Application No.: A.21-09-001
Exhibit No.: SDG&E-05
Witness: Hannah Campi

PREPARED REBUTTAL TESTIMONY OF

HANNAH CAMPI

ON BEHALF OF

SAN DIEGO GAS & ELECTRIC COMPANY

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

FEBRUARY 11, 2022

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PREPARED REBUTTAL TESTIMONY OF HANNAH CAMPI ON BEHALF OF SAN DIEGO GAS & ELECTRIC COMPANY

I. INTRODUCTION

The purpose of my rebuttal testimony is to address the January 14, 2022, Prepared Direct Testimony of intervenors[1] in San Diego Gas and Electric Company's ("SDG&E") Application to Update Rate Design to Include a Residential Untiered Time-of-Use Rate with a Fixed Charge[2] ("Application"). Specifically, my rebuttal testimony addresses the following statements and contentions made in intervenor testimony:

- SDG&E appreciates Cal Advocates', UCAN's and SDCP-CEA's willingness to consider an innovative fixed charge design;
- SDG&E responds to parties' claims that the level of SDG&E's proposed fixed charges is too high;
- SDG&E responds to intervenors that state that its fixed charges are not cost based. Specifically:
    - SDG&E disagrees with parties that would limit costs recovered through the fixed charge to marginal distribution customer costs;
    - SDG&E responds to claims that its fixed charge should be based on coincident peak demand; and

[1] SDG&E is responding to the Prepared Direct Testimony of Nathan Chau and Alan M. Siebuhr on Behalf of the California Public Advocates Office ("CalPA" or "Cal Advocates"), Prepared Testimony of David Cheng on Behalf of The Utility Reform Network ("TURN"), Direct Testimony of Melissa Whited on Behalf of Sierra Club, the Direct Testimony of R. Thomas Beach on Behalf of the Solar Energy Industries Association ("SEIA"), the Prepared Direct Testimony of Brian Dickman on Behalf of San Diego Community Power and Clean Energy Alliance ("SDCP-CEA"), and the Direct Testimony of Mark Fulmer on Behalf of the Utility Consumers' Action Network ("UCAN") – ERRATA.

[2] SDG&E filed its Application ("A.") 21-09-001 on September 1, 2021, with revised testimony filed on December 1, 2021.

SDG&E's current time-of-use ("TOU") periods and current TOU-differentiation for various rate components are appropriate

- SDG&E shows that its commodity rates based on SDG&E's 2019 General Rate Case ("GRC") Phase 2 marginal commodity costs are appropriate in this proceeding.

SDG&E's failure to address any individual issue in this rebuttal testimony does not imply agreement by SDG&E with any argument, position or proposal asserted by parties.

II. PARTIES SUPPORT KEY ASPECTS OF SDG&E'S DESIGN

Notably, there is support around key aspects of SDG&E's opt-in electrification rate. First, parties acknowledge the role of a fixed charge as a key component of TOU-ELEC and of electrification rates broadly. In order to be effective for electrification, a fixed charge must be high enough to offer a meaningful reduction in volumetric rates. SDG&E appreciates that both Cal Advocates and Sierra Club recognize the tradeoffs between a fixed charge that recovers a larger portion of costs and lower volumetric rates that enable increased electricity usage.[3]

SDG&E's proposal to differentiate the fixed charge to reflect individual demand[4] also received support. Cal Advocates and UCAN conceptually support SDG&E's proposal for a demand-differentiated fixed charge to mitigate revenue shifting between customers.[5] This design distinguishes SDG&E's proposal from existing residential rate schedules, provides an incentive for residential customers to reduce and manage their demand, which benefits the grid, and limits revenue shifting that would occur if the same fixed charge was applied to all customers. Sierra Club also acknowledges that a demand-based rate component could be a useful rate design.[6]

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[3] Cal Advocates Amended Direct Testimony, pp. 11-12, Sierra Club Direct Testimony, p. 11.
[4] Revised Direct Testimony of Hannah Campi, p. HC-10.
[5] Cal Advocates Amended Direct Testimony, p. 12, UCAN Direct Testimony – ERRATA, pp. 6 and 9.
[6] Sierra Club Direct Testimony, p. 19 lines 5-10.

While more complicated than SDG&E's proposal and likely more confusing for customers, Sierra Club states that SDG&E could implement an "excess demand" charge if the customer's demand rises above a threshold.[7]

In addition, SDG&E's proposal to move a portion of generation capacity costs to the winter to create more consistent, year-round price signals received support from Cal Advocates and SEIA. Cal Advocates proposed identical Off to Super-Off Peak TOU differentials as SDG&E and affirmed that SDG&E's proposal to shift 20% of generation capacity costs to the winter has merit.[8] Moreover, SEIA supports SDG&E's proposed TOU-ELEC commodity rates.[9]

Lastly, the Community Choice Aggregation ("CCA") Parties are not opposed to SDG&E's rate design proposal for TOU-ELEC.[10] Support for many aspects of SDG&E's design from a range of intervenors highlights the merit of key components of SDG&E's proposed rate design.

III. THE LEVEL OF SDG&E'S PROPOSED FIXED CHARGE AND DISTRIBUTION COST RECOVERY IS APPROPRIATE

Parties point to the fixed charges in Southern California Edison ("SCE") and Pacific Gas and Electric's ("PG&E") electrification rates as evidence that SDG&E's proposed fixed charges are too high.[11] As described in the Rebuttal Testimony of SDG&E witness Gwendolyn Morien, there is a direct tradeoff between costs recovered through a fixed charge and the corresponding decrease in volumetric rates that enables the increased kWh consumption that results from beneficial electrification.[12]

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7 Sierra Club Direct Testimony, p. 24.
8 Cal Advocates Amended Direct Testimony, p. 23.
9 SEIA Direct Testimony, p. 29.
10 SDCP-CEA Direct Testimony, p. 8.
11 UCAN Direct Testimony – ERRATA, p. 4 Figure 1.
12 Rebuttal Testimony of Gwendolyn Morien, pp. GM-2 – GM-5.

A. Existing Utilities Have Higher Fixed Charges

The California Public Utilities Commission ("Commission") should not only look to California's other investor-owned-utilities when evaluating the amount and type of fixed charges that residential customers will accept. Rate designs that seek to advance bold electrification and decarbonization goals should consider structures that have been successfully implemented both in other regions and in other industries in order to avoid viewing available options through an unnecessarily narrow lens. Electric utilities in other states, as well as municipal utilities in California, have implemented a range of optional residential rates that include fixed charges. SDG&E presents select residential rate schedules below as evidence that other electric utilities have adopted and offer higher fixed charges to residential customers:

- City of Riverside Public Utilities: Schedule D, Domestic Service. Customer Charge = $11.26/month, plus a "Reliability Charge" based on a customer's electric panel size, ranging from $10/month for customers with panel sizes <= 100 Amp to $60/month for customers with panel sizes > 400 Amp;[13]
- Southern Nevada: Schedule OLRS-TOU, Optional Large Residential. Basic Service Fee - Option A = $70.70/month, Option B = $181.10/month;[14]

[13] City of Riverside Public Utilities Department, Schedule D, Domestic Services, (applicable to Single-Family and Multi-Family dwelling units for domestic purpose), available at https://riversideca.gov/utilities/sites/riversideca.gov.utilities/files/pdf/rates-electric/Electric%20Schedule%20D%20-%20Effective%2001-1-19.pdf.

[14] Nevada Power Company, Statement of Rates, (available to residential customers who have three-phase service to a separately-metered, permanent, single-family dwelling), available at https://www.nvenergy.com/publish/content/dam/nvenergy/brochures_arch/about-nvenergy/rates-regulatory/electric-schedules-south/StatementofRates.pdf.

- Modesto Irrigation District: Opt-in EV pilot rate, Schedule EV-D. Fixed Charge = $30/month;[15]
- Grand Valley Power: Optional Schedule EV-TOU. Fixed "Grid Connectivity" Charge = $30/month;[16]
- Mohave Electric Cooperative: Residential Demand Service, Schedule RD: Fixed Charge = $25.60/month plus $8/kW monthly non-coincident peak ("NCP") demand charge;[17] and
- Los Angeles Department of Water and Power: Large TOU Residential Customers, Schedule A-1: Customer Charge = $7/month, plus $5.36/kW monthly facility (demand) charge.[18]

These rates indicate that a range of rate schedules are currently available to residential customers throughout the country. Existing demand response and critical peak pricing programs also support residential customers' ability to understand more complex rate designs that are

[15] Modesto Irrigation District, Electric Rate Schedule EV-D, Residential Service, Time of Use Option, p. 1, ("Rate applicable to individual family accommodations devoted primarily to residential customers and who have a currently registered Motor Vehicle, as defined by the California Motor Vehicle Code, which is: 1) a plug-in battery electric vehicle (PBEV) or plug-in hybrid electric vehicle (PHEV) recharged via a recharging outlet at the customer's premises."), available at https://www.mid.org/tariffs/rates/ev-d.pdf."

[16] Grand Valley Power, Electric Vehicle – Time of Use (EV-TOU) (Residential), ("available to all residential consumers that own a qualified Electric Vehicle that is charged on the served premise."), available at https://gvp.org/rates.

[17] Mohave Electric Cooperative, Residential Demand Service, avilable at https://www.mohaveelectric.com/member-services/rates/.

[18] Los Angeles Department of Water and Power, Large TOU Residential Customers, (available to single-family residential customers with a dedicated on-site transformer. Although LADWP's fixed charge is lower, these customers are subject to a demand charge), available at https://www.ladwp.com/ladwp/.

offered on an opt-in basis. Looking beyond electric utilities, water utilities also utilize rate design structures with fixed charges scaled to consumption to recover larger shares of fixed costs.[19]

B. Non-Coincident Demand ("NCD") is Appropriate to Set a Demand-Differentiated Fixed Charge

Although there is support for the concept of a fixed charge scaled to demand, parties claim that this charge should be based on On-Peak (or "Coincident") demand only.[20] Since SDG&E's proposed fixed charge recovers distribution costs, there is no cost basis to set this charge based on peak demand only. Based on SDG&E's 2019 GRC Phase 2 distribution cost studies, most distribution costs are not coincident-peak, or capacity driven.[21] Distribution load is measured at the circuit level, with circuit peaks not always corresponding to system peaks.[22] While some circuits may peak during the On-Peak period from 4-9 pm, not all circuits do. It would not make sense to send customers a distribution price signal to reduce their demand during the On-Peak period if their circuit does not peak at that time. This could actually encourage consumption during the circuit's peak if the circuit peaks during hours outside 4-9 pm. In contrast to commodity generation, which is driven by system-wide costs, distribution circuits and substations peak at different times of the day based on customer makeup and usage patterns of customers served on the specific circuit and substation.

Expanded electrification and the adoption of high-use, programable technologies such as heat pumps and home electric vehicle ("EV") charging can lead to both greater demand and

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[19] The City of San Diego, Water Billing Rates, *Water rates effective Jan. 1, 2022, Single-Family Domestic Customers*, available at https://www.sandiego.gov/public-utilities/customer-service/water-and-sewer-rates/water

[20] Cal Advocates Amended Direct Testimony, p. 11 lines 3-5, and SEIA Direct Testimony, p. 17,

[21] A.19-03-002, Rebuttal Testimony of William Saxe on Behalf of SDG&E (May 20, 2020), p. WGS-29.

[22] A.15-04-012, Direct Testimony of John Baranowski on Behalf of SDG&E (February 9, 2016), p. JB-2.

variability in residential demand patterns. SDG&E's proposal to use NCD instead of coincident demand to determine the customer charge supports the reduction of a customer's individual peak load, rather than system peak load. SEIA falsely claims that SDG&E's design does not encourage reduction in coincident peak demand.[23] SDG&E's proposed commodity rates encourage reduction of coincident peak demand. While SDG&E's proposed TOU differentials signal to shift use out of the on-peak period, and its proposed fixed charges send price signals to encourage reduction of overall load. SEIA also falsely claims "there is nothing inherently more accurate with charging customers for demand (kW) than energy (kWh)."[24] This logically does not make sense. The price signal from a kW demand-based charge is wholly different than from a kWh volumetric charge. Distribution demand charges incent continuous reduction of demand; a customer must manage their demand effectively over the entire period or they will pay a higher demand charge. TOU volumetric rates allow customers to increase their demand during the on-peak period significantly but wind up with lower bills than the customer with the demand charge. This is not the same incentive. A customer is less likely to care about increasing their demand for 10 minutes during the on-peak period if they pay volumetric rates than if they pay a demand charge. Demand charges clearly incent different behavior. SDG&E's proposed TOU-ELEC design is also consistent with Rate Design Principles 4 and 5, which states that rates should incent reduction of both on-peak demand and NCD.[25]

C. SDG&E's Volumetric Distribution Rates Should not be Time-Differentiated

UCAN states that CCA customers should benefit from the ability to shift load through TOU-differentiated distribution charges.[26] Under SDG&E's proposed design, CCA customers

[23] SEIA Direct Testimony, p. 21.
[24] *Id.*
[25] Revised Direct Testimony of Gwendolyn Morien, p.GM-6.
[26] UCAN Direct Testimony – ERRATA, pp. 14-15.

would see a benefit of lower distribution rates relative to the default rate and incentives to reduce overall demand. Additional opportunities for savings driven by load shifting would be available through their commodity rates as currently structured, although this is subject to change by the CCA provider.[27] However, TOU differentiated distribution charges have the potential to create challenges for customers if there is a mismatch between the TOU periods associated with their commodity and distribution rates. TOU differentiated distribution rates would constrain the customer's choice of commodity rate schedule to only those rates with corresponding TOU periods and could create challenges if CCA commodity TOU periods are not aligned with SDG&E's distribution TOU periods.

Further, very little distribution costs are driven by the On-Peak period. An individual circuit may be at capacity and thus benefit from price signals that lead to a reduction in demand even when the distribution system as a whole is not at its peak. Consistent reduction in NCD at the circuit level is necessary to avoid system upgrades.[28] Currently, there is no incentive structure in residential rates to smooth total demand.

Several parties have proposed updates to the TOU periods associated with this rate.[29] SDG&E responds in more detail below and in the Rebuttal Testimony of SDG&E witness Gwendolyn Morien.[30] However, these proposals are also relevant to the discussion of NCD- versus On-Peak-based distribution demand charges as they demonstrate that changes in the mix of distributed energy resources on the grid have the potential to shift when both circuit peaks and

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[27] San Diego Community Power, Residential Rates, (example TOU-differentiated commodity rates with from one of the CCAs in SDG&E's service territory), available at Residential Rates - San Diego Community Power (sdcommunitypower.org).

[28] A.15-04-012, Direct Testimony of John Baranowski on Behalf of SDG&E (February 9, 2016), p. JB-7, lines 4-8.

[29] Cal Advocates Amended Direct Testimony, p. 20, Sierra Club Direct Testimony, p. 20.

[30] Rebuttal Testimony of Gwendolyn Morien, pp. GM-12 – GM-16.

system peaks occur. Highly electrified residential customers who are the target group for this rate will have a larger impact on their local circuit peak than similar residential customers who do not have these technologies. The specific usage patterns that result from the widespread adoption of electrification technologies could lead to further changes in both circuit and system-wide peaks. The exact impacts of these changes remain to be seen and could lead to the development of TOU periods distinct from what is in place or proposed by intervenors in this proceeding. Shifting on or off-peak hours can create marketing and customer understanding challenges.[31] Paired with the Commission's goals of reducing both peak and non-peak demand, encouraging reduction in NCD through an NCD-based fixed charge is appropriate.

D. The Costs Recovered in SDG&E's Proposed Fixed Charge are Appropriate

Parties argue that costs recovered in the fixed charge should be limited to marginal distribution customer costs[32] or limited to 25% of SDG&E's distribution revenue requirement.[33] As mentioned above, there is a direct tradeoff between the costs recovered through the fixed charge and the costs recovered through volumetric rates. As illustrated in the designs proposed by Cal Advocates[34] and Sierra Club,[35] a reduction in the monthly fixed charge leads to an increase in the volumetric rates in all TOU periods. This increases the cost of marginal kWh consumption associated with electrification. In order for the final design of this rate to achieve its goal of enabling beneficial electrification, the reductions in volumetric rate must be meaningful enough to allow for the use of these technologies to not be cost-prohibitive. All parties in this proceeding limited fixed cost recovery to the distribution rate component. Table 1 presents each

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31 Rebuttal Testimony of Gwendolyn Morien, p. GM-14.
32 Cal Advocates Amended Direct Testimony, p. 2, lines 8-10, SEIA Direct Testimony, p. 14, lines 20-22, Sierra Club Direct Testimony p. 19, lines 3-10.
33 UCAN Direct Testimony – ERRATA, p. 12.
34 Cal Advocates Amended Direct Testimony, p. 4, Table 2.
35 Sierra Club Direct Testimony, p. 25, Table 6.

party's fixed charge proposal and the resulting reduction in volumetric rates. As displayed in Table 1, SDG&E's proposed rate is superior because it achieves the most volumetric rate reduction while still being cost-based. SEIA's proposal to replicate Schedule EV-TOU-5 only achieves a 13% reduction in SDG&E's already high volumetric rates.

Table 1: Reduction in Distribution Volumetric Rate Achieved Through Parties' Fixed Charge Design Proposals

	Unit	Default Residential Rate	SDG&E	CalPA	UCAN[36]	Sierra Club	SEIA
Fixed Charge: 0-4 kW	$/month	$0	$28.53	$15.61	$12.35	$20.00	$16.00
4-8 kW	$/month		$51.28	$24.19	$23.77		
8-10 kW	$/month		$68.35	$24.28			
>10 kW	$/month		$85.41	$36.39			
Distribution Volumetric Rate	$/kWh	0.12180	0.03524	0.07667	0.08999	0.07077	0.08127
Volumetric Rate Reduction	$/kWh	n/a	(0.08656)	(0.04513)	(0.03181)	(0.05103)	(0.04053)
Average Residential Volumetric Rate[37]	$/kWh	0.31348	0.22692	0.26835	0.28167	0.26245	0.27295
Reduction in Volumetric Rate (%)			-28%	-14%	-10%	-16%	-13%

Other than to say that a fixed charge should only recover customer costs, Sierra Club offers no cost-basis for its proposed $20/month fixed charge.[38] Sierra Club's proposal should be rejected based on this alone. SEIA attempts to cast doubt on Decision ("D.")21-11-016's[39] categorical rejection of D.17-09-035,[40] stating that the Commission "indicated a desire to re-visit this determination anew, especially for non-default residential rates."[41] In fact, the Commission

[36] Tiers for UCAN based on under and over 6kW demand ranges, as proposed by UCAN in Direct Testimony – ERRATA, p.12 Table 4.
[37] Average and distribution volumetric rate based on rates accepted and effective June 1, 2021 per Advice Letter 3756-E.
[38] Sierra Club Direct Testimony, pp. 25-26.
[39] D.21-11-016, Decision Adopting Marginal Costs, Revenue Allocation, and Rate Designs for Pacific Gas and Electric Company.
[40] D.17-09-035 approved fixed costs eligible for a default residential fixed charge.
[41] SEIA Direct Testimony, pp. 16-17 (citing to D. 21-11-016 in the PG&E GRC Phase 2, pp. 113-114.).

wholly rejected the fixed cost categories from D.17-09-035 for *all* residential rates, not just "non-default residential rates," as SEIA inaccurately states. SEIA has no basis for claiming that D.17-09-035 should have any bearing in the instant proceeding, as D.21-11-016 stated that D.17-09-035 does not hold precedential value outside of the context of its originating, now closed proceeding (A.16-06-013).[42]

In addition, D.21-11-016 found that "the design of the fixed charge for [PG&E's] E-ELEC is intended to further state policy goals related to decarbonization and therefore has a particular policy purpose that may justify any dissonance with previous Commission decisions regarding the application of [equal percent of marginal cost] EPMC to residential fixed charges," and that "any future proposals for a default residential fixed charge or optional residential fixed charge (as in this case) should be able to proceed without the need to comply with cost category and EPMC determinations made in a since-closed proceeding that failed to make a determination concerning a residential fixed charge on the merits."[43] Therefore, any argument to limit cost categories of costs recovered in TOU-ELEC should be disregarded, as the Commission has clearly stated that it may consider proposals for fixed charge that recover other costs beyond the cost categories determined in D.17-09-035.

E. Determination of a Customer's Fixed Charge Tier Should Balance Accurate Price Signals and Customer Understanding

UCAN claims that a fixed charge should be based on a customer's top six peak demands, measured over a full hour rather than 15 minutes.[44] First, SDG&E is already proposing to base

[42] D. 21-11-016, Conclusion of Law 32, p. 166.
[43] D. 21-11-016, p. 114 (citation omitted).
[44] UCAN Direct Testimony – ERRATA, p. 10.

the demand charge on demand as measured over hourly intervals.[45] Second, the price signal associated with the fixed charge is diluted with every additional data point incorporated into the average and resulting final tier. SDG&E's proposed design already mitigates penalization for a single instance of unusually high demand by taking the average of the top three demands from three different billing cycles. The inclusion of additional data would reduce the effectiveness of the tiering mechanism and increase the potential for revenue shifting. Therefore, UCAN's proposal should be rejected.

IV. TIME OF USE PERIODS SHOULD BE BASED ON SDG&E'S MARGINAL COSTS AND HAVE SUFFICIENT SUPPORT

The Commission should not adopt new TOU periods for TOU-ELEC. As discussed in the Rebuttal Testimony of SDG&E witness Gwendolyn Morien, new TOU-ELEC rate-specific TOU periods could cause customer confusion and would not be based on the most up-to-date information that will be provided in SDG&E's upcoming 2024 GRC Phase 2.[46] However, there are also significant issues with the cost basis for these new TOU period proposals.

Cal Advocates proposes that TOU-ELEC adopt nearly identical TOU periods as SCE's TOU-D-PRIME rate.[47] It would be inappropriate to adopt TOU periods that are based on another utility's cost structure and cost-causation. To that end, Cal Advocates has demonstrated that their proposed TOU periods are not well reasoned. Cal Advocates had originally proposed TOU periods with no Summer Weekend On-Peak period, which would allow participating customers to consume energy during the 4 pm to 9 pm "peak" period on summer weekends at a rate of

[45] UCAN Data Request – SDG&E Response, Data Request #03 (January 19, 2022), question 6, p. 2, available at https://www.sdge.com/rates-and-regulations/proceedings/Application-for-a-Residential-Untiered-Time-of-Use-Rate-with-a-Fixed-Charge.
[46] Rebuttal Testimony of Gwendolyn Morien, p. GM-14.
[47] Cal Advocates Amended Direct Testimony, p. 20, n.53.

approximately $0.09/kWh.[48] Although this significant oversight was corrected in Cal Advocates' Amended Testimony, it was not corrected until January 31, 2022. SDG&E appreciates the correction; however, Cal Advocates does not provide enough evidence to support these new TOU periods, and SDG&E believes that a proposal for drastically different TOU periods would require more attention and consideration.

SDG&E appreciates Cal Advocates amended testimony that corrects their proposed TOU periods to include on-peak hours on weekends during summer months. Summer weekends are obviously not exempt from experiencing high levels of demand associated with the summer on-peak period, as seen during rolling blackouts on August 14th and 15th, 2020, a Friday and Saturday.[49] However, such an oversight in the initial filing serves to emphasize SDG&E's point that this proceeding, meant to evaluate a single proposed rate, should not be expanded to include issues applicable to all rates when a more appropriate and thorough review of base TOU periods is already planned for SDG&E's 2024 GRC Phase 2 proceeding.

Furthermore, although Cal Advocates uses SDG&E's 2020 marginal energy costs to support their proposed TOU periods, this data is not actually used to develop its proposed TOU periods. Although a correction was made to testimony and workpapers, Cal Advocates' amended rate design and marginal commodity costs are based on the original TOU periods it requested from SDG&E – TOU periods that have no weekend Summer On-Peak period, as seen in Cal

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[48] *See* Cal Advocates Direct Testimony, p. 20, *cf.*, Cal Advocates Amended Direct Testimony, p. 20.

[49] California Independent System Operator, California Public Utilities Commission, and California Energy Commission, *Final Root Cause Analysis, Mid-August 2020 Extreme Heat Wave* (January 31, 2021), available at http://www.caiso.com/Documents/Final-Root-Cause-Analysis-Mid-August-2020-Extreme-Heat-Wave.pdf

Advocates Data Request #002[50]. Therefore, the marginal costs and design that Cal Advocates proposes in its amended testimony have no evidentiary support on the record and should be rejected.

V. THE PROPOSED RATE DESIGN SHOULD NOT BE EVALUATED BASED ON ADVANTAGES FOR A SINGLE TECHNOLOGY

The proposed rate would be available to customers with any one of several eligible electrification technologies. As such, it should not be evaluated on its benefits to EV customers alone, for example. Additionally, a comparison to savings seen under EV-TOU-5,[51] a currently available residential EV rate,[52] is inappropriate without mentioning the rate design includes incentives to charge EVs during certain times: there is no transmission or distribution rate in the Super-Off Peak.[53] SDG&E believes it would be inappropriate to replicate that design here. The other eligible technologies, electric heat pump water heaters ("HPWH") and behind-the-meter storage devices, currently represent a small subset of SDG&E's customers as well as a wide range of possible usage patterns. Customers may also purchase more than one of the eligible technologies. The aggregate effects of these choices on usage patterns and resulting bill impacts will depend on a variety of factors, including individual customer choices and potential advancements in technology such as greater efficiency or improved programmability. As a result, evaluating this rate on its potential to provide savings for EV customers, who already have multiple rate offerings in SDG&E's service territory, is too narrow a metric.

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50 Cal Advocates Data Request – SDG&E Response, Data Request #02 (September 9, 2021), question 1, p. 1, available at https://www.sdge.com/rates-and-regulations/proceedings/Application-for-a-Residential-Untiered-Time-of-Use-Rate-with-a-Fixed-Charge.

51 UCAN Direct Testimony – ERRATA, pp. 24-25.

52 SDG&E, Schedule EV-TOU-5, Cost-Based Domestic Time-of-Use For Households with Electric Vehicles, available at https://tariff.sdge.com/tm2/pdf/ELEC_ELEC-SCHEDS_EV-TOU-5.pdf.

53 *See* Advice Letter 3928-E/E-A, approved January 7, 2022 and effective January 1, 2022, SDG&E increased the Super Off-Peak distribution rate for EV-TOU-5 from $0.0000/kWh to $0.00748/kWh.

UCAN also critiqued SDG&E's bill impact analysis modeling as insufficient.[54] Since filing its Direct Testimony, SDG&E was ordered to analyze the residential customer bill impacts of switching from a natural gas water heater to HPWH.[55] SDG&E used its default residential rate for this analysis but also included an analysis using its proposed TOU-ELEC design. SDG&E has included the results herein as record evidence that TOU-ELEC creates customer bill savings when a customer increases consumption due to HPWH adoption. The study methodology and results are described in Attachment A, attached below. SDG&E's proposed design for TOU-ELEC showed bill savings under a variety of scenarios. However, bill impacts are highly dependent on individual customer choice, as well as the interaction of behavior changes that could occur with the adoption of multiple technologies.

The illustrative bill impacts shown for each customer charge tier using current TOU usage patterns as shown in SDG&E's original bill impact model allows for analysis of the impacts of a rate change only, rather than incorporating additional variables that would complicate such a review.

VI. CONCLUSION

SDG&E appreciates parties' general support of the concepts put forth in its Application for TOU-ELEC. SDG&E requests the Commission to adopt SDG&E's proposed TOU-ELEC rate design, including its fixed charge and commodity rate proposals, as the record shows that it is the most appropriate and cost-based rate design presented.

This concludes my prepared rebuttal testimony.

[54] UCAN Direct Testimony – ERRATA, p. 19-20.
[55] D.21-11-002, Ordering Paragraph 4, pp. 113-114.

Attachment A

AL3952-E/3063-G
SDG&E Submission of Net Electric and Gas Bill Impact Study
D.21-11-002

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February 7, 2022

ADVICE LETTER 3952-E/3063-G
(U902-M)

PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

SUBJECT: SAN DIEGO GAS & ELECTRIC SUBMISSION OF NET ELECTRIC AND GAS BILL IMPACT STUDY PURSUANT TO DECISION (D.)21-11-002

PURPOSE

In compliance with California Public Utilities Commission ("Commission" or "CPUC") Decision (D.)21-11-002, San Diego Gas & Electric Company (SDG&E) hereby submits this Tier 3 advice letter containing SDG&E's study on the net electric and gas bill impacts that result when a residential customer switches from a natural gas water heater to an electric heat-pump water heater (HPWH) (fuel switching), as described in more detail below.

BACKGROUND

D.21-11-002 requires the utilities[1] to study the net electric and gas bill impacts that result when a residential customer switches from a natural gas water heater to an electric HPWH (fuel switching). SDG&E is required to submit and file this study to the Commission through a Tier 3 Advice Letter (AL) within 90 days of the issuance of D.21-11-002. If a utility's study show [sic] a net increase in customers' net energy bills resulting from fuel switching, the utilities shall propose a rate adjustment for their residential customers who install electric HPWH in a new Rate Design Window (RDW) application within six months of the issuance of the decision.[2]

DISCUSSION

Pursuant to OP 4(s) of D.21-11-002, SDG&E conducted a study on the net total bill (electric and gas) impacts resulting from a residential customer switching from a natural gas water heater to an electric HPWH (fuel switching). A net bill impact of greater than $0 indicates that switching from a gas water heater to a HPWH results in higher annual energy spending. The study is included in this AL submittal as Attachment A and discussed briefly below. Bill impact summary tables are included as Attachment B.

SDG&E's bill impact results show significant variability across customer segments. There are many factors that affect whether a customer will see a net bill increase as a result of switching from a gas water heater to an electric HPWH, including but not limited to climate zone, electric

[1] Pacific Gas and Electric Company, Southern California Edison Company, and SDG&E.
[2] D.21-11-002, Ordering Paragraph (OP) 4.

rate schedule, efficiency ratings of water heater being replaced and replacement water heater, water heater size, tank water temperature, gas prices, and customer usage profile.

A. Methodology

SDG&E modeled residential customer bills before and after replacing a gas water heater with a HPWH in California Energy Commission (CEC) defined climate zones 7 and 10, which are SDG&E's "Coastal" and "Inland" climate zones.[3] To estimate standard, pre-HPWH customer electric usage, SDG&E used historical "dual-fuel"[4] residential customer data aggregated into annual kilowatt-hour (kWh) load profiles that are representative of residential electric use patterns. SDG&E selected publicly available natural gas water heater energy hourly use profiles (in therms)[5] from the CEC's Database for Energy Efficient Resources (DEER).[6] SDG&E also selected different DEER electric HPWH kWh usage profiles to add to its SDG&E-specific customer electric load profiles and represent a customer's electric load after adopting a HPWH.

SDG&E developed "before" bills using these SDG&E-specific customer load profiles, assuming the customers were taking service on SDG&E's default residential time-of-use (TOU) rate, TOU-DR1.[7] SDG&E then calculated representative bills for gas water heating using the DEER gas water heater profiles and SDG&E gas rates. An "after" electric usage profile was then developed by adding the DEER electric HPWH hourly usage to the standard pre-HPWH electric hourly usage profile. Other household gas consumption was not accounted for since the study was focused on the net bill impacts of water heater appliance replacement. Using the "new" customer usage profiles that now include the impacts of adding a HPWH, SDG&E calculated "after" bills. This process is summarized in the table below:

Table 1 – Illustrative Bill Impact Calculation

Data Point	Unit	
Existing Electric Load Profile for Dual-Fuel Customers	kWh	**(A)**
Initial Electric bill	$	**(B) = (A) * electric rate**
Natural Gas WH Load Profile	therms	**(C)**
Natural gas WH bill	$	**(D) = (C) * Gas Rate**

[3] While SDG&E has customers residing in Climate Zones 13 and 14 ("Mountain" and "Desert"), the overwhelming majority of residential customers (more than 95%) in its service territory are located in zones 7 and 10, and therefore, an analysis of Coastal and Inland climate zones represents most customers.

[4] Dual fuel, or "Basic" service customers receive both gas and electric service from SDG&E and receive the Basic daily baseline allowance amounts.

[5] One therm is equivalent to 100,000 British thermal units (BTU).

[6] DEER profiles can be found at: http://www.deeresources.com/index.php/23-deer-versions. Details of selected profiles can be found in Attachment A.

[7] https://tariff.sdge.com/tm2/pdf/ELEC_ELEC-SCHEDS_TOU-DR1.pdf

Initial WH Gas & Electric Bill	$	**(E) = (B) + (D)**
Load profile of HPWH	kWh	**(F)**
New Electric Load Profile	kWh	**(G) = (A) + (F)**
New Electric Bill	$	**(H) = (G) * Electric Rate**
Net Bill Impact	$	**(I) = (H) – (E)**

1. Inputs

a. Customer Base Electric Usage

SDG&E utilized aggregated customer load profiles from Coastal and Inland climate zones, which represent most of its residential customers. Annual electric usage of aggregated profiles ranged from 2,758 – 7,990 kWh.

b. Gas Water Heaters

SDG&E selected DEER usage profiles for 40- and 50-gallon gas water heaters with UEFs of 0.52, 0.56, 0.58, and 0.64 in Coastal and Inland climate zones. SDG&E selected these models based on market research and input from its Customer Programs department.

For scenarios selected, annual gas water heater usage ranged from 137–206 therms. Annual gas water heater bills averaged approximately $290–525.

c. HPWHs

SDG&E selected DEER usage profiles for 50- and 65-gallon HPWHs with UEFs from 3.00–3.44 in Coastal and Inland climate zones. These HPWH models are consistent with models that received up-front incentives through SDG&E's 2019-2020 Energy Efficiency Residential Plug-Load and Appliance Program budget.

For scenarios selected, tank temperature was defaulted to 135º F. At the default tank temperature and assuming customers do not program their devices to shift load outside the On-Peak TOU period, annual electric HPWH usage ranged from 1,313–1,517 kWh. Annual HPWH bills ranged from $510–690.

2. Sensitivities

To test the sensitivity of different variables, SDG&E examined the impacts of different water heaters, both gas and electric HPWH. SDG&E analyzed bill impacts for different tank sizes, water temperature settings, and Uniform Energy Factors (UEF), which are a unit of efficiency. A higher UEF means that a unit is more efficient. The HPWH usage profiles selected from the DEER database were

consistent with HPWH models eligible to receive up-front incentives through SDG&E's 2019 and 2020 Energy Efficiency programs.[8]

Certain inputs can dramatically change the results of bill impact analysis. Technological efficiency (UEF) is a critical driver of bill impacts. Replacing a lower efficiency gas water heater will yield greater bill savings than replacement of a higher efficiency gas water heater. Customer usage profiles, water tank size, water tank temperature, and load shifting can also significantly impact a customer's individual bill impacts. Lowering the tank temperature by 10 degrees reduces HPWH consumption by approximately 340-400 kWh per year, thus lowering electric bill increases from the addition of a HPWH. Programable devices and load shifting have the potential to reduce bills further.

B. Results

SDG&E sees non-uniform impacts across customer segments and scenarios that make it difficult to conclude if there is a "net increase in customers' net energy bills resulting from fuel switching", as required by D.21-11-002.[9] Under SDG&E's assumptions, bill impacts for non-CARE customers on Schedule TOU-DR1 range from small decreases to larger increases, while CARE customers on Schedule TOU-DR1 typically saw bill decreases. The savings for CARE customers on Schedule TOU-DR1 is largely driven by a difference in the CARE discount for natural gas and electric rates.[10] All customer segments saw savings under SDG&E's proposed Electrification Rate, TOU-ELEC.

Tables 2 and 3 below present the range of bill impacts under SDG&E's default residential rate, TOU-DR1, and SDG&E's proposed electrification rate, TOU-ELEC.

Table 2 – Minimum and Maximum Impacts: Schedule TOU-DR-1

Rate: TOU-DR-1, Tank Temperature: 135^0 F				
Profile	**Climate Zone**	**CARE Status**	**Minimum Bill Impact (Annual)**	**Maximum Bill Impact (Annual)**
1	Coastal	Non-Care	($4)	$208
2	Coastal	Non-Care	$24	$236
1	Coastal	CARE	($102)	($48)
2	Coastal	CARE	($92)	($38)
3	Inland	Non-Care	$0	$207
4	Inland	Non-Care	$22	$311
3	Inland	CARE	($98)	($45)
4	Inland	CARE	($91)	($38)

Table 3 – Minimum and Maximum Impacts: Proposed TOU-ELEC[11]

Rate: SDG&E Proposed TOU-ELEC

[8] A description of SDG&E's Energy Efficiency Programs Annual Report 2019 Results Plug Load and Appliance Program.

[9] D.21-11-002 at OP 4(b).

[10] Per Schedule G-CARE, gas CARE customers receive an effective discount of 20% on gas usage, but per Schedule E-CARE, electric CARE receive an effective discount of 35% on electric usage.

[11] SDG&E's proposed TOU-ELEC rate in Application (A.).21-09-001 is currently pending before the CPUC. Per D.20-03-003, TOU-ELEC is limited to customers with one or more eligible technologies. HPWHs are one of three eligible technologies.

Profile	Climate Zone	CARE Status	Minimum Bill Impact (Annual)	Maximum Bill Impact (Annual)
1	Coastal	Non-Care	($78)	($19)
2	Coastal	Non-Care	($203)	($144)
1	Coastal	CARE	($122)	($73)
2	Coastal	CARE	($207)	($158)
3	Inland	Non-Care	($77)	($20)
4	Inland	Non-Care	($188)	($130)
3	Inland	CARE	($120)	($72)
4	Inland	CARE	($195)	($147)

SDG&E also examined scenarios where customers lower the HPWH tank temperature. A lower tank temperature allows a customer to save more energy. For example, analysis showed that when a non-CARE TOU-DR1 customer reduces the temperature setting on a heat pump water heater just 10 degrees to an average of 125 customers see additional bill savings of $22-25 per year. Results from this sensitivity analysis are displayed in Table 4.

Table 4 – Minimum and Maximum Impacts:
Non-CARE, Schedule TOU-DR-1 With Lower Tank Temperature

Rate: TOU-DR-1, Tank Temperature: 125^0 F				
Profile	**Climate Zone**	**CARE Status**	**Minimum Bill Impact (Annual)**	**Maximum Bill Impact (Annual)**
1	Coastal	Non-Care	($135)	$71
2	Coastal	Non-Care	($108)	$97
3	Inland	Non-Care	($129)	($71)
4	Inland	Non-Care	($107)	($93)

Additionally, customers could realize additional bill savings by shifting HPWH usage to lower-cost TOU periods. Many HPWHs are programmable devices that allow customers to optimize usage during lower-cost TOU periods. It is reasonable to expect customers to program their devices to lower their bills when possible.

Among TOU-DR1 non-CARE customers, results vary widely and are largely dependent on inputs. While SDG&E's usage profiles are aggregated averages, an individual customer may see very different impacts based on usage patterns and other variables. SDG&E lists the input variables below in Table 5 and additional variables for consideration in Table 6.

Table 5 – Study Scenario Variables

Study Scenario Variables	Number of Scenarios
Customer Usage (Size)	2
Non-CARE/CARE Status	2
Replacement HPWH UEF	4
Replacement HPWH Tank Size	2
Replacement HPWH Tank Temperature	2
Existing Gas Water Heater UEF	4
Existing Gas Water Heater Tank Size	2
Existing Gas Water Heater Tank Temperature	1
Gas Rate above or below baseline	2

Table 6 – Additional Variables for Consideration

Additional Variables for Consideration	Directional Impact
Approval of TOU-ELEC	Decrease bill impact[12]
Programmable Devices/Load Shifting	Decrease bill impact
Gas Market Price Increases	Decrease bill impact
Gas Market Price Decreases	Increase bill impact
HPWH Technological Efficiency Improvement	Decrease bill impact

C. Conclusion

Given the variable impacts across customer segments, and that results are highly dependent on inputs and individual customer behavior, SDG&E cannot conclude that customers see a net bill increase as a result of switching from a gas water heater to an electric heat pump water heater. While some individual customers may see a bill increase from switching to an electric HPWH from a gas water heater before a theoretical rate adjustment, other individual customers would see a decrease. Any uniform HPWH rate adjustment would then discount the already-advantaged customer's bill on top of the bill decrease resulting from adoption of the HPWH.

This study is a snapshot of current bill impacts, and technological improvements or continued volatility in natural gas market prices could significantly change the results. In the scenarios where non-CARE, TOU-DR-1 customers see a net bill change closer to zero,[13] it is worth noting that these instances represent more optimal technology switching scenarios where the least efficient technologies are being replaced with the most efficient technologies.[14] SDG&E believes these optimal scenarios are the scenarios in which customers should be incentivized to replace their gas water heaters.

For example, if a theoretical rate adjustment was designed based on the bill increase that is seen when newer or more efficient gas water heaters are replaced with HPWHs, the result could be to incentivize customers to replace a water heater before it is fully depreciated and needs replacing, instead of replacing older gas water heater stock that would have been replaced anyway. Rates should incentivize customers to install the most efficient HPWHs. If customers can achieve zero net energy bill change or a small decrease by replacing the oldest, least efficient gas water heaters with the most efficient HPWHs, then creating a rate adjustment (discount) could incentivize unwanted behaviors and customers may install less efficient HPWHs.

Many unknowns remain about how customer costs will change in both the near- and long-term. SDG&E is undergoing significant load departure in 2022 and 2023, with many residential customers being defaulted to community choice aggregator (CCA) service. Thus, their costs to operate a HPWH will depend partly on the rates that their CCA provider sets. Additionally, because all scenarios saw net bill decreases or no change using SDG&E's proposed TOU-ELEC rate, SDG&E believes the final adopted TOU-ELEC design could address any bill increases across all scenarios examined in this study.

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[12] While SDG&E does not know the final rate design that will be adopted by the Commission, because TOU-ELEC requires a fixed charge in its design, and fixed charges result in lower volumetric rates, it is reasonable to assume that bill impacts on TOU-ELEC will be not be as great as TOU-DR1.

[13] Coastal profiles 1 and 2, and Inland profiles 3 and 4 when replacing a 40 gallon 0.52 UEF natural gas water heater with a 50 gallon 3.44 UEF HPWH.

[14] Most and least efficient of the profiles selected to meet other criteria of the study.

EFFECTIVE DATE

SDG&E believes this submittal is subject to Energy Division disposition and should be classified as Tier 3 (effective after Commission approval) pursuant to GO 96-B and Decision 21-11-002. SDG&E respectfully requests that this submittal be approved effective no later than March 9, 2022.

PROTEST

Anyone may protest this Advice Letter to the California Public Utilities Commission. The protest must state the grounds upon which it is based, including such items as financial and service impact, and should be submitted expeditiously. The protest must be submitted electronically and must be received by February 28, 2022, which is 21 days from the date filed. There is no restriction on who may file a protest.

The protest should be sent via e-mail to the attention of the Energy Division at EDTariffUnit@cpuc.ca.gov. A copy of the protest should also be sent via e-mail to the address shown below on the same date it is delivered to the Commission.

Attn: Greg Anderson
Regulatory Tariff Manager
E-mail: GAnderson@sdge.com
SDGETariffs@sdge.com

NOTICE

A copy of this submittal has been served on the utilities and interested parties shown on the attached list, and to service list R.19-01-011 by providing them a copy hereof either electronically or via the U.S. mail, properly stamped and addressed.

Address changes should be directed to SDG&E Tariffs by email to SDGETariffs@sdge.com.

/s/ Clay Faber

CLAY FABER
Director – Regulatory Affairs

California Public Utilities Commission

ADVICE LETTER SUMMARY

ENERGY UTILITY

MUST BE COMPLETED BY UTILITY (Attach additional pages as needed)

Company name/CPUC Utility No.: San Diego Gas & Electric (U902-M)

Utility type:
☑ ELC ☑ GAS ☐ WATER
☐ PLC ☐ HEAT

Contact Person: Norma Toothman
Phone #: 619-605-9877
E-mail: NLToothman@sdge.com
E-mail Disposition Notice to: SDGETariffs@sdge.com

EXPLANATION OF UTILITY TYPE
ELC = Electric GAS = Gas WATER = Water
PLC = Pipeline HEAT = Heat

(Date Submitted / Received Stamp by CPUC)

Advice Letter (AL) #: 3952-E/3063-G

Tier Designation: 3

Subject of AL: San Diego Gas & Electric Submission Of Net Electric And Gas Bill Impact Study Pursuant To Decision (D.)21-11-002

Keywords (choose from CPUC listing): Compliance

AL Type: ☐ Monthly ☐ Quarterly ☐ Annual ☐ One-Time ☑ Other:

If AL submitted in compliance with a Commission order, indicate relevant Decision/Resolution #: D.21-11-002

Does AL replace a withdrawn or rejected AL? If so, identify the prior AL: N/A

Summarize differences between the AL and the prior withdrawn or rejected AL: N/A

Confidential treatment requested? ☐ Yes ☑ No

If yes, specification of confidential information:
Confidential information will be made available to appropriate parties who execute a nondisclosure agreement. Name and contact information to request nondisclosure agreement/ access to confidential information:

Resolution required? ☐ Yes ☑ No

Requested effective date: 3/9/22

No. of tariff sheets: N/A

Estimated system annual revenue effect (%):

Estimated system average rate effect (%):

When rates are affected by AL, include attachment in AL showing average rate effects on customer classes (residential, small commercial, large C/I, agricultural, lighting).

Tariff schedules affected: N/A

Service affected and changes proposed[1]: N/A

Pending advice letters that revise the same tariff sheets: N/A

[1]Discuss in AL if more space is needed.

Clear Form

Protests and all other correspondence regarding this AL are due no later than 20 days after the date of this submittal, unless otherwise authorized by the Commission, and shall be sent to:

CPUC, Energy Division
Attention: Tariff Unit
505 Van Ness Avenue
San Francisco, CA 94102
Email: EDTariffUnit@cpuc.ca.gov

Name: Greg Anderson
Title:
Utility Name: San Diego Gas & Electric
Address: 8330 Century Park Court, CP32C
City: San Diego
State: California Zip: 92123
Telephone (xxx) xxx-xxxx:
Facsimile (xxx) xxx-xxxx:
Email: GAnderson@sdge.com

Name: SDG&E Tariff Department
Title:
Utility Name: San Diego Gas & Electric Company
Address: 8330 Century Park Court; CP 31D
City: San Diego
State: California Zip: 92123
Telephone (xxx) xxx-xxxx:
Facsimile (xxx) xxx-xxxx:
Email: SDGETariffs@Sdge.com

Clear Form

General Order No. 96-B
ADVICE LETTER SUBMITTAL MAILING LIST

cc: (w/enclosures)

Public Utilities Commission
CA. Public Avocates (CalPA)
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F. Oh
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M. Salinas
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SD Community Power
L. Fernandez
L. Utouh
Shute, Mihaly & Weinberger LLP
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R.19-01-011

San Diego Gas & Electric Advice Letter 3952-E/3063-G

ATTACHMENT A
SDG&E BILL IMPACT STUDY:
ADOPTION OF HEAT PUMP WATER HEATERS

I. Introduction

This study examines the net, total utility bill impacts of replacing a natural gas fueled water heater with a Heat Pump Water Heater (HPWH) for a residential customer in San Diego Gas & Electric Company's (SDG&E) service territory. The study seeks to determine whether the adoption an electric HPWH will lead to an increase in total household energy spending on an annual basis, as required by California Public Utilities Commission (CPUC or Commission) Decision (D.) 21-11-002.

This potential for a change in total energy spending is driven by both a decrease in the natural gas portion of the bill, as well as an increase in the electric portion of the bill. Importantly, it focuses on bill impacts isolated to illustrative individual customers, using current gas and electric rates and currently available technologies. SDG&E's study is a snapshot of the technologies available.

There are multiple factors that impact bill changes for an individual customer switching to a HPWH under current conditions. Because the majority of SDG&E's residential electric customers are on time-of-use (TOU) rates, and because residential gas rates are not time differentiated, customers programming their HPWHs to shift usage to less expensive time periods can impact the net change in utility bills. Further, an individual customer's decision or ability to reduce their hot water use, adjust temperature settings, or select alternative electric rate options will all influence the resulting bill impacts. The average results presented are accompanied by sensitivities that account for some of the above factors. The aggregate effect and extent to which individual customer choice influences net bill impacts is significant, and a complicating factor in developing a single rate adjustment aimed at providing operating cost parity between natural gas and HPWHs. Ultimately, the range of impacts that these inputs produce and the inability to know what choices an individual customer may make prevents any definitive conclusions that customers see a net increase in their net energy bills.

A. Regulatory Background

The Commission opened Rulemaking 19-02-011 on February 8, 2019 to examine issues related to building decarbonization. Issued on November 4, 2021, Decision (D.) 21-11-002 identified existing electric rate design as a possible barrier to the adoption of HPWHs and directed California's three electric Investor-Owned utilities (IOUs) to study the net energy bill impacts of residential customers switching from a natural gas water heater to a HPWH. If the results show a net bill increase, the IOUs were directed to propose a rate adjustment for eligible residential customers who install a HPWH.[1] This report details the methodology, assumptions and results of that study.

II. Methodology

A. Representative Customer Usage Profiles

SDG&E's methodology for determining the net energy bill impacts of replacing a natural gas water heater with a HPWH involved three types of annual energy use load profiles. Baseline electricity use profiles were developed by SDG&E by aggregating customer data by climate zone and size. SDG&E used natural gas water heater energy use profiles and electricity use profiles of HPWHs from the California Energy Commission's (CEC) Database for Energy Efficient Resources (DEER)[2] [OBJ]. There

[1] D. 21-11-002, Ordering Paragraph ("OP") 4.

[2] Home (deeresources.com)

are four climate zones as defined by the (CEC) in SDG&E's service territory; Coastal, Inland, Desert and Mountain[3] Over 95% of SDG&E's residential customers are located in Coastal and Inland climate zones. As a result, the DEER data and internal data used Coastal and Inland climate zones for analysis.

For all analysis we focused our comparisons around 4 customer profiles (Large / Small Coastal and Large / Small Inland). From there we further divided our analysis into CARE and Non-CARE customers. Large and Small refers to customers who have above or below average consumption among other customers in the same climate zone and CARE status.

SDG&E utilized aggregated representative hourly customer usage electric load profiles from dual-fuel customers based on 2019 historical data.[4] Four profiles were selected for analysis: two Coastal and two Inland. These profiles represent the pre-HPWH level of electricity consumption for customers assumed to currently have natural gas-powered water heaters, based on their status as "dual fuel".[5] A table of customer profiles with annual electric usage amounts pre-HPWH are below.

Table 1 – Annual Electric Usage Pre-HPWH

Customer Profile	Climate Zone	Annual Electric Usage (kWh)
1	Coastal	2,758
2	Coastal	7,990
3	Inland	3,045
4	Inland	7,683

B. Differing HPWH Types and Efficiencies

Uniform Energy Factor (UEF) as determined by the Department of Energy (DOE) is the newest measure of water heater overall efficiency. The higher the UEF value is, the more efficient the water heater.[6] HPHWs with a UEF range from 3.00–3.44 along with gas water heaters with UEFs ranging from 0.52–0.64 were selected based on internal data provided by SDG&E's Customer Programs department's projections as the most generalized representative models currently existing within the customer base as likely to be replaced and most likely replacement technology. HPWHs with UEFs consistent with models that received upfront incentives through SDG&E's Residential Plug-Load and Appliance Program were also included as replacement technology for comparison.[7]

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3 https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/climate-zone-tool-maps-and

4 Dual-fuel customers have both gas and electric service.

5 SDG&E does not currently collect data on the type of water heater a customer has installed.

6 https://www.energystar.gov/products/water_heaters/

7 See San Diego Gas & Electric Company Energy Efficiency Programs Annual Report 2019 Results for Statewide CALSPREE - Plug Load and Appliance program, at https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M337/K861/337861950.PDF.
The POS Rebates Program offered a $500 upfront incentive for the purchase of a HPWH to replace a non-HP electric water heater. From 2019-2021, the HPWH model that received incentives through the program had a UEF of 3.31.

C. Representative Gas Water Heater Profiles

SDG&E selected a range of 40- and 50-gallon gas water heater profiles from DEER with UEFs ranging from 0.52 to 0.64. SDG&E's analysis used the default DEER water tank temperature of 135º F for gas water heaters. As seen in Table 2, gas water heater efficiency and size can also affect a customer's starting annual gas energy usage. Different tank sizes and UEFs can result in annual usage differences of approximately 64-65 therms.[8] Attributes and DEER IDs are displayed in the table below.

Table 2 – Gas Water Heater Profiles

Climate Zone	DEER ID	Tank Size (gallons)	UEF	Annual Usage (therms)
Coastal	Stor_UEF-Gas-040gal-LW-0.52UEF	40	0.52	206
Coastal	Stor_UEF-Gas-040gal-MD-.58UEF	40	0.58	166
Coastal	Stor_UEF-Gas-040gal-HI-0.64UEF	40	0.64	141
Coastal	Stor_UEF-Gas-050gal-MD-.056UEF	50	0.56	175
Inland	Stor_UEF-Gas-040gal-LW-0.52UEF	40	0.52	201
Inland	Stor_UEF-Gas-040gal-MD-.58UEF	40	0.58	161
Inland	Stor_UEF-Gas-040gal-HI-0.64UEF	40	0.64	137
Inland	Stor_UEF-Gas-050gal-MD-.056UEF	50	0.56	171

D. Representative HPWH Profiles

SDG&E selected a range of 50- and 65-gallon HPWH profiles from DEER with UEFs ranging from 3.00 to 3.44. 50-gallon HPWHs are the smallest tank size available through the DEER model and reflect modest upsizing that can accompany technology switching to HPWHs. When switching to a HPWH, it can be beneficial to increase tank size in order to maintain hot water availability as well as take advantage of demand response or TOU based incentives.[9] Models that received upfront incentives from SDG&E between 2019 and 2021 were 45-55 gallons. For SDG&E's base analysis, SDG&E used the default DEER tank temperature of 135º F for HPWH profiles selected. However, SDG&E also tested HPWH tank temperatures of 125º F, as discussed below. As seen below in Table 3, a more efficient unit and lower tank size, with tank temperature set at 135º F, can result in lowering annual HPWH usage by approximately 200 kilowatt hours (kWh).[10] When set at 125º F, a more efficient unit and lower tank size can result in lowering usage by approximately 150 kWh/year.[11] Customers can significantly lower their annual usage by lowering the tank temperature from 135º F to 125º F. Lowering the temperature of the tank 10 degrees results in lower annual usage of 341 – 396 kWh.[12]

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8 For Coastal climate zone customers: 206 – 141 = 65 therms/year. For Inland climate zone customers: 201 – 137 = 64 therms/year.

9 Heat-Pump-Water-Heater-Buyers-Guide-Digital-Updated-2020.pdf (svcleanenergy.org) at p. 9.

10 For Coastal climate zone customers: 1,553 kWh – 1,344 kWh = 209 kWh/year. For Inland climate zone customers: 1,517 – 1,313 = 204 kwh/year.

11 For Coastal climate zone customers: 1,157 kWh – 1,003 kWh = 154 kWh/year. For Inland climate zone customers: 1,127 – 977 = 150 kwh/year.

12 SDG&E subtracted annual usage for 125º F from 135º F. The difference is additional achievable kWh conservation.

Attributes and DEER IDs are displayed in the table below.

Table 3 – HPWH Profiles

Climate Zone	DEER ID	Tank Size (gallons)	UEF	Annual Usage at 135º F (kWh)	Annual Usage at 125º F (kWh)
Coastal	Stor_UEF-ElecHP-050gal-3.09UEF	50	3.09	1,509	1,125
Coastal	Stor_UEF-ElecHP-050gal-3.31UEF	50	3.31	1,400	1,045
Coastal	Stor_UEF-ElecHP-050gal-MD-3.44UEF	50	3.44	1,344	1,003
Coastal	Stor_UEF-ElecHP-065gal-MD-3.00UEF	65	3.00	1,553	1,157
Inland	Stor_UEF-ElecHP-050gal-3.09UEF	50	3.09	1,474	1,096
Inland	Stor_UEF-ElecHP-050gal-3.31UEF	50	3.31	1,368	1,018
Inland	Stor_UEF-ElecHP-050gal-MD-3.44UEF	50	3.44	1,313	977
Inland	Stor_UEF-ElecHP-065gal-MD-3.00UEF	65	3.00	1,517	1,127

E. Calculation of Illustrative Net Bill Impacts

Illustrative bill impacts from switching from a gas water heater to a HPWH were generated using gas rates effective 1/10/2022 and electric rates effective 1/1/2022. This analysis does not account for non-water heater gas usage, so pre-HPWH bills account for standard electric usage and gas water heater usage but not gas use from other appliances. Because only the bill impacts of HPHW use are being evaluated, other gas uses are assumed to remain the same before and after switching to a HPWH and therefore not impact resulting bill impacts.

First, a standard pre-HPWH electric utility bill was calculated based on the aggregated hourly energy use profiles, which show hourly energy use in kWhover one calendar year. Electric customer bills were based on the default residential electric rate, TOU-DR-1, which has rates that vary across three daily time-of-use periods and seasons.[13] Multiplying the kWh usage in each hour by the $/kWh rate applicable to that hour and aggregating in each month generates an illustrative dollar amount for the electric portion of the bill in that month.[14]

SDG&E then calculated the amount of a customer's natural gas bill driven by only gas water heating. As described above, annual profiles showing the hourly therm consumption of water heaters in SDG&E's climate zones were downloaded from the DEER model. The same process is followed to produce a monthly dollar value for the portion of the gas bill driven by water heating using the residential natural gas rate, Schedule GR.[15] Importantly, because gas rates include a baseline and non-baseline amount, the use of a gas heater alone was not sufficient to activate above-baseline pricing. To account for this, SDG&E generated a minimum and maximum bill based on all gas water heater use falling either below or above the baseline. Or, where "minimum initial gas bill" calculates all therms at the tier 1 rate of $2.27/therm and where "maximum initial bill" calculates all therms at the

[13] https://tariff.sdge.com/tm2/pdf/ELEC_ELEC-SCHEDS_TOU-DR1.pdf
[14] Actual billing cycles do not always align with calendar months.
[15] https://tariff.sdge.com/tm2/pdf/GAS_GAS-SCHEDS_GR.pdf

tier 2 rate of $2.54/therm. This creates a range of potential initial bills. A sample output is shown below.[16]

Table 4 – Illustrative Bill Range: Combined Gas Water Heater Bill and Pre-HPWH Electric Bill

Month	Minimum Initial Bill ($/month)	Maximum Initial Bill ($/month)
January	$133.60	$137.75
February	$121.25	$124.95
March	$123.65	$128.13
April	$113.14	$117.42
May	$109.70	$113.42
June	$106.25	$109.77
July	$119.75	$123.02
August	$123.02	$126.06
September	$127.42	$130.79
October	$115.99	$119.97
November	$116.61	$120.93
December	$124.39	$127.94
Annual Bill	**$1,434.76**	**$1,480.14**

These gas water heater bill ranges provide the point of comparison used for determining if HPWH switching leads to a net change in energy spending. Because other household gas consumption is not accounted for, these values should not be used to represent total household energy spending.

Second, a new electric bill was calculated that included the additional kWh consumption associated with a HPWH. Annual kWh load profiles of HPWHs in the Inland and Coastal climate zones were downloaded from the DEER model. These are added to the annual kWh load profiles used to calculate the baseline bills described above, creating a new electric load profile with both the initial kWh and the HPWH kWh consumption in each hour of the year. Generating a new combined load profile allows the impact of above or below baseline rates to be captured in the analysis for the relevant rates. The same process from step one was then applied to these new profiles to produce monthly dollar amounts representing the electric bill that would be produced with the new level of consumption. Existing usage patterns by TOU period were applied and no load-shifting was assumed.

These steps create several values for each month: an initial electric bill, and initial gas bill, an initial total utility bill, and a new electric bill. SDG&E analyzed the results on an annual basis. Determining if there has been a net change in energy spending involves comparing the sum of the initial electric and gas bills with the new electric bill. This process and the various data points are summarized in the table below.

Table 5 – Illustrative Bill Impact Calculation

[16] Illustrative bill impacts for a Coastal, non-CARE dual-fuel customer with an annual kWh consumption of 2758 and 40 gallon, 0.58 UEF natural gas water heater using 166 therms/year.

Data Point	Unit	
Existing Electric Load Profile for Dual-Fuel Customers	kWh	**(A)**
Initial Electric bill	$	**(B) = (A) * electric rate**
Natural Gas WH Load Profile	therms	**(C)**
Natural gas WH bill	$	**(D) = (C) * Gas Rate**
Initial WH Gas & Electric Bill	$	**(E) = (B) + (D)**
Load profile of HPWH	kWh	**(F)**
New Electric Load Profile	kWh	**(G) = (A) + (F)**
New Electric Bill	$	**(H) = (G) * Electric Rate**
Net Bill Impact	$	**(I) = (H) – (E)**

A net bill impact of greater than $0 indicates that switching to a HPWH results in higher annual energy spending relative to a natural gas heater in the scenario being analyzed. This analysis was performed for the eight initial load profiles using several models of natural gas and HPWHs under the default residential electric and gas rate options. A summary of all profile selections and resulting bill impacts on an annual basis is presented in Attachment B.

III. Results

A. Overview of Results

The spectrum of possible impacts on an annual basis is shown in the tables below for the various conditions analyzed. The results show inconsistent bill impacts across customer types, months, and rate schedules. Non-CARE customers see a wide range of annual bill impacts. Under TOU-DR-1, some scenarios result in small decreases and some in larger increases. SDG&E's proposed electrification rate, TOU-ELEC, results in bill decreases for non-CARE customers as well as CARE customers. TOU-ELEC is a proposed, opt-in, untiered TOU rate with a fixed charge that would be available to residential customers with one of three electrification technologies, including HPWHs. SDG&E's proposed design has four tiers based on non-coincident peak demand and higher year-round TOU differentials between the On-Peak and Off-Peak than TOU-DR-1.[17] The addition of a fixed charge allows for lower volumetric rates, which result in savings when increasing electric load relative to rates without a fixed charge.

[17] SDG&E's proposed TOU-ELEC rate in (A.) 21-09-001 is currently pending before the CPUC. Per D.20- 03-003, TOU-ELEC is limited to customers with one or more eligible technologies. HPWHs are one of three eligible technologies.

As the default electric rate, TOU-DR-1 is the most likely rate for a residential customer to take service on. However, unlike gas rates, residential customers have a range of rate schedules to select for electric service, and different rates will yield different bill impacts.

On TOU-DR-1 the CARE discount leads to savings after switching in all scenarios. This is due to a difference in the CARE discount for natural gas and electric rates. CARE customers receive an effective 20% discount on gas service[18] and an effective 35% discount on electric service.[19] As a result, in the cases analyzed, switching from a gas to electric water heater yields a greater discount on energy expenditure related to water heating that was enough to overcome the additional kWh usage from operating a HPWH. The minimum and maximum changes seen are summarized below in Table 6. These include sensitivities around efficiency of the gas water heater and HPWH as well as above and below baseline gas rates. Table 7 include impacts of water temperature adjustments for non-CARE customers on Schedule TOU-DR1 as described in more detail below.

SDG&E has proposed an electrification rate, TOU-ELEC, that is available to residential customers with technologies identified by the CPUC as having the potential to contribute to beneficial electrification.[20] This opt-in, untiered TOU rate would be available to customers using a HPWH, among other technologies. Table 8 shows the same impacts as Table 6, except it is assumed that customers take service on SDG&E's proposed electrification rate (TOU-ELEC).

As shown in Table 8, under SDG&E's proposed electrification rate, TOU-ELEC, customers see savings relative to their bill under TOU-DR-1 after switching to a HPWH. The ability to select a new electric rate schedule, and the ability to shift load on a TOU rate should be considered alongside the bill impacts under TOU-DR-1. A proposed decision for TOU-ELEC is expected August 2022.

Table 6 – Minimum and Maximum Impacts at 135º F: Schedule TOU-DR-1

Rate: TOU-DR-1				
Profile	**Climate Zone**	**CARE Status**	**Minimum Bill Impact* (Annual)**	**Maximum Bill Impact (Annual)**
1	Coastal	Non-Care	($4)	$208
2	Coastal	Non-Care	$24	$236
1	Coastal	CARE	($102)	($48)
2	Coastal	CARE	($92)	($38)
3	Inland	Non-Care	$0	$207
4	Inland	Non-Care	$22	$311
3	Inland	CARE	($98)	($45)
4	Inland	CARE	($91)	($38)

**Maximum and minimum impacts are across all scenarios analyzed, not the maximum and minimum impact associated with a single scenario. For example, the minimum impact ($4) seen for Profile 1, Non-CARE is for replacing a 40 gallon, 0.52 UEF gas water heater with a 50 gallon 3.44 UEF HPWH, whereas the maximum impact ($208) is the result of replacing a 40 gallon 0.58 UEF gas water heater with a 50 gallon 3.09 UEF HPWH.*

[18] Per Schedule G-CARE, found at: https://tariff.sdge.com/tm2/pdf/GAS_GAS-SCHEDS_G-CARE.pdf
[19] Per Schedule E-CARE, found at: https://tariff.sdge.com/tm2/pdf/ELEC_ELEC-SCHEDS_E-CARE.pdf
[20] A.21-09-001.

Table 7 – Minimum and Maximum Impacts at 125º F: Non-CARE Schedule TOU-DR-1

Rate: TOU-DR-1				
Profile	**Climate Zone**	**CARE Status**	**Minimum Bill Impact (Annual)**	**Maximum Bill Impact (Annual)**
1	Coastal	Non-Care	($135)	$71
2	Coastal	Non-Care	($108)	$97
3	Inland	Non-Care	($129)	($71)
4	Inland	Non-Care	($107)	($93)

Table 8 – Minimum and Maximum Impacts at 135º F: TOU-ELEC

Rate: TOU-ELEC				
Profile	**Climate Zone**	**CARE Status**	**Minimum Bill Impact (Annual)**	**Maximum Bill Impact (Annual)**
1	Coastal	Non-Care	($78)	($19)
2	Coastal	Non-Care	($203)	($144)
1	Coastal	CARE	($122)	($73)
2	Coastal	CARE	($207)	($158)
3	Inland	Non-Care	($77)	($20)
4	Inland	Non-Care	($188)	($130)
3	Inland	CARE	($120)	($72)
4	Inland	CARE	($195)	($147)

B. Inputs Affecting Results

As seen above, even when limiting the sensitives analyzed to above- and below-baseline gas rates and technological efficiency, the bill impacts are varied. There are a variety of additional factors that affect whether a customer sees a net bill increase. Some of these, such as the ability or willingness to take advantage of demand response programs or load shifting to maximize savings will be dependent on individual customer preferences. Others involve more widespread market changes. Together, these factors complicate the ability to draw conclusions about the bill impacts of HPWH adoption, particularly in the longer term.

Table 9 – Study Scenario Variables

Study Scenario Variables	Number of Scenarios
Customer Usage (Size)	2
Non-CARE/CARE status	2
Replacement HPWH UEF	4
Replacement HPWH Tank Size	2
Replacement HPWH Tank Temperature	2
Existing Gas Water Heater UEF	4
Existing Gas Water Heater Tank Size	2

Existing Gas Water Heater Tank Temperature	1
Gas Rate above or below baseline	2

Additional Variables to Consider	Directional Impact
Approval of TOU-ELEC	Decrease bill impact[21]
Programmable Devices/Load Shifting	Decrease bill impact
Gas Market Price Increases	Decrease bill impact
Gas Market Price Decreases	Increase bill impact
HPWH Technological Efficiency Improvement	Decrease bill impact

1. Technological Efficiency

Technological efficiency is a critical driver of the bill impacts seen, both for the gas water heater being replaced and the HPWH that is replacing it. The scenarios below show the change in annual bill impacts for the same customer types, and same HPWH with different efficiencies for the natural gas heater being replaced. When replacing a lower efficiency (0.52 UEF) natural gas water heater, there are savings on an annual basis. However, if the customer starts with a higher efficiency gas water heater (0.64), there is a bill increase.

While replacing the lower efficiency gas heater with the highest efficiency HPWH represents a specific circumstance that may not be relevant to all customers replacing gas water heaters, it is important to note that this is an optimal scenario for technology switching. Ideally, older and less efficient technologies are fully depreciated before being replaced with the most efficient systems. In these scenarios, annual net bill increases that remain are much more moderate. The highlighted scenarios in Table 10 display these cases.

Table 10: Coastal Customers, TOU-DR1 Bill Impact Summary

Climate Zone: Coastal, Rate: TOU-DR-1[22]									
Profile	Electric Consumption pre-HPWH (kWh)	Electric Consumption with HPWH (kWh)	Gas Tank Size (Gallons)	Gas UEF	HPWH Tank Size (Gallons)	HPWH UEF	Annual Utility Bill Range Gas WH, no HPWH	New Annual Electric Bill	Annual Utility Bill Change ($)
1	2,758	4,101	40	0.64	50	3.44	$1,377 - $1,416	$1,579	$163 - $202
1	2,758	4,101	50	0.56	50	3.44	$1,456 - $1,504	$1,579	$75 - $123
1	2,758	4,101	40	0.52	50	3.44	$1,527 - $1,583	$1,579	$(4) - $53
2	7,990	9,334	40	0.64	50	3.44	$3,388 - $3,426	$3,617	$191 - $230
2	7,990	9,334	40	0.52	50	3.44	$3,537 - $3,593	$3,617	$24 - $80

[21] While SDG&E does not know the final rate design that will be adopted by the Commission, because TOU-ELEC requires a fixed charge in its design, and fixed charges result in lower volumetric rates, it is reasonable to assume that any bill increases on TOU-DR1 will be lower on TOU-ELEC.

[22] Assumes a 135º F tank temperature.

2. Gas price changes

Residential natural gas rates have historically been lower than residential electric rates in California. This difference in end use prices is what drives the increase seen for TOU-DR-1, Non-CARE customers in this analysis. However, this relationship is not fixed. Residential gas rates have increased from $1.81/therm for baseline rates in January 2021 to $2.27/therm for baselines rates in January 2022 in SDG&E's service territory.[23] Volatility in natural gas markets, increased electrification, and other external factors and policy decisions all have the potential to increase or decrease natural gas prices.[24]

3. Load Shifting and Temperature Adjustment

The ability to program HPWH to take advantage alternative rate schedules and to shift load under electric rates creates a greater range of potential impacts that are dependent on individual customer behavior. If a customer were able to shift more of their water heater energy usage to Off-Peak or even Super Off-Peak hours, the potential for yearly bill savings increases. With the inclusion of smart technology embedded within some HPWHs, the ease with which a customer would be able set their unit to heat during optimal TOU hours and shut down during more expensive periods makes the potential for savings more accessible and likely.[25]

While we are not including specific program results in this study, a potential for further reduction in bill impact when switching to an electric HPWH comes from the customers ability to adjust the positioning of their unit within their home. Since heat pump water heaters get their heat from the air around them, optimal spacing in one's home can create additional energy efficiencies.[26]

Finally, temperature settings on HPWHs significantly affect the results of this study. Lowering the tank temperature by just 10º F drastically changes the results of the bill impacts, as shown in Tables 6 and 7.

IV. Conclusion

This analysis is focused on the estimated total utility bill impacts a bundled customer in SDG&E's service territory would see today when replacing a traditional water heater with a HPWH. Because there is so much variability in the gas water heater and HPWH technology, customer usage profiles, tank sizes, and tank temperatures, among other factors, SDG&E cannot conclude that there is a net increase in customers' net energy bills as a result of fuel switching.

Many unknowns remain about how customer costs will change in both the near and long term. In the near term, many of SDG&E's residential customers will be defaulted to CCA service in 2022 and 2023 and thus their costs to operate a HPWH will depend in part on the commodity rates set by their

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[23] https://www.sdge.com/rates-and-regulations/historical-tariffs

[24] Short-Term Energy Outlook - U.S. Energy Information Administration (EIA), at: https://www.eia.gov/outlooks/steo/report/winterfuels.php

[25] https://www.svcleanenergy.org/wp-content/uploads/2019/07/Heat-Pump-Water-Heater-Buyers-Guide-June-2019.pdf

[26] https://www.efficiencymaine.com/docs/EM_HPWH_User_Tips.pdf

CCA. Additionally, 2021 saw a marked increase in residential gas prices.[27] Future gas prices increases could lead to higher operational costs for traditional water heaters and reduce the operational costs associated with switching. Longer term, advancements in HPWH technology may further increase their efficiency or programmability, leading to a reduction in associated electricity use. A rate adjustment designed for certain non-CARE customers, as seen today, may not be accurate in the context of the above-described market changes.

[27] https://www.sdge.com/rates-and-regulations/historical-tariffs.

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ATTACHMENT B
HEAT PUMP WATER HEATERS STUDY

Coastal (Climate zone 7) TOU-DR-1; CARE Temperature set to 135 degrees					(A)	(B) =(A) * Electric Rate	(C) = Therms * gas rate	(D) = (B) + (C)	(E)	(F) =[(A) + (E)] * Electric Rate	(G) = (F) – (D)
Customer Profile	**Gas Tank Size (Gallons)**	**Gas UEF**	**HPWH Tank Size (Gallons)**	**HPWH UEF**	**Electric Consumption pre-HPWH (kWh)**	**Pre-Adoption Electric Bill**	**Gas Water Heater Bill (Annual)**	**Annual Utility Bill Range Gas WH, no HPWH**	**Electric Consumption with HPWH (kWh)**	**New Annual Electric Bill**	**Annual Utility Bill Change ($)**
1	40	0.58	50	3.09	2758	$464	$301 - $337	$765 - $801	4266	$717	($84) - ($48)
2	40	0.58	50	3.09	7990	$1,343	$301 - $337	$1,644 - $1,680	9498	$1,606	($74) - ($38)
1	50	0.56	65	3.00	2758	$464	$318 - $356	$782 - $820	4311	$725	($96) - ($57)
2	50	0.56	65	3.00	7990	$1,343	$318 - $356	$1,661 - 1,700	9543	$1,614	($86) - ($47)
1	40	0.58	50	3.31	2758	$464	$301 - $337	$765 - $801	4158	$699	($102) - ($66)
2	40	0.58	50	3.31	7990	$1,343	$301 - $337	$1,644 - $1,680	9390	$1,588	($92) - ($56)

Coastal (Climate zone 7) TOU-DR1; Non-CARE Temperature set to 135 degrees					(A)	(B) =(A) * Electric Rate	(C) = Therms * gas rate	(D) = (B) + (C)	(E)	(F) =[(A) + (E)] * Electric Rate	(G) = (F) – (D)
Customer Profile	**Gas Tank Size (Gallons)**	**Gas UEF**	**HPWH Tank Size (Gallons)**	**HPWH UEF**	**Electric Consumption pre-HPWH (kWh)**	**Pre-Adoption Electric Bill**	**Gas Water Heater Bill (Annual)**	**Annual Utility Bill Range Gas WH, no HPWH**	**Electric Consumption with HPWH (kWh)**	**New Annual Electric Bill**	**Annual Utility Bill Change ($)**
1	40	0.58	50	3.09	2758	$1,059	$376 - $421	$1,435 - $1,480	4266	$1,643	$163 - $208
2	40	0.58	50	3.09	7990	$3,069	$376 - $421	$3,445 - $3,490	9498	$3,681	$191 - $236
1	50	0.56	65	3.00	2758	$1,059	$398 - $446	$1,456 - $1,504	4311	$1,660	$156 - $204
2	50	0.56	65	3.00	7990	$3,069	$398 - $446	$3,466 - $3,514	9543	$3,698	$184 - $232
1	40	0.58	50	3.31	2758	$1,059	$376 - $421	$1,435 - $1,480	4158	$1,601	$121 - $166
2	40	0.58	50	3.31	7990	$3,069	$376 - $421	$3,445 - $3,490	9390	$3,639	$149 - $194
1	40	0.64	50	3.44	2758	$1,059	$319 - $357	$1,377 - $1,416	4101	$1,579	$163 - $202
2	40	0.64	50	3.44	7990	$3,069	$319 - $357	$3,388 - $3,426	9334	$3,617	$191 - $230
1	40	0.52	50	3.44	2758	$1,059	$468 - $524	$1,527 - $1,583	4101	$1,579	($4) - $53
2	40	0.52	50	3.44	7990	$3,069	$468 - $524	$3,537 - $3,593	9334	$3,617	$24 - $80

Inland (Climate zone 10) TOU-DR1; CARE Temperature set to 135 degrees					(A)	(B) =(A) * Electric Rate	(C) = Therms * gas rate	(D) = (B) + (C)	(E)	(F) =[(A) + (E)] * Electric Rate	(G) = (F) – (D)
Customer Profile	**Gas Tank Size (Gallons)**	**Gas UEF**	**HPWH Tank Size (Gallons)**	**HPWH UEF**	**Electric Consumption pre-HPWH (kWh)**	**Pre-Adoption Electric Bill**	**Gas Water Heater Bill (Annual)**	**Electric Consumption with HPWH (kWh)**	**Annual Utility Bill Range Gas WH, no HPWH**	**New Annual Electric Bill**	**Annual Utility Bill Change ($)**
3	40	0.58	50	3.09	3045	$513	$293 - $328	4519	$806 - $842	$761	($80) - ($45)
4	40	0.58	50	3.09	7683	$1,296	$293 - $328	9157	$1,589 - $1,625	$1,551	($73) - ($38)
3	50	0.56	65	3.00	3045	$513	$309 - $347	4562	$823 - $860	$769	($92) - ($55)
4	50	0.56	65	3.00	7683	$1,296	$309 - $347	9200	$1,606- $1,643	$1,556	($85) - ($47)
3	40	0.58	50	3.31	3045	$513	$293 - $328	4413	$806 - $842	$744	($98) – ($63)
4	40	0.58	50	3.31	7683	$1,296	$293 - $328	9051	$1,589 - $1,625	$1,534	($91) – ($56)

Inland (Climate zone 10) TOU-DR1; Non-CARE Temperature set to 135 degrees					(A)	(B) =(A) * Electric Rate	(C) = Therms * gas rate	(D) = (B) + (C)	(E)	(F) =[(A) + (E)] * Electric Rate	(G) = (F) – (D)
Customer Profile	**Gas Tank Size (Gallons)**	**Gas UEF**	**HPWH Tank Size (Gallons)**	**HPWH UEF**	**Electric Consumption pre-HPWH (kWh)**	**Pre-Adoption Electric Bill**	**Gas Water Heater Bill (Annual)**	**Annual Utility Bill Range Gas WH, no HPWH**	**Electric Consumption with HPWH (kWh)**	**New Annual Electric Bill**	**Annual Utility Bill Change ($)**
3	40	0.58	50	3.09	3045	$1,170	$366 - $410	$1,537 - $1,581	4519	$1,742	$162 - $206
4	40	0.58	50	3.09	7683	$2,957	$366 - $410	$3,323 - $3,368	9157	$3,552	$185 - $229
3	50	0.56	65	3.00	3045	$1,170	$387 - $434	$1,557 - $1,604	4562	$1,759	$155 - $201
4	50	0.56	65	3.00	7683	$2,957	$387 - $434	$3,344 - $3,391	9200	$3,569	$178 - $224
3	40	0.58	50	3.31	3045	$1,170	$366 - $410	$1,537 - $1,581	4413	$1,702	$121 - $165
4	40	0.58	50	3.31	7683	$2,957	$366 - $410	$3,323 - $3,368	9051	$3,511	$144 - $188
3	40	0.64	50	3.44	3045	$1,170	$311 - $348	$1,481 - $1,518	4358	$1,681	$162 - $200
4	40	0.64	50	3.44	7683	$2,957	$311 - $348	$3,268 - $3,305	8996	$3,490	$185 - $222
3	40	0.52	50	3.44	3045	$1,170	$456 - $511	$1,626 - $1,681	4358	$1,681	$0 - $55
4	40	0.52	50	3.44	7683	$2,957	$456 - $511	$3,413 - $3,468	8996	$3,490	$22 - $77

Coastal (Climate zone 7) TOU-DR1; Non-CARE (50% Load Shifting On-Peak to Off-Peak) Temperature set to 135 degrees					(A)	(B) =(A) * Electric Rate	(C) = Therms * gas rate	(D) = (B) + (C)	(E)	(F) =[(A) + (E)] * Electric Rate	(G) = (F) – (D)
Customer Profile	**Gas Tank Size (Gallons)**	**Gas UEF**	**HPWH Tank Size (Gallons)**	**HPWH UEF**	**Electric Consumption pre-HPWH (kWh)**	**Pre-Adoption Electric Bill**	**Gas Water Heater Bill (Annual)**	**Annual Utility Bill Range Gas WH, no HPWH**	**Electric Consumption with HPWH (kWh)**	**New Annual Electric Bill**	**Annual Utility Bill Change ($)**
1	40	0.58	50	3.09	2758	$1,059	$376 - $421	$1,435 - $1,480	4266	$1,616	$136 - $181
2	40	0.58	50	3.09	7990	$3,069	$376 - $421	$3,445 - $3,490	9498	$3,660	$170 - $216
1	50	0.56	65	3.00	2758	$1,059	$398 - $446	$1,456 - $1,504	4311	$1,632	$128 - $176
2	50	0.56	65	3.00	7990	$3,069	$398 - $446	$3,466 - $3,514	9543	$3,677	$163 - $211

Inland (Climate zone 10) TOU-DR1; Non-CARE (50% Load Shifting On-Peak to Off-Peak) Temperature set to 135 degrees					(A)	(B) =(A) * Electric Rate	(C) = Therms * gas rate	(D) = (B) + (C)	(E)	(F) =[(A) + (E)] * Electric Rate	(G) = (F) – (D)
Customer Profile	**Gas Tank Size (Gallons)**	**Gas UEF**	**HPWH Tank Size (Gallons)**	**HPWH UEF**	**Electric Consumption pre-HPWH (kWh)**	**Pre-Adoption Electric Bill**	**Gas Water Heater Bill (Annual)**	**Annual Utility Bill Range Gas WH, no HPWH**	**Electric Consumption with HPWH (kWh)**	**New Annual Electric Bill**	**Annual Utility Bill Change ($)**
3	40	0.58	50	3.09	3045	$1,170	$366 - $410	$1,537 - $1,581	4519	$1,718	$137 - $181
4	40	0.58	50	3.09	7683	$2,957	$366 - $410	$3,323 - $3,368	9157	$3,532	$165 - $209
3	50	0.56	65	3.00	3045	$1,170	$387 - $434	$1,557 - $1,604	4562	$1,734	$129 - $176
4	50	0.56	65	3.00	7683	$2,957	$387 - $434	$3,344 - $3,391	9200	$3,549	$157 - $204

Coastal (Climate zone 7) TOU-ELEC*; CARE Temperature set to 135 degrees					(A)	(B) =(A) * Electric Rate	(C) = Therms * gas rate	(D) = (B) + (C)	(E)	(F) =[(A) + (E)] * Electric Rate	(G) = (F) – (D)
Customer Profile	**Gas Tank Size (Gallons)**	**Gas UEF**	**HPWH Tank Size (Gallons)**	**HPWH UEF**	**Electric Consumption pre-HPWH (kWh)**	**Pre-Adoption Electric Bill**	**Gas Water Heater Bill (Annual)**	**Annual Utility Bill Range Gas WH, no HPWH**	**Electric Consumption with HPWH (kWh)**	**New Annual Electric Bill**	**Annual Utility Bill Change ($)**
1	40	0.58	50	3.09	2758	$620	$301 - $337	$992 - $958	4158	$848	($109) - ($73)
2	40	0.58	50	3.09	7990	$1,713	$301 - $337	$2,014 - $2,050	9390	$1,856	($158) - ($194)
1	50	0.56	65	3.00	2758	$620	$318 - $356	$939 - $977	4311	$855	($122) - ($83)
2	50	0.56	65	3.00	7990	$1,713	$318 - $356	$2031 - $2070	9543	$1,863	($207) - ($169)

Coastal (Climate zone 7) TOU-ELEC*; Non-CARE Temperature set to 135 degrees					(A)	(B) =(A) * Electric Rate	(C) = Therms * gas rate	(D) = (B) + (C)	(E)	(F) =[(A) + (E)] * Electric Rate	(G) = (F) – (D)
Customer Profile	**Gas Tank Size (Gallons)**	**Gas UEF**	**HPWH Tank Size (Gallons)**	**HPWH UEF**	**Electric Consumption pre-HPWH (kWh)**	**Pre-Adoption Electric Bill**	**Gas Water Heater Bill (Annual)**	**Annual Utility Bill Range Gas WH, no HPWH**	**Electric Consumption with HPWH (kWh)**	**New Annual Electric Bill**	**Annual Utility Bill Change ($)**
1	40	0.58	50	3.09	2758	$1,044	$376 - $421	$1,420 - $1,466	4266	$1,401	($64) - ($19)
2	40	0.58	50	3.09	7990	$2,855	$376 - $421	$3,231 - $3,277	9498	$3,087	($189) - ($144)
1	50	0.56	65	3.00	2758	$1,044	$398 - $446	$1442 - $1490	4311	$1,412	($78) - ($30)
2	50	0.56	65	3.00	7990	$2,855	$398 - $446	$3253 - $3301	9543	$3,098	($203) - ($155)

Inland (Climate zone 10) TOU-ELEC*; CARE Temperature set to 135 degrees					(A)	(B) =(A) * Electric Rate	(C) = Therms * gas rate	(D) = (B) + (C)	(E)	(F) =[(A) + (E)] * Electric Rate	(G) = (F) – (D)
Customer Profile	**Gas Tank Size (Gallons)**	**Gas UEF**	**HPWH Tank Size (Gallons)**	**HPWH UEF**	**Electric Consumption pre-HPWH (kWh)**	**Pre-Adoption Electric Bill**	**Gas Water Heater Bill (Annual)**	**Annual Utility Bill Range Gas WH, no HPWH**	**Electric Consumption with HPWH (kWh)**	**New Annual Electric Bill**	**Annual Utility Bill Change**
3	40	0.58	50	3.09	3045	$669	$293 - $328	$962 - $998	4519	$890	($72) - ($108)
4	40	0.58	50	3.09	7683	$1,671	$293 - $328	$1,964 - $1,999	9157	$1,817	($182) - ($147)
3	50	0.56	65	3.00	3045	$669	$310 - $347	$979 - $1,016	4562	$896	($120) - ($83)
4	50	0.56	65	3.00	7683	$1,671	$310 - $347	$1980 - $2017	9200	$1,823	($195) - ($157)

Inland (Climate zone 10) TOU-ELEC*; Non-CARE Temperature set to 135 degrees					(A)	(B) =(A) * Electric Rate	(C) = Therms * gas rate	(D) = (B) + (C)	(E)	(F) =[(A) + (E)] * Electric Rate	(G) = (F) – (D)
Customer Profile	**Gas Tank Size (Gallons)**	**Gas UEF**	**HPWH Tank Size (Gallons)**	**HPWH UEF**	**Electric Consumption pre-HPWH (kWh)**	**Pre-Adoption Electric Bill**	**Gas Water Heater Bill (Annual)**	**Annual Utility Bill Range Gas WH, no HPWH**	**Electric Consumption with HPWH (kWh)**	**New Annual Electric Bill**	**Annual Utility Bill Change**
3	40	0.58	50	3.09	3045	$1,120	$366 - $410	$1,4862 - $1,531	4519	$1,466	($64) - ($20)
4	40	0.58	50	3.09	7683	$2,788	$366 - $410	$3,155 - $3,199	9157	$3,025	($174) - ($130)
3	50	0.56	65	3.00	3045	$1,120	$387 - $434	$1507 - $1554	4562	$1,477	($77) - ($31)
4	50	0.56	65	3.00	7683	$2,788	$387 - $434	$3175 - $3222	9200	$3,035	($188) - ($141)

Coastal (Climate zone 7) TOU-DR1; Non-CARE Temperature set to 125 degrees					(A)	(B) =(A) * Electric Rate	(C) = Therms * gas rate	(D) = (B) + (C)	(E)	(F) =[(A) + (E)] * Electric Rate	(G) = (F) – (D)
Customer Profile	**Gas Tank Size (Gallons)**	**Gas UEF**	**HPWH Tank Size (Gallons)**	**HPWH UEF**	**Electric Consumption pre-HPWH**	**Pre-Adoption Electric Bill**	**Gas Water Heater Bill (Annual)**	**Annual Utility Bill Range Gas WH, no HPWH**	**Electric Consumption with HPWH**	**New Annual Electric Bill**	**Annual Utility Bill Change**
1	40	0.58	50	3.09	2758	$1,059	$376 - $421	$1,435 - $1,480	3882	$1,495	$15 - $60
2	40	0.58	50	3.09	7990	$3,069	$376 - $421	$3,445 - $3,490	9115	$3,532	$42 - $87
1	50	0.56	65	3.00	2758	$1,059	$398 - $446	$1,456 - $1,504	3914	$1,507	$3 - $51
2	50	0.56	65	3.00	7990	$3,069	$398 - $446	$3,466 - $3,514	9146	$3,544	$30 - $78
1	40	0.58	50	3.31	2758	$1,059	$376 - $421	$1,435 - $1,480	3802	$1,464	($16) - $29
2	40	0.58	50	3.31	7990	$3,069	$376 - $421	$3,445 - $3,490	9035	$3,501	$11 - $56
1	40	0.64	50	3.44	2758	$1,059	$319 - $357	$1,377 - $1,416	3761	$1,448	$32 - $71
2	40	0.64	50	3.44	7990	$3,069	$319 - $357	$3,388 - $3,426	8993	$3,485	$59 - $97
1	40	0.52	50	3.44	2758	$1,059	$468 - $524	$1,527 - $1,583	3761	$1,448	($135) - ($79)
2	40	0.52	50	3.44	7990	$3,069	$468 - $524	$3,537 - $3,593	8993	$3,485	($108) - ($52)

Inland (Climate zone 10) TOU-DR1; Non-CARE Temperature set to 125 degrees					(A)	(B) =(A) * Electric Rate	(C) = Therms * gas rate	(D) = (B) + (C)	(E)	(F) =[(A) + (E)] * Electric Rate	(G) = (F) – (D)
Customer Profile	**Gas Tank Size (Gallons)**	**Gas UEF**	**HPWH Tank Size (Gallons)**	**HPWH UEF**	**Electric Consumption pre-HPWH**	**Pre-Adoption Electric Bill**	**Gas Water Heater Bill (Annual)**	**Annual Utility Bill Range Gas WH, no HPWH**	**Electric Consumption with HPWH**	**New Annual Electric Bill**	**Annual Utility Bill Change**
3	40	0.58	50	3.09	3045	$1,170	$366 - $410	$1,537 - $1,581	4141	$1,597	$17 - $61
4	40	0.58	50	3.09	7683	$2,957	$366 - $410	$3,323 - $3,368	8779	$3,406	$39 - $83
3	50	0.56	65	3.00	3045	$1,170	$387 - $434	$1,557 - $1,604	4172	$1,609	$5 - $52
4	50	0.56	65	3.00	7683	$2,957	$387 - $434	$3,344 - $3,391	8810	$3,418	$27 - $74
3	40	0.58	50	3.31	3045	$1,170	$366 - $410	$1,537 - $1,581	4063	$1,568	($13) - $31
4	40	0.58	50	3.31	7683	$2,957	$366 - $410	$3,323 - $3,368	8701	$3,376	$8 - $53
3	40	0.64	50	3.44	3045	$1,170	$311 - $348	$1,481 - $1,518	4022	$1,552	$34 - $71
4	40	0.64	50	3.44	7683	$2,957	$311 - $348	$3,268 - $3,305	8660	$3,360	$55 - $93
3	40	0.52	50	3.44	3045	$1,170	$456 - $511	$1,626 - $1,681	4022	$1,552	($129) - ($74)
4	40	0.52	50	3.44	7683	$2,957	$456 - $511	$3,413 - $3,468	8660	$3,360	($107) - ($52)

*TOU-ELEC kW fixed charge ranges as proposed in A.21-09-001. Actual fixed charges would depend on individual customer profile demand.