The Consequences of Wildfire Liability for Firm Precaution: Evidence from Power Shutoffs in California*

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Abstract

Across all sectors of the U.S. economy, regulators use liability regulations to encourage firms to take actions that reduce the costs associated with low probability, high severity events such as oil spills and production defects. Despite the widespread use of these regulations, there is limited evidence of their effectiveness in influencing firms' tradeoff between expected liability cost and incentives for precautions. This study provides causal evidence of firm responses to the entire distribution of potential liability and quantifies the distribution of liability costs between firms and the public by studying power line-ignited fires in California's electric utility sector. In this setting, when a power line-ignited fire damages a structure, the owner of the power line assumes the cost. Using exogenous variation in the replacement cost of structures that lie downwind of power lines, I find that firms increase their precaution by 130% in response to a $680 million increase in liability. In the short run, the estimates from this study imply that the implemented liability regulation had welfare costs up to $7 billion.

JEL Codes: D22, Q40, L51, K13

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I. Introduction

Low probability, high severity events such as oil spills or product defects characterize many sectors of the U.S. economy. A popular approach to mitigate the frequency of such events is to make firms liable for potential damages in part to incentivize precaution. To understand the effectiveness of liability regulation we need to know how firms' precautions respond to: (1) the application of liability and (2) changes in the amount of damages they are liable for.

In settings where a firm faces large potential liabilities from an accident, its liability cannot exceed its asset value because it may use bankruptcy to avoid further damages. This discrete drop in firms' incentives for precautions at their asset value is commonly termed the judgment-proof problem (Shavell (1986)). One common solution used to solve the judgment proof problem is to cap firms' level of potential liability. However, determining the liability cap level is a difficult task for a regulator: higher caps induce firms to undertake greater precautions as they bear a larger share of liability costs, but setting too high a cap may cause the firm to declare bankruptcy, shifting liability costs onto the public. This creates ambiguity about a fundamental question in public economics: What are the efficiency tradeoffs associated with capping liability?

Motivated by this gap in the literature on liability regulation, this paper provides the first causal evidence of how firms' precautions responds to the imposition of a negligence standard in California's electric utility sector. Between 1999 and 2017, firms faced with covering liabilities due to power line fires were allowed to recoup these costs through increases in retail electricity prices. However, since November 2017, utilities have borne liability costs whenever the regulator found that their imprudence led to an ignition. Using this setting, I estimate an empirical model that shows how firms' use of one type of precaution, called a Public Safety Power Shutoff event (PSPS), changed following the policy shift. Furthermore, I develop an empirical model which uses daily variation in the replacement cost of structures that are downwind of power lines to estimate how firms' use of power shutoffs respond to the entire distribution of potential liability. Since firms in this setting are responsible for the replacement cost of structures damaged by power line-ignited fires, variation in downwind regions across days creates exogenous changes in potential liability.

Firms use Public Safety Power Shutoff events to prevent fire ignitions along their power lines. During a power shutoff, utilities turn the power off on sections of their energy infrastructure when forecasted climate conditions suggest an ignition is likely to occur. Because electricity must be running through a power line for an ignition to happen, power shutoffs significantly reduce the likelihood of fire and potential liabilities that a firm faces. In contrast, other types of precaution available to firms such as clearing vegetation away from power lines do not provide the same assurance because an ignition could still occur.

This is an important setting to study liability regulation. Climate change is increasing the severity of power line-ignited fires in the western U.S., making it important to understand how to incentivize firms to prevent ignitions in this setting (Syphard and Keeley (2015)). Furthermore, power line-ignited fires are more damaging than fires from other ignition sources because they typically occur during high wind speed events when the wind carries vegetation into the line. Since fires are also more likely to spread rapidly and grow out of control during windy conditions, power line-ignited fires tend to cause more damage than fires from other sources (Keeley and Syphard (2018)). For example, one privately owned utility, Pacific Gas and Electric, faced over $30 billion dollars in liability from several fires ignited in 2017 and 2018.[1] Figure 1 plots total damages in billions of 2021 dollars by source of fire ignition and shows that, although power line-ignited fires make up less than one percent of ignitions historically, they account for most of the damage from fires in California between 2008 and 2019.

My setting also has a key advantage: it allows me to causally estimate the relationship between the level of liability a firm faces and its precaution using exogenous changes in the direction that the wind is blowing across days.[2] Prior work has typically relied on regulatory changes that cap the level of liability a firm faces to study this relationship, but in this setting I am able to measure firms' responses across the full distribution of potential liabilities that they face.

Using administrative data on precautionary measures taken by the three largest privately owned utilities in California, I find three results. First, I show that firms dramatically increase their use of power shutoffs following the 2017 policy change. Prior to the reform, power shutoffs occurred on 0.1 percent of days when the ignition risk was elevated and, on average, created 2 lost customer hours of power. After the reform, power shutoffs happened on 4 percent of days with heightened

[1] Los Angleles Times "Pacific Gas and Electric to file for bankruptcy as wildfire costs hit $30 billion. Its stock plunges 52%", January 14, 2019.

[2] The privately owned utilities in California's electric utility industry that I study are representative of most electric utilities in the United States. In fact, in 2017 privately owned utilities supplied 72% of electricity customers in the United States (EIA Annual Electric Power Industry Report).

ignition risk and the number of customer hours without power increased by 734 customer hours, on average. Using lower and upper bounds on consumers' value of electricity use from the literature, I find that this increase in power shutoffs translates to between \$150 and \$51,000 of lost consumer surplus at the average distribution circuit.[3] I also show that although firms increase shutoffs most in the regions of greatest *ex ante* ignition risk, these are more likely to be areas with high shares of customers that rely on electricity for their medical needs, making the shutoffs particularly costly.[4]

Second, I show that firms' precaution is positively related to the level of liability that they face. Since utilities are liable for the cost of replacing structures damaged by fires that their power lines ignite, I measure liability using this value. In most settings, causal estimation of the relationship between the level of liability that firms face and precaution is difficult because liability is likely to be endogenous. My setting allows me to remove this endogeneity by using daily variation in the replacement cost of structures that lie downwind of each firm's power lines between 2018 and 2020 to generate daily variation in each utility's potential liability. I estimate that power shutoffs increase by 130 percent relative to the average likelihood of a shutoff when the total replacement cost of structures in downwind areas increases by 10 percent (\$680 million).

Third, I estimate that the short-run welfare impact of the 2017 liability rule change is negative and large. Depending on the chosen estimate of consumer's value of electricity from the literature, the policy resulted in a welfare loss of between \$7 billion (\$76.11 per kilowatt hour valuation of electricity use) and \$17 million (\$0.22 per kilowatt hour). From the social planner's perspective, this suggests that utilities have overused shutoffs as a precautionary measure in the short term. I also develop a conceptual framework that suggests this increase in shutoffs reduced utilities' use of other types of precautionary measures such as vegetation management or infrastructure upgrading.

These results have several policy relevant implications. I provide an empirical framework to estimate how firms' precautionary behaviors change across the distribution of potential liabilities, a key parameter for determining the liability cap level. Current and past policy proposals have

[3]The lower bound of consumers' value of electricity is the average retail price of electricity in California as of August 2022 (\$0.22 per kWh) and the upper bound is \$76.11, the largest residential value of electricity use from Collins et al. (2019). The upper bound of consumers' electricity use may be much higher however, because the shutoffs left commercial and industrial consumers, who have higher use values of electricity, without power as well.

[4]Customers relying on electricity for their medical needs may require reliable energy to power respirators, electric wheelchairs, and other devices. Because these customers have an above average use value of electricity, this result implies that using an average value of consumers' value of lost load would systematically underestimate the welfare consequences of power shutoffs.

included limits on the amount of damages homeowners can recover from electric utilities.[5] However, such policy proposals note that it is unclear what level liability should be limited at and how such limits would distribute costs between homeowners, electricity consumers, and utility shareholders.

Furthermore, I estimate how economic incentives influence the reliability of electricity supply using a novel dataset of distribution power lines. This is relevant for regulators across the U.S. who want to incentivize utilities to make investments that improve the reliability of electricity supply and upgrade aging infrastructure. Because of the projected growth of renewable energy generation in the United States, the federal government has made upgrades of energy infrastructure a cornerstone of its energy platform.[6] My work in this paper underscores that having detailed administrative data on distribution networks across the U.S. will be important for effectively upgrading energy infrastructure.

This paper makes three contributions to the literature in public economics. First, it poses a channel, expected damages, through which liability regulations impact firms' decisions and quantifies how the burden of precautionary costs is distributed between firms and electricity consumers. I show that, when firms bear liability costs, they direct more precautionary effort to areas with high levels of expected liability. Since power shutoffs are socially costly, utilities' increased reliance on shutoffs to prevent ignitions causes electricity consumers to bear a greater share of costs associated with ignition prevention. This adds to previous work documenting other determinants of firms' choice of precaution such as bankruptcy (Shavell (1986)), subjective firm beliefs (Currie and MacLeod (2014)), risk aversion (Shavell (1982)), and market structure (Chen and Hua (2017)). Furthermore, this result contributes to a growing literature that examines the determinants of wildfire suppression (Plantinga, Walsh and Wibbenmeyer (2022), Baylis and Boomhower (2023)).

Second, I show how precaution varies across the distribution of potential liabilities that firms face. Previous research has estimated how capping medical liability impacts doctors' prescribing behavior (Helland et al. (2021)), medical outcomes (Danzon (1985), Kessler and McClellan (1996), Currie and MacLeod (2008), Frakes (2013)), and the labor supply of doctors (Malani and Reif (2015), Kessler, Sage and Becker (2005), Klick and Stratmann (2007), Matsa (2007)). Another

[5] "Allocating Utility Wildfire Costs: Options and Issues for Consideration", California Legislative Analysts Office, 2019.

[6] See here.

related literature examines how changes in liability impact toxic waste discharges and abatement technology adoption (Akey and Appel (2021), Alberini and Austin (2002), Stafford (2002)). Many of these studies estimate how precaution responds to the level of liability a firm faces at one point in the liability distribution because their variation comes from caps on liability at a particular value. The empirical strategy in this paper allows me to estimate how precaution changes across the entire distribution of liability that firms face in practice.

Previous work on the judgment-proof problem by Boomhower (2019) shows that requiring firms to purchase insurance which covers damages beyond their own assets encouraged greater production by larger firms with better environmental outcomes in Texas' oil and gas sector. This paper complements Boomhower (2019) by directly estimating how firms' precautions change across the distribution of potential liability they face. Since requirements to cover damages beyond firm assets may not be feasible in settings with concentrated market power, such as the electric utility sector, the estimates in this paper provide relevant information that can be used to implement other solutions to the judgment-proof problem such as capping liability.

This paper also makes important contributions to a recent literature in environmental economics and engineering. I show that liability considerations drive firms' decision to declare power shutoffs. Previous work by Abatzoglou et al. (2020) applied one utility's publicly stated climate thresholds for declaring power shutoffs to observed weather data during 2019, finding that the utility used shutoffs more than would be predicted by its own decision rules. I provide an economic explanation for this overuse of power shutoffs by documenting the role of liability in determining firms' precaution.

I also provide evidence that utilities' use of power shutoffs are costly. This adds to a recent literature that estimates the costs and benefits of public safety power shutoffs in California (Sotolongo, Bolon and Baker (2020), Wong-Parodi (2020), Zanocco et al. (2021), Mildenberger et al. (2022)). I provide the first causal estimates of power shutoffs' impact on customers that rely on electricity for their medical needs, finding results consistent with the descriptive analysis performed by Sotolongo, Bolon and Baker (2020).

Finally, I provide the first evidence of fire liability's impact on firms in the electric utility industry. Yoder (2008) shows that the number of fires escaping from private landowners' property during a prescribed burn declines following the implementation of strict liability regulations. I add to this evidence by causally showing that electric utilities increase precautionary actions to prevent fire ignitions along their power lines in response to greater liability for fire damages.

The rest of this paper proceeds as follows: section II. provides background on liability regulation for power line-ignited fires in California and utilities' ignition prevention decision environment. Section III. presents a simple theoretical model with testable predictions of liability regulation's effect on utility's precautionary effort. In section IV., I develop an empirical framework to study how the application of liability impacts precaution, describe the data used in this analysis, and present results. Section V. develops an empirical strategy to causally estimate the relationship between liability and shutoffs, describes the data sources used in this analysis, and presents results. Section VI. discusses the results and outlines opportunities for future research.

II. Background

II..I Institutional Background

This paper focuses on electricity distribution to residential and commercial consumers, the final link in the U.S. electricity supply chain which consists of generation, transmission, and distribution.[7] Electric distribution utilities are generally considered natural monopolies and most are regulated by Public Utility Commissions (PUCs). The California Public Utility Commission (CPUC) mandate states that its goal is to provide "...access to safe, clean, and affordable utility services and infrastructure."

PUCs' primary regulatory tool to influence utilities' actions is called a rate case. CPUC defines rate cases as quasi-judicial "proceedings used to address the costs of operating and maintaining the utility system and the allocation of those costs among customer classes." At each rate case proceeding, the PUC determines the electricity price schedules which a utility can charge customers until its next rate case proceeding. The three largest Investor Owned Utilities (IOUs) in California each have their own separate rate cases every three years. In this way, most transmission and distribution utilities in the U.S. face price cap regulation with periodic adjustment of the cap. The PUC adjusts the price schedule so that each utility earns a fair rate of return on its capital and recovers its operating expenses. However, the PUC may disallow a capital expense from being

[7] According to the CPUC post-event reports, transmission lines account for less than 1% of lost customer hours related to power shutoffs to prevent fire ignitions. Therefore, I exclude transmission lines from the analysis in this paper.

included in the retail price if it does not meet a standard of being "used and useful."

Importantly, in California utilities could request to recover uninsured costs associated with fires ignited by their distribution infrastructure during rate cases between 1999 and 2017. Thus, while utilities paid for residential damages and suppression costs associated with fires ignited by their equipment, they expected to recover these costs through an increase in the electricity price cap. After a 2017 ruling in a rate case proceeding that rejected San Diego Gas and Electric's application to recover fire-related costs through electricity rates, utilities faced a greater likelihood that they would be financially accountable for such costs, increasing their expected liability. The next section discusses the history of fire liability for utilities in California.

II..II Liability Regulation in California

Liability regulations impact the incentives for individuals and firms to take risk and exert precaution. In the case of fire ignited by utility-operated infrastructure, utilities may adjust their level of precaution according to the proportion of fire-related damages they would be held accountable for if an ignition occurs. Similarly, individual homeowners may increase effort to reduce the probability of wildfire-related damage to their property when a firms' share of liability from a power line ignited wildfire is low. Regulators choose the degree of liability that a firm faces by choosing from two types of regulations: strict liability and a negligence rule. Under strict liability, the firm is fully liable for the resulting damages of a fire ignited by their equipment. In contrast, the negligence rule sets a minimum threshold of precaution that firms must meet in order to avoid financial responsibility for damages. In the canonical model, the firm will take the highest level of precaution under strict liability and reduce its level of ignition prevention to just meet the threshold when subject to the negligence rule (Kaplow and Shavell (1999)).

In California, the state has held IOUs to a strict liability standard for fire damages since a 1999 state supreme court decision, *Barham v. Southern California Edison Company (1999).* A key factor in the Court's decision was the fact that, just as a government can raise revenue through taxes, IOUs can raise revenue through retail electricity rates in California.[8] The Court reasoned that since the state government is strictly liable for damages it causes under the Takings clause of

[8]The Court's decision argues that IOUs' ability to raise electricity rates is akin to a government's ability to levy taxes. IOUs are currently challenging this logic in court by pointing out that their ability to raise electricity rates is subject to approval by the CPUC.

the California constitution, IOUs could be held strictly liable for damages related to power line-ignited fires. As a result, IOUs faced strict liability for fire damages in excess of their insurance coverage, but could recover these costs through increases in the retail price of electricity. IOUs continued to challenge the Court's ruling in *Barham* as recently as 2012, arguing that they could not have the same liability status as a government because their ability to raise rates is subject to the approval of the CPUC.[9] The Court continued to maintain, however, that because there was no evidence CPUC would not allow IOUs to recover costs through electricity rate increases, strict liability would continue to apply.

Although IOUs faced strict liability, the precedent established by *Barham* ensured that their liability net of revenue increases from raised electricity rates would be low. The precedent that IOUs could recover liability costs through increased electricity rates was not tested until several damaging fires ignited by power lines operated by San Diego Gas and Electric in 2007. The 2007 fires were the first time since the *Barham* decision that the liability costs associated with power line-ignited fires exceeded an IOU's liability insurance coverage (Hafez (2020)). As a result, San Diego Gas and Electric's application to recover uninsured liability costs through electricity rate increases was a novel test of the strict liability standard. Ultimately, CPUC rejected San Diego Gas and Electric's application to recover liability costs through electricity rates in December 2017, citing San Diego Gas and Electric's lack of precaution in preventing the 2007 fires as the deciding factor.[10] Because IOUs could no longer expect to automatically recover costs through electricity rate increases following the 2017 CPUC decision, their liability for fire damages increased dramatically. CPUC's decision states that "If the preponderance of the evidence shows that the utility acted prudently, the Commission will allow the utility to recover costs from the ratepayers." While CPUC declined to define a precise negligence threshold in its decision, the decision dramatically increased each IOU's expected share of responsibility for liability.

The "prudent manager" standard remained in effect until SB 901 added section 451.1 to the Public Utilities Commission Code which took effect for all fires ignited after January 1, 2019. Section 451.1 replaced the "prudent manager" standard with twelve non-exclusive criteria that

[9]Pacific Bell Telephone Co. v. Southern California Edison Co., 208 Cal. App. 4th 1400, 1403 (2012).

[10]Application of San Diego Gas & Electric Company (U 902 E) for Authorization to Recover Costs Related to the 2007 Southern California Wildfires Recorded in the wildfire Expense Memorandum Account, filed Sept. 25, 2015. Decided Dec. 26, 2017.

CPUC uses to determine whether an IOU can recover costs associated with fire liabilities through electricity rates. The criteria take into account the IOU's design, maintenance, and operation of assets in addition to the severity and unpredictability of the weather event which caused the ignition. While, section 451.1 clarified the standard used to judge each utility's negligence it still significantly increased the share of costs associated with fire damages utilities expected to bear relative to the pre-2017 regulatory environment. If the reader is interested in learning more about the history of liability law and IOUs in California, Hafez (2020) provides a complete and succinct description. The next section describes utilities' allocation of ignition prevention effort and demonstrates how increasing the share of damages born by IOUs changes this allocation.

II..III The ignition prevention decision environment

IOUs face a complex decision making environment as they determine how and where to invest in strategies that lower the risk of fire ignited by their electrical infrastructure.[11] Utilities' ignition-prevention decisions have significant economic consequences; despite accounting for 1-5% of total fire ignitions in Southern California, utility-operated equipment accounts for 20-30% of total area burned by wildfires (Syphard and Keeley (2015)). Ignitions by power lines typically occur between July and December and their two leading causes are wind-blown vegetation and equipment failure. Much of the transmission and distribution infrastructure operated by IOUs in California is dilapidated (in 2017 Pacific Gas and Electric estimated that the average age of its transmission towers was 68 years old). As climate change has increased vegetative aridity and the severity of weather events in IOU service territories, the risk of fire ignition has also risen. In determining which areas to prioritize for ignition mitigation activities, utilities weigh the benefits of providing electricity to their residential, industrial, and commercial customers with the cost of each activity and the ignition risk associated with each section of their distribution and transmission infrastructure.

To determine the ignition risk of a section of power line, utilities consider historical and forecasted weather conditions, infrastructure age, vegetative growth, presence of outdated equipment with known ignition risk, and the value of electricity demanded by customers on that section. After determining the baseline risk of a power line segment, a team at each utility then chooses an

[11] This section draws from Wildfire Mitigation Plans submitted by Southern California Edison, Pacific Gas and Electric, and San Diego Gas and Electric to CPUC in 2019, 2020, and 2021.

ignition mitigation activity which reduces the risk at least cost. Utilities perform a range of ignition prevention activities including vegetation management, installation of weather stations along power lines, burying power lines underground, upgrading equipment, inspecting power lines, and turning off the power to targeted sections of the grid when weather conditions elevate the probability of ignition. Use of ignition prevention activities differs across utilities and over time as conditions change and utilities learn more about the effectiveness of each action. For example, Pacific Gas and Electric primarily deployed shutoff events and infrastructure upgrades in 2019 to reduce the probability of ignition, while Southern California Edison focused on installing covered conductors that reduce the probability of ignition on high risk assets. Recently, each IOU has increased efforts to bury sections of high-risk assets underground.

Precautionary actions available to utilities differ widely in their ability to prevent ignitions, their cost, and which individuals bear that cost. Power shutoffs, when targeted well, guarantee that an ignition cannot occur because electricity is not running through the line when an incident occurs. However, power shutoffs are also socially costly, sometimes leaving affected communities without power for extended periods of time. In contrast, the effectiveness of other types of precaution such as vegetation management may be more difficult to measure and impose costs on either the utilities or (if the cost of precautionary measures is incorporated into retail electricity rates) all electricity consumers in California.

Historically, utilities in California have not relied on power shutoffs to reduce the likelihood of ignition because they disrupt the service of electricity to customers. The California Public Utilities Commission (CPUC) defines Public Safety Power Shutoff events as actions taken by utilities to temporarily turn off power to specific areas in order to reduce the risk of fires caused by electric infrastructure. Of the three largest IOUs in California, only San Diego Gas and Electric utilized shutoffs to prevent ignitions prior to 2017.[12] Because shutoff events require the utility to interrupt service to customers it is seen as a measure of last resort to mitigate fire ignitions. As a result, each IOU has invested in devices which further segment high-risk areas of their transmission and distribution networks, allowing more targeted blackouts that affect fewer customers.

CPUC approves the use of power shutoff events by IOUs, first granting approval to San Diego

[12]San Diego Gas and Electric sought and received approval from CPUC to initiate power shutoffs in its service territory starting in 2013.

Gas and Electric in 2012, Pacific Gas and Electric in 2018, and Southern California Edison in 2018. Figure 2 plots the share of total customer hours impacted by shutoff events between 2013 and 2020 by year separately for each of the three largest California utilities. The most affected customer hours occurred during 2019 in Pacific Gas and Electric's and Southern California Edison's service territories. A similar pattern exists for the number of commercial customer hours and medically vulnerable customer hours affected by power shutoffs.

Utilities consider climatic conditions, the condition of electrical infrastructure, and the value of lost electricity load in potentially impacted areas to determine when and where to declare power shutoffs. Pacific Gas and Electric reports the criteria it uses to declare shutoff events on page 982 of its 2021 Wildfire Mitigation Plan. The minimum criteria for deciding a shutoff in a high fire threat area are sustained wind speeds greater than 20 MPH, dead fuel moisture below 9%, relative humidity below 30%, and a fire potential index greater than 0.2.[13] Despite these criteria, utilities have discretion in declaring power shutoffs: Abatzoglou et al. (2020) provide evidence that shutoff events are used more frequently by Pacific Gas and Electric than would be implied by their minimum climate criteria.[14]

According to the canonical economic model of liability regulation, the increase in the share of liability born by utilities following CPUC's 2017 decision should increase the level of ignition prevention effort (Kaplow and Shavell (1999)). Furthermore, increasing the liability born by utilities should also increase their use of more costly prevention activities such as shutoff events. Finally, the increase in liability should cause utilities to direct ignition prevention efforts to regions of their service area with a high property values. Since destroyed property values make up a significant portion of liability damages born by utilities when their equipment ignites a fire, they have an incentive to direct ignition prevention activities to these regions.

The next section develops a simple model of liability in the context of the electric utility industry and presents several testable hypotheses.

[13] The fire potential index measures the likelihood of an ignition causing a catastrophic wildfire using wind speeds, temperature, humidity, dead and live fuel moisture, and vegetative cover types.

[14] Abatzoglou et al. (2020) note that this could be due to differences in climate modelling between their study and Pacific Gas and Electric's internal methods.

III. Conceptual Framework

The conceptual framework demonstrates three points: (1) Decreasing the return on defensive capital investment increases utilities' use of shutoffs, leading to less defensive investment that mitigates ignitions along power lines. (2) Increasing the level of potential liabilities leads firms to use more power shutoffs. (3) Utilities use more shutoffs when ignitions are likely.

The framework in this paper is adapted from Lim and Yurukoglu (2018) who show that a regulator's inability to commit to a predictable path of capital returns leads utilities to systematically underinvest in capital. Here, I consider a simplified version of the model with no strategic interaction between the regulator and the utility. In this model, the utility takes the regulator's choice of capital return as given rather than as an output from a negotiation process.

For simplicity, I model a single utility's decision to make defensive capital investments and supply electricity to one distribution circuit. If the utility supplies electricity, it receives future net revenue and faces expected liability damages from a potential ignition along its power lines. However, if the utility declares a power shutoff it receives no revenue and faces no expected damages. The utility self protects against expected damages by making defensive capital investments that reduce the probability of ignition.[15] In making its decisions, the firm compares the marginal reduction in damages from self protection to total expected damages. Whenever expected damages exceed the marginal benefit of self protection, the firm shuts off the power.

I make several important assumptions in this model. First, because the model only considers one distribution circuit, the firm will never make additional defensive capital investments if it shuts off the power. In practice, defensive investments may complement power shutoffs because utilities could self protect against damages on days when the ignition risk is low. Second, in a departure from reality, I do not allow for strategic interaction between the firm and the regulator. The results from Lim and Yurukoglu (2018) suggest that allowing for such interaction would cause firms to increase shutoff use more and invest in defensive capital less. Third, I do not model the firm's non-defensive capital investment decisions. Finally, the model assumes that consumers value their homes at the structure replacement cost. This simplifying assumption does not affect the framework's predictions, but it would increase the benefit of shutoffs for households in the

[15] I define self protection in the same way as Ehrlich and Becker (1972), where defensive investments reduce the probability of ignition rather than total damages.

calculation of how liability regulation affects welfare in section VI..

III..I Firm's Problem

The regulator sets a per unit output price p that allows the utility to recoup a reasonable return on defensive capital (γk) and per-unit liability costs (ν).

$$p = \gamma k + \nu \tag{1}$$

Where k represents the stock of firm defensive investment which it uses to self insure against damages from a potential fire ignition and γ is the exogenous rate of return on defensive investment that is set by the regulator. The firm inelastically supplies Q units of electricity to consumers who purchase a quantity Q of electricity up to a "choke" price ($\bar{p}$) above which they are no longer willing to pay.

$$D(p) = \begin{cases} Q & \text{if } p \leq \bar{p} \\ 0 & \text{otherwise} \end{cases} \tag{2}$$

The utility earns revenue by supplying electricity to retail consumers and reduces expected liability costs by renting defensive capital that reduces damages from a potential ignition from households at the prevailing interest rate (r). The utility can also prevent ignitions by supplying no electricity to consumers.

$$\max\{\pi_1, \pi_0\}$$

Where

$$\pi_1(k) = \max_{k'}\{-r(k' - (1-\delta)k) + \beta(\phi p Q)\}$$

$$\pi_0(k) = \max_{k'}\{-r(k' - (1-\delta)k) + \beta(pQ - \theta(k')\bar{d})\}$$

Where the utility earns π_1 in profits if it shuts off the power and π_0 in profits if it supplies power, δ is the capital depreciation rate, and $\bar{d}$ is the dollar amount of expected liability damages if an ignition occurs. In the empirical analysis later in this paper, $\bar{d}$ is the total replacement cost of structures threatened by a power line ignition. The utility can self protect against liability costs by investing in defensive capital (k') which reduces the probability of ignition ($\theta(k')$). The utility chooses whether to declare a blackout and investment in capital subject to an uncertain probability of ignition ($\theta(k')$). When the utility shuts off the power it recoups a fraction $\phi \in (0,1)$ of its revenues by exerting market power in wholesale electricity markets. β is the per-period discount factor. Substituting the price of electricity from equation 1, allows us to rewrite the utility's profit functions.

$$\pi_1 = \max_{k'}\{-r(k' - (1-\delta)k) + \phi\beta(\gamma k + \nu)\}$$

$$\pi_0 = \max_{k'}\{-r(k' - (1-\delta)k) + \beta(\gamma k + \nu - \theta(k')\bar{d})\}$$

Intuitively, when the firm supplies electricity (π_0) it pays defensive capital rental costs today and receives future net revenues (pQ) while facing expected liability costs from a potential ignition ($\theta(k')\bar{d}$). When the firm chooses to shutoff the power (π_1), it pays capital rental costs today and receives only a fraction of its revenue in the future, but since an ignition cannot occur it also faces no expected damages.

Figure 3 presents a simplified version of the firm's shutdown decision to demonstrate its incentive to use a power shutoff. Both graphs show example demand (red) and supply (blue) curves for electricity when the utility supplies electricity (left) and shuts off the power (right). For simplicity, I am showing the case where the utility does not recoup any revenue when it declares a blackout ($\phi = 0$). When the utility shuts off the power, the supply curve shifts all the way to the left, creating lost producer and consumer surplus. Intuitively, the utility incurs a private cost from shutoffs through lost producer surplus and benefits from shutoffs because it faces no expected liability cost. So the utility's privately optimal choice of shutoffs depends on the relative magnitude of producer surplus and expected liability costs. Importantly, the utility does not internalize the loss in consumer surplus when it turns off the power, causing the utility's privately optimal choice of shutoffs to exceed the socially optimal level.

Assuming without loss of generality that the utility starts with no defensive capital ($k = 0$), solving the firm's problem when it does not declare a blackout is trivial. When the firm shuts off the power, its profit is constant regardless of defensive capital investment made by the firm.

$$\pi_1^* = \beta\phi\nu \quad \forall \quad k_1'^*$$

In the state of the world where it does not declare a blackout (π_0) the firm invests in defensive capital such that the marginal benefit of investment (reduction in expected damages and increased revenue) equals the marginal cost of investment (the rental rate paid to households).

$$-\beta\theta'(k')\bar{d} + \beta\gamma = r \tag{3}$$

Where $-\beta\theta'(k')\bar{d}$ is the reduction in expected liability costs from increasing defensive investment, $\beta\gamma$ is the increase in revenue the firm receives by increasing its defensive capital stock, and r is the rental rate of capital. The utility then chooses whether or not to declare a shutoff by comparing its optimized profit when it declares a shutoff (π_1^*) to when it supplies electricity (π_0^*). Figure 4 presents the utility's decision rule for declaring a shutoff. Whenever the firm can earn greater expected profits by supplying electricity, it does not shut off the power.

This paper empirically studies how two changes impact utilities' use of power shutoffs. First, I use a difference in differences research design to descriptively study how a policy which effectively reduced the rate at which utilities pass liability costs on to consumers. In the model, the policy is akin to reducing the amount of damages that the regulator allows the utility to recoup through higher electricity rates (ν). As a result of the policy, we expect the firms' profit function when it supplies electricity (π_0) to decrease by more than its shutoff profit function (π_1) decreases. As a result, if the firm supplies electricity prior to the policy, it is unclear whether it will increase or decrease blackouts following the change. I test this ambiguous prediction and show that utilities increase their use of shutoffs following the policy change.

Second, I use exogenous variation in wind direction and speed across days to estimate how utilities' use of shutoffs changes when they face higher total expected liability costs. In the model, firms face higher liability costs when the total replacement cost of structures threatened by a potential ignition ($\bar{d}$) is large. Increasing $\bar{d}$ in the model shifts π_0 down, but leaves π_1 unchanged. Depending on how large the drop in π_0 is, the firm may use more shutoffs or keep supplying electricity. I show that firms increase their use of shutoffs when areas with higher total structure replacement cost are threatened by a potential ignition. Finally, utilities should utilize blackouts more when they face high realizations of the probability of ignition ($\theta(k')$). As a result, we expect there to be more blackouts on days when the weather is conducive to fire ignitions along power lines (prediction (3)).

IV. How does firms' precautions change when they face any liability?

IV..I Empirical Framework

I provide descriptive evidence of the overall effect of the regulatory change on one utility's implementation of shutoffs using a two way fixed effects research design. As explained in section II., a 2017 regulatory change made by the California Public Utility Commission shifted the burden for liability costs from consumers of electricity to utilities in California. Several factors make estimation of the causal effect of the regulatory change on utilities' shutoff use difficult. First, due to a changing climate, the likelihood of fire ignited by power lines has increased over time. As a result, a pre-post regulatory change comparison of shutoff use may reflect this increasing trend in ignition probability. Second, the regulatory change affected all utilities at the same time, making it difficult to separate the policy effect from annual changes in firms' investment behavior.

I address these difficulties by using a two way fixed effects research design that compares the pre/post regulatory change in shutoff use at circuits with high ex ante ignition risk to their counterparts with low ex ante ignition risk. Low ignition risk circuits are a valid control group because the regulatory change was unlikely to impact firms' behavior in regions with low fire risk. Indeed, in section III. I show that changing the amount of liability born by the firm does not impact its behavior if there is no chance of an ignition occurring at a circuit. Importantly, I control for daily weather conditions at each circuit such as wind speed, humidity, temperature, and relative humidity which are significant determinants of ignition risk.

Equation 4 models shutoff use (y_{it}) at each circuit i on day t as a function of daily weather conditions, infrastructure age, ex ante ignition risk, and the regulatory change.

$$y_{it} = \beta_0 + \beta_1 Treated_i \times Post_t + \beta_2 X_{it} + \gamma_i + \delta_t + \varepsilon_{it} \tag{4}$$

Where y_{it} is either equal to one when there is an active shutoff at circuit i on day t or the total number of customer hours of lost power at circuit i on day t. $Treated_i$ is equal to one for all circuits with positive ex post ignition risk, and $Post_t$ equals one for all days following the regulatory change in December 2017. I determine ex post ignition risk at each circuit using San Diego Gas and Electric's modeled measure of ignition risk which it included in its 2021 wildfire mitigation plan that was submitted to the California Public Utility Commission.[16] The ignition risk reflects the annual likelihood and consequence of fire risk at each circuit as of 2021.

The vector X_{it} contains daily wind speed, temperature, humidity, and precipitation binned into septiles as well as the average age of infrastructure in circuit i. The circuit fixed effects account for characteristics of each circuit, such as the slope of the land, which do not change over time. Since there is seasonality in ignition threats along power lines, the calendar day fixed effects control for daily conditions across all circuits. The coefficient of interest ($\beta_1 \times 100$) measures how the likelihood of a shutoff changes, on average, at high risk circuits relative to low risk circuits after the policy shift. I cluster standard errors at the high fire threat district by week level to allow for correlation in shutoff use in areas with similar ignition risk during a calendar week.[17]

The two way fixed effects research design relies on a conditional parallel trends assumption which states that, conditional on the covariates, the trend in shutoff use would have been the same at high and low ignition risk circuits. I provide suggestive evidence of this assumption by estimating the following event-study model.

$$y_{it} = \alpha + \sum_{j=-3}^{2} \nu_j Treated_{i,t-j} + \psi X_{it} + \gamma_i + \delta_t + \varepsilon_{it} \tag{5}$$

Where the event time end points are binned at $t = -3, 2$ following Schmidheiny and Siegloch (2023).[18] The variable $Treated_{i,t}$ again takes a value of one if circuit i has a non-zero probability

[16] See San Diego Gas and Electric's 2021 Wildfire Mitigation Plan. Modeled ignition risk is included in the attachment "2021 WMP CalPA-SDGE-DR1 02-11-2021".

[17] High fire threat districts were determined by the California Public Utility Commission in 2012. They are designed to show the areas which represent elevated risk for power line-ignited wildfires.

[18] Using binned end points in this way assumes that the treatment effect is constant more than 3 periods prior to treatment or 2 periods after treatment.

of ignition at post regulatory change calendar day t. Just as in equation 4, X_{it} includes nonlinear controls for daily changes in temperature, precipitation, humidity, wind speed, and infrastructure age. Again, I cluster standard errors at the high fire threat district by calendar week level. Figure 5 presents the event study estimates.

Each coefficient represents the cumulative annual effect of the 2017 rule change on power shutoff declaration in percentage points for years leading up to and following 2017. All coefficients are interpreted as the effect relative to the year prior to the rule change. For example, shutoff events were used around 0.025 percentage points more one year after the rule change than they were used one year prior to the rule change. The pre-treatment coefficients in Figure 5 demonstrate that there are no anticipatory effects or underlying time trends in shutoff use that drive the results. All pre-period coefficients are statistically indistinguishable from zero and economically insignificant, providing support for the parallel trends assumption.

IV..II Data Used in Extensive Margin Analysis

Power Shutoff Events I obtain the date, duration, location, and number of impacted customers from power shutoff post-event reports for the period 2013-2020 from the California Public Utilities Commission.[19] Since Pacific Gas and Electric, Southern California Edison, and San Diego Gas and Electric serve the majority of electricity consumers in California and account for the largest share of power shutoffs historically, I restrict the sample to events initiated by one of these utilities. Furthermore, I exclude publicly owned utilities from this analysis because they have not been granted the authority to conduct power shutoff events by the regulator. Since San Diego Gas and Electric was the only utility to receive permission to use power shutoff events prior to 2018, I use exclude Pacific Gas and Electric and Southern California Edison when estimating how the 2017 liability rule change influenced utilities' use of shutoffs. The intensive margin analysis of the relationship between replacement costs and power shutoff use between 2018 and 2020 in Section V. uses data from all three of California's largest private utilities.

Energy Infrastructure Information on the geographic location of distribution and transmission lines operated by Pacific Gas and Electric, Southern California Edison, and San Diego Gas and

[19] Utilities are required to submit under Ordering Paragraph 1 of California Public Utilities Commission (CPUC) Decision (D.) 19-05-042.

Electric is collected from publicly available Geographic Information System (GIS) files submitted to the California Office of Infrastructure Safety in 2020. The GIS data shows the location of each transmission and distribution line within a circuit and exclude critical energy infrastructure. Since the California Public Utility Commission reports shutoff events at the circuit level, I aggregate the line level data to the circuit level before string matching events to circuits by circuit name. On average across the three utilities, I match 97 percent of events to circuits using string matching.

Climate Data I obtain wind speed and direction at ten minute intervals from the 3,041 weather stations operated by Pacific Gas and Electric, Southern California Edison, and San Diego Gas and Electric along their energy infrastructure. In addition, I collected information on temperature, relative humidity, and precipitation from the 892 weather stations operated by the National Weather Service and Remote Automatic Weather Stations in California.[20] For each station, I compute daily average and maximum temperature, humidity, precipitation, and wind speed. Then, for each circuit I compute the inverse distance weighted average for each climate variable across all stations within 20 kilometers the circuit, generating daily average and maximum temperature, relative humidity, precipitation, and wind speed for each distribution circuit operated by Pacific Gas and Electric, Southern California Edison, and San Diego Gas and Electric in California.

Summary Statistics Table 1 reports summary characteristics for the daily panel of distribution circuits operated by San Diego Gas and Electric between 2013 and 2020. At the daily level shutoff events are rare, occurring on 0.02 percent of circuit-days, on average.[21] The average maximum daily wind speed across all circuits between 2013 and 2020 is 7.4 meters per second, but there is substantial variation with some circuits experiencing wind speeds as high as 96 meters per second. Across San Diego Gas and Electric's service territory, 88 distribution circuits ever experience a shutoff event between 2013 and 2020, reflecting San Diego Gas and Electric's efforts to target only the highest risk circuits.

[20] The weather station data was accessed through the Mesonet API.

[21] However, shutoff events become much more prevalent conditional on high wind speeds. In particular, conditional on a circuit having wind speeds greater than 9 m/s the average likelihood of a power shutoff event increases to 0.3 percent.

IV..III Results

Since prior theoretical work shows that applying liability to firms may be ineffective, I first estimate how San Diego Gas and Electric's use of power shutoffs changes after the 2017 policy change which increased their expected liability for damages. Table 2 presents results from the model presented in equation 4. The reported estimates compare how San Diego Gas and Electric's use of shutoffs differs at *ex ante* high ignition risk circuits relative to low risk circuits following the 2017 policy change which increased their expected liability. Column 1 displays the effect of applying liability on the likelihood of a shutoff and column 2 presents the same effect, but for the number of customer hours without power. Both specifications include weather controls, circuit fixed effects, and calendar day fixed effects.

The estimated effect suggests that the rule change is associated with a 5.6 percentage point increase in power shutoffs. Relative to the average probability of a shutoff prior to the 2017 reform, this amounts to more than an 80-fold increase in shutoff use. The estimate in column 2 implies that, on average, the number of customer hours impacted by shutoff events increased by 923 customer hours following the rule change (a 6-fold increase relative to the pre-treatment mean). Assuming each of the 923 customer hours of lost power would have had average energy use as reported by the Energy Information Administration in 2020, this estimate implies that the policy led to between \$150 and \$51,000 in lost consumer surplus at the average distribution circuit. Together these results suggest that the liability regulation effectively encouraged ignition prevention behavior in this setting.

Although shifting fire liability costs onto electric utilities increased their precautionary behavior, the greater reliance on shutoffs may have been socially costly if affected individuals highly value their electricity use. Since consumers whose medical or life-supporting devices rely on electricity likely value their electricity use highly, I estimate how San Diego Gas and Electric's use of shutoffs changes by the share of total customers that rely on electricity for medical needs. San Diego Gas and Electric publicly reports the number of customers with medical devices that rely on electricity by census tract, so I estimate an aggregated version of equation 4 on a daily panel of census tracts in California. The results of this analysis are reported in figures 6 and 7. These estimates suggest that shutoff use increased the most in census tracts with the highest share of customers relying on electricity for their medical needs and for life support. Because these customers have a high value of energy use, San Diego Gas and Electric's increased use of shutoffs following the policy change was likely socially costly.

To provide support for the descriptive empirical model above, I estimate the effect of increasing electric utilities' share of liability costs by circuit-level ignition risk and daily weather conditions in Appendix A. The utilities' stated criteria for power shutoffs suggest wind speed and humidity are two prominent drivers of ignition risk. If the model is correctly specified, San Diego Gas and Electric should increase its use of power shutoffs the most at circuits with the highest ignition risk. As expected, I find that shutoff use increased almost 200-fold at the circuits with the highest risk of ignition. Furthermore, I find that wind speed and humidity are also significant predictors of shutoff use. These results help to provide confidence that the empirical model above is correctly specified and captures utilities' ignition prevention behavior. In the next section, I develop an empirical research design that provides causal evidence of the relationship between the level of liability that each utility faces and its use of power shutoffs.

V. How does the level of liability that a firm faces affect precaution?

V..I Empirical Framework

Precaution and Threatened Property Values

According to the theory developed in section III., utilities' use of shutoffs should respond (either positively or negatively) to the liability cost they bear. One way to test this hypothesis would be to estimate a linear model that relates the probability of a shutoff at circuit i on day t (y_{it}) to the total replacement cost of structures near circuit i ($Value_i$).

$$y_{it} = \nu Value_i + \varepsilon_{it} \tag{6}$$

Under the conditional independence assumption, ν identifies the effect of liability on firms' use of shutoffs. However, the conditional independence assumption is unlikely to hold in this example because unobserved determinants of shutoffs such as the moisture content of vegetation, regional weather conditions, and the presence of critical energy infrastructure are likely correlated with structure replacement costs. To overcome this challenge and isolate the effect of structure replacement cost on shutoffs, I use daily changes in wind direction to create exogenous variation in structure replacement costs that would be threatened by an ignition, if it occurred. Since power line-ignited fires are more likely to occur during periods of extreme wind speeds (Syphard and Keeley (2015)), wind direction is likely to be a relevant determinant of whether a region is threatened by a wildfire on any given day, t. Furthermore, since average daily variation in wind direction is uncorrelated with both power shutoffs and structure replacement costs the conditional independence assumption likely holds.

Following a procedure implemented by Missirian (2020), I use reported wind conditions from stations operated by Pacific Gas and Electric, Southern California Edison, and San Diego Gas and Electric to determine which zip codes are downwind of each circuit. Figure 8 displays this process. I compute the horizontal ("U-wind") and vertical ("V-wind") wind vectors by multiplying the wind speed by the sine or cosine of the wind direction (in radians). After converting the horizontal and vertical wind vectors from meters per second to degrees latitude or longitude per second, I can compute how far away an object would travel if it could remain airborne for one second (the end of the blue arrow in Figure 8). Finally, I scale the horizontal and vertical wind vectors up by an estimate of how long a lit ember could remain airborne if picked up by the wind from Albini, Alexander and Cruz (2012).[22]

I use circuit level changes in wind direction across days to assign which zip codes lie downwind of a utility's power lines. I choose to use zip codes as the unit of analysis for several reasons. First, it uses borders which are determined by the California government, rather than boundaries that I have chosen myself. Second, using zip codes allows me to control for other characteristics that are important determinants of utilities' shutoff use such as population and total energy use which are not available at finer geographic scales using publicly available data. Finally, the data on structure replacement costs is available for the universe of parcels in California at the zip code level, but may be missing at more granular levels of aggregation. In a robustness analysis, I re-estimate the relationship between structure replacement cost and shutoff use using only variation in wind

[22] Albini, Alexander and Cruz (2012) estimate that the maximum spotting distance for a wind driven fire is 10 kilometers. Assuming that wind speeds are at the third quartile observed across my sample between 2018 and 2020 (6.7 meters per second), the 10 kilometer estimate implies that an ember could remain airborne for up to 24 minutes. Estimates are robust to other assumptions of how long a lit ember could remain airborne (such as 5 minutes).

direction within twenty kilometers of power lines, finding similar results to the aggregate zip code analysis.

Figure 9 demonstrates how I determine downwind structure replacement cost in the empirical analysis using an example of 13 zip codes from San Diego County in California. The tan zip code in the center of both panels contains three distribution circuits and the black circles represent the centroid of each circuit. In my empirical framework, I define each tan zip code in my sample as an "origin" zip code. All of the white and yellow zip codes lie downwind of the origin zip code at some point during 2018 and 2020. I define these zip codes as "destination" zip codes because they are the set of possible destinations where an ember could land if picked up at a circuit in the origin zip code. Each black line points in the direction that the wind is blowing, and its end point is how far away from each circuit a lit ember could travel given observed wind speed and direction. When the black line intersects with a zip code, I define the zip code as downwind of the origin zip code. Therefore, in panel (a) the three yellow destination zip codes to the north of the origin are downwind, while the following day (shown in panel (b)) the three destination zip codes to the west are downwind. I estimate the relationship between the total replacement cost in the downwind zip codes and shutoff use at circuits in the origin zip code. As a result, this strategy uses daily variation in liability that is driven by exogenous changes in wind speed and direction. Equation 7 formally presents this research design.

Since there may be underlying static characteristics about each zip code, such as geography, that correlate with shutoff declaration and threatened property values, I construct a paired data set of origin and destination zip codes and control for a pair fixed effect following Kuhn et al. (2011). For each day t and origin zip code o the data file contains a set $(N(o))$ of neighboring destination zip codes indexed by d which are ever downwind of zip code o between 2018 and 2020. By including pair fixed effects, ν_{od}, this strategy accounts for time invariant characteristics of pairs that may be correlated with structure replacement cost and power shutoffs, such as vegetation moisture. Furthermore, I include a calendar day fixed effect which accounts for day-specific unobserved heterogeneity which impacts all zip code pairs, such as seasonality or statewide climatic factors.

$$y_{jodt} = \beta_1 Value_{jd} \times DW_{jodt} + \beta_2 Value_d + \beta_3 DW_{jodt} + \beta_3 X_{jot} + \beta_4 X_{jdt} + \nu_{od} + \delta_t + \gamma_{jt} + \varepsilon_{odt} \quad (7)$$

Where y_{jodt} is a binary variable indicating whether a shutoff is in effect in zip code o which is ever upwind of zip code d on day t. $Value_d$ is the de-meaned log total (or average) structure replacement cost in zip code d and DW_{odt} is equal to one if zip code d is downwind of zip code o on day t. The model includes time-varying covariates (X_{jot}, X_{jdt}) which are specific to zip codes o and d respectively and include average daily wind speed, temperature, specific humidity, and maximum wind speed. In order to allow the effect of the climatic controls to non-linearly impact the outcome, I bin each control variable into septiles.

The coefficient of interest, β_1 may not capture the causal effect of liability on power shutoff declaration if daily variation in wind direction is correlated with a community's underlying fire severity. I account for this possibility by controlling for a categorical measure of underlying wildfire risk (called the wildfire hazard potential) and the share of zip code population living in a region of heightened fire risk (share of population living in the Wildland Urban Interface in 2010) interacted with the downwind indicator. I provide more information on these controls and their sources in section V..II. Finally, I include utility by year fixed effects (γ_{jt}) which account for annual changes in utilities' plans to prevent ignitions.

Since I de-mean the structure replacement cost in equation 7, β_3 is the change in shutoff likelihood when a zip code with average structure replacement cost is downwind. The coefficient of interest β_1 measures the average percentage point change in the likelihood of a power shutoff with respect to a one percent increase in downwind structure replacement cost. Furthermore note that while the coefficient β_2 captures the effect of non-threatened property values, it cannot be estimated because the replacement cost is collinear with the pair fixed effects. Under the conditional independence assumption, β_1 and β_3 identify the causal effect of downwind structure replacement cost on the probability of a shutoff.

Causal identification of the relationship between potential liability and power shutoffs in equation 7 relies on exogenous changes in wind speed and direction across days. To provide suggestive evidence that the daily variation in wind conditions is as good as randomly assigned, I compare average socioeconomic and demographic characteristics of destination zip codes by downwind status in Table 3. The average characteristics for not-downwind and downwind zip codes are shown in columns 1 and 2 while the difference in means as a percent of a standard deviation is presented in column 3. Although downwind and not-downwind zip codes are statistically different across nearly all characteristics, all differences are small, accounting for less than 8% of a standard deviation for all observed variables. For example, although the median replacement cost of structures in downwind zip codes is around $1,000 more than in non-downwind zip codes, this is less than 2% of the average replacement cost. Furthermore, the empirical framework in equation 7 includes a pair fixed effect which controls for all time-invariant zip code characteristics.

V..II Additional Data Used in Intensive Margin Analysis

Replacement Cost of Structures Since electric utilities are liable for the cost of replacing structures damaged by power line-ignited fires, I use parcel-level structure replacement costs to measure potential damages rather than the market value of each property. I obtain parcel level replacement costs of each property in California in the year that it is assessed from the Zillow Transaction and Assessment Database (ZTRAX) which contains parcel-level assessed values and transaction information for most counties in the U.S. Zillow computes the replacement cost by taking the difference between the market value of the property and the market value of the land in the year of assessment. I adjust replacement costs to 2021 dollars using the consumer price index.[23]

Vegetative Cover I use the discrete Wildfire Hazard Potential index to capture underlying vegetative conditions in the areas surrounding distribution circuits in California.[24] Values of the WHP index indicate wildfire risk and range from 1 (very low) to 5 (very high). The WHP index is intended to guide strategic long-term management of vegetation and is based on vegetation and fuels data from LANDFIRE 2014, a collection of databases which describe vegetation and fire characteristics across the U.S..[25] As a result, the WHP reflects vegetative conditions at the end of 2014.

Wildland Urban Interface Since utilities' decision to declare a shutoff event could be impacted by whether a circuit is located in an area that is high fire risk, I obtain the boundaries of the Wildland Urban Interface (WUI) from the California Department of Forestry and Fire Protection's Fire and Resource Assessment Program. The WUI is defined as an area with dense housing adjacent

[23]https://fred.stlouisfed.org/series/CPALTT01USA659N.

[24]Dillon, Gregory K; Gilbertson-Day, Julie W. 2020. Wildfire Hazard Potential for the United States (270-m), version 2020. 3rd Edition. Fort Collins, CO: Forest Service Research Data Archive. https://doi.org/10.2737/RDS-2015-0047-3

[25]The LANDFIRE program is jointly supported by the U.S. Department of Agriculture, the Forest Service, and the U.S. Department of the Interior.

to vegetation that can burn in a wildfire.[26] Because the property value analysis is estimated at the zip code level, I compute the share of total 2010 zip code population living within the WUI.

Potential Liabilities In order to identify structures that would be threatened by a potential ignition, I use daily variation in wind direction at the centroid of the area where each distribution circuit operated by Pacific Gas and Electric, Southern California Edison, or San Diego Gas and Electric in California overlaps with a zip code. Using data on the daily average wind direction and maximum wind speed described above, I assign destination zip codes to each origin zip code for each day of the sample. I describe this process in detail below.

As shown in figure 8, I use two results from trigonometry to calculate the vertical and horizontal wind vectors in degrees of latitude or longitude per second.[27] After converting the vertical and horizontal wind vectors to degrees of longitude per second and latitude per second respectively, I multiply each vector by a measure of how many seconds a lit ember can stay airborne from Albini, Alexander and Cruz (2012).[28] I then use the scaled-up vertical and horizontal wind vectors to compute where an ember would land if it were picked up by the wind at each distribution circuit. Finally, I connect the start and end points with a line and assign a zip code as downwind if it intersects with that line. As shown in table 4, the daily wind speeds across distribution circuits during the sample period range between 24 and 88 miles per hour.

Summary Statistics Table 4 reports the summary statistics for relevant variables that I use in this analysis. On the most active day of power shutoffs in my sample there were 46 concurrent power shutoffs. However, shutoff events are very infrequent at the daily level, occurring on average 2.5% percent of total pair-days in the sample. The last row of table 4 shows that there are 539 zip codes in California that ever experience a shutoff between 2018 and 2020. The average replacement cost is substantial at around $7.2 billion and there is significant variation across zip codes with a standard deviation of $6.6 billion.

I construct the final sample by dropping all days that do not fall under the minimum criteria for a shutoff event as defined by Pacific Gas and Electric on p.982 of their 2021 wildfire mitigation

[26] Specific housing density and vegetation thresholds for WUI classification can be found here.

[27] The vertical wind vector is given by $x \sin\theta$ and the horizontal wind vector is given by $x \cos\theta$, where x is the wind speed in meters per second and θ is wind direction measured from the x-axis in radians.

[28] Albini, Alexander and Cruz (2012) report a maximum spotting distance of 10 kilometers for wind driven fires. To convert this estimate to seconds that an ember is airborne, I multiply 10,000 meters by the inverse of the third quartile of wind speed in the sample yielding an estimate of about 18 minutes. This estimate means that at it would take a lit ember 18 minutes to travel 10 kilometers at the third quartile of wind speed in the sample.

plan.[29] I make this sample restriction based on the reported wind speeds and humidity in origin zip codes rather than destination zip codes because this reflects climate conditions around the power lines themselves. I further drop months where no shutoff events occur between 2018 and 2020 since these months do not help identify the coefficient of interest from model 7. The final sample consists of a daily panel of 13,039 unique origin-destination zip code pairs.

V..III Results

In settings where firms' assets are significantly less than their liability costs from an accident, it may be optimal for firms to declare bankruptcy (Shavell (1986)). A common solution to this problem posed by regulators is to cap firm liability, providing incentives for precaution without leading to bankruptcy. However, because prior estimates of firms' precautionary response to liability are from one point in the distribution of potential liabilities, regulators have limited information about which level to place the cap on damages. The estimates in this section leverage firms' full distribution of potential liabilities from power line-ignited fires, allowing me to flexibly estimate their precautionary response to liability.

Table 5 reports the main results from regression model 7. The coefficient of interest is reported in row 1 and is interpreted as the percentage point change in power shutoff declaration probability that results from a 10 percent increase in the replacement cost of downwind structures relative to days when the properties are not downwind. Since I de-mean the replacement cost of structures, the estimate in row 2 reflects the change in shutoff likelihood when a zip code with average total (or mean) replacement cost lies downwind. Columns 1 and 2 report the estimate of firms' precautionary response to liability with total and mean zip code replacement cost as the independent variable of interest. Both specifications include controls for daily maximum wind speed, maximum temperature, average relative humidity, and cumulative precipitation in the origin and destination zip codes. In addition, both specifications include origin-destination zip code pair fixed effects and calendar day fixed effects.

The estimate in column 1 suggests that, on average, utilities are 0.02 percentage points (100%) more likely to use a power shutoff when a region with 10% higher total zip code replacement cost

[29] The minimum criteria are wind speeds greater than 20 mph and relative humidity less than 30%. Pacific Gas and Electric has many other criteria for declaring a shutoff, but these are the minimum criteria that I can observe using the publicly available climate data.

lies downwind. Assuming that baseline total replacement cost is at the average level I observe in the sample ($6.8 billion) implies that shutoff use increases by 100% when potential liabilities increase by $680 million. However, the positive relationship between total liability and shutoff use could reflect utilities' increased willingness to undertake precaution when densely populated regions lie downwind. The estimate in column 2 shows that firms consider liabilities independently of population, suggesting that utilities use shutoffs 160% more when the mean downwind zip code structure replacement cost is about $6,000 higher.[30]

Although prior work suggests that the relationship between liability and precaution should be nonlinear, the estimates in table 5 assume a linear relationship. I relax this linearity assumption by binning total (or mean) zip code replacement cost by decile and re-estimating equation 7. Figures 10 and 11 report the resulting estimates of downwind total and mean replacement cost on power shutoff use. The estimates in figure 10 suggests that shutoff use increases in total structure replacement cost until liability exceeds $10 billion (the eighth decile of total replacement cost), after which it begins to decrease. Similarly, the response of shutoffs to average zip code replacement costs in figure 11 is increasing until mean liability cost exceeds $85 thousand (the eighth decile of mean replacement cost). Shavell (1986) posits that as the ratio of liability to assets increases, the firm will eventually begin to take fewer precautions to prevent an accident. The estimates I report above are consistent with this prediction. Utilities take greater precautions until their total liability from a potential ignition exceeds $10 billion and then begin to take less precautions.

Because utilities direct shutoffs to areas with higher structure replacement costs, there may be systematically more precaution taken in high socioeconomic status communities that tend to have greater property values. I explore this possibility in Appendix A and find that because low socioeconomic status communities tend to live in low ignition risk areas in this setting, there is not relationship between firms' response to liability and socioeconomic status. In other settings where high and low socioeconomic status communities live in high risk areas at similar rates, there may be systematic distributional consequences of liability regulation.

[30] In Appendix A, I estimate robustness specifications that explicitly control for population. While I find that downwind population is a relevant determinant of shutoff use, it does not alter the estimates in table 5.

V..IV Robustness

Factors such as vegetation conditions near power lines, extent of interaction between housing and wilderness, and energy consumption patterns could drive utilities' use of shutoffs. If these factors are also correlated with structure replacement costs, then the estimated relationship between shutoffs and potential liability could be biased. In table 6, I estimate several modifications of regression model 7 to test the robustness of the main result in table 5. Column 1 replicates the main estimate from table 5. Column 2 adds a control for the share of total population in destination zip code d living in the WUI interacted with the downwind indicator, DW_{odt}. This covariate captures daily changes in the number of structures near vegetation that is likely to burn in the event of a fire. In column 2, I also control for the average WHP index in each destination zip code interacted with the downwind indicator. This covariate measures the conduciveness of vegetation in the downwind zip code to spreading fire. Column 3 adds separate controls for monthly electricity usage in the origin and destination zip codes respectively. These additional covariates capture patterns in electricity usage that are relevant to firms' shutoff decision.

The empirical model in equation 7 uses daily changes in downwind structure costs to estimate the relationship between shutoffs and liability. However, evidence suggests that utilities monitor forecasted wind conditions in addition to current conditions. As a result, utilities may base their shutoff decisions on their expectation of which regions will be downwind in the upcoming days. To account for this behavior, I define a destination zip code as downwind if it lies downwind of the origin zip code at any time in the next five days. For example, the downwind indicator, DW_{odt}, is set equal to one if a destination zip code is downwind anytime over the next five days (between day t and day $t+5$). I report the results from this specification in column 4 of table 6. The main estimate of interest is positive, significant, and of a similar magnitude in all specifications.

Since the empirical framework in equation 7 is specified at the zip code level, it may include properties that are located far away from high-ignition risk circuits. If utilities only consider structures that are very close to high-risk power lines (and therefore very likely to be destroyed if an ignition occurs), then the zip code analysis could be misspecified. In appendix A, I address this by estimating 7 at the circuit level. I do this by using daily variation in the replacement cost of structures that lie downwind of power lines and are located within 20 kilometers of a circuit. Using this local variation, I estimate similar effects to the main result from table 5.

VI. Discussion and Conclusion

This paper provides the first causal evidence of how firms' precautions responds to liability across the full distribution of potential liabilities that they face. I document a nonlinear relationship between potential liability and firm precautions in California's electric utility sector, showing that firms increase precautions until liabilities are extreme. While this is a novel result that helps inform existing models of firm precautions, it can also be used to determine how the application of strict liability to investor-owned electric utilities in California affected social welfare. The welfare effects of strict liability are unclear in this setting because the type of precaution firms utilize in the short run, power shutoffs, provide both positive and negative welfare consequences to Californians. Power shutoffs generate positive welfare effects because they reduce the likelihood of fire ignition by power lines. However shutoffs also leave consumers without power, sometimes for extended periods of time. In the short run, the net change in social welfare depends on the relative magnitude of averted damages from power shutoffs and the value of consumers' lost electricity use during shutoffs. The long-run welfare consequences of liability in this setting additionally depend on the relationship between power shutoffs and other types of precautions like burying power lines underground, the relative effectiveness of shutoffs versus other types of precautions, and the long-run effect of liability on other types of precautions such as electrical grid hardening. Since this paper is focused on firms' short-run precautionary response to liability, I leave the long-run welfare consequences of liability regulations for future work.

VI..I Short Run Welfare

Using the conceptual framework from section III., I derive the short-run welfare change resulting from a decrease in the pass through rate of liability costs in Appendix C. Since total welfare is the sum of consumer and producer surplus, I can write the change in short-run welfare from a change in the rate of capital return as the sum of the change in consumer and producer surplus.

$$WF(\nu') - WF(\nu) = \Big(\beta\theta(k')\bar{d} - (\bar{p} - p)Q\Big)\Big[P(L = 1 \mid \nu') - P(L = 1 \mid \nu)\Big] \tag{8}$$

Where $\bar{p}$ is the consumers' maximum willingness to pay per kilowatt hour and $\nu' < \nu$ is the capital return after the 2017 CPUC rate case decision. There are three parameters that characterize the short-run welfare change from an increase in the share of liability born by firms in equation 8: (1) the change in probability of shutoff event following an increase in the share of liability born by firms $(P(L = 1 \mid \nu') - P(L = 1 \mid \nu))$, (2) expected damages $(\theta(k')\bar{d})$, and (3) consumers' maximum willingness to pay for electricity $(\bar{p})$.

There are several important caveats to the welfare change represented in equation 8. In the model, consumers value their home at its replacement cost and receive a payment from the utility equal to the home replacement cost if the structure burns down. As a result, consumers in this model do not care whether their home burns down. In practice, consumers may have a value of their home which exceeds the replacement cost, causing consumer surplus to potentially increase when firms use more shutoffs. Thus, the welfare change in equation 8 is likely larger (in absolute terms) than a more detailed model that incorporates intrinsic home values.

Another caveat to keep in mind is that I am assuming the adjustment of defensive capital cannot occur in the short term (making term three in Appendix C, equation 12 equal to zero). Since the sample includes three post-policy years and the utilities have extensive networks of power lines, the extent of defensive capital investment is limited in this setting. However, future analyses of defensive capital's impact on the likelihood of ignition would be informative.

To calculate expected damages from a potential ignition and lost consumer welfare from foregone electricity use during a power shutoff, I collect additional data from several sources.

Expected Damages Because the welfare calculation in equation 8 requires a measure of expected damages at each distribution circuit $(\theta(k')\bar{d})$, I obtain parcel level replacement costs and a measure of the fire risk faced by each structure. To compute the expected damages at each circuit if an ignition were to occur, I multiply the replacement cost of each parcel by a measure of fire risk. First, I compute the total replacement cost of structures within 5 kilometers of a circuit using the ZTRAX data described in section V..II. Second, I use the Risk to Potential Structures (RPS) index created by Scott et al. (2020) to capture the likelihood that each structure in the ZTRAX database would be damaged by a fire. The RPS index ranges from 0 (no damage) to 12 (fully destroyed) at the 30 meter pixel level and answers the question: "What would be the relative risk to a house if one existed here?" Since the RPS uses data from 2014, it reflects the risk to structures based on 2014 vegetation conditions. I compute expected damages at each circuit by multiplying the property value at each parcel by the inverse of its RPS index and summing to the circuit level.

Likelihood of Ignition at Each Circuit Since the welfare calculation in equation 8 requires knowledge of the ignition probability at each circuit ($\theta(k')$), I collect circuit level wildfire risk scores from publicly available data files submitted by San Diego Gas and Electric as part of its 2021 Wildfire Mitigation Plan.[31] The circuit level ignition probabilities are raw wildfire risk scores from San Diego Gas and Electric's internal fire risk model called the Wildfire Next Generation System. Each risk score represents the probability of ignition adjusted for wind patterns, vegetation, and infrastructure hardening at a circuit. Since San Diego Gas and Electric only applied the model to its circuits in areas with elevated ignition risk, I assume that the probability of ignition is zero at unmodelled circuits.

Energy Usage The final information necessary for the welfare calculation in equation 8 is a measure of energy usage at each circuit. I use publicly available energy usage data reported by San Diego Gas and Electric at the zip code level for each quarter of the year. For each zip code, I compute the average energy use between 2013 and 2017. Then, I assign energy use to each circuit in a zip code in proportion to its share of total circuit miles in that zip code. For example, if there are two circuits in a zip code that have the same total length of power lines, then I would assign half of the total zip code energy use to each circuit.

In order to compute term (1) in equation 8, I use the estimates by ignition risk presented in Figure A1. This strategy assigns the same probability change to all circuits that are in the same decile of ignition risk. Then, I use parcel-level assessed values from the Zillow ZTRAX dataset and the Risk to Potential Structures index created by Scott et al. (2020) to compute term (2) as described above. Multiplying potential damages by the likelihood of ignition yields expected damages (term 2). In order to compute term (3) in equation 8, I multiply the average historic energy use at each circuit by estimates of the value of lost load per kilowatt hour of energy use from a 2019 value of service study conducted by Southern California Edison.

Since the empirical literature on the value of lost load is still young, I first estimate the per kilowatt hour value of lost load required for there to be a welfare change of zero at each circuit.

[31] See San Diego Gas and Electric's response to data request CALPA-SDGE-01 questions 4 and 5 here.

Figure 12 plots the number of circuits by the value of lost load necessary for welfare to remain the same following the policy. For most circuits in the sample, the maximum value of lost load required for a non-negative welfare change is less than \$3 per kWh. The average value of lost load necessary for welfare to remain unchanged across all circuits is \$0.3 per kWh and the median is \$0.01 per kWh. The smallest estimate of the value of lost load conducted for Southern California Edison customers is \$1.90 for residential customers, implying that the observed change in liability likely leads to a reduction in welfare.

To calculate a conservative estimate of the short run welfare change at each circuit, I assume that consumers' value of electricity is \$0.22 per kilowatt hour, the average retail price of electricity in California. Figure 13 plots a histogram of the estimated welfare change at each circuit in millions of dollars. The short run welfare effect is negative at nearly every circuit in the sample, suggesting that the value of lost electricity use at each circuit during power shutoffs outweighs the reduction in expected damages. Adding the welfare effects across circuits implies that the regulatory change reduced welfare by between \$17 million and \$7 billion depending on the value of lost load used in the calculation. In the next section I provide a short discussion of the results, explore policy implications, and suggest directions for future research.

VI..II Conclusion

In this paper I use exogenous daily variation in wind direction to estimate the causal relationship between liability and short-run firm precaution across the full distribution of liabilities that firms face in California's electric utility sector. Theoretical models of firm behavior suggest that the firm precaution responds ambiguously regulator's application of liability and that firm precaution should respond non-linearly to the level of liability that it faces. Prior empirical work estimates the relationship between liability and firm precaution at one point in the distribution of liabilities that it faces, ignoring important non-linearities in firm precaution. This paper advances the previous empirical literature by developing an empirical framework that can estimate the causal relationship between liability and firm precaution across the full distribution of liabilities it faces, capturing important non-linearities.

To evaluate the effectiveness of liability regulations, I study California's electric utility sector, a setting where firms face extreme liability from fires ignited by the power lines that they operate. I construct a daily panel of upwind-downwind zip code pairs across California between 2018 and 2020 and use exogenous daily variation in wind direction to estimate how firms use of power shutoffs to prevent fire ignitions changes as the value of structures downwind of their power lines varies. Since the empirical framework leverages daily variation in wind direction and I control for other important drivers of firms' power shutoff use such as wind speed, I am able to causally estimate the relationship between liability and firm precaution.

This paper finds that firms increase precautions in response to the level of liability that they face. However, firms' precautionary response to liability is highly non-linear: firms are very responsive to the level of liability that they face at lower levels of liability, but are less responsive at the highest deciles of liability that they face. This result provides evidence that the risk of bankruptcy when potential liabilities exceed firm value likely dampens firms' precautions.

There are several key implications for policymakers from this paper: First, these results suggest that policymakers can increase utilities' ignition prevention effort by increasing the share of liability for fire-related damages that they bear. Second, the policymaker can influence which ignition prevention efforts the utility undertakes by clearly defining which strategies will allow the utility to avoid a negligence ruling. In the California context, the 2017 rule change and subsequent rule amendments did not clearly specify what utility actions (or lack thereof) would lead them to be negligible for fire damages. This lack of clarity may have led utilities to use shutoff events as a signal that they are not acting negligently, leading to an overuse of blackouts at the expense of longer term mitigation investments. Third, since utilities appear to direct precautionary effort towards regions with higher threatened property values, policymakers should be wary of potential distributional consequences of liability regulations.

There are several areas where future research can extend this analysis to further inform our knowledge of liability regulations and how they impact firm precaution in the power line-ignited fire setting. First, future research should explore whether the circuits with the highest welfare loss from an increase in liability are located in areas with a large share of disadvantaged community members. For example, if expected damages are low and the VOLL is high in disadvantaged communities, then this implies that increasing the share of liability on firms is regressive in this setting. Second, future studies should take a longer term view of the impact of liability regulation on utilities' ignition prevention behavior. Researchers could do this by collecting data on other measures of ignition prevention, such as burying power lines, which utilities can take in the long term. Although liability regulation has a negative welfare impact in the short term, it could be beneficial in the long term if it encourages precautionary activities that both reduce the likelihood of ignition and the probability that a power shutoff occurs. Finally, more work is needed to identify which ignition prevention strategies most effectively reduce the likelihood of a fire caused by power lines. In particular, cost benefit analyses may need to be revised to account for the fact that capital investments both reduce the probability of ignitions *and* blackouts in the future.

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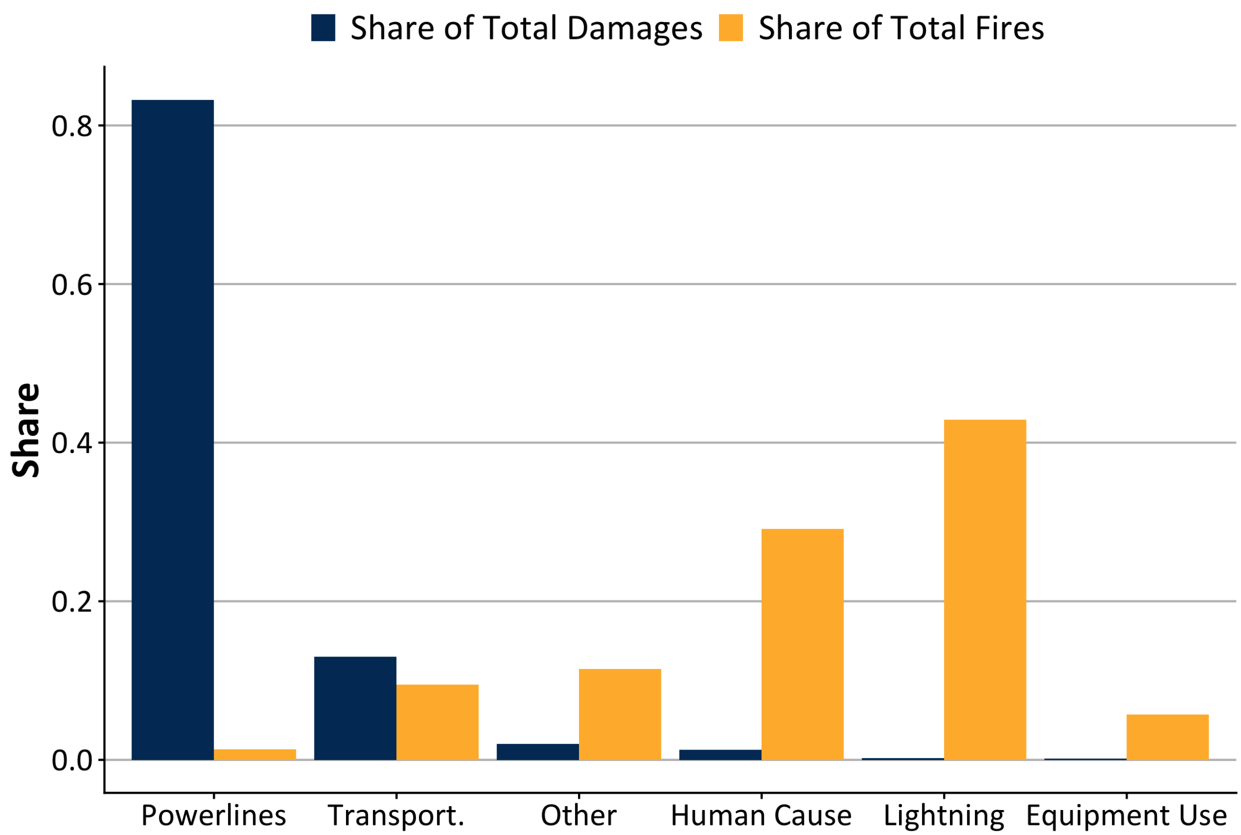
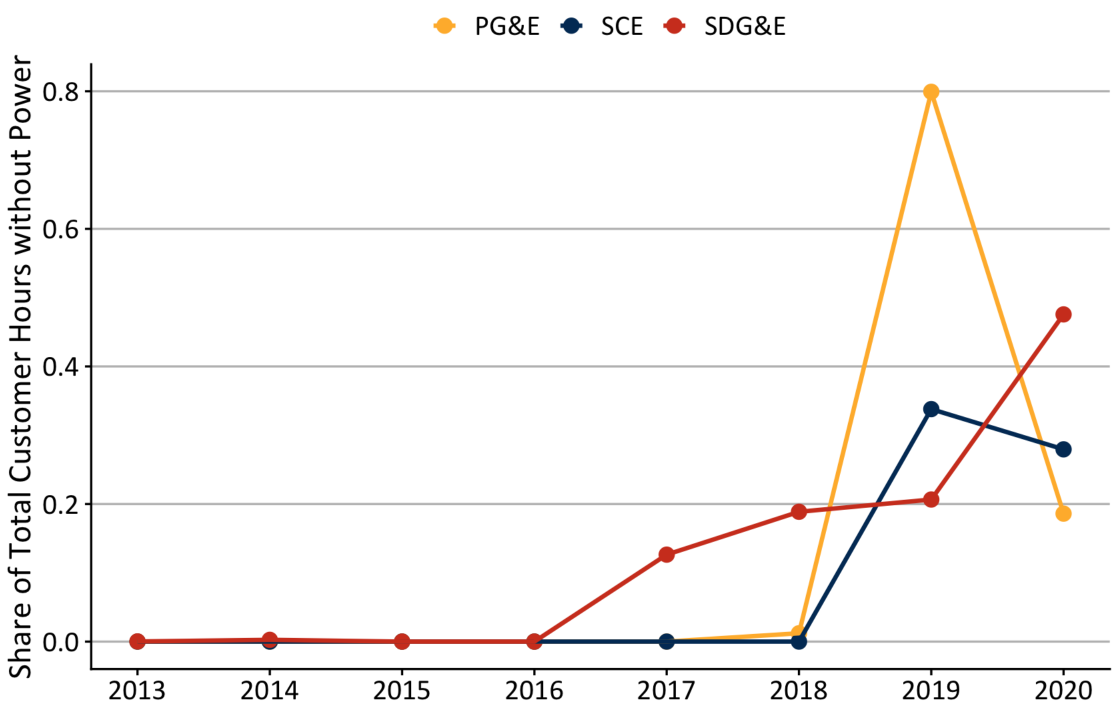
VII. Figures

Figure 1 Share of Wildfire Ignitions (1910-2016) and Damages (2008-2019) by Source



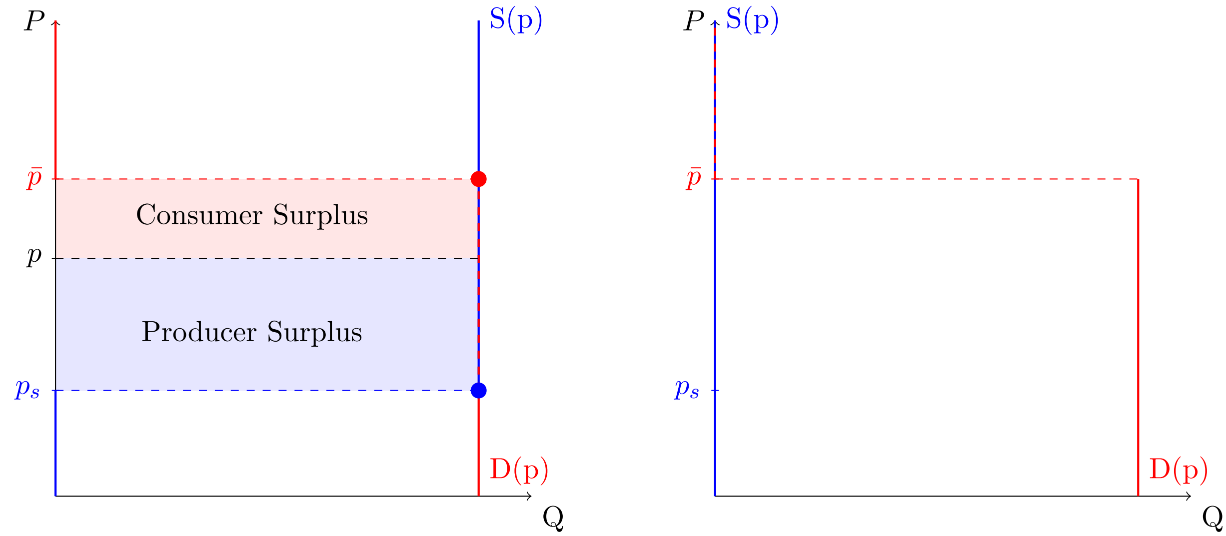
Notes: Share of total wildfire ignitions in California by cause of ignition between 1910 and 2016 are shown in yellow. The "Other" category includes fires caused by arson, debris, smoking, camping, playing with fire, railroads, lumber, equipment, and vehicles. Data are from Keeley and Syphard (2018). Share of total wildfire damages by ignition cause between 2008 and 2019 in California are shown in blue. Damages are defined as the replacement cost of homes destroyed by wildfire. The "Other" category includes fires caused by arson, debris, smoking, camping, playing with fire, railroads, lumber, equipment, and undefined cause. Data were collected by the author from CalFire historical wildfire activity data, also referred to as "redbooks."

Figure 2 Share of Total Customer Hours Impacted by Shutoff Events



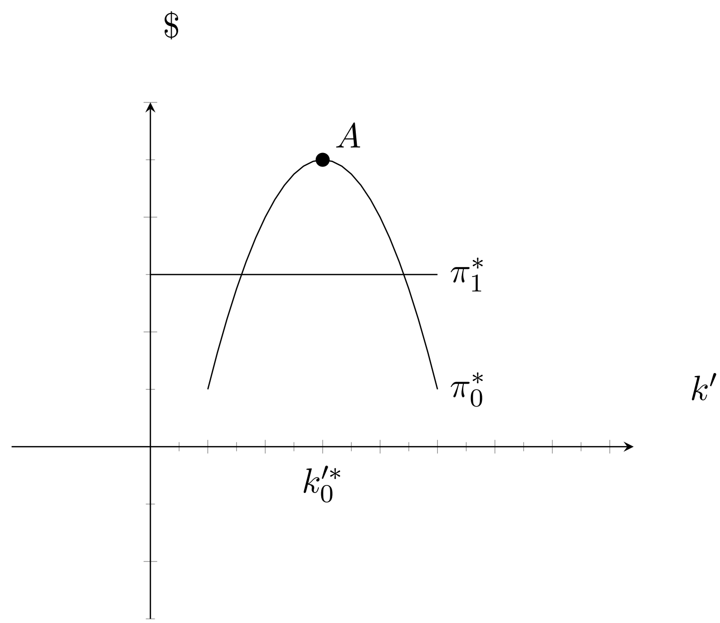
Notes: Total customer hours computed by the author from public safety power shutoff post event reports. The share is computed by dividing impacted customer hours in each year by each utility's cumulative customer hours impacted by shutoff events between 2013 and 2020. Customer hours include commercial and residential customers served by California's three largest privately-owned utilities, Pacific Gas and Electric, Southern California Edison, and San Diego Gas and Electric. Reports are available from the California Public Utility Commission.

Figure 3 Demand, Supply, and the Shutoff Decision for an Example Firm



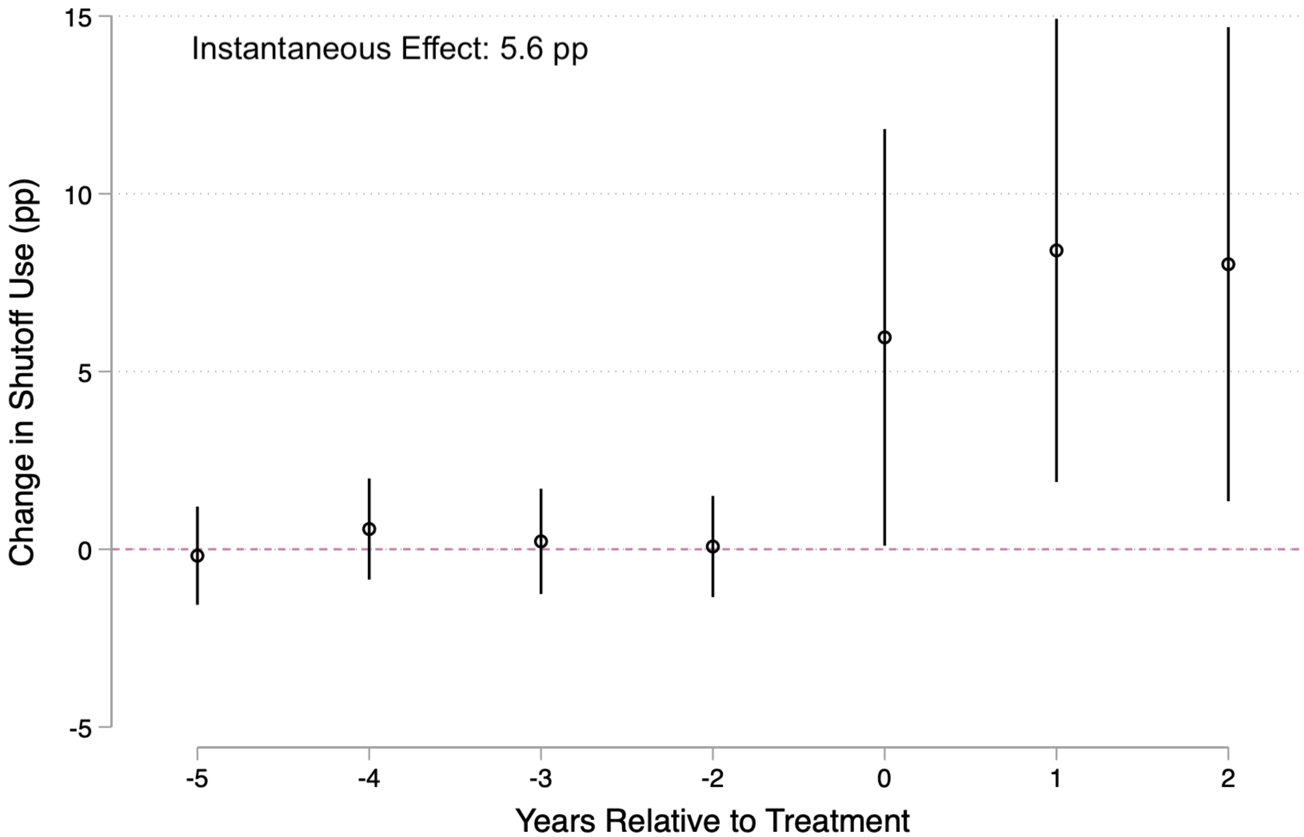
Notes: Supply and demand curve for an example firm when the firm provides electricity (left) and uses a power shutoff (right). Consumers' maximum willingness to pay for electricity is $\bar{p}$ and the firm's shutdown price is p_s.

Figure 4 Firms supply electricity when $\pi_0 > \pi_1$



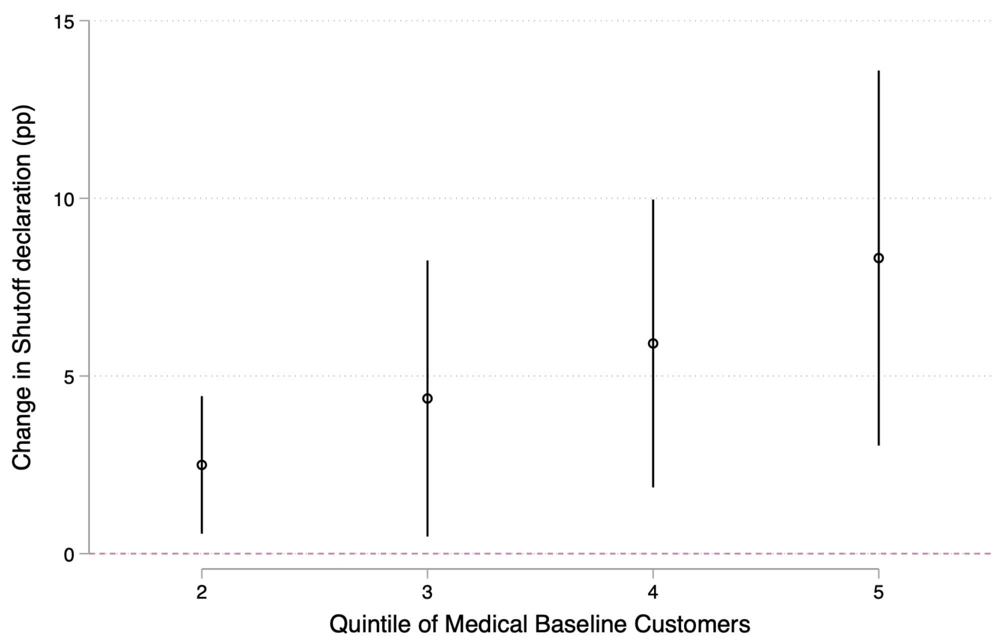
Notes: Solution to the firm's problem. Defensive capital investment is on the x-axis and dollars of profit is on the y-axis. The firm does not use a shutoff whenever its earns higher expected from supplying electricity (π_0) than from using a shutoff (π_1).

Figure 5 Effect of 2017 Rule Change on Power Shutoff Use



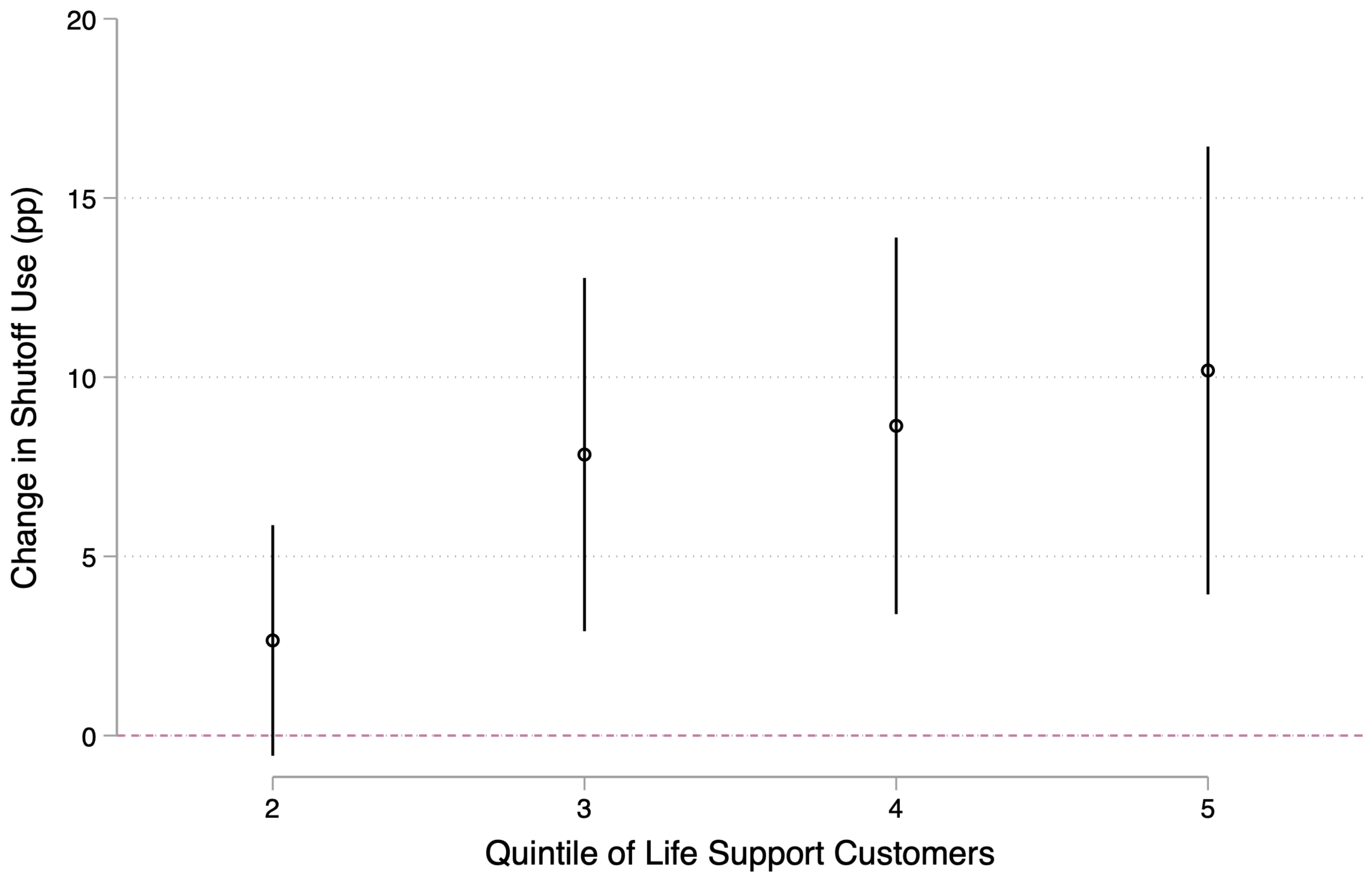
Notes: Estimated effect on shutoff use (in percentage points) of shifting liability for power line-ignited fire damages from electricity consumers to utilities. The x-axis plots event time in years relative to the 2017 liability rule change. The coefficient for period "-1" is excluded in this figure because it is zero by construction. Coefficient estimates are plotted with their 95% confidence intervals. The figure is created by estimating an event study version of regression model 7 on a daily panel of distribution circuits operated by San Diego Gas and Electric between 2013 and 2020. Standard errors are clustered at the high fire threat district by calendar week level to allow for correlation in Shutoff use across circuits with similar ignition risk during the same week.

Figure 6 Effect of 2017 Rule Change on Shutoff Declaration by Share of Medical Baseline Customers



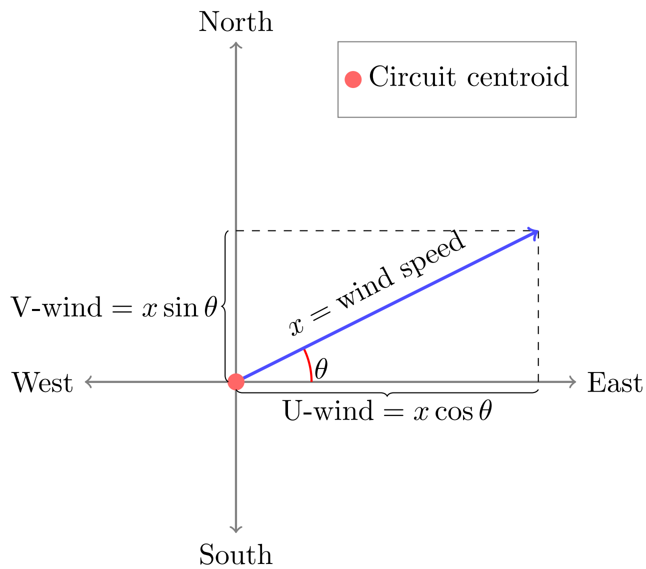
Notes: Estimated effect on shutoff use (in percentage points) of shifting liability for power line-ignited fire damages from electricity consumers to utilities by quintile of medical baseline customer share. A customer self selects into medical baseline status by notifying San Diego Gas and Electric of a qualifying medical condition or device. The share is calculated as the Coefficient estimates are plotted with their 95% confidence intervals. Each coefficient is interpreted relative to the estimated effect on days in the lowest septile of each climate condition. The figure is created by estimating a version of regression model 7 where treatment is interacted with binned climate conditions on a daily panel of on a daily panel of census tracts containing distribution circuits operated by San Diego Gas and Electric between 2013 and 2020. Daily climate conditions are from weather stations operated by San Diego Gas and Electric along their power lines. Standard errors are clustered at the high fire threat district by calendar week level to allow for correlation in shutoff use across circuits with similar ignition risk during the same week.

Figure 7 Effect of 2017 Rule Change on Shutoff Declaration by Share of Life Support Customers



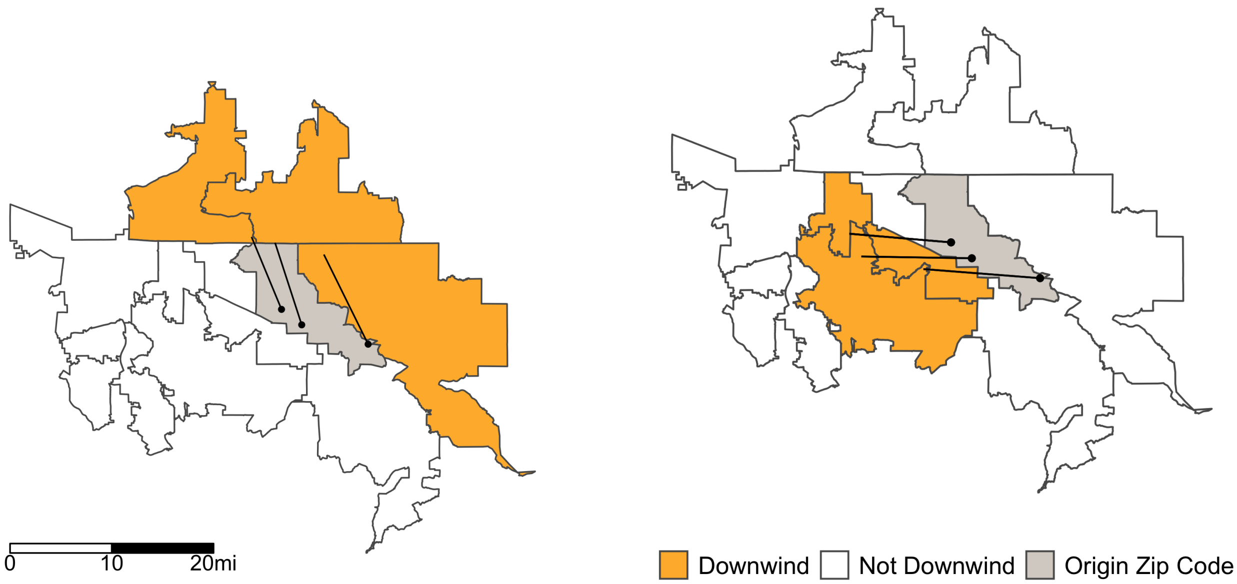
Notes: Estimated effect on shutoff use (in percentage points) of shifting liability for power line-ignited fire damages from electricity consumers to utilities by quintile of life support customer share. A customer self selects into medical baseline status by notifying San Diego Gas and Electric of a qualifying medical condition or device. The share is calculated as the Coefficient estimates are plotted with their 95% confidence intervals. Each coefficient is interpreted relative to the estimated effect on days in the lowest septile of each climate condition. The figure is created by estimating a version of regression model 7 where treatment is interacted with binned climate conditions on a daily panel of census tracts containing distribution circuits operated by San Diego Gas and Electric between 2013 and 2020. Daily climate conditions are from weather stations operated by San Diego Gas and Electric along their power lines. Standard errors are clustered at the high fire threat district by calendar week level to allow for correlation in shutoff use across circuits with similar ignition risk during the same week.

Figure 8 Description of Downwind Assignment



Notes: Figure shows how to compute U and V wind vectors from station-level wind speed (x) in meters per second and direction (θ) in radians. U and V wind vectors are scaled up by 18 minutes, the amount of time it takes for a lit ember to travel 10 km at wind speeds of 9.5 meters per second, and converted to degrees latitude and longitude to compute where a lit ember would land if picked up by the wind at the circuit centroid.

Figure 9 Example of Regions that are Downwind of Power Lines Across Days

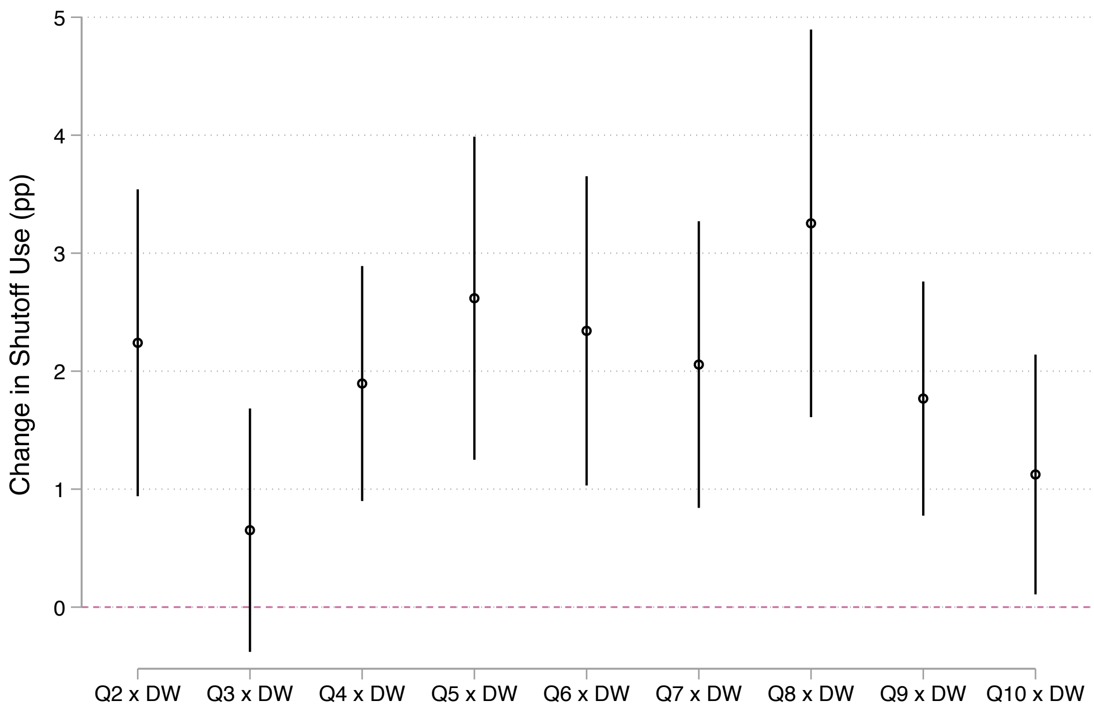


(a) Oct. 10, 2019

(b) Oct. 11, 2019

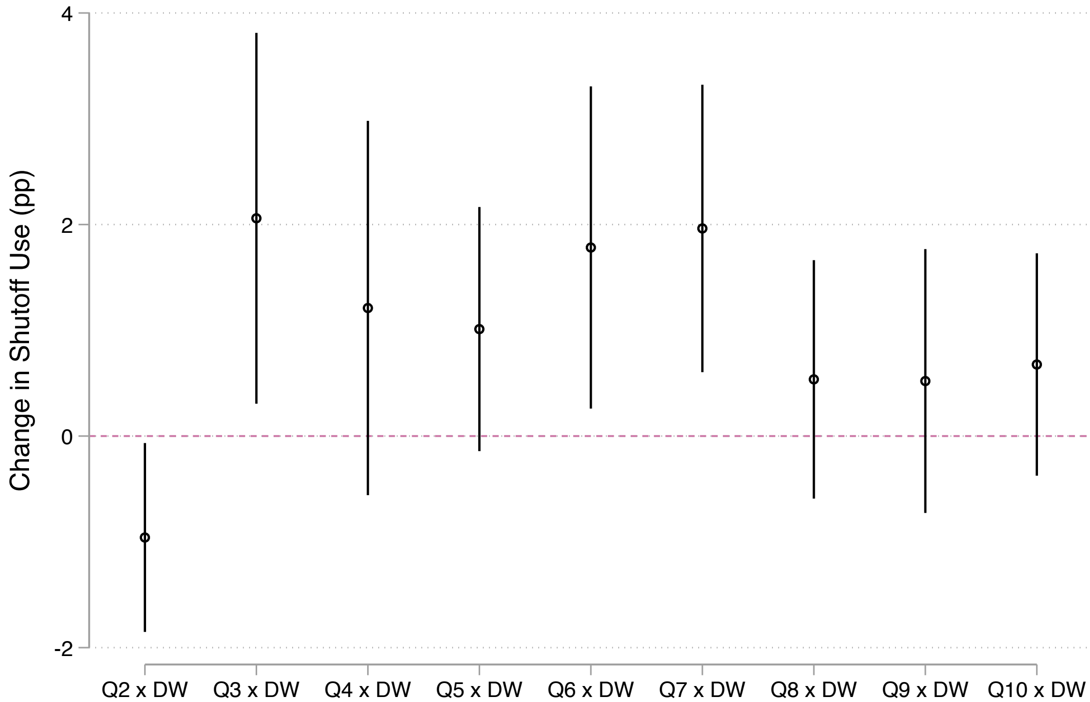
Notes: Daily variation in which zip codes are downwind of zip code 95917 (shown in tan) on October 10 and 11, 2019. The yellow and white shaded zip codes are the set of zip codes that are downwind of 95917 on any day between 2018 and 2020. The yellow zip codes are downwind of 95917 on a given day and the white zip codes are not downwind on the day shown. The black dot is the centroid of an electrical distribution circuit in zip code 95917 and the black line indicates the maximum daily wind direction and speed at the circuit on the day shown. The black line is using maximum daily wind speed and direction, an estimate of how far the wind can carry a lit ember from Albini, Alexander and Cruz (2012), and several trigonometric identities. I calculate the total structure replacement cost for the yellow and white zip codes and changes in liability are generated by variation in wind direction and speed across days.

Figure 10 Results by Decile of Total Zip Code Replacement Cost



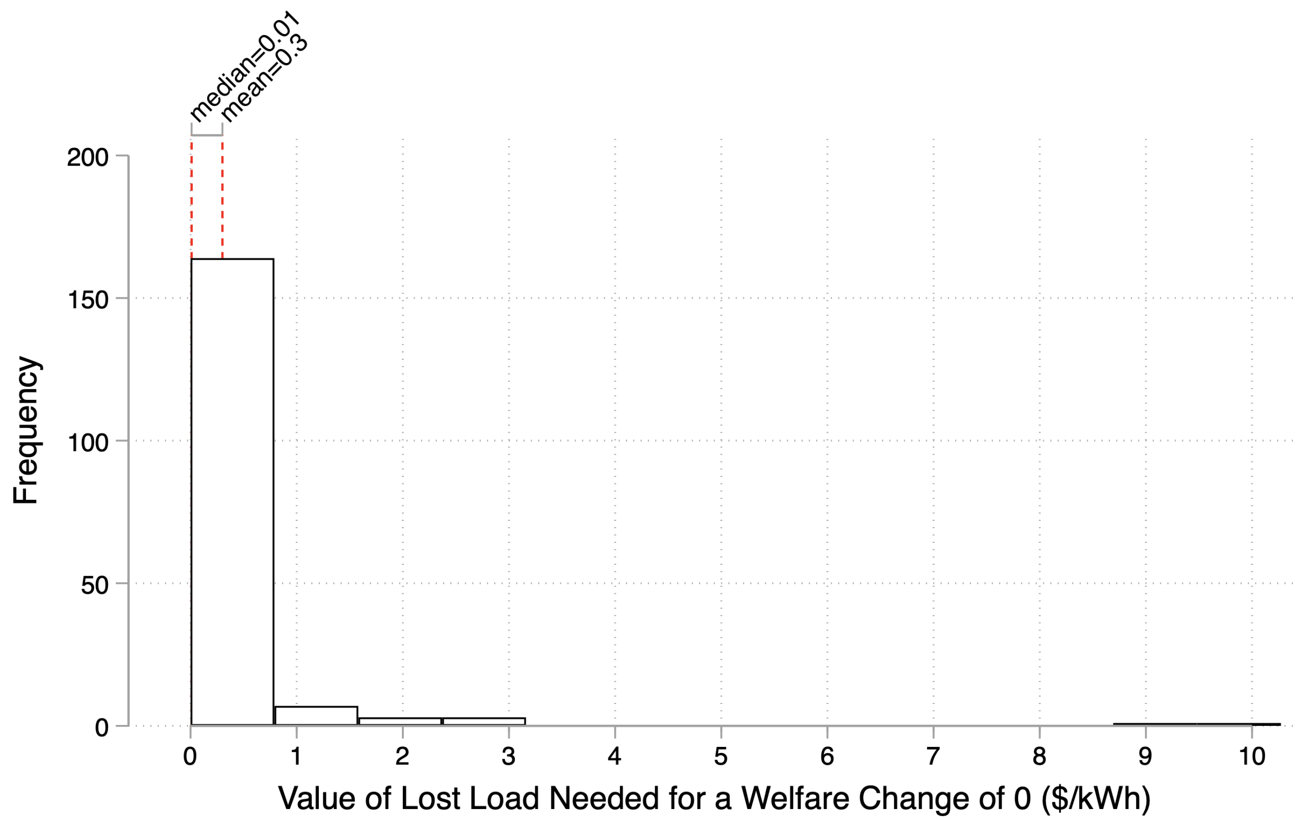
Notes: Wind and climate data is taken from weather stations operated by utilities in California and interpolated to each distribution circuit centroid using inverse distance weighting. Replacement costs are taken from the Zillow ZTRAX dataset. The underlying data consists of pairs of upwind, ever-downwind zip codes for selected days during January and April-December 2018-2020. Only days with wind speeds greater than 20 mph and relative humidity less than 30% are included in the sample. The outcome is a binary variable equal to 1 if there is an active shutoff in origin zip code o. The variables of interest are indicator variables for whether the total replacement cost in each destination zip code d is in one of ten bins on days when it lies downwind of zip code o. The excluded category is decile one, so all estimates represent the impact of threatened property values in each decile relative to the first decile. Controls include daily average temperature, wind speed, humidity, and maximum wind speed binned by septiles for each origin zip code o and destination zip code d. Standard errors are clustered at the high fire threat district by calendar week level.

Figure 11 Results by Decile of Mean Zip Code Replacement Cost



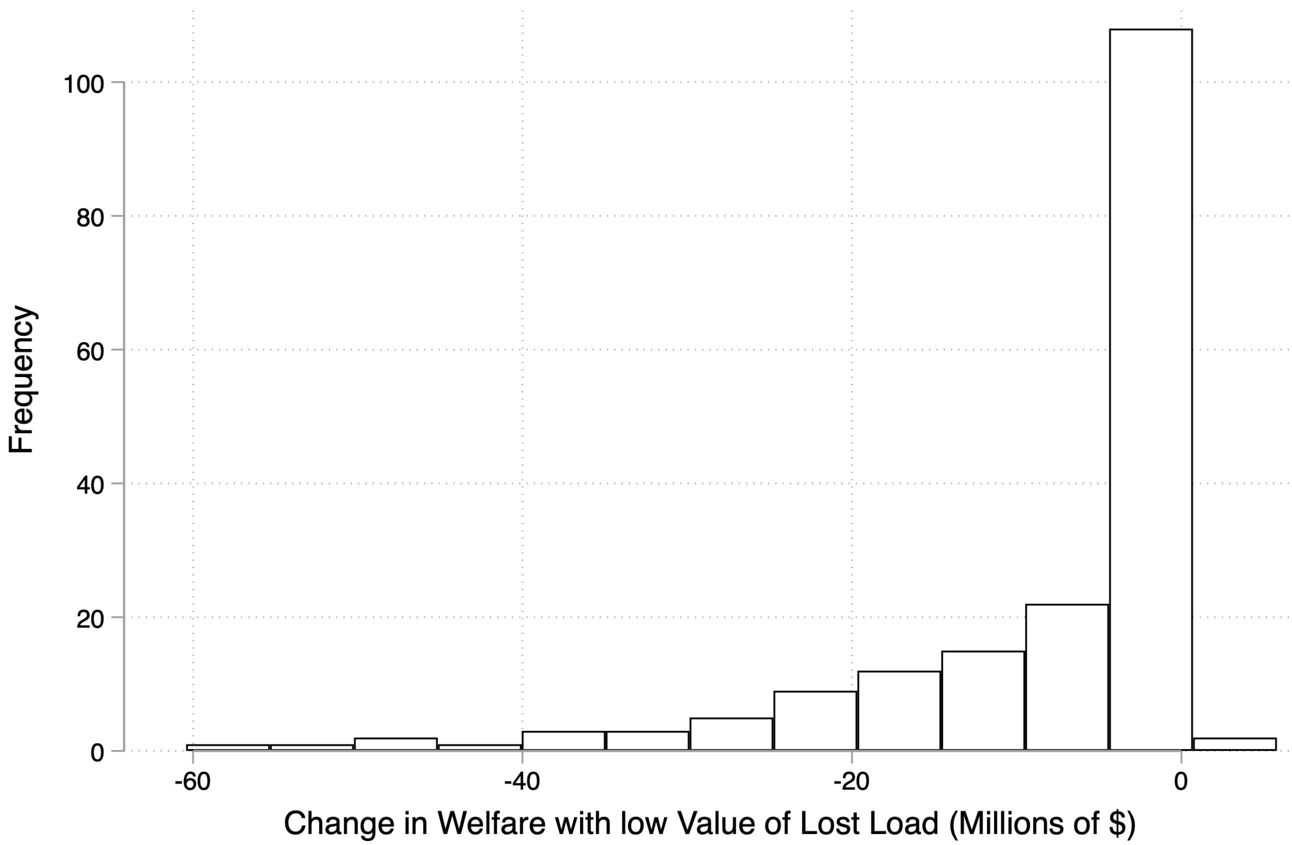
Notes: Wind and weather data is taken from weather stations operated by utilities in California and interpolated to each distribution circuit centroid using inverse distance weighting. Mean replacement costs are computed from the Zillow ZTRAX dataset for each zip code. The underlying data consists of pairs of upwind, ever-downwind zip codes for selected days during January and April-December 2018-2020. Only days with wind speeds greater than 20 mph and relative humidity less than 30% are included in the sample. The outcome is a binary variable equal to 1 if there is an active shutoff in origin zip code o. The variables of interest are indicator variables for whether the median replacement cost in each destination zip code d is in one of ten bins on days when it lies downwind of zip code o. The excluded category is decile one, so all estimates represent the impact of threatened property values in each decile relative to the first decile. Controls include daily average temperature, wind speed, humidity, and maximum wind speed binned by septiles for each origin zip code o and destination zip code d. Standard errors are clustered at the high fire threat district by calendar week level

Figure 12 Value of Lost Load Needed for a Welfare Change of 0 at Each Circuit



Notes: This figure plots the value of lost load, or consumer's maximum willingness to pay for electricity, required for the observed shift of liability onto utilities to be welfare neutral. Values are computed by computing equation **??** for each circuit operated by San Diego Gas and Electric between 2013 and 2020. The change in the likelihood of shutoff use at each circuit is taken from the estimated coefficients in figure A1. Ignition probabilities at each circuit are from San Diego Gas and Electric's internal model of circuit-level ignition risk. Energy usage at each circuit is computed from zip code level energy usage statistics reported by San Diego Gas and Electric. The author assigns energy usage to each circuit based on its share of total power line length in a given zip code. Future versions of this paper will use restricted access circuit-level energy use data. Damages are computed as the total commercial and residential property value within 20 kilometers of a circuit.

Figure 13 Short Run Welfare Change at Each Circuit with a Low Value of Lost Load



Notes: This figure plots the short run welfare change for San Diego Gas and Electric customers following a 2017 policy change which increased utilities' share of liability costs from power line-ignited fires. Values are computed by computing equation **??** for each circuit operated by San Diego Gas and Electric between 2013 and 2020. The change in the likelihood of shutoff use at each circuit is taken from the estimated coefficients in figure A1. Ignition probabilities at each circuit are from San Diego Gas and Electric's internal model of circuit-level ignition risk. Energy usage at each circuit is computed from zip code level energy usage statistics reported by San Diego Gas and Electric. The author assigns energy usage to each circuit based on its share of total power line length in a given zip code. Future versions of this paper will use restricted access circuit-level energy use data. Damages are computed as the total commercial and residential property value within 20 kilometers of a circuit.

Table 1 Circuit by Day Panel Summary Statistics

	Mean (SD)	Min	Max	N
PSPS Likelihood (%)	0.02	0	100	2,960,650
	(1.43)			
Temperature (C)	23.74	0	46	2,960,650
	(5.11)			
Precipitation (mm)	0.71	0	165	2,960,650
	(3.56)			
Humidity (%)	64.74	3	100	2,960,650
	(16.44)			
Max Wind Speed (m/s)	7.43	0	96	2,960,650
	(1.86)			
Energy Usage (Millions kWh)	1.04	0	6	2,960,650
	(0.90)			
Property Value (Billions of $)	5.03	0	52	2,960,650
	(2.99)			
Expected Damages (Millions of $)	2.02	0	20	2,960,650
	(3.30)			
Probability of Ignition (%)	0.01	0	2	2,960,650
	(0.09)			
Installation Year	1969.24	1928	2019	2,815,192
	(20.15)			
N Circuits	88.00			

Notes: Statistics are computed for a daily panel of distribution circuits operated by San Diego Gas and Electric between 2013 and 2020. Shutoff event use data was collected from post-event reports submitted to the California Public Utility Commission. Daily temperature, humidity, and maximum wind speed are collected at 10 minute intervals from weather stations operated by San Diego Gas and Electric along their power lines. Energy usage data was collected from zip code level reports published on the San Diego Gas and Electric website. Property values were collected from the Zillow ZTRAX database. The probability of ignition was collected from a public data submission by San Diego Gas and Electric to the California Public Utility Commission in their wildfire management plan. Expected damages is the product of circuit-level ignition probabilities and property values at each circuit. "N Circuits" refers to the number of circuits that ever experience a shutoff event between 2013 and 2020.

Table 2 Effect of Liability Regulation on Shutoff Probability and Customer Hours without Power

	Shutoff Indicator	Customer Hours
	(1)	(2)
Treated x Post 2017	5.27***	734.40***
	(1.56)	(212.43)
Controls	x	x
Circuit FE	x	x
Day FE	x	x
Mean of Dep. Var	0.07	1.33
Observations	50,809	50,809

Notes: All columns estimate the change in shutoff use following a reform that increased the share of liability born by firms. The outcome is a binary variable equal to 1 when there is an active shutoff event at circuit i on day t. Column 1 reports the estimate from a regression with no controls. Column 2 adds nonlinear controls for daily climate conditions at circuit i. Column 3 adds circuit fixed effects and column 4 adds month fixed effects. Post 2017 is a binary variable that takes a value of 1 for all days following November 30, 2017. Standard errors are clustered at the calendar week level to allow correlation in shutoff declaration across circuits within a week. The average value of the outcome conditional on wind speeds being in the highest septile observed during the sample period is also reported.

Table 3 Zip Code Characteristics by Downwind Status

	Mean (Not Downwind)	Mean (Downwind)	Difference (% of SD)
Replacement Cost (Billions)	5.4	5.6	-2.8***
Median Replace Cost (Thousands)	47.3	48.4	-4.1***
Share Disadvantaged	0.5	0.4	7.7***
Wildfire Hazard Potential	3.1	3.1	-0.9
Pop. Living in WUI (% of Total)	0.6	0.4	5.9***
Avgerage kWh Consumed	4,182.6	3,889.9	1.4***
N Houses	7,345.2	7,305.8	0.5
Total Population	20,039.4	19,705.6	1.6***
% White	58.8	60.2	-5.9***
% Black	3.2	3.1	1.0*
% Asian	6.1	5.6	4.9***
% Other Race	4.2	4.4	-4.8***
% Hispanic	27.7	26.7	5.0***
Employment	5,715.0	5,376.3	3.9***
Annual Payroll (Thousands)	264,031.3	253,718.2	1.7***
N Establishments	432.4	416.3	3.1***
N Medicare Beneficiaries	2,992.5	2,967.2	0.9*
N Medical Devices	111.1	113.4	-1.9***
Temperature(F)	38.1	38.4	-6.1***
Relative Humidity (%)	12.8	13.1	-3.2***

Notes: Wind and weather data is taken from weather stations operated by utilities in California and interpolated to each distribution circuit centroid using inverse distance weighting. Total replacement costs are taken from the Zillow ZTRAX dataset and converted to 2021 dollars. Median replacement costs are computed for each zip code from the parcel-level Zillow data. Disadvantaged community (DAC) status comes from the CalEnviroScreen 3.0 update and is computed as the share of total 2010 zip code population living in a census tract categorized as a DAC. Wildfire hazard potential is an index varying from 1 (low) to 5 (very high) which quantifies the relative potential for wildfire that may be difficult to control (Dillon and Gilbertson-Day (2020)). The share of 2010 population living within the wildland urban interface is computed using data from Radelof et al. (2017). All population data is from the California Department of Finance. Employment, payroll, and the number of establishments are collected from the 2013 Census zip code business patterns database. Medicare beneficiaries and the number of medical devices that rely on electricity are collected from the U.S. Department of Health and Human Services emPOWER Map 3.0.

Table 4 Zip Code Pair Panel Summary Statistics

	Mean (SD)	Min	Max	N
N Shutoffs	0.090	0	46	523,779
	(0.85)			
Shutoff(0/1)	0.025	0	1	523,779
	(0.16)			
Replacement Cost (Billions)	7.198	0	37	523,779
	(6.55)			
Median Replace Cost (Thousands)	52.090	0	223	523,779
	(27.30)			
DAC Status	0.145	0	1	523,779
	(0.35)			
DW DAC Status	0.143	0	1	523,779
	(0.35)			
Temperature(F)	35.450	31	72	523,779
	(4.17)			
Humidity(%)	5.470	0	30	523,779
	(7.16)			
Wind Speed (mph)	24.124	20	88	523,779
	(4.15)			
Downwind Temp. (F)	37.533	27	117	505,825
	(7.96)			
Downwind Humid. (%)	7.422	0	100	505,825
	(10.28)			
Downwind Wind Speed (mph)	22.093	2	88	333,532
	(5.18)			
Downwind WHP Share	3.007	0	5	523,779
	(1.00)			
Downwind WUI Pop Share	0.003	0	0	523,779
	(0.02)			
Energy Use (GWh)	8.112	0	833	500,294
	(27.12)			
Downwind Energy Use (GWh)	8.231	0	833	516,768
	(28.97)			
N Zip Codes	539.000			

Notes: Wind and weather data is taken from weather stations operated by utilities in California and interpolated to each distribution circuit centroid using inverse distance weighting. Total replacement costs are taken from the Zillow ZTRAX dataset and converted to 2021 dollars. Median replacement costs are computed for each zip code from the parcel-level Zillow data. Disadvantaged community (DAC) status comes from the CalEnviroScreen 3.0 update and is computed as the share of total 2010 zip code population living in a census tract categorized as a DAC. The number of zip codes denotes the total number of zip codes that ever experience a shutoff during 2018-2020.

Table 5 Effect of Total Zip Code Replacement Cost on the Probability of a Shutoff

	Total Value (1)	Mean Value (2)
Value x DW	0.02***	0.04**
	(0.01)	(0.02)
DW	0.04**	0.04**
	(0.02)	(0.02)
Controls	x	x
Pair FE	x	x
Day FE	x	x
Mean of Dep. Var	0.025	0.025
1 SD Effect	0.286	0.224
Bootstrap 95% CI	[0.005,0.038]	[0.004,0.078]
Observations	505,656	505,656

Notes: Wind and weather data is taken from weather stations operated by utilities in California and interpolated to each distribution circuit centroid using inverse distance weighting. Total replacement costs are taken from the Zillow ZTRAX dataset and converted to 2021 dollars. The underlying data consists of pairs of upwind, ever-downwind zip codes for every day during January and April-December 2018-2020. The outcome is a binary variable equal to 1 if a shutoff event is active in origin zip code o. Value measures the total cost of replacing structures in each destination zip code d and DW is a binary variable equal to 1 when zip code d is downwind of zip code o on day t. Controls include daily average temperature, relative humidity, precipitation, and maximum wind speed binned by septiles for each origin zip code o and destination zip code d. Standard errors are clustered at the high fire threat district by calendar week level.

Table 6 Robustness Analysis Estimates

	Main Model (1)	WUI Controls (2)	Usage Controls (3)	5 Day Treatment (4)
Value x DW	0.02^{***}	0.02^{**}	0.02^{**}	0.02^{**}
	(0.01)	(0.01)	(0.01)	(0.01)
DW	0.04^{**}	0.09^{**}	0.10^{**}	0.02
	(0.02)	(0.04)	(0.05)	(0.01)
Controls	x	x	x	x
Pair FE	x	x	x	x
Day FE	x	x	x	x
Mean of Dep. Var	0.025	0.025	0.025	0.025
1 SD Effect	0.286	0.224	0.264	0.198
Observations	505,656	505,656	498,324	505,563

Notes: Column 1 replicates the main estimate from column 4 of table 5. Column 2 adds controls for the share of total population in zip code d living in the Wildland Urban Interface. Column 3 adds controls for monthly zip code electricity usage in zip codes o and d separately. Column 4 assigns a destination zip code (d) as downwind if it is downwind anytime in the next 5 days (from t to $t+5$). Wind and weather data is taken from weather stations operated by utilities in California and interpolated to each distribution circuit centroid using inverse distance weighting. Total replacement costs are taken from the Zillow ZTRAX dataset and converted to 2021 dollars. The underlying data consists of pairs of upwind, ever-downwind zip codes for every day during September-December 2019-2020. The outcome is a binary variable equal to 1 if a shutoff is active in origin zip code o. Value measures the total structure replacement cost in each destination zip code d and DW is a binary variable equal to 1 when zip code d is downwind of zip code o on day t. Standard errors are clustered at the high fire threat district by calendar week level.

Appendix A: Further Results and Robustness Checks

A.I Extensive Margin

Estimates by Ignition Risk

For this analysis, I measure ignition risk using San Diego Gas and Electric's modelled probability of ignition at each circuit as reported in its 2020 Wilfire Mitigation Plan. This measure captures the likelihood of ignition at each circuit operated by San Diego Gas and Electric as of 2020. Unlike the measure of ignition risk used in the main analysis, the modelled probabilities are *ex-post* because they reflect conditions after the 2017 policy change.

I bin the circuits by ignition probability into 11 categories: one category for circuits with an ignition probability of 0 and one category for each decile of the ignition probability conditional on it being positive. Figure A1 plots the coefficients from a modified version of equation 4 where treatment is interacted with the 11 mutually exclusive indicator variables representing different risk percentiles. Since the 0 ignition probability category is excluded, each coefficient reflects the treatment effect at a specified decile of ignition risk relative to the treatment effect at circuits with no ignition risk. The coefficients in figure A1 increase with wildfire risk, suggesting that San Diego Gas and Electric's increase in precaution following the policy was largely concentrated at circuits with high ignition risk. At the highest risk circuits, power shutoffs increased (on average) by around 12 percentage points, a more than 170-fold increase relative to the pre-period mean.

Precaution and Climatic Conditions

In order to test how changes in daily climate conditions influence precautionary activity, I use the daily panel of distribution circuits operated by San Diego Gas and Electric between 2013 and 2020. I examine how the change in shutoff use following the 2017 rule change differs by daily maximum wind speed, relative humidity, temperature, and cumulative precipitation. Based on the IOUs' explanation of ignition risk in their Wildfire Mitigation Plans, maximum wind speed and humidity should be particularly important predictors of power shutoff use because fire risk is elevated during periods of high wind speed and low humidity. Equation 9 presents how I model the relationship between shutoff declaration (y_{imt}) and climate characteristics using a fixed effects framework with climate variables binned into septiles.

$$y_{imt} = \beta_0 + \sum_{k=1}^{7} \beta_{2k} X_{kimt} + \sum_{k=1}^{7} \beta_{3k} X_{kimt} Post_{mt} + \gamma_i + \delta_m + \nu_t + \varepsilon_{imt} \tag{9}$$

Where X_{kimt} is a vector of climate variables including maximum daily wind speed, daily average relative humidity, cumulative precipitation, and temperature each binned into septiles. The model conditions on fixed effects for each circuit (γ_i), month (δ_m), and calendar day (ν_t). Finally, the coefficients of interest, β_{3k}, capture how the percentage point change in power shutoff declaration following the 2017 rule change varies by daily climate conditions. Standard errors are clustered at the week by high fire threat district zone level to allow for correlation in utility decision making across all circuits with similar ignition risk during the same week.

Estimates by Daily Weather Conditions

Figure A2 plots the estimates from Equation 9 by septile for each of the four daily climate variables (maximum wind speed, relative humidity, temperature, and cumulative precipitation). In Panel (a) the coefficients imply that the increase in shutoff declaration following the 2017 rule change is increasing in maximum daily wind speed, with power shutoffs increasing by approximately 0.6 percentage points on days with wind speeds in the top septile. Panel (b) shows that San Diego Gas and Electric's increase in shutoff event use following the 2017 rule change was also decreasing in relative humidity. These results are reassuring, since utilities present wind speed and humidity as two primary drivers of ignition risk in documents submitted to the regulator. Panel (c) provides evidence that San Diego Gas and Electric's power shutoff event use increased more on cooler days following the 2017 rule change. Finally, Panel (d) shows that there is no clear relationship between daily cumulative precipitation and shutoffs.

A.II Intensive Margin

Pre-Post Difference in Firm Response to Downwind Liability

Despite the reliance on daily wind patterns in the empirical model to create exogenous variation in liability that a firm faces downwind of its power lines, the estimates from this paper could be biased if an unobserved factor exists that is correlated with "downwindedness", liability, and power shutoffs. I assess this concern by examining how utilities' use of power shutoffs responds to downwind liability after versus before the 2017 ruling which dramatically increased utilities' expected liability costs. If utilities' use of power shutoffs in response to higher downwind structure replacement costs is driven by liability, then one should expect that shutoff use only responds to liability after the 2017 ruling.

To estimate the pre-post 2017 difference in the relationship between power shutoffs and downwind liability, I modify equation 7 to include a binary variable which equals one for all years after 2017.

$$\begin{aligned} y_{jodt} = &\beta_1 Value_{jd} \times DW_{jodt} \times Post_t + \beta_2 Value_{jd} \times DW_{jodt} + \beta_3 Value_{jd} \times Post_t + \\ &\beta_4 DW_{jodt} \times Post_t + \beta_5 Value_{jd} + \beta_6 DW_{jodt} + \beta_7 X_{jot} + \beta_8 X_{jdt} + \nu_{od} + \delta_t + \gamma_{jt} + \varepsilon_{odt} \end{aligned} \tag{10}$$

Where all variables are defined as in section V.. The coefficient of interest, β_1, measures the differential change in how firms' shutoff use responds to downwind liability after the 2017 regulatory decision. Just as in the main empirical specification described in section V., the controls include average daily wind speed, temperature, specific humidity, and maximum wind speed.

Table A1 presents the results from this modified empirical specification with either a binary indicator variable equal to one if there is an active shutoff in origin zip code o on day t (Column 1) or the number of customer hours without power in origin zip code o on day t (Column 2) as the outcome variables. The estimate in column one suggests that, after 2017, utilities are 0.03 percentage points more likely to declare a power shutoff when total downwind liability increases by 10%. Similarly, the estimate in column two suggests that, after 2017, the number of customer hours without power is (on average) 304 hours higher when total downwind liability increases by 10%. Importantly, downwind liability does not appear to be correlated with power shutoff use prior to the 2017 regulatory change which increased utilities' expected liability for power line-ignited fire damages.

Analysis Using Local Variation in Replacement Cost

To alleviate the concern that the estimates of potential liability's effect on shutoff use may be spuriously driven by the replacement cost of structures that are not close to a distribution circuit, I estimate a modified version of equation 7 which uses local variation in wind direction around each circuit. Figure A4 provides an example of the methodology for this circuit-level analysis. As shown in figure, A4, I create 10 and 20 kilometer buffers around each circuit, and divide each buffer into quarters to create 8 potentially downwind regions around each circuit. I then compute the total and median structure replacement cost in each region and use daily variation in wind direction and speed to generate changes in potential liabilities across days just as in the zip code analysis. Finally, I estimate a modified version of 7 at the circuit level that controls for daily weather conditions at each circuit, circuit-region fixed effects, utility-year fixed effects, and calendar day fixed effects.

Table A3 reports the results of this analysis. The coefficient in column 2 implies that the likelihood of a shutoff increases by 0.05 pp (208% relative to the mean) when the median downwind structure replacement cost increases by 10%. Reassuringly, this effect is very similar to the effect of potential liability on precaution from the zip code analysis.[32]

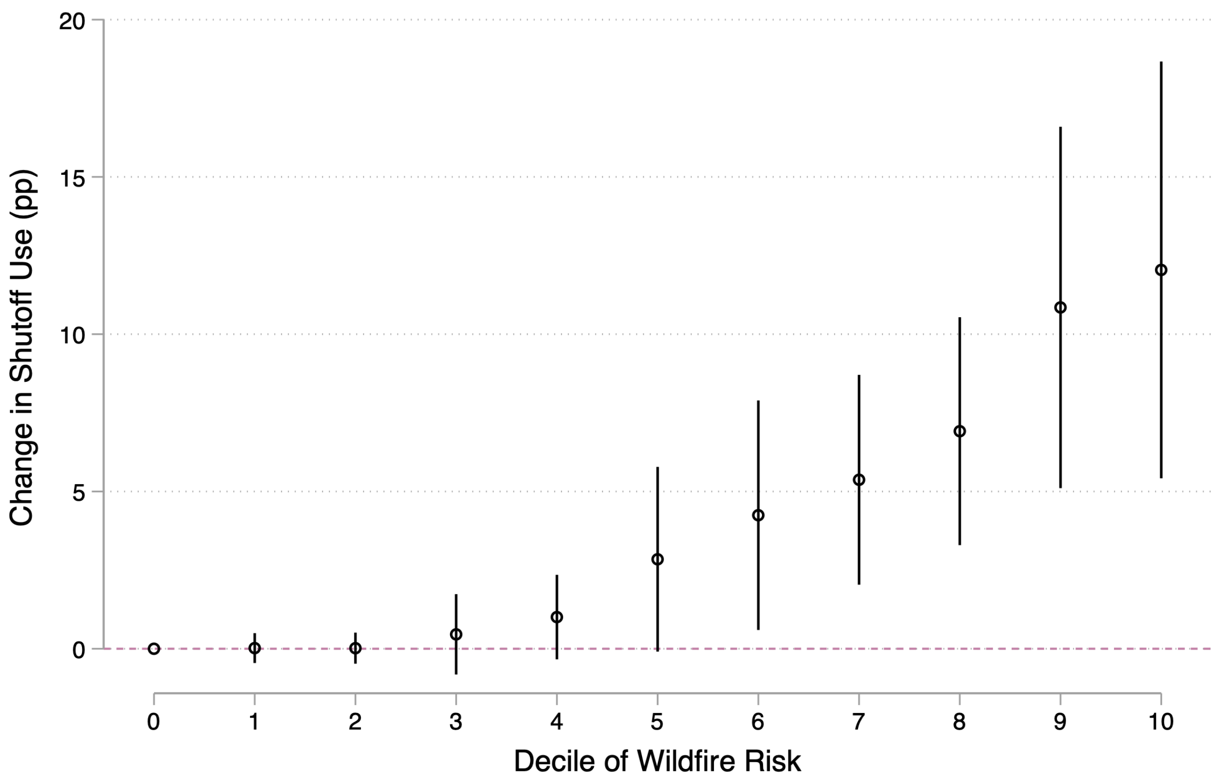
Estimates by Zip Code Socioeconomic Status

Since I find that utilities use shutoffs more in regions with higher structure replacement cost, which is positively correlated with socioeconomic status, there could be distributional consequences associated with liability regulation. For example, utilities may be more likely to use a shutoff in a low socioeconomic status community in response to higher potential liability in a downwind high socioeconomic status community. To test for distributional impacts, I re-estimate equation 7 and decompose the effect by whether the origin or destination zip code has an above-average share of its 2010 population living in a census tract defined as a disadvantaged community by the California state government.

Table A4 reports the estimated relationship between potential liability and shutoff use by socioeconomic status. Row 1 reports the effect when a high socioeconomic status community lies downwind of a low socioeconomic status community, while row 2 reports how shutoffs respond to potential liability when a low socioeconomic status community lies downwind of a high socioeconomic status community. The estimates in rows 3 and 4 reflect the relationship between shutoffs and liability when both the upwind or downwind zip codes are high socioeconomic status. The results suggest that the relationship between potential liability and shutoff use is driven by zip codes of high socioeconomic status, providing no evidence of distributional consequences in this setting.

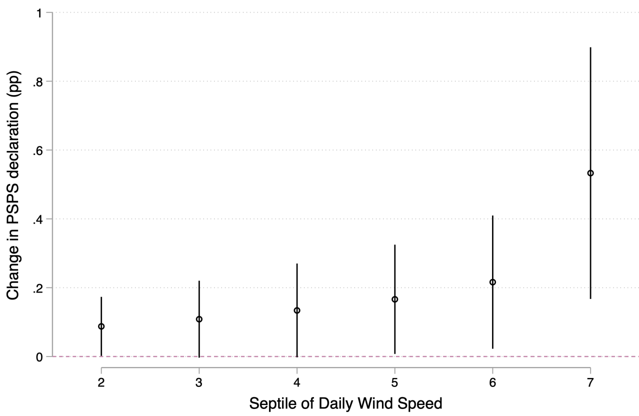
[32] The effect in column 1 is no longer significant, but this is unsurprising because I had to drop all of the parcels in the ZTRAX data that did not have geocoordinates or that were geocoded to zip code centroids. As a result, the total replacement cost is no longer accurate. I am in the process of manually geocoding these parcels.

Figure A1 Effect of 2017 Rule Change on Shutoffs by Circuit Ignition Risk

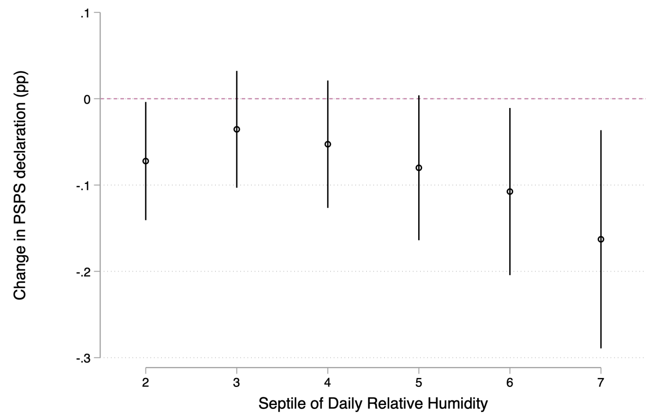


Notes: Estimated effect on shutoff use (in percentage points) of shifting liability for power line-ignited fire damages from electricity consumers to utilities by decile of circuit ignition risk. Coefficient estimates are plotted with their 95% confidence intervals. Each coefficient is interpreted relative to the estimated effect at circuits with no ignition risk. The figure is created by estimating a version of regression model 7 where treatment is interacted with binned circuit ignition risk on a daily panel of distribution circuits operated by San Diego Gas and Electric between 2013 and 2020. Ignition risk is from an internal model created by San Diego Gas and Electric. Standard errors are clustered at the high fire threat district by calendar week level to allow for correlation in shutoff use across circuits with similar ignition risk during the same week.

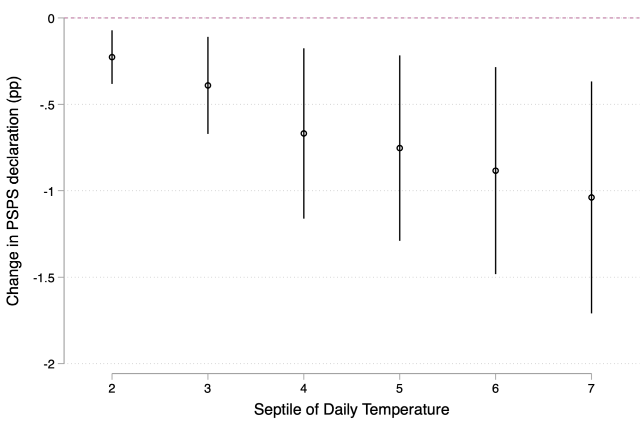
Figure A2 Effect of 2017 Rule Change on Shutoff Declaration by Daily Weather Conditions



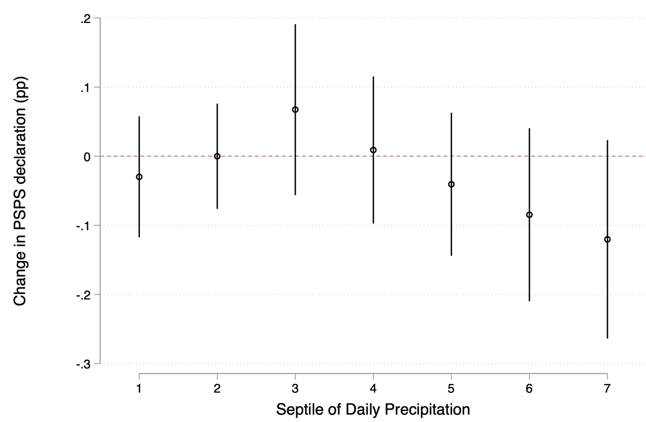
(a) Maximum Wind Speed



(b) Relative Humidity



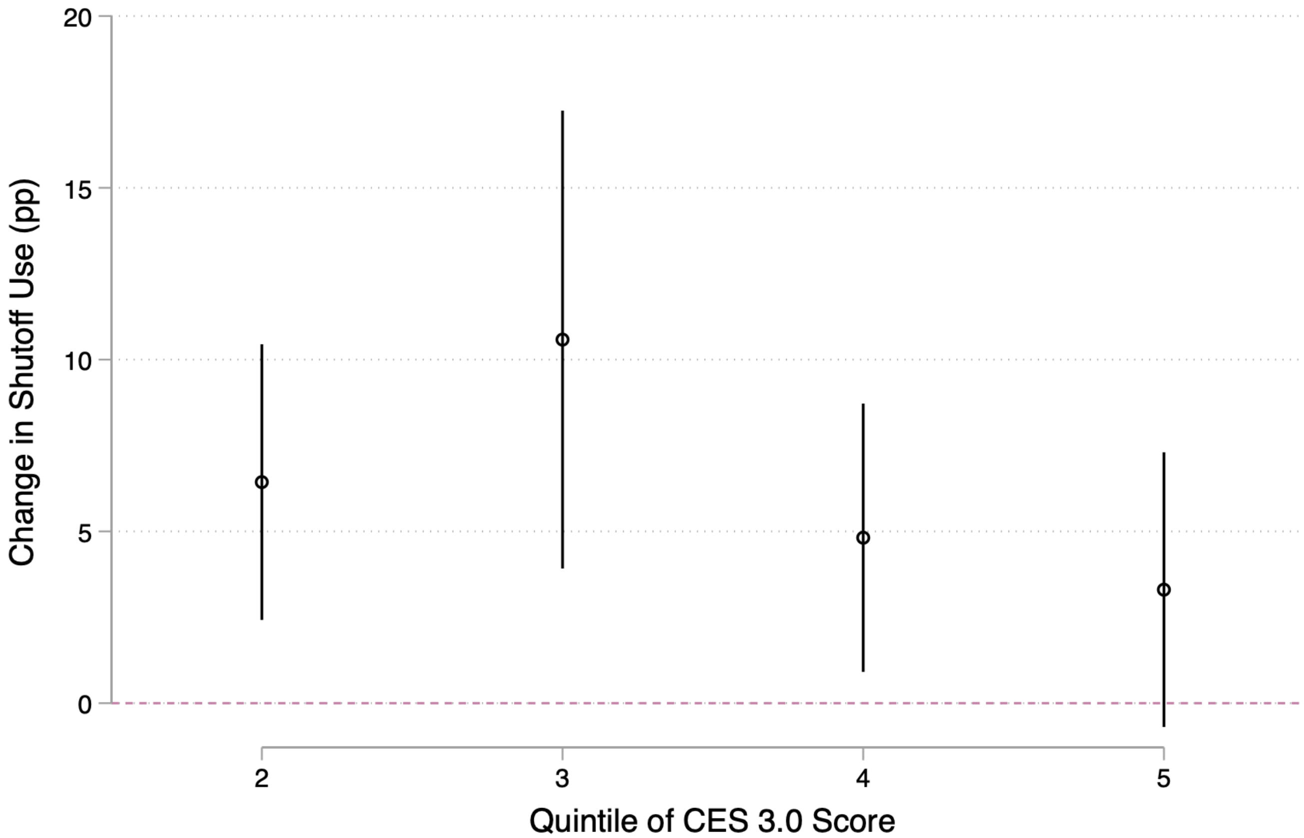
(c) Temperature



(d) Cumulative Precipitation

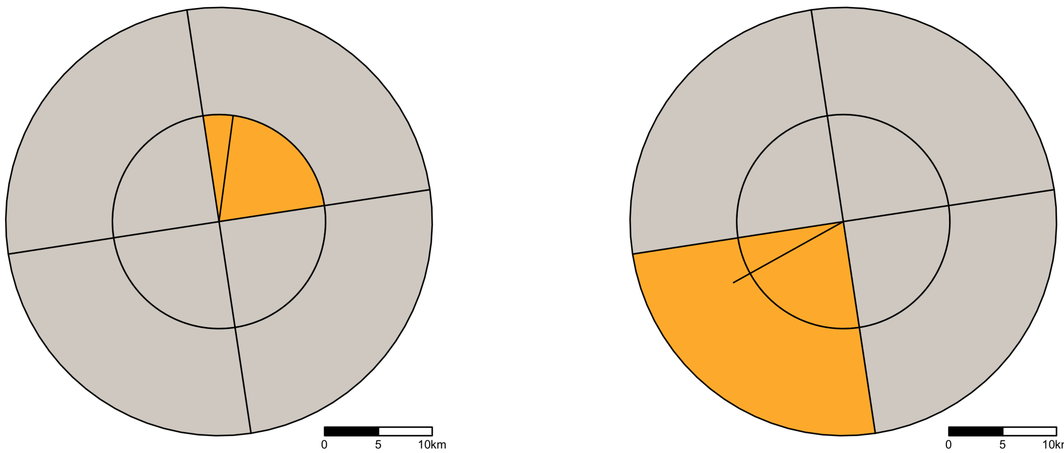
Notes: Estimated effect on shutoff use (in percentage points) of shifting liability for power line-ignited fire damages from electricity consumers to utilities by septile of daily climate conditions. Coefficient estimates are plotted with their 95% confidence intervals. Each coefficient is interpreted relative to the estimated effect on days in the lowest septile of each climate condition. The figure is created by estimating a version of regression model 7 where treatment is interacted with binned climate conditions on a daily panel of distribution circuits operated by San Diego Gas and Electric between 2013 and 2020. Daily climate conditions are from weather stations operated by San Diego Gas and Electric along their power lines. Standard errors are clustered at the high fire threat district by calendar week level to allow for correlation in shutoff use across circuits with similar ignition risk during the same week.

Figure A3 Effect of 2017 Rule Change on Shutoff Declaration by Socioeconomic Status



Notes: Estimated effect on shutoff use (in percentage points) of shifting liability for power line-ignited fire damages from electricity consumers to utilities by quintile CalEnviroscreen (CES) 3.0 score. The CES score is a composite index used by the California state government to rank census tracts by pollution exposure, demographic characteristics, and socioeconomic characteristics. The top 25% of census tracts based on the CES 3.0 score are defined as disadvantaged. Coefficient estimates are plotted with their 95% confidence intervals. Each coefficient is interpreted relative to the estimated effect at circuits in census tracts that are the least disadvantaged (lowest CES score). The figure is created by estimating a version of regression model 7 where treatment is interacted with binned CES scores on a daily panel of census tracts containing distribution circuits operated by San Diego Gas and Electric between 2013 and 2020. Daily climate conditions are from weather stations operated by San Diego Gas and Electric along their power lines. Standard errors are clustered at the high fire threat district by calendar week level to allow for correlation in shutoff use across circuits with similar ignition risk during the same week.

Figure A4 Example of Daily Variation in Replacement Cost at the Circuit Level



(a) Sep. 23, 2019

(b) Sep. 24, 2019

Notes: Daily variation in which regions are downwind of a circuit operated by Pacific Gas and Electric on September 23 and 24, 2019. The centroid of the circuit is the center of the circle, and it is encircled by 10 and 20 kilometer buffers. Each buffer is divided into 4 regions, creating 8 possible downwind regions for each day between 2018-2020. Yellow shaded regions are downwind of the circuit on each day, while the tan regions are not downwind. The black line indicates which direction the wind is blowing and its length indicates how strongly the wind is blowing. The black line is created using maximum daily wind speed and direction, an estimate of how far the wind can carry a lit ember from Albini, Alexander and Cruz (2012), and several trigonometric identities.

Table A1 Pre/Post Policy Difference in the Effect of Replacement Costs on Shutoff Probability

	Customer Hours (1)
Value x DW x Post 2017	227.80**
	(112.95)
Value x DW	36.94
	(25.91)
DW x Post 2017	2072.71*
	(1092.88)
DW	458.77
	(348.25)
Controls	x
Pair FE	x
Utility x Year FE	x
Day FE	x
Mean of Dep. Var	208.65
Observations	148,944

Notes: Estimates are from a regression of total customer hours of lost power during a shutoff at circuit i on day t on the total zip code replacement cost in regions that are downwind of circuit i on day t. Both regressions control for septiles of maximum wind speed, maximum temperature, average relative humidity, and cumulative precipitation at circuit i on day t. Furthermore, both regressions include calendar day and circuit-downwind region pair fixed effects. Each circuit has 8 potentially downwind regions as shown in figure A4. Standard errors are clustered at the high fire threat district by calendar week level.

Table A2 Effect of Replacement Costs on Shutoff Probability by Sample

	Main Estimate (1)	Full Sample (2)
Value x DW	0.026***	0.004***
	(0.003)	(0.000)
DW	0.071***	0.013***
	(0.006)	(0.001)
Controls	x	x
Pair FE	x	x
Week FE	x	x
Mean of Dep. Var	0.025	0.004
1 SD Effect	0.341	0.037
Observations	505,656	7,561,524

Notes: Estimates are from a regression of total customer hours of lost power during a shutoff at circuit i on day t on the total zip code replacement cost in regions that are downwind of circuit i on day t. Both regressions control for septiles of maximum wind speed, maximum temperature, average relative humidity, and cumulative precipitation at circuit i on day t. Furthermore, both regressions include calendar day and circuit-downwind region pair fixed effects. Each circuit has 8 potentially downwind regions as shown in figure A4. Standard errors are clustered at the high fire threat district by calendar week level.

Table A3 Effect of Replacement Costs on Shutoff Probability at the Circuit Level

	Shutoff Indicator (1)	Customer Hours (2)
Value x DW	0.05**	269.25*
	(0.02)	(142.88)
Controls	x	x
Pair FE	x	x
Day FE	x	x
Mean of Dep. Var	0.024	450.459
1 SD Effect	1.788	9,646.735
Observations	105,273	105,273

Notes: Estimates are from a regression of a binary variable equal to one if there is an active shutoff event at circuit i on day t on the total (column 1) or median (column 2) replacement cost in regions that are downwind of circuit i on day t. Both regressions control for septiles of maximum wind speed, maximum temperature, average relative humidity, and cumulative precipitation at circuit i on day t. Furthermore, both regressions include calendar day and circuit-downwind region pair fixed effects. Each circuit has 8 potentially downwind regions as shown in figure A4. Standard errors are clustered at the high fire threat district by calendar week level.

Table A4 Effect of Total Replacement Cost on the Probability of a Shutoff by Socioeconomic Status

	Total Value (1)
DAC_o x Value x DW	-0.015
	(0.015)
DAC_d x Value x DW	-0.004
	(0.019)
DW	0.041**
	(0.018)
Value x DW	0.024***
	(0.009)
Controls	x
Pair FE	x
Day FE	x
Mean of Dep. Var	0.025
1 SD Effect	-0.191
Observations	505,656

Notes: Wind and weather data is taken from weather stations operated by utilities in California and interpolated to each distribution circuit centroid using inverse distance weighting. Total replacement costs are taken from the Zillow ZTRAX dataset and converted to 2021 dollars. Disadvantaged community status is taken from the CalEnviroScreen 2018 data release. The underlying data consists of pairs of upwind, ever-downwind zip codes for every day during January and April-December 2018-2020. The outcome is a binary variable equal to 1 if a shutoff event is active in origin zip code o. Value measures the total cost of replacing structures in each destination zip code d and DW is a binary variable equal to 1 when zip code d is downwind of zip code o on day t. I code an origin zip code as a disadvantaged community if more than 50% of its population lives in a census tract designated as a DAC by the California government. Controls include daily average temperature, relative humidity, precipitation, and maximum wind speed binned by septiles for each origin zip code o and destination zip code d. Standard errors are clustered at the high fire threat district by calendar week level.

Appendix B: Heterogeneous Treatment Effects

I use observed data on power shutoff use from three large investor owned utilities in California called Pacific Gas and Electric, Southern California Edison, and San Diego Gas and Electric to estimate the relationship between potential liability and precaution. Because each utility has different exposure to ignition risk in its service territory and varying experience with ignition prevention historically, there are likely heterogeneous treatment effects across firms in the sample. For example, over half of Pacific Gas and Electric's service territory lies within regions of heightened ignition risk while 35% of San Diego Gas and Electric's service territory is in high risk areas.[33]

Recent econometric research has shown that in settings with heterogeneous treatment effects (like in the case of the California's electric utility industry), two-way fixed effects or difference in differences estimators identify a weighted average of treatment effect parameters which may not correspond to the overall average treatment effect on the treated (Sun and Abraham (2020), de Chaisemartin and D'Haultfœuille (2020), Borusyak, Jaravel and Spiess (2023), Goodman-Bacon (2021)). Furthermore, recent work has pointed out that many environmental policies have different effects across units and over time (Steigerwald, Vazquez-Bare and Maier (2021)).

Since heterogeneity across firms is the primary source of treatment effect heterogeneity in this setting, I re-estimate equation 7 by firm. As a result, the regression model identifies three parameters of interest: the response of shutoffs to liability for Pacific Gas and Electric, San Diego Gas and Electric, and Southern California Edison. Following Steigerwald, Vazquez-Bare and Maier (2021), the overall effect of liability on shutoff use can be estimated by taking a weighted average of the three coefficients of interest, where each weight is the group's proportion of the sample.

$$\hat{\beta_\lambda} = \sum_g \lambda_g \beta_{FE}^{\hat{g}}$$

Where λ_g is the fraction of observations in the sample that are part of group g.[34] Since the cluster-robust variance estimator is sensitive to heterogeneity in between-cluster variation (Carter, Schnepel and Steigerwald (2017)), I compute the effective number of clusters using the *summclust*

[33]See Pacific Gas and Electric and San Diego Gas and Electric's 2020 wildfire mitigation plans for a detailed breakdown of their service territories by ignition risk.

[34]In this setting the weights are 0.39 (Pacific Gas and Electric), 0.39 (San Diego Gas and Electric), and 0.22 (Southern California Edison).

Stata command. There are 20 effective clusters in this setting, suggesting that using the wild cluster bootstrap procedure recommended by Cameron, Gelbach and Miller (2008) is warranted. I report the bootstrapped 95% confidence interval for the overall effect of potential liability on shutoff use in table B1.

The results of the heterogeneity analysis are presented in table B1. Columns 1 and 2 report estimates for the effect of total and average structure replacement costs on the likelihood of a power shutoff. The coefficients of interest in columns 1 through 3 suggest that most of the relationship between potential liability and shutoff use is driven by San Diego Gas and Electric and (to a lesser extent) Pacific Gas and Electric. The overall effect of structure replacement cost on shutoffs is reported as the "Pooled Estimate". Reassuringly, the pooled estimates are of a similar magnitude as the main estimates in table 5 and both are statistically different from zero at the 95 percent confidence level.

Table B1 Effect of Structure Replacement Cost on Shutoffs by Firm

	Total Value	Mean Value
	(1)	(2)
Value x DW x PGE	0.01	0.01
	(0.01)	(0.02)
Value x DW x SDGE	0.04***	0.15***
	(0.01)	(0.04)
Value x DW x SCE	-0.01	-0.06
	(0.02)	(0.04)
DW x PGE	-0.01	-0.01
	(0.02)	(0.02)
DW x SDGE	0.07**	0.09**
	(0.03)	(0.03)
DW x SCE	0.04	0.03
	(0.03)	(0.03)
Controls	x	x
Pair FE	x	x
Day FE	x	x
Mean of Dep. Var	0.025	0.025
Pooled Estimate	0.016	0.048
Bootstrap 95% CI of Pooled Estimate	[0.0002,0.0304]	[0.0039,0.0922]
Observations	505,656	505,656

Notes: Wind and weather data is taken from weather stations operated by utilities in California and interpolated to each distribution circuit centroid using inverse distance weighting. Total replacement costs are taken from the Zillow ZTRAX dataset and converted to 2021 dollars. The underlying data consists of pairs of upwind, ever-downwind zip codes for every day during January and April-December 2018-2020. The outcome is a binary variable equal to 1 if a shutoff event is active in origin zip code o. Value measures the total cost of replacing structures in each destination zip code d and DW is a binary variable equal to 1 when zip code d is downwind of zip code o on day t. The variables PGE, SDGE, and *Southern California Edison* equal one for observations from Pacific Gas and Electric, San Diego Gas and Electric, and Southern California Edison. Controls include daily average temperature, relative humidity, precipitation, and maximum wind speed binned by septiles for each origin zip code o and destination zip code d. Standard errors are clustered at the high fire threat district by calendar week level. The "Pooled Estimate" is a weighted average of the estimates in rows 1, 2, and 3 where the weights are the utility's proportion of observations in the sample. Since there are 20 effective clusters in this analysis, I construct a bootstrapped 95% confidence interval for the pooled estimate following Cameron, Gelbach and Miller (2008).

Appendix C Derivation of Welfare Condition

This section presents the change in social welfare from a non-marginal change in the rate at which investor owned utilities can recover liability costs through retail electricity prices (ν) using the conceptual framework from section III.. I compute the total change in welfare as the sum of the changes in consumer and producer surplus from the change in liability costs recovered through retail electricity rates.

$$\Delta Welfare = \Delta PS + \Delta CS$$

As explained in section VI., consumer surplus is composed of consumers' use value of electricity when a shutoff does not occur $((\bar{p} - p)Q(1 - P(L = 1 \mid \nu))$, the payments for electricity use that they make to utilities $(\beta(\gamma k + \nu')(1 - P(L = 1 \mid \nu))$, and rental payments from utilities for defensive capital investments $(r(k'(\nu) - (1 - \delta)k))$.

$$CS = (\bar{p} - p)Q(1 - L) - \beta(\gamma k'(\nu) + \nu)(1 - L) + r(k'(\nu) - (1 - \delta)k) \tag{11}$$

Where $\bar{p}$ is consumers' maximum willingness to pay for electricity, p is the retail price of electricity consumers face, L is a binary variable equal to one if a utility declares a power shutoff, Q is the quantity of electricity demanded by consumers, β is the discount factor, γ is the allowable rate of return on capital (exogenously set by the regulator), k are defensive capital investments, r is the rate at which utilities rent defensive capital from households, and δ is the defensive capital depreciation rate. When the regulator changes the rate at which liability costs are recovered through retail electricity prices, consumer surplus is affected in three ways. First, as documented in this paper, utilities alter their use of power shutoffs in response to changes in the amount of liability costs the regulator allows them to recover through retail rates, affecting reliability and consumers' use-value of electricity. Second, changes in recoverable liability costs affect utilities' incentive to invest in defensive capital, indirectly altering both the retail price of electricity that consumers pay and the rental payments that households receive. Finally, changes in recoverable liability costs directly affect retail electricity prices that consumers pay.

Producer surplus is determined by firms' profit functions. Firms make defensive capital rental payments $(r(k'(\nu) - (1-\delta)k))$, receive a fraction of their revenue when they declare a power shutoff $(\phi\beta\gamma k L(\nu))$, and receive revenue net of liability costs when they do not declare a shutoff $(\beta(\gamma k + \nu - \theta(k'(\nu))\bar{d})(1 - L(\nu))$.

$$PS = -r(k'(\nu) - (1-\delta)k) + \phi\beta\gamma k L(\nu,\omega) + \beta(\gamma k + \nu - \theta(k'(\nu))\bar{d})(1 - L(\nu,\omega))$$

Where $\phi \in [0,1]$ is the fraction of revenue that utilities can recover (by exerting market power in wholesale electricity markets) when they declare a power shutoff, $\theta(k')$ is the probability of a fire ignition from a power line, and $\bar{d}$ is the total value of structures that would be threatened by a power line-ignited fire. The regulator's choice of ν affects producer surplus in four ways. First, the amount of liability cost recoverable through electricity rates changes firms' rental payments to consumers by altering the level of defensive capital investment. Since the level of defensive capital investment directly influences the probability of fire ignition, changing ν also affects expected damages from a fire ignition. Since utilities are liable for expected damages from power line-ignited fires in this setting, the regulator's choice of ν affects their total liability costs. The level of recoverable liability cost also directly influences firms' revenues by changing retail electricity prices. Finally, firm's use of power shutoffs also responds to changes in liability costs that are recoverable through electricity rates.

In the conceptual framework firms' shutoff decision depends on how much of liability costs are recoverable through retail prices (ν) and random weather shocks (ω), reflecting their environmental and economic incentives. After taking expectations over random weather shocks, producer surplus depends on the probability of a power shutoff $(P(L = 1 \mid \nu)$.

$$PS = -r(k'(\nu) - (1-\delta)k) + \phi\beta\gamma k P(L=1 \mid \nu) + \beta(\gamma k + \nu - \theta(k'(\nu))\bar{d})(1 - P(L=1 \mid \nu))$$

Since the change in liability costs that utilities may recover through electricity rates (ν) that I observe in 2017 is not marginal, I derive the change in welfare from a non-marginal change from ν to ν'. The total change in consumer surplus, $CS(\nu') - CS(\nu)$ can be simplified to the following expression:

$$CS(\nu') - CS(\nu) = (\beta\gamma k - (\bar{p} - p)Q)\Big[P(L = 1 \mid \nu') - P(L = 1 \mid \nu)\Big] + \beta(\nu' - \nu) +$$
$$\beta\Big[\nu' P(L = 1 \mid \nu) - \nu P(L = 1 \mid \nu)\Big] + r(k'(\nu') - k'(\nu))$$

While the change in producer surplus is:

$$PS(\nu') - PS(\nu) = -r(k'(\nu') - k'(\nu)) - \beta\Big[\nu' P(L = 1 \mid \nu) - \nu P(L = 1 \mid \nu)\Big] -$$
$$(1 - \phi)\beta\gamma k\Big[P(L = 1 \mid \nu') - P(L = 1 \mid \nu)\Big] -$$
$$\beta\Big[\theta(k'(\nu'))\bar{d}(1 - P(L = 1 \mid \nu')) - \theta(k'(\nu))\bar{d}(1 - P(L = 1 \mid \nu))\Big]$$

Since this model has a constant marginal cost, producer surplus is zero by assumption. By including producer surplus in the welfare derivation, I therefore obtain an upper bound on the short-run welfare change. Since the total change in welfare is the sum of the changes in consumer and producer surplus, I combine the two terms above.

$$\begin{aligned} WF(\nu') - WF(\nu) = &(\beta\phi\gamma k - (\bar{p} - p)Q)\Big[P(L = 1 \mid \nu') - P(L = 1 \mid \nu)\Big] - \\ &\beta\Big[\theta(k'(\nu'))\bar{d}(1 - P(L = 1 \mid \nu')) - \theta(k'(\nu))\bar{d}(1 - P(L = 1 \mid \nu))\Big] \end{aligned} \tag{12}$$

Equation 12 describes the long-run change in welfare resulting from a change in the level of liabilities which the regulator allows utilities to recover through electricity rates because it allows firms to adjust their defensive capital investments.The welfare effect of changing recoverable liability costs depends on three factors. First, long run welfare depends on whether ν and the probability of a shutoff are positively or negatively correlated. Second, the welfare change depends on whether the fraction of revenue that firms recover during a power shutoff exceeds consumers' lost welfare because they cannot use electricity. Finally, the second term is the change in expected damages when a utility does not declare a power shutoff. The change in expected damages depends on several factors: (1) the relationship between ν and the probability of a shutoff, (2) changes in firms' defensive capital investments in response to a change in ν, (3) the effectiveness of defensive capital investments at reducing the likelihood of power line-ignited fires, and (4) whether power shutoffs and defensive investments are complements or substitutes.

Since this paper's central goal is to estimate how firms' short-run precautions respond to the level of liability that they face, I focus on the short run change in welfare. In the short run, firms' cannot adjust their defensive capital investments to the level of liability that they face, simplifying the welfare expression.

$$WF(\nu') - WF(\nu) = \left(\beta\left[\theta(k')\bar{d} + \phi\gamma k\right] - (\bar{p} - p)Q\right)\left[P(L = 1 \mid \nu') - P(L = 1 \mid \nu)\right]$$

Where $\theta(k')\bar{d}$ is the expected damages from a power line-ignited fire, $\phi\gamma k$ is the fraction of revenue utilities recover during a power shutoff, $(\bar{p} - p)Q$ is consumers' lost welfare during a power shutoff, and $P(L = 1 \mid \nu') - P(L = 1 \mid \nu)$ is the change in power shutoff probability across liability regimes. I assume that utilities cannot recover revenue during power shutoffs ($\phi = 0$).

Since San Diego Gas and Electric was the only investor owned utility which used power shutoffs to prevent fire ignitions prior to the California Public Utility Commission's 2017 liability decision, I only calculate the change in welfare for San Diego county.

Appendix D Aggregate Zip Code Statistics on Structure Replacement Costs

Zip Code	Total Value (Thousands 2018 $)	Mean Value (2018 $)	Median Value (2018 $)
90001	2,922,886.470	31,493	21,756
90002	2,998,019.512	30,047	22,444
90003	4,228,923.710	35,646	23,254
90004	8,361,885.549	98,245	48,661
90005	5,082,092.208	157,996	72,086
90006	3,762,620.186	76,333	32,838
90007	3,372,015.454	63,137	27,498
90008	4,628,920.189	54,466	34,459
90010	892,175.930	180,822	122,455
90011	5,496,685.601	41,241	28,105
90012	4,618,647.210	120,781	47,981
90013	1,041,493.032	98,505	40,259
90014	927,710.268	102,680	21,226
90015	3,309,985.384	98,079	43,903
90016	3,922,414.909	32,860	23,131
90017	3,695,058.736	231,520	63,192
90018	3,453,166.483	35,217	20,869
90019	6,738,580.708	53,628	33,278
90020	6,165,156.187	175,771	63,895
90021	212,682.326	76,449	34,905
90022	3,890,116.839	33,827	23,870
90023	2,099,490.684	35,072	21,100
90024	18,628,029.642	150,520	80,016
90025	12,342,389.749	104,756	71,729
90026	6,320,229.085	51,540	28,637

90027	9,497,765.906	104,029	57,235
90028	3,855,872.510	183,718	57,269
90029	2,534,722.884	70,587	33,428
90030	120.878	60,439	60,439
90031	2,380,059.064	36,392	19,625
90032	3,599,692.249	31,192	21,202
90033	2,030,447.012	42,319	24,105
90034	9,816,649.022	94,212	46,730
90035	6,898,731.533	82,431	57,018
90036	7,516,852.757	115,736	57,837
90037	3,149,207.036	35,591	19,486
90038	2,552,839.698	88,745	43,753
90039	4,603,391.434	48,356	32,829
90040	1,018,249.610	35,856	25,401
90041	3,798,093.842	47,130	32,510
90042	6,914,707.482	42,747	28,212
90043	5,134,304.392	34,124	21,752
90044	4,734,723.204	28,022	17,825
90045	9,560,049.746	67,113	40,993
90046	15,568,971.690	114,195	61,070
90047	4,316,376.283	25,416	18,680
90048	6,855,877.335	92,927	58,161
90049	26,502,674.228	166,962	96,177
90052	138.430	23,072	24,156
90053	863.832	78,530	84,761
90056	3,067,486.194	83,738	69,839
90057	3,602,628.659	182,319	42,661
90058	76,281.019	31,957	11,077

90059	2,645,256.920	30,230	23,907
90061	1,925,762.738	32,513	22,437
90062	1,829,190.033	23,502	16,298
90063	2,874,721.662	30,286	20,340
90064	8,192,534.634	77,027	47,254
90065	5,580,988.269	42,989	29,002
90066	11,338,502.541	64,864	39,150
90067	2,988,567.394	119,047	78,069
90068	9,115,560.324	89,876	59,393
90069	11,989,981.902	111,581	66,239
90071	65,587.528	40,536	20,090
90077	13,555,341.297	257,937	118,696
90086	77.647	25,882	29,573
90089	12,919.506	145,163	36,111
90093	13.703	13,703	13,703
90094	2,602,241.450	147,645	108,013
90102	20.444	20,444	20,444
90201	5,652,937.067	54,231	37,780
90202	24,983.852	1,665,590	1,778,063
90209	463.583	38,632	42,813
90210	31,238,404.975	284,159	140,991
90211	3,104,506.092	111,870	77,864
90212	4,503,621.183	134,465	98,224
90220	3,918,357.273	30,211	23,228
90221	3,523,915.511	31,632	25,829
90222	2,087,953.047	27,189	20,179
90230	6,919,060.240	52,685	40,083
90232	2,996,331.353	63,680	42,776

90240	5,344,697.906	63,697	44,160
90241	7,186,544.366	65,667	45,357
90242	5,654,655.237	54,613	38,185
90245	4,215,842.524	74,979	51,883
90246	18.967	18,967	18,967
90247	5,335,703.530	47,341	29,907
90248	1,377,967.202	40,580	27,478
90249	3,018,221.730	35,628	26,733
90250	10,509,399.051	58,548	32,447
90254	7,816,446.981	91,017	57,474
90255	5,186,347.514	45,947	35,236
90260	3,693,934.157	47,219	33,695
90261	1,674.076	186,008	208,469
90262	4,887,491.741	39,895	32,364
90263	7,204.904	128,659	51,579
90265	17,857,931.494	180,745	97,232
90266	19,697,346.910	116,617	63,085
90270	1,585,255.459	42,948	30,249
90272	19,251,570.117	159,842	91,855
90273	1,625.798	406,450	451,910
90274	19,459,201.340	145,279	86,332
90275	19,580,365.629	95,611	64,918
90277	12,460,756.373	84,336	58,859
90278	11,410,699.221	72,707	59,480
90280	8,219,982.311	43,249	34,872
90290	2,273,124.678	78,071	49,734
90291	6,215,662.929	66,948	39,578
90292	8,462,436.044	125,802	87,929

90293	5,000,675.737	89,681	60,824
90297	11,117.773	264,709	280,668
90301	3,242,019.079	47,888	30,729
90302	3,131,802.999	48,613	32,123
90303	1,865,151.832	33,606	24,835
90304	1,487,928.117	37,047	25,542
90305	2,747,806.579	43,553	31,886
90320	110.361	110,361	110,361
90401	1,773,073.746	224,525	63,018
90402	10,183,593.724	161,514	94,316
90403	7,919,037.713	103,161	68,684
90404	3,629,321.314	75,244	50,681
90405	7,292,054.389	76,844	48,079
90477	354.094	88,524	88,524
90501	6,314,547.530	56,199	37,631
90502	2,815,847.556	41,286	33,415
90503	10,071,239.010	67,189	46,272
90504	5,406,774.250	46,622	33,870
90505	8,531,187.997	63,550	44,557
90507	104.765	52,382	52,382
90509	7.715	3,857	3,857
90510	367.894	61,316	59,156
90601	6,443,362.607	57,742	45,577
90602	3,453,317.867	60,067	39,538
90603	4,594,041.018	54,546	43,636
90604	5,798,994.462	45,406	35,918
90605	5,613,797.309	46,020	33,150
90606	3,406,345.754	34,745	28,495

90607	102.571	12,821	13,988
90620	6,080,298.228	33,707	26,081
90621	5,410,487.951	63,362	36,628
90622	290.711	29,071	32,335
90623	3,501,440.498	53,607	45,041
90630	10,223,659.640	50,083	38,633
90631	12,421,257.720	53,701	32,802
90632	134.771	33,693	30,286
90638	10,241,068.296	54,256	43,029
90640	8,248,458.183	52,481	38,117
90650	11,388,379.656	37,608	29,766
90651	397.373	66,229	62,878
90652	5.136	5,136	5,136
90660	6,832,398.406	36,606	28,183
90670	1,820,815.388	38,886	29,781
90680	2,956,665.135	38,862	28,450
90701	2,098,261.662	43,480	27,966
90702	87.893	29,298	27,452
90703	13,909,549.125	65,250	55,118
90704	1,427,384.917	94,404	56,920
90706	8,818,882.930	56,295	38,219
90710	3,672,796.617	54,249	41,743
90711	109.246	54,623	54,623
90712	5,684,132.458	42,231	32,110
90713	4,957,420.628	37,555	32,524
90714	4.961	4,961	4,961
90715	2,731,208.280	45,322	35,944
90716	1,244,584.337	41,442	29,691

90717	3,253,672.188	50,719	35,151
90720	5,409,830.767	56,435	41,148
90723	4,890,037.744	49,482	34,836
90731	6,037,699.559	52,361	34,165
90732	5,144,291.075	56,229	47,787
90733	511.327	127,832	101,691
90734	11,977.525	1,088,866	56,585
90740	7,405,378.957	90,154	39,902
90742	82,541.893	50,056	24,935
90743	1,970.552	89,571	84,905
90744	4,169,307.988	42,126	28,953
90745	7,271,227.845	42,805	35,153
90746	4,599,740.340	45,584	37,217
90747	160.871	40,218	41,293
90748	143.762	143,762	143,762
90749	2,897.808	2,897,808	2,897,808
90755	2,548,129.651	74,365	61,941
90800	84.829	42,415	42,415
90801	89.491	29,830	25,158
90802	7,404,017.565	61,492	33,496
90803	11,440,540.478	80,899	53,876
90804	4,865,571.416	65,188	40,435
90805	8,639,663.207	43,133	32,970
90806	4,135,219.828	46,549	34,872
90807	6,848,685.359	57,177	40,011
90808	8,458,720.429	44,988	35,679
90810	3,093,031.759	33,993	27,081
90813	4,064,035.608	60,741	32,348

90814	4,549,405.180	68,903	44,935
90815	8,266,565.154	47,778	34,471
90846	77.774	77,774	77,774
90873	7.854	7,854	7,854
91001	8,144,456.427	51,449	34,776
91004	24.720	8,240	7,846
91006	11,660,736.354	88,557	58,657
91007	10,765,146.058	94,534	65,321
91008	525,469.297	175,683	87,357
91010	4,621,816.902	50,005	37,640
91011	11,064,307.098	115,616	74,938
91012	168.385	168,385	168,385
91016	7,331,821.681	53,725	39,267
91020	1,338,530.328	63,579	44,606
91024	3,389,660.169	66,591	45,151
91030	6,373,661.592	73,726	50,773
91031	89.502	89,502	89,502
91040	4,484,429.377	51,837	39,137
91041	965.449	160,908	162,336
91042	4,997,691.035	51,029	37,812
91046	44,052.967	3,146,640	3,359,986
91101	4,889,729.715	112,374	50,450
91103	4,563,217.086	60,232	32,957
91104	5,559,497.101	45,661	33,173
91105	5,967,418.330	102,122	62,394
91106	7,192,701.194	84,984	49,681
91107	8,560,231.979	62,012	41,843
91108	8,278,060.715	129,622	85,503

91131	39.257	39,257	39,257
91175	363.935	90,984	92,383
91201	3,938,702.361	70,646	44,082
91202	5,471,535.368	75,963	50,506
91203	2,121,901.817	71,071	41,272
91204	1,480,783.217	76,689	33,925
91205	4,265,996.228	74,107	36,422
91206	7,581,909.793	76,148	51,323
91207	4,052,501.126	91,008	61,574
91208	5,637,637.802	78,579	57,596
91210	210,542.784	489,634	173,648
91214	7,259,236.411	55,773	42,939
91243	287.914	287,914	287,914
91301	12,006,120.562	102,673	75,632
91302	19,964,755.603	183,039	110,449
91303	3,481,369.512	71,332	35,585
91304	10,442,920.493	75,133	50,131
91306	7,838,552.336	54,121	43,765
91307	8,233,430.549	70,571	51,031
91309	63.549	31,774	31,774
91310	1,545.504	33,598	14,916
91311	12,141,807.020	83,644	59,995
91312	595.934	595,934	595,934
91316	10,904,528.603	87,471	49,101
91319	1,445.734	131,430	167,388
91320	15,091,948.726	89,403	78,111
91321	7,641,283.737	69,662	48,929
91322	20.589	20,589	20,589

91324	6,478,690.663	77,675	55,601
91325	8,544,385.911	84,878	58,296
91326	13,895,015.095	97,228	80,524
91331	9,069,872.185	40,600	34,620
91334	81.389	81,389	81,389
91335	10,880,111.472	50,060	36,655
91337	44.634	44,634	44,634
91340	3,307,762.226	39,342	32,424
91341	5.119	5,119	5,119
91342	14,050,873.780	55,545	46,462
91343	9,341,762.123	60,621	49,066
91344	13,916,086.828	68,183	53,911
91345	2,838,041.827	47,746	42,516
91346	390.906	195,453	195,453
91350	10,210,655.195	74,597	66,921
91351	7,291,255.307	63,472	54,309
91352	5,396,108.773	45,667	35,449
91354	10,113,828.432	92,079	80,067
91355	11,150,968.399	78,587	64,653
91356	12,951,313.082	106,462	64,605
91357	23.184	23,184	23,184
91359	1,208.411	92,955	73,152
91360	12,467,670.607	77,183	65,507
91361	8,515,874.080	121,985	83,409
91362	12,338,135.486	103,081	82,788
91363	2,429.282	97,171	105,692
91364	10,774,448.011	91,183	64,227
91367	13,892,484.794	87,594	58,922

91369	93.984	46,992	46,992
91372	1,553.330	129,444	143,454
91377	6,406,987.193	102,463	90,569
91381	8,553,250.645	124,676	105,238
91384	7,019,932.916	83,414	75,214
91387	10,851,819.249	94,531	67,394
91390	7,578,082.685	100,964	89,568
91401	7,363,536.816	73,810	50,857
91402	6,930,286.099	57,851	40,742
91403	9,304,909.614	100,697	62,264
91405	6,187,303.004	70,894	44,483
91406	7,704,036.081	56,839	39,116
91409	508.613	63,577	49,366
91411	3,415,500.033	69,501	40,485
91413	1,675.170	128,859	103,396
91423	11,008,946.724	98,278	60,338
91436	9,606,507.704	131,059	86,648
91455	41.491	41,491	41,491
91501	5,040,903.785	88,285	57,178
91502	1,716,131.342	121,427	48,780
91504	5,906,306.819	66,529	46,900
91505	6,432,507.607	53,343	35,684
91506	3,697,249.622	48,931	35,640
91521	102.655	25,664	25,276
91601	5,903,334.779	82,249	41,945
91602	5,937,552.511	98,734	57,004
91603	60.141	30,071	30,071
91604	12,583,435.552	107,862	67,503

91605	6,249,608.397	56,194	42,728
91606	5,317,619.965	54,462	38,589
91607	6,931,925.587	87,459	52,690
91608	0.004	2	2
91612	595.996	66,222	75,159
91614	186.592	46,648	45,943
91701	14,924,349.733	87,932	77,976
91702	7,192,828.287	46,141	33,443
91703	111.000	111,000	111,000
91704	40.690	40,690	40,690
91706	7,741,886.467	40,847	34,351
91708	1,055,079.865	108,570	88,865
91709	30,723,398.296	114,841	98,610
91710	19,422,337.395	76,354	64,256
91711	9,882,524.242	74,916	55,262
91719	1,794.392	119,626	79,807
91720	16,407.497	1,093,833	128,911
91722	4,995,333.290	42,612	34,637
91723	2,830,769.325	54,717	41,542
91724	6,054,250.093	63,728	50,388
91729	27,014.016	135,749	106,597
91730	16,875,873.079	88,098	61,659
91731	2,242,456.838	43,213	29,163
91732	5,695,915.018	47,901	36,796
91733	3,188,165.339	42,667	31,616
91737	12,028,578.742	122,734	98,656
91739	12,963,706.810	126,962	105,703
91740	4,659,759.373	51,978	42,386

91741	7,670,457.389	69,100	47,960
91743	285.793	57,159	62,579
91744	7,974,025.464	37,443	31,886
91745	13,280,743.586	62,284	50,784
91746	3,020,053.111	36,302	31,060
91747	7,285.330	45,250	48,225
91748	11,549,260.762	78,564	55,533
91749	165.072	27,512	25,013
91750	9,008,972.899	71,318	56,422
91752	6,193,178.632	72,203	50,513
91754	6,420,062.310	53,973	39,813
91755	4,872,331.530	58,434	45,430
91759	63,253.100	35,219	26,190
91760	6,340.053	186,472	114,586
91761	13,009,104.475	69,623	59,104
91762	8,822,124.225	58,490	44,998
91763	6,023,718.696	59,506	48,960
91764	8,409,985.187	62,500	45,236
91765	17,851,882.083	85,536	65,478
91766	8,647,454.984	48,612	38,906
91767	5,673,065.780	41,606	34,322
91768	3,388,807.240	42,335	32,868
91769	586.167	97,694	37,378
91770	7,264,220.977	46,608	34,131
91771	10.208	10,208	10,208
91773	9,008,623.151	69,139	56,008
91775	5,514,653.917	59,180	44,236
91776	5,200,475.703	55,447	36,817

91780	6,628,370.251	53,923	41,629
91784	14,242,754.794	113,080	97,770
91785	3,657.089	89,197	73,763
91786	12,104,061.474	78,459	55,099
91789	14,988,686.176	87,604	76,170
91790	7,078,192.109	49,556	40,106
91791	8,492,884.040	75,055	54,790
91792	5,509,359.259	58,105	49,288
91793	82.149	82,149	82,149
91801	8,720,657.914	60,819	44,601
91803	4,058,136.473	45,035	33,753
91901	6,811,646.032	100,164	81,371
91902	7,707,724.841	94,102	75,198
91903	720.174	37,904	40,234
91905	228,328.880	44,241	35,234
91906	548,002.840	44,808	34,949
91909	280.164	56,033	29,226
91910	16,571,852.649	70,962	53,494
91911	12,527,511.419	58,532	40,068
91912	129.163	16,145	10,946
91913	12,963,461.081	96,371	81,690
91914	6,946,343.368	132,296	111,314
91915	8,436,163.717	97,808	85,057
91916	456,082.568	61,658	46,607
91917	100,585.569	51,875	38,654
91928	53.619	53,619	53,619
91931	9,718.093	26,625	15,335
91932	3,871,877.091	54,789	36,734

91933	49.660	24,830	24,830
91934	57,833.609	20,774	13,467
91935	3,960,738.333	106,773	83,112
91941	12,174,287.526	72,982	50,934
91942	5,979,905.700	50,234	35,182
91944	607.841	50,653	36,291
91945	4,588,520.233	49,462	39,843
91946	19.596	19,596	19,596
91948	4,086.589	36,816	36,293
91950	5,047,834.537	42,852	29,682
91951	98.831	12,354	11,860
91962	355,319.405	59,259	51,919
91963	99,482.301	41,747	29,163
91976	352.889	32,081	22,551
91977	11,382,695.882	56,303	43,561
91978	2,270,907.019	68,438	51,209
91979	477.800	36,754	36,097
91980	10,900.666	35,740	24,969
92003	2,424,216.383	120,698	78,549
92004	474,794.570	40,980	30,042
92007	3,687,506.888	76,030	51,636
92008	10,576,199.815	66,667	44,542
92009	24,984,477.150	110,897	86,186
92010	4,062,772.621	74,862	66,955
92011	9,172,353.927	88,652	64,630
92014	9,343,040.938	95,012	56,584
92018	496.146	55,127	56,842
92019	13,905,020.410	81,596	64,075

92020	10,827,627.540	69,031	49,237
92021	12,315,123.014	66,690	45,741
92022	972.034	34,716	37,780
92023	92.885	23,221	26,078
92024	21,640,998.907	98,669	65,790
92025	8,837,347.919	76,195	52,445
92026	13,642,303.279	33,875	1,373
92027	10,542,387.170	61,102	47,792
92028	17,031,683.308	92,336	67,296
92029	7,959,205.885	98,773	78,908
92030	152.178	16,909	3,001
92033	921.666	28,802	17,938
92036	818,034.673	46,718	32,438
92037	26,667,950.597	111,216	61,277
92038	1,745.298	109,081	63,924
92039	20.363	20,363	20,363
92040	9,284,768.177	60,655	47,038
92051	189.590	27,084	17,147
92052	70.226	35,113	35,113
92054	8,612,924.525	51,922	38,870
92055	97.912	48,956	48,956
92056	15,262,937.974	61,541	54,162
92057	13,970,741.530	60,528	49,971
92058	2,181,835.277	48,098	35,874
92059	104,408.249	98,406	68,424
92060	28,726.484	25,177	11,741
92061	492,317.587	85,650	63,357
92064	20,251,077.045	99,521	65,854

92065	12,168,742.785	68,815	55,124
92066	78,272.115	42,842	32,114
92067	8,343,180.888	340,691	216,159
92068	232.669	38,778	20,600
92069	11,413,809.944	71,452	54,996
92070	141,893.880	61,989	46,567
92071	12,438,928.819	57,070	47,464
92072	33.528	16,764	16,764
92074	1,226.828	87,631	25,661
92075	5,575,733.107	64,485	37,597
92078	12,069,561.246	85,628	67,515
92079	15.114	15,114	15,114
92081	6,859,669.244	75,813	63,434
92082	6,091,213.803	95,291	76,291
92083	5,856,015.807	53,297	40,585
92084	11,100,500.371	72,410	51,820
92085	712.316	41,901	35,110
92086	306,613.262	42,967	32,168
92088	831.616	51,976	50,279
92091	2,876,204.846	210,634	102,179
92101	13,330,803.942	91,501	48,661
92102	4,331,587.079	42,895	26,110
92103	10,317,159.212	77,425	48,653
92104	8,198,906.759	55,017	35,237
92105	7,065,680.524	44,423	29,622
92106	6,453,528.787	74,796	49,096
92107	6,193,432.775	55,211	36,642
92108	4,482,906.493	56,443	32,375

92109	12,273,120.299	60,130	38,581
92110	5,348,711.857	51,626	35,912
92111	7,514,198.829	43,236	33,747
92113	3,435,290.885	36,333	21,853
92114	10,445,391.425	45,480	38,161
92115	10,335,841.381	55,307	37,474
92116	7,351,089.053	58,861	38,485
92117	10,064,191.992	43,077	33,433
92118	9,838,347.090	83,514	40,340
92119	7,097,113.086	56,359	42,071
92120	8,528,247.758	57,465	42,096
92121	1,870,113.375	90,932	74,408
92122	10,369,434.501	72,094	49,758
92123	5,784,490.653	59,549	38,090
92124	9,009,212.093	93,794	70,837
92126	15,703,184.081	55,511	47,436
92127	17,474,694.146	128,666	92,061
92128	20,949,807.078	80,413	67,833
92129	20,488,925.795	93,050	81,162
92130	29,544,482.872	144,798	112,427
92131	19,440,795.110	116,515	97,322
92132	359.720	89,930	80,741
92134	240.467	80,156	73,609
92136	220.951	73,650	55,531
92139	6,032,662.988	49,943	42,356
92140	47.612	47,612	47,612
92154	12,829,995.238	61,065	44,168
92155	222.629	74,210	101,839

92158	475.572	79,262	63,537
92159	49.840	24,920	24,920
92161	7.930	7,930	7,930
92162	382.477	95,619	92,334
92163	186.683	62,228	38,061
92165	22.408	22,408	22,408
92166	59.115	19,705	19,863
92167	68.532	68,532	68,532
92168	25.111	25,111	25,111
92169	613.535	51,128	42,857
92170	58.097	19,366	15,108
92173	2,117,367.471	53,644	36,241
92174	61.148	20,383	15,177
92175	106.301	53,150	53,150
92176	54.363	10,873	10,950
92177	328.200	41,025	42,382
92178	153.739	76,869	76,869
92184	54.699	27,350	27,350
92191	1,308.129	261,626	300,069
92193	29.269	29,269	29,269
92195	7.180	7,180	7,180
92196	38.407	38,407	38,407
92198	302.663	75,666	62,397
92201	12,934,286.035	57,095	38,087
92202	63,927.520	1,486,687	177,463
92203	7,930,423.322	74,886	57,061
92210	15,489,414.567	237,768	137,061
92211	22,343,331.189	94,690	77,069

92220	6,504,478.968	42,832	31,295
92222	71.332	11,889	9,334
92223	8,511,508.877	54,489	43,307
92225	2,256,160.155	30,706	18,342
92227	1,836,118.056	37,759	26,518
92230	259,502.579	19,456	8,064
92231	3,098,762.170	44,080	36,073
92232	507.287	46,117	30,329
92233	169,378.754	27,649	14,262
92234	13,410,332.240	54,487	41,933
92236	3,498,046.427	45,469	33,364
92239	47,497.338	20,933	14,574
92240	6,488,684.439	43,637	30,393
92241	1,067,510.641	28,661	12,259
92242	419,680.007	27,309	16,825
92243	3,863,221.557	43,603	30,676
92244	1,368.697	47,196	28,035
92249	465,338.565	43,624	37,984
92250	536,907.989	33,694	24,938
92251	2,158,065.827	46,556	39,899
92252	2,004,203.216	32,708	25,553
92253	34,039,073.364	128,880	83,119
92254	754,944.401	34,083	21,963
92256	824,251.200	34,761	26,879
92257	32,996.768	10,008	2,931
92258	59,263.155	19,136	10,060
92259	7,691.572	9,323	3,219
92260	22,595,240.532	90,430	52,800

92262	15,228,207.806	75,764	46,723
92263	8,117.592	105,423	73,779
92264	13,834,786.011	69,726	44,243
92266	8,881.237	12,051	7,488
92267	93,846.380	25,059	11,968
92268	213,115.402	44,866	31,348
92270	23,470,177.474	141,459	96,877
92272	1,385.140	11,170	6,462
92273	57,703.549	26,914	15,809
92274	771,293.461	24,762	16,323
92275	28,129.521	29,735	26,309
92276	1,251,560.062	33,329	22,553
92277	3,282,297.439	31,824	23,499
92278	716.613	19,368	18,166
92280	5,145.530	20,665	12,556
92281	70,301.038	26,449	17,474
92282	189,212.355	28,220	19,590
92283	29,774.454	16,060	7,861
92284	6,191,412.834	43,617	33,558
92285	437,970.983	18,454	13,874
92286	2,313.174	40,582	39,938
92301	4,604,464.582	47,228	34,248
92302	780.083	65,007	56,868
92304	882.005	25,200	19,661
92305	282,530.180	42,390	25,483
92306	99.312	49,656	49,656
92307	10,610,301.020	62,967	50,909
92308	9,459,184.873	57,830	45,602

92309	19,353.625	21,409	14,474
92310	3,154.635	17,624	14,517
92311	4,414,403.852	35,307	26,124
92312	296.562	32,951	38,465
92313	2,563,538.779	64,306	55,327
92314	7,042,701.870	58,633	43,922
92315	9,166,510.505	74,853	50,254
92316	3,458,056.624	47,281	37,635
92317	188,880.949	61,028	46,018
92318	10,826.075	32,030	19,837
92319	222.582	20,235	16,340
92320	1,812,523.174	43,157	30,468
92321	225,446.517	42,698	30,984
92322	345,556.945	45,630	35,382
92323	4,657.758	26,923	21,408
92324	9,566,458.872	54,705	37,410
92325	3,482,770.206	54,583	45,591
92326	37,810.390	44,431	36,277
92327	43,427.122	18,956	11,317
92328	5,945.751	11,347	7,650
92329	13,295.091	55,862	35,965
92331	19.382	19,382	19,382
92332	3,826.660	24,530	15,461
92333	839,706.790	66,617	44,763
92334	64,201.081	79,654	67,189
92335	12,669,378.985	53,188	40,687
92336	23,867,921.222	84,904	73,473
92337	8,934,203.209	71,546	61,219

92338	1,440.464	24,836	11,130
92339	411,805.980	45,080	36,733
92340	412.743	34,395	28,425
92341	539,745.032	41,183	33,150
92342	2,420,373.406	58,473	49,739
92343	-1.147	-1,147	-1,147
92344	4,325,592.468	79,793	59,466
92345	16,222,048.725	52,388	43,004
92346	13,349,784.980	67,568	53,998
92347	177,850.339	22,743	16,495
92349	353.354	39,262	53,725
92350	7,482.191	99,763	32,053
92351	651.678	65,168	44,511
92352	10,137,971.367	115,285	85,782
92353	204.049	40,810	44,518
92354	5,944,883.058	86,769	64,405
92356	916,111.049	28,658	21,433
92357	1,984.209	66,140	27,445
92358	216,787.332	37,468	28,243
92359	1,738,762.066	53,369	41,422
92362	140.481	70,241	70,241
92363	1,008,117.296	30,724	20,959
92364	3,284.196	32,198	23,231
92365	419,955.446	27,175	19,144
92366	918.358	20,408	9,967
92368	104,517.005	27,976	18,117
92369	259.450	43,242	50,098
92370	240.471	48,094	52,464

92371	3,423,646.869	49,106	39,080
92372	1,349,225.017	47,831	37,938
92373	13,049,843.927	91,446	62,372
92374	9,241,219.056	66,509	52,109
92375	14,295.215	102,843	95,026
92376	13,434,556.116	55,062	44,808
92377	4,230,462.837	71,140	64,994
92378	111,943.056	46,701	39,341
92380	141.410	28,282	31,775
92382	2,084,217.025	55,003	43,509
92383	287.373	47,896	47,827
92384	1,013.162	7,915	4,595
92385	122,371.405	84,452	63,989
92386	1,405,947.265	35,120	29,904
92387	107.719	21,544	21,838
92389	20,903.756	9,846	5,434
92391	773,646.851	51,642	42,557
92392	14,249,550.335	60,446	47,657
92393	5,404.562	55,149	51,168
92394	5,515,393.430	59,780	44,476
92395	6,103,499.156	55,050	40,722
92396	566.562	40,469	21,468
92397	1,725,269.880	59,349	48,646
92398	169,233.164	27,666	17,657
92399	14,126,893.241	73,967	57,098
92401	205,973.312	48,902	26,821
92402	3,464.069	43,301	36,651
92403	3,781.984	22,783	17,107

92404	9,423,882.883	50,664	35,553
92405	5,035,219.049	42,557	32,454
92406	6,464.915	52,560	48,500
92407	10,176,745.785	60,391	44,692
92408	1,852,670.123	50,344	35,642
92410	4,241,003.416	42,638	27,751
92411	2,427,667.909	31,453	21,292
92412	704.066	46,938	52,370
92413	1,149.180	60,483	46,139
92415	5,407.895	43,263	34,433
92418	953.064	68,076	56,404
92423	14.578	14,578	14,578
92424	278.111	27,811	28,221
92501	3,460,622.460	52,252	36,095
92502	497.650	17,160	13,357
92503	17,801,545.602	64,944	45,806
92504	11,453,590.515	61,145	38,717
92505	8,682,314.019	64,233	44,210
92506	16,803,817.588	77,967	57,404
92507	9,561,268.446	70,702	36,881
92508	11,354,412.769	93,070	78,523
92509	12,445,854.887	51,395	40,529
92518	1,239.911	61,996	58,196
92522	378.148	94,537	91,842
92530	10,048,547.197	55,043	40,773
92531	201.007	40,201	24,667
92532	4,829,846.767	76,886	62,108
92536	696,389.158	33,983	14,516

92539	676,201.966	27,381	16,339
92543	4,557,292.721	32,066	16,838
92544	9,414,317.328	46,212	33,052
92545	8,179,283.140	45,498	30,872
92548	676,413.613	20,970	8,256
92549	2,861,395.078	53,332	42,345
92550	12,638.243	42,842	28,710
92551	6,193,153.636	58,147	46,765
92553	11,722,314.588	54,638	40,384
92555	9,409,592.609	82,451	65,609
92556	91.069	30,356	41,481
92557	12,445,726.537	64,607	53,264
92561	816,639.665	76,429	49,689
92562	24,440,401.019	101,351	80,011
92563	17,363,202.465	86,249	72,984
92564	103.235	34,412	45,516
92567	1,752,460.535	49,758	37,354
92570	7,139,573.124	42,236	23,278
92571	7,213,497.219	55,272	40,908
92582	2,091,571.011	47,826	37,498
92583	4,924,520.064	43,313	29,856
92584	11,008,059.443	75,405	61,377
92585	3,997,842.755	55,948	45,094
92586	5,420,465.834	39,966	31,977
92587	7,124,640.060	81,164	63,413
92589	47.441	47,441	47,441
92590	1,562,137.884	182,152	128,786
92591	13,343,802.986	98,046	77,866

92592	27,128,471.883	95,997	80,609
92595	7,220,897.144	60,529	48,019
92596	5,210,514.207	77,494	65,283
92599	611.009	61,101	63,922
92602	8,758,678.613	132,975	100,230
92603	9,643,067.668	135,220	89,185
92604	7,183,972.682	56,268	47,899
92606	6,828,643.391	102,014	70,640
92610	4,703,174.113	94,371	88,976
92612	8,668,637.465	90,482	56,815
92614	7,689,884.801	74,881	57,367
92617	1,109,638.607	116,059	116,820
92618	5,015,728.493	93,450	53,427
92619	63.244	63,244	63,244
92620	13,823,214.310	86,245	70,975
92624	2,633,574.760	38,326	2,751
92625	2,728,612.474	88,932	62,362
92626	9,239,062.270	57,376	39,992
92627	8,503,461.551	53,286	33,919
92629	12,592,817.446	87,249	63,974
92630	14,892,621.662	59,919	51,591
92632	17.780	17,780	17,780
92637	1,691,031.502	42,320	31,348
92641	95.200	19,040	22,686
92643	18.507	18,507	18,507
92646	12,947,115.921	45,335	36,751
92647	8,964,093.576	45,830	34,184
92648	17,828,453.840	95,391	72,761

92649	10,665,855.505	66,485	43,834
92651	14,827,150.364	84,148	38,262
92652	92.323	92,323	92,323
92653	12,943,675.036	95,809	65,488
92655	800,286.830	36,268	24,418
92656	19,011,266.195	87,508	69,262
92657	14,095,832.946	264,760	182,736
92658	617.119	56,102	51,223
92660	18,970,280.384	121,706	69,595
92661	1,965,318.150	71,932	36,474
92662	1,294,424.797	61,513	34,572
92663	8,222,883.897	77,777	43,469
92667	83.567	41,784	41,784
92668	36.800	12,267	12,750
92670	133.986	44,662	46,421
92672	11,592,245.496	48,234	25,696
92673	15,121,551.399	118,109	97,320
92674	6.124	6,124	6,124
92675	14,186,872.689	89,901	48,395
92676	582,931.703	80,216	22,992
92677	31,946,657.243	95,523	74,223
92678	15,649.229	66,877	45,847
92679	23,096,440.488	144,515	115,510
92680	134.397	67,199	67,199
92683	12,511,293.987	42,448	32,870
92684	593.700	593,700	593,700
92688	16,823,399.436	81,757	70,481
92689	737.892	245,964	255,650

92690	414.179	34,515	35,378
92691	12,243,939.503	52,612	47,236
92692	21,312,163.346	84,713	70,966
92693	2.961	2,961	2,961
92694	11,794,973.255	143,509	113,183
92701	2,759,434.497	38,377	21,874
92703	3,821,522.777	30,793	21,125
92704	7,127,163.807	36,692	28,372
92705	12,774,486.111	79,603	51,591
92706	3,532,073.735	42,171	30,894
92707	4,281,909.243	31,406	22,958
92708	12,068,694.551	49,135	42,449
92709	854.177	94,909	61,840
92714	153.708	38,427	38,497
92775	55.481	27,740	27,740
92780	7,434,880.649	49,904	36,547
92782	11,123,546.721	117,152	90,635
92801	5,994,461.203	48,912	28,846
92802	4,438,530.759	51,120	33,888
92803	24.983	24,983	24,983
92804	8,600,973.009	42,706	29,454
92805	6,047,348.711	39,749	26,441
92806	5,050,724.839	53,464	36,906
92807	13,349,109.626	75,115	57,767
92808	10,691,819.426	102,200	85,980
92812	67.689	33,844	33,844
92821	8,889,851.671	61,157	44,728
92822	49.813	24,907	24,907

92823	1,463,315.270	93,312	74,426
92831	6,374,946.982	61,917	36,537
92832	2,628,023.708	41,896	22,936
92833	9,974,117.695	53,189	36,701
92835	8,804,024.905	77,627	50,251
92840	5,977,725.719	37,554	28,761
92841	3,872,978.162	39,366	30,447
92843	4,150,774.919	36,842	28,129
92844	2,797,871.080	45,274	33,869
92845	2,852,680.371	33,556	30,481
92850	236.552	47,310	26,109
92860	8,217,504.670	84,638	62,991
92861	3,993,569.672	125,202	94,462
92862	116.111	116,111	116,111
92865	3,234,452.266	43,462	37,142
92866	1,966,646.690	39,798	27,600
92867	11,735,217.526	71,412	45,913
92868	2,400,153.807	43,220	28,493
92869	10,967,587.804	72,906	54,895
92870	12,457,016.498	62,378	47,057
92871	59.676	29,838	29,838
92878	732.338	122,056	95,233
92879	11,265,016.964	74,852	56,503
92880	18,716,364.820	108,168	93,925
92881	12,236,603.889	105,185	84,955
92882	19,650,969.003	84,998	66,330
92883	11,977,331.799	99,937	82,557
92885	81.773	81,773	81,773

92886	18,777,975.411	82,638	56,832
92887	11,902,851.549	118,178	103,800
92897	132.796	66,398	66,398
93001	5,684,238.030	53,589	37,882
93002	1,451.809	69,134	38,614
93003	11,081,797.993	59,955	45,833
93004	6,628,768.622	66,758	57,685
93005	290.210	41,459	31,583
93006	771.005	59,308	47,009
93007	496.760	124,190	115,975
93009	45,149.293	152,531	161,560
93010	12,523,647.343	78,362	62,904
93011	2,645.102	146,950	180,567
93012	12,294,157.033	88,036	71,662
93013	6,120,092.304	93,495	58,197
93014	17.305	3,461	1,862
93015	2,134,095.913	47,613	38,679
93016	73.285	73,285	73,285
93020	1,977.956	79,118	92,732
93021	10,307,197.028	84,611	74,736
93022	342,514.800	48,221	37,901
93023	5,133,629.326	63,408	46,471
93024	601.057	42,933	11,677
93030	9,093,527.226	63,058	48,506
93031	2,096.197	61,653	46,589
93032	296.441	26,949	32,199
93033	7,379,401.585	46,726	38,508
93034	1,178.201	117,820	140,394

93035	8,472,212.597	68,678	57,123
93036	4,676,492.907	64,102	47,298
93040	119,113.034	32,011	22,511
93041	3,416,607.176	45,206	37,981
93042	1,304.323	108,694	112,733
93043	2,446.486	31,773	31,053
93060	3,435,312.795	44,097	32,326
93061	1,387.031	44,743	39,077
93062	1,927.780	83,817	79,293
93063	13,992,846.575	67,945	59,910
93064	2,924.590	153,926	168,018
93065	20,286,365.023	77,868	65,629
93066	256,798.710	96,360	69,365
93067	772,799.564	130,452	76,284
93093	8.955	8,955	8,955
93094	151.629	75,814	75,814
93099	559.716	93,286	107,863
93101	6,875,250.856	95,588	60,786
93102	344.099	14,961	11,230
93103	6,567,804.010	100,365	63,070
93105	10,615,883.641	100,336	72,956
93108	20,541,579.472	318,198	152,241
93109	5,074,533.470	97,792	67,378
93110	8,518,657.037	140,167	72,254
93111	6,918,941.149	92,089	66,570
93116	1,844.168	87,818	22,349
93117	10,607,938.834	92,062	64,630
93121	668.654	41,791	8,911

93130	1.641	1,641	1,641
93140	21.095	10,548	10,548
93160	489.233	30,577	11,978
93201	10,324.764	11,210	5,279
93202	190,195.858	27,113	25,204
93203	1,575,589.781	35,513	25,880
93204	523,161.414	29,081	22,771
93205	254,291.795	18,604	12,682
93206	137,319.458	26,474	18,301
93207	18,110.141	17,634	10,615
93208	7,788.400	19,569	14,584
93210	1,629,317.111	38,718	28,032
93212	1,159,285.645	31,375	22,778
93214	542.538	18,708	20,243
93215	4,738,188.609	38,567	31,251
93216	109.804	36,601	38,805
93218	17,772.899	20,499	16,000
93219	226,331.712	24,264	19,308
93220	1,130.532	24,577	15,233
93221	2,166,651.970	48,356	34,334
93222	297,328.321	40,403	34,214
93223	707,408.278	28,046	23,386
93224	24,324.401	17,899	9,064
93225	1,022,171.379	44,679	34,431
93226	17,202.322	26,547	15,561
93227	58,580.293	23,228	19,424
93230	10,055,809.541	48,951	34,946
93232	72.190	72,190	72,190

93234	67,285.667	24,701	17,087
93235	297,713.517	25,145	20,797
93237	74.745	10,678	13,763
93238	187,446.317	37,206	27,522
93239	33,646.131	20,027	8,505
93240	913,242.271	29,408	20,256
93241	1,037,700.382	25,216	18,171
93242	223,398.290	30,031	21,777
93243	112,775.257	32,002	20,393
93244	25,505.649	36,858	24,463
93245	4,658,827.337	52,270	41,557
93247	1,297,774.969	34,875	25,898
93248	2.680	2,680	2,680
93249	35,865.335	21,412	8,717
93250	925,454.746	29,912	24,619
93251	3,440.150	13,651	8,773
93252	69,687.536	14,628	9,661
93254	68,396.591	22,007	16,158
93255	44,277.064	19,909	8,983
93256	237,922.302	24,246	18,397
93257	7,113,075.249	37,674	29,697
93258	13,008.735	24,499	16,838
93260	30,872.613	18,388	9,782
93261	29,610.049	18,472	15,884
93262	1,107.076	24,067	20,194
93263	1,933,756.595	34,848	27,656
93265	781,025.635	56,461	40,799
93266	69,204.861	27,419	15,566

93267	368,050.969	28,522	19,462
93268	1,764,329.018	23,760	14,871
93269	66.555	33,277	33,277
93270	372,042.489	35,375	27,635
93271	626,172.183	58,076	48,015
93272	134,482.207	27,513	21,229
93274	7,427,396.231	40,860	31,972
93275	810.500	38,595	33,479
93276	4,199.327	10,685	6,652
93277	8,718,078.005	50,311	39,611
93278	331.885	27,657	17,025
93279	768.573	59,121	61,937
93280	2,043,538.495	34,377	26,633
93282	1,428.881	20,125	12,630
93283	218,817.358	18,056	10,989
93285	618,599.677	27,226	18,360
93286	730,618.905	33,184	25,056
93287	10,235.210	35,787	13,066
93290	222.853	222,853	222,853
93291	7,335,158.496	55,501	38,074
93292	5,510,690.870	52,086	41,249
93301	2,001,569.686	46,610	27,973
93302	318.065	21,204	20,255
93303	229.320	28,665	24,057
93304	6,138,948.767	33,010	24,496
93305	3,899,005.848	30,356	21,426
93306	11,947,703.537	46,740	32,500
93307	8,126,470.533	33,131	23,386

93308	9,719,839.141	49,456	34,993
93309	12,850,061.281	52,503	39,191
93311	14,106,158.965	84,197	64,012
93312	18,347,209.832	73,503	62,907
93313	9,092,591.925	54,164	47,383
93314	7,159,232.616	87,663	75,338
93380	500.132	45,467	48,075
93383	16.046	2,674	2,132
93386	1,030.580	103,058	37,576
93387	649.747	36,097	13,765
93389	1,573.449	157,345	176,673
93401	5,877,182.166	79,284	58,915
93402	3,407,708.285	62,649	51,347
93405	3,206,477.761	73,251	51,977
93406	2,802.160	68,345	56,454
93407	284.649	71,162	33,049
93408	145.463	36,366	18,057
93409	51.006	51,006	51,006
93410	84.633	84,633	84,633
93412	288.784	26,253	27,079
93420	8,426,550.427	86,214	63,420
93421	1,812.041	62,484	19,951
93422	6,645,898.261	68,589	57,731
93423	10,861.884	70,532	55,545
93424	112,139.867	64,448	37,784
93426	319,976.720	50,855	34,254
93427	1,660,297.751	86,384	65,719
93428	2,329,692.955	81,988	67,245

93429	12,077.748	18,108	10,256
93430	717,717.540	58,907	42,376
93432	156,624.795	63,902	42,113
93433	1,760,940.472	52,794	45,236
93434	704,103.993	36,184	29,634
93435	5,672.851	105,053	26,628
93436	10,157,361.841	56,207	42,107
93437	2.601	2,601	2,601
93438	1,872.465	55,073	17,917
93440	438,668.255	68,843	56,555
93441	564,998.362	106,143	77,837
93442	2,202,885.472	59,969	46,245
93443	267.665	66,916	68,633
93444	4,554,812.592	75,138	60,046
93445	626,973.439	41,297	34,106
93446	9,359,936.895	69,258	56,342
93447	1,648.041	74,911	62,095
93448	1,567.377	87,077	89,430
93449	2,618,999.045	74,594	57,894
93450	12,766.278	20,264	12,761
93451	508,949.689	65,225	50,656
93452	57,680.983	49,469	44,311
93453	215,459.124	45,475	30,164
93454	8,013,757.591	54,293	42,628
93455	11,019,614.879	60,471	49,162
93456	1,675.664	38,969	5,889
93457	8,859.902	553,744	116,701
93458	4,423,432.273	48,518	31,475

93459	234.194	78,065	71,213
93460	3,274,359.171	146,951	93,419
93461	86,584.075	39,736	33,359
93463	3,803,982.640	112,073	78,586
93464	846.900	94,100	39,888
93465	2,498,977.181	92,353	71,977
93483	319.001	39,875	6,718
93501	526,467.449	23,266	15,384
93502	436.011	6,921	686
93503	42.146	42,146	42,146
93504	1,688.059	46,891	44,325
93505	2,014,454.167	33,849	23,962
93506	118.235	39,412	26,665
93510	3,191,409.314	95,096	81,447
93512	15,189.465	28,445	14,202
93513	316,665.502	40,263	35,331
93514	3,071,369.563	48,784	33,762
93516	203,584.174	16,078	11,393
93517	131,322.716	46,030	35,294
93518	170,248.337	28,715	17,818
93519	1,707.871	7,693	2,726
93522	3,739.739	5,753	2,957
93523	135,530.853	22,653	16,272
93526	121,453.378	28,404	20,816
93527	273,101.279	27,653	17,992
93528	3,947.464	6,962	3,846
93529	260,566.764	38,078	138
93530	6,812.066	7,848	3,537

93531	218,714.145	92,207	79,722
93532	724,345.270	52,401	45,425
93534	5,801,770.812	47,699	33,263
93535	10,798,410.039	46,101	37,110
93536	16,656,589.084	68,153	56,448
93539	32.129	10,710	9,951
93541	46,408.741	52,677	36,537
93542	179.453	4,078	2,711
93543	2,252,588.424	44,870	38,677
93544	349,335.306	46,479	33,602
93545	323,491.660	35,963	22,730
93546	3,806,010.931	87,517	59,542
93549	44,472.746	23,872	15,107
93550	11,534,792.308	50,575	40,238
93551	16,515,707.933	81,982	71,652
93552	7,198,035.365	58,496	51,395
93553	406,404.092	48,970	37,923
93554	1,956.386	4,807	3,243
93555	6,352,464.905	38,651	31,128
93556	3,000.600	30,309	22,071
93558	98.323	32,774	34,065
93560	3,119,745.466	40,859	32,114
93561	8,492,719.229	58,496	47,792
93562	190,543.109	12,500	8,855
93563	23,473.780	45,580	31,094
93581	4,720.089	42,523	33,710
93590	185.194	61,731	56,916
93591	983,376.634	34,534	29,219

93592	1,085.577	11,192	6,269
93596	339.754	16,179	14,191
93601	494,860.640	55,728	42,145
93602	750,863.157	41,496	30,784
93603	17,856.689	30,112	15,872
93604	854,863.933	61,215	40,561
93605	10,193.316	34,554	19,949
93606	29,732.833	21,671	19,085
93607	592.527	10,773	1,777
93608	21,374.978	13,676	10,761
93609	385,988.955	32,431	25,105
93610	1,997,721.992	48,570	29,307
93611	16,392,671.549	73,286	59,207
93612	5,431,971.297	49,553	33,611
93613	1,529.424	101,962	89,022
93614	3,190,924.217	60,473	49,277
93615	255,408.944	26,129	21,215
93616	143,121.517	33,510	20,944
93618	2,244,522.795	37,043	29,754
93619	6,841,329.668	87,594	72,722
93620	908,129.703	32,796	24,082
93621	29,239.568	22,457	8,523
93622	704,222.160	33,284	25,827
93623	65,341.339	55,800	33,017
93624	2,774.707	64,528	18,181
93625	902,105.278	43,544	33,556
93626	444,345.838	83,226	41,646
93627	2,538.501	149,324	11,190

93628	28,635.974	34,879	26,924
93630	1,856,858.457	42,891	33,956
93631	2,692,605.008	49,649	38,310
93633	1,689.478	10,178	2,119
93634	14,240.216	47,786	37,389
93635	8,771,895.879	60,714	45,759
93636	2,302,146.443	68,394	54,445
93637	5,152,768.977	53,889	36,980
93638	4,857,917.701	41,810	31,612
93639	6.138	6,138	6,138
93640	610,990.937	30,671	21,580
93641	49,283.592	21,616	12,472
93642	61.356	30,678	30,678
93643	723,996.241	43,528	30,785
93644	2,397,093.644	54,445	41,369
93645	39,333.084	41,888	22,951
93646	610,270.466	31,744	22,101
93647	625,823.629	30,997	25,244
93648	953,422.505	31,594	24,643
93649	1,009.515	21,946	7,436
93650	310,462.542	24,770	12,359
93651	402,674.461	62,654	53,343
93652	16,789.753	26,482	20,324
93653	179,852.824	43,203	28,748
93654	3,430,844.494	41,441	32,427
93656	439,121.779	30,083	22,400
93657	4,528,501.597	42,416	31,998
93660	132,532.558	26,888	22,201

93662	3,205,262.641	36,879	28,172
93664	537,227.619	58,926	43,380
93665	7,394.186	12,575	7,224
93666	5,691.934	19,100	11,205
93667	374,123.103	37,566	29,310
93668	76,939.326	29,856	22,482
93669	88,268.529	33,410	21,761
93670	593.071	11,629	8,978
93673	7,821.919	13,603	10,760
93675	594,648.666	31,378	20,719
93701	663,670.100	26,143	15,857
93702	3,169,684.628	24,805	17,913
93703	3,099,093.415	30,870	24,191
93704	5,959,016.356	48,091	35,591
93705	4,466,334.633	34,839	26,385
93706	2,425,073.678	24,574	16,008
93707	51.869	10,374	8,600
93708	442.460	36,872	39,357
93709	279.967	55,993	45,197
93710	4,955,377.898	50,616	37,702
93711	14,809,754.485	84,732	60,884
93712	1,519.017	89,354	75,220
93715	299.581	42,797	33,697
93716	740.391	61,699	73,478
93717	151.846	37,962	44,297
93720	16,787,043.285	74,193	60,329
93721	377,209.384	42,840	15,671
93722	14,171,617.524	51,415	41,212

93723	716,927.103	53,702	47,392
93724	968.844	33,408	28,856
93725	1,993,726.121	30,766	22,544
93726	4,993,862.744	37,801	28,070
93727	10,042,348.983	47,355	35,184
93728	1,889,014.470	29,649	20,615
93729	879.686	46,299	43,035
93730	3,120,952.671	107,227	81,178
93737	239,844.946	47,835	46,430
93743	18.048	18,048	18,048
93745	267.511	22,293	23,040
93747	400.521	100,130	132,910
93750	386.586	38,659	26,113
93755	902.886	41,040	38,301
93760	486.096	44,191	52,429
93762	59.845	19,948	20,768
93771	434.211	86,842	68,892
93772	187.047	62,349	52,109
93775	30.198	30,198	30,198
93786	16.074	5,358	7,328
93791	391.901	65,317	72,854
93793	521.130	130,283	135,076
93830	253.042	50,608	51,132
93888	202.880	101,440	101,440
93901	6,494,090.535	70,015	50,533
93902	546.053	182,018	169,258
93904	36.607	36,607	36,607
93905	6,207,982.062	56,175	41,893

93906	11,333,094.604	66,127	50,398
93907	6,426,452.768	78,106	61,539
93908	7,329,229.292	118,890	100,206
93912	531.465	265,732	265,732
93920	211,768.526	106,363	51,654
93921	10,299.627	89,562	60,096
93922	3,983.800	362,164	421,489
93923	11,665,952.568	135,493	88,880
93924	3,440,365.932	112,647	81,947
93925	121,543.467	66,563	44,884
93926	1,035,402.555	61,786	50,539
93927	1,782,856.238	48,566	36,128
93928	4,625.940	31,256	19,692
93930	1,918,408.116	51,362	36,828
93932	43,019.694	38,862	12,711
93933	3,639,289.287	65,860	51,467
93934	190.793	95,397	95,397
93940	11,299,849.904	91,148	57,118
93944	59.901	59,901	59,901
93950	5,407,716.561	66,422	45,987
93953	6,067,467.119	176,211	99,956
93954	8,482.485	17,599	12,124
93955	4,957,742.623	52,400	36,955
93960	2,596,116.949	63,568	47,876
93962	29,792.521	69,609	65,332
94001	44.706	44,706	44,706
94002	14,313,009.163	121,558	95,157
94005	2,375,341.713	100,629	81,006

94010	36,589,010.469	191,466	126,606
94013	3,725.586	93,140	62,793
94014	12,259,043.581	79,350	65,050
94015	17,985,434.963	77,629	61,069
94016	92.678	92,678	92,678
94017	271.704	135,852	135,852
94018	924,699.337	106,902	95,698
94019	8,861,640.223	116,617	95,523
94020	710,723.463	62,066	38,215
94021	53,677.431	63,224	45,688
94022	18,712,841.530	197,934	108,785
94024	16,125,636.818	150,360	100,581
94025	28,152,832.071	148,570	96,953
94026	675.704	675,704	675,704
94027	15,963,436.170	390,342	184,333
94028	8,175,787.774	221,039	144,465
94030	11,083,256.021	111,221	83,152
94035	21.745	21,745	21,745
94037	1,320,392.181	101,265	90,707
94038	1,428,426.628	101,494	88,076
94040	11,699,715.745	124,704	77,439
94041	4,827,029.739	123,627	74,777
94043	9,457,830.632	96,272	67,934
94044	15,087,313.969	81,063	63,744
94059	83.039	41,519	41,519
94060	250,928.264	73,976	34,844
94061	14,901,291.794	102,571	76,849
94062	23,423,768.776	170,608	102,797

94063	6,294,895.672	93,666	59,596
94064	60.066	60,066	60,066
94065	10,453,176.764	158,238	139,264
94066	15,366,240.639	81,241	60,694
94070	20,006,525.362	123,782	100,057
94074	26,935.784	73,999	52,621
94080	21,301,874.634	83,055	65,349
94085	5,202,095.838	97,045	54,379
94086	12,755,630.877	109,375	70,369
94087	19,438,687.169	97,629	74,821
94089	4,678,671.528	125,282	47,223
94100	1,691.879	169,188	198,575
94102	5,158,020.446	70,692	1,633
94103	7,537,782.995	163,124	91,036
94104	480,110.134	261,356	184,726
94105	7,954,559.033	205,959	115,203
94106	1,465.409	209,344	91,656
94107	15,845,105.436	151,100	97,436
94108	4,315,271.285	137,468	28,886
94109	22,693,795.515	149,430	59,708
94110	16,562,922.182	92,714	63,134
94111	2,763,306.282	192,270	116,211
94112	15,113,900.626	56,784	45,272
94114	16,031,348.835	127,776	89,118
94115	18,861,591.045	203,544	99,704
94116	13,387,836.010	67,058	50,453
94117	13,597,356.604	140,482	94,197
94118	17,012,621.708	143,634	80,613

94120	42.777	42,777	42,777
94121	14,380,771.202	100,855	58,837
94122	15,992,487.811	75,348	54,624
94123	17,034,003.027	222,014	128,564
94124	5,581,870.863	58,748	43,761
94127	9,442,876.358	89,174	62,727
94129	1,606.494	229,499	223,325
94130	273.763	91,254	106,984
94131	12,284,396.840	93,170	63,193
94132	7,264,524.069	90,891	52,998
94133	9,155,511.627	175,980	96,723
94134	7,596,175.829	58,504	44,639
94135	1,669.071	69,545	45,381
94136	658.453	131,691	138,667
94137	1,565.518	130,460	153,463
94158	1,493,579.179	204,600	114,627
94159	65.557	65,557	65,557
94171	875.538	125,077	138,829
94278	99.262	99,262	99,262
94301	12,495,884.862	171,294	99,340
94303	12,902,000.974	87,604	53,378
94304	2,167,952.514	1,288,914	207,163
94305	1,511,558.379	119,396	87,562
94306	12,556,259.870	117,185	72,294
94307	741.642	123,607	112,208
94401	12,440,276.750	97,803	71,826
94402	16,458,568.655	133,530	97,535
94403	19,061,455.371	109,579	79,874

94404	20,920,058.206	131,194	103,417
94405	57.620	57,620	57,620
94428	170.857	85,428	85,428
94500	91.083	45,542	45,542
94501	18,721,161.604	100,746	64,333
94502	8,859,417.896	116,311	100,759
94503	6,634,557.846	93,162	65,427
94504	132.967	66,484	66,484
94505	4,731,290.724	97,234	81,826
94506	21,503,784.199	190,953	157,264
94507	15,589,926.462	196,124	145,499
94508	1,225,232.309	106,496	71,219
94509	14,682,424.551	56,369	42,856
94510	12,581,974.222	95,301	79,433
94511	368,322.034	29,402	6,620
94512	5,885.656	30,977	19,044
94513	23,373,627.400	105,259	89,055
94514	3,829,574.190	133,263	113,977
94515	2,892,082.844	101,794	60,775
94516	21,850.155	42,100	14,754
94517	6,591,800.290	102,002	89,066
94518	7,732,829.795	60,609	44,817
94519	4,246,519.072	47,364	36,590
94520	5,639,902.250	52,331	32,096
94521	14,183,383.962	67,482	52,066
94523	11,397,487.893	68,709	50,030
94525	837,019.878	49,740	33,170
94526	19,360,942.270	112,452	87,292

94528	1,229,759.033	262,041	172,656
94529	221.047	55,262	59,462
94530	6,892,711.528	56,654	37,126
94531	16,982,352.768	97,838	84,719
94533	18,596,636.922	69,200	47,792
94534	16,340,255.131	112,055	90,299
94535	2,119.481	88,312	90,785
94536	26,941,063.043	106,442	77,802
94538	17,809,961.090	96,241	65,854
94539	35,947,971.556	166,470	131,007
94541	14,402,864.286	81,343	57,428
94542	5,776,801.054	118,084	89,743
94544	16,171,071.302	83,130	56,059
94545	8,238,510.136	78,612	56,009
94546	15,281,140.558	84,881	61,051
94547	9,798,192.384	84,322	70,362
94548	107,729.591	84,627	43,316
94549	16,798,830.714	125,181	80,375
94550	26,557,167.399	117,400	84,211
94551	14,415,177.750	101,721	85,579
94552	9,500,189.702	135,334	125,453
94553	15,143,204.651	65,561	50,373
94555	15,302,417.382	100,694	85,499
94556	8,476,479.326	103,934	77,726
94558	28,362,753.470	89,683	57,323
94559	8,101,542.005	71,373	48,019
94560	14,085,559.922	88,233	66,158
94561	11,103,618.993	74,829	64,179

94562	10,663.605	888,634	695,579
94563	12,622,728.810	127,635	82,171
94564	5,105,109.475	56,883	45,777
94565	18,492,935.031	59,467	43,317
94566	29,872,576.206	172,032	120,888
94567	272,310.891	73,637	53,390
94568	23,527,289.905	139,214	103,718
94569	37,253.763	43,572	31,148
94571	3,050,762.639	68,928	56,206
94572	1,965,270.810	54,706	44,010
94573	3,896.407	77,928	86,390
94574	6,198,234.329	141,325	69,696
94576	76,221.976	98,351	62,851
94577	14,239,951.640	81,052	59,340
94578	8,633,279.591	79,979	53,756
94579	6,580,631.968	74,000	53,309
94580	7,873,194.985	65,774	46,829
94582	18,595,343.745	152,882	136,053
94583	18,071,604.860	101,262	75,893
94585	8,717,701.373	70,242	57,912
94586	357,923.294	90,751	45,968
94587	24,182,221.735	100,898	77,085
94588	18,697,775.941	144,153	108,952
94589	7,151,019.160	55,507	43,368
94590	7,953,698.006	55,105	35,679
94591	20,132,613.195	78,278	61,821
94592	284,414.932	111,710	79,767
94595	10,258,608.037	72,757	45,095

94596	9,195,204.901	90,656	53,320
94597	7,127,802.292	81,376	56,670
94598	13,341,511.562	91,562	68,758
94599	1,191,422.687	88,162	60,149
94601	6,534,526.297	56,507	37,609
94602	11,055,911.718	87,814	60,041
94603	5,102,128.896	47,268	29,262
94605	12,066,256.914	67,189	43,146
94606	6,182,468.985	82,263	45,981
94607	3,957,222.501	77,041	44,962
94608	6,784,902.089	71,203	44,567
94609	4,831,644.674	77,157	49,037
94610	12,190,647.500	129,346	69,401
94611	26,585,577.699	155,221	99,383
94612	2,215,390.220	155,259	58,932
94613	1,085.590	24,124	24,763
94618	10,814,007.647	135,101	92,574
94619	9,360,236.087	84,313	55,924
94621	3,823,494.377	43,511	27,053
94625	26.516	26,516	26,516
94627	45.101	45,101	45,101
94628	152.265	76,132	76,132
94649	491.012	245,506	245,506
94655	36.966	36,966	36,966
94660	74.954	24,985	5,685
94701	980.858	326,953	309,840
94702	4,874,422.782	73,997	47,466
94703	5,247,048.880	81,970	53,267

94704	4,012,829.144	186,878	85,130
94705	7,759,634.390	146,267	88,408
94706	6,147,894.002	83,671	55,876
94707	7,193,955.270	98,727	48,170
94708	7,179,425.783	107,562	58,038
94709	2,980,739.309	124,410	77,942
94710	1,601,043.232	75,375	46,778
94801	4,644,422.882	46,850	26,022
94802	3,538.527	73,719	33,774
94803	7,663,270.478	63,208	47,918
94804	6,577,394.298	40,856	26,683
94805	2,665,911.628	39,455	28,494
94806	10,106,537.647	51,538	31,826
94807	1,288.389	41,561	33,831
94808	231.183	17,783	11,347
94865	139.082	34,770	37,413
94901	16,341,768.305	118,327	84,562
94903	12,661,246.378	94,615	70,519
94904	8,494,242.893	157,639	105,025
94912	75.885	75,885	75,885
94913	1,806.162	150,513	158,970
94914	240.613	120,307	120,307
94915	19.890	19,890	19,890
94920	14,675,531.738	232,454	148,952
94922	11,991.842	61,814	47,195
94923	521,762.727	83,123	75,057
94924	332,567.016	76,470	52,111
94925	4,711,885.774	103,431	80,876

94926	453.771	453,771	453,771
94927	220.468	55,117	53,905
94928	12,754,030.120	75,205	56,406
94929	147,376.490	76,282	59,837
94930	3,399,257.444	81,492	66,740
94931	3,135,527.509	74,384	58,835
94933	95,399.676	57,678	46,315
94935	111.516	111,516	111,516
94937	455,237.902	87,462	52,305
94938	77,298.375	56,422	50,451
94939	3,894,826.979	126,727	91,136
94940	31,244.358	69,742	47,174
94941	20,582,176.324	141,030	103,209
94942	877.019	97,447	102,416
94945	8,322,982.722	105,373	79,827
94946	691,874.580	296,814	166,510
94947	10,481,326.764	91,056	68,027
94948	682.055	62,005	44,439
94949	8,412,026.194	123,264	99,718
94950	10,628.317	76,463	71,365
94951	1,244,788.665	90,715	72,801
94952	10,850,853.162	76,549	54,119
94953	87.407	29,136	30,283
94954	14,105,361.165	82,053	66,103
94955	1,090.191	155,742	154,080
94956	144,727.162	87,133	68,101
94957	723,937.031	217,922	129,699
94958	377.684	125,895	98,980

94960	7,974,827.899	109,453	82,299
94963	99,451.464	87,622	66,302
94964	24,793.717	72,709	52,932
94965	6,801,212.743	142,700	104,651
94966	1,737.650	133,665	142,405
94970	367,403.669	113,642	73,910
94971	28,164.238	57,244	45,267
94972	5,165.958	38,266	17,662
94973	189,888.629	61,018	51,405
94974	206.293	206,293	206,293
94975	48.711	48,711	48,711
94982	532.191	133,048	131,722
95000	43.534	14,511	15,331
95001	554.996	138,749	142,309
95002	286,999.418	68,025	33,599
95003	12,988,752.006	85,061	66,912
95004	1,120,880.338	84,283	68,371
95005	2,062,823.009	64,665	54,300
95006	3,185,010.115	57,641	46,561
95007	199,434.773	57,457	42,339
95008	14,186,114.673	94,752	64,821
95010	3,166,879.547	59,574	41,814
95012	1,379,352.543	56,621	38,539
95013	1,682.649	31,748	27,620
95014	27,110,884.743	125,219	86,309
95017	158,197.095	54,777	28,234
95018	2,331,437.517	54,847	44,653
95019	752,538.296	52,129	38,843

95020	19,125,222.109	113,351	83,899
95022	294.843	147,421	147,421
95023	13,256,026.036	83,186	67,324
95024	1,882.242	94,112	59,259
95029	126.651	126,651	126,651
95030	11,496,679.448	184,938	121,408
95032	14,975,050.624	136,193	89,731
95033	4,782,866.423	105,127	76,713
95035	23,005,975.042	107,311	82,653
95037	21,285,725.761	137,143	104,731
95038	682.100	75,789	80,426
95039	82,625.650	37,884	24,652
95041	185,282.967	42,731	33,471
95042	37.181	9,295	8,767
95043	21,541.199	45,832	15,734
95044	885.716	19,683	16,516
95045	866,763.784	94,203	56,610
95046	2,183,073.146	120,973	85,585
95050	9,382,672.015	81,977	53,577
95051	15,291,604.288	81,295	51,949
95053	382.360	76,472	77,818
95054	14,260,511.772	263,318	93,820
95060	14,369,101.514	76,964	55,818
95061	72.754	36,377	36,377
95062	10,187,100.065	64,477	49,493
95063	119.142	119,142	119,142
95064	127,724.335	67,758	68,793
95065	2,827,234.877	80,262	64,410

95066	6,286,047.405	91,301	73,618
95067	107.918	53,959	53,959
95069	16.933	16,933	16,933
95070	25,225,980.047	169,585	118,333
95073	3,924,434.063	85,251	62,641
95075	124,058.601	108,065	86,806
95076	15,791,846.202	66,577	47,495
95077	331.856	165,928	165,928
95100	152.427	25,405	29,007
95110	3,987,916.567	77,486	41,298
95111	12,785,928.999	89,987	60,748
95112	10,693,652.012	90,872	46,641
95113	817,003.078	229,624	116,973
95116	7,573,252.934	69,608	46,815
95117	6,558,531.159	89,934	61,659
95118	9,616,133.481	73,810	62,592
95119	3,359,751.819	83,344	72,087
95120	22,531,108.100	129,853	112,468
95121	11,085,710.932	91,773	70,476
95122	9,118,151.732	72,388	50,310
95123	22,735,034.314	93,205	63,142
95124	17,562,576.296	81,266	64,732
95125	20,966,691.551	100,490	67,232
95126	10,207,700.357	115,532	65,777
95127	14,342,293.131	76,366	54,193
95128	8,490,753.413	82,905	52,300
95129	15,341,146.670	105,792	69,994
95130	5,613,344.841	81,576	61,511

95131	10,859,262.063	112,486	86,276
95132	13,298,978.212	88,593	71,654
95133	8,576,087.238	106,345	68,093
95134	6,394,718.748	344,803	95,413
95135	12,542,664.055	131,509	113,114
95136	15,214,793.002	114,785	74,834
95137	41.185	41,185	41,185
95138	13,888,666.247	205,323	157,914
95139	2,768,298.544	92,502	80,521
95140	150,175.150	166,861	146,202
95141	15,689.133	86,680	54,034
95142	16.806	2,801	545
95148	16,717,250.117	109,143	91,090
95150	5,694.501	79,090	59,154
95194	18.091	9,046	9,046
95201	3,352.316	42,434	38,054
95202	649,196.206	71,814	28,921
95203	2,092,669.017	34,877	23,851
95204	5,528,484.193	38,896	27,439
95205	3,567,603.954	28,212	18,941
95206	10,020,843.820	46,039	34,193
95207	8,573,704.322	52,100	34,173
95208	895.508	31,982	31,365
95209	10,089,149.846	62,495	53,821
95210	5,870,228.768	45,924	35,712
95211	1,693.372	112,891	69,032
95212	6,635,529.349	83,134	64,551
95213	326.685	29,699	24,526

95215	3,051,900.142	39,689	24,425
95219	10,016,285.083	91,016	69,122
95220	2,388,079.034	81,921	54,185
95221	1,068.627	48,574	36,593
95222	613,203.564	90,563	65,975
95223	702,691.647	45,832	41,232
95224	12,202.079	43,892	40,036
95225	6,543.769	30,722	24,427
95226	53.915	8,986	9,470
95227	284,507.193	102,414	56,079
95228	1,015,763.691	84,668	62,698
95229	2,322.445	22,331	19,757
95230	99,207.224	63,149	31,984
95231	342,863.137	43,450	29,229
95232	7,609.367	27,471	20,719
95233	14,621.968	39,306	35,581
95234	2,300.102	79,314	23,458
95236	1,191,015.194	76,667	59,378
95237	773,186.965	60,438	47,627
95238	86.467	43,234	43,234
95240	8,570,697.226	53,287	37,824
95241	663.155	44,210	41,959
95242	8,368,022.607	71,370	54,807
95245	113,635.416	42,385	32,107
95246	64,653.679	37,372	29,430
95247	588,318.437	79,492	64,045
95248	4,814.386	21,884	13,577
95249	186,220.381	43,167	33,351

95251	7,507.977	29,794	25,258
95252	2,439,320.198	76,377	63,430
95253	12,967.170	23,969	14,753
95254	16,808.420	52,526	43,196
95255	66,911.778	28,979	22,450
95257	20,297.949	26,885	20,719
95258	1,314,518.133	73,110	60,974
95267	200.529	66,843	80,053
95296	19.547	9,774	9,774
95301	5,647,189.314	47,987	36,643
95303	51,619.069	43,524	27,161
95304	4,389,728.454	101,361	80,160
95305	353.886	17,694	12,450
95306	244,317.770	62,231	41,794
95307	7,707,986.267	51,852	40,634
95308	2,118.773	117,710	123,701
95309	6,647.004	38,201	32,994
95310	320,994.308	59,521	50,104
95311	458,546.611	40,383	28,704
95312	7,477.355	27,901	15,234
95313	163,217.286	44,006	19,997
95315	1,686,122.638	44,054	36,108
95316	1,371,362.720	54,040	34,998
95317	31,657.821	36,599	7,802
95318	32,661.374	29,319	21,822
95319	239,416.141	30,932	22,041
95320	3,472,039.597	70,049	50,126
95321	1,169,176.946	62,296	51,940

95322	1,443,808.879	43,444	30,982
95323	240,510.953	56,885	29,178
95324	1,199,673.588	48,100	39,900
95325	9,857.146	29,961	17,601
95326	1,931,223.262	60,991	47,352
95327	748,216.038	44,656	31,422
95328	370,734.295	39,331	26,879
95329	731,252.855	59,211	49,288
95330	3,979,179.502	62,776	51,137
95333	197,863.995	29,714	21,646
95334	1,751,527.648	43,125	32,043
95335	62,800.477	26,004	12,777
95336	10,148,968.826	59,318	47,038
95337	8,149,603.164	75,042	60,346
95338	2,724,152.743	48,802	38,771
95340	9,409,317.956	53,030	38,401
95341	1,680,708.665	32,908	23,390
95343	502.379	251,190	251,190
95344	124.552	124,552	124,552
95345	132,029.661	42,142	32,129
95346	79,444.363	27,547	17,918
95347	367.927	73,585	33,994
95348	5,338,669.871	57,152	41,783
95350	9,989,188.796	44,377	34,137
95351	4,934,598.623	35,120	25,763
95352	13,444.498	114,910	151,387
95353	14,144.105	70,020	21,812
95354	4,334,287.799	40,200	31,054

95355	15,446,097.802	65,333	52,788
95356	11,042,969.847	80,593	58,857
95357	2,853,610.124	63,583	54,180
95358	4,877,603.314	43,886	34,357
95360	2,097,426.132	48,914	36,936
95361	8,588,497.017	64,876	46,546
95363	5,360,717.630	62,209	47,949
95364	163.286	20,411	4,378
95365	152,625.639	24,829	16,408
95366	5,425,697.478	78,562	60,271
95367	4,876,676.205	56,870	47,128
95368	3,565,745.696	62,739	59,271
95369	49,582.803	28,045	17,173
95370	6,506,285.290	60,471	47,336
95372	334,717.324	52,870	44,199
95373	39.533	39,533	39,533
95374	47,790.248	28,447	16,543
95375	12,004.441	24,251	11,276
95376	13,878,436.751	70,366	57,951
95377	11,852,166.589	108,695	95,655
95378	1,209.716	109,974	121,400
95379	464,359.101	47,715	37,459
95380	6,531,139.606	47,779	34,561
95381	8,335.197	93,654	87,657
95382	9,694,103.812	70,859	58,056
95383	900,552.812	55,921	44,963
95384	19.500	9,750	9,750
95385	15,090.709	52,581	31,345

95386	1,767,617.421	49,180	38,242
95387	27,836.864	35,780	10,456
95388	1,170,303.092	34,453	25,202
95389	207,186.823	56,578	37,309
95390	91.271	45,636	45,636
95391	2,763,849.595	100,712	88,783
95392	60.967	30,484	30,484
95395	70.263	70,263	70,263
95397	83.320	83,320	83,320
95401	10,039,641.890	69,083	50,859
95402	118.393	59,196	59,196
95403	16,019,210.949	91,785	63,626
95404	18,184,166.824	101,552	67,574
95405	9,472,727.731	83,874	63,474
95406	155.506	77,753	77,753
95407	7,585,598.361	67,725	49,725
95409	13,627,299.570	91,330	71,022
95410	258,470.254	54,346	35,527
95412	34,963.402	55,941	42,489
95415	116,592.930	42,274	30,312
95416	66,438.037	47,832	37,561
95417	16,472.475	28,548	15,931
95418	147.751	49,250	63,483
95419	28,020.439	22,151	14,594
95420	152,251.879	76,508	50,404
95421	317,900.189	44,749	29,743
95422	2,503,065.040	27,851	16,249
95423	1,330,213.662	38,924	27,559

95424	292,251.638	33,012	20,352
95425	3,758,070.437	77,103	60,329
95426	791,832.144	54,779	43,083
95427	13,868.020	30,082	17,361
95428	159,641.996	24,313	15,602
95429	10,200.994	19,580	14,247
95430	1,440.276	38,926	31,426
95432	67,906.966	62,015	40,029
95433	128,706.438	47,563	41,266
95435	69,773.666	47,987	30,186
95436	1,618,243.456	64,619	49,731
95437	3,740,690.896	52,150	36,274
95439	110,354.267	72,601	55,228
95441	342,778.152	83,381	60,337
95442	1,287,020.229	95,910	58,524
95443	77,853.987	43,085	26,329
95444	213,541.812	61,932	52,040
95445	1,151,336.175	69,580	53,028
95446	1,694,167.651	49,449	36,170
95448	6,879,261.718	91,409	61,176
95449	147,142.483	42,222	26,390
95450	83,854.980	62,346	35,015
95451	4,394,698.614	63,796	49,470
95452	759,819.544	114,448	67,166
95453	3,288,511.716	56,860	40,907
95454	152,431.934	24,981	14,671
95456	209,864.013	56,506	28,300
95457	910,769.673	40,811	25,257

95458	873,099.319	40,027	24,041
95459	222,733.074	67,515	54,654
95460	1,075,058.232	83,222	62,854
95461	1,498,337.791	53,472	40,322
95462	215,963.504	43,708	29,066
95463	7,158.038	37,477	22,450
95464	487,077.413	29,429	18,353
95465	468,945.049	86,029	66,349
95466	109,331.502	42,708	25,123
95467	2,433,227.322	90,958	77,277
95468	114,485.947	43,300	25,802
95469	277,689.441	43,917	32,628
95470	1,410,266.554	57,052	44,536
95471	7,436.416	31,377	18,064
95472	10,787,248.520	84,347	64,512
95473	864.045	123,435	105,722
95476	12,486,693.672	95,264	66,073
95480	313.933	78,483	69,850
95481	21,460.261	33,375	21,088
95482	6,204,860.775	57,144	38,854
95485	455,685.253	38,549	26,274
95486	2,085.829	42,568	29,546
95487	49.832	24,916	24,916
95488	66,349.285	48,184	27,364
95490	2,795,618.055	46,454	37,252
95492	11,552,568.598	91,075	78,808
95493	76,832.855	53,617	37,588
95494	27,880.684	45,781	20,719

95495	20.815	6,938	7,212
95496	94.787	31,596	35,283
95497	217,809.665	60,436	21,499
95501	3,971,494.081	41,186	30,199
95502	1,984.952	79,398	68,706
95503	5,047,708.106	44,495	33,989
95511	13,445.396	22,484	6,969
95514	7,359.465	22,234	6,439
95518	1,394.969	46,499	33,977
95519	3,777,648.054	54,384	43,164
95521	3,349,675.426	50,248	35,333
95524	437,277.695	63,081	49,985
95525	70,400.108	27,098	17,207
95526	39,836.257	34,640	16,306
95527	20,857.743	35,777	29,333
95528	131,760.044	41,908	29,341
95531	3,324,466.224	39,438	24,189
95534	693.170	49,512	42,419
95536	354,051.862	55,442	34,523
95537	8,573.698	21,542	15,953
95538	1,347.810	44,927	35,433
95540	2,782,452.958	49,881	37,250
95542	320,799.519	48,262	33,788
95543	132,108.118	35,870	21,002
95545	5,038.809	25,840	7,183
95546	6,543.570	14,738	3,378
95547	169,955.514	51,627	32,023
95548	112,281.389	22,291	10,506

95549	100,255.526	69,525	51,716
95550	4,583.358	71,615	16,116
95551	104,028.903	47,610	30,647
95552	11,097.775	36,149	29,650
95553	16,026.346	27,395	11,224
95554	31,294.198	30,923	9,464
95555	6,464.437	18,313	8,202
95556	9,505.957	19,929	7,120
95558	17,390.186	30,999	16,969
95559	3,817.950	19,090	5,662
95560	64,350.549	28,638	17,581
95562	470,259.074	32,205	25,187
95563	4,018.833	29,122	20,886
95564	22,095.373	24,854	14,665
95565	12,717.670	28,579	14,311
95567	359,721.917	40,000	18,156
95568	4,593.879	23,680	11,361
95569	15,365.049	27,785	11,638
95570	443,884.392	51,880	31,807
95571	9,547.549	25,059	17,360
95573	83,154.475	29,719	19,145
95585	15,639.646	20,180	10,598
95587	7,876.650	20,406	5,949
95589	542,853.994	65,769	54,113
95595	11,916.282	26,778	16,633
95601	13,421.650	30,643	21,060
95602	7,384,028.347	84,222	63,226
95603	10,262,308.213	73,477	56,682

95604	808.908	62,224	60,062
95605	1,746,306.206	40,504	23,433
95606	5,402.073	53,486	34,060
95607	39,564.905	42,090	25,246
95608	20,133,790.551	77,983	52,561
95610	12,303,711.867	70,633	52,075
95612	229,602.747	70,279	40,845
95613	6,601.921	57,912	33,700
95614	1,509,312.532	80,531	72,267
95615	106,996.635	49,998	31,240
95616	15,268,799.996	99,294	69,546
95617	620.869	310,434	310,434
95618	7,709,998.169	112,237	81,213
95619	757,716.262	51,785	42,726
95620	5,900,514.351	75,964	62,985
95621	10,980,287.770	54,568	41,880
95623	1,223,293.460	74,036	63,201
95624	23,069,518.961	93,634	74,756
95625	33,395.881	42,488	28,109
95626	1,414,923.496	51,093	40,206
95627	572,446.658	51,107	39,210
95628	17,367,335.110	82,916	60,198
95629	288,597.900	60,553	47,603
95630	33,788,634.419	119,635	96,261
95631	2,277,031.839	65,911	56,819
95632	8,043,083.941	69,224	57,099
95633	688,993.272	57,555	50,607
95634	430,616.337	54,800	46,617

95635	291,854.699	65,926	55,658
95636	113,614.062	45,049	38,838
95637	30,622.041	38,278	26,850
95638	679,610.975	76,155	63,648
95639	37,965.961	27,937	11,753
95640	2,119,334.315	56,599	46,439
95641	292,677.944	38,663	22,131
95642	2,295,670.180	61,743	45,456
95645	134,232.306	34,095	26,049
95646	32,027.681	59,531	45,110
95647	768.240	128,040	127,343
95648	22,023,924.569	96,702	80,022
95650	6,151,639.712	93,786	60,004
95651	77,673.733	60,921	46,559
95652	47,969.952	631,184	424,752
95653	47,701.440	29,104	24,406
95655	1,520,867.936	97,799	83,573
95656	23,955.512	85,251	71,822
95658	2,844,671.872	87,268	65,921
95659	56,277.663	42,895	24,181
95660	4,853,629.646	39,542	28,104
95661	12,780,102.255	96,873	74,207
95662	10,915,118.625	70,283	54,633
95663	1,212,524.268	85,317	65,174
95664	465,049.280	86,828	69,521
95665	1,669,183.627	61,358	51,299
95666	2,619,448.676	53,985	44,685
95667	10,380,843.762	70,967	57,941

95668	57,152.314	48,475	29,020
95669	593,477.765	65,949	49,441
95670	15,946,354.022	75,863	48,196
95672	1,928,374.115	97,897	84,508
95673	3,216,929.631	46,874	36,361
95674	45,125.017	41,172	28,077
95675	13,287.829	14,459	11,673
95676	14,599.766	48,829	41,129
95677	9,090,392.113	79,935	61,023
95678	13,507,335.585	71,946	54,162
95679	20,275.922	48,623	33,749
95680	22,114.417	58,349	43,286
95681	300,951.716	44,858	33,124
95682	10,673,644.874	90,384	78,544
95683	4,204,638.518	114,188	98,460
95684	620,361.502	56,742	46,482
95685	1,562,822.010	64,646	48,617
95686	138,550.181	52,402	29,410
95687	20,448,471.008	80,471	64,015
95688	13,448,698.271	82,595	67,766
95689	669,388.992	64,600	53,392
95690	432,916.222	61,337	35,143
95691	8,825,625.814	68,640	51,072
95692	1,157,728.493	59,179	45,298
95693	2,983,391.790	97,037	76,406
95694	2,082,705.553	65,881	50,949
95695	8,040,742.993	58,615	42,519
95696	116.826	116,826	116,826

95697	46,199.839	40,741	21,968
95698	36,164.119	61,608	51,664
95699	4,811.998	47,644	25,293
95701	359,953.937	51,592	38,917
95703	579,883.543	58,432	48,987
95709	1,262,626.816	73,799	61,148
95711	81.002	81,002	81,002
95712	2,611.121	62,170	62,113
95713	2,699,619.825	63,642	50,071
95714	156,636.067	45,733	31,275
95715	270,124.846	71,937	25,755
95717	79,333.762	46,915	34,019
95720	14,690.277	25,818	13,615
95721	5,440.616	21,170	7,475
95722	2,506,164.381	93,503	64,109
95724	101,974.868	66,217	42,186
95726	2,442,177.390	62,683	54,452
95728	615,703.511	100,753	78,074
95730	89.484	89,484	89,484
95734	1,471.217	367,804	378,610
95735	13,952.093	31,854	12,857
95736	708,297.860	79,432	60,793
95742	2,324,935.720	102,983	72,986
95746	18,126,447.242	156,210	122,936
95747	23,590,646.381	96,423	84,363
95757	13,374,800.642	124,417	100,270
95758	24,388,643.000	90,413	74,634
95759	51.654	51,654	51,654

95762	20,410,197.109	134,548	115,009
95765	14,776,472.441	108,211	87,721
95776	4,285,279.619	69,268	55,894
95811	933,270.053	93,843	55,444
95814	2,265,106.453	114,359	53,154
95815	3,666,244.581	44,488	24,731
95816	5,102,566.649	81,153	54,810
95817	2,854,026.467	44,083	27,355
95818	7,166,557.832	70,167	50,500
95819	7,008,429.371	67,002	48,060
95820	6,178,147.811	36,445	26,110
95821	8,492,294.980	65,985	40,710
95822	9,593,233.752	47,816	33,082
95823	13,821,540.239	55,751	40,416
95824	3,875,150.091	40,079	26,958
95825	7,451,532.732	79,459	42,313
95826	9,607,182.547	57,293	42,589
95827	4,773,407.182	58,022	43,782
95828	12,761,182.138	55,549	43,529
95829	9,641,673.824	97,780	75,819
95830	383,859.895	118,695	77,690
95831	17,349,504.631	89,087	65,573
95832	1,822,160.618	51,278	30,455
95833	9,814,485.458	75,884	47,729
95834	7,071,531.080	109,892	63,129
95835	14,072,479.365	115,096	91,517
95836	83.827	5,239	3,489
95837	180,585.509	131,049	108,837

95838	5,803,942.506	43,470	30,344
95840	42.012	42,012	42,012
95841	4,883,704.770	65,449	42,426
95842	6,847,518.578	54,144	39,769
95843	13,584,013.089	77,603	63,705
95864	11,459,874.727	87,107	53,025
95865	11.398	11,398	11,398
95901	4,250,477.634	42,361	28,767
95903	4,618.880	12,483	9,987
95910	1,417.791	7,197	2,651
95912	591,254.052	47,509	32,678
95913	9,802.215	26,492	16,523
95914	98,783.639	24,971	12,761
95915	196.594	12,287	10,196
95916	335,958.006	23,016	11,936
95917	378,602.076	37,360	24,858
95918	789,503.638	73,388	58,904
95919	163,888.986	28,662	16,346
95920	4,378.105	22,684	12,077
95922	77,194.535	30,755	17,090
95923	33,208.622	39,161	29,575
95924	1,941.616	45,154	27,576
95925	29,151.124	30,493	16,383
95926	7,765,813.078	55,744	39,761
95927	86.449	21,612	23,791
95928	8,406,693.951	63,282	41,591
95929	222.009	74,003	85,237
95930	23,905.927	24,099	16,830

95931	1,092.857	36,429	36,740
95932	1,258,021.448	41,701	30,592
95934	24,355.738	30,521	18,099
95935	52,196.893	28,063	17,571
95936	11,570.748	20,662	12,478
95937	99,357.134	33,544	20,244
95938	956,505.539	64,826	44,891
95939	4,831.292	12,883	6,464
95940	1,051.015	8,907	1,761
95941	51,753.440	20,885	10,759
95942	409,527.438	51,242	37,063
95943	44,902.761	45,819	28,995
95944	1,818.787	13,573	7,270
95945	7,315,943.221	64,678	48,362
95946	5,363,884.974	86,881	72,170
95947	186,936.724	32,131	20,183
95948	1,482,687.462	38,005	26,951
95949	8,447,661.967	76,821	63,038
95950	27,139.941	26,978	18,424
95951	28,355.948	17,812	12,082
95953	994,250.435	39,602	30,703
95954	2,925,055.821	32,300	18,217
95955	135,803.941	30,662	20,268
95956	26,776.816	32,222	26,517
95957	29,631.076	31,289	16,867
95958	1,904.070	22,941	17,050
95959	7,274,553.858	78,370	59,695
95960	91,592.750	41,128	28,288

95961	3,392,253.498	46,576	28,177
95962	111,246.529	40,263	30,425
95963	1,478,416.169	37,176	28,088
95965	2,412,578.221	33,026	21,023
95966	5,201,552.499	32,935	22,034
95968	177,741.909	19,778	12,039
95969	7,088,668.349	41,726	29,282
95970	48,667.829	35,241	20,572
95971	959,111.830	54,538	34,963
95972	15,432.575	20,827	12,753
95973	7,951,698.349	60,375	44,544
95974	21,089.329	32,296	21,306
95975	429,189.717	67,653	54,752
95976	497.627	82,938	101,716
95977	369,864.981	58,793	48,265
95978	11,111.149	13,087	7,004
95979	86,860.510	28,110	22,338
95980	121.991	10,166	6,483
95981	26,035.706	24,820	14,221
95982	505,161.264	47,053	36,005
95983	85,868.889	50,099	29,567
95984	6,719.057	27,425	22,731
95986	2,475.992	19,808	12,482
95987	783,525.974	50,101	38,401
95988	926,013.068	34,691	26,816
95991	5,180,417.754	49,799	40,705
95992	245.699	27,300	33,665
95993	7,528,039.661	65,902	56,976

96001	8,722,456.714	57,503	44,390
96002	7,470,446.506	54,393	41,406
96003	10,595,511.725	56,980	44,685
96006	7,467.107	15,622	7,884
96007	3,474,176.301	37,551	27,829
96008	209,258.402	44,580	23,615
96009	14,914.882	19,370	5,766
96010	158.817	31,763	12,983
96011	3,779.041	12,942	3,196
96013	637,014.974	31,249	23,639
96014	20,657.614	26,586	14,587
96015	14,616.072	29,058	8,103
96016	63,947.313	36,169	29,119
96017	16,212.571	25,899	16,671
96019	1,740,338.600	35,897	28,269
96020	288,736.580	46,782	33,426
96021	1,378,910.204	28,814	19,921
96022	2,742,586.125	46,269	35,905
96023	84,616.345	20,883	14,916
96024	4,734.260	36,139	31,942
96025	359,036.978	32,192	24,094
96027	327,342.702	40,867	31,078
96028	157,104.814	33,356	22,024
96029	6,154.466	46,625	31,930
96031	11,816.593	25,857	15,882
96032	370,148.291	43,394	31,987
96033	29,793.552	20,704	7,909
96034	31,074.199	40,887	23,649

96035	226,203.636	26,114	15,466
96037	63,267.821	51,647	35,684
96038	55,060.781	33,472	25,313
96039	83,044.847	19,987	11,147
96040	24,760.272	33,642	26,992
96041	21,930.209	25,324	19,043
96044	181,000.641	31,866	21,041
96045	1,127.011	26,210	21,020
96046	328.558	20,535	18,131
96047	56,764.888	26,725	10,987
96048	36,256.091	39,495	31,330
96049	533.792	33,362	20,341
96050	72,180.742	32,661	21,068
96051	207,456.955	40,057	27,625
96052	69,694.729	40,473	32,679
96054	3,901.037	14,833	4,688
96055	380,738.470	28,914	18,615
96056	175,368.466	35,797	17,455
96057	299,980.124	36,966	25,458
96058	41,857.056	18,770	10,913
96059	59,225.406	31,587	22,413
96061	11,675.561	13,436	4,132
96062	103,276.592	47,571	31,419
96063	1,328.135	14,595	13,810
96064	708,596.519	35,665	26,420
96065	16,999.293	23,742	10,472
96067	2,164,573.419	60,380	45,189
96068	592.142	6,436	1,620

96069	58,563.165	26,523	14,361
96070	1,381.398	35,420	37,044
96071	60,054.098	37,534	31,406
96073	865,766.435	63,965	54,111
96074	2,669.893	11,558	7,964
96075	15,903.764	11,550	4,694
96076	9,307.303	21,951	11,802
96078	3,815.830	22,713	17,088
96079	908.338	64,881	69,650
96080	4,365,968.381	40,931	30,024
96084	29,883.487	25,739	16,939
96085	13,986.136	33,143	18,136
96086	40,537.900	26,478	15,568
96087	162,955.928	44,354	24,948
96088	1,014,639.094	43,084	34,400
96089	11,806.437	21,427	12,537
96090	12,367.011	22,323	16,357
96091	60,838.498	39,608	31,060
96092	7,343.737	25,411	7,161
96093	32,162.252	38,426	34,537
96094	1,691,963.530	50,398	36,287
96095	117.363	29,341	22,632
96096	55,223.228	36,236	20,811
96097	1,589,777.839	39,300	29,569
96099	1,285.352	128,535	78,733
96101	393,734.035	26,634	20,444
96103	292,101.193	44,419	38,705
96104	23,131.945	18,961	12,054

96105	17,536.329	27,530	21,847
96106	108,689.958	67,804	55,506
96107	113,773.975	46,457	35,015
96108	4,542.084	16,823	5,705
96109	26,552.628	16,472	5,592
96110	2,947.936	17,443	4,798
96111	6,020.550	32,195	25,239
96112	3,025.327	14,071	5,510
96113	8,256.735	9,277	6,209
96114	467,814.745	48,298	41,509
96115	6,711.951	24,319	12,188
96116	2,160.276	17,422	5,920
96117	28,360.067	40,572	22,754
96118	36,808.309	18,043	8,840
96119	1,236.150	11,553	2,736
96120	215,047.131	59,438	38,597
96121	38,539.824	40,654	25,322
96122	597,773.884	40,393	26,516
96123	2,091.764	13,762	3,784
96124	15,867.736	23,683	11,321
96125	27,668.481	25,572	12,381
96126	11,998.078	23,759	9,354
96127	1,405.244	40,150	29,282
96128	47,228.290	43,368	34,299
96129	41,372.428	42,390	29,101
96130	2,143,826.055	43,952	36,390
96132	772.775	10,443	2,328
96133	21,851.890	46,198	27,532

96134	114,999.032	19,534	12,751
96135	2,367.780	18,075	4,415
96136	7,078.128	32,028	21,230
96137	1,502,990.414	69,894	50,901
96140	3,155,737.266	105,240	72,591
96141	1,888,215.204	119,682	63,549
96142	831,597.876	74,210	53,803
96143	2,392,558.321	86,290	61,515
96145	7,600,450.618	54,568	2,600
96146	4,286,384.500	135,405	90,050
96148	1,860,180.752	88,433	64,145
96150	5,305,208.609	25,469	1,243
96151	9,782.205	90,576	61,114
96152	655.314	54,610	64,424
96154	836.789	83,679	64,833
96155	4,564.388	65,206	66,218
96156	1,412.307	47,077	28,411
96157	1,624.276	52,396	54,784
96158	4,426.501	75,025	75,150
96160	2,681.767	65,409	52,240
96161	23,373,679.345	124,033	86,797
96162	10,511.451	194,656	84,391
96340	38.934	38,934	38,934
96370	24.432	12,216	12,216
96561	8.111	4,056	4,056
96585	1.962	981	981
96612	46.745	46,745	46,745
96633	9.656	4,828	4,828

96697	23.938	11,969	11,969
96834	64.551	32,275	32,275
96880	3.341	1,671	1,671
97201	34.156	17,078	17,078
97310	326.632	81,658	84,057
97382	421.521	105,380	109,875
97635	16.395	5,465	3,686
97735	0.844	422	422
97845	8.549	4,274	4,274
97953	4.678	2,339	2,339
98006	26.652	13,326	13,326
98203	45.916	22,958	22,958
98577	10.329	5,164	5,164
98662	125.775	25,155	26,559
98730	66.816	16,704	11,403
99225	19.613	6,538	6,073
99411	101.553	101,553	101,553

Tabulated from parcel-level structure replacement costs from Zillow's ZTRAX dataset.