Wires and Fires: Wildfires drive network cost differences across California's power providers

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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% when 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 and maintenance expenses to identify sources of increasing utility costs, one of the factors contributing to rising electricity prices in the state. Across IOUs, generation capital assets have declined. Fuel and power purchase expenses have increased, although these increases remain within their historical ranges. Transmission and distribution (T&D) expenses have increased significantly and are the majority of overall costs. T&D operations and maintenance spiked following major 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 and exit fees levied on them. POUs, which service 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.

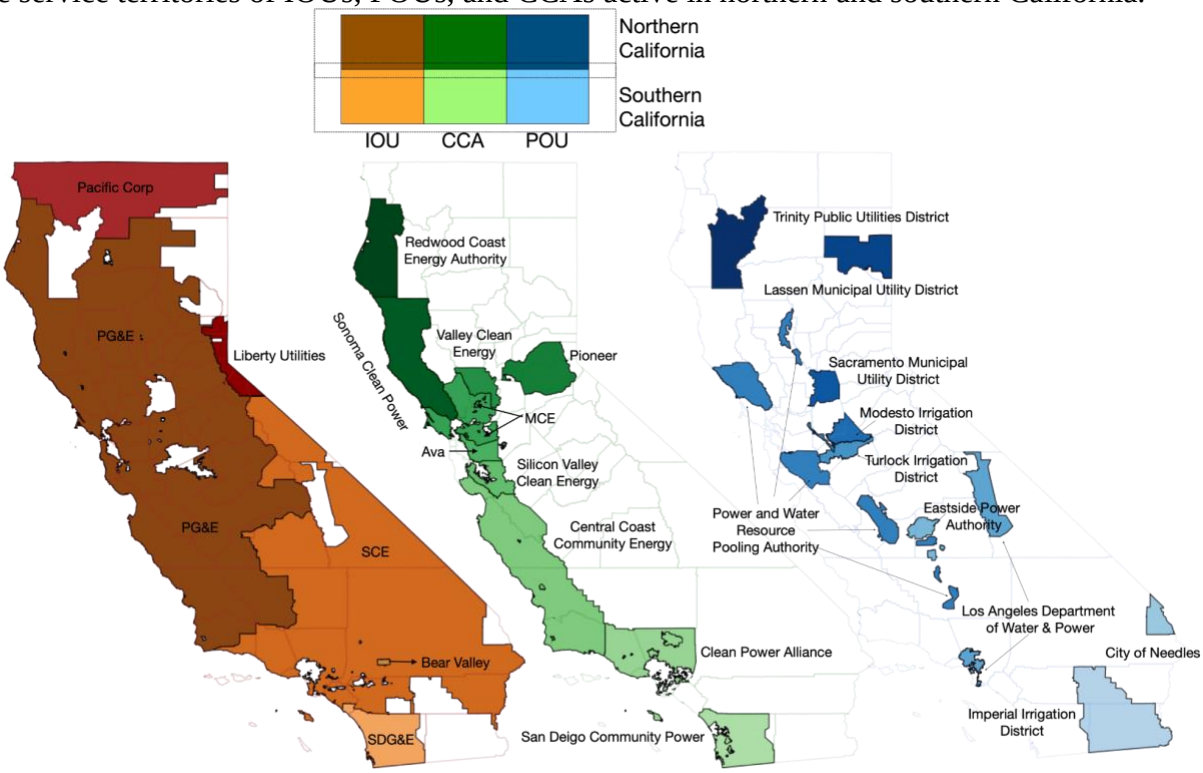
Keywords: electricity pricing, utility policy, rate design, equity

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 more efficient for a single firm to serve an area with its network than for multiple firms to build 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 Energy Regulatory Commission (FERC) [4], [5]. In 2022, IOUs supplied electricity for about 40% of California's retail demand[1] [6].

POUs and CCAs, the other two key power providers, operate on a non-profit basis. POUs are owned and operated by cities, counties, and irrigation districts. They are governed by local laws and are not subject to PUC regulations. CCAs have emerged as a new player in the state's electricity sector, operating within IOU territories. CCAs procure their own power but use IOU distribution and transmission networks to deliver it. In 2022, POUs and CCAs served 25% and 23% of California's total electricity demand [6]. 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.



[1] IOUs have "bundled" customers, for whom they provide both energy and delivery. These customers represent about 40% of the retail demand in California. IOUs also have "delivery-only" customers, which are primarily CCA and Direct Access customers.

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. As of 2024, 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]. Wildfire mitigation expenses were quickly reflected in electricity prices, and as of early 2024, PG&E charged its residential customers a baseline rate of 42 cents per kWh, up 20 cents since 2018.

In this study, we analyze the utility costs of seven power providers—PG&E, 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). Together, these providers supply about 60% of California's total electricity demand and 65% of all customers. Figure 2 presents the residential baseline rate (in $/kWh) of each power provider. Prices have increased across IOUs and CCAs, but POU prices have remained low. By early 2024, the IOUs and CCAs charged their residential customers between 37- 42 cents/kWh. In comparison, SMUD and LADWP, which together serve roughly the same demand as PG&E, have managed to provide more affordable electricity at 12 and 20 cents per kWh. Note the two POUs also have fixed charges ($/month) as part of their monthly bill, which are not shown in Figure 2. We show the evolution of monthly bills in Appendix Section 7 and provide rates for commercial customers and values adjusted for inflation in Appendix Sections 1 and 2. Detailed information on the selected rates and their components are available in the accompanying supplementary data [67].

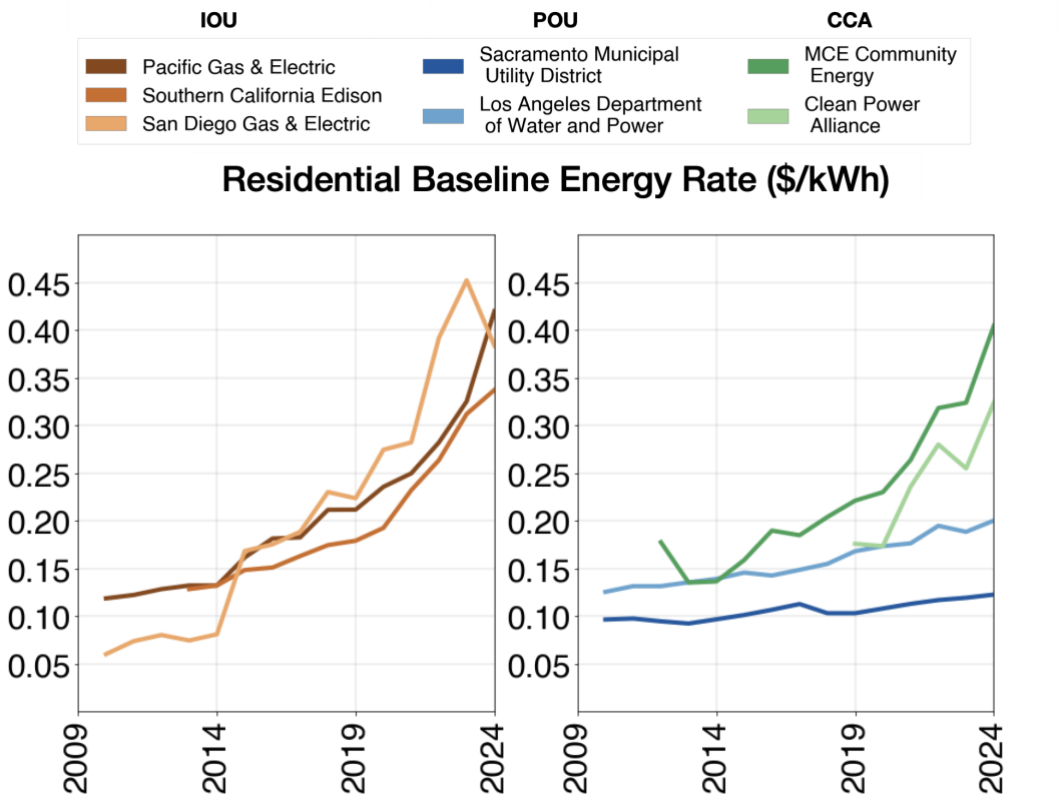


Figure 2: Residential baseline electricity rate ($/kWh) for California IOUs, POUs, and CCAs (nominal $). In addition to electricity rates, bills include fixed charges ($/month) not shown in the figure. Source: Historical tariff books and data requests [11], [12], [13], [14], [15], [16].

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	2,700
CPA	CCA	5.3	1.5	4.1	4,700

Source: Electricity sales data from EIA Form 861, 2022 [6]. Service area for POUs and IOUs is taken from power providers' web pages [10], [17], [18], [19], [20]. Service area for CCAs is calculated by summing the area of included cities and counties listed on CCA websites [21], [22]

using 2020 US Census land area [23], [24]. 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.

Overall utility cost increases and divergent price trends have been noted in California agency reports and expert commentary, but much of the detail—which components of costs are rising most severely, how these trends have evolved over time, and how they affect various types of power providers—remains understudied. To our knowledge, this paper is novel in its breadth and depth. We aggregate price and cost data for California utilities from a number of sources, including utilities' historical price archives, financial reports, regulatory filings, and financial market data to provide a more complete accounting of cost. Second, California PUC reports are necessarily limited to IOUs and CCAs, as they do not regulate the POUs. In contrast, our study is one of the first to compare all three major types of power providers—IOUs, POUs, and CCAs ([25] does consider POU prices relative to IOUs, but it does not discuss CCAs). Compared to previous studies, this paper's novel contributions are the combination of a time series analysis, a breakdown of the components of rising costs, and coverage across all three power provider types [25], [26].

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$), adjusted using the core Consumer Price Index for All Urban Consumers: All Items Less Food and Energy in U.S City Average [25] and cost trends are normalized to the reference year 2010. Although our focus is on California's largest power providers, the lessons and insights extend to other utilities in the state and beyond. Nationwide, utilities have experienced varying cost pressures, with average real electricity prices increasing by 3.4% between 2010 and 2022. This increase has not been uniform: electricity became substantially more expensive in California, New England, West Virginia, and Indiana, prices in Delaware, Maryland, Texas, and New Jersey declined after adjusting for inflation [26]. These regional differences will likely become more pronounced, driven by growing electricity demand, grid reliability challenges, costs related to climate risks as well as utility ownership and governance structures [28], [29], [30]. Our work is also relevant for other wildfire-prone states like Oregon and Hawaii, where electric utilities have proposed rate increases to fund extensive grid hardening and vegetation management programs [27], [28].

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

IOUs are for-profit entities with geographic monopolies in their territories. The 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, which is the total cost of owning, operating, and maintaining the electricity grid, along with 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 trends and drivers of rising utility costs, it is important to note that declining electricity sales resulting from customer generation also play a significant role in increasing electricity prices in California [3], [29], [30], [31], [32], [72], [73]. We provide trends in electricity sales across power providers in Appendix Section 3.

A 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% and taxes made up less than 10% [33]. To identify drivers of rising utility costs, we 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)[2] [35].

1.1 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 the Camp Fire), and 2022 (all in 2022$). The California PUC's historical electric cost data and annual electric and gas utility cost reports provide the rate base values [37], [38], [39], [40].

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 substantially since 2018, falling by 7-23%, as utilities shifted away from investing in their own power plants in favor of procuring power through wholesale energy markets. The transmission and distribution rate base has increased by 20-32% after 2018. This is largely due to capital investments in wires, poles, transformers, and fixtures. For example, PG&E's authorized distribution capital expenses grew from under $90 million in 2018 to nearly $600 million in 2020 [41, pp. 91–92]. 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 [42].

[2] 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 [34]. We use FERC Form 1 data collected by the Catalyst Cooperative as part of the Public Utilities Data Liberation (PUDL) project [35], [36]. In this paper, we use Schedule 320 of Form 1 corresponding to operation and maintenance costs of IOUs.

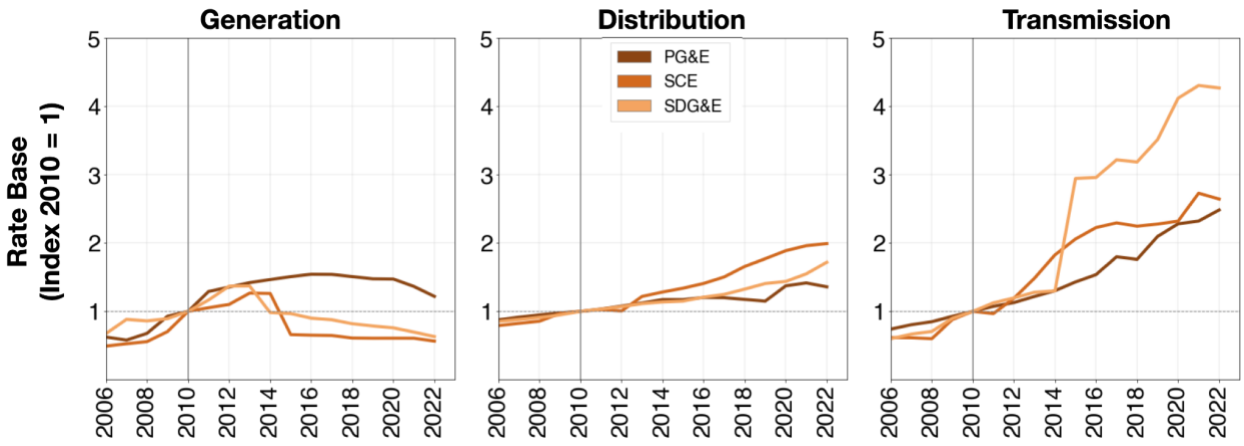


Figure 3: Ratio of rate base (in 2022$) for the three IOUs in generation, distribution, and transmission of a year to rate base (in 2022$) of the reference year (2010). *Source: California Public Utilities Commission Historical Electric Cost Data [37]*

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 [37]

1.2 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 [43]. 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 operational efficiency, cost management, weather changes, and unexpected events such as wildfires [44].

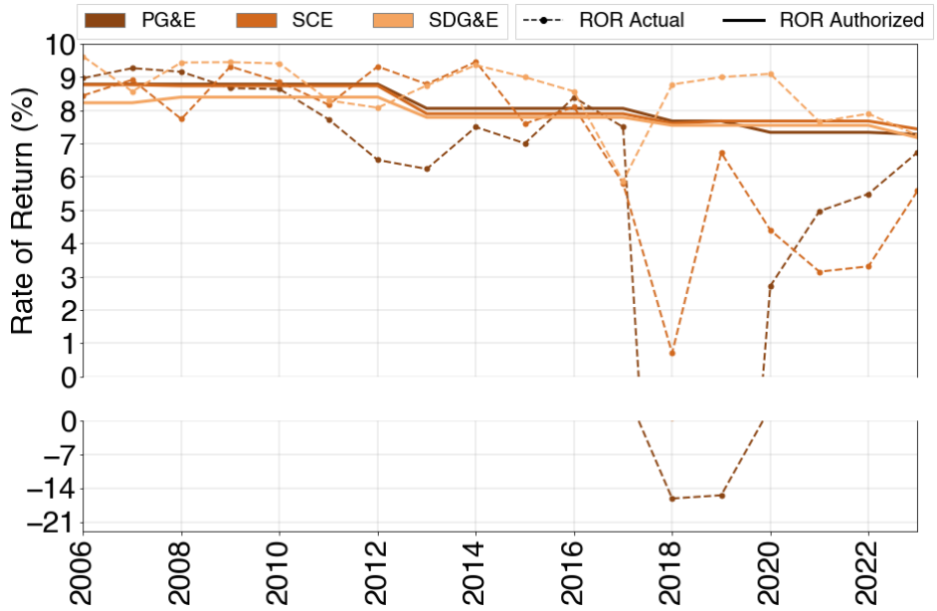


Figure 4: Authorized and actual rate of return for three California IOUs (PG&E, SCE, and SDG&E). Source: CPUC Historical Electric Cost Data [43].

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 exceeding its authorized value: for 12 out of the last 15 years, SDG&E has earned more than its authorized ROR. While actual ROR can exceed authorized values, a persistently higher-than-authorized ROR may indicate that utilities tend to overstate expenses or do not pass on improved cost management and operational efficiency gains to ratepayers, preferring to increase returns instead [45].

A subcomponent of the ROR of particular 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 [46].

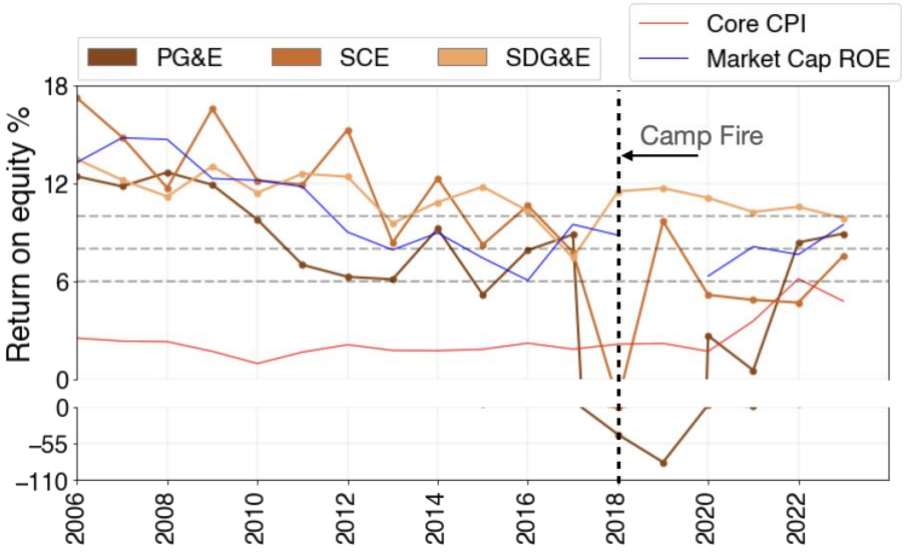


Figure 5: ROE for California IOUs compared to the core consumer price index and the market capitalization-weighted ROE for electric utilities in the United States. Source: ROE data from S&P Capital IQ pro database [47][3] and Core CPI from US Bureau of Labor Statistics [25].

Figure 5 shows the actual ROE for the holding companies of the three IOUs since 2006: PG&E Corporation for PG&E, Edison International for SCE, and Sempra Energy for SDG&E. 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 [25], [47].

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 [48]. 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.[4] Since 2006, SDG&E ROE has been higher than 10%, apart from 3 years.

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

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 other hand, research documents that electricity utilities, in general, earn ROE exceeding market benchmarks [44], [49], [50]. 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 [51]. To mitigate the gap between ROE and capital costs, the California PUC uses a formula adjustment mechanism that adjusts ROE when capital costs change beyond a 'dead band' [44], [48], [52]. 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.

1.3 Operations and Maintenance

Operations and maintenance (O&M) expenses are the largest component of IOUs' revenue requirement [33]. O&M costs include fuel costs, purchased power, 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 3 provides O&M costs for 2010, 2018 (pre-Camp Fire), and 2022. O&M data are taken from FERC form 1, which documents utilities' expenses as reflected in the financial statements. Notably, utilities don't earn a rate of return on O&M expenses.

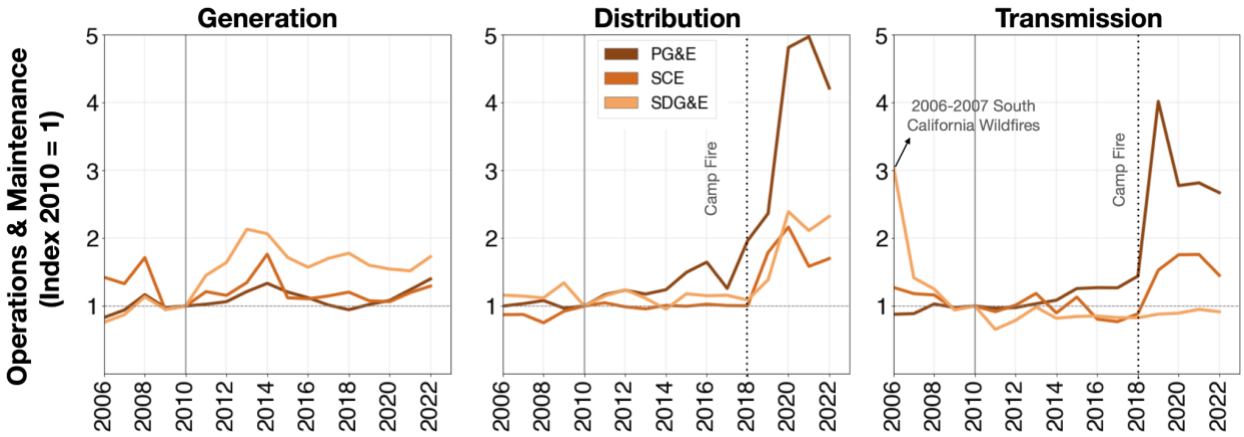

Figure 6: California IOUs' generation, distribution, and transmission operation and maintenance costs. The figure shows the ratio of a year's real costs (in 2022$) to that of a reference year (2010). Source: FERC Form 1 data via PUDL [35].

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

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

Source: FERC form 1 data via PUDL [35].

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. Generation 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 increases for SCE and SDG&E are within historical ranges, 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 [35], [40].

T&D O&M costs, smaller in magnitude compared to generation O&M, have risen dramatically since 2019 due to post-wildfire vegetation management, liability insurance, and catastrophic event expenses [40] (Figure 6). Notably, these costs remained relatively steady until 2018 despite the growth in the grid and aging infrastructure. Immediately after Camp Fire, PG&E increased its T&D O&M expenses by factors of four and five, respectively, with more than doubled overhead line maintenance expenses [35]. Part of this was in response to the California PUC's Safety and Enforcement Division report, which noted inadequate inspection and maintenance of PG&E's transmission facilities in their reports post Camp Fire [53], [54]. A similar response was previously seen when SDG&E power lines caused the 2006-07 wildfires burned over 200,000 acres and destroyed over 1,300 homes [55]. 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[5] (Figure 7).

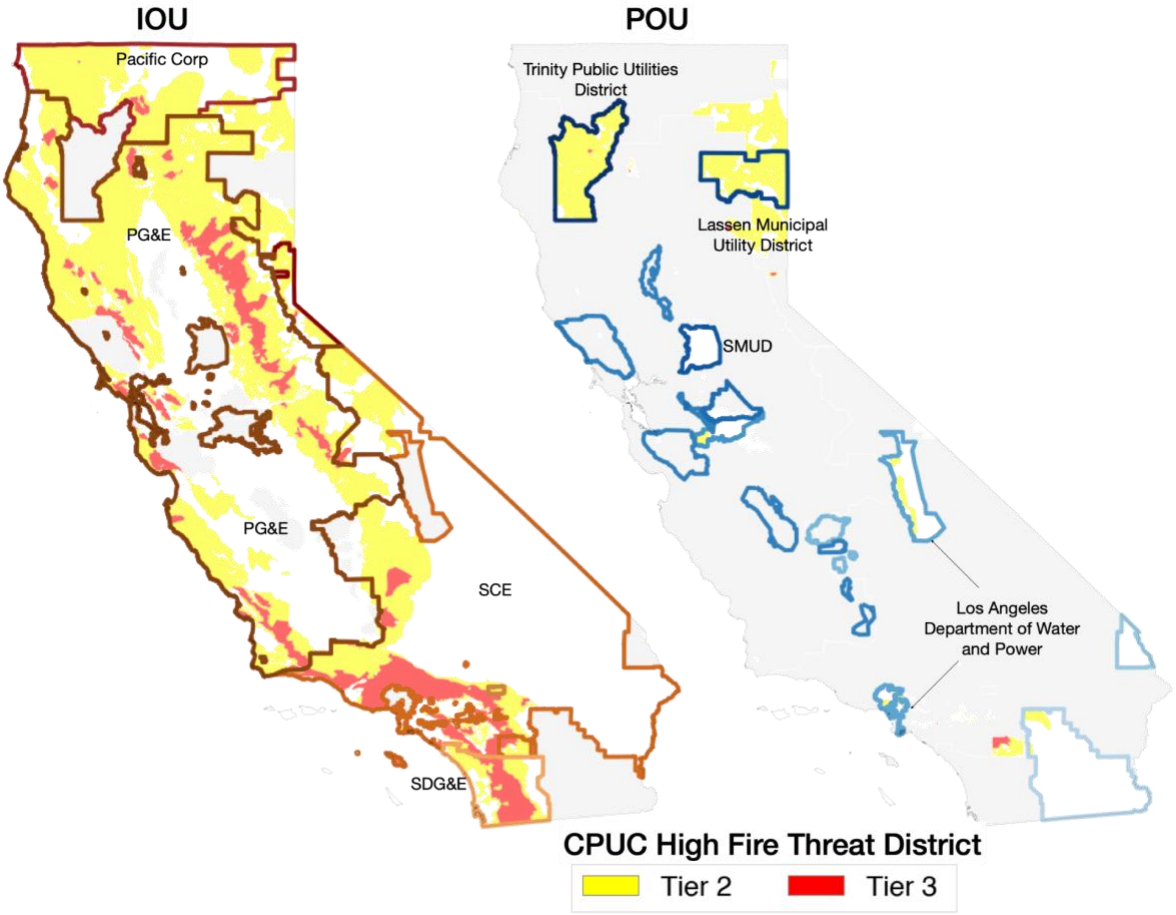

Figure 7: High fire threat districts in IOU and POU territories. Fire threat districts are outlined based on the "likelihood and potential impacts on people and property from utility-related wildfires." Tier 2 denotes higher risk, while Tier 3 denotes extreme risk. Source: CPUC Fire Threat Maps [56] 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 the impact 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 [40]. 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) [33]. Depreciation will continue to increase as network capital expenses rise. Additionally, the revenue requirement includes various taxes, such as property and income taxes.[6] Taxes on

[5] Although Trinity Public Utilities District (TPUD) and Lassen Municipal Utility District (LMUD) are POUs located in Tier 2 fire threat areas, together they serve under 20,000 customers, or just about 0.1% of California's total load. We therefore consider them minor with respect to the broader statewide challenges of rising expenses and affordability [69], [70].

[6] Certain taxes, such as property and income taxes payable by utilities, are included in the revenue requirement, and are not explicit line items on customer bills. Certain other taxes, namely utility users taxes set by local governments

generation and distribution have declined by 38% in real terms since 2012 and are the smallest component of revenue requirement [40]. 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) [33].

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

POUs are non-profit entities owned and operated by cities, municipalities, and irrigation districts.[7] Their expenses and electricity rates are decided considering each territory's strategic priorities with public feedback and 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 analyzes the two largest POUs in the state, the 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], [57]. 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.

2.1 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. Figure 8 and Table 4 provide trends and values of generation, distribution, and transmission utility plant in service (in real terms).

While the magnitude of POUs' depreciable utility plant differs from that of IOUs' rate base, the trends are directionally similar: POU generation assets have declined or remained relatively constant with growing network infrastructure investments. 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, and transmission assets have almost doubled for both the POUs.

and the California Energy Commission Tax, are payable by customers, and are shown explicitly on customer bills [71].

[7] POUs are "non-profit" in contrast to IOUs, which earn returns for their shareholders. It is important to note, however, that some POUs can and do transfer money to the local governments that own them. For example, LADWP transferred approximately $230 million to the reserve fund of the City of Los Angeles in 2023 [59].

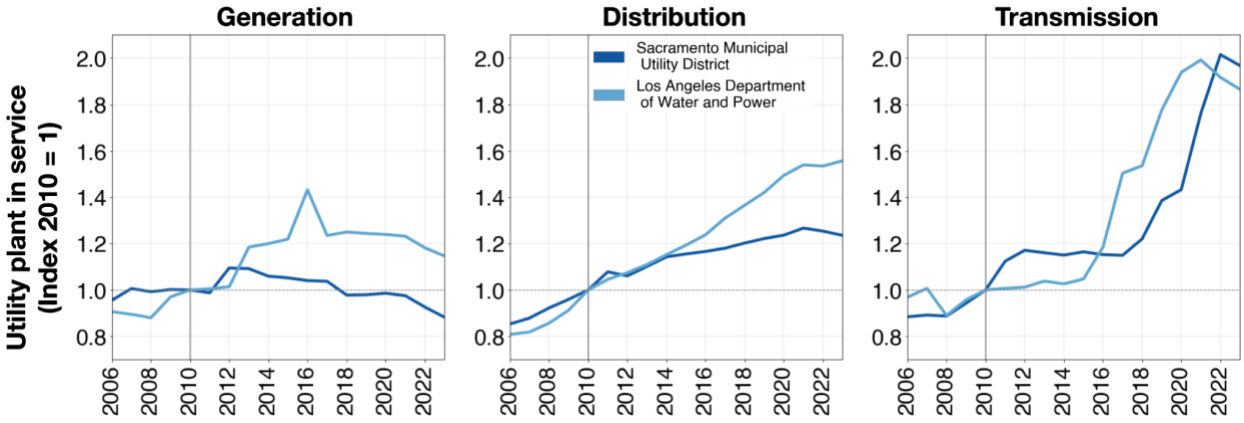

Figure 8: Generation, distribution, and transmission depreciable utility plant assets of LADWP and SMUD. The figure shows the ratio of a year's real costs (in 2022$) to the real costs of the reference year (2010). Source: Annual financial statements of SMUD and LADWP [58], [59].

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 [58], [59].

2.2 Operations and Maintenance

POUs incur operational and maintenance costs for their infrastructure. Expenses to purchase and produce power are the largest component of LADWP and SMUD O&M costs, accounting for approximately 45% of the total [58],[59]. 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 [60] and 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 [61]. In contrast, 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 may 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 Los Angeles hills and Owens Valley (Figure 7).

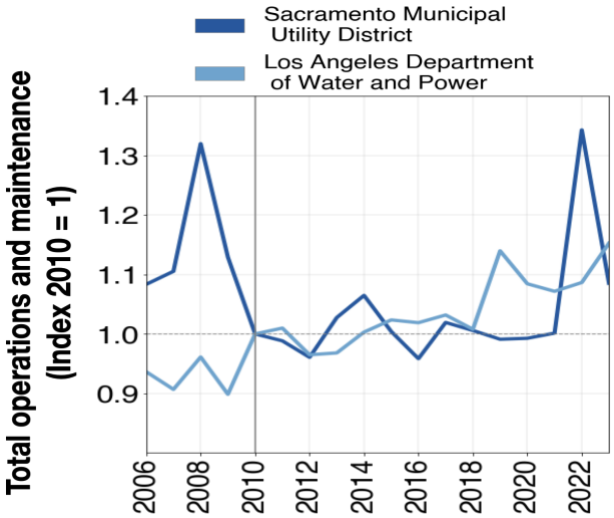

Figure 9: Total operations and maintenance costs for LADWP and SMUD. The figure shows the ratio of a year's real costs (in 2022$) to the real costs of the reference year (2010)—source: Annual financial statements of SMUD and LADWP.

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 [58], [59].

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 [62]. 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 [63], [64], [65]. 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 [66]. 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.

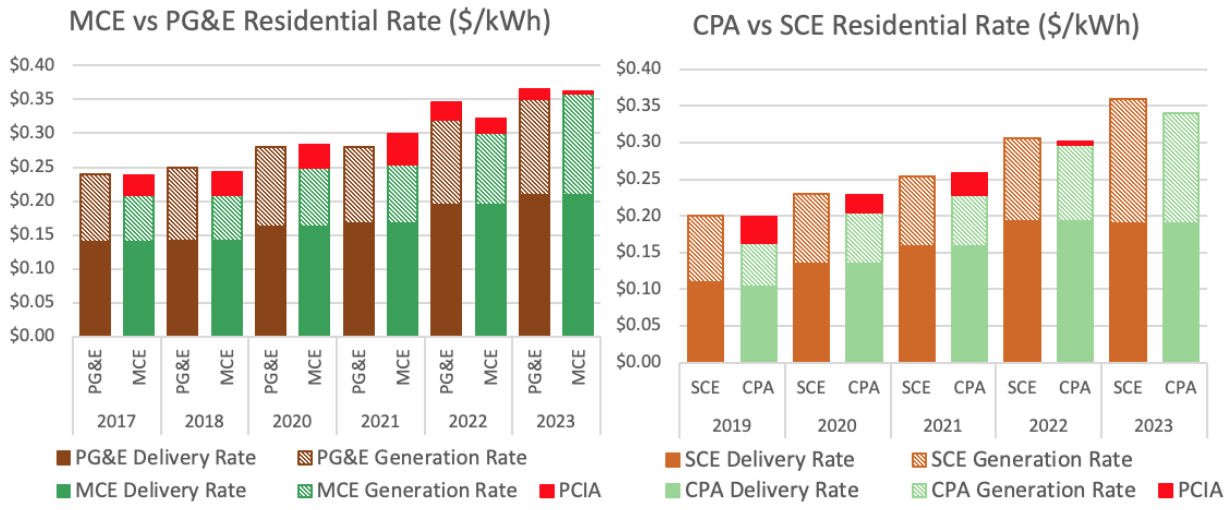

Figure 10: Comparison of the average residential rate, by component, faced by CCA customers versus the rate charged to IOU customers in the same geographic service territory.[8] The left panel compares MCE with PG&E, while the right panel compares CPA with SCE. Source: Joint Rate Comparisons prepared by CCAs and IOUs [63], [64], [65].

[8] 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.

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 simultaneously facing the 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.

Across all power providers, trends for capital investments are directionally similar: a flattening or reduction in generation assets and an increase in T&D assets. Since 2018, the IOU generation rate base has declined by 7-23% and the POU generation utility plant in service declined by 8-9%, as most utilities move to procure power from the wholesale markets instead of self-generation. Utilities' expenses on generation—largely driven by purchased power—show mixed trends. While generation O&M increased for PG&E by 48%, it remained relatively flat for SCE (7% increase) and SDG&E (3% decrease) compared to their 2018 expenses.

Network costs, on the other hand, have been the important drivers of overall utility costs. T&D capital assets increased for all utilities since 2018 (PG&E 24%, SCE 20%, SDG&E 32%, SMUD 12%, and LADWP 14%). However, expenses related to operations and maintenance have diverged sharply, particularly in the years following wildfires. Between 2018 and 2022, PG&E's total O&M expenses increased by more than 100%, with a five-fold increase in O&M expenses for distribution and a four-fold increase in transmission. For SCE and SDG&E, T&D O&M costs increased by 67 and 73% in the same time frame. In contrast, overall O&M expenses of POUs have increased by less than 15% since 2018. We also show that IOU network O&M costs have only ballooned following wildfires, remaining relatively constant in the years prior. This suggests that network O&M expenditures by IOUs have tended to be reactive rather than proactive despite an aging and expanding grid. Expenses for network infrastructure and 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 costs.

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, our findings should not be taken to imply that municipalization itself will necessarily relieve bill pressure. POU territories have historically experienced fewer wildfires. However, as demonstrated by the ongoing wildfires in Los Angeles in January 2025, this pattern may be shifting—potentially leading to increased upward pressure on LADWP rates. 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.

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).

Authorship contribution statement

Madalsa Singh - conceptualization, investigation, data visualisation, writing: original draft, writing: review and editing. **Alison Ong -** conceptualization, investigation, writing: original draft, writing: review and editing. **Rayan Sud -** conceptualization, data curation, investigation, writing: original draft, writing: review and editing.

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Research Data

Data referenced in this paper are available in an online repository [67].

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