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Witnesses: Alejandra Mejia Cunningham, Erin Camp, PhD

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

Application of Pacific Gas and Electric Company to Revise its Electric Marginal Costs, Revenue Allocation and Rate Design. (U 39 M).	Application 19-11-019 (Filed November 22, 2019)

Prepared Direct Testimony of
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On Behalf of Natural Resources Defense Council and Sierra Club

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TABLE OF CONTENTS

LIST OF ATTACHMENTS

I. INTRODUCTION AND KEY FINDINGS AND RECOMMENDATIONS

This testimony focuses on the new optional time-of-use ("TOU") rate, called "E-ELEC," proposed in A. 19-11-019, Pacific Gas and Electric Company's ("PG&E") 2020 General Rate Case ("GRC") Application. The experts sponsoring this testimony are Alejandra Mejia Cunningham, Building Decarbonization Advocate in the Climate and Clean Energy Program at the Natural Resources Defense Council ("NRDC") and Erin Camp, PhD, Senior Associate at Synapse Energy Economics, Inc. Copies of the resumes of Ms. Mejia Cunningham and Dr. Camp are included at the end of this testimony as Attachments 1 and 2, respectively. The individual sponsoring a particular section of testimony is indicated at the end of each heading.

The key findings and recommendations are:

1) Widespread residential electrification, including homes of low-income Californians, is essential to meeting state climate goals. (Mejia Cunningham)

There is no situation in which California meets its climate goals at a reasonable cost that does not involve significant building electrification. This transition will take many years of concerted work across the state, and that work must begin now. The building equipment that most needs to be electrified—water heating and space conditioning equipment—has a life expectancy of between ten and fifteen years, meaning we have a singular opportunity this decade to electrify end uses as existing appliances reach the end of their useful lives. If we miss this opportunity, those appliances will be replaced with new fossil powered equipment that will need to be replaced again before they fully depreciate, increasing the societal cost of the transition.

As this transition begins, it is essential that the Commission adopt policies that prioritize low-income customers and eliminate the barriers those customers face to electrifying their homes. Without supportive policies, the Commission runs the risk that low-income families will be exposed to the escalating costs of maintaining a gas system serving a shrinking number of customers.

2) Rate design can help facilitate equitable electrification. (Mejia Cunningham)

Low-income customers face higher than average energy burdens and are markedly less likely to be able to absorb any kind of increase in their monthly energy costs. In order to give these households the confidence to transition off the gas system, an electricity rate must be available that makes electrification decisively cost-competitive with the cost of operating gas appliances. The rate should provide cost parity with gas without assuming load-shifting, as these customers may not have the ability to shift load to reduce their bills. However, a rate with strong TOU signals will enable low-income customers to save more on their bills if they are able to use their new electric appliances to shift load.

3) E-ELEC will not reliably reduce energy bills for CARE customers who electrify. (Camp)

Bill impact modeling shows that while CARE customers living in single family homes are likely to see bill decreases on E-ELEC relative to their pre-electrification energy costs, customers in multi-family dwellings will see increases in their bills: fixed charges make up a greater portion of multi-family residents' bills and their baseline space heating and cooling load (which drives savings from electrification) is lower. Since over 42 percent of low-income Californians live in multi-family homes, PG&E's proposed rate will not enable equitable electrification, but instead lead to bill increases for many of the state's most vulnerable customers.

4) An additional rate for income-qualified customers is necessary to support equitable electrification. (Camp)

In this testimony, we propose an income-qualified time of use rate, E-ELEC-CARE, designed to protect CARE-eligible customers from the risk of higher bills while also providing the price signals that encourage beneficial load shifting and enabling them to experience even larger bill savings by responding to those signals. E-ELEC-CARE has a reduced fixed charge and lower volumetric rates in most periods, focusing on reducing costs in off-peak periods in alignment with marginal costs. We propose that E-ELEC-CARE be adopted in addition to a building electrification rate for non-CARE customers.

II. THE ROLE OF RATES IN FACILITATING EQUITABLE ELECTRIFICATION AND ACHIEVING GREENHOUSE GAS REDUCTION GOALS (MEJIA CUNNINGHAM)

Q. What is the role of building electrification in meeting California's climate goals?

A. Building electrification is a cornerstone least-cost strategy for reaching California's goals of achieving carbon neutrality by 2045,[1] and reducing greenhouse gas emissions 80% below 1990 levels by 2050.[2] The California Energy Commission's most recent Integrated Energy Policy Report confirmed the "growing consensus that building electrification is the most viable and predictable path to zero-emission buildings," and concluded that electrification is "essential to California's strategy to meet its [greenhouse gas] reduction goals for 2030 and 2050."[3] Similarly, in a draft report commissioned by the California Air Resources Board, E3 found that "[a]chieving carbon neutrality by 2045 requires ambitious near-term actions around deployment of . . . building electrification," which is a least-regrets strategy common to every scenario where the state meets its climate goals.[4] In other words, there is no situation in which California meets its climate goals at a reasonable cost that does not involve significant building electrification.

Electrifying California's building stock will be a multi-decade process that we must start now. With concerted action, we have enough time before 2050 to transform the market for building appliances and replace all existing fossil power equipment as it reaches the end of its useful life with clean, all-electric alternatives. If we miss this opportunity, those appliances will be replaced with new fossil-powered equipment that will need to be

[1] Cal. Exec. Order No. B-55-18 (Sept. 10, 2018), *available at* https://www.ca.gov/archive/gov39/wp-content/uploads/2018/09/9.10.18-Executive-Order.pdf.
[2] Cal. Exec. Order No. S-3-05 (June 1, 2005).
[3] *2018 Integrated Energy Policy Report Update*, Docket No. 18-IEPR-01, CEC 2018 IEPR Update Vol. II at 28, 32 (Cal. Energy Comm'n Mar. 21, 2019) [hereinafter "2018 IEPR Update Volume II"], *available at* https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report/2018-integrated-energy-policy-report-update.
[4] Energy and Environmental Economics ("E3"), *Achieving Carbon Neutrality in California*, at 8 (Aug. 2020), *available at* https://ww2.arb.ca.gov/sites/default/files/2020-08/e3_cn_draft_report_aug2020.pdf.

replaced again before it has fully depreciated, increasing overall societal cost to California.[5]

Q. How has the Commission taken a leadership role in supporting building electrification in California, including supporting electrification in low-income and environmental justice communities?

A. In recent years, the Commission has taken a strong leadership role in the state's push to decarbonize its building stock. In 2019, the Commission updated its decades-old test for fuel substitution to allow energy efficiency dollars to more easily be invested in building electrification measures.[6] The decision included the assumption that there will be virtually no free ridership in utility building electrification programs, essentially recognizing that building electrification will not occur without support from public programs.[7] The same year, the Commission initiated a new rulemaking to implement the legislatively-mandated Building Initiative for Low-Emissions Development ("BUILD") program and the Technology and Equipment for Clean Heating ("TECH") initiative and included guidance to prioritize low-income communities in both efforts. At least 75 percent of the BUILD funds must be spent on new low-income housing.[8] For TECH, the Commission supported "the development of program designs that consider barriers to participation faced by low-income, disadvantaged, and hard-to-reach customers in order to maximize the market development benefits for these customer segments."[9]

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[5] Building Decarbonization Coalition, *A Roadmap to Decarbonize California Buildings*, at 6 (2019) *available at* https://www.buildingdecarb.org/archived/a-roadmap-to-decarbonize-californias-buildings. *See also* E3, *Deep Decarbonization in a High Renewables Future*, Publication Number CEC-500-2018-012, at iii (Cal. Energy Comm'n June 2018), *available at* https://www.ethree.com/wp-content/uploads/2018/06/Deep_Decarbonization_in_a_High_Renewables_Future_CEC-500-2018-012-1.pdf (finding that "[t]o achieve high levels of adoption of electric vehicles, energy efficiency and electrification in buildings, near-term action is necessary to avoid costly replacement of long-lived equipment in 10-15 years.").

[6] *See* D.19-08-009.

[7] *Id.* at 21, 22 (finding that "it is reasonable to assume at the outset that if fuel substitution occurs, it is likely because of programmatic intervention").

[8] D. 20-03-027 at 97 (Finding of Fact #9).

[9] *Id.* at 6.

Q. What is your understanding of the barriers to residential electrification faced by residents of environmental and social justice communities?

A. As the Greenlining Institute found in their report on equitable building electrification, residents of environmental and social justice communities "experience multiple and often compounding economic barriers that make electrification nearly impossible if they are expected to go it alone."[10] The often higher up-front cost of appliance replacement, coupled with the fact that homes may have structural or maintenance issues that must be addressed before electrifying, are costs that low-income households simply cannot prioritize.[11] In addition, 65 percent of low-income Californians are renters who do not control the energy sources used in their homes.[12] Regulatory and information barriers—including limited funding, a plethora of programs that are not coordinated and therefore difficult to navigate, and the lack of culturally appropriate education and awareness campaigns—also frustrate the growth of building electrification in environmental and social justice communities.[13]

In addition to the inability to afford the high upfront cost of replacing household appliances, low-income households are also less able to withstand the risk of higher electric bills that may accompany electrification. While the majority of Californians spend five percent or less of their income on energy expenses, the likelihood of living in a more energy cost burdened household increases as household income decreases.[14] In other words, poorer Californians spend a greater percentage of their income on energy bills. In fact, nearly all California households devoting 20 percent or more of their income to energy costs are also living within thirty percent or less of their region's area

[10] Carmelita Miller et al., *Equitable Building Electrification: A Framework for Powering Resilient Communities*, Greenlining Institute, at 17 (Sept. 30, 2019) [hereinafter "Greenlining Report"] (provided as Attachment 3).
[11] *Id.* at 17.
[12] Reem Rayef, *Housing Equity and Building Decarbonization in California* at 30 (Aug. 2020) [hereinafter "Rayef 2020"] (provided as Attachment 4).
[13] *See* Attachment 3, Greenlining Report at 17-21.
[14] Attachment 4, Rayef 2020 at 34.

median income.[15] For households contemplating a home with a higher electricity load, if the increase in electric bills is not offset by the elimination of gas bills, the household risks not being able to afford their utility bills, "risking disconnection or making potentially dangerous trade-offs."[16]

Q. Do you believe it is important for the Commission to institute policies addressing these barriers and ensuring low-income customers are among the first to benefit from building electrification?

A. Yes. The early and successful electrification of low-income Californians should be a guiding priority in all ongoing building decarbonization efforts. Not doing so would shift an unacceptable amount of risk onto an already overburdened and underserved population.

The state's climate policies and a warming climate are contributing to a long-term reduction in gas use, increasing the unit cost of gas for remaining uses.[17] Furthermore, every time a customer switches to clean electric building equipment, the gas system's customer base shrinks. As the number of customers from which costs can be recovered dwindles, costs per customer will increase:[18] A report commissioned by the California Energy Commission that forecast the costs of achieving state climate goals estimates that gas rates will rise by 80 percent by 2030 and 480 percent by 2050.[19]

Without policies that explicitly prioritize low-income customers, those who can most easily afford to go all-electric on their own will do so, and the customers left paying the

[15] *Id.* at 34. *See also id* at 15 (defining extremely low income as living within 30 percent or less of area median income).
[16] Attachment 3, Greenlining Report at 17.
[17] *See, e.g.*, California Gas and Electric Utilities, *2020 California Gas Report*, at 4-5 *available* at https://www.pge.com/pipeline_resources/pdf/library/regulatory/downloads/cgr20.pdf.
[18] Gridworks, *California's Gas System in Transition: Equitable, Affordable, Decarbonized and Smaller*, at 5 (2019) (provided as Attachment 5).
[19] E3 and University of California, Irvine, *The Challenge of Retail Gas in California's Low-Carbon Future*, Publication Number CEC-500-2019-055-F, at 49 (Cal. Energy Comm'n Apr. 2020).

rising costs of maintaining the gas system will be those least able to do so.[20] Low-income and disadvantaged communities are "disproportionately impacted by the criteria pollutants related to fossil fuel production."[21] We must not also burden them with a disproportionate share of the cost of the solution

Unfortunately, simply extending California's usual approach to demand side clean energy programs will not sufficiently ensure that low-income customers are prioritized in the transition to all-electric buildings. While successful in many ways, many of those programmatic approaches have historically underserved residents of disadvantaged communities.[22] The move to clean, all-electric buildings is an opportunity to apply the lessons learned from past programs towards a more equitable outcome in building electrification. To do this, the Commission must ensure building electrification programs deliver a decisively positive experience for low-income customers, including options for managing the post-electrification utility bills.

Q. What is the role of rate design to support existing building decarbonization policies and initiatives, and address barriers to electrification?

A. The Commission has found that electric rates designed to support beneficial electrification by compensating load shifting can improve grid utilization and reduce future system costs for all customers.[23]

In addition, adopting a rate open only to income-qualified customers will help economically vulnerable customers be among the first to transition off the gas system. Such a rate would need to protect customers from the risk of higher bills while also

[20] Attachment 3, Greenlining Report at 22.
[21] Attachment 5, Gridworks Report at 7.
[22] *See* Eric D. Fournier et al., *On energy sufficiency and the need for new policies to combat growing inequities in the residential energy sector*, Vol. 8, Elementa: Science of the Anthropocene, Art. 24 (2020), *available at* https://online.ucpress.edu/elementa/article/doi/10.1525/elementa.419/112771/On-energy-sufficiency-and-the-need-for-new?searchresult=1. *Id* at 6 of 12 (finding "strong and consistent negative relationships" between a zip code's Cal Enviro Screen score and the level of adoption of electric vehicles, hybrid vehicles, and residential solar).
[23] D.17-01-006 at 4.

exposing them to the right price signals and enabling them to create even larger savings by responding to those signals. Low-income customers would have to be confident that their energy costs would not increase post electrification, regardless of their ability to adjust their electric demand around peak TOU periods. One way to do this is by stripping out legacy and administrative costs and setting volumetric rates closer to marginal costs. By offering cost-reflective discounts for each TOU period, this approach would give low-income customers the certainty and confidence needed to electrify their home energy use while preserving the marginal cost-based off-peak volumetric rates that promote load shifting to the benefit of both participating and non-participating customers.

Q. Please describe how TOU rates for electrified households impact customer bills and overall system costs.

A. Rates can convey important price signals regarding when to use electricity in ways that can benefit all electric customers. The Commission has long recognized this potential for TOU rates to provide wide ranging benefits to all customers. As stated in D.17-01-006,

> TOU rates better reflect cost causation and motivate customers to shift their usage to periods that promote more efficient use of the electrical system. This shift should assist in reaching state energy goals by minimizing costs, encouraging energy conservation at appropriate times, and increasing electric supply at times that best serve the needs of the electric grid.[24]

Well-designed TOU rates encourage customers to shift load away from hours with higher costs and emissions to hours with abundant, low-cost renewable energy. This will be increasingly important as we shift more of the state's energy uses to run on clean electricity.

The electric grid is significantly underutilized during the overnight hours when most residential customers are asleep; similarly, California's grid is often flooded with inexpensive solar power during sunny mid-days when residential demand also wanes. The GHG profile of California's electricity tends to be lowest at both of these times, when it would be ideal for customers to pre-cool or pre-heat their homes and water for

[24] *Id*.

later use. Flexible electricity use can help integrate even more renewable power into the electric grid and can reduce the cost of meeting California's economy wide GHG goals by tens of billions of dollars per year:

> [I]f flexible loads in buildings, flexible electric vehicle charging, and flexible hydrogen electrolysis are also not available and other sectoral strategies are unchanged, the annual cost premium would reach $36 billion per year by 2050.[25]

In the past, low-income customers have been less likely to engage in load shifting.[26] Modern building electrification equipment (e.g. smart heat pump water heaters and thermostats) can allow these customers to more easily shape their energy demand by using "set and forget" functions on their electric space and water heating appliances (e.g. setting their heat pump water heater so that it pre-heats water when electricity is most plentiful).[27] A rate designed to help low-income customers benefit economically from electrification with equipment controls could have the threefold consequence of reducing building GHG emissions, engaging a historically underserved customer segment in demand-side programs, and reducing system costs for all customers.

Q. What programmatic and outreach elements do you recommend to maximize the potential benefits of a low-income building electrification rate?

A. Market transformation for building decarbonization is a complex undertaking dependent on three inter-related tactics that are within the purview of the Commission and Investor Owned Utilities ("IOUs"): incentives that reduce the cost of new equipment, customer

[25] E3, *Deep Decarbonization in a High Renewables Future*, Publication Number CEC-500-2018-012, at 41 (Cal. Energy Comm'n June 2018), *available at* https://www.ethree.com/wp-content/uploads/2018/06/Deep_Decarbonization_in_a_High_Renewables_Future_CEC-500-2018-012-1.pdf.

[26] Nexant, *California Statewide Opt-in Time-of-Use Pricing Pilot: Second Interim Evaluation*, at 4, 237 (Nov. 1, 2017), *available at* https://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442455573.

[27] Pierre Delforge and Joseph Vukovich, *Can Heat Pump Water Heaters Teach the California Duck to Fly?*, prepared by NRDC for the 2018 ACEEE Summer Study on Energy Efficiency in Building (2018), *available at* https://www.nrdc.org/sites/default/files/hpwh-teach-ca-duck-fly-2018.pdf.

outreach and education, and electrification-friendly customer rates. Without one, the other two would fail. Getting a customer excited about electrification will do nothing if they can't find a heat pump water heater at their local store; making those water heaters widely available at a competitive price for them to only increase participating customer's energy bills would create a backlash against electrification; enrolling that electrified customer on a TOU rate without explaining how to set up their water heater for TOU rates could lead to unnecessary strain on the grid and future costs for all customers.

Ensuring these three tactics are working closely together to provide a smooth electrification experience is even more important as we target low-income customers. For many families who qualify for the California Alternate Rates for Energy ("CARE") program, getting an out of the ordinary utility bill might mean the inability to cover their rent or mortgage that month. Fortunately, the Commission and IOUs are already hard at work developing several of the key solutions, including equipment rebates and now electrification-friendly rates. But we cannot assume customers will find all of the necessary pieces on their own—that a CARE customer who receives a rebated heat pump water heater will know to sign up for a new electric rate, or that even after signing up for that rate they will know how to set up the equipment to heat water when electricity is cheapest.

In order to prioritize the successful residential electrification of low-income customers, PG&E should, to the extent possible, connect CARE customers (and the owners or managers of buildings where CARE customers live) who participate in electrification programs to customer representatives who can enroll them in the optimal rate option and counsel them on how to maximize their potential bill savings. PG&E should also endeavor to include control technology in their all-electric program offerings, particularly those targeting CARE customers. Automated controls will help CARE customers who electrify their building end uses to optimize their energy use in relation to grid needs, maximize their bill savings, and help manage grid costs for all customers.

Q. Are there low-income customers who will not be able to participate in electrification unless further support is provided by the utilities, the Commission, or other California agencies?

A. Providing a targeted rate would enable many CARE-eligible customers to be early adopters in California's clean energy transition, but likely not those customers who are currently living with incomplete energy services or are unable to afford the energy necessary to meet their essential needs. The rate was designed to work for economically vulnerable customers who are swapping equipment "like for like"—replacing a full set of average efficiency gas equipment with more efficient electric equipment along with moderate investments in envelope efficiency. These are conservative assumptions, but unfortunately likely not protective enough for a family that is using extra blankets to stay warm in winter and withstanding unhealthy indoor temperatures in summer. We encourage the Commission and IOUs to work with other state agencies to find creative solutions and funding sources to address the pressing needs of these vulnerable families and to do so by helping them upgrade their home to healthy, all-electric standards.

III. BILL IMPACT ANALYSIS OF PG&E'S PROPOSED E-ELEC RATE, AND RECOMMENDED NEW RATE FOR CARE CUSTOMERS (CAMP)

Q. Please provide an overview of PG&E's proposed E-ELEC rate.

A. PG&E's proposed residential time of use ("TOU") rate, Schedule E-ELEC, is an un-tiered TOU rate with a fixed charge. This rate proposal was prompted by D.20-03-003, which requires PG&E to "create an un-tiered residential TOU rate to encourage residential electrification."[28] PG&E states that this rate was designed to encourage electrification because the fixed charge component allows volumetric charges to be commensurately lower, reducing the cost of operating electric appliances.[29] This rate would be available to residential customers using any of the following qualifying

[28] D.20-03-003 at 42; *see also id.* at Ordering ¶ 11.
[29] PG&E-5, Update Testimony of Dennis Keane and Erika Wasmund on Behalf of Pacific Gas and Electric Company, at 1-1: 12-14 (May 15, 2020) [hereinafter "PG&E-5"].

technologies: electric vehicles, energy storage, or electric heat pumps for water heating or climate control. [30] E-ELEC would consist of the following components:[31]

- A fixed charge of $25 per month
- Seasonal volumetric charges for peak, part-peak, and off-peak periods ($/kWh):

	Summer	Winter
Peak	$0.419	$0.213
Part-peak	$0.256	$0.192
Off-peak	$0.205	$0.177

Q. How should the Commission determine if E-ELEC will encourage residential electrification for all interested customers?

A. To encourage residential electrification, a rate should yield equivalent or lower annual energy bills relative to existing energy bills (the combined total of both gas and electric costs). To ensure that all customers have an opportunity to benefit from electrification, the electrification rate should provide energy bill savings for all types of customers in the residential class, including low-income customers.

A bill analysis that compares current energy bills to projected future bills can provide guidance to the Commission on the anticipated impact of the proposed rate.

Q. Please describe the bill impact analysis you performed to estimate the energy bills of low-income households enrolling in E-ELEC.

A. I used a bill impacts model developed by Synapse Energy Economics to analyze the impact of building electrification with E-ELEC on customers in PG&E service territory who qualify for the CARE program.

The bill impacts model assessed the varying climates across PG&E's territory by analyzing customers in Climate Zones R, S, and T. For reference, Fresno is located in Climate Zone R, which has hot humid summers and cool winters; Sacramento is located

[30] *Id.* at 1-1:12-20.
[31] Rates are rounded to the nearest tenth of a cent. The volumetric rates include a surcharge of $0.065 per kWh. PG&E-5 at 1-8, Table 1-3.

in Climate Zone S, which has hot summers and cold winters; and San Francisco is located in Climate Zone T, which has a coastal climate with moderate temperatures year-round.

The model assumes that the baseline (pre-electrified) customer was on rate G1 for gas service and E-TOU-C for electric service.[32] It also assumes that the customer is enrolled in the CARE program, receiving a 35 percent discount on their electric bill and a 21 percent discount on their gas bill.[33]

The baseline customer uses gas for space heating, water heating, clothes drying, and cooking, and electricity for air conditioning, lighting, and other appliances. Conversely, the model assumes that the customer on E-ELEC has electrified the following end uses with the accompanying technologies:

- Space heating and cooling: an air source heat pump ("ASHP"),
- Water heating: heat pump water heater,
- Cooking stove: induction stovetop, and
- Clothes drying: electric resistance clothes dryer.

The model uses annual energy consumption values that differ by climate zone and residential building type from the 2009 Residential Appliance Saturation Study ("RASS") and the initial findings from the 2019 RASS.[34] The model uses end-use load shapes from the OpenEI database for all end-uses except for space heating.[35] For space heating, the model uses an Air Source Heat Pump ("ASHP") performance curve that relates ambient air temperature to system efficiency, which is applied to Typical Meteorological Year data to develop annual consumption values and hourly load shapes for each climate

[32] We assume PG&E's proposed E-TOU-C rate; PG&E-3, Chapter 3 at Attachment B-1.
[33] Cal.P.U.C., CARE/FERA Programs, *available at* https://www.cpuc.ca.gov/lowincomerates/ (last accessed Sept. 2020).
[34] DNV GL, 2019 Residential Appliance Saturation Study, prepared for CPUC Energy Division EM&V Stakeholder Quarterly Meeting (Sept. 22, 2020), *available at* https://ww2.energy.ca.gov/appliances/rass/previous_rass.html.
[35] OpenEI Main Page, https://openei.org/wiki/Main_Page (last accessed Sept. 2020).

zone.[36] For all electrification pathways, the model uses efficiency ratings for gas and electric equipment to convert RASS gas consumption values to electric consumption.

The model also separately analyzes energy consumption for both residents of single-family homes and multi-family buildings, as consumption can differ greatly for these two types of residences. The model assumes that the electrification process involves some envelope and air sealing improvements that yield a 14 percent energy reduction for space heating and cooling. The model does not analyze customer economics of the upfront cost of the electrification technologies.

Q. What are the results of your analysis on the bill impacts of E-ELEC?

A. The modeling showed that the bill impacts for CARE customers who electrify their homes and switch to the proposed E-ELEC rate are substantially different depending on if they live in a single-family home or a multi-family building. Over the course of a year, CARE customers who live in single-family homes are likely to see net bill decreases as a result of electrifying on E-ELEC, whereas CARE customers who live in multi-family dwellings are likely to see net bill *increases* as a result of electrifying on E-ELEC (Table 1). Given that 42 percent of low-income Californians live in multi-family dwellings, this is an area where the E-ELEC rate should be improved in order to comprehensively and equitably incentivize electrification for all types of CARE customers.[37]

[36] Center for Energy and Environment, *Cold-Climate Air-Source Heat Pumps* (Feb. 2018) *available at* http://www.duluthenergydesign.com/Content/Documents/GeneralInfo/PresentationMaterials/2018/Day1/ccASHPs.pdf.

[37] IPUMS USA, 2018 1-year American Community Surveys Data, *available at* https://usa.ipums.org/usa-action/samples (last accessed August 2020). *See also* Attachment 4, Rayef 2020 at 30 (indicating 42% of low-income residents living in multi-family dwellings), 13 (citing reliance on IPUMS data).

Table 1. Annual bill impacts of CARE customers when electrifying on E-ELEC relative to TOU-C/G1.

	E-ELEC vs. TOU-C/G1	
	Single Family	Multi-Family
Climate Zone R (Fresno)	-$138	+$249
Climate Zone S (Sacramento)	-$247	+$233
Climate Zone T (San Francisco)	-$258	+$145

Q. How do you explain the bill increases for residents of multi-family buildings?

A. There are two primary reasons customers in multi-family dwellings will see their energy bills increase relative to their pre-electrification bills, while single-family residents save money.

First, the fixed charge associated with E-ELEC ($25 per month) represents a larger fraction of the total bills for customers in multi-family buildings than for those in single-family homes. This is because customers who live in multi-family dwellings use less energy for space heating and cooling than customers who live in single-family homes. Multi-family customers use less energy on space heating and cooling because their homes tend to be smaller than single-family homes and because of the significant efficiency gained from having other living units above, below, or to the sides that are also heated or cooled.[38]

Second, in my model, customers with lower baseline space heating and cooling load (which includes residents of multi-family buildings) will save less money from electrifying than customers who have higher space heating and cooling load. Electrifying space heating and cooling on the E-ELEC rate tends to yield cost savings because of the timing of the load and the efficiency improvement of air conditioning with a heat pump;

[38] RASS 2009 estimates that multi-family units use about 24 percent the energy of a single-family home for climate control (space heating and cooling).

whereas electrifying cooking and clothes drying end uses tend to yield cost increases. If the baseline space heating and cooling load is lower for a multi-family home customer, the associated savings from electrifying will also be lower for that customer; therefore, the benefits of electrifying space heating and cooling will not be large enough to compensate for the increased costs driven by electric cooking and clothes drying.

Q. What changes to E-ELEC are necessary to increase the likelihood that electrification will not increase energy bills for CARE customers across PG&E's territory?

A. Adopting PG&E's E-ELEC rate alone will not sufficiently facilitate equitable electrification, because many CARE customers living in multi-family buildings are expected to experience annual bill increases on E-ELEC relative to their pre-electrification energy costs. To encourage electrification in an equitable manner within PG&E's service territory, the Commission should adopt an additional alternate rate, available to all CARE customers, that provides greater assurances of bill parity with pre-electrification energy costs.

There are two potential approaches for altering the E-ELEC rate design to make it cost-competitive with non-electrified energy bills and sufficiently incentivize electrification. The first approach is to discount the volumetric rates ($/kWh); the second approach is to discount the fixed charge. Both approaches have their merits. Discounting the fixed charge is a simple solution that provides the most benefit (relative to total electric bills) to customers who have lower electric load (e.g., multi-family customers). Discounting the off-peak volumetric rate has the benefit of further incentivizing consumption during the off-peak hours of the day. I recommend using both approaches to improve the E-ELEC rate.

As designed, the E-ELEC rate is well above marginal costs (Table 2), especially for winter and off-peak rates.[39]

[39] Marginal costs were taken from PG&E's Response to NRDC Data Request Set 001, Question 02. The referenced Data Response is provided as Attachment 6.

Table 2. Comparison of E-ELEC (without adders) to PG&E marginal costs.

	E-ELEC (without adders)		Marginal Costs		% Diff. from Marg. Costs	
	Summer	Winter	Summer	Winter	Summer	Winter
Peak	0.353	0.148	0.318	0.076	+10%	+49%
Part-Peak	0.191	0.127	0.102	0.048	+47%	+62%
Off-Peak	0.140	0.112	0.033	0.029	+76%	+74%

I recommend an alternative E-ELEC-CARE rate that does the following:

- Discounts the fixed charge to $12.21/month, as recommended by the California Public Advocates Office.[40]
- Discounts the volumetric rates to bring the rate into cost parity with the non-electrified bills for customers in the climate zone with the worst bill impacts. Discounts do not go below PG&E's marginal costs.

E-ELEC-CARE maintains the price signal for shifting load from on-peak hours to off-peak hours in the summer, brings the winter rates closer to marginal costs, aligns the summer peak rate with marginal cost, and reduces the severity of the fixed charge to benefit customers with lower loads (Table 3).

E-ELEC-CARE was also designed with the "duck curve" problem in mind. The duck curve is worst in the shoulder season, whose months are included in the "winter" months of PG&E's rate. Reducing the winter off-peak rate by 35 percent and creating a winter peak to off-peak ratio of 2.0:1 incentivizes increased electric consumption during the winter off-peak hours and helps flatten the duck curve in those months.

Table 3. Proposed E-ELEC-CARE rate.

	Difference from E-ELEC		E-ELEC-CARE Rates		% Change from E-ELEC		% Diff. from Marg. Costs	
Rate	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Peak	-0.04	0.00	0.32	0.15	-10%	0%	0%	49%
Part-Peak	0.00	-0.01	0.19	0.11	0%	-10%	47%	58%
Off-Peak	-0.03	-0.04	0.11	0.07	-20%	-35%	70%	61%

E-ELEC-CARE should be available to all CARE customers, even though CARE customers living in single-family homes are more likely to save money by electrifying

[40] Exh. Cal Advocates-1, Prepared Testimony of Jieli Feng And Nathan Chau on Behalf of the Public Advocates Office, Chapter 7, at 7-13 (Oct. 23, 2020).

with E-ELEC. I recommend this for three reasons: (1) Administration of E-ELEC-CARE by PG&E will be simpler if offered to all CARE customers regardless of their housing type; (2) CARE customers in single-family homes will have added bill protection if they electrify their homes without undergoing the efficiency improvements assumed in my model; and (3) because my analysis does not include the cost of the electrification equipment (e.g., air source heat pump, heat pump water heater, etc.), so additional bill savings for low-income customers will improve the payback period for the purchase of that equipment. Table 1 summarizes the bill impacts for single-family and multi-family CARE customers in each climate zone on the E-ELEC-CARE rate.

Table 4. Annual bill impacts of CARE customers when electrifying on E-ELEC-CARE relative to TOU-C/G1

	E-ELEC-CARE vs. TOU-C/G1	
	Single Family	Multi-Family
Climate Zone R (Fresno)	-$448	-$3
Climate Zone S (Sacramento)	-$574	-$17
Climate Zone T (San Francisco)	-$567	-$97

Q. How will customers who are unable to shift load be affected by this rate?

A. Customers who are unable to shift load on E-ELEC-CARE would not be penalized on their bills. My model assumes that customers do not shift any load when electrifying, therefore E-ELEC-CARE was designed to be cost-competitive without any load shifting. Low-income customers may not have the ability to shift load, due to reasons including lack of access to smart/programmable technologies or an inability to shift load during

specific times of day.[41] Therefore, the electrification rate for low-income customers should be cost-competitive without load shifting.

However, if low-income customers are able to respond to the price signal and shift load away from the grid's peak hours, customers would see more bill savings than estimated by my model. With load shifting of water heating and space cooling, low-income customers could save as much as an additional $27 per year, depending on the climate zone and building type. Furthermore, any load shifting by low-income customers in response to the price signals of E-ELEC-CARE would improve the utilization of the grid. In conclusion, the design of E-ELEC-CARE strikes a balance between optimizing the use of the grid and protecting low-income households to support equitable and grid-beneficial electrification.

[41] Navigant *Residential Energy Time of Use (RE-TOU) Trial Evaluation Report 2*, prepared for Public Service Company of Colorado) (Nov. 22, 2019) (filed as Attachment BAT-3 in Colo. P.U.C. Docket 19AL-0687E), *available* at https://www.xcelenergy.com/staticfiles/xe-responsive/Company/Rates%20&%20Regulations/Regulatory%20Filings/TOU/19AL-XXXXE_Attachment%20BAT-3_RE-TOU%20Evaluation%20Report%202%20Final_November%202019.pdf.