CALIFORNIA SOLAR + STORAGE ASSOCIATION
smart local energy

M3

Rooftop Solar Reduces Costs for All Ratepayers

February 2025

This report was authored by:
Richard McCann, M.Cubed Consulting
Brad Heavner, CALSSA
Bernadette Del Chiaro, CALSSA

The California Solar & Storage Association (CALSSA) has advanced the common interest of the solar and storage industry for over 40 years, making California the most robust market in the U.S. The association is the state's largest clean energy business group, with 700 member companies representing an array of businesses that manufacture, design, install, finance and provide other resources to the growing local solar and storage market in California. Learn more at www.calssa.org.

M.Cubed Consulting, founded in 1993, provides economic and public policy consulting services to public and private sector clients. Dr. McCann has served as an expert witness for 30 years. He has worked for water districts and utilities, CCAs, county governments, tribes, regional energy networks, and the California Energy Commission, as well as environmental, agricultural, and business associations. He holds a Ph.D. and M.S. in Agricultural and Resource Economics from the University of California, Berkeley, and an M.P.P. from the University of Michigan.

Table of Contents

I. Executive Summary

As California policy makers seek to address energy affordability in 2025, new research shows why rooftop solar can and has helped control rate escalation. This research stands in direct contrast to claims that rooftop solar is to blame for rising rates. This report shows that the real reason electricity rates have increased dramatically in recent years is out of control utility spending and utility profit making, enabled by a lack of proper oversight by regulators.

Policy makers wanting to address California's affordability crisis should reject the utility's so-called "solar cost shift" and instead partner with consumers who have helped save all ratepayers $1.5 billion in 2024 alone by investing in rooftop solar. The state should prioritize these resources that simultaneously reduce carbon, increase resiliency, and minimize grid spending. This realignment of energy priorities away from what works for investor-owned utilities – spending more on the grid – and toward what works for consumers – spending less – is particularly important in the face of increased electricity consumption due to electrification. More rooftop solar is needed, not less, to control costs for all ratepayers and meet the state's clean energy goals.

Utilities have peddled a false "cost shift" theory that is based on the concept of "departing load." Utilities claim that the majority of their costs are fixed. When a customer generates their own power from onsite solar panels, the utilities claim this forces all other ratepayers to pick up a larger share of their "fixed" costs. A close look at hard data behind this theory, however, shows a different picture.

While California's gross consumption – the "plug load" that is actual electricity consumption – has grown, that growth has been offset by customer-sited rooftop solar. This has kept the state's peak consumption from the grid remarkably flat over the past twenty years, despite population growth, temperature increases, increased economic activity, and the rise in computers and other electronics in homes and businesses. Rooftop solar has not caused departing load in California. It has avoided load *growth*. By keeping our electric load on the grid flat, rooftop solar has avoided expensive grid expansion projects, in addition to reducing generation expenses, lowering costs for everyone.

Contrary to messaging from utilities and their regulators, California electricity consumption still peaks in mid-afternoon on hot summer days. There has been so much focus on the evening "net peak," depicted by the "duck curve," that many people have lost sight of the true peak. The annual peak in plug load happens when the sun is shining brightest. Clear, hot days lead to both high electricity usage from air conditioning and peak solar output.

The "net peak" is grid-based consumption minus generation from utility-scale solar and wind farms. It is an important dynamic to look at as we seek to reduce non-renewable sources of energy, and it shows us that energy storage will be essential going forward. However, an exclusive focus on net peak misses a bigger picture, particularly when looking at previously installed resources, and hides the value of solar energy.

California's two million rooftop solar systems installed under net metering, including those that do not have batteries, continue to reduce statewide costs year after year by reducing the true peak. While most new solar systems now have batteries to address the evening net peak, historic solar continues to play a critical role in addressing the mid-day true peak.

Utilities and their regulators ignore these facts and focus the blame of rising rates on consumers seeking relief via rooftop solar. Politicians looking to address a growing crisis of energy affordability in California should reject the scapegoating of working- and middle-class families who have invested their own money in rooftop solar, and should instead promote the continued growth of this important distributed resource to meet growing needs for electricity.

The state is at a crossroads. As we power more of our cars, appliances, and heating with electricity, usage will increase dramatically. Relying entirely on utilities to deliver that energy from faraway power plants on long-distance power lines would involve massive delays and cause costs to rise even higher. Aggressive rooftop solar deployment could offset significant portions of the projected demand increase from electrification, helping control costs in the future.

This report uses the common term "rooftop solar" to refer to all customer-sited solar, including solar on parking lots, warehouses, farms, schools, and other customer locations. This includes both ground-mounted and rooftop systems.

The Public Advocates Office (PAO), a branch of the California Public Utilities Commission, recently published a fact sheet that doubles down on the utility-inspired solar "cost shift" falsehood, claiming rooftop solar consumers shifted $8.5 billion in costs to non-solar consumers in 2024. This agency is misleading policy makers into thinking consumers are to blame for rising electricity rates and distracting from

the real cause of the energy affordability crisis: runaway utility spending and the lack of proper regulatory oversight. The PAO analysis is deeply flawed, containing major errors both on the inputs used and the overall approach to studying the costs and benefits of rooftop solar.

1. PAO considers solar self-generation a "cost" to the utilities, as if customers are obligated to buy all of their electricity from the utilities. Generating and consuming electricity onsite in real time simply results in purchasing less electricity from the utilities, just like energy efficiency. A utility does not incur any additional generation or transmission costs to serve rooftop solar customers beyond the energy those customers continue to use after installing solar, for which they pay full rates.

2. PAO made obvious errors on inputs. They used incorrect inputs for electricity rates, and they exaggerate the amount of energy produced by each net metered solar panel.

3. They use the Avoided Cost Calculator (ACC), a tool developed to estimate future cost savings, to measure the benefits of rooftop solar built in the past. If the first 17 gigawatts of rooftop solar had not been built, utilities would have had to build more grid infrastructure and sign more expensive long-term contracts for renewable energy projects. Ratepayers would still be paying for those expenses in today's rates.

4. PAO ignores the fact that when CARE customers generate their own energy they reduce the cost of the CARE subsidy that is borne by other ratepayers.

5. PAO does not consider the bill payments that are made by solar customers after installing solar. They set out to determine if solar customers are paying their "fair share" of utility costs, but they only look at part of the solar customers' bills. They intentionally ignore that the average NEM customer pays a $80-$160 monthly bill after installing solar.

Correcting these five errors and omissions changes the purported cost shift to a net benefit to all ratepayers of $1.5 billion. Every solar panel installed by a California consumer reduces strain on the electric grid and thereby pushes costs and rates downward for all ratepayers.

The real reason for rate increases is runaway utility spending, driven by the utilities' interest in increasing profits. Utility spending on grid infrastructure at the transmission and distribution levels has increased 130%-260% for each of the utilities over the past 8-12 years. These increases in spending track at a nearly 1:1 ratio with rate increases. This demonstrates that rates have gone up because utility spending has gone up. If utility costs were anything close to fixed and rates kept going up, there could be room for a cost shift argument. Or, if utility spending increased and rates increased significantly more, there could be a cost shift. The data shows neither of these trends. Rates have been increasing commensurate with spending, demonstrating that it is utility spending increases that have caused rates to increase, not consumers investing in clean energy.

Inspired by this faulty approach to measuring solar costs and benefits, the CPUC rolled out a transition from net metering to net billing that was abrupt and extreme. It has caused massive layoffs of skilled solar professionals and bankruptcies or closures of long-standing solar businesses. The poorly managed policy change set the market back ten years. A year and a half after the transition, the market still has not recovered.

California needs more rooftop solar and customer-sited batteries to contain costs and thereby rein in rate increases for all California ratepayers. To get the state back on track, policy makers need to stop attacking solar and adopt smart policies without delay.

- Respect the investments of customers who installed solar under NEM-1 and NEM-2. Do not change the terms of those contracts.
- Reject solar-specific taxes or fees in all forms, via the CPUC, the state budget, or local property taxes.
- Cut red tape in permitting and interconnection, and restore the right of solar contractors to install batteries. Do not use contractor licensing rules at the CSLB to restrict solar contractors from installing batteries.
- Establish a Million Solar Batteries initiative that includes virtual power plants and targeted incentives.
- Fix perverse utility profit motives that drive utilities to spend ratepayer money inefficiently, and even unnecessarily, and that motivate them to fight rooftop solar and other alternative ways to power California families and businesses.
- Launch a new investigation into utility oversight and overhaul the regulatory structure such that government regulators have the ability to properly scrutinize and contain utility spending.

California should be proud of its globally significant rooftop solar market. This solar development has diversified resources, served as a check on runaway utility spending, and helped clean the air all while tapping into private investments in clean energy. As the state looks to decarbonize its economy, the need to generate energy while minimizing capital intensive investments in grid infrastructure makes distributed solar and storage an even higher priority. State regulators need to stop being weak in utility oversight and exercise bold leadership for affordable clean energy that will benefit all ratepayers. California can start by getting back to promoting, not attacking, rooftop solar and batteries for all consumers.

II. Introduction: Rooftop Solar Has Been Good to California

California's leadership on rooftop solar has produced many strong benefits within California. It has not just been a way to help the world by developing cleaner, alternative forms of energy. It has been a smart way to bring about better economic wellbeing for California families and businesses. Rooftop solar has avoided expensive grid expansion projects, created local jobs that are hard to outsource, helped stabilize state energy supplies, and attracted innovators and creative thinkers. By literally inventing the modern-day photovoltaic cell and then incubating a burgeoning industry to bring it to scale, California set itself up for continued beneficial transformations in energy and industry. Adding to this, the environmental benefits such as cleaner air and water have made solar energy clearly a win-win-win investment.

Because solar panels generate electricity at the same time that California needs it most, rooftop solar has reduced the need for expensive grid expansions over the past twenty years. The electric grid is built to deliver the maximum amount of electricity that consumers use from the grid at any one moment. California's peak demand happens in the middle of the afternoon on hot summer days when air conditioning is running at its highest levels throughout the state. Those are hours when solar output peaks, trimming the need to deliver power over expensive and often stressed wires and associated equipment. Putting generation resources, e.g., rooftop solar, next to load, e.g. air conditioners, reduces strain on the grid, bringing economic and grid reliability benefits to all.

Rooftop solar also provides the additional value of creating local jobs that pay well and offer opportunity for advancement. At its peak, California's solar industry employed 80,000 people, the majority of which worked in the distributed market.[1] These jobs are located in communities large and small throughout the state, and a majority of the employment is with small local businesses. This directly supports workers and their families, and provides ripple effects throughout the economy.

The two million customers who led the first part of the solar energy transformation mirror the economic diversity of the state. The stereotype of solar customers as rich, white, coastal liberals pushed by solar critics is simply not true. Solar is fundamentally a middle-class home improvement. Solar installers are hard at work, day after day, in working-class neighborhoods throughout the state, especially in the Central Valley where families need air conditioning without breaking the bank.

The next wave of transformation in the California energy landscape is electrification. The development of electric vehicles and electric heat in buildings must be done hand in hand with solar and storage in the same neighborhoods to avoid bottlenecks on the grid and to avoid unnecessary grid expansion costs. Continuing to install rooftop solar efficiently and at scale will be essential as we add vast amounts of new electricity demand.

Half of the output of a rooftop solar system is used onsite in real time, making that home more energy efficient. Since electricity follows the path of least resistance, the other half that is exported is immediately consumed by neighbors, making the entire community more efficient from a grid perspective. This helps reduce strain on the grid and reduces expensive grid investments.

Big conversations are underway in California about energy affordability, and for good reason. Electric rates at the state's three largest utilities are the highest in the continental U.S. Spending increases have been orchestrated by the utilities to maintain high profits, directly driving up rates. Regulators have failed to contain the problem. The data in this report demonstrates that customer-sited solar is not to blame for high electricity rates in California but, rather, is a source of cost savings for all ratepayers.

Why do rates keep going up, making electricity in this state so much more expensive than other states? This is a very important question and should be the focus of intense scrutiny by policy makers. The answers should lead to real reform, not false scapegoating of consumers who have responded to the crisis by adding solar to their homes, schools, and businesses.

1. Interstate Renewable Energy Council, "National Solar Jobs Census 2023," available at https://irecusa.org/census-solar-jobs-by-state.

Scapegoating the Competition

In 2012, rooftop solar was just starting to emerge as a resource that could go to scale, with 32,000 customers investing in solar, 51% of whom were low-, working- and middle-class.[2] That year, SDG&E sponsored AB 2514, authored by Assemblymember Steven Bradford, a former utility executive and Chair of the Utilities and Energy Committee. It directed the CPUC to conduct a study on the costs and benefits of net energy metering. A previous CPUC analysis had treated self-consumption of onsite electricity generation as purely a benefit.[3] This bill mandated that the CPUC treat self-consumption as a cost to the utilities for purposes of the study.[4]

A year later, in January 2013, Edison Electric Institute, the national association of utilities, issued a report titled "Disruptive Challenges." The report described the threat of customer generation to utility profits, and characterized reductions in utility revenue as a cost. It advised the utility community on the concept of "shifting costs/lost revenues" from solar customers to non-solar customers. This led to panic about a utility "death spiral" and claims that nobody would be around to run the electric grid if policies continued.

That same year, Assemblymember Henry Perea, also a member of the Assembly Utilities and Energy Committee, introduced AB 327. This bill ended the Legislature's more than two decade-long support of rooftop solar and net energy metering. The bill directed the CPUC to modify NEM to address a "shifting of costs."

NRDC echoed concerns about the cost shift and utility death spiral, worried that clean energy progress was dependent on healthy utility profits.[5]

The death spiral story gradually fizzled as everyone realized that electric vehicles would bring in plenty of new business to the utilities, but the utility campaign against customer solar was relentless.

The California rooftop solar market grew from 80,000 new systems in 2014 to 130,000 new systems in 2015. The 2016 NEM2 decision required solar customers to be on TOU rates, increased the assessment of non-bypassable charges on solar customers, and set NEM3 in motion. This stunted solar growth but did not reverse it. The average installation rate from 2016 through 2020 was below the 2015 level.

This did not appease the utilities. In 2017, Edison Electric Institute hired PR firm Maslansky and Partners to help refine their message.[6] It recommended utilities directly disparage rooftop solar while promoting utility scale solar. The memo advises the utility industry to cast rooftop solar as having only "private" benefits for a small number of people who use the grid but don't pay for it, whereas utility scale solar projects should be called "universal" and "solar for all." This memo created a false narrative about equity as the foundation for attacking net metering and rooftop solar and ushered in a new era of pitting one clean energy resource against another.

The utilities and their allies have been highly successful in promoting this message not only in California but increasingly across the United States. It is essential that policy makers and energy commentators not swallow the rhetoric. We can expect utilities to continue blaming rooftop solar for their inability to keep rates under control. This is nothing more than scapegoating a sector they see as an adversary and a source of competition.

Public data from utility regulatory filings paints a different picture. The utilities' own numbers show that rooftop solar is saving everyone money while questionable spending by the utilities has driven rates higher, fueling record utility profits. The regulation of investor-owned utilities in California, including the largest utility in the country, PG&E, is in need of urgent and deep reform. Resuming growth in rooftop solar is part of the solution.

2. LBNL, "Solar Demographics Tool." In 2012, 8.8% of solar adopters earned a household income under $50,000, 22.9% earned a household income between $50,000-$100,000, and 19.6% earned household income between $100,000-$150,000.

3. CPUC, "Introduction to the Net Energy Metering Cost Effectiveness Evaluation," March 2010.

4. AB 2514 text: "In evaluating program costs and benefits for purposes of the study, the commission shall consider **all** electricity generated by renewable electric generating systems, **including the electricity used onsite to reduce a customer's consumption of electricity that otherwise would be supplied through the electrical grid,** as well as the electrical output that is being fed back to the electrical grid for which the customer receives credit or net surplus electricity compensation under net energy metering." [emphasis added]

5. Utility Dive, "NRDC: Nobody wins if utilities are caught in a death spiral," April 8, 2014, available at https://www.utilitydive.com/news/nrdc-nobody-wins-if-utilities-are-caught-in-a-death-spiral/248885.

6. EEI, Maslansky and Partners, "The Lexicon Project: Is Our Language Getting in the Way of Our Success?" September 2017.

III. The Cost Shift Fabrication

A. California's Rooftop Solar Market Is Diverse

One part of the solar "cost shift" myth invented by the investor-owned utilities and pushed by their allies is a claim that the rooftop solar market is dominated by rich white people who tend to be politically liberal and live in coastal areas. A look at actual data shows this to be false in every way.

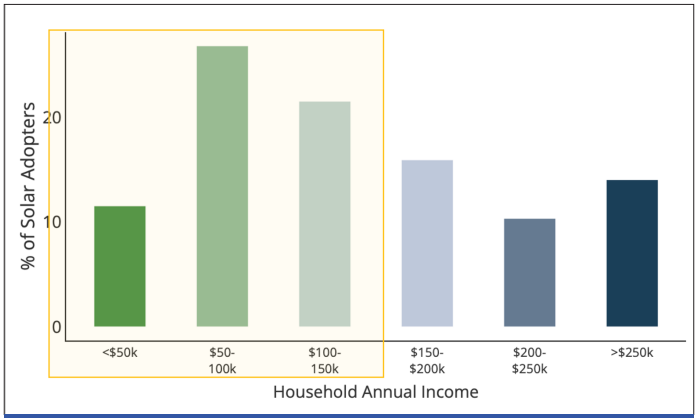
Lawrence Berkeley National Laboratory conducts an analysis each year on the demographics of households that install solar. The analysis includes a data visualization tool that allows users to select the state and demographic criteria.[7]

For this analysis, LBNL uses actual customer addresses and matches them with household income estimates from Experian. It refines this by cross referencing with data from the U.S. Census and the Bureau of Labor Statistics. This is the best picture that exists for the adoption of rooftop solar by household income and race.

LBNL finds that 60% of households that installed solar in 2023 were low- to middle-income, with total household income of less than $150,000, as shown in Figure 2. The largest segment of the market is households earning $50,000-$100,000.

It is noteworthy that LBNL's analysis is for all residential households, including multifamily rental properties. Today, there are over 400 low-income apartments with rooftop solar systems directly serving 35,000 income-qualified renters. If the state's Solar on Multifamily Affordable Housing (SOMAH) program is allowed to continue, another 1,200 low-income apartment projects are in the pipeline to serve another 300,000 renters. In addition, there are many hundreds more market-rate apartments with solar as well.

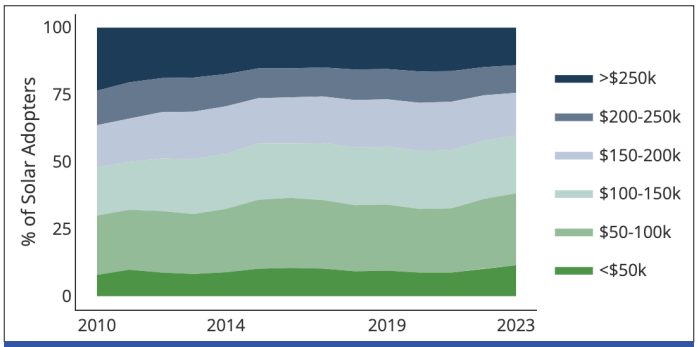
Figure 2. 2023 California Solar Customer Income Distribution



Solar customers mirror the economic diversity of California. The largest adopters are families with income below $150,000 per year.

The highest earning households had a larger share of the market in 2010 than they do today, but that was a share of a much smaller market. In 2010, total rooftop solar installations in California were 173 MW, compared to 2,268 MW in 2023.[8] Even then, families earning less $150,000 per year still made up nearly 50% of California's earliest adopters. As the price of solar has declined, market growth increasingly focused on lower income neighborhoods, as shown in Figure 3.

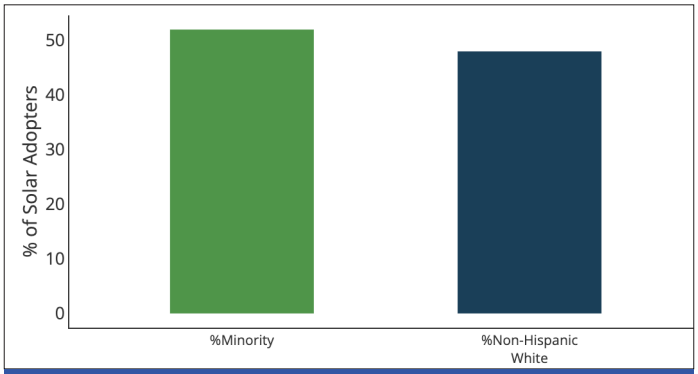
Figure 3. Solar Customer Income Distribution Time Trend



Households earning $50k-$150k have always been the heart of the market, even going back to 2010. As the total solar market has grown, it has trended toward lower income families. In 2010, 10,000 low- and middle-income families installed solar, compared with over 155,000 in 2023 – a 15-fold increase. Families in the highest income bracket (>$250,000) went from 4,600 in 2010 to 36,000 in 2023 – a 9-fold increase.

LBNL also analyzes solar customers by race. In California, 52% of households that installed solar in 2023 were families of color, as shown in Figure 4.

Figure 4. 2023 Solar Customers by Race



A majority of residential solar installed in 2023 was at minority households

7. LBNL Solar Demographics Tool, available at https://emp.lbl.gov/solar-demographics-tool. This site includes a chart generator that produced Figures 2-4 as well as a downloadable Excel file for specific figures.

8. California Distributed Generation Statistics, www.californiadgstats.gov.

B. The Myth of Departing Load and Fixed Costs

The utility attack on rooftop solar relies on the false notion that nearly all utility costs are fixed. "Fixed" means costs that do not vary with changes in electricity demand, such as administrative costs, utility poles within neighborhoods, and the wires that go from each house to the transformer. These truly fixed costs are small in comparison to large grid expansion projects. The need for grid expansion is not fixed. It depends on how much electricity people consume.

When customers generate their own power from solar panels on their roofs, they are buying less energy from the utilities. With the incorrect definition of fixed costs, the utility argument states that some customers buying less energy forces other customers to cover a bigger share of the "fixed" costs. They label solar as "departing load," as if utilities have rights to customers' energy consumption and rooftop solar unfairly takes something from them.

This theory is flawed on three fronts. First, most utility costs are not fixed. If customers consume more electricity from the grid, the utilities need to contract for more generation and build bigger power lines and substations to deliver more energy to homes, schools, and businesses. The opposite is also true: when customers consume less electricity, the utilities need to contract for less generation and there is reduced need for capital intensive grid projects.

While it is true that once a grid expansion project is built the money spent becomes "sunk" and is amortized over many years, the decision whether to build a grid expansion project in the first place depends directly on projected electricity usage. If electricity demand is not increasing, there is no need for big grid expansion projects. Sunk costs are from previous spending that varied with usage. Fixed costs do not vary with usage, such as local utility poles and the administration of metering and billing. Utilities confuse sunk costs with fixed costs in their attacks on rooftop solar.

Second, rooftop solar in California has offset growth in peak electricity demand. This is the inverse of reducing or taking away existing demand. It is not "departing load." Rooftop solar has not pulled kilowatt hours out of a fixed pie of electricity consumption over the past twenty years. Instead, it has helped keep the pie from growing. Peak electricity consumption served by the utilities has been flat over the past twenty years, despite increased economic activity, increased temperatures, and increased use of electronics in homes and businesses. This has avoided the need for grid expansion, lowering costs for all ratepayers.

Third, the concept of departing load is also based on a notion that the utility owns customer consumption, or at least has the sole responsibility for generating and transmitting enough electricity to cover all consumption. This is based on a flawed perspective. The grid is not an end goal. It is a tool. Serving customer needs is the purpose. If there are alternative ways to serve customers, utilities need to not stand in the way.

The utilities are allowed to operate as monopolies on the premise that it would be economically inefficient for other companies to build parallel infrastructure for transmitting energy.[9] It is about building poles and wires. This allowance was never intended to give utilities the sole responsibility for generating the energy that powers our homes and businesses. Reducing reliance on the grid has always been encouraged with energy efficiency, and rooftop solar was stimulated for the same reason.[10] At no point has a utility asserted a right to revenues from reduced sales due to energy efficiency.

Utilities and their regulators have used the cost shift argument to justify deep and sudden cuts to net metering and for taking solar self-consumption away from schools, farms, businesses and apartments. It is also used to justify expensive monthly flat fees charged to all energy consumers and proposals to tax solar panels and batteries installed behind the meter on private property. These radical changes to California's clean energy programs set the state back not only on its clean energy and climate goals, but also on its ability to deliver lower energy costs for families.

1. Containing Load Growth

The California Energy Commission (CEC) is the agency tasked with assessing long-range energy demands, as well as setting some of the most ambitious energy efficiency standards in the world. In 2005, CEC forecast that California's peak grid load would grow from 46,000 MW to 61,000 MW by 2023.[11]

Peak grid load is the highest amount of electricity at any moment in the year demanded of the high-voltage transmission system managed by CAISO. California's peak load occurs on hot summer afternoons driven by air conditioning in businesses and homes. California's peak electricity usage in the summer is nearly twice as high as in the winter.

Historic data shows that the projected increase in demand on the electric grid did not materialize. Instead, CAISO metered peak load has remained relatively flat for the past twenty years, as shown in Figure 5.[12] The difference between the forecasted peak and the CAISO metered peak in 2023 was 15,300 MW.

However, that does not mean actual peak electricity usage remained flat during this time period. The 2005 forecast was

9. Some communities are now challenging this premise.

10. In 2005, the Public Utilities Commission summarized the goals of the California Solar Initiative as, "Add clean, distributed contribution to our peak demand resources; Reduce risk by diversifying California's energy portfolio; Lower the burden of expanding and maintaining the State's transmission, pipeline, and distribution systems for electricity and natural gas." (CPUC, *Order Instituting Rulemaking Regarding Policies, Procedures and Incentives for Distributed Generation and Distributed Energy Resources,* p. 5.)

11. CEC, *2005 Integrated Energy Policy Report*, Committee Final Report, CEC-100-2005-017, November 2025, p.41.

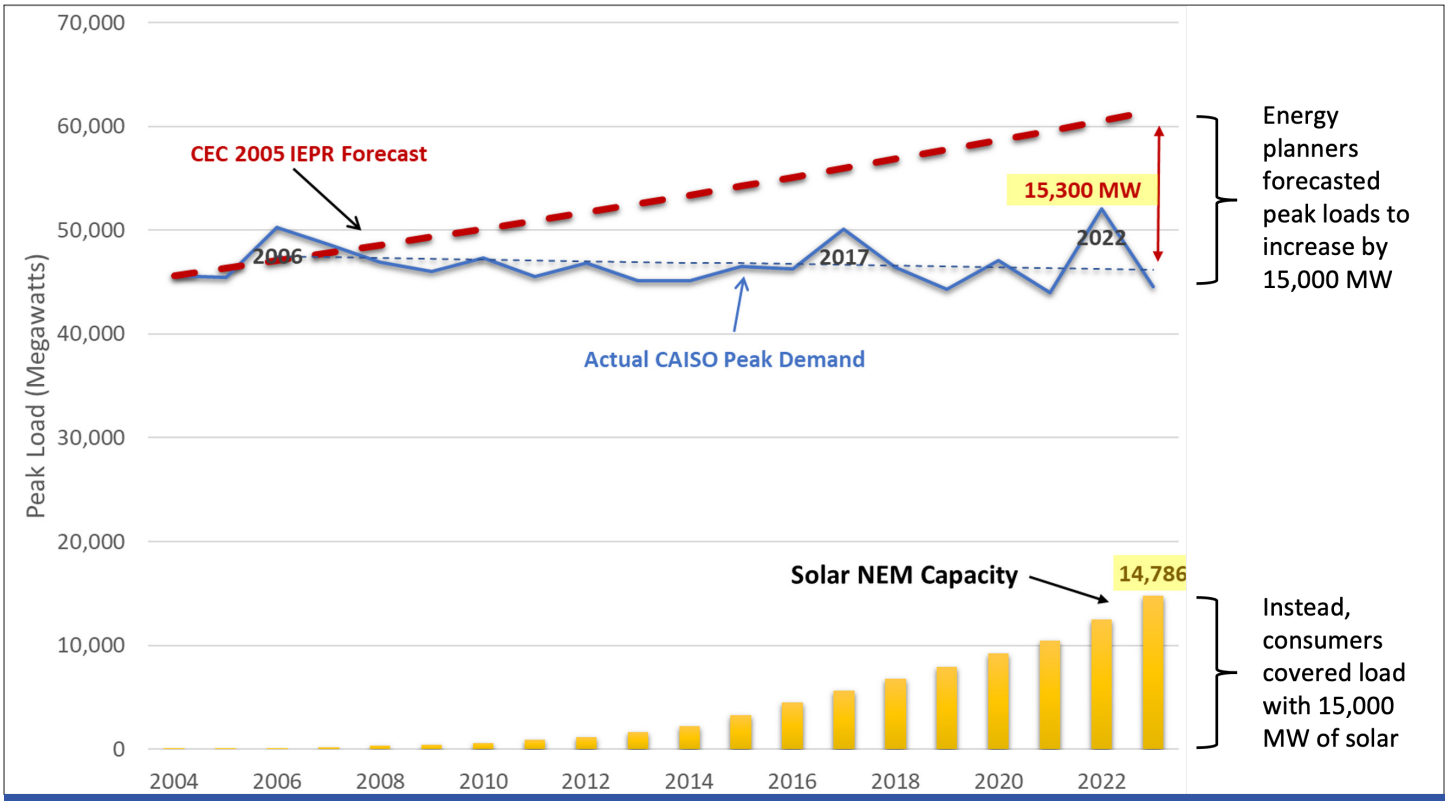
12. CAISO, "California ISO Peak Load History 1998 through 2023," https://www.caiso.com/Documents/CaliforniaISOPeakLoadHistory.pdf.

before rooftop solar emerged as a mainstream resource. CEC understandably assumed the energy to supply growth in usage would come almost entirely from the electric grid. In the following two decades, consumers did increase their peak electricity usage at the plug as predicted by the CEC. Instead of getting all those electrons from the centralized grid, though, the increased demand was offset with rooftop solar.

The peak CAISO metered load remained flat.

The correlation of the data is striking. By 2023, nearly two million customers had installed 14,786 MW of distributed solar, almost exactly the same as the 15,300 MW difference between forecast peak load and measured CAISO peak load.[13]

Figure 5. Customer Solar Compared to Load Deviation from Forecast



Total peak electricity usage, i.e. "plug load," has increased over the past twenty years due to population growth, increased economic activity, rising temperatures and an increased use of electronic devices, just as the CEC predicted with the dashed red line. However, California's annual metered peak consumption as experienced by CAISO, which happens on hot summer days in the mid-afternoon, has remained flat thanks to the growth of rooftop solar. Over the course of twenty years, keeping peak demand flat avoided the need for spending increases on the grid.

13. *California Distributed Generation Statistics*, https://www.californiadgstats.ca.gov.

Peak Demand Drives Grid Expansion

Grid planners size the transmission and distribution system to the state's annual peak load. Just like more water can flow through a large pipe than a small pipe, more electricity can flow through a fat wire than a thin wire without overheating and breaking. The larger the wires and associated electrical equipment – transformers, connectors, switches, fuses, voltage regulators, and other devices – the more electricity it can carry. One of the biggest utility expenses is expanding substations, which convert electricity from high-voltage transmission lines to lower-voltage local distribution feeders.

Larger wires, devices, and substations cost more, so grid operators closely watch customer demand and order the utilities to build infrastructure that is only large enough to deliver the amount of electricity needed for periods of peak demand.[14] Sizing for peak usage leaves excess capacity the rest of the year, just like freeways that are sized for rush hour have more capacity than is needed for times of low traffic. From an economic perspective, the best thing California can do to lower the overall cost of the grid is to prevent growth in peak demand. This avoids the need to replace smaller wires, devices and substations with bigger ones.

A dynamic that distorts this forecast/investment decision making process is the fact that California's investor-owned utilities profit from building more and larger grid infrastructure. While they do not have a profit margin on every electron a customer uses, they do directly profit from the purported need to build more grid infrastructure to deliver more electricity.[15] In this way, anything that lowers peak demand directly lowers utility profits. Anything that increases peak demand promises to increase utility profits. This conflict of interest between utility profit motives and what's in the best interest of customers (not to mention the protection of open space) is at the core of the conflict over rooftop solar. Rooftop solar generation peaks at the time California actual usage peaks: hot summer afternoons when air conditioners are working hard throughout the state. The effectiveness of local solar gets in the way of utility profits and therefore attracts utility opposition to its growth.

It is important to understand that the CEC, in developing their load growth forecast in 2005, anticipated ongoing and aggressive improvements to energy efficiency through enhanced appliance and building standards, energy efficiency incentive programs, and demand response programs. This included measures and programs that were in place at the time as well as an expectation of future measures and programs that had not yet been developed. Without these efficiency and conservation measures, California's peak demand forecast would have been even higher than what was predicted.

Another important consideration is the distinction between the peak electricity consumption measured by CAISO and actual customer electricity consumption, some of which is covered by self-generation. CAISO only measures demand on the high-voltage transmission lines that crisscross the state. They do not monitor activity below the substations, the border between the transmission and distribution systems. They do not see rooftop solar generation whether it is self-consumed behind one customer's electric meter or used by neighboring customers. Electricity consumption that is covered by local generation is invisible to CAISO. Because of distributed generation, true electricity consumption, is higher than the CAISO-monitored transmission load.

Solar directly addresses peak load. The times of the year when we are using the most electricity are hot summer days when air conditioning is in its heaviest usage. Those are also clear sunny days when solar is at its maximum output.

We can therefore conclude that the 2005 CEC forecast was largely correct. The peak level of gross usage – the "plug load" of actual electricity consumption – did increase over the past twenty years. The delta between the CEC forecast, which included energy efficiency, and CAISO-measured load corresponds with the growth of rooftop solar. If the solar had not been installed, it would have shown up at the substation and CAISO would have had to order utilities to build enough resources to serve it. This undermines the utility mindset that rooftop solar inherently creates a shrinking pie of consumers.

The reduction in load growth from rooftop solar occurred over a twenty year period and from well-established and popular programs to specifically drive adoption of rooftop solar. Utilities cannot claim they had to invest in grid expansion projects because they were unaware of the growth in rooftop solar and its impacts. If the utilities spent extravagantly on the grid in order to drive higher profits, and their grid expansions were not needed, it was a risk taken by their shareholders and should not be included in the rate base.

14. This does not include the rare super-peaks such as those seen in 2006, 2017, and 2022, which are better managed by paying customers to use less electricity during extreme events.

15. Utilities in California are not penalized after the fact for overbuilding infrastructure. The CPUC could create a "used and useful" review, and require unwarranted expenses to be covered by shareholders.

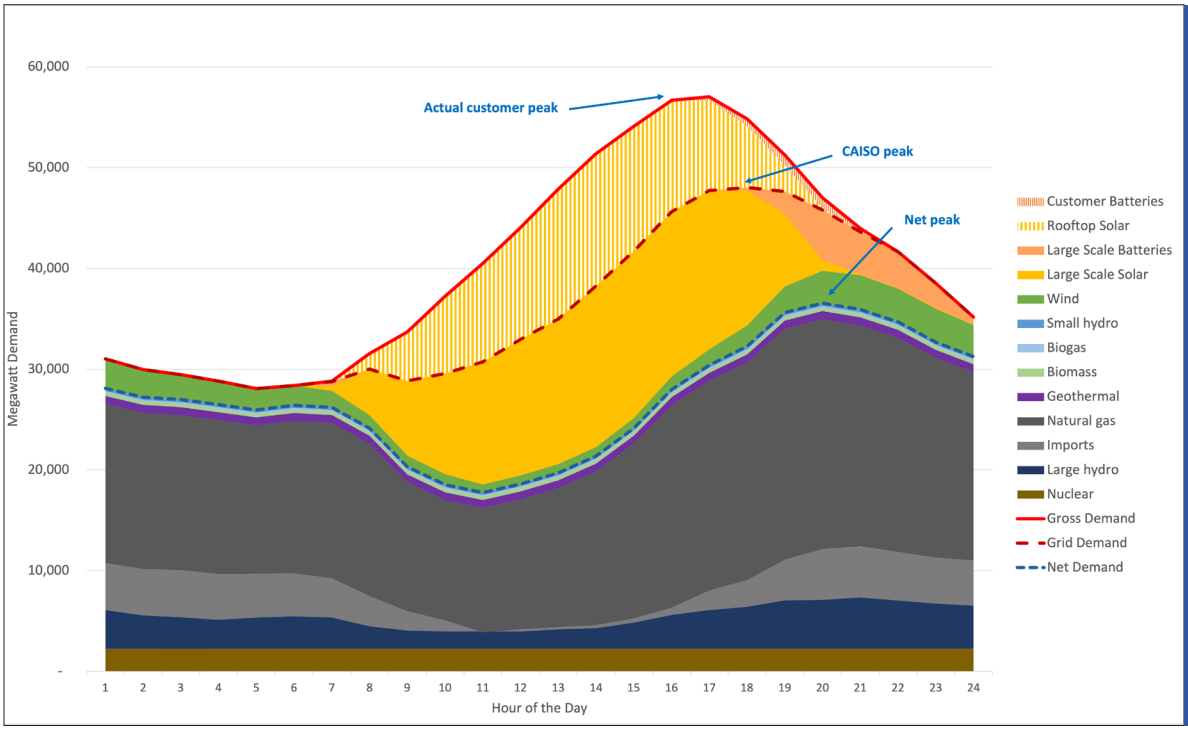
2. Actual Peak Is Still Mid-Day, Not Evening

The benefit of the two million solar installations built to date is evident when looking at the resource mix on hot summer days. Compiling a graph that includes both transmission-tied resources and rooftop solar provides a picture of California's actual electricity consumption. The solid red line in Figure 6 is the amount of electricity we actually consume – the "plug load."[16]

On hot sunny days, our electricity usage peaks in mid-afternoon. This is also when solar panels are at or near their peak output. If rooftop solar were to disappear suddenly, California's total demand for electricity from the centralized grid during this critical time of the day would have to be met with other resources and would put major strain on an already strained grid.

Covering this actual peak with local solar has enormous value for containing grid costs. As discussed in the box in the previous section, utilities build the grid for the annual peak in transmission-dependent load. If we have higher peak demand for electricity, utilities need to build bigger wires, devices, and substations to deliver the needed power. It is the hours of the year when we are using the greatest amount of electricity that create the need to expand the grid. If we lower or flatten demand during these hours of the year, we can avoid expensive grid investments.

Figure 6. California Energy Sources Covering Actual Gross Peak Load



Adding rooftop solar and customer batteries to CAISO data on wholesale generation shows true hourly consumption, which is at its highest annual level on hot summer days. The 2024 peak day was September 5. We build grid capacity to serve the summer peak. Solar reduces that peak, reducing costs for everyone.

There is an incredible amount of animosity toward the first two million solar users in California ("NEM1" and "NEM2" customers) in part because 85% of them do not have batteries. There is an understanding that we now need solar systems to include batteries to cover evening electricity demand. While it is true that, going forward, the market should be dominated by paired solar and storage systems, the existing solar systems without batteries should be respected for addressing the mid-day actual peak. That is a value that continues year after year as those systems continue to operate with high levels of reliability. The state offered an appropriate billing structure for those customers. Those terms should be respected and maintained.

CAISO is now focused on the "net peak," which is all consumption from the electric grid minus what can be covered with utility-scale solar and wind generation. They have publicized the "duck curve" to highlight that the net peak is in the evening. In Figure 6, the duck curve is the dotted blue line.

Addressing the net peak is the objective going forward, and we can absolutely meet that challenge with the growth of solar paired with batteries. But the evening net peak does not undermine the fact that existing rooftop solar without storage continues to provide a valuable service year after year addressing the actual peak in the afternoon.

16. All transmission resources from "CAISO Supply Trend" for August 7, 2024, available at https://www.caiso.com/todays-outlook/supply. Rooftop solar figures generated by applying a PV Watts generating profile for Stockton on August 7 to the 17.7 GW of customer solar installed in the three IOU territories. Customer storage values are the energy from discharging the 2,371 MW of customer-sited energy storage installed in the three IOU territories to an 80% depth of discharge in a typical discharging profile. This storage amount is subtracted from the PV generation according to a typical storage charging profile.

3. Electrification Makes Rooftop Solar Even More Important

After keeping the transmission-dependent load flat for twenty years, we are now entering a new era thanks to efforts to decarbonize the state's transportation sector, buildings, and appliances. With electric vehicles and electric heat in buildings, California's electricity consumption is poised to grow dramatically. CEC analysis for the 2024 IEPR projects that electricity consumption will increase by 59 TWh/yr by 2030, not including load from new data centers.[17]

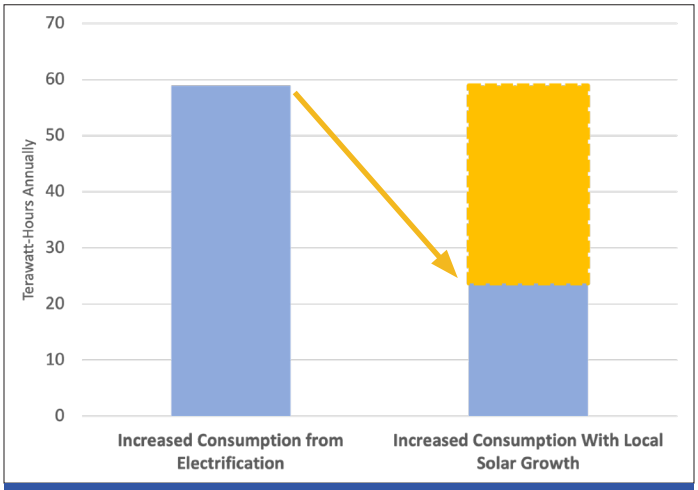
The utilities' preferred response to this load growth is to rely almost entirely on expanding long distance power lines and faraway power plants, but doing so would require significant capital expenditures, which would, in turn, result in continued rate increases. The utilities' record on spending efficiency has not been promising, as transmission rates have risen strikingly over the last two decades. Utilities have a financial incentive to spend more money on transmission and distribution (T&D), as their profits are tied to capital spending. They like it when expensive grid upgrades are required because for every ratepayer dollar spent on T&D, they earn a guaranteed profit on the order of 10%.[18]

In response to this critique, the utilities try to change the frame, focusing instead of the theory that if every ratepayer simply uses more electricity, rates will decrease. However, this simplicity misses an important fact. Some of the increased usage will come at the peak times that directly correlate with increased spending. In its 2023 report contracted by the CPUC, Kevala estimated that California will incur $50 billion in grid expansion costs by 2035 as a result of transportation and building electrification if load management approaches are not included.[19] PAO was highly critical of the Kevala report and produced a counter analysis. However, when PAO included load management, they still calculated a price tag of $26 billion, and that was only from transportation electrification and not building electrification.[20]

Instead of giving utilities free rein to increase spending, the state should continue to offset new load growth with rooftop solar to the maximum extent possible. If customer solar adoption increases from the 2024 pace by 25% per year through 2030, it will cover up to 60% of the increased load from electrification, as shown in Figure 7. California must strive to maximize local generation opportunities to avoid exposure to even higher utility rate increases.

Looking at this future picture, the notion of departing load is non-sensical. The system is not static. Electricity consumption is growing. Rooftop solar is not pulling consumption from a fixed pie. It is constraining the growth of the pie, which saves everyone money.

Figure 7. Growth in Electricity Consumption by 2030 With and Without Solar



CEC forecasts we will consume an additional 59 TWh/yr by 2030 from electric vehicles and electric heat in buildings. Relying completely on utilities to deliver all of that energy from remote sources is a recipe for continued runaway utility spending. If rooftop solar grows by 25% per year from the 2014 pace, it will meet 60% of the increased demand by 2030.

In addition to being excessively expensive, relying entirely on energy from the grid for load growth would likely slow down electrification. The Kevala study finds the utilities "may not be able to plan for the expected rapid increase in transportation electrification-related infrastructure due to the lead times involved."[21] In other words, even putting costs aside, we may not be able to expand the grid fast enough to serve EVs if we try to do it all with faraway generators. Grid capacity is a bottleneck.

C. Rooftop Solar Is a Net Benefit, Not a Net Cost

The previous sections of this paper have clarified and offered data showing that rooftop solar, including stand-alone solar without batteries, has helped avoid peak demand growth on California's electricity grid. This has avoided expensive grid infrastructure investments that the utilities would have otherwise been forced to make over the past twenty years and has helped keep the lights on during hot summer afternoons when the grid is most stressed. Rooftop solar built by and for consumers has also avoided the need for utilities to build 18 GW of new renewable energy genera-

17. CEC, "Draft Transportation Energy Demand Forecast," "Additional Achievable Fuel Substitution (AAFS) Draft Results," November 7, 2024.

18. CPUC, Decision 22-12-031, December 15, 2022.

19. Kevala, "Electrification Impacts Study: Bottom-Up Load Forecasting and System-Level Electrification Impacts Cost Estimates," May 9, 2023.

20. Public Advocates Office, "Distribution Grid Electrification Model Findings," August 1, 2024. The PAO analysis was also less rigorous than the Kevala study because it didn't look at impacts at different points in a distribution circuit and did not consider distribution transformers.

21. Kevala, "Electrification Impacts Study: Bottom-Up Load Forecasting and System-Level Electrification Impacts Cost Estimates," May 9, 2023, p. 19.

tors to meet California's Renewable Portfolio Standard – the state's minimum threshold for the transition to renewable energy resources. Far from removing load from the electric grid and stranding grid assets, rooftop solar has prevented the need to build new, expensive grid infrastructure and generators by tapping into the private investments of a diversity of families and businesses from all over the state.

This success story for years has been an envy of the world, but recently the utilities and their cohorts have been on the attack against rooftop solar. A prominent face of these attacks has been the Public Advocates Office (PAO), an agency that is housed within the CPUC. PAO published a fact sheet in August 2024 stating that the rooftop solar "cost shift" has grown to $8.5 billion per year.[22] Rather than focusing on structural flaws in the regulatory process, today's appointed utility regulators are scapegoating solar customers and providers. Their analysis is error-ridden and takes an analytical approach that does not match the technical questions they purportedly seek to address.

Correcting their analysis changes the $8.5 billion cost shift to a $1.5 billion net benefit. The errors and omissions can be grouped into the following five categories.

1. Self-Generation Is Not a Cost

The single biggest error the PAO makes is to include self-consumption as a cost to the utilities. Roughly half of the electricity generated by rooftop solar panels is directly consumed by the customer in real time.[23] The other half is exported to the grid and consumed immediately by a neighbor, using only the small wires connected to the transformer.

The electricity that customers produce from their own solar panels and use in real time without ever touching a single utility wire should be treated the same as energy efficiency, not as "lost revenue" or a cost to the utilities. Treating it as a cost is wrong on three fronts.

First, when customer usage goes up, utility costs go up. The portion of utility costs that are truly fixed is small. Diluting those expenses would not have a major impact, and further, all customers will soon start paying fixed charges to more than cover all of those costs. The majority of utility costs are for expanding the electric grid. If self-generation did not exist, the utilities would spend more money on grid expansion projects. By generating their own energy during peak hours, rooftop solar customers free up grid capacity to serve other customers. Buying less energy from the utilities, especially on hot summer afternoons, is positive behavior.

Second, utilities do not own a customer's electricity usage. Their monopoly status does not extend behind the meter to cover the electricity a customer doesn't buy. Anyone would be hard-pressed to identify a single business, monopoly or otherwise, that gets guaranteed revenue from consumers not buying their product.

Third, PAO does not show any evidence that a utility incurs additional generation or transmission costs to serve rooftop solar customers beyond the energy those customers continue to use from the grid after installing solar.

By removing self-consumption from the PAO calculation, $4 billion in phantom "costs" are deleted.[24]

$8.46 billion – $3.99 billion = $4.47 billion

Rooftop Solar Is Like Energy Efficiency: Why the Double Standard?

Every year, California ratepayers save 64,000 GWh of electricity by investing in insulation, double paned windows, and more efficient appliances, among other energy efficiency measures.[25] Ratepayers subsidize the adoption of these more efficient devices in order to save everyone money on grid costs. The benefits of energy efficiency are well understood.

It is a double-standard to give the self-consumption portion of rooftop solar different treatment. The 15,000 GWh that are generated and used behind-the-meter should not be counted as a cost to other ratepayers.[26] This is roughly 50% of the energy generated by a rooftop solar system for residential customers and around 70% for commercial customers. If the solar antagonists were to apply their same faulty analysis to California's world-renowned energy efficiency programs, it would result in a purported cost shift of $17 billion per year. By this logic, we should all increase our energy consumption to reduce rates. The result would be higher customer bills feeding inefficient utility spending.

22. Public Advocates Office, "Rooftop Solar incentive to cost customers without solar an estimated $8.5 billion by the end of 2024," August 22, 2024, available at https://www.publicadvocates.cpuc.ca.gov/press-room/reports-and-analyses/nem-cost-shift-methodology-fact-sheet-2024.

23. PAO assumes 50% of residential solar generation is exported for PG&E and SCE, which is a reasonable assumption. They assume 60% for SDG&E without explanation, which is likely too high.

24. The correction amounts for this and the following categories are documented in M.Cubed, "How California's Rooftop Solar Customers Benefit Other Ratepayers Financially to the Tune of $2.3 Billion," available at https://mcubedecon.com/2024/11/14/how-californias-rooftop-solar-customers-benefit-other-ratepayers-financially-to-the-tune-of-1-5-billion/. The M.Cubed inputs and calculations are available at https://mcubedecon.com/wp-content/uploads/2024/11/240906-public-advocates-office-cost-shift-calculations-m3-updated-clean-1.xlsx.

25. CEC Energy Assessments Division, *California Energy Demand 2018-2030* Revised Forecast, Commission Final Report, CEC-200-2018-002-CMF, February 2018, Figure 19; and extended to 2024 with incremental energy efficiency savings reported in each subsequent *Integrated Energy Policy Report*.

26. Based on PAO assumptions of self-generation and distributed solar capacity by utility from California Distributed Solar Statistics.

2. Corrected Rates & Solar Output

The second biggest error in the PAO's analysis is their use of incorrect rates and solar outputs within its spreadsheet. First, on their use of incorrect rates, by using an inflated rate for solar consumers, the PAO falsely increases the "cost" part of their cost-benefit analysis.

For PG&E and SCE, the PAO used numbers they got from the utilities, seemingly without documentation.[27] This fact alone sounds an alarm that the PAO is not doing its own analysis on a calculation that is very straightforward. Rates are published in easily accessible public documents that PAO reviews regularly. PAO has documentation of typical solar customer behavior from the CPUC proceeding on net metering. They should not need to go to the utility to multiply hourly consumption and exports by the associated TOU rates, and they have not been transparent about the information they got from the utilities.

The rates provided by the utilities do not line up with the rates solar customers actually face. Average rates using the solar profiles from the E3 model that was developed under contract with the CPUC for the NEM-3 proceeding are much lower, as shown in Table 1.[28]

The PAO attempts to apply a solar profile for SDG&E rates, but that profile is not aligned with the hours when a typical solar customer exports energy to the grid. PAO's rates for that utility are closer to reality but are still not accurate.

Further, PAO fails to account for the percentage of NEM customers who are on CARE rates (15% for PG&E, 18% for SCE, and 8% for SDG&E). This lowers the average rate for solar customers as a whole.

Table 1. Rates for Solar Customers Under NEM-2 (¢/kWh)

	PG&E	SCE	SDG&E
Non-CARE NEM rates using E3 profiles	37.1	28.5	37.5
NEM rates using E3 profiles and including solar CARE customers	35.2	26.8	36.4
Rates used by PAO	48.0	37.6	39.4
PAO inflated value	12.8	10.8	3.0

In addition to using incorrect rates, PAO also inflated the amount of energy produced by each solar panel. The amount of energy that a solar panel is expected to generate in a year is called the "capacity factor." It is expressed as a percentage of what the solar panels could produce if ideal conditions existed throughout the year (i.e., full sunlight every hour every day on panels tilted at a perfect angle to the sun). This is a common metric for classifying the output of any generating facility, whether it is a nuclear power plant, a natural gas plant, a hydroelectric dam, or a rooftop solar panel. In their "cost shift" calculations, the PAO uses a capacity factor of 20% for rooftop solar.[29] This is higher than commonly used values.[30] NREL documents a California rooftop solar capacity factor of 17%-18%.[31] PG&E uses a 17.1% solar capacity factor.[32] In its critique of the PAO analysis, M.Cubed used 17.5%. Applied across 50 million customer-sited solar panels, this difference has a major impact on the results.

Correcting these errors on rates and solar output reduces PAO's estimated cost shift by another $2.5 billion.

$4.47 billion – $2.46 billion = $2.01 billion

3. Historic Grid Savings from Twenty Years of Rooftop Solar Installations

The third major error of the PAO's analysis is their failure to use a full and accurate accounting of historic benefits. The PAO uses a tool that is designed to measure forward-looking benefits and pretends that it also works looking backward. The Avoided Cost Calculator (ACC) was built to project the benefits of installing additional customer-sited resources in the current year. It does not attempt to measure the benefits of resources installed in previous years. It is a fundamental error for PAO to use the tool in this way. The things that will drive costs in the future are different from what drove costs in the past.

California hit its first major milestone, building 500 MW of rooftop solar – the size of a typical coal-fired power plant – in 2010. The second major milestone, building a gigawatt of rooftop solar – the size of a typical nuclear power plant – came in 2012. These earliest adopters provided benefits that are unique to that time period. They displaced the need for the utilities to sign more expensive contracts for utility-scale solar and wind projects, for example. The first gigawatt of rooftop solar installed between 2000 and 2012 did not have the same impacts as the 16th gigawatt installed in 2023.

It is also essential to recognize that historic solar installations are addressing our mid-day peak energy consumption (See Figure 6). Our highest rate of electricity consumption is still on hot summer afternoons. Without the solar that customers

27. Per email communications from the PAO report author.

28. E3 is a consulting firm that mostly works for utilities (https://www.ethree.com/about/clients). The CPUC hired them to create analytical tools for the NEM-3 proceeding. This model is available at https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/net-energy-metering-nem/nemrevisit/nbt-model--12142022.xlsb.

29. PAO took the 20% capacity factor from the draft NEM-3 Lookback Study by Verdant Associates. After criticism on that assumption in the draft, Verdant stopped using 20% and used an approach not based on capacity factor.

30. Solar systems with "trackers" that rotate the panels to face the sun throughout the day have higher capacity factors, but rooftop systems are always "fixed tilt."

31. NREL, Annual Technology Baseline, Residential PV Resource Classes, available at https://atb.nrel.gov/electricity/2022/residential_pv#:~:text=Residential%20PV,-0.0. California is Resource Class 3 and 4.

32. PG&E, "Agreement and Customer Authorization," p. 2, fn B, available at https://www.pge.com/tariffs/assets/pdf/tariffbook/ELEC_FORMS_79-1151A.pdf.

have installed, generation in those hours would still be the most valuable. For new resources in 2025, the highest value is in the evening to address the net peak, but PAO treats previously installed solar as if it were a new resource. This is a core flaw in their approach to studying solar costs and benefits. Their analysis essentially pretends that all existing rooftop solar systems were installed in the current year, and limits its estimate to the utility cost reduction achieved within one year.

If historic solar had not avoided grid costs in the year it was installed and the years following, the costs from those years would have been amortized and would be in today's rates. The PAO's exclusive focus on 2024 numbers ignores this essential fact. They are using a forward-looking model to evaluate previous investments. This renders irrelevant the entire "benefits" side of their analysis. Purporting to measure the impacts of past solar installations without accounting for displaced past costs is not credible.

Rooftop solar displaced 15,000 megawatts of capacity additions over a 20 year period. This avoided construction translates into lower rates today. As shown in Figure 5, this amount of avoided load growth compares almost exactly to the amount of predicted load growth in the CEC 2005 forecast.

Rather than using the one-year value of solar in the forward-looking Avoided Cost Calculator for the value of previously installed solar, the M.Cubed analysis uses the historic costs of the investments that would have been made if the solar had not been installed.[33] This approximates marginal value in 2010 for 2010 installations, in 2011 for 2011 installations, etc. The M.Cubed assumptions are reasonable and transparent. This results in an increase in net savings of another $2.2 billion compared to the PAO fact sheet.[34]

$2.01 billion - $2.16 billion = –$0.15 billion

Understanding Marginal Value

It is important to understand the concept of "marginal value." A cost-benefit analysis often looks at the value of the next unit that is added, in this case an additional installed kilowatt of solar. Ten years ago, the value of one additional kilowatt of solar was highest in the middle of the day because that is when our demand for electricity from the centralized grid peaked. After we installed two million rooftop solar systems and consumer demand on the grid during annual peak hours was kept flat, the marginal value of electricity put on the grid at mid-day also decreased.

Applying the 2024 marginal value to solar systems that were installed five, ten, even fifteen years ago is blatantly incorrect. It ignores the value at the time when those systems were installed. If this type of hubris was applied to utility investments, few of them would be justified from a ratepayer perspective.

It is greatly discouraging to see this approach from the California agency charged with advocating for fairness in energy policy. If those rooftop systems had not been installed over the past twenty years, we would still have the greatest need for incremental grid resources in the middle of the day. The value of an incremental kWh of solar at mid-day has declined *because of* all the solar that is already installed. This devaluation is a benefit from all those consumer investments in rooftop solar. The value of those solar systems must account for this very real reduction in utility spending. PAO is using today's value of a new kilowatt-hour put on the grid to evaluate solar that was installed years ago. This approach is fundamentally wrong.

4. Avoided CARE Subsidies

CARE is a program in which qualifying low-income ratepayers get an automatic 32%-35% rate discount. Every electron a CARE customer buys from the utility costs the customer 32%-35% less than a non-CARE customer. This discount is paid for by non-CARE ratepayers in the form of a public purpose charge within electric rates.

When a CARE customer goes solar, they buy less electricity from the utility. Because each kWh consumed by a CARE customer increases the cost of the CARE program, installing solar reduces the subsidy paid for by other ratepayers.

PAO ignores the fact that 15% of NEM customers are on CARE rates. Because those customers generate some of their own electricity, the cost of the CARE subsidy has decreased $160 million, a benefit to all ratepayers that should be subtracted from PAO's total "cost shift."

–$0.15 billion – $0.16 billion = –$0.31 billion

33. The value of deferred generation capacity at the beginning of the solar build-out is the CEC's cost of a combustion turbine (CEC, Comparative Costs of California Central Station Electricity Generation Technologies, CEC-200-2007-011-SF, December 2007). It decreases linearly over time to the marginal costs filed in the most recent decided general rate cases. Generation energy is the mix of average CAISO market prices in 2023 (CAISO, 2023 Annual Report on Market Issues & Performance, Department of Market Monitoring, July 29, 2024) and the utilities' average renewable energy contract prices (CPUC, "2023 Padilla Report: Costs and Cost Savings for the RPS Program," May 2023). Avoided transmission costs are conservatively set at the current retail transmission rate components. Distribution investment savings are the weighted average of the marginal costs included in the utilities' general rate case filings from 2007 to 2021.

34. This estimate is conservative because it does not include the accumulated time value of money created by investment begun 18 years ago, and does not include a net present value of future savings.

5. Solar Customers Pay the Utility $80-$160 Per Month After Installing Solar

The final error covered by the M.Cubed counter-analysis is PAO's failure to account for monthly bill payments that solar customers make after installing solar. PAO sets out to claim that solar customers do not cover the utilities' fixed costs, but they ignore the parts of the bill that solar customers continue to pay.

Utility fixed costs are per customer, not per kilowatt-hour of electricity delivered. PAO's analysis is limited to the kWh of customer generation, ignoring the additional amount of electricity consumed by solar customers, the impact of time-of-use rates, the minimum bill, and the fixed charges. This mismatch undermines the PAO analysis by leaving out perhaps the most important financial contribution of these customers to the utilities' current costs. The analysis is not structured to answer the fundamental question of whether solar customers pay an appropriate amount for their use of the grid. That question cannot be answered by looking at only part of a solar customer's bill.

First, it is glaring that the PAO analysis does not include the minimum bill. Since 2016, all residential customers have been required to pay a minimum amount each month, which was set at $10 in 2016 and indexed to inflation. The logic behind the minimum bill is that the utility company incurs some level of cost for every customer connected to the grid. This includes the administrative cost of sending the customer a bill every month and the amortized cost of the utility meter, a portion of the shared transformer, and the wire between the two. This applies to all residential customers.[35]

All solar customers in California either pay the minimum bill or buy more than $10 of electricity. If PAO was not willing to look further than that into the question of how much solar customers pay the utility each month, they at least could have included a $120/year payment to the utility when evaluating whether those solar customers were paying their "fair share."

Second, it is disingenuous for PAO not to even mention the new "fixed charge" of $24/month adopted by the CPUC in 2024 that all consumers, including solar users, will start paying in 2026. The fixed charge was pushed past the Legislature, amidst great controversy, specifically to ensure that low energy users pay their fair share of grid costs. When evaluating whether additional policy changes are needed for net metering customers, the PAO should have included fixed charges. The M.Cubed counter-analysis also does not include the fixed charge because it is not recommending any policy changes. PAO is acting deviously by recommending additional policy changes without recognizing this major policy change that has already been adopted. Once the fixed charge is in place, it will result in nearly $600 million per year in payments from current solar customers.

Third, time-of-use rates result in substantial payments from the solar customer to the utility even if the amount of electricity a NEM customer exports to the grid in a year is equal to the amount they consume from the grid. Time-of-use rates are lower in the daytime and higher from 4-9pm. Solar customers receive credit for the electrons they export to the grid in the afternoon at a lower value than the cost of electrons they import from the grid in the evening. All residential NEM2 customers are required to be on time-of-use rates, and many NEM1 customers have been moved to those rates as part of all residential customers getting defaulted to TOU.[36] All commercial rates have been TOU since 2017.

Fourth, most solar customers generate less electricity per year than they consume. Even among those whose systems were designed to offset all of their load, many have added electric vehicles, heat pumps and other electric appliances while maintaining the same sized panel arrays. This makes them net consumers of grid-supplied electricity. Solar users pay the full retail rate for grid-supplied electrons just like everyone else.

Combining all of these elements, the average bill payment for NEM1 and NEM2 customers, after installing solar, is $80-$163 per month, depending on the utility and the tariff.[37] The average of all NEM customers, weighted by the number of customers in each category, is $105 per month. These monthly bill payments more than cover the fixed cost of providing utility service to those homes.

Table 2. Average Post-Solar Monthly Bills

	NEM 1	NEM 2
PG&E	$ 155	$ 94
SCE	$ 163	$ 99
SDG&E	$ 132	$ 80

35. Commercial customers all pay fixed charges higher than $10, so the minimum bill is not relevant to them.

36. Approximately 80% of residential NEM customers in California are on time-of-use rates. This is derived from an SCE data point that 33% of NEM1 customers are on TOU rates and the fact that all NEM2 customer must be on TOU.

37. IOU responses to data requests, May 25, 2021, adjusted for rate escalation since 2021.

Utilities and the PAO like to argue that solar users generate electricity when the grid doesn't need it (i.e. mid-day) and then turn around and consume electricity in the evening or at night when the sun is down. They paint a picture of a solar user providing superfluous electrons by day, and being a burden by night. However, putting aside the point that rooftop solar plays a critical role on hot summer afternoons that drive grid expansion costs (see Figure 6), the very fact that rooftop solar users are paying sizable utility bills every month, even after going solar, needs to be accounted for in the PAO cost-benefit analysis. If PAO is estimating whether or not solar users are paying their "fair share" of truly fixed grid costs, then PAO should include actual bill payments made by solar customers.

M.Cubed totaled the NEM customer bill payments and subtracted PAO's estimate of the variable costs of grid energy purchases to arrive at payments for fixed costs. PAO considers the avoided costs produced by the ACC as the variable costs, so that amount was subtracted from bill payments. The remainder is $70 per month per customer. This is far more than the monthly amount that PAO or the utilities represented as customer fixed costs in the 2023 CPUC proceeding that established residential fixed charges. Solar customers are paying more than their share of fixed costs through their post-solar monthly bill payments. This equates to a net benefit of $1.2 billion that was excluded from the PAO analysis.

–$0.31 billion – $1.18 billion = –$1.49 billion

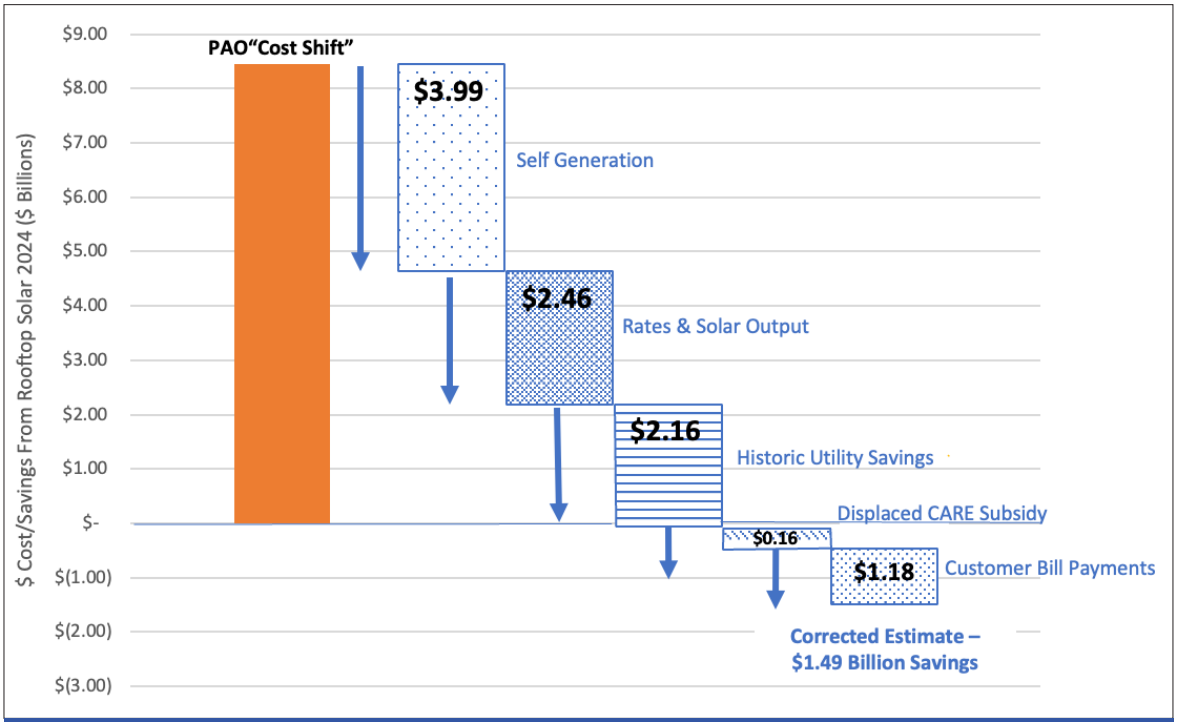
6. Total Net Savings

Summing up the corrections of the five categories above shows that California's 2 million rooftop solar customers are saving all other ratepayers $1.5 billion every year, as shown in Figure 8.

This number is conservative because it does not include a net present value of future cost reduction from recent solar installations. It only includes reductions that are already being experienced in today's rates. It also uses conservative estimates of past savings and ignores the time value of money from those savings in previous years that have accrued to ratepayers.

PAO's cost shift is in the wrong direction. Rooftop solar is a net benefit. More rooftop solar would save all ratepayers more money.

Figure 8. Corrections to PAO "Cost Shift" Estimate (2024 $ billion)



The Public Advocates Office at the California Public Utilities Commission manufactured a bogus "cost shift" estimate of $8.5 billion. Correcting five obvious errors produces a net cost savings from rooftop solar of $1.5 billion.

D. Manipulating E3's Faulty "Avoided Cost Calculator"

Building upon the corrections made in the third point above regarding historic utility savings from previously installed rooftop solar, the way the CPUC has chosen to evaluate the benefits of rooftop solar in general is manipulative. The failure of the cost shift proponents to recognize historic utility savings was made evident when E3 presented its updates to the ACC in July 2024.

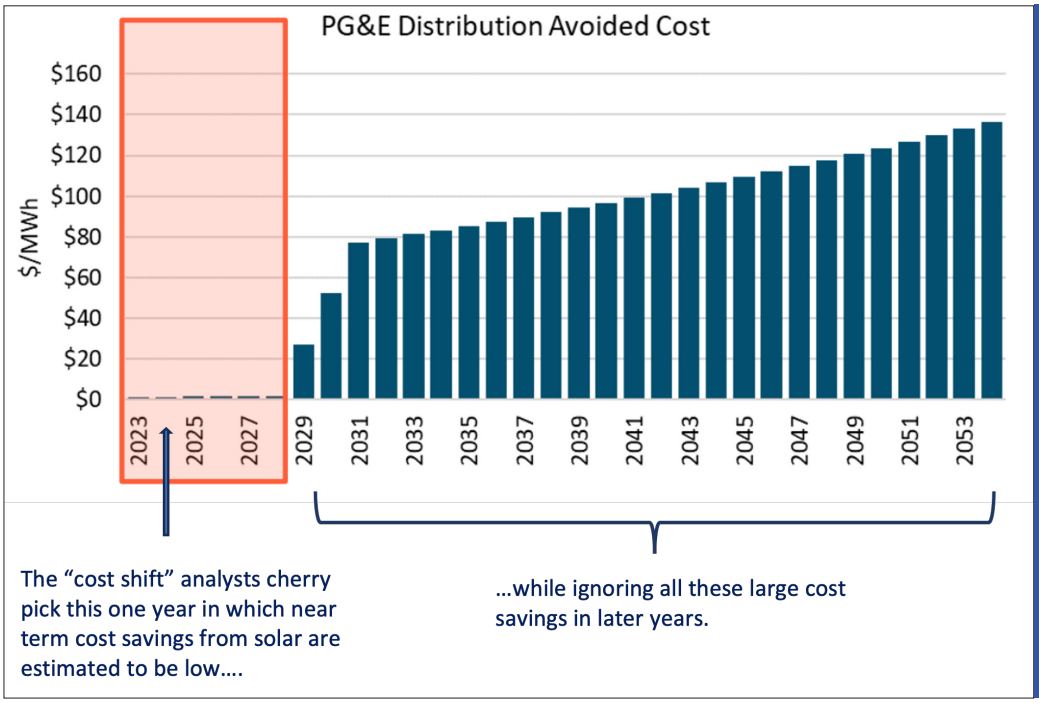
E3 is a consulting firm that mostly works for the utilities.[38] The CPUC also contracts with them to manage the ACC. This tool attempts to measure the utilities' avoided costs when customers install rooftop solar. It estimates the amount that utility costs go down for every additional kWh of electricity produced by customers.

Recently, as part of the CPUC proceeding that considers updates to the ACC, E3 described their methodology for calculating the reduction in grid spending due to the growth of rooftop solar, i.e. the benefits of rooftop solar. A key piece of their methodology is shown in Figure 9, which is a direct screenshot of the E3 presentation with two arrows and text boxes added.[39]

The purpose of this graphic is to show anticipated utility spending reductions due to rooftop solar and to demonstrate that E3 calculates those savings differently in the short term versus the long term. The logic behind the short-term savings being smaller is the fact that in the near-term, it is hard to reverse course on grid expansion projects that are already under construction. Installing more solar than had been projected for 2024, for example, does not reduce much spending on grid expansions in 2024 or even 2025. These construction projects are already underway. E3 takes this point much too far by assigning a near zero value for the first six years of a solar system being in operation, but having a different methodology for the current year and future years is valid.

However, beyond the first year or two, building more solar will clearly reduce the amount of grid expansion that will be needed. If we build more generation close to load, we will need less grid capacity to serve that load from faraway power plants. Even E3's biased ACC has very significant numbers for future years. Figure 9 shows utility cost reductions of 8 ¢/kWh to 14 ¢/kWh in future years. Given that rooftop solar panels are warrantied for at least 20 years, a true value of solar calculation would include the net present value of future savings. The ACC produces that number, but PAO chose not to use it. This error compounds PAO's faulty approach of applying projected future costs to value past savings.

Figure 9. Utility Spending Reduction Due to Rooftop Solar



E3 undervalues solar in the initial years of operation but projects large utility cost reductions thereafter. The cost shift proponents ignore the current savings from previous installations and future savings from current installations. They pretend all solar systems were built this year and only consider the benefits that would result within this year, effectively cherry-picking the lowest possible number on this E3 chart, instead of averaging 20-years of estimated savings and assigning that much higher value to the benefit calculation of rooftop solar.

38. *See* https://www.ethree.com/about/clients.

39. E3, presentation at "2024 CPUC Draft Avoided Cost Calculator Workshop," July 23, 2024, Slide 46, available at https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/demand-response/cost-effectiveness/2024-draft-acc-workshop---final.pdf

The cost shift proponents manipulate this methodology to fabricate an extremely low value of solar. They cherry-pick the near-term savings number (i.e. the one that is near zero) and apply it to 100% of the solar systems past and present. They pretend all two million existing solar systems were installed this year, and count only the utility cost reduction measured by the ACC for this year. This is blatantly fraudulent.

Systems installed in years prior to those shown on the E3 chart above avoided grid costs that would have been baked into today's rates. Had California consumers not responded to California's pro-rooftop solar policies to build 17 GW of distributed solar, utilities would have needed to buy more utility-scale resources and build more grid capacity. Grid upgrade costs are amortized over many years. The cost of building a new transmission line to service new load is recovered via rates over the course of many years, not just the year in which the grid expansion project began. The opposite is also true. If grid expansion costs are avoided, those avoided costs should be calculated out over many years, the same as the incurred costs would be.[40]

PAO cherry-picks the ACC output relevant to current year savings from current year installations. They apply this number to all installations past and present as if solar never avoids significant grid expansions. This hides the real savings that come from rooftop solar shared by all ratepayers, leading to an inflated "cost shift" for the past installations of rooftop solar and devaluing the benefits of rooftop solar being built today.

If utilities fully incorporated solar and storage into ongoing grid management, they could reduce costs even more. A 2021 report found that expansion of distributed solar and storage could reduce the total costs of the statewide electric system by $120 billion through 2050.[41] The utilities should be required to use local resources to meet local needs by making use of solar-charged batteries through virtual power plant programs. These programs send signals for customers to discharge batteries when other customer usage is projected to strain the grid, matching hourly energy needs with hourly dispatch signals. This should be the first approach to managing grid capacity, with approval to build grid expansions only when local resources will not be adequate to meet customer demand.

40. Furthermore, a calculation of the value of solar today should include the avoided costs that can be attributed to that solar system over the course of the 20 years it will be in service. For the impact on today's rates, any analysis should include the avoided historic costs. PAO does not do this and M.Cubed corrects that. A full value of solar analysis would additionally include a net present value of future savings. Neither of the two analyses include that. This makes the M.Cubed response a conservative perspective.

41. Vibrant Clean Energy, "Role of Distributed Generation in Decarbonizing California by 2045," July 2021, available at https://vibrantcleanenergy.com/wp-content/uploads/2021/07/VCE-CCSA_CA_Report.pdf.

IV. The Real Reason Rates Keep Going Up

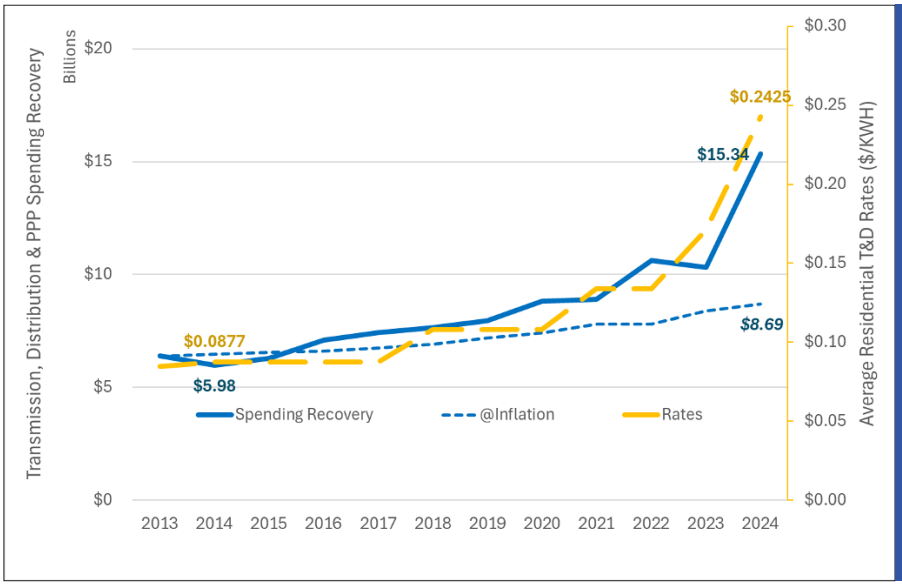
A. Out of Control Utility Spending Goes Hand in Hand with Rate Increases

Utilities like to say most of their costs are fixed and rates continue to go up because solar customers are leaving the system and therefore not "paying their fair share." This is false. Rapidly increasing utility spending dispels the departing load myth, and it also is the real reason rates have increased sharply.

We reviewed T&D spending authorization from general rate cases over the past 8-12 years and found increases on the order of 150%-250%. Reviews of rates back to 2002 reveal the same trend of rates rising much faster than inflation. In other words, utilities have more than doubled or tripled their T&D spending. This fact alone proves that most utility costs are not "fixed" but rather have increased sharply. It is true that once an upgrade happens its cost is "sunk" and is amortized over many years, but that does not mean the expansion project was inevitable regardless of customer electricity usage. Most grid upgrades are justified by claimed expectations of increased customer load. Grid spending is not fixed.

This increased utility spending has driven up rates. The M.Cubed research shows that T&D rate increases have tracked with T&D spending increases at a nearly 1:1 ratio.

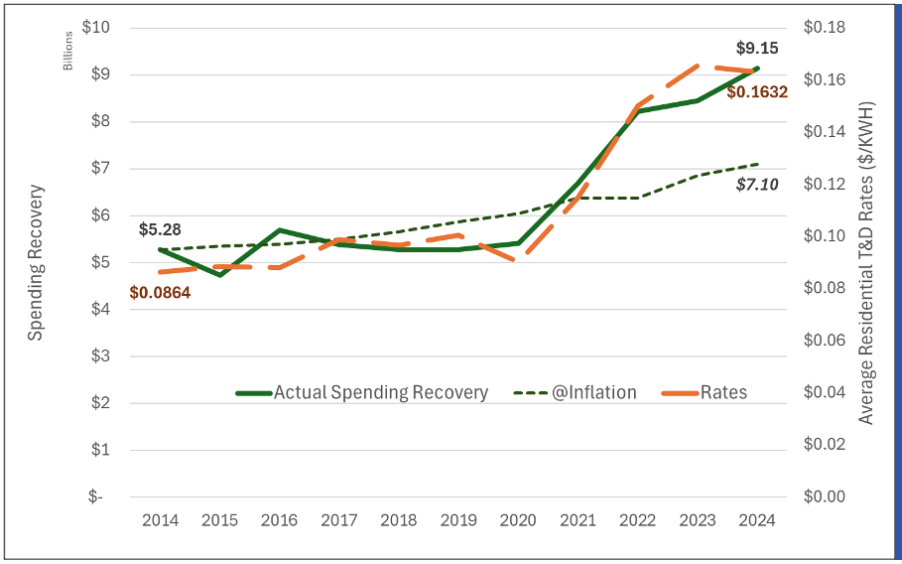
Figure 10. PG&E Rates Have Increased Because Spending Has Increased



PG&E rate increases have tracked closely with spending increases. These lines would diverge if there were a solar cost shift, with controlled spending covered by fewer customers buying utility energy. The marker of a cost shift would be the dashed yellow line (rates) climbing more sharply than the solid blue line (spending).

This is true of each of the three large utilities. Data from PG&E and SCE allows us to track T&D spending back to 2013-2014, and the correlation between spending and rates is glaring. SDG&E did not report T&D spending separately prior to 2018, and their biggest rate increases happened prior to that. Since then, SDG&E's rates and spending diverged when the utility over-collected for a two year period, but their rates and spending came back into alignment.

Figure 11. SCE Rates Have Increased Because Spending Has Increased



Like PG&E, spending at SCE has tracked closely with rate increases. It is spending that is causing rate increases, not departing load from solar customers buying less electricity.

Categories of Utility Spending

There are four categories of utility spending – Transmission and Distribution (T&D), Energy Generation/Generating Capacity, Public Purpose Programs, and Bonds and Fees.

The analysis in this report focuses on T&D spending. This is where solar antagonists claim the "cost shift" lies. They paint a picture of people who use the grid at night without paying their fair share of grid costs. They consider T&D spending inevitable, or "fixed," despite evidence to the contrary. This paper demonstrates how rooftop solar users pay more than their fair share of grid costs and provide net benefits.

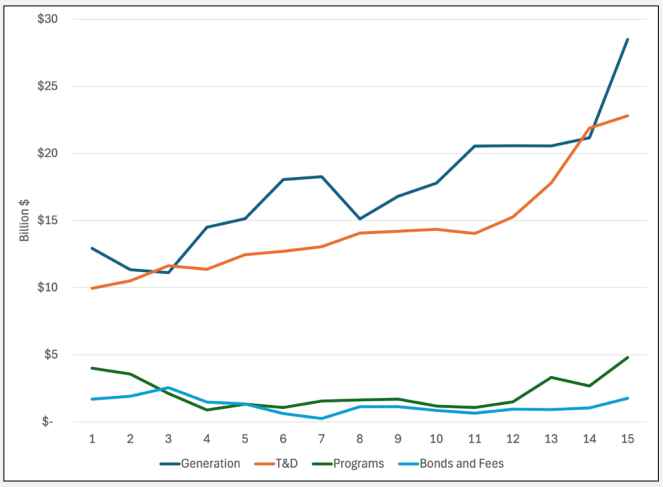
The analysis in this report also focuses on T&D over generation because generation costs are largely composed of third-party power purchase agreements driven by market conditions. These energy purchases are priced on a cents per kilowatt-hour basis and can be displaced when load growth is served by an alternative resource such as energy efficiency and rooftop solar. In this way, increases in rooftop solar fully offset wholesale generation costs.

Further, T&D spending is based on utility analysis rather than the transparent public forecast of generation needs, and it is not checked by competitive forces. Utilities have a financial incentive to skew their analysis toward justifying higher T&D spending, because they earn a set rate of return on T&D spending.[42] Regulators and ratepayer advocates have not invested in their own capabilities to conduct T&D analyses, and they only critique the utility analysis at the margins. Once the spending totals are approved, utilities have discretion on what projects to actually undertake. If they claim to have achieved O&M goals on the grid while spending less money, they send the savings to shareholders. Regulators rarely audit distribution spending, and FERC only reviews transmission spending when intervenors file a complaint.

In contrast, generation spending stems from CEC demand forecast analysis that feeds energy procurement obligations. Most generation capacity contracts are reflective of market discipline. The only generating facilities owned by the utilities are the Diablo Canyon nuclear plant, the fleet of legacy hydropower facilities, and nine gas-fired power plants. Utility-owned generation provides about 10% of CAISO capacity.

T&D and generation are both part of the reason for recent rate increases.[43] Recent rising generation costs are largely due to increases in natural gas commodity costs and higher wholesale market prices. This illustrates the risk of relying on fossil fuel generation delivered by the utilities, and an important offsetting benefit of rooftop solar. Also, in 2023 PG&E reclassified its spending categories and put more costs into the generation category.[44]

Figure 12. Annual Utility Spending by Cost Category



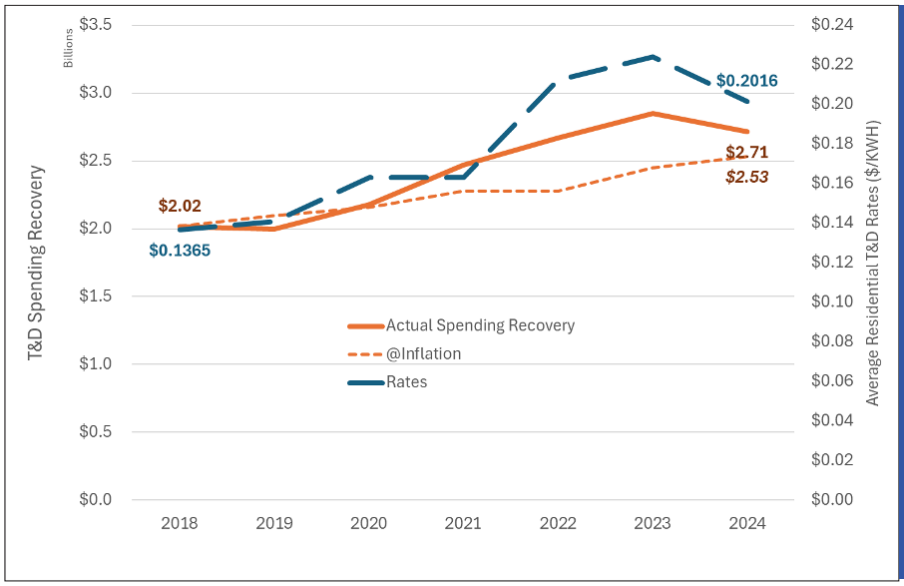
Program costs are relatively small and are the result of policy decisions that are mostly based on societal goals such as helping low-income households or stimulating energy efficiency. These charges have been directly assessed to solar users since 2016 through non-bypassable charges.

42. Economists have a name for the perverse incentive for the utilities to increase investments in T&D in order to earn higher profits. It is known as the Averch-Johnson effect. The CPUC defines this effect as being "the perception that the rate of return is higher than what the utility actually needs to ensure that shareholders continue to provide capital for investment, and the utility increases its returns to shareholders by making investments beyond the need threshold." (CPUC, "Utility Costs and Affordability of the Grid of the Future", February 2021, p. 24.)

43. The AB 67 reports show total generation spending by the IOUs but do not factor in the migration of load to CCAs. Looking only at spending amounts gives the appearance that generation costs are relatively flat. The data in Figure 12 is levelized for load served by the IOUs.

44. CPUC, "2023 California Electric and Gas Utility Costs Report," April 2024.

Figure 13. SDG&E Rates Have Increased Because Spending Has Increased



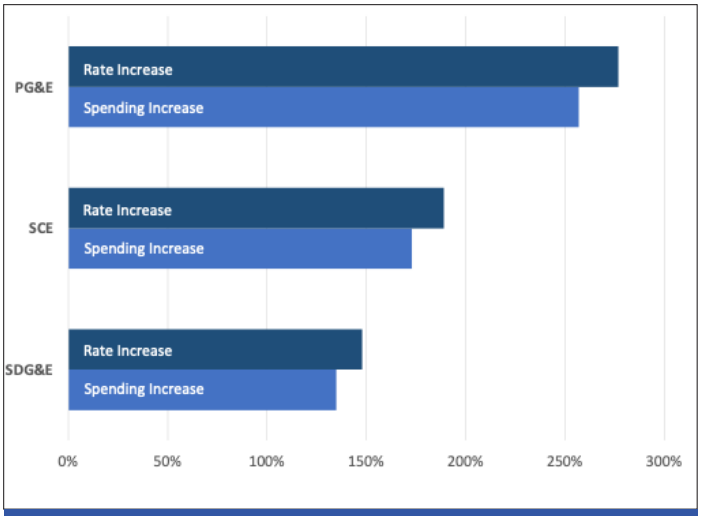
SDG&E didn't report T&D spending separately until 2018, and their biggest rate increases were before that. The utility overcollected for two years, but spending and rates have come back into alignment.

Totaled over roughly two decades, 91%-93% of the utilities' T&D rate increases are the direct result of spending increases, as shown in Figure 14. The 7%-9% percent difference is due to demand elasticity. When something becomes more expensive, people figure out ways to use less of it. Customers using less air conditioning in response to electricity becoming more expensive is an example of demand elasticity.

If the cost shift were real, rates would increase far more than spending. Spending increases would have been mild, according to the utility myth that their costs are fixed, and rates would have increased much faster than spending. If solar were departing load, it would have caused a major deviation between rates and spending. This is not what has happened.[45]

What we observe from the data shown in Section III.B is that solar offset load growth, which should have enabled the utilities to spend less money and stabilize rates. Instead, the utilities drove rates higher by rapidly increasing their spending. What did they spend those billions of ratepayer dollars on in the face of flat demand should be the subject of an extensive investigation by regulators. Instead, some California regulators today are blaming rooftop solar, repeating the utility's cost shift myth, while turning a blind eye to the glaring problem of runaway spending. Customer solar did not cause rate increases. Utility spending did.

Figure 14. Nearly All T&D Rate Increases Are Due to T&D Spending Increases



Nearly all T&D rate increases across utilities and over time can be directly attributed to increases in T&D spending, with demand elasticity playing a minor role. If there were a solar cost shift, spending increases would be mild compared to large increases in rates.

B. Utilities Have Increased Spending Despite Flat Demand

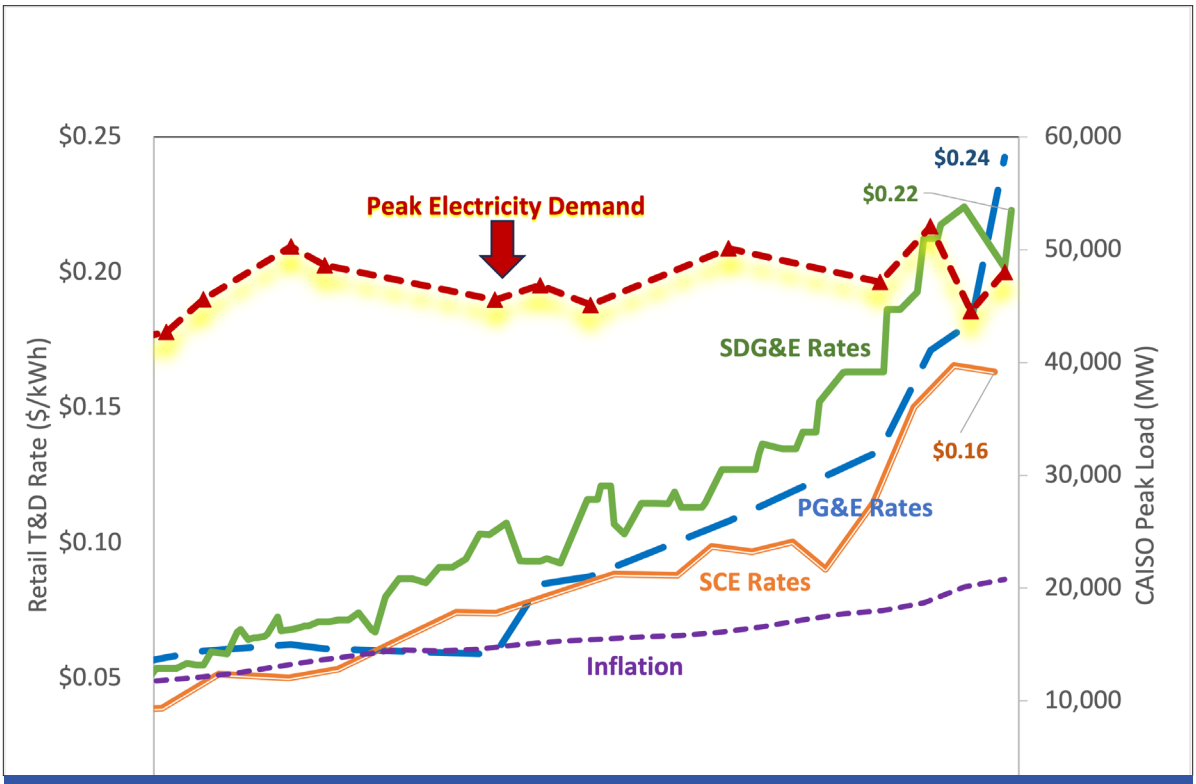
The cost shift theory rests on large fixed costs and a shrinking pool of electricity sales. The evidence demonstrates that neither of these is true. Costs are mostly not fixed (Figures 10-13), and electricity loads have not decreased (Figures 5 and 15). With the cost shift theory dispelled, the next question is what has driven increased spending.

Electricity loads have been flat for twenty years, both in terms of peak demand and annual electricity consumption. Increased grid spending was not driven by a need to serve increased electrical loads.

As discussed in Section III.B, it is peak load that causes grid investment. The grid needs to have enough capacity to meet our needs during the hours of greatest consumption. As shown in Figure 15, the CAISO peak load has been steady for the past twenty years as grid spending has increased dramatically.

Peak load varies annually with weather conditions. The 2006 peak is still the second highest, and first among those occurring in normal expected conditions. This last summer saw a peak load nearly 2,000 MW less than the 2006 record. Notably, 2022 saw a one-year increase due to a one-in-35-year weather pattern. That type of short term peak is addressed with targeted load reduction programs. It should never be the goal to build the grid for a 1-in-35 scenario. Demand flexibility will always be the better option for rare events. Even with that year in the mix, the overall trend of peak load has been remarkably steady in the face of population increases and other increased electrical needs.

Figure 15. Electricity Demand Has Been Flat for Decades, Yet T&D Spending Has Risen 300%



Normally, peak energy consumption is the main driver for grid expansion, but utility spending increases have not been for the purposes of serving higher peak load.

45. Solar departing load is certain not to be an issue in the future due to rapid load growth. See Figure 7.

C. Wildfire Spending Has Not Been the Primary Driver of Spending Increases

Another category that has not been a primary driver of spending increases is costs related to wildfire risk and grid hardening. This is in contrast to statements from the utilities that portray wildfire spending as a primary reason for rate increases. As shown in Figure 16, wildfire costs are significant but not the bulk of increased T&D spending. There was no increase from 2023 to 2024, while overall T&D spending increased by $5 billion.[46]

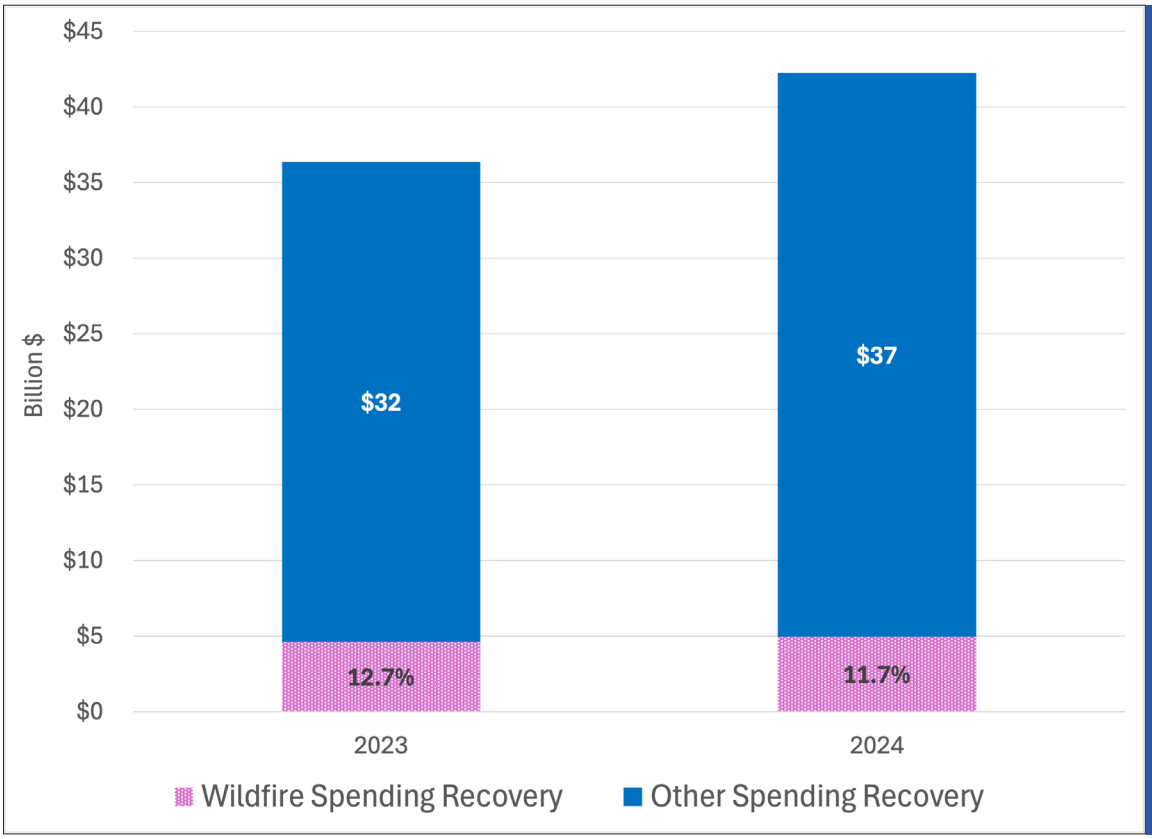
Much of the concern about wildfire spending is PG&E's proposal to underground up to 10,000 miles[47] of power lines at a potential cost of $40 billion.[48] To date they have only completed 800 miles.[49] PG&E prefers this expensive response to wildfire risks because this spending boosts their profits, but it is highly questionable whether this spending should continue to be authorized when there are more affordable options. Either way, the spending has not yet occurred, so it is not a major cause of recent rate increases.

D. Transmission Spending Has Been for the Renewable Portfolio Standard

A majority of the spending on transmission in recent years was to interconnect utility scale solar and storage projects, which has been the only significant generating capacity addition on the transmission network since 2010. However, even with those costs, transmission spending as a whole is far less than distribution spending.

Future transmission costs are projected to increase as our goals for large scale renewables have gone up sharply and the sites with best access to existing transmission capacity have mostly been developed. CAISO reports: "Planned infrastructure has ramped up from 10 year average of $650 million per year to $3 billion in 2021-2022 plan, $8.1 billion in 2022-2023 plan and $6.1 billion in the 2023-2024 plan."[50] Rooftop solar directly displaces the need for these costs.

Figure 16. Wildfire Mitigation Costs Are Not the Main Reason for Spending Increases



Utilities claim that wildfire spending has been the cause of recent rate increases, but the data does not justify that claim. Wildfire spending accounts for 12% of utility spending in recent years, and not much of PG&E's expensive transmission undergrounding has occurred. California has yet to experience the impact of PG&E's push to underground thousands of miles of transmission lines.

46. PG&E: 2020 and 2023 General Rate Cases Testimony and Workpapers, and 2020-2024 Annual Electric True-up Advice Letters; SCE & SDG&E: PAO, 2023-2024 Wildfire-Related Cost Increases of California's Three Major Investor-Owned Electric Utilities, June 14, 2024; SDG&E General Rate Case, A.22-05-015, May 16, 2022), San Diego Gas & Electric Company's (U 902 M) Submission And Supplemental Testimony Supporting Its Track 2 Request To Authorize Recovery Of Incremental Wildfire Mitigation Costs Incurred From 2019-2022, at https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M520/K650/520650636.PDF; Data Request Number: SPD-SDGE-SB884-001 SB-884 Program: CPUC Guidelines Publish To: Safety Policy Division – California Public Utilities Commission, Date Received: 4/3/24, Date Responded: 4/17/24.

47. PG&E, "Undergrounding and system upgrades," https://www.pge.com/en/outages-and-safety/safety/community-wildfire-safety-program/system-hardening-and-undergrounding.html, retrieved January 2025.

48. Alejandro Lazo, "Californians pay billions for power companies' wildfire prevention efforts. Are they cost-effective?" *CalMatters*, https://calmatters.org/environment/2024/12/pge-utilities-wildfire-prevention-customer-bills-california/, December 3, 2024.

49. PG&E, "Making your energy system safer and stronger," Bill Insert, January 2025.

50. CAISO, "Transmission and Interconnection Update" (workshop slides), November 21, 2024.

E. Causes for Rate Increases Deserve Attention

Some distribution spending is justified to provide service to new subdivisions and new buildings. However, this is a justification for continued spending, not increased spending. California is not building new construction at a faster rate than we have previously. Further, these costs are shared with property developers. CEC reports that grid spending to handle increased load from electrification is all in future years, so that type of spending does not appear to be the main factor.[51]

We know that the costs of grid upgrades triggered by customer solar installations are not significant because utilities report those costs and they are tiny in comparison to total spending.[52]

In sum, the traditional drivers of grid spending do not appear to be justification for the staggering increases in utility spending. It is not evident what macro forces would have caused the increases, beyond utility desire to satisfy shareholders. This report does not contend that all of the utility spending increases represent money poorly spent. We are showing that rate increases have been caused by increases in utility spending, not California families and businesses investing their own money in rooftop solar. And we are suggesting that policy makers wanting to address the energy affordability crisis would be wise to focus on utility spending and the conflict of interest between the utilities' drive for profit and consumers' need to control that spending.

NEM Credits Are Not Energy Purchases

Solar antagonists make a comparison between the value of NEM credits and the price of contracts with large-scale solar plants to deliver energy to the transmission system. This is not a useful comparison.

NEM credits are not a purchase of energy by the utilities from a power producer. They are a way to account for reduced energy purchases by consumers from the utility. Net metering is not energy procurement for utilities. It is a compact between utilities and solar customers stating that all of the customer's generation will be treated as reduced energy consumption. In the words of the CPUC: "NEM is not designed as an energy procurement program. Rather, it is a billing mechanism to facilitate customer generation."[53]

The portion of a solar customer's generation that is used on-site in real time is literally a reduction of consumption from the electric grid. The portion that is not used on-site in real time is exported to the grid and consumed immediately by neighboring customers, who pay the utility full rates for the energy. The utility delivers less energy to the solar customer and their neighbors as a combined unit, and the utility's revenue is reduced by the same amount.[54] The bill reduction benefit goes to the solar customer who made the investment in what is effectively a shared energy resource. Their neighbors are neutral from the perspective of energy purchases, and actually come out ahead from reduced grid spending pushing down rates.

NEM credits are not an expense for the utilities. They are reduced sales. NEM credits do not show up in rates. Load growth from all customers statewide make up for reduced sales to keep the utility whole for their grid investments, which is the subject of this paper.

51. CEC, "Electricity Rate Forecast," November 7, 2024.

52. Annual net energy metering cost reporting advice letters. The three large utilities combined have spent an average of $18 million per year on grid upgrades triggered by customer solar installations, and an undisclosed portion of that is paid for by the customers installing those projects. This compares to $17 billion that utilities spend each year on distribution.

53. CPUC, "Introduction to the Net Energy Metering Cost Effectiveness Evaluation," March 2010.47. PG&E, "Undergrounding and system upgrades," https://www.pge.com/en/outages-and-safety/safety/community-wildfire-safety-program/system-hardening-and-undergrounding.html, retrieved January 2025.

54. NEM2 customers pay non-bypassable charges on the amount of energy they export to help fund public purpose programs, so utility collections do increase with these payments.

F. Why Utilities Love Spending

One of the greatest misunderstandings in energy policy is the notion that utilities are agnostic to how much electricity a ratepayer consumes from the grid. In the 1980s, California adopted a policy called "decoupling." Decoupling was intended to remove the opposition to energy efficiency measures that utilities had for many decades. Utilities previously earned a profit off of every electron sold, just like a grocer profits off of every carrot a shopper buys. Utilities had previously obstructed efforts to promote more efficient lightbulbs, for example, because they would earn a smaller profit as a result.

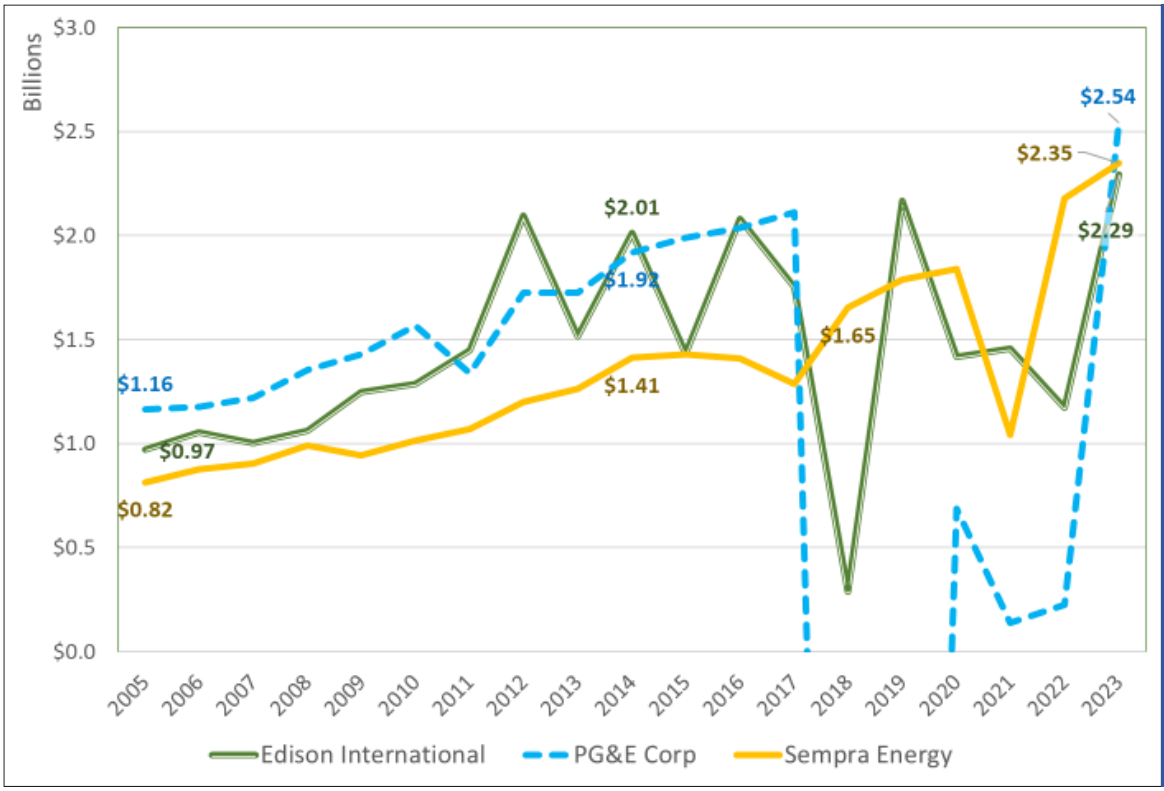
After decoupling, California utilities earned a profit not on a per kilowatt-hour of sales basis, but instead off of every dollar spent on poles and wires and other grid infrastructure built to meet electricity demand. In other words, after decoupling, California's utilities became giant construction companies, earning money off of their capital intensive construction projects. However, the link to electricity consumption still exists. If all the electricity comes from distant power plants, increased electricity demand leads to increased construction projects. If ratepayers are forecasted to use more electricity, the utilities get to do more construction projects and earn higher profits as a direct result. Because construction of the grid is directly tied to peak load growth, the higher the peak demand, the more money utilities earned. Decoupling did not fix the perverse incentive for utilities to be rewarded by increased electricity consumption. It left the motivation in place and reduced transparency.

Utilities also have an incentive to build smaller capacity increases every few years rather than larger increases less frequently. Why do something once when you can do it twice and make more money. Without competition or effective regulation, they get away with this type of management.

Because utility profits are a percentage of spending on grid infrastructure, utilities are acting rationally when they oppose local self-generation technologies that have a powerful effect on reducing peak demand and thereby reducing the need for more grid infrastructure. Investor-owned utilities have a fiduciary responsibility to shareholders to continually increase profits and they do that by continually increasing the amount of ratepayer money they spend on transmission and distribution. Because T&D costs are directly associated with peak demand, keeping peak demand high and growing, even if overall electricity usage remains flat, is good for utility profits. It is also to the utilities' advantage when grid expansion projects are expensive. They do not have competition, and their income stream is assured.

Due to increased T&D spending, profits at California's large investor-owned utilities have steadily increased over the past twenty years, as shown in Figure 17. PG&E's net income went negative during its most recent bankruptcy, caused by felony violations, but quickly rebounded to its highest level ever. Excepting that bankruptcy, the consistent upward trend mirrors the consistent upward trend of T&D spending.

Figure 17. Despite Flat Demand and an Affordability Crisis, Utility Profits Have Soared[55]



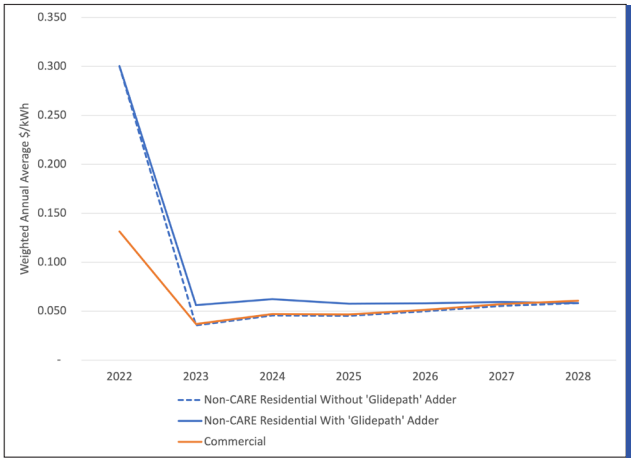
Utilities are acting rationally when they oppose energy sources that reduce reliance on the grid such as rooftop solar. Wall Street investors demand increasing profits, which are directly linked to spending on grid infrastructure. Utilities spend more money because it earns them higher profits. Despite flat demand for their product over the past twenty years, utilities have managed to grow their profits 250%.

55. Utilities' FERC Form 1 filings for 2005-2023.

V. The Transition to Net Billing Was Poorly Managed and Caused Damage

The CPUC's transition to lower mid-day export rates was poorly executed and highly damaging. The "NEM3" decision that created the net billing tariff (NBT) reduced the weighted average export rate by 80% overnight.[56] The decision included an element that was called a glidepath but it was so small that it provided no meaningful transition. A 2 ¢/kWh adder to the year one export rate did not offset the 27 ¢/kWh reduction in the underlying export rate, with the combined impact as shown in Figure 18.[57] This was not a glidepath.

Figure 18. Non-CARE Residential Export Rates Under NEM2 in 2022 and NBT Thereafter[58]

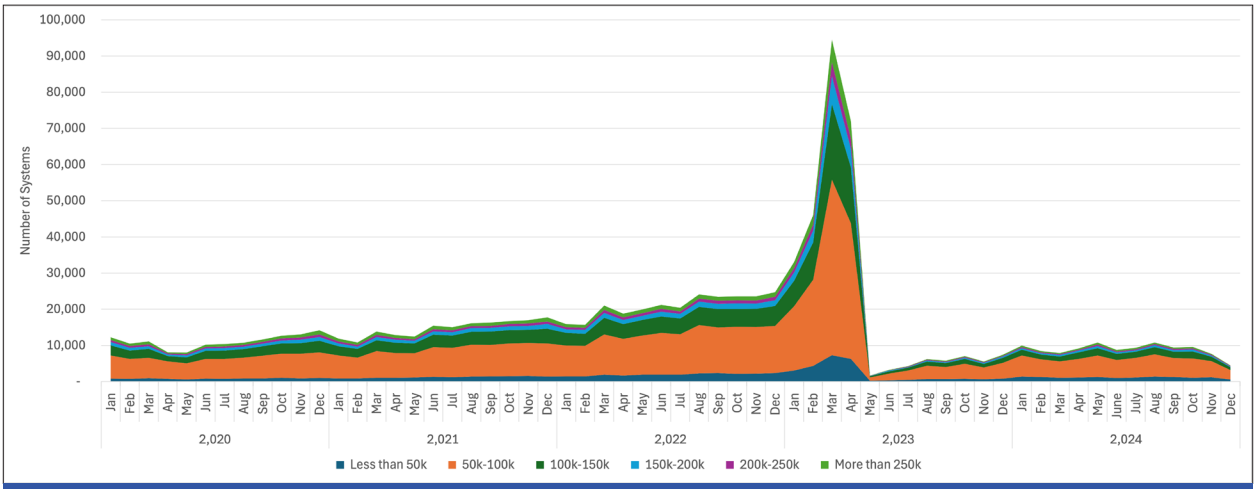


In its decision to create the Net Billing Tariff, the CPUC claimed it included a glidepath to transition to lower export rates, but it was not financially meaningful. The residential export rate averaged across the three investor-owned utilities dropped 80% overnight. The commercial export rate didn't even pretend to have a transition. The abruptness and severity of this decline caused a surge in applications before the transition in April 2023, followed by a depressed market that still has not recovered a year and a half later.

Customer adoption of solar in California cratered as a result of this poorly considered CPUC decision that was pushed heavily by the utilities. The solar industry expected some difficult months after the switch to NBT, but a year and a half later the market still has not rebounded.

The market declined severely at all income levels, but especially in communities with less than $100,000 in average income, as shown in Figure 19. That segment has been the heart of the California solar market. Solar is a working class bill reduction measure. Solar contractors have been working in lower and middle income neighborhoods day after day for many years (see Figure 3). Much of that work abruptly halted after the beginning of NBT.

Figure 19. Residential Solar Market Has Not Rebounded Under NBT



California's rooftop solar market was severely reduced at all income levels, but especially in communities with less than $100,000 in average household income. Despite a year and a half since the changes took effect, the market remains at its lowest point in ten years with no clear signs of recovery.

56. CPUC, Decision 22-12-056, December 15, 2022.

57. These rates are averaged across the three investor-owned utilities.

58. Commercial export rates started at a lower point because commercial rates include demand charges. Net metering credits were less valuable for commercial customers, so the need for a transition was just as strong.

The surge in applications before the transition to NBT resulted in solar installations under NEM2 after the transition. This helped keep a reduced pool of installation crews productive for a period of time even as sales dropped off. However, businesses were nonetheless forced to lay off installation workers.

Many anti-rooftop solar voices are trying to claim that the solar industry of California is in good shape because of the surge in sales back in the winter of 2023. This reflects a misunderstanding of what it takes to run a small business. No business can continue to operate without new customer activity.

Many residential contractors downsized their installation crews to stretch out the backlog. Even with that, few contractors have remaining NEM2 systems to install and new business has not recovered. Figure 20 shows the dwindling tail of residential NEM2 applications. With the market still at a 2014 level, installation companies and associated businesses are struggling to remain in operation.

Figure 20. Residential Solar Installations by Installation Date

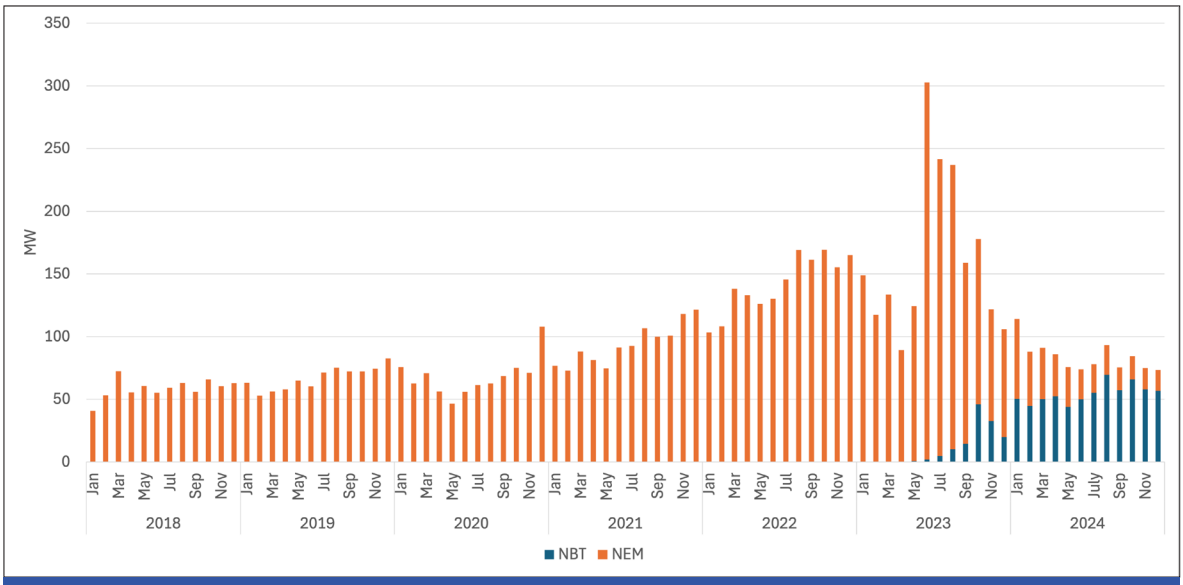
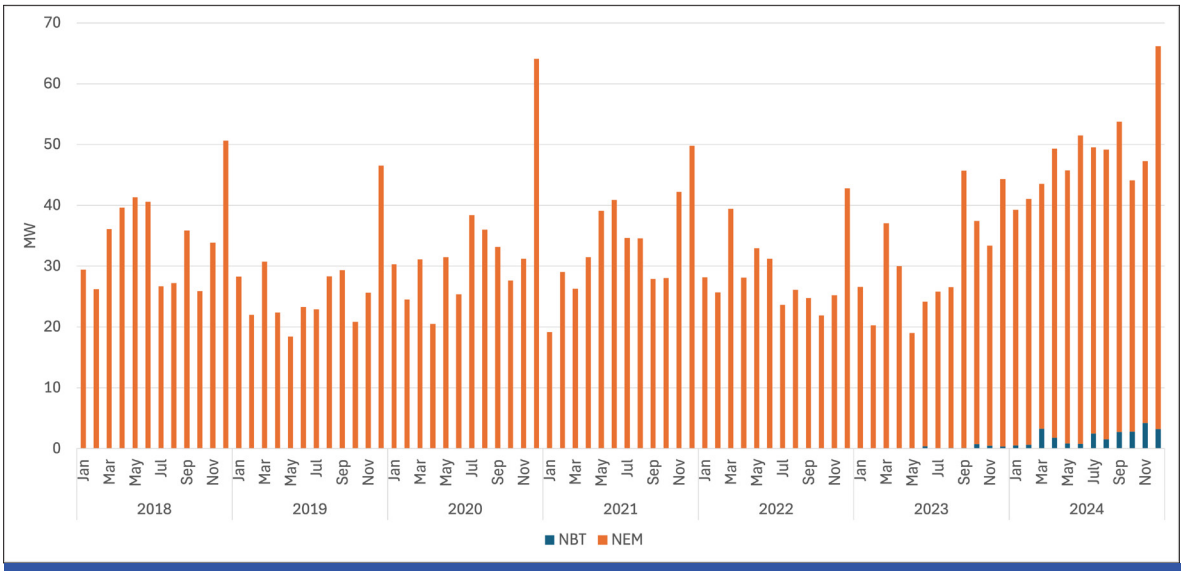


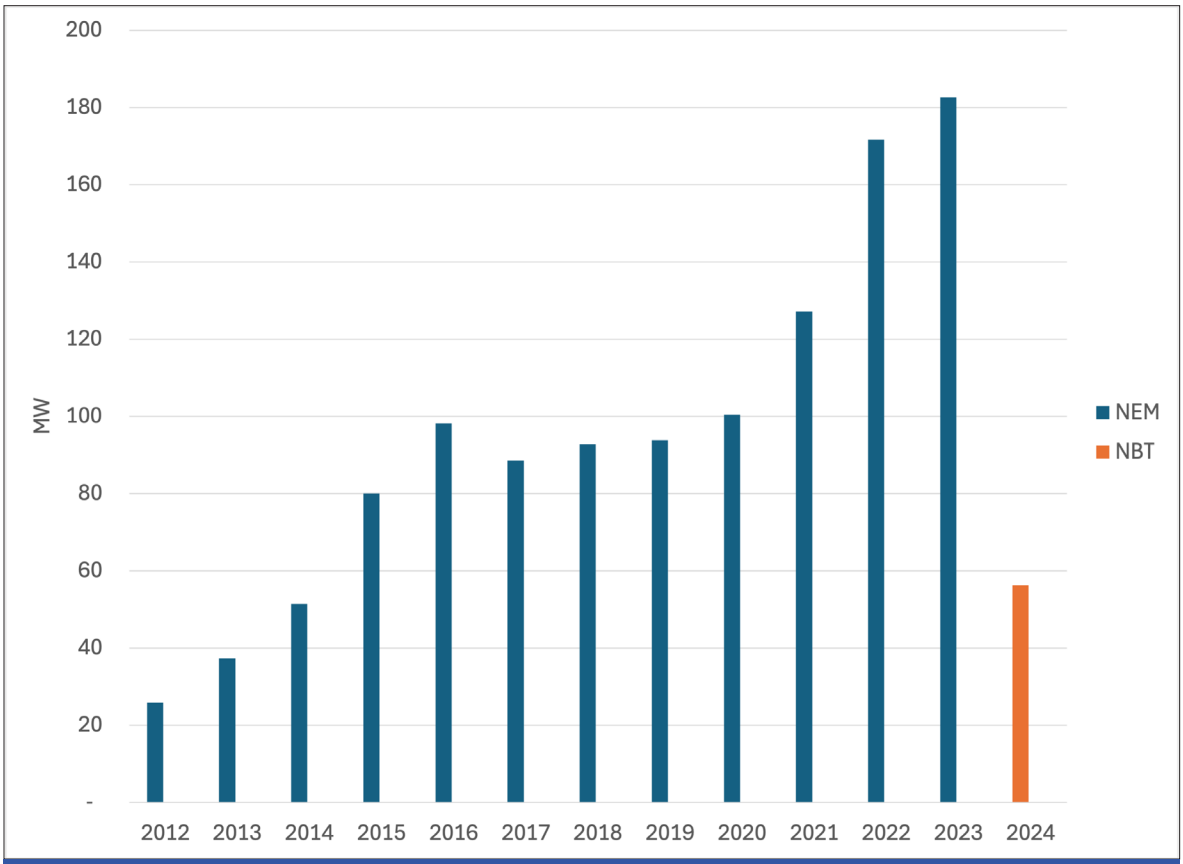
Figure 19 shows solar projects by the date when a customer submitted the interconnection application to the utility. This is akin to when customers signed contracts for installation. Figure 20 shows solar projects by the date when the utility gave final approval to the installation, which is akin to the installation date. Some of the projects contracted before the NBT transition were installed after the transition. Those grandfathered applications are dwindling and sales have not rebounded.

Figure 21. Commercial Solar Installations by Installation Date



Solar installers that focus on commercial customers have a longer pipeline of grandfathered applications, but their NBT sales have been even worse than for residential customers. If the market does not rebound soon, we will likely see even more bankruptcies than what has occurred in the residential sector.

Figure 22. Residential Solar Monthly Installation Rate[59]



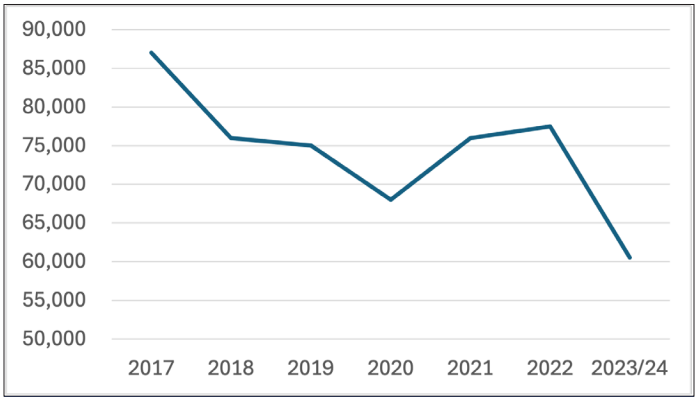
The pace of residential solar installations under NBT in 2024 was lower than any year of NEM installations since 2014.

59. California Distributed Generation Statistics.

A. California Suffered Massive Business and Job Losses Due to NEM-3 Transition

Long-standing solar businesses have downsized and folded as a result of the policy-driven downturn in the market. At least 17,000 California jobs were eliminated, more than 20% of the state's total solar jobs.[60] These were mostly solid construction jobs paying an average of $75,000 per year, with benefits and growth potential. The loss of this level of highly trained workers is a major setback for clean energy in California.

Figure 23. California Solar Jobs, 2017-2024

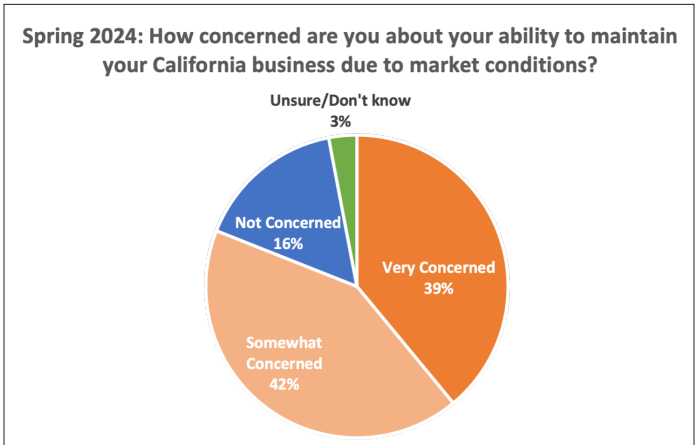


The NBT transition in 2023/2024 caused greater job loss than the Covid pandemic in 2020.

Solar companies large and small have declared bankruptcy. Major players like Sunpower, Sunworks, and Infinity Energy went out of business. Medium-sized storage providers like Swell Energy and Electriq Power no longer exist. Small and medium-sized contractors throughout the state have closed their doors, including Bratton Solar and Enver Solar in Fresno, Kuubix Energy in Visalia, Peak Power in Bakersfield, Penguin Home Solutions in Riverside, Harness Energy in Corona, SunStor Solar in Oroville, Sungrade Solar in Walnut Creek, Green Day Power in Sacramento, and many more. Many of these companies have existed for decades and survived other tough times, but could not survive this mismanaged policy change. There are also an untold number of companies that dropped the solar side of their business or moved operations to other states, leaving California behind.

A Spring 2024 survey of CALSSA member companies revealed a staggering level of concern among the solar businesses a year after NEM-3 went into effect. Of the 225 business respondents, 81% said they are concerned about their ability to stay in business. The state cannot afford to continue losing these valuable businesses if it wants to get on track to meeting clean energy goals.

Figure 24. Solar Business Outlook



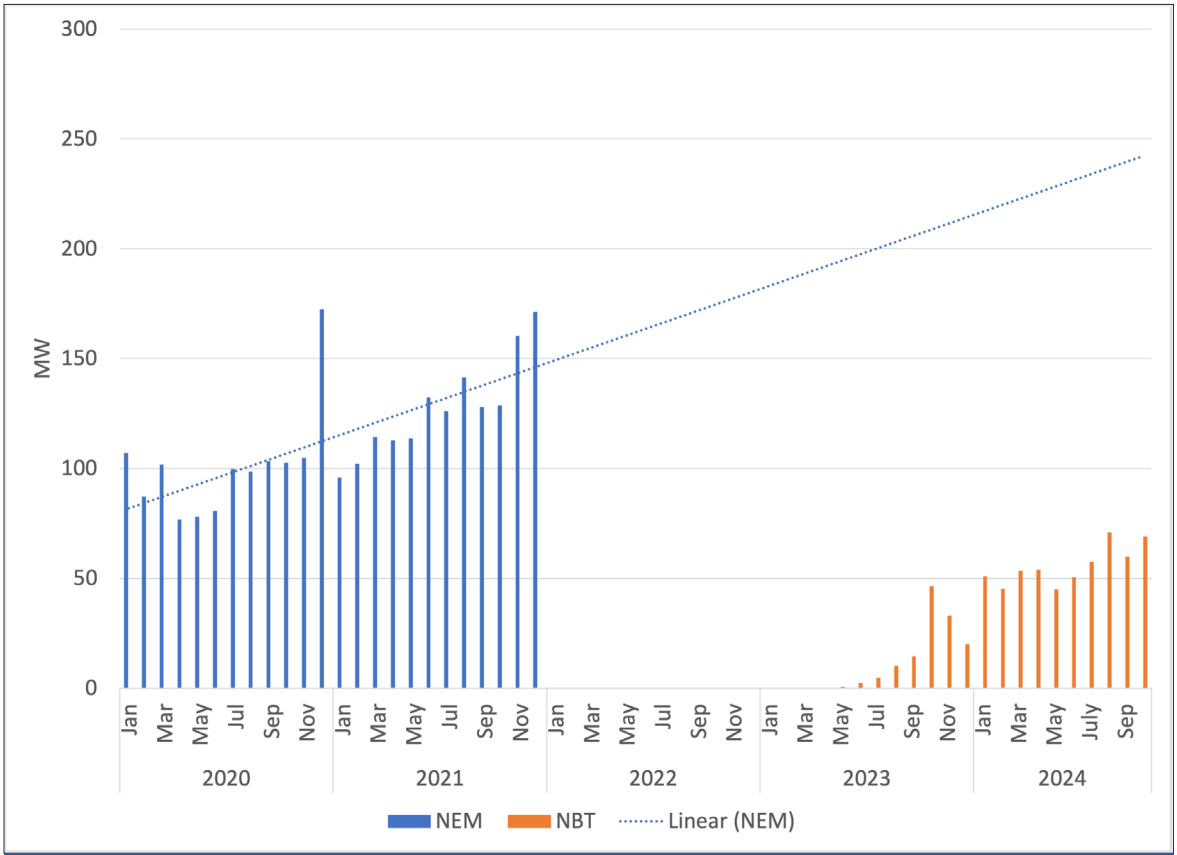
A survey of CALSSA member found a staggering 81% of companies were concerned about their ability to stay in business a year after NBT went into effect.

B. Federal Dollars Are Being Left on the Table

The market downturn is causing California to leave federal incentive dollars for clean energy unused. The Investment Tax Credit covers 30% of the cost of installing solar and storage. If the market does not rebound, California will forgo $1.1 billion of federal money over five years compared to the historic installation trajectory.

60. CALSSA survey of member companies, May 2024.

Figure 25. Current Customer Solar Market Compared to Historic Trend[61]



If the rooftop solar market doesn't rebound, we will fail to leverage available federal dollars for the growth of clean energy. The difference between our current trajectory and our previous trajectory is $1.1 billion over the next five years. In calculating the previous trajectory, we exclude the surge at the end of NEM2, which was above the trendline.

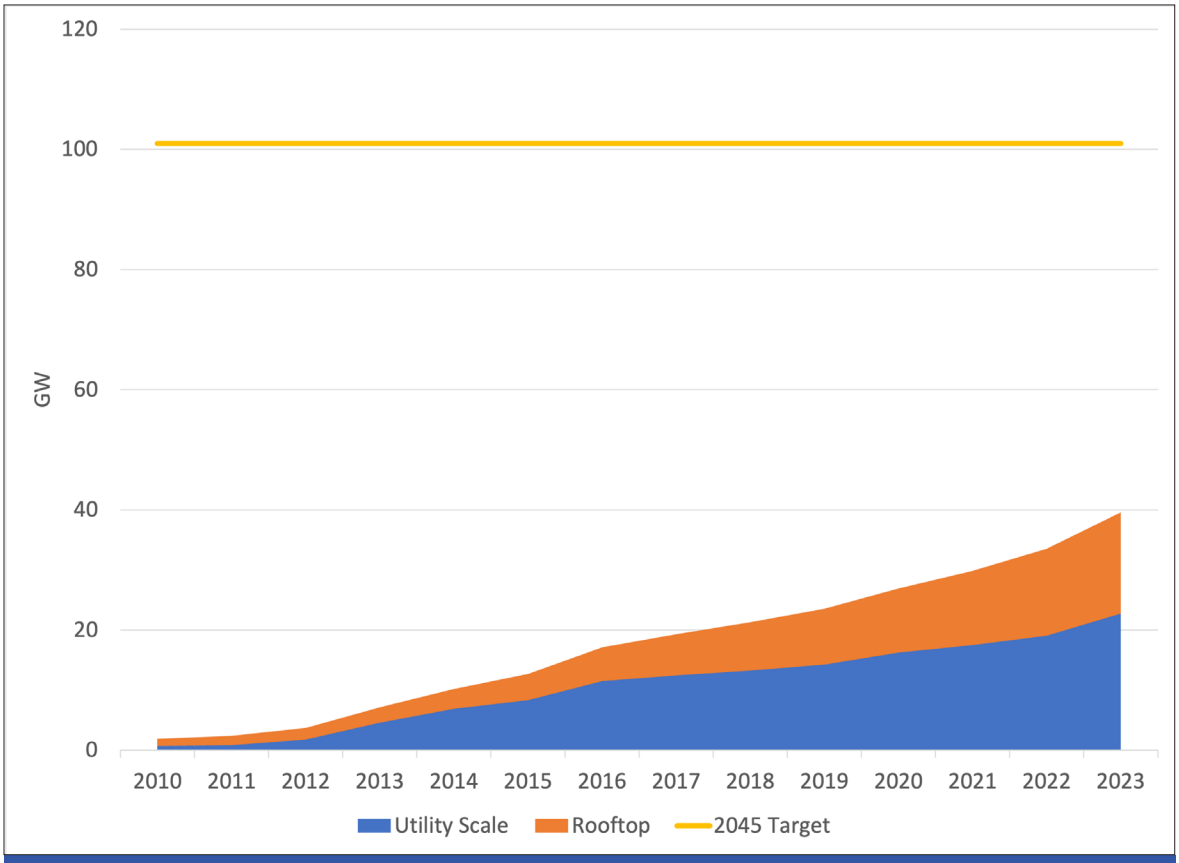
61. California Distributed Generation Statistics, Interconnected Project Sites Data Set. Trendline is based on the 2020-2021 pace, before the surge at the end of NEM-2. Assumes $3.50/watt cost of solar with 30% tax credit.

VI. Where Do We Go from Here

Both rooftop solar and utility scale solar have grown steadily over the past decade, but there is a long way to go. The California Air Resources Board projects that we need 101 GW of solar to meet our decarbonization goals by 2045. As of the end of 2023, we had 17 GW of rooftop solar and 23 GW of utility scale solar.[62]

Rooftop solar is an essential part of the mix. Utility scale projects will get more difficult over time as the best sites are used and transmission siting challenges get in the way of otherwise viable projects. If offshore wind does not come to fruition, even more solar will be needed.

Figure 26. Solar Growth Needed to Decarbonize the Grid



Rooftop solar is 43% of the current total installed solar capacity in California. The setback in the market for rooftop solar due to the poorly managed transition to net billing harms the ability to meet our decarbonization goals affordably.

62. Rooftop solar figure from California Distributed Generation Statistics. This includes an estimated 1857 MW of rooftop solar in municipal utility territories.

The downturn in customer solar adoption is a major setback for decarbonization and energy security in California. We cannot count on large scale renewables making up the difference without increasing costs and delaying state commitments.

Rooftop solar is needed to decarbonize the grid without excessive costs or delays. To get this sector back on track, the state needs to reject policies that would take further steps backward and adopt policies to move solar forward.

1. **First, stop harassing NEM-1 and NEM-2 customers.** They did the right thing at the right time. Changing the terms of their investments would be profoundly wrong and would cause customers to abandon trust in other state efforts to encourage clean energy behavior. The existing NEM customers continue to provide valuable generation year after year that addresses the annual peak in gross consumption that still occurs in the middle of the afternoon on hot summer days.

2. **Do no *more* harm.** Solar taxes were rejected by the CPUC in the creation of the net billing tariff, yet they have still been proposed each year in the budget. Legislators have so far rejected those moves, but the state should stop its efforts to create a fee on self-generation. Also, the CPUC has established a residential fixed charge of $24 per month. This is too high. Proposals to increase it even higher should be rejected. Departing load charges are another utility mechanism for charging customers for their own power. These charges should not be applied to rooftop solar. Local governments might soon start taxing rooftop solar panels unless the state Legislature acts to prohibit it.

3. **Stop tying the hands of solar companies**. The California State Licensing Board has proposed to block solar contractors (C-46) from installing batteries in many situations. We need to facilitate storage installation, not hinder it.

4. **Think big about rooftop solar and batteries again.** California should have a Million Batteries Initiative akin to the very successful program that kickstarted customer solar. Programs like Demand Side Grid Support (DSGS), which mobilizes customer batteries during times of grid stress, have been proven effective. The state has not committed to them long-term and keeps changing the rules. Stability is needed for storage providers to invest in expansion.

5. **Remove red tape and unnecessary barriers** in the interconnection and permitting processes. Utilities are painfully slow in approving customer installations and regularly erect obstacles. The CPUC has not been successful in pushing the utilities to be timely and fair. This needs to change.

6. **Fix perverse utility profit incentives.** Utilities have a shareholder obligation to maintain an energy system that is primarily focused on faraway power plants and long-distance power lines. They see local generation as a threat to their profits. Incentives should change, and regulators need a stronger hand to force utilities to be good actors.