Trends and drivers of utility costs in California

Authors:
Madalsa Singh[1*], Alison Ong[2], Rayan Sud[3]

Affiliations:
[1]Department of Energy Science & Engineering, Stanford University, Stanford, CA, USA
[2] Emmett Interdisciplinary Program in Environment and Resources, Stanford University, Stanford, CA, USA
[3] The Bill Lane Center for the American West, Stanford University, Stanford, CA, USA
*madalsa@stanford.edu

Abstract:

Electricity affordability is a salient policy concern in California. We compare drivers of increasing utility costs for three types of power providers in California: investor-owned utilities (IOUs), publicly-owned utilities (POUs), and community choice aggregators (CCAs). Since 2019, the IOU and CCA residential baseline electricity rates have increased by 44-80% after accounting for inflation, making them some of the most expensive power providers in the United States. POU prices, however, remained nearly unchanged. We compare long-term trends in capital assets, returns, and operation & maintenance expenses to identify sources of increasing utility costs contributing to rising electricity prices in the state. Across IOUs, generation capital assets have declined, and fuel and power purchase expenses have increased but are within historical ranges. Transmission and distribution (T&D) expenses have increased significantly and are the majority of overall costs. T&D operations and maintenance spiked post wildfires after years of remaining constant despite an aging and expanding electricity grid. CCAs reach price parity with IOUs due to the high costs of T&D infrastructure they share and exit fees levied on them. POUs, servicing smaller territories with low wildfire risks, also expanded their T&D capital assets, operations, and maintenance expenses, but the increase is modest. We foresee continued price divergence among power providers due to wildfire mitigation costs, which will have important affordability consequences.

Introduction:

Affordable and reliable access to electricity is vital to decarbonizing our energy systems and adapting to climate change. Expensive electricity can reduce the adoption of clean electric technologies and consumers may forgo cooling and heating in extreme weather [1], [2], [3]. California lies at the center of this challenge: the state has ambitious electrification and climate goals but some of the country's most expensive power providers.

California has three main types of power providers: investor-owned utilities (IOUs), publicly-owned utilities (POUs), and community choice aggregators (CCAs). IOUs are privately owned firms participating in the generation, transmission, and distribution of electricity. Owing to the capital-intensive nature of distribution and transmission assets used in electricity supply, these firms enjoy a monopoly in their territory: it is cheaper if a single firm serves an area with its

network instead of multiple firms building redundant infrastructure. In exchange for a service territory monopoly, IOUs accept the obligation to serve all customers and regulatory oversight of their electricity rates, investment returns, and overall costs by the state Public Utilities Commission (PUC) and Federal Electricity Regulatory Commission (FERC) [4], [5]. In 2022, IOUs serviced about 40% of California's total retail electricity demand.[6]

POUs and CCAs, the other two key power providers, operate on a non-profit basis. POUs are owned and operated by municipalities, irrigation districts, and city governments. They are governed by local laws and are not subject to PUC regulations. In 2022, POUs served roughly 25% of California's total retail electricity demand [6]. CCAs have emerged as a new player in the state's electricity sector, operating with IOU territories. CCAs procure their own power but use IOU distribution and transmission networks to deliver it. In 2022, they served 23% of California's total electricity demand. Direct Access providers, "behind-the-meter" rooftop solar providers, one federal utility, and four small rural electric cooperatives meet the residual 14% of state electricity demand [6] and are not the focus of this paper. Figure 1 shows the service territories of IOUs, POUs, and CCAs active in northern and southern California.

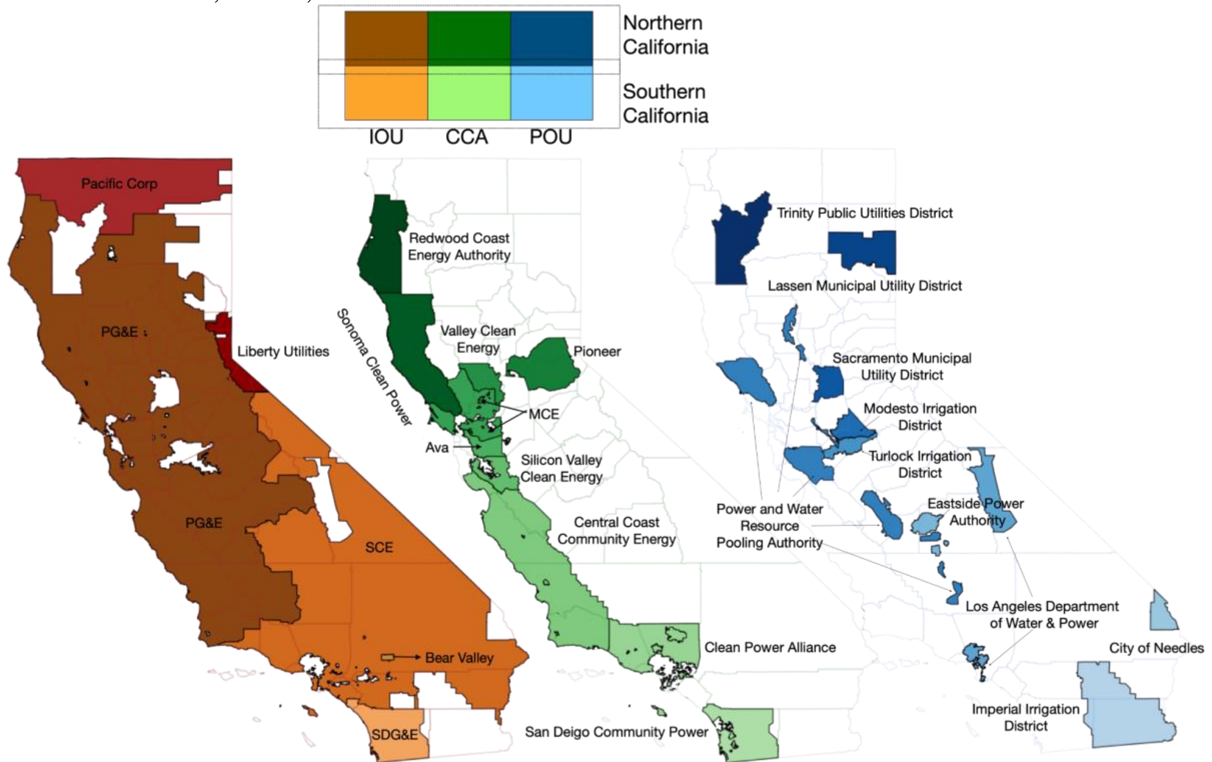

Figure 1: The geographic territories of IOUs (brown), CCAs (green), and POUs (blue) in California. Darker colors denote power providers active in northern California, while lighter colors denote those in southern California. CCAs are formed inside IOU territories. Source: California Energy Commission GIS open data [7], CalCCA [8].

2018 was a pivotal year for California's utilities. More than a decade after power lines caused wildfires in southern California, a transmission tower owned by PG&E, the largest IOU in northern California, started the Camp Fire. The Camp Fire remains the deadliest wildfire in California's history, killing eighty-five people and destroying the town of Paradise. Shortly after,

PG&E filed for bankruptcy due to financial liabilities [9] and promised to overhaul wildfire mitigation across its 125,000 circuit miles of power lines [10].

Growing expenses were quickly reflected in electricity prices. Figure 2 compares PG&E's residential baseline rate (in $/kWh) to Southern California Edison (SCE) and San Diego Gas and Electric (SDG&E) (IOUs), MCE Clean Energy and Clean Power Alliance (CPA) (CCAs), and Los Angeles Department of Water and Power (LADWP) and Sacramento Municipal Utility District (SMUD) (POUs). Prices have increased across IOUs and CCAs, but POU prices have remained low. By early 2024, PG&E charged its residential customers a baseline rate of 42 cents per kWh, up 20 cents since 2018, while SMUD and LADWP have increased prices by less than 5 cents per kWh. SMUD and LADWP serve about 13% of the statewide load—approximately equal to PG&E. SMUD and LADWP also have fixed charges ($/month) as part of the monthly bill not shown in the figure. Rates for commercial customers show similar trends (appendix). Table 1 details the power providers selected as case studies, encompassing about 60% of California's total electric load.

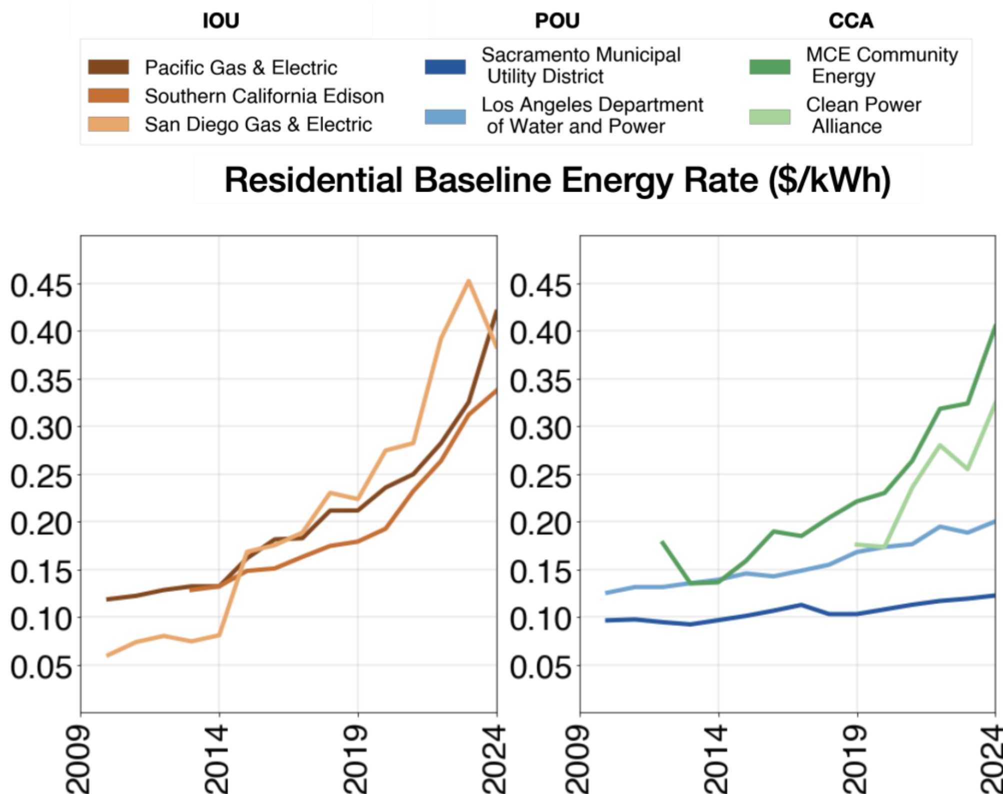

Figure 2: Residential baseline electricity rate ($/kWh) for California IOU, POU, and CCA (nominal $). In addition to electricity rates, bills include fixed charges ($/month) not shown in the figure. Source: Historical tariff books and data requests [11], [12], [13], [14], [15], [16].

Table 1: Residential, industrial, and commercial sales (in TWh) of power providers analyzed in this study

Power provider	Type	Residential sales (TWh)	Industrial sales (TWh)	Commercial sales (TWh)	Approx. area served in square miles

PG&E	IOU	12.0	11.8	7.4	70,000
SCE	IOU	22.5	4.0	28.4	50,000
SDG&E	IOU	3.9	1.2	2.6	4,100
SMUD	POU	4.8	2.1	3.7	900
LADWP	POU	8.5	1.2	12.1	465
MCE	CCA	2.8	0.0	2.6	-
CPA	CCA	5.3	1.5	4.1	-

Source: Electricity sales data from EIA Form 861 2022 [6]. Service area is taken from power providers' web pages [10], [17], [18], [19], [20]. IOU customers receive all services (energy, transmission, distribution) from IOUs, while CCA customers receive energy services from CCAs using the IOU T&D network.

In this paper, we use historical regulatory, financial, and rate data to contextualize California's key power providers and their growing costs. We analyze long-term trends in capital, returns, and operations and maintenance (O&M) expenses to identify the drivers of cost increase for IOUs and CCAs and the relative constancy of POU prices. Increasing utility costs and the growing price divergence between POU and non-POU prices have important affordability implications across California. The rest of the paper is organized as follows. Sections 1 and 2 provide historical cost trends for IOUs and POUs. Section 3 decomposes CCA electricity rates to identify sources of price increase, and section 4 concludes. Throughout this paper, all cost values are reported in real terms (2022$), and cost trends are normalized to the reference year 2010. While we focus on California's power providers, the lessons and insights apply nationwide as electricity demand increases and the grid faces reliability challenges [21], [22], [23].

1. Trends in returns and costs for California's Investor-Owned Utilities (IOUs)

IOUs are for-profit entities with geographic monopolies in their territories. PUC and FERC regulate IOU costs in a periodic, multi-party, formal regulatory process called the 'rate case'. The rate case determines the revenue requirement: the total costs of owning, operating, and maintaining the electricity grid and reasonable returns on assets and investments. Prices are then set to ensure IOUs recover their revenue requirement given total electricity sales. Electricity prices may rise due to growing utility expenses and/or declining electricity sales. While our paper primarily examines the causes behind rising utility costs, it is important to note that declining electricity sales resulting from customer generation also play a significant role in rising electricity prices in California [3], [24], [25], [26], [27].

Utility's revenue requirement primarily consists of operations and maintenance (O&M) expenses, depreciation, taxes, and returns on capital investments. In 2023, O&M represented

46% of the revenue requirement for PG&E and SDG&E and 34% for SCE. Depreciation and return on rate base each accounted for 20-30%, while taxes made up less than 10% [28]. To identify drivers of rising utility costs, we'll examine trends in rate base, rate of return, and O&M expenses for California's IOUs. Our analysis includes both authorized expenses and returns (set during rate cases) and actual expenses and returns (from financial statements as part of FERC Form 1)[1][30].

(a) Rate base

The rate base is the value of a utility's capital and assets minus depreciation. IOUs earn a regulated rate of return on their rate base. An increasing rate base—expansion of IOU capital and assets—raises the revenue requirement even if returns remain constant or decline marginally. Figure 3 shows the ratio of real generation, distribution, and transmission rate base in a year to that of a reference year (2010), and Table 2 provides the rate base for 2010, 2018 (the year of Camp Fire), and 2022 (all in 2022$). California PUC's historical electric cost data and annual electric and gas utility cost reports provide the rate base values [32], [33], [34], [35].

Since 2010, the total rate base has increased by an annual average of 4.6% (PG&E), 6.5% (SCE), and 9.1% (SDG&E). Distribution is the largest share of the overall rate base, followed by transmission and generation. Across the three IOUs, the generation rate base declined due to the growing share of power procured through wholesale energy markets. On the other hand, the transmission and distribution rate base has increased due to the expansion of wires, poles, transformers, and fixtures, particularly after wildfires. For example, PG&E's authorized distribution capital expenses grew from under $90 million in 2018 to nearly $600 million in 2020 [36, pp. 91–92]. Despite recent increases, PG&E has the smallest transmission and distribution rate base increase among the three IOUs. SCE, the largest utility in electricity sales, has doubled its transmission and almost tripled its distribution rate base since 2010. SDG&E, the smallest of the three IOUs, tripled its transmission rate base in less than five years due to updates to their cost methodology, new and planned transmission lines, and recouping under-collected revenues from previous years [37].

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[1] FERC Form 1 is a financial and operating report where major IOUs of the United States report their costs, sales, demand, and customer counts annually for market oversight, financial audits, and electric rate regulation [29]. We use FERC Form 1 data collect by the Catalyst Cooperative as part of the Public Utilities Data Liberation (PUDL) project [30], [31]. In this paper, we use Schedule 320 of Form 1 corresponding to operation and maintenance costs of IOUs.

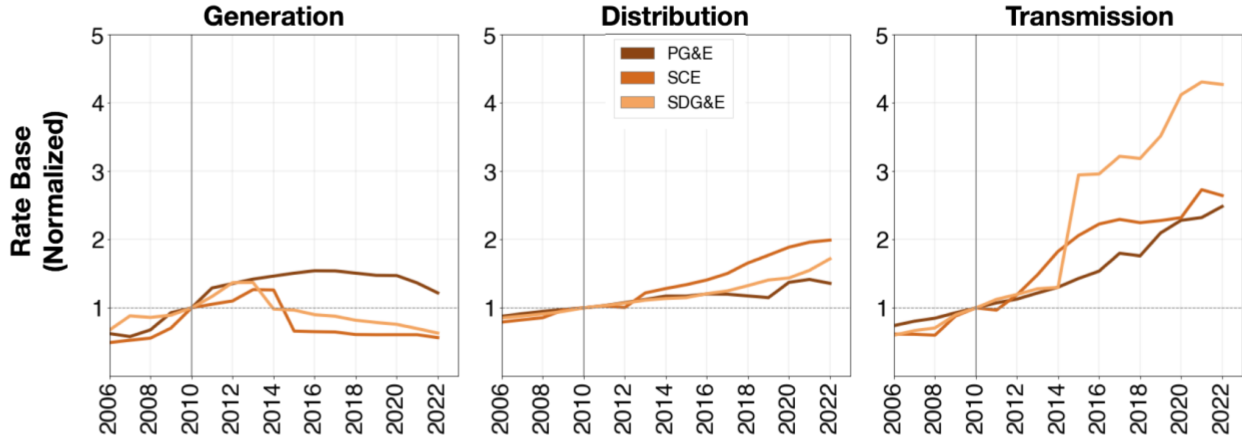

Figure 3: Ratio of rate base (in 2022$) for the three IOUs in generation, distribution, and transmission of a year to rate base (in 2022$) of the reference year (2010). *Source: California Public Utilities Commission Historical Electric Cost Data [32]*

Table 2: Generation, Distribution, and Transmission rate base (in billion, $2022)

Utility	Year	Generation	Distribution	Transmission	Sum
PGE	2010	4.0	13.5	4.5	22.0
	2018	6.1	15.8	8.0	29.8
	2022	4.9	18.3	11.2	34.4
SCE	2010	4.2	13.8	2.8	20.8
	2018	2.6	22.9	6.2	31.7
	2022	2.4	27.6	7.3	37.2
SDG&E	2010	0.9	3.4	1.2	5.4
	2018	0.7	4.5	3.7	8.9
	2022	0.6	5.8	5.0	11.3

Source: California Public Utilities Commission Historical Electric Cost Data [32]

(b) **Rate of Return**

The rate of return (ROR) is the regulated return earned on the rate base by an IOU. It is the weighted average cost of debt and equity issued by a utility to finance its capital investments.[38]. Actual ROR, on the other hand, reflects the recorded profits or losses in a year. Authorized and actual RORs can diverge due to a utility's operation efficiency, cost management, weather changes, and unexpected events such as wildfires [39].

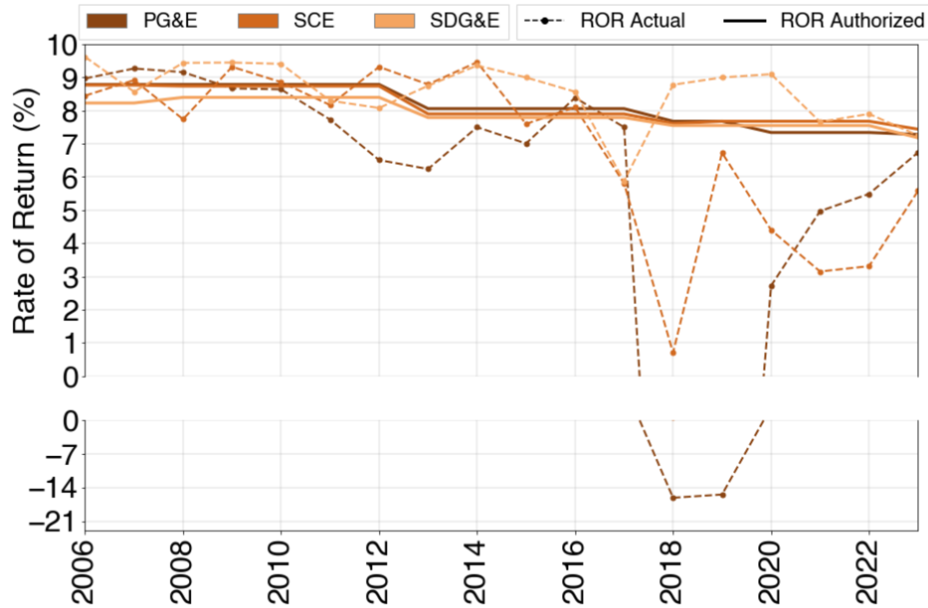

Figure 4: Authorized and actual rate of return for three California IOUs - PG&E, SCE, and SDG&E. Source: CPUC Historical Electric Cost Data [38]

Figure 4 shows the authorized and actual ROR earned by the California IOUs since 2006. The authorized ROR for California IOUs declined from 8.77-8.4% in 2006 to 7.68-7.5% by 2022. In 2023, the authorized ROR was further reduced to 7.44% (PG&E), 7.27% (SCE), and 7.15% (SDG&E). The actual ROR for PG&E and SCE declined sharply in 2018 – with negative values for two years for PG&E – due to the damages of the Camp and Woolsey fires. SDG&E shows the opposite trend of actual ROR being higher than its authorized value: for 12 out of the last 15 years, SDG&E has earned more than its authorized ROR. Actual ROR can exceed authorized values. However, persistently higher-than-authorized ROR may indicate that utilities overstate expenses or don't pass on improved cost management and operational efficiency gains to ratepayers, preferring to increase returns instead [40].

A subcomponent of the ROR of interest is the return on equity (ROE). ROE measures the company's returns to its shareholders and is calculated by dividing net income by overall shareholders' equity [41].

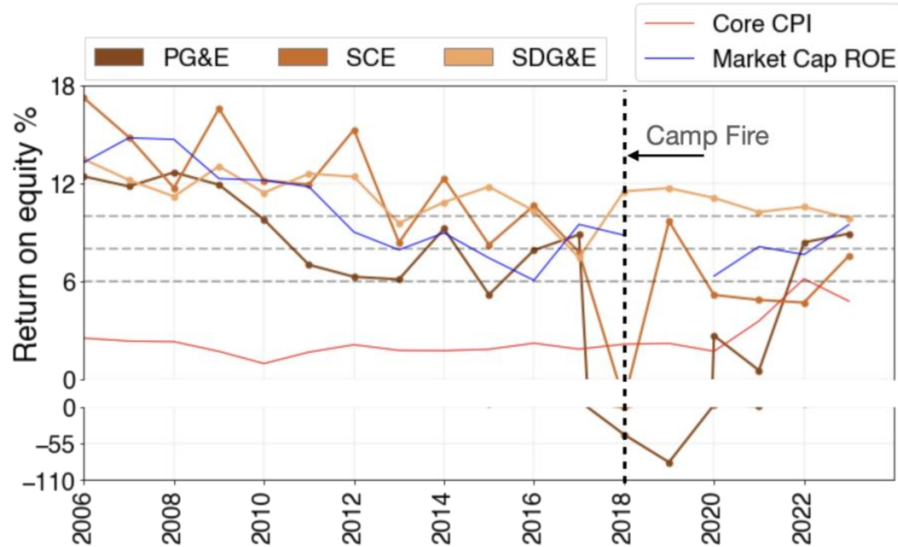

Figure 5: ROE for California IOUs compared to the core consumer price index and the market capitalization-weighted ROE for electric utilities in the United States. Source: ROE data from S&P Capital IQ pro database[42][2] and Core CPI from US Bureau of Labor Statistics.[43]

Figure 5 shows the actual ROE for the three IOUs since 2006. For comparison, we also plot market capitalization-weighted ROE for all electric utilities in the United States and the core consumer price index (inflation). ROE values are taken from the S&P Capital IQ database, and inflation values from the US Bureau of Labor Statistics [42], [43].

ROE has declined for the three IOUs since 2006. SCE's ROE declined from 18% in 2006 to 9.7% in 2019 and 7.6% in 2023. It is 1-3% below the US market-capitalization weighted ROE of electric utilities. PG&E's ROE declined from 12% in 2006 to roughly 8.9% in 2017. After the Camp Fire, PG&E recorded a negative ROE and filed for bankruptcy, but as of 2023, its ROE has recovered. Wildfire costs may be financed via lower shareholder returns and/or higher costs to ratepayers [44]. Figure 5 shows that after the Camp Fire, PG&E's ROE rebounded to previous levels in a few years while rates have increased. SDG&E's ROE declined from 13% in 2006 to 10% in 2023 but continues to be higher than the industry average for all years in the last decade except 2017.[3] Since 2006, SDG&E ROE has been higher than 10%, apart from 3 years.

Determining optimal ROE for California IOUs is a complex exercise. On the one hand, they face unique wildfire-related financial risks that may justify higher ROEs to attract capital. On the

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[3] Industry average ROE data were unavailable for 2019.

other hand, research documents that electricity utilities, in general, earn ROE exceeding market benchmarks [39], [45], [46]. A recent study also shows that utility ROEs rise quickly when market capital costs increase, but a proportional response is not seen when costs fall [47]. To mitigate the gap between ROE and capital costs, California PUC uses a formula adjustment mechanism that adjusts ROE when capital costs change beyond a 'dead band' [39], [44], [48]. The implications of these factors are significant as elevated ROE at a time when IOUs are investing vast amounts of capital in wildfire prevention would result in more severe increases in revenue requirements and, consequently, rates.

c) **Operations and Maintenance**

Operations and maintenance (O&M) is the largest component of IOU revenue requirement [28]. O&M expenses include fuel costs, labor, rent, and capital maintenance costs, along with wildfire mitigation expenses like vegetation management, network inspection, and repairs. Figure 6 shows O&M expenses normalized to the reference year (2010), and Table 2 provides O&M costs for 2010, 2018 (before Camp Fire), and 2022. O&M data are taken from FERC form 1, which documents utilities' expenses as reflected in the financial statements. The utility does not earn a rate of return on O&M expenses.

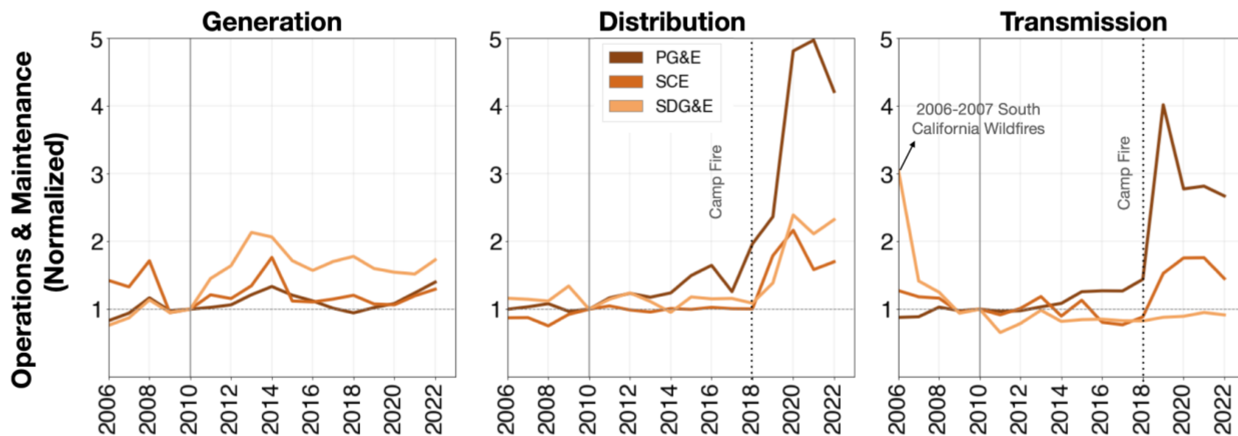

Figure 6: California IOUs' generation, distribution, and transmission operation and maintenance costs. The figure shows the ratio of a year's real costs (in 2022$) to that of a reference year (2010). Source: FERC Form 1 data via PUDL [30]

Table 3: Generation, Distribution, and Transmission Operations and Maintenance costs (billions of $2022)

Utility	Year	Generation	Distribution	Transmission	Sum
	2010	5.78	0.28	0.67	6.73
	2018	5.47	0.40	1.32	7.19
PGE	2022	8.10	0.74	2.84	11.68
	2010	5.17	0.34	0.61	6.11
	2018	6.23	0.30	0.61	7.13
SCE	2022	6.69	0.49	1.03	8.21
	2010	1.31	0.12	0.15	1.58
	2018	2.34	0.10	0.16	2.60
SDG&E	2022	2.27	0.11	0.34	2.72

Source: FERC form 1 data via PUDL [30]

O&M trends differ from those of rate base. Across the three IOUs, generation is the largest share of overall O&M expenses by a factor of four to six. Gen O&M costs include purchased power and fuel, rent, and maintenance expenses for utility-owned generators. Since 2019, real generation O&M costs have increased for all three IOUs. While the increase for SCE and SDG&E is within historical ranges, the generation O&M expenses peaked for PG&E in 2022. All three IOUs source over 75% of their power from external purchases, and the increase in generation O&M costs is due to rising natural gas and wholesale power prices [30], [35].

While far smaller in magnitude than generation O&M, T&D O&M has increased sharply since 2019 due to post-wildfire vegetation management, liability insurance, and catastrophic event expenses [35] (figure 6). PG&E, in particular, increased its T&D O&M expenses by four and five factors, but only after the Camp Fires occurred. Until 2017, T&D O&M expenses remained relatively constant despite an aging and growing electricity grid. In 2018-2020, PG&E spent around $0.8 billion (in 2022$) on maintenance of overhead lines. By 2020-2023, it more than doubled to around $2 billion (in 2022$) [30]. California PUC's Safety and Enforcement Division noted inadequate inspection and maintenance of PG&E's transmission facilities in their reports after the 2018 Camp Fire [49], [50]. A similar response was seen when SDG&E power lines caused the 2006-07 wildfires that burned over 200,000 acres and destroyed over 1,300 homes [51]. The transmission O&M expenses tripled immediately but declined by 2010 and have since remained relatively constant. These trends suggest that investments in T&D O&M increase sharply in response to wildfires but don't consistently and systematically increase with the expansion of the grid. A continued understanding of IOU's capital and operating and maintenance expenses on the T&D network will be crucial for the affordability and resiliency of the state's electricity, as areas most susceptible to wildfires almost entirely lie in IOU territories

(Figure 7).

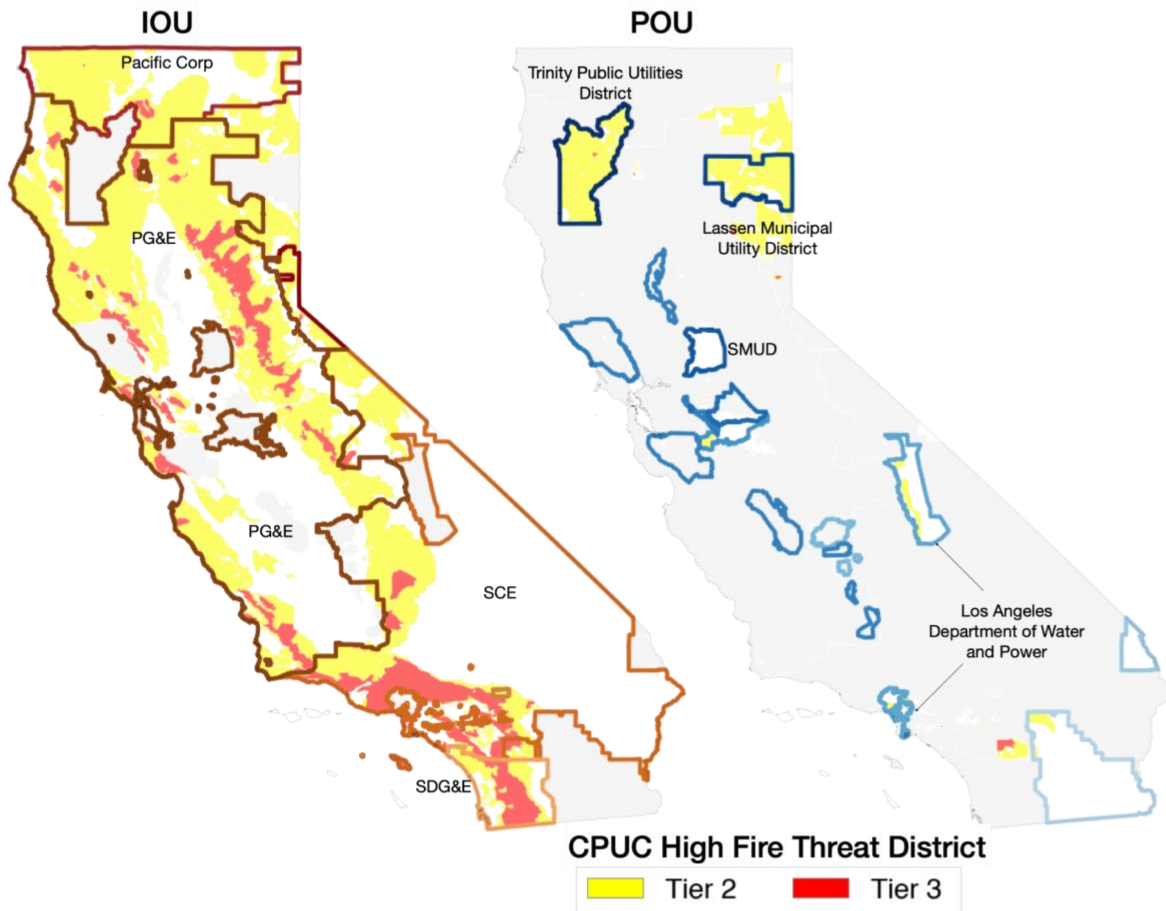

Figure 7: High fire threat districts in IOU and POU territories. Fire threat districts are outlined based on the "likelihood and potential impacts on people and property from utility-related wildfires." Tier 2 denotes higher risk, while Tier 3 denotes extreme risk. Source: CPUC Fire Threat Maps [52] and California Energy Commission GIS open data [7]

Depreciation and taxes are the two remaining components of the IOU revenue requirement. IOUs initially finance capital investments but spread out to ratepayers over their useful lifetime through the annual recovery of depreciation costs. Between 2012 and 2022, combined generation and distribution depreciation had grown by 26% in real terms [35]. Utilities spent almost $5 billion on generation and distribution depreciation in 2023 (PG&E $2.4 billion, SCE $2.1 billion, and SDG&E $0.4 billion). This is similar in magnitude to the returns earned on the rate base of roughly $4.5 billion (PG&E $1.7 billion, SCE $2.3 billion, and SDG&E $0.4 billion) [28]. Depreciation will continue to increase as network capital expenses rise. Additionally, the revenue requirement includes various taxes, such as property and income taxes, which aren't directly assessed on consumers' bills. Taxes on generation and distribution have declined by 38% in real terms since 2012 and are the smallest component of revenue requirement.[35] In 2023, the IOUs recovered roughly $1.5 billion on taxes as part of the revenue requirement (PG&E $0.6 billion, SCE $0.8 billion, and SDG&E $0.2 billion) [28].

2. Trends in Costs for California's Publicly Owned Utilities

POUs are non-profit entities owned and operated by cities, municipalities, and irrigation districts. Their expenses and electricity rates are decided considering each territory's strategic priorities and public feedback. POUs are outside the regulatory purview of the PUC. While POUs do not use precise revenue requirement formulations as used for IOUs, they must still adhere to their internal governance rules when setting their electricity rates.

This section examines the two largest POUs in the state – Sacramento Municipal Utility District (SMUD) and the Los Angeles Department of Water and Power (LADWP). In 2022, SMUD served ~650,000 customers throughout the Sacramento area, while LADWP served ~1.4 million customers in the greater Los Angeles region and Owens Valley [20], [53]. The combined load of SMUD (10 terawatt-hours) and LADWP (22 terawatt-hours) is approximately equal to half of the entire POU load served in California and slightly larger than PG&E's bundled service load [6] but servicing a very small territory in comparison. We present capital, operations, and maintenance expenses for SMUD and LADWP to understand their cost drivers and possible sources of rate divergence relative to IOUs.

(a) Depreciable Utility Plant

The depreciable utility plant is the total property, plant, and equipment assets a POU owns to service its generation, distribution, and transmission needs. It serves as an indicator of POU capital costs and does not include depreciation. While the scale of POUs' depreciable utility plant differs from that of IOUs', the trends are similar. Figure 8 and Table 4 provide trends and values of generation, distribution, and transmission utility plants in service (in real terms).

The total depreciable utility plant for the two POUs has grown by 37% in real terms since 2010, primarily driven by a 47% increase in the distribution rate base, the largest component across all POUs. Since 2010, distribution assets have increased roughly 50% for LADWP and 20% for SMUD, while transmission assets have almost doubled for both the POUs. Like IOUs, POU generation assets have relatively declined since 2014, while T&D assets have increased.

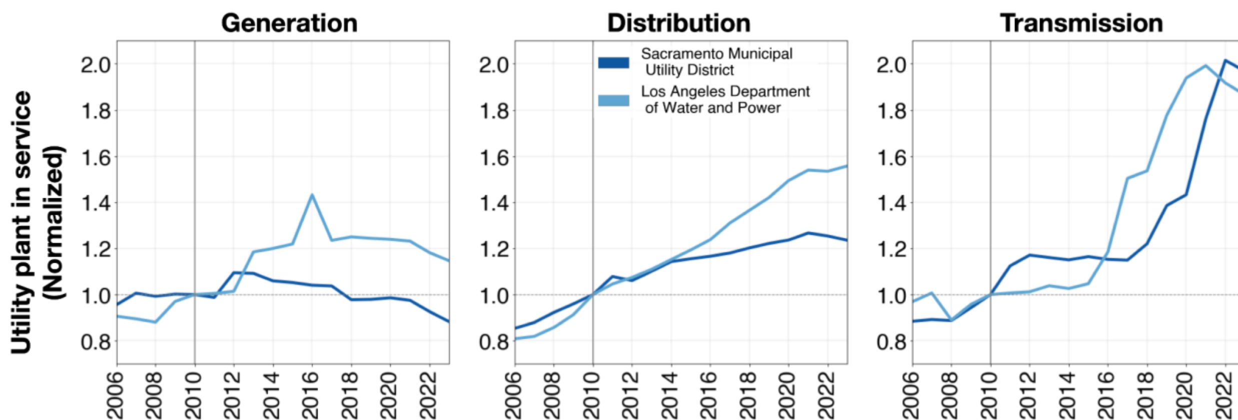

Figure 8: Generation, distribution, and transmission depreciable utility plant assets of LADWP and SMUD. The figure shows the ratio of a year's real costs (in 2022$) to the real costs of the reference year (2010)—source: Annual financial statements of SMUD and LADWP [54], [55].

Table 4: Generation, Distribution, and Transmission depreciable utility plant assets of SMUD and LADWP (billions of $2022)

Utility	Year	Generation	Distribution	Transmission	Sum
SMUD	2010	1.91	2.22	0.32	4.44
	2018	1.86	2.67	0.38	4.92
	2022	1.77	2.79	0.63	5.19
LADWP	2010	5.41	7.51	1.22	14.14
	2018	6.76	10.25	1.88	18.89
	2022	6.39	11.52	2.35	20.25

Source: Annual financial statements of SMUD and LADWP

(b) **Operations and maintenance**

POUs incur operational and maintenance costs for their infrastructure. Figure 9 and Table 5 show O&M trends and values for LADWP and SMUD. We present a combined O&M expense value due to a lack of disaggregation by generation, distribution, and transmission in their financial statements. POU O&M costs have increased modestly between 2010 and 2023, with an increase of 9% for LADWP and under 10% for SMUD. For SMUD, the 2008 spike was due to high wholesale prices and increased electricity consumption [56], while the recent 2022 increase was due to an unplanned outage of SMUD's Cosumnes Power Plant, which temporarily forced it to rely on more expensive purchased power [57]. In the same period, IOU's overall O&M expenses have increased by ~35% (SCE) and more than 70% (SDG&E and PG&E). POU O&M expenses will remain relatively constant due to limited exposure to high-fire threat districts: SMUD does not serve any high-fire threat areas, but LADWP has some Tier 2 territory in the Owens Valley (Figure 7).

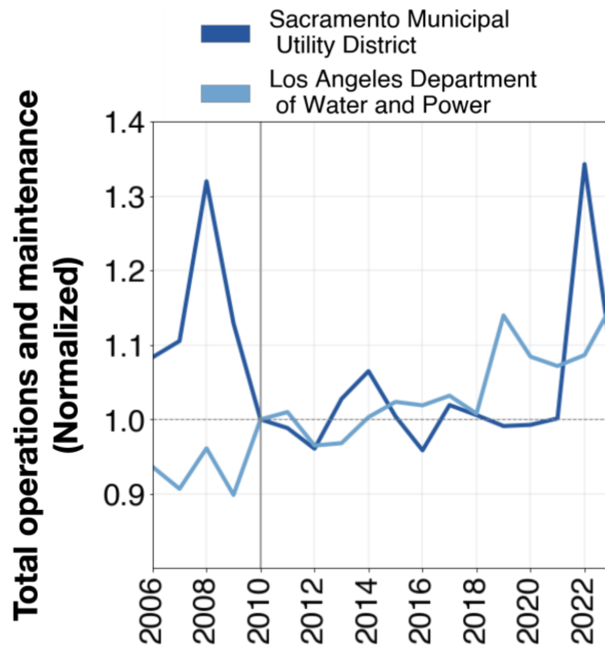

Figure 9: Total operations and maintenance costs for LADWP and SMUD. The figure shows the ratio of a year's real costs (in 2022$) to the real costs of the reference year (2010)—source: Annual financial statements of SMUD and LADWP.

Table 5: Total operations & maintenance costs of selected POUs (billions of $2022)

Utility	Year	Total O&M
SMUD	2010	1.54
	2018	1.55
	2022	2.07
LADWP	2010	3.49
	2018	3.52
	2022	3.79

Source: Annual financial statements of SMUD and LADWP [54], [55]

The analysis shows that POUs have similar capital investment trends as IOUs but differ in O&M expenses. Like IOUs, POU generation assets have declined or remained relatively constant while their network infrastructure investments are growing. However, in contrast, POU O&M expenses have increased modestly compared to IOU O&M expenses, potentially due to their relatively limited wildfire exposure.

3. Relationship between IOU and CCA Rate Increases

The third type of power provider of interest is community choice aggregators (CCAs). CCAs procure power through wholesale markets and independent power providers but use IOU distribution and transmission infrastructure to deliver electricity to consumers [58]. While many CCAs positioned themselves as an alternative to the IOUs, their ability to offer customers substantial bill savings is limited. A CCA can set its generation charges but is assessed the same transmission and distribution charges as its parent IOU. As Figure 10 shows, network costs form a large portion of the overall rate charged to the customer, so the T&D drivers of price increases discussed in the previous sections apply equally to IOU and CCA customers [59], [60], [61]. CCAs will only be insulated from overall price increases if their generation cost savings—the only thing they control—are large enough to offset T&D hikes.

However, CCA rates also diverge from IOU rates with respect to a surcharge they must pay through a mechanism known as the Power Charge Indifference Adjustment (PCIA). When large swaths of residential load departed IOUs for CCA service, IOUs had already procured generation resources to serve those customers, and losing CCA customers' generation revenue would subsequently cause a cost shift onto the remaining IOU customers. The PCIA is determined by the CPUC through a dedicated regulatory proceeding and is meant to be set at such a level as to offset this adverse effect [62]. Then, a CCA's net savings will be the generation procurement savings minus the PCIA charge. A relatively high PCIA and/or small-generation procurement savings may even result in a CCA customer paying more than an IOU customer.

For California's two largest CCAs, MCE and CPA, Figure 10 contextualizes the magnitude of network charges, generation charges, and PCIA fees using data from Joint Rate Comparison mailers produced by IOUs and CCAs. While these CCAs consistently offer lower generation rates than their parent IOUs, the PCIA often ends up being approximately equal to the difference in generation costs between the IOU and CCA, rendering total rates very similar. As IOU rates continue to rise, driven by T&D costs, CCA rates will likely follow a similar trend.

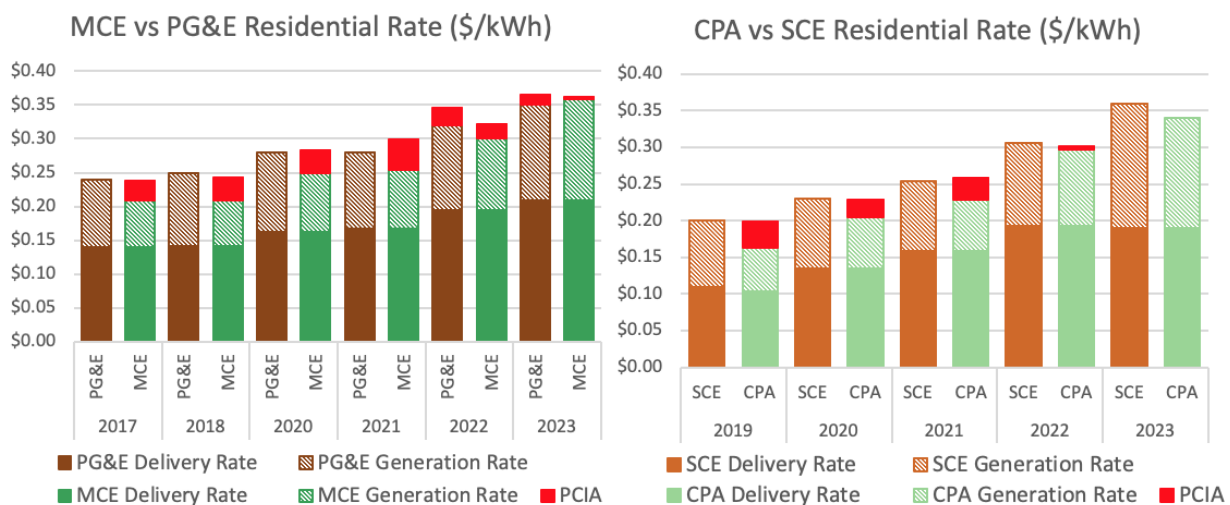

Figure 10: Comparison of the average residential rate, by component, faced by CCA customers versus the rate charged to IOU customers in the same geographic service territory.[4] The left panel compares MCE with PG&E, while the right panel compares CPA with SCE. Source: Joint Rate Comparisons prepared by CCAs and IOUs. [59], [60], [61]

Conclusion

Rising electricity prices have become a high-priority concern for policymakers and consumers alike in California. Electricity prices are high and rapidly increasing in IOU and CCA territories, while prices remain low in POU territories. Our study identifies drivers of rising utility costs in a system facing triple challenges of affordability, decarbonization, and climate change adaptation. The state has ambitious renewable energy integration and electrification goals yet faces mounting pressure to harden the grid against wildfires.

While significant supply-side changes continue and utilities' generation O&M costs have increased, our calculations demonstrate that network cost increases are the important drivers of bill increases. Across all power providers, trends for capital investments are similar: a flattening or reduction in generation assets and an increase in T&D assets. IOU T&D capital assets have increased by an average of 97% in real terms between 2010 and 2022, while POU T&D depreciable utility plant has increased by an average of 51% in the same time frame. A source of divergence between IOU and POU costs are operations and maintenance expenses: total IOU O&M has increased by an average of 51% in real terms between 2010 and 2022, while the comparable increase for POUs is just 17%. Notably, the IOU O&M increases correlate with the years following damaging wildfires. This suggests that network O&M expense increases tend to be reactive rather than proactive management for an aging and expanding grid. T&D expenditures, particularly for wildfire mitigation—capital investments in grid hardening, maintenance costs of overhead lines, and vegetation management—will continue to be a source of divergence between POU and non-POU prices.

Despite this upward trend in IOU T&D spending, the trend for IOU profits in the aftermath of wildfires is somewhat more complex. The ROR has trended downward over time, and PG&E even reported a negative ROR in the immediate years following the Camp Fire. Historical evidence from SDG&E shows that one possible outcome is the strong recovery of the ROE and a temporary, reactive spike in O&M expenditures. Indeed, PG&E's returns appear to have already returned to previous ranges; more time is needed to determine whether PG&E's O&M expenses will remain high.

Finally, though our work confirms that POUs have tended to be insulated from such severe cost increases, we caution that our analysis is not causal. Our findings, therefore, should not be taken to imply that municipalization itself will necessarily relieve bill pressure. The case of CCAs shows that even under a (partial) public nonprofit structure, exposure to wildfire hardening costs will result in upward pressure on bills. CCAs also reach price parity with IOUs due to the PCIA exit fees levied on them.

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[4] As of 2022, PG&E has started separately reporting the PCIA charged to their bundled customers. This charge was previously part of their generation component of rates. The PCIA charged to PG&E customers in 2022 and 2023 was larger than the PCIA charged to the CCA customers.

A useful direction for future study would be to formally quantify the impact of a public vs. private governance model alongside the importance of many other factors, such as vertical integration, a more concentrated service territory, and a lack of HFTDs (as shown in Figure 7).

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References

[1] California Public Utilities Commission, "Affordability Ratio (AR) Interactive Map," 2019 Annual Affordability Report. Accessed: Mar. 18, 2024. [Online]. Available: https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/affordability/affordability-ratio

[2] S. Cong, D. Nock, Y. L. Qiu, and B. Xing, "Unveiling hidden energy poverty using the energy equity gap," *Nat. Commun.*, vol. 13, no. 1, p. 2456, May 2022, doi: 10.1038/s41467-022-30146-5.

[3] "2021 and 2022 Annual Affordability Report." Accessed: Mar. 20, 2024. [Online]. Available: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/affordability-proceeding/2021-2022/2021-and-2022-annual-affordability-report.pdf

[4] California State Senate Energy, Utilities and Communications Committee, "Background on Electricity Policy." Accessed: Mar. 18, 2024. [Online]. Available: https://seuc.senate.ca.gov/backgroundonelectricitypolicy

[5] P. Sabin, "Electricity and the Public Good: Private-Public Power Debates in the 1920s-30s," Yale University, Overview, 2023. [Online]. Available: https://energyhistory.yale.edu/electricity-and-the-public-good-private-public-power-debates-in-the-1920s-30s/

[6] U.S. Energy Information Administration, "Annual Electric Power Industry Report, Form EIA-861 detailed data files." 2022. Accessed: Mar. 18, 2024. [Online]. Available: https://www.eia.gov/electricity/data/eia861/

[7] California Energy Commission, "California Electric Load Serving Entities (IOU & POUs)." May 01, 2024. Accessed: Mar. 18, 2024. [Online]. Available: https://cecgis-caenergy.opendata.arcgis.com/datasets/CAEnergy::electric-load-serving-entities-iou-pou/about

[8] CalCCA, "Interactive CCA Map/ Address Lookup," CalCCA. Accessed: Mar. 18, 2024. [Online]. Available: https://cal-cca.org/cca-map/

[9] J. Daniels, "Officials: Camp Fire, deadliest in California history, was caused by PG&E electrical transmission lines," *CNBC*, Los Angeles, May 15, 2019. Accessed: Sep. 29, 2024. [Online]. Available: https://www.cnbc.com/2019/05/15/officials-camp-fire-deadliest-in-california-history-was-caused-by-pge-electrical-transmission-lines.html

[10] "Company Profile." Accessed: Sep. 29, 2024. [Online]. Available: https://www.pge.com/en/about/company-information/company-profile.html

[11] "Clean Power Alliance - Residential Rates," Clean Power Alliance. Accessed: Oct. 11, 2024. [Online]. Available: https://cleanpoweralliance.org/residential-rate/

[12] "Residential Rates | Los Angeles Department of Water and Power." Accessed: Oct. 11, 2024. [Online]. Available: https://www.ladwp.com/account/customer-service/electric-rates/residential-rates

[13] "Electric Rates." Accessed: Mar. 30, 2024. [Online]. Available: https://www.pge.com/tariffs/en/rate-information/electric-rates.html

[14] "Residential rates." Accessed: Oct. 11, 2024. [Online]. Available: https://www.smud.org/Rate-Information/Residential-rates

[15] "Total Electric Rates | San Diego Gas & Electric." Accessed: Mar. 30, 2024. [Online]. Available: https://www.sdge.com/total-electric-rates

[16] "Historical Rate Schedules for 2023." Accessed: Mar. 30, 2024. [Online]. Available: https://www.sce.com/regulatory/tariff-books/historical-rates/historical-rate-schedules-for-2023

[17] Southern California Edison, "About Us." Accessed: Sep. 29, 2024. [Online]. Available: https://www.sce.com/about-us

[18] San Diego Gas & Electric, "Our Company." Accessed: Sep. 29, 2024. [Online]. Available: https://www.sdge.com/more-information/our-company

[19] Sacramento Municipal Utility District, "Our service area." Accessed: Sep. 29, 2024. [Online]. Available: https://www.smud.org/Corporate/About-us/SMUDs-Territory-Map

[20] Los Angeles Department of Water and Power, "Facts & Figures." Accessed: Sep. 29, 2024. [Online]. Available: https://www.ladwp.com/who-we-are/power-system/facts-figures

[21] E. Halper, "Growing U.S. anger with electric utilities finds its epicenter in Maine," *The Washington Post*, Saco, Maine, Nov. 04, 2023. [Online]. Available: https://www.washingtonpost.com/business/2023/11/04/maine-power-utilities-ballot/

[22] C. Sherwood, "Pacific Power seeks 17% Oregon rate hike," *Oregon Public Broadcasting*, Feb. 15, 2024. [Online]. Available: https://www.opb.org/article/2024/02/15/pacific-power-rate-hike-oregon/

[23] Nida Çakır Melek and Alex Gallin, "Powering Up: The Surging Demand for Electricity," Federal Reserve Bank of Kansas City. Accessed: Sep. 29, 2024. [Online]. Available: https://www.kansascityfed.org/research/economic-bulletin/powering-up-the-surging-demand-for-electricity/

[24] S. Borenstein, "Private Net Benefits of Residential Solar PV: The Role of Electricity Tariffs, Tax Incentives, and Rebates," *J. Assoc. Environ. Resour. Econ.*, vol. 4, no. S1, pp. S85–S122, Sep. 2017, doi: 10.1086/691978.

[25] S. Borenstein, M. Fowlie, and J. Sallee, "Paying for Electricity in California: How Residential Rate Design Impacts Equity and Electrification".

[26] S. Borenstein, J. Sallee, and M. Fowlie, "Designing Electricity Rates for An Equitable Energy Transition." Accessed: Dec. 26, 2023. [Online]. Available: https://www.next10.org/sites/default/files/2021-02/Next10-electricity-rates-v2.pdf

[27] "2024 Public Advocates Office NEM cost shift." Accessed: Oct. 11, 2024. [Online]. Available: https://www.publicadvocates.cpuc.ca.gov/-/media/cal-advocates-website/files/press-room/reports-and-analyses/240822-public-advocates-office-2024-nem-cost-shift-fact-sheet.pdf

[28] California Public Utilities Commission, "2023 California Electric and Gas Utility Costs Report," Apr. 2024. Accessed: Mar. 18, 2024. [Online]. Available: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/office-of-governmental-affairs-division/reports/2024/2023-ab-67-report.pdf

[29] Federal Energy Regulatory Commission, "FERC FORM No. 1 for PACIFIC GAS AND ELECTRIC COMPANY." Apr. 13, 2021. Accessed: Mar. 31, 2024. [Online]. Available: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/electric-costs/ferc-form-1s/pge-2020q4-fercform14302021.pdf

[30] Z. Selvans *et al.*, *The Public Utility Data Liberation (PUDL) Project*. (Feb. 04, 2024). Zenodo. doi: 10.5281/zenodo.10614467.

[31] "Catalyst Cooperative - Open Data Science for a Stable Climate," Catalyst Cooperative. Accessed: Oct. 11, 2024. [Online]. Available: https://catalyst.coop/

[32] California Public Utilities Commission, "Rate Base." Accessed: Sep. 29, 2024. [Online]. Available: https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-costs/historical-electric-cost-data/rate-base

[33] California Public Utilities Commission, "2020 California Electric and Gas Utility Costs Report," Apr. 2021. Accessed: Mar. 18, 2024. [Online]. Available: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/office-of-governmental-affairs-division/reports/2020/2020-ab-67-report.pdf

[34] California Public Utilities Commission, "2021 California Electric and Gas Utility Costs Report," Apr. 2022. Accessed: Mar. 18, 2024. [Online]. Available: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/reports/reports-on-utility-costs/2021-ab-67-report.pdf

[35] California Public Utilities Commission, "2022 California Electric and Gas Utility Costs Report," Apr. 2023. Accessed: Mar. 18, 2024. [Online]. Available: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/office-of-governmental-affairs-division/reports/2023/2022-ab-67-report.pdf

[36] Marybel Batjer, Liane M. Randolph, Martha Guzman Aceves, Clifford Rechtschaffen, and Genevieve Shiroma, *Decision Addressing the Test Year 2020 General Rate Case of Pacific Gas & Electric Company*. 2020. Accessed: Sep. 29, 2024. [Online]. Available: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M354/K486/354486687.PDF

[37] "Exhibit SDG-1 : T04 - Cycle 2. Formula Cost of Service Statements." Accessed: Oct. 11, 2024. [Online]. Available: https://www.sdge.com/sites/default/files/1vol%201.pdf

[38] California Public Utilities Commission, "Historical Electric Cost Data." Accessed: Mar. 18, 2024. [Online]. Available: https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-costs/historical-electric-cost-data

[39] D. C. Rode and P. S. Fischbeck, "Regulated equity returns: A puzzle," *Energy Policy*, vol. 133, p. 110891, Oct. 2019, doi: 10.1016/j.enpol.2019.110891.

[40] Grant Parks, "Electricity and Natural Gas Rates," California State Auditor, 2022–115, Aug. 2023. Accessed: Sep. 29, 2024. [Online]. Available: https://information.auditor.ca.gov/reports/2022-115/index.html

[41] California Public Utilities Commission, "Cost of Capital." Accessed: Mar. 18, 2024.

[Online]. Available: https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-costs/cost-of-capital

[42] S&P Global Market Intelligence, "S&P Capital IQ Pro 2024." 2024. Accessed: Mar. 18, 2024. [Online]. Available: https://www.spglobal.com/marketintelligence/en/solutions/sp-capital-iq-pro

[43] U.S. Bureau of Labor Statistics, "Consumer Price Index for All Urban Consumers: All Items Less Food and Energy in U.S. City Average." FRED, Federal Reserve Bank of St. Louis, Jan. 01, 1957. Accessed: Mar. 31, 2024. [Online]. Available: https://fred.stlouisfed.org/series/CPILFESL

[44] "Allocating Utility Wildfire Costs: Options and Issues for Consideration." Accessed: Oct. 10, 2024. [Online]. Available: https://lao.ca.gov/Publications/Report/4079

[45] T. Haug and L. Wieshammer, "Cost of equity for regulated networks: Recent developments in continental Europe," *Electr. J.*, vol. 32, no. 3, pp. 1–3, Apr. 2019, doi: 10.1016/j.tej.2019.02.001.

[46] R. L. Hagerman and B. T. Ratchford, "Some Determinants of Allowed Rates of Return on Equity to Electric Utilities," *Bell J. Econ.*, vol. 9, no. 1, pp. 46–55, 1978, doi: 10.2307/3003611.

[47] K. D. Werner and S. Jarvis, "Rate of Return Regulation Revisited," Apr. 2024. [Online]. Available: https://haas.berkeley.edu/wp-content/uploads/WP329.pdf

[48] Leuwam Tesfai, "Energy Division Disposition of Pacific Gas & Electric Advice Letter 4813-G/7046-E, Southern California Edison Advice Letter 5120-E, San Diego Gas and Electric Advice Letter 4300- E/3239-G and Southern California Gas Company Advice Letter 6207-G, Regarding the 2024 Cost of Capital Formula Adjustment Mechanism," Dec. 22, 2023. Accessed: Sep. 29, 2024. [Online]. Available: https://www.pge.com/tariffs/assets/pdf/adviceletter/ELEC_7046-E.pdf

[49] D. Brekke, "State Probe Says PG&E Missed Deadly Flaw on Line That Sparked Camp Fire," *KQED*, Dec. 03, 2019. Accessed: Oct. 01, 2024. [Online]. Available: https://www.kqed.org/news/11789259/state-probe-says-pge-missed-deadly-flaw-on-line-that-sparked-camp-fire

[50] "Safety and Enforcement Division Incident Investigation Report for 2018 Camp Fire with Attachments." Accessed: Oct. 11, 2024. [Online]. Available: https://www.cpuc.ca.gov/-/media/cpuc-website/industries-and-topics/documents/wildfire/staff-investigations/i1906015-appendix-a-sed-camp-fire-investigation-report-redacted.pdf?sc_lang=en&hash=FC40497355B496C4BE040275A72A43B4

[51] San Diego Gas & Electric, "Note 10: Commitments and Contingencies," Notes to Consolidated Financial Statements, Jun. 2012. Accessed: Sep. 29, 2024. [Online]. Available: https://www.sec.gov/Archives/edgar/data/86521/000008652112000086/R16.htm

[52] California Public Utilities Commission, "CPUC High Fire Threat District (HFTD)." Jan. 19, 2018. Accessed: Mar. 18, 2024. [Online]. Available: https://www.arcgis.com/apps/webappviewer/index.html?id=5bdb921d747a46929d9f00dbdb6d0fa2

[53] Sacramento Municipal Utility District, "Company information." Accessed: Sep. 29, 2024. [Online]. Available: https://www.smud.org/Corporate/About-us/Company-Information

[54] "Reports and documents." Accessed: Oct. 11, 2024. [Online]. Available: https://www.smud.org/Corporate/About-us/Company-Information/Reports-and-Statements

[55] "Audited Financial Statements | Los Angeles Department of Water and Power." Accessed:

Oct. 11, 2024. [Online]. Available: https://www.ladwp.com/doing-business-ladwp/investor-relations/audited-financial-statements
[56] Sacramento Municipal Utility District, “Annual Report,” 2008.
[57] Sacramento Municipal Utility District, “Financial Statements: Report of Independent Auditors, December 31, 2023 and 2022.” Accessed: Sep. 29, 2024. [Online]. Available: https://www.smud.org/-/media/Documents/Corporate/About-Us/Company-Information/Reports-and-Documents/2023/SMUD-2023-Audited-Financial-Statements---Final.ashx
[58] Desert Community Energy, “Community Choice Aggregation - Frequently Asked Questions.” Accessed: Mar. 18, 2024. [Online]. Available: https://cvag.org/wp-content/uploads/2021/10/CVAG_CCA_FAQ_vr2-10-11-17-FINAL.pdf
[59] Southern California Edison, “Community Choice Aggregation.” Accessed: Mar. 20, 2024. [Online]. Available: https://www.sce.com/customer-service/Community-Choice-Aggregation
[60] Pacific Gas & Electric Company, “Community Choice Aggregation (CCA).” Accessed: Mar. 20, 2024. [Online]. Available: https://www.pge.com/en/account/alternate-energy-providers/community-choice-aggregation.html#ccaprograms
[61] San Diego Gas & Electric, “Community Choice Aggregation.” Accessed: Mar. 20, 2024. [Online]. Available: https://www.sdge.com/customer-choice/community-choice-aggregation
[62] California Public Utilities Commission, “Power Charge Indifference Adjustment.” Accessed: Sep. 29, 2024. [Online]. Available: https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-power-procurement/power-charge-indifference-adjustment