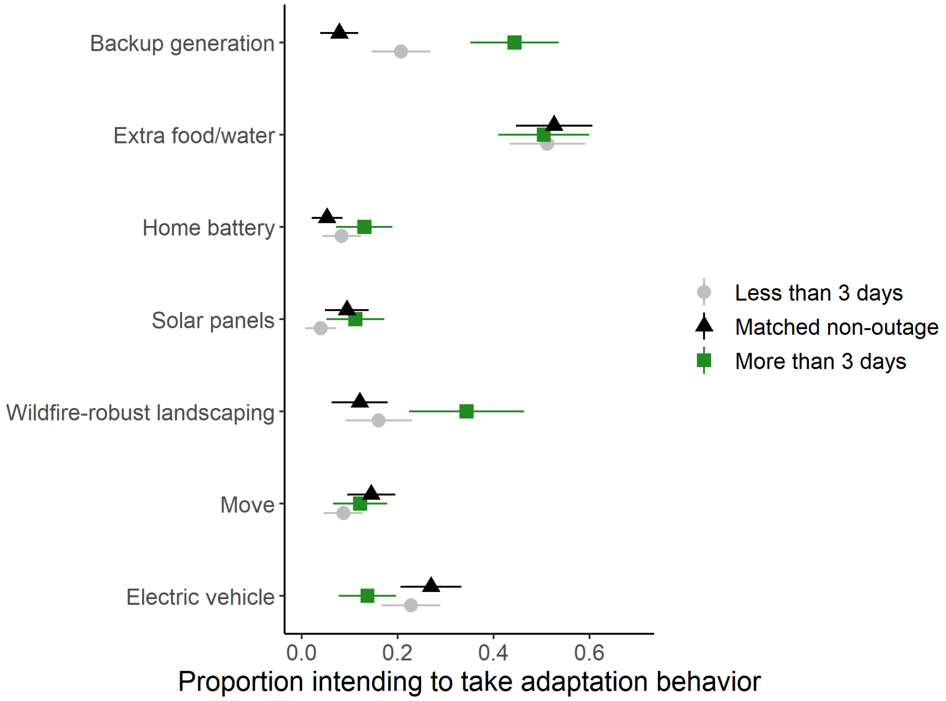

Figure A8: **Adaptation intentions by self-reported length of exposure**. Estimated proportions drawn from matched sample. Bars are 95 percent confidence intervals.

At the same time, we do not observe statistically significant heterogeneous treatment effects by length of outage exposure when it comes to attitudes towards utilities, as demonstrated by Figure A9.

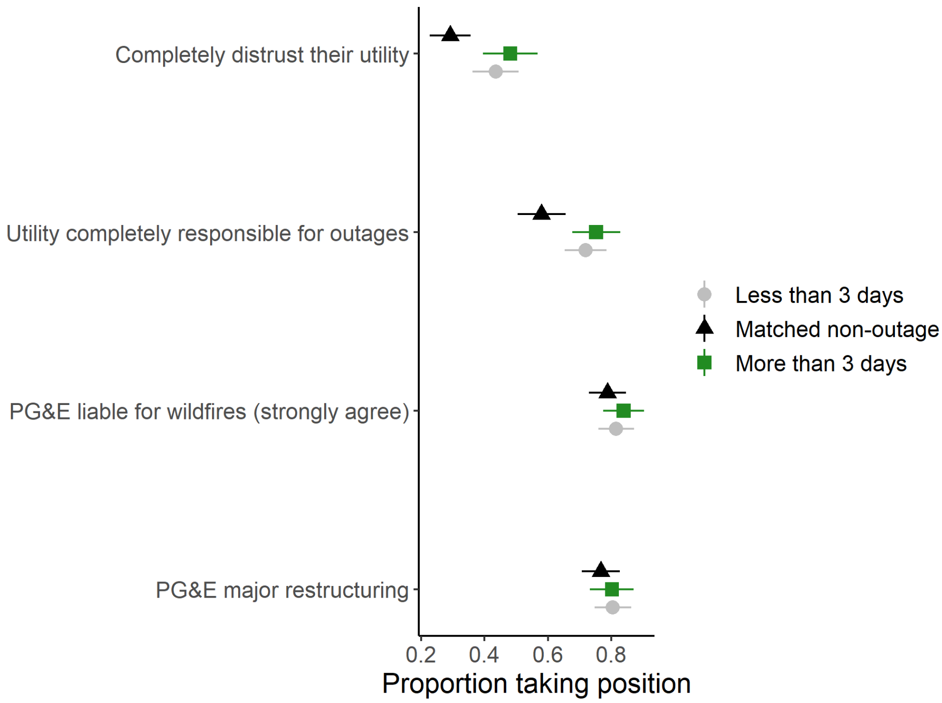

Figure A9: **Utility attitudes by self-reported length of exposure**. Estimates from OLS regression on matched sample. Bars are 95 percent confidence intervals.

4 Robustness to including Southern California sample

We implemented two sets of analyses to ensure that main results were robust to changes to the composition of the sample. In the first, we include respondents in the control group sampled from Southern California census tracts similar on demographic variables to the outage-exposed regions. This increased the matched sample size from 678 to 718. As demonstrated by the figures below, we recover broadly consistent results, except when it comes to estimating the effect of outage exposure on plans to purchase an EV.

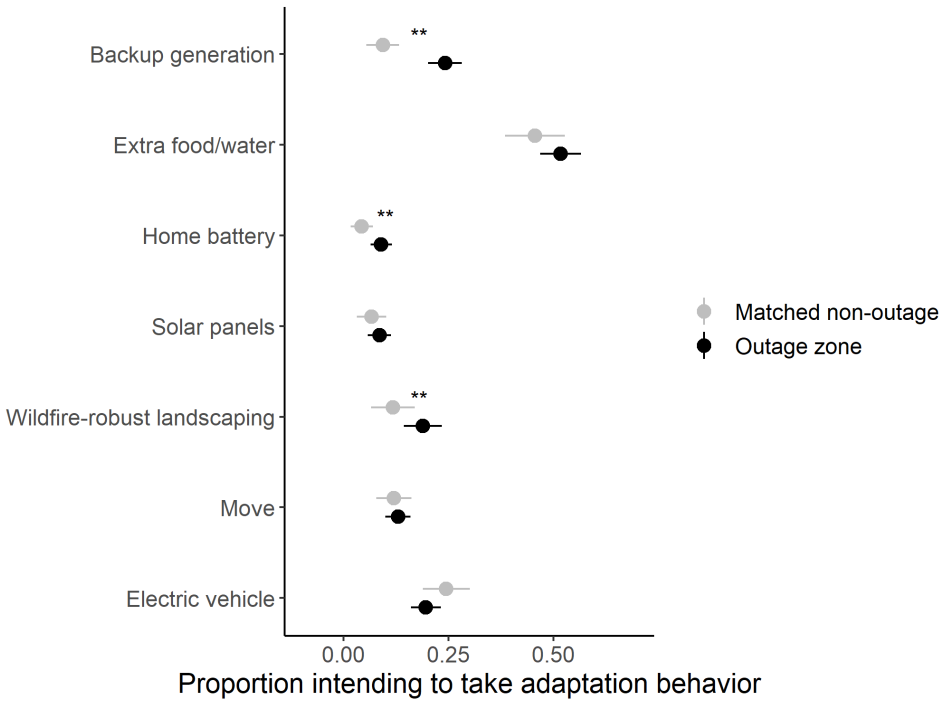

Figure A10: **Effect of outage exposure on household-level adaptation and purchasing intentions, including Southern California sample** Figure presents proportion of respondents stating intention to adopt behavior in outage-exposed zones and matched non-outage exposed zones. Bars are 95 percent confidence intervals. **p<.05 estimated treatment effect.

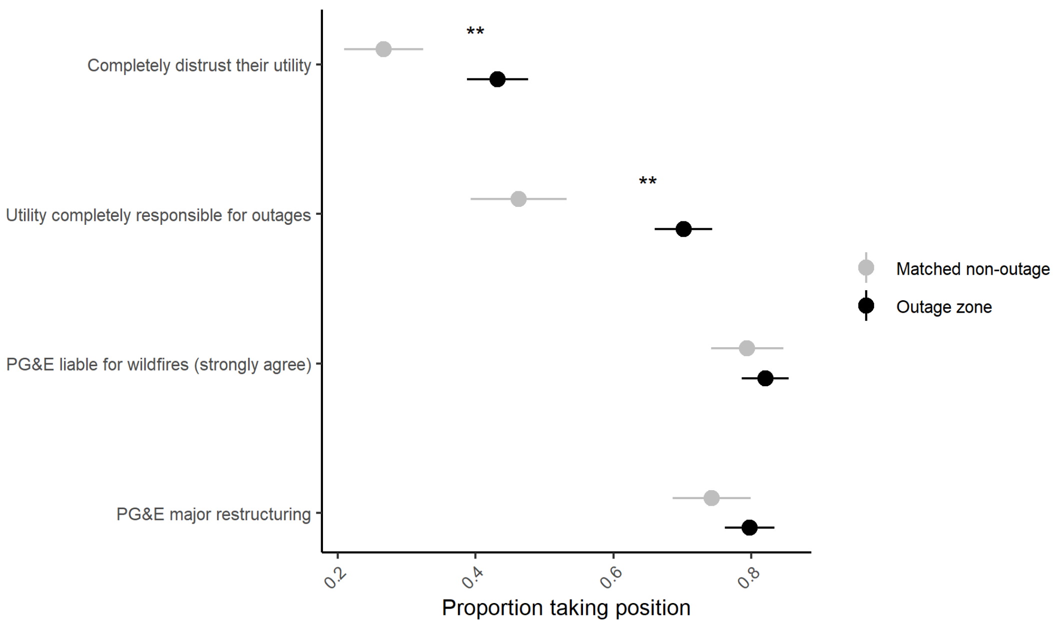

Figure A11: **Effect of outage exposure on attitudes towards utilities, including Southern California sample** Figure presents proportion of respondents stating each position with respect to electric utilities, particularly PG&E. Bars are 95 percent confidence intervals. **p<.05 estimated treatment effect.

5 Robustness to excluding those within 1km from boundary

In the second broad robustness check, we excluded individuals within 1km of the boundary between outage and non-outage exposed areas, lowering the matched sample size from 678 to 426. This robustness check is meant to account for the fact that treatment close to the boundary was fuzzy (e.g. some respondents in outage areas did not report experiencing outages). We, again, recover broadly consistent results, except when it comes to estimating the effect of outage exposure on plans to purchase an EV.

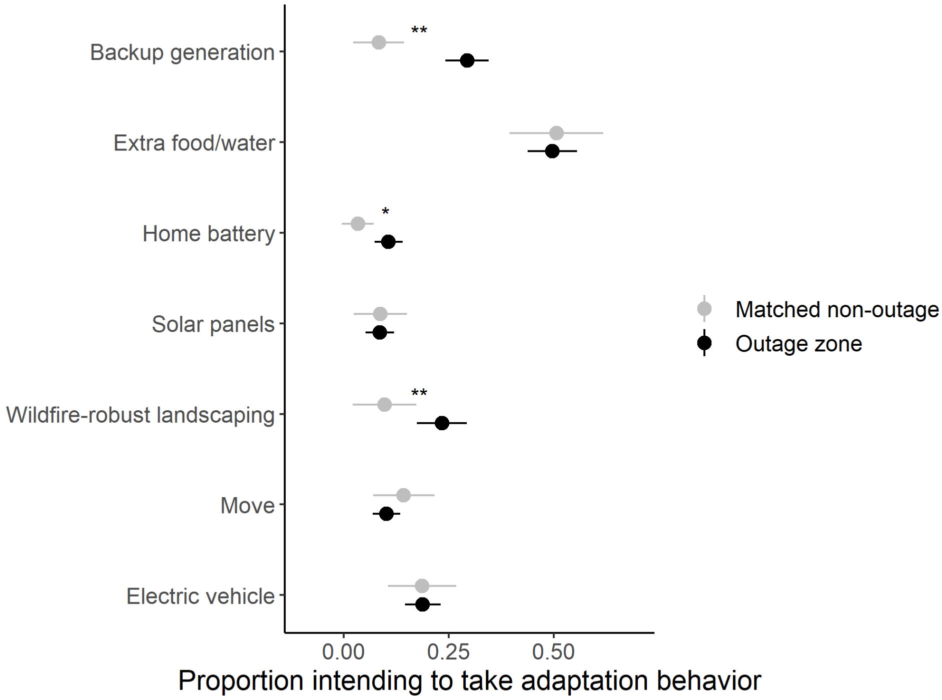

Figure A12: **Effect of outage exposure on household-level adaptation and purchasing intentions, excluding observations close to boundary** Figure presents proportion of respondents stating intention to adopt behavior in outage-exposed zones and matched non-outage exposed zones. Bars are 95 percent confidence intervals. **p<.05 estimated treatment effect, *p<.1.

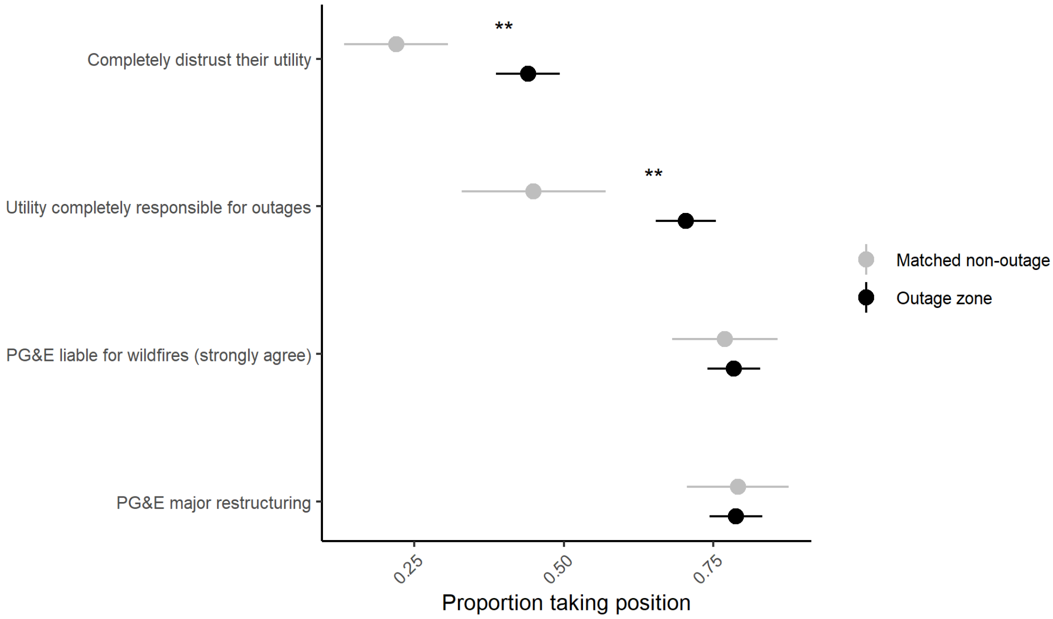

Figure A13: **Effect of outage exposure on attitudes towards utilities, excluding observations close to boundary** Figure presents proportion of respondents stating each position with respect to electric utilities, particularly PG&E. Bars are 95 percent confidence intervals. **p<.05 estimated treatment effect.

6 Example Recruitment Letter

Your Invitation

Public Opinion Research Survey on California's Power System

November 12, 2019

To: Current resident

Current Resident 1 18

Dear fellow Californian,

As you know, there have been a lot of power outages across California over the past month. We hope that you or other members of your household were not harmed by the power outages or fires. We are **inviting you to participate in an online survey** to help understand the views and experiences of Californians about these important recent events. There is a lot of confusion about how people were affected, so your participation will help California officials make informed policy decisions.

Your address was randomly selected from a public list of California addresses, and we would invite anyone age 18 or over in your household to complete the survey. We expect this will take between 8 and 12 minutes. Responses are voluntary and will be kept confidential.

Summaries of our research findings will be made available to the public, the media, and to policymakers in California. Also, as a small token of our appreciation, we will send you a **$5 digital gift card for completing the survey, redeemable at over 100 online vendors like Amazon or iTunes.**

To answer the survey or to learn more, use your smartphone or computer to visit **http://ucsurvey.com/P7061** and then enter the log-in information below. If you have any questions, or are having trouble accessing the survey, you can email Principal Investigator Matto Mildenberger, the project director at mildenberger@ucsb.edu.

ucsurvey.com/P7061

By taking a few minutes to share your thoughts and you will help us understand what Californians want. The survey is available now. We would appreciate if you would respond by November 27.

We hope you enjoy completing the questionnaire and look forward to receiving your responses. Many thanks,

Matto Mildenberger

Professor of Political Science, University of California Santa Barbara

Figure A14: Sample recruitment letter with address blanked out

7 Survey instrument

Quality of life

Looking into the future, over the next five years, do you think the quality of life in your city, town, or community will...

- Get significantly better
- Get somewhat better
- Stay the same
- Get somewhat worse
- Get significantly worse

Electricity Provider

We'd like to ask you a few questions about your home. Who is your electricity provider?

- Pacific Gas and Electric Company (PGE)
- Southern California Edison (SCE)
- San Diego Gas Electric
- Los Angeles Department of Water and Power
- Other
- Don't know

Outage occurrence

Since the beginning of October, did the electricity in your home get shut off at any time?

- Yes
- No

Outage occurrence: result of planned power shutoff

[if YES] Was your electricity shut off as part of a planned power shutoff?

- Yes
- No
- Don't know

Outage occurrence: frequency

[if YES] How many times was your power shut off as part of a planned power shutoff?

- Once
- Twice
- Three times
- Four times
- Five or more times

Outage occurrence: duration

[if YES] How many days total was your power shut off, across all planned power shutoffs?

- 1 day or less
- 2 days
- 3 days
- 4 days
- 5 days
- 6 days
- 7 days or more

Outage occurrence: reason

[if YES] In a few words, why do you think your electricity was shut off? [Text Entry]

Outage occurrence: longest outage

Now we'd like you to think about the longest power shutoff you've experienced since the beginning of October. This might be the most recent shutoff you've experienced, but it could also be an earlier shutoff. How long did your longest power shutoff last?

- Less than 1 hour
- 1-6 hours
- 7-24 hours
- 1 day
- 2 days
- 3 days
- 4 days
- 5 days or more

Stay during outage

Where did you stay overnight during the shutoff?

- In my own home, even though the power was shut off
- In my own home, but my power was never shut off overnight
- At the home of a friend or relative
- At a motel or hotel
- Other (please specify)

Worry about outage

How worried were you personally about the following issues during the shutoff? [Scale: Very worried, Somewhat worried, Not very worried, Not at all worried]

- Running out of food
- Running out of water

- Running out of medecine or medical supplies
- Traveling to and from work
- Completing basic household tasks
- Not being able to contact people (e.g. losing cell phone signal)
- Caring for your family

Outage warning

Did you receive adequate warning about the planned power shutoff?

- I received enough warning to adequately prepare
- I received a warning, but could not adequately prepare
- I received no warning and was completely surprised

Outage warning mode

How did you hear beforehand about the planned power shutoff in your community? (Check all that apply)

- Word of mouth from friends, family or colleagues
- Radio
- Internet
- Television
- Newspaper or print media
- Email
- Phone call from your utility
- Other
- I did not hear about the shutoff beforehand

Outage preparations

Before the recent power shutoffs, did you take any of the following actions to prepare in advance for a power shutoff? (Please check all that apply)

- Buy additional food
- Buy a diesel generator
- Buy gasoline
- Charge my electric car fully
- Get additional refills for my medicine
- Fill up my bathtub with water
- Buy extra drinking water
- Buy flashlights, candles or rechargeable batteries
- Buy a camp stove
- Other
- None

Financial impact

Which of the following statements best characterizes the impact that the recent power outages had on you financially? In answering this question, please consider both the costs of preparing for the outages (e.g. buying supplies) and, if applicable, responding to the outage (e.g. eating out, hotel costs, loss perishable food, loss of medications)?

- I couldn't afford what I needed during the outages
- It was difficult to afford the outages, but I was able to make ends meet
- The outages impacted my finances a little bit, but not seriously
- The power outages did not impact me financially

Financial impact: preparation estimate

About how much money did you spend during the outage on preparing (e.g. buying supplies) for the outage? (Optional) [TEXT ENTRY]

Financial impact: response estimate

If applicable, about how much money did you spend during the outage on responding to the outage (e.g. eating out, hotel costs, loss perishable food, loss of medications)? (Optional) [TEXT ENTRY]

Workplace impact

Since the beginning of October, did any of your close friends or family experience a planned power shutoff?

- Yes
- No
- Don't know

Contact impact

Since the beginning of October, did any of your close friends or family experience a planned power shutoff?

- Yes
- No
- Don't know

Area impact

Since the beginning of October, did you travel anywhere (local stores, neighborhoods) that was experiencing a planned power shutoff?

- Yes
- No
- Don't know

Time in current residence

About how long have you lived in your current place of residence?

- Less than 1 year
- 1 to 5 years
- More than 5 years

Home ownership status

Do you rent or own your current place of residence?

- Rent
- Own
- Other (please specify)

Wildfire risk zone

To the best of your knowledge, what wildfire risk zone is your home located in?

- Not in a wildfire zone
- Low
- Moderate
- High
- Very high
- Extreme

Number of cars

How many cars does your household own or lease?

- 0
- 1
- 2
- 3
- 4 or more

EV ownership

Do you currently own a plug-in electric vehicle?

- Yes
- No

Future EV ownership

Will the next car you purchase be an electric vehicle?

- Yes
- No
- Don't know

Future solar panels

Do you plan to install solar panels on your home in the next year?

- Yes
- No
- Don't know
- I already have solar panels on my home

Future gas or diesel backup generator

Do you plan to buy a gas or diesel backup generator in the next year?

- Yes
- No
- Don't know
- I have had a gas or diesel backup generator for more than one month
- I just bought a gas or diesel backup generator in the last month

Future battery storage

Do you plan to install a home battery storage system for electricity in the next year?

- Yes
- No
- Don't know
- I have already installed a household battery storage system

Future move

How likely are you to move to a different home in the next year?

- Very likely
- Somewhat likely
- Not very likely
- Not at all likely

Future supply purchases

Over the next 12 months, do you plan to purchase additional food and water supplies to prepare for future power shutoffs?

- Yes
- No
- Don't know
- I have already purchased additional food and water supplies

Future landscaping changes

Over the next 12 months, do you plan to change your home's landscaping to reduce risk from wildfires?

- Yes
- No

- Don't know
- I already have wildfire-resistant landscaping

Future building changes

Over the next 12 months, do you plan to upgrade your home's building materials to reduce risk from wildfires?

- Yes
- No
- Don't know
- I have already upgraded my home's building materials

Trust in utility

How much do you trust [RESPONDENT'S UTILITY]

- Not at all
- Somewhat
- A moderate amount
- Completely

Utility responsibility

When you think about [RESPONDENT'S UTILITY], how much is [RESPONDENT'S UTILITY] responsible for causing the planned power shut-offs in California since the beginning of October?

- Not at all
- Somewhat
- A moderate amount
- Completely

Willingness to forgo electricity

Would you be willing to live without electricity for [RANDOMIZED LEVEL] each year to reduce the risks of wildfires in California?

- Yes
- No

PGE ownership structure

The utility company PGE is currently in bankruptcy. A number of different options are being considered. Which ownership structure would you prefer. [RANDOMIZED ADDITION TO VIGNETTE: Remember, whoever owns PGE is also responsible for any damages caused by PGE's equipment in the future.]

- Keep PGE a privately-owned utility, letting a private group of investors restructure the company
- Make PGE a publicly-owned utility, making the State of California buy and operate the utility
- Break PGE into several smaller publicly-owned utilities, making cities and other local areas buy and operate the utility
- Make PGE into an energy cooperative owned and managed by local consumers

WTP for no shutoffs

Would you be willing to pay a surcharge of [RANDOMIZED LEVELS] every month on your electricity bill to avoid future planned power shutoffs?

- Yes
- No

WTP for burying power lines

A number of different policy ideas are being discussed to try to make the electricity system in California more stable.

One idea is to bury power lines underground. This would likely cost $3 million per mile. Currently, California has over 175,000 miles of overhead power lines. This means that burying all California power lines would cost over $525 billion dollars, more than twice the state's total annual budget for all government spending.

How much would you support burying power lines in California if it cost you [RANDOMIZED LEVELS] more per month on your utility bill for the next 10 years?

- Strongly support
- Somewhat support
- Somewhat oppose
- Strongly oppose

WTP for storage adoption

A number of different policy ideas are being discussed to try to make the electricity system in California more stable.

One idea is to invest heavily in solar panels and battery storage within homes.

A typical house would likely need to invest about $40,000 to install this solar and battery system. In addition to providing some backup power during possible shutoffs, these systems can also save customers around $90 per month on their utility bills.

Would you be willing to purchase and install a solar and battery system on your own home if there was a government subsidy of [RANDOMIZED LEVELS] to support this effort?

- Yes, definitely
- Yes, maybe
- No
- I already have a solar and battery system on my home

PGE liability

Under California law, companies like PGE are liable for damages caused by wildfires that their equipment causes. For example, PGE estimates it will face about $10 billion in liabilities from the 2018 Camp Fire, which destroyed the town of Paradise and killed 85 people in Northern California. [RANDOMIZED CONTENT:How much do you agree that companies like PGE should be financially responsible for wildfire damages linked to their equipment?; OR How much do you agree that companies like PGE should be financially responsible for wildfire damages linked to their equipment, even if this will mean that power bills will go up to cover these extra costs?; OR, How much do you agree that companies like PGE should be financially responsible for wildfire damages linked to their equipment, even if this will mean that state taxes will go up to cover these extra costs?]

- Strongly agree
- Somewhat agree
- Strongly disagree
- Somewhat disagree

Weather changes

In your opinion, over the past several years, has the weather in your community been getting...

- Much worse
- Somewhat worse
- About the same
- Somewhat better
- Much better

Extreme Weather experiences

In the past year, have you personally experienced any of the following extreme weather events or natural disasters listed below? (Check as many as are applicable)

- Severe storm
- Heat wave
- Flood
- Wildfire
- Other unusual weather
- None of the above

Extreme Weather harm

How much were you harmed by these extreme weather event(s) or natural disaster(s)? [SCALE: Not at all; Only a little; A moderate amount; A great deal]

Home evacuation

Since the beginning of October, did you evacuate your home in response to nearby wildfires?

- Yes
- No

Wildfire concern

How worried are you about a wildfire damaging your home?

- Very worried
- Somewhat worried
- Not very worried
- Not at all worried

Air quality

Since the beginning of October, has smoke made the air quality in your community worse?

- No, not at all
- Yes, somewhat
- Yes, a moderate amount
- Yes, severely

CES support

Currently, California has a clean energy requirement of 60% by 2030. How much would you support increasing this to 80% by 2030, even if it means the price of electricity will go up?

- Strongly support
- Somewhat support

- Somewhat oppose
- Strongly oppose

2035 target support

Currently, California aims to eliminate all its net carbon pollution by 2045. How much would you support bringing this timeline forward to 2035, even if it means the price of electricity will go up?

- Strongly support
- Somewhat support
- Somewhat oppose
- Strongly oppose

Global warming happening

Recently, you may have noticed that global warming has been getting some attention in the news. Global warming refers to the idea that the world's average temperature has been increasing over the past 150 years, may be increasing more in the future, and that the world's climate may change as a result. What do you think: Do you think that global warming is happening?

- Yes
- No
- Don't know

Global warming cause

Assuming global warming is happening, do you think it is...

- Caused mostly by human activities
- Caused mostly by natural changes in the environment
- None of the above because global warming isn't happening

Global warming worry

How worried are you about global warming?

- Very worried
- Somewhat worried
- Not very worried
- Not at all worried

Demographics

QUESTIONS ON EDUCATION, GENDER, MARITAL STATUS, YEAR OF BIRTH, HOUSEHOLD INCOME, NUMBER OF PEOPLE IN HOUSEHOLD, NUMBER OF PEOPLE UNDER 18, EMPLOYMENT STATUS, LANGUAGE SPOKEN AT HOME

Ideology

One way that people talk about politics in the United States is in terms of left, right, and center, or liberal, conservative, and moderate. Where would you place yourself on that scale?

- Extremely liberal
- Liberal
- Slightly liberal
- Moderate; middle of the road
- Slightly conservative
- Conservative
- Extremely conservative

Partisan ID

Generally speaking, do you consider yourself a...

- Democrat
- Republican

- Independent
- Other party

[IF INDEPENDENT OR OTHER PARTY] Do you think of yourself as closer to the Republican Party or to the Democratic Party?

- Closer to the Republican Party
- Closer to the Democratic Party
- Neither

Job approval

Please indicate on a scale of 1 to 100, how much you approve of the job that the following elected officials are doing? [SLIDER SCALE FROM 0 TO 100]

- Your local city or community government
- California Governor Gavin Newsom
- US President Donald Trump