Rulemaking 12-06-013
Exhibit No.
Witness: Paul Chernick

**BEFORE THE PUBLIC UTILITIES COMMISSION**
**OF THE STATE OF CALIFORNIA**

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|---|---|
| Order Instituting Rulemaking on the Commission's Own Motion to Conduct a Comprehensive Examination of Investor Owned Electric Utilities' Residential Rate Structures, the Transition to Time Varying and Dynamic Rates, and Other Statutory Obligations. | Rulemaking 12-06-013<br>(Filed June 21, 2012) |

# DIRECT TESTIMONY OF PAUL CHERNICK ON BEHALF OF THE NATURAL RESOURCES DEFENSE COUNCIL

September 15, 2014

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## I. Identification and Qualifications

**Q: Mr. Chernick, please state your name, occupation and business address.**

A: I am Paul L. Chernick. I am the president of Resource Insight, Inc., 5 Water Street, Arlington, Massachusetts.

**Q: Summarize your professional education and experience.**

A: I received an SB degree from the Massachusetts Institute of Technology in June 1974 from the Civil Engineering Department, and an SM degree from the Massachusetts Institute of Technology in February 1978 in technology and policy. I have been elected to membership in the civil engineering honorary society Chi Epsilon, and the engineering honor society Tau Beta Pi, and to associate membership in the research honorary society Sigma Xi.

I was a utility analyst for the Massachusetts Attorney General for more than three years, and was involved in numerous aspects of utility rate design, costing, load forecasting, and the evaluation of power supply options. Since 1981, I have been a consultant in utility regulation and planning, first as a research associate at Analysis and Inference, after 1986 as president of PLC, Inc., and in my current position at Resource Insight. In these capacities, I have advised a variety of clients on utility matters.

My work has considered, among other things, the cost-effectiveness of prospective new generation plants and transmission lines, retrospective review of generation-planning decisions, ratemaking for plant under construction, ratemaking for excess and/or uneconomical plant entering service, conservation program design, cost recovery for utility efficiency programs, the valuation of environmental externalities from energy production and use, allocation of costs of service between rate classes and jurisdictions, design of retail and wholesale rates, and performance-based ratemaking and cost recovery in restructured gas and electric industries. My professional qualifications are further described in **Error! Reference source not found.**.

**Q: Have you testified previously in utility proceedings?**

A: Yes. I have testified more than two hundred and eighty times on utility issues before various regulatory, legislative, and judicial bodies, including utility regulators in thirty-three states, six Canadian provinces, and two U.S. Federal agencies.

## II. Introduction

**Q: On whose behalf are you testifying in this rate case proceeding?**

A: My testimony is sponsored by the Natural Resources Defense Council.

**Q: What issues does your testimony address?**

A: My testimony discusses the benefits of tiered residential rates, in which energy rates increase with usage, especially in terms of improved conservation incentives and the extensive literature that indicates that consumers respond to the marginal utility prices they face. My testimony primarily deals with the costs, bill-frequency data, and proposals of Pacific Gas & Electric (PG&E) and Southern California Edison (SCE), although I occasionally reference the filings of San Diego Gas & Electric (SDG&E).

I explain the errors in PG&E's estimation of the effects of tiered rates and construct sample simplified three-tier rates for PG&E and SCE. I estimate the increased conservation incentives of those sample rates compared to entirely flat rates or the nearly flat rates proposed by the utilities. I also discuss briefly options for improving the communication to consumers of the operation and incentives of tiered rates.

Finally, I explain why the utility emphasis on increasing fixed charges is over-stated and inappropriate, including an explanation of how fixed charges reduce conservation incentives, a discussion of the narrow range of costs that might reasonably be reflected in a fixed charge, and an explanation of the superiority of minimum bills over fixed charges.

**Q: To which previous filings do you respond?**

A: Most of my testimony responds to the following two documents:

- Long-Term Residential Electric Rate Design Reform Proposal: Phase 1 Prepared Testimony. Dennis M. Keane, Philip J. Quadrini and Karen J. Zelmar. Pacific Gas and Electric Company, February 28, 2014 (PG&E Proposal).
- Phase One Rate Change Proposal of Southern California Edison Company (U-338-E) For Post-2014 Residential Rates. February 28, 2014 (SCE Proposal).

**Q: What Commission rulings and filings are particularly relevant to your testimony?**

A: I refer to the following documents:

- Energy Division Staff Proposal on Residential Rate Reform in Compliance with R.12-06-013 and Assembly Bill 327. January 3, 2014 (Staff Proposal on Residential Rate Reform).
- Scoping Memo and Ruling of Assigned Commissioner. November 26, 2012 (Principles of Optimal Residential Rate Design).
- Assigned Commissioner's Ruling Requiring Utilities to Submit Phase 1 Rate Change Proposals. February 13, 2013 (TOU Scoping Order).

**Q: Please summarize your recommendations.**

A: I recommend that the Commission mandate three-tier residential tariffs generally as follows:

1. The baseline tier, to about half of average group use.
2. The second tier, between the baseline and roughly average usage, priced 30–40% higher than the baseline tier.
3. The third tier, for all additional usage, priced about 40% higher than the second tier and roughly twice the baseline price.

I recommend that the utilities adopt focused communication strategies, both generic and personalized, to maximize customer understanding that the tiered rate increases the benefits of conservation and energy-efficiency.

Finally, I recommend that the Commission not include fixed charges in the residential rates. If the Commission is inclined to require some contribution by every customer every month to some costs driven by the number of customers, a minimum charge would achieve that goal more efficiently than a fixed monthly charge. In any case, the fixed costs driven by the number of customers on the system, even for very small customers, would be much smaller than the values suggested by the utilities.

## III. The Rationale for Tiered Rates

**Q: What is the purpose of charging for electricity using increasing tiered rates?**

A: The major purposes of a tiered rate design are to accomplish the following, under a revenue-requirements constraint:

- encourage and reward customer conservation;
- reinforce existing incentives for customer conservation;
- concentrate conservation incentives on the larger customers with more end uses and greater energy usage, who are likely to have more opportunities to conserve than smaller customers;

- reflect the likely tendency for larger customers, with more weather-sensitive load, to impose higher costs per kWh on the system;[1]
- provide savings to customers who are able and willing to keep their usage low;
- decrease the payback period for energy efficiency and distributed generation investment by customers.

### *A. Tiered Rates and Conservation Incentives*

**Q: How does a tiered rate design increase conservation incentives?**

A: The customers whose consumption includes at least some usage in a tier priced higher than the average rate will have a higher incentive to conserve, and that incentive applies to all the customer's consumption, not just the kilowatt-hours in the higher tiers.

Only the customer's highest tier affects the incentive to conserve. While smaller-use customers see lower marginal rates, and thus have weaker incentive to conserve, their low usage results in the weak conservation incentive applying to a relatively small amount of energy. In addition, these smaller-use customers may already be relatively efficient in their use of electricity.

This reality is best explained through an example. Table 1 shows two rate designs that generate the same total revenue. The flat rate charges 16¢/kWh for all energy, while the tiered rate charges 10¢/kWh for the first 600 kWh per month and 24¢/kWh for additional kWh. The average bill is 600 kWh/month. Of the 200,000

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[1] Larger summer PG&E and SDG&E customers tend to use a greater percentage of their energy in the 2–6 PM on-peak period and tend to have lower coincident-peak load factors (Marcus, Ruszovan, and Nahigian at 33–38; works cited in my testimony are listed in **Error! Reference source not found.**). I am not aware of a comparable analysis for SCE.

customers, 125,000 use less than 600 kWh/month, with an average of 300 kWh, and the remaining 75,000 use an average of 1,100 kWh/month.

**Table 1: Simple Tiered-Rate Example**

| Usage | Tier | Price | Customers | Average Use kWh/month | Total Use GWh/year |
|---|---|---|---|---|---|
| *Flat Rate* | | | | | |
| Total | | $0.16 | 200,000 | 600 | 1,440 |
| *Inclining Block Rate* | | | | | |
| 600 | 1st | $0.10 | 125,000 | 300 | 450 |
| >600 | 1st | $0.10 | 75,000 | 600 | 540 |
| | 2nd | $0.24 | 75,000 | 500 | 450 |
| | sum | | | 1,100 | 990 |
| Total | | | 200,000 | 600 | 1,440 |

With the tiered rate, the larger-use customers pay 24¢/kWh for their usage over 600 kWh. The two prices are not tagged to individual kWh; any reduction in energy use by a large-use customer will save 24¢/kWh.[2] Hence, the conservation incentive for the tiered rate is 24¢/kWh for 990 GWh and 10¢/kWh for 450 GWh. That averages out at 20.3¢/kWh, which is 27% higher than the 16¢/kWh incentive from the flat rate. The customers as a whole still pay an average of 16¢/kWh, but their average saving from reducing usage is 20.3¢/kWh.[3]

The tiered rate allows for higher conservation incentives, without increasing revenues, and, at the same time, decreases bills for a majority of customers.

[2] The saving would fall to 10¢/kWh if the large customer reduces usage below 600 kWh, but that would require a reduction of nearly half for the average large customer.

[3] In addition, the large customers probably have more options for reducing usage than the small customers, and can respond more effectively to the price signals. Large customers will tend to have more electric end uses (from clothes washers to hot tubs and home theaters) than small customers, and larger consumption per appliance (e.g., for a 60″ plasma screen versus a 36″ LED screen); both the larger number of uses and the larger consumption per appliance provide more opportunities for energy efficiency and conservation.

**Q: What types of conservation does a tiered rate encourage?**

A: The stronger price signals from higher marginal rates should encourage the following three kinds of conservation:

- Short-term behavioral changes, such as greater attention to turning off lights and entertainment equipment when not in use, installing and using switched power strips to avoid standby usage, reducing winter thermostat settings and increasing summer thermostat settings (especially when the space is unoccupied), opening and closing window treatments to minimize solar gain in the summer and maximize it in the winter, selecting lower temperatures for domestic hot water, and using appliances more efficiently (e.g., running full loads, turning off electric drying on dishwashers).
- Participation in utility-funded energy-efficiency programs.
- Long-term consumption decisions that affect consumption but are not easy to influence with utility-funded programs, such as home remodeling and redecorating, and choice of equipment size and technology (e.g., LED versus plasma screens).

**Q: Are flat residential rates under consideration in this proceeding?**

A: Not quite. Some form of baseline tier is required by AB327, and the Staff Proposal on Residential Rate Reform (at 16) recommends a 20% differential between the tiers. Within the legal constraints, the utilities have proposed moving to nearly flat energy rates. In Section V I will discuss a more-detailed comparison of the utilities' proposed minimally tiered rates versus the moderately tiered rates I explore in this testimony.

***B. Guiding Principles***

**Q: Are tiered rates consistent with the traditional guiding principles of rate design?**

A: Yes. For example, Bonbright's list of rate-design objectives includes both "discouraging wasteful use of service" and "reflection of all of the present and future private and social costs and benefits occasioned by a service's provision (i.e., all internalities and externalities)" (Bonbright, Danielsen, and Kamerschen 1988 at 383–384).[4] Significantly tiered rates can discourage the wasteful use of energy and reflect long-term social costs better than flatter rates, including untired time-varying rates.

**Q: How do tiered rates align with the Principles of Optimal Residential Rate Design set forth by the Assigned Commissioner?**

A: Tiered rates are consistent with all those principles (Principles at 5–7).

*1. Low-income and medical baseline customers should have access to enough electricity to ensure basic needs (such as health and comfort) are met at an affordable cost.*

Tiered rates reduce the bills for customers with lower usage (meeting basic needs) and are compatible with other features for discounting bills for these vulnerable groups.

*2. Rates should be based on marginal cost.*

In particular, rates should be informed by long-run marginal societal costs, including the following costs:

[4] I list most of the works I cite in my testimony in **Error! Reference source not found.**.

- the high social costs related to burning fossil fuels (including coal-fired economy imports from the Southwest and Mountain states), such as global warming, conventional air pollutants, and water use;
- the price and reliability risks associated with heavy reliance of the electric utility system on natural gas;
- the costs of meeting the residential evening load ramp, when that coincides with falling evening PV generation.

3. *Rates should be based on cost-causation principles.*

Tiered rates allow for higher effective marginal prices without higher total revenue recovery. This permits rates to reflect the range of private and social costs that are affected by customer consumption choices. In contrast, fixed charges do not track well the real drivers of utility costs.

4. *Rates should encourage conservation and energy efficiency.*

By raising marginal price for the average kilowatt-hour of sales, tiered rates encourage conservation and energy efficiency in ways that flatter rates cannot. Large reductions in bills to large customers and large increases in charges to small customers (including fixed costs) would send a clear signal that California no longer considers efficiency to be important.

5. *Rates should encourage reduction of both coincident and non-coincident peak demand.*

By reducing usage and encouraging efficiency, tiered rates will tend to reduce peak loads as well as energy usage. The large customers who will receive the strongest conservation price signals tend to have disproportionately high peak loads. In addition, tiered rates are consistent with time-of-use rates, as I explain in Section VI.B.

6. *Rates should be stable and understandable and provide customer choice.*

Tiered rates can be designed to be simpler and more understandable than the current tiered rates, by (1) reducing the number of tiers from four or five to three, and (2) through more effective and specific communication from the utilities to consumers. Communication can include regular reminders and customer-specific feedback on each bill. The messaging could include reminders that the customer's rate will increase if usage increases and/or fall as usage decreases, depending on the customer's current tier; congratulations on staying in a lower tier or reducing usage; and pointing out when the customer has increased usage, or moved into a higher tier, or is close to doing so.

Tiered rates increase customers' control over their bills. Fixed charges reduce customers' control over their bills.

7. *Rates should generally avoid cross-subsidies, unless the cross-subsidies appropriately support explicit state policy goals.*

Considering the multiple ways that utility costs can be described, and the multitude of factors that influence costs, it is essentially impossible to design rates that cannot be said to include "cross-subsidies" of one type or another. Design of rates often involves trade-offs between recovery of marginal cost of electric consumption and recovery of customer-related costs. A fixed charge below the allocated customer cost does not mean that large customers are subsidizing small customers. Elimination of tiered rates would result in a subsidy of large users and customers who increase their usage, requiring the addition of new expensive new resources, complicating the decarbonization of the California economy, and as well as T&D capacity upgrades. The subsidy would be at the expense of customers who are living within California's existing clean-resources and delivery capacity, as well as at the expense of everyone affected by the operation of existing polluting resources.

"Cross subsidy" is used more often as an epithet than as a technical term of art, especially in the context of joint and common costs (such as generators' joint production of capacity, reliability services and energy at various times, or the area-spanning transmission and distribution system). A party that identifies a feature of cost allocation or rate design as creating a "cross subsidy," usually means that the feature raises bills to its clients, provides incentives that the party does not favor, or (in the case of utilities) endangers revenue stability.[5]

Even if tiered rates introduced cross-subsidies, state policy goals strongly endorse the energy-efficiency benefits of tiered rates. The PUC and the Energy Commission have concluded as follows:

> the loading order…describes the priority sequence for actions to address increasing energy needs. The loading order identifies energy efficiency and demand response as the state's preferred means of meeting growing energy needs. After cost-effective efficiency and demand response, we rely on renewable sources of power and distributed generation, such as combined heat and power applications. (Energy Action Plan II: Implementation Road-map for Energy Policies, Implementation Roadmap For Energy Policies, September 21, 2005)

8. *Incentives should be explicit and transparent.*

The only rate incentives to which residential customers can respond are energy rates. Those rates should be communicated to customers as clearly and compellingly as possible.

9. *Rates should encourage economically efficient decision* making.

Recovering the residential class revenue requirement through energy charges will encourage energy efficiency and conservation. Inclining tiers increase the rewards for conservation and the costs of wasteful usage, without increasing

[5] The California utilities have no reason to be concerned about revenue stability, since their revenues are decoupled from sales.

total revenue requirements. In contrast, high fixed charges do not encourage economically efficient decision making, since few if any customers can respond in any way to high fixed charges.

10. *Transitions to new rate structures should emphasize customer education and outreach that enhances customer understanding and acceptance of new rates, and minimizes and appropriately considers the bill impacts associated with such transitions.*

    In Section 0, I describe approaches that may be useful in enhancing customer understanding. Moderating the radical flattening of rates proposed by the utilities would mitigate the significant bill impacts of those proposals.

**Q: What cost guidelines should be used in rate design?**

A: Rate design should be informed by the full social cost of consumption decisions. The overall benefits of markets are maximized when the average marginal price paid by consumers for incremental usage equals the social cost of that usage. Considering the long-term implications of customer commitments to energy-consuming equipment and buildings, rate design should reflect costs over future decades, not just the rate year that determines the revenue requirement.

## IV. Effect of Marginal Rates on Energy Use

**Q: Is it widely accepted that residential customers respond to price signals?**

A: Yes. Any suggestion that customers do not respond to rate design would be counter-intuitive, inconsistent with experience, and contrary to a century of rate design.

Many econometric studies have estimated the response of residential electricity consumers to price. That response is usually expressed as the price elasticity, the percentage change in load resulting from a 1% increase in price. In other words, if the price of electricity goes up by 5% and consumers, as a result, use 1% less electricity, the elasticity is said to be

$$0.01 \div 0.05 = -0.2$$

The following surveys compiled estimates of residential electric price elasticities, both in the short run (e.g., over one year) and long run (e.g., over decades):

- A review by Espey and Espey (2004) of 36 articles on residential electricity demand published between 1971 and 2000 reports short-run price elasticity estimates range from −0.004 to −2.01 (with a central tendency of −0.35) and long−run price elasticities range from −0.04 to −2.25 (with a central tendency of −0.85).
- A review of nine studies from 1980 to 2002 by EPRI (2008) reports short-run elasticities of −0.2 to −0.6 and long-run elasticities of −0.7 to −1.4.
- Alberini, Gans, and Velez-Lopez (2011) reviewed 16 studies, published between 1999 and 2010, with short run price elasticities ranging from -0.08 to −1.1.

### *A. Consumer Response to Marginal Rates*

**Q: Would you expect marginal or tailblock energy rates to affect customer usage decisions?**

A: Yes. If customers only paid attention to their total bill or average rate, they would not alter their consumption regardless of whether the utility's rate design was 20¢/kWh or $105/month plus 1¢/kWh. That outcome is implausible.

Utilities and their regulators have generally believed that rate design affects customer energy usage. Until the 1970s, many US electric utilities offered declining tier rates, in the belief that the lower final tiers would increase usage of their product, the cost of which was falling with technological improvements and economies of scale. Once the economics of load growth changed to an increasing-cost regime, many regulators (including the California PUC) flattened rates and moved to increasing tiers, to encourage conservation.

**Q: Does anyone other than the residential customers themselves refer to the marginal prices in making decisions about energy efficiency?**

A: Yes. Marginal prices would be used by energy-efficiency program implementers, appliance retailers, architects, home performance contractors, and other professionals, in explaining to customers the benefits of energy-efficient products and retrofits. Even if customers are not regularly aware of their individual marginal rates, these parties would focus the customers on that important economic input during the decision-making process for the purchase of a new appliance or investment in home energy retrofits.[6]

**Q: Are you aware of any research on whether residential customers pay attention to the structure of their utility bills?**

A: Yes. A survey of customers of the three large California investor-owned utilities found that 50% of them knew they were billed on a tiered rate (Hiner & Partners Inc. 2013 at 17). Considering the low level of interest of many customers in their utility bills (illustrated by only 27% of the survey respondents correctly reporting that they were not subject to a demand charge), that is a good result, although it could certainly be improved through better communication with customers.

**Q: Have any other utilities estimated the effect of residential tiered rates on usage?**

A: Yes. Without having conducted a comprehensive literature review, I am aware of

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[6] To facilitate payback analysis be customers, their contractors, and energy-efficiency implementers, the utilities should make it easy for customers to identify their marginal energy rate, such as by printing it on every bill.

two such studies, from Xcel Energy (2012) and BC Hydro (2013).

Xcel describes Xcel Colorado's two-tier summer rate, first implemented in 2010, which has (1) rates of 4.6¢/kWh for the first 500 kWh in a billing period, and (2) a rate of 9¢/kWh (a ratio of 1.95:1) for all additional use. Xcel estimates that the tiered rate resulted in summer savings of about 1.9% in 2010 and 4.4% in 2011 and 4% in 2012.

Xcel estimated that summer energy use would decrease by 0.26% for each 1% increase in the marginal price attributable to tiered rates (an elasticity of −0.26). Based on that elasticity estimate, Xcel expected to observe a 3.65% reduction in consumption. The first-year response was about half that estimate (perhaps reflecting a lag in customer understanding of the rate change) and the second and third years were somewhat higher than the forecast, suggesting a marginal elasticity of about −0.3.

British Columbia Hydro implemented a two-block residential tiered rate in October 2008 (the beginning of fiscal year 2009), with a break at 675 kWh/month (90% of median residential consumption). BC Hydro (2013 at 18) graphs the prices charged in each block each year 2009 to 2012 along with the comparable non-tiered rate. By 2012, the two blocks were priced around 6¢/kWh and 9.6¢/kWh. BC Hydro estimated that the elasticity in the second block was −0.08 to −0.13, in addition to an elasticity of −0.05 for class average price elasticity.[7] BC Hydro found that consumption by small customers (averaging 370 kWh monthly) did not increase, while consumption by the large customers (averaging about 1,350 kWh

[7] It is important to note that marginal price signals are cumulative with, and not competitive with, the signals from average costs. Once revenue requirements are determined, so are average costs for the class; rate design can affect the marginal price signals without interfering with the effects of average rates.

monthly) fell, for cumulative savings of 1.1% to 2.5% of BC Hydro's 18,000 GWh total residential use by 2012.

**Q: Have you identified any other studies of the price response of residential customers to tiered rates?**

A: Yes. I have found several published papers that estimate the effect of tiered rates on residential consumption of electricity. In this response, I discuss eight such papers.[8] The three earliest papers examined the effect of the declining-block rates prevalent until the 1970s, while the five later ones consider inclining tiered rates.

Acton, Bridge, and Mowill (1976) use data from the LA DWP and SCE to find an elasticity for the marginal rate faced by customers of −0.35 to −0.7. The authors (at 50) find,

> There is a good reason to believe that these measured elasticities represent lower extremes (in absolute value) of the elasticities one would find with respect to price when both utilization and stocks can be adjusted in the long run.

They also conclude (at 43) that the effect on the fixed charge and infra-marginal tiers was "very near zero, of the wrong sign about half the time, and frequently not statistically different from zero." In other words, prices other than the marginal price appeared to have little if any effect on consumption.

Finally, based on differences in appliance stocks, Acton, Bridge, and Mowill (1976 at vii) find,

> Important differences in the price elasticity in different blocks of the rate structure can be expected, with low consumption blocks exhibiting a smaller price elasticity of demand (in absolute terms) than high consumption blocks"

[8] A few earlier studies estimated elasticity of demand with respect to marginal rates, but did not account for fixed charges and other intra-marginal charges. If only one price variable is used in an analysis, and all rate components are changing together over time or space, it can be difficult to determine what part of the usage effect is due to marginal price, as opposed to other bill components.

They estimate (at 55) that marginal demand elasticities were about −0.25 under 150 kWh monthly, −0.35 for 150 to 400 kWh, and −0.44 for customers with bills of 400 to 1,000 kWh.

McFadden, Puig, and Kirshner (1977) use a national survey of individual households and find (at unnumbered 4th) that

> average consumption of electricity, conditioned on the availability of air conditioning and on water and space heating fuel type, has an elasticity with respect to family income of 0.22, and an elasticity with respect to marginal cost (where marginal costs at different points in the rate schedule are proportional) of approximately −0.25 for households without electric space heat and −0.52 for households with electric space heat. When average cost of electricity rises in proportion to marginal cost, these elasticities increase to approximately −0.33 and −0.60, respectively.

In other words, the marginal price signal explained 76%–87% of the total price effect.

Barnes, Gillingham, and Hageman (1981) used national household appliance, income and rate-schedule data to estimate a marginal price elasticity of −0.55 and an overall price elasticity of −0.884, so marginal price was 62% of the total price effect.

Henson (1984) finds that marginal price is an important driver of residential consumption. He concludes (at 155) that "the elasticity of residential electricity demand with respect to marginal price are in the range −27 to −30. Changes…in infra-marginal prices are not found to have significant effects on consumption."

Herriges and King (1994) use data from a controlled experiment with 227 Wisconsin Electric customers on four tiered rates, using two different break points (250 kWh and 500 kWh) and two first-block rates (each of which determined the second-block rate. Each experimental rate applied to only 50 or 60 customers; another 143 customers were on the flat rate. Only participants using less than 1,500 kWh monthly were included. The experiment appears to have been run for a year or less. Given the small sample and the short period for behavior to adapt to the block rates, it is not surprising that the coefficients were not consistently statistically significantly different from zero.[9]

Reiss and White (2002) used data from California utilities to estimate an average marginal price elasticity of −0.39, along with estimates for various subsets of the data. The authors observe (at 867) that

> The smallest effect is associated with baseline use, and is effectively zero. All other appliance price sensitivities are of considerable practical significance. For example,… a one cent per kilowatt-hour (“kWh”) increase in the marginal price would reduce a household’s annual utilization of pool pumps and motors by approximately 330 kWh per year, which is 15% of a pool’s typical electricity use.

They also find that customers with electric heat and air conditioning have much higher elasticities than customers without them.

Faruqui (2008) reviewed the previously described studies and reported on a simulation of the effects of four two-block IBRs. “Based on a synthesis of the best available information,” Faruqui estimated that short-run elasticity was most likely to be about −0.13 in the first tier and −0.26 in the second tier, rising to −0.39 and −0.78 in the long term.[10]

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[9] The CLECA comments (May 29, 2013, at 8) assert, “the own-price elasticity of −02 to −04…was found not statistically significant.” In fact, Herriges and King (1994 at 424) report short-term elasticities of –0.02 in the summer and −0.04 in the winter and explain, “The estimate of [price elasticity] in the current study is not statistically significant for the summer season, even at the 10% level, but is statistically significant at the 5% level for the winter season.”

[10] The CLECA comments (at 8) suggest that Faruqui’s estimates of price elasticity relied on a 2008 report from EPRI that did not review any studies of tiered rates. In fact, Faruqui cites three reports that estimate the demand effects of marginal prices (BC Hydro 2013; Herriges and King 1994; Reiss and White 2005), some of which cite earlier studies. The CLECA comments do not provide any basis for disputing Faruqui’s claim to have used “the best available information.”

Orans et al. (2014) provide additional information on BC Hydro's experience with tiered rates. That analysis indicates that introduction of block rates in British Columbia (1) did not increase usage by customers with consumption entirely in the lower tier and (2) decreased usage by customers with consumption in the higher tier. Even within the higher tier (more than 675 kWh/month, which is roughly average California residential consumption), larger customers (more than 1,200 kWh/month) showed higher elasticity.

**Q: What do you consider a reasonable estimate of the elasticity of demand with respect to marginal price?**

A: While the exact value is uncertain, and probably varies with a number of factors, a conservative range of values over one to four years might be −0.1 to −0.3. Longer-term effects may be twice as high.

**Q: Have any studies suggested that residential customers do not respond to tiered rates?**

A: The only such study of which I am aware is by Koichiro Ito (2012).[11] That study was based on monthly data for a very small portion (six communities) of the Southern California Edison and San Diego Gas & Electric service territories in Orange County from 1999 through 2007. Ito concluded that his sample indicated "that consumers respond to average price rather than marginal or expected marginal price."

In addition, Ito's supervisor Severin Borenstein released preliminary results from the Ito analysis in the seminar paper cited in the SCE Proposal (at note 79) (Borestein 2009). His paper examined the change in March–May usage for the

[11] Ito published a version of the same paper under the same title in American Economic Review 2014, 104(2): 537–563. My references are to the 2012 working paper.

customers in those six communities over the biennial periods: 2002–2004, 2004–2006, and 2006–2008.

**Q: Does this study change your view of customer response to tiered rates?**

A: No. Common experience and previous studies create a strong presumption that customers respond to tiered rates, and any assertion that they do not would constitute an extraordinary claim.

Any conclusion that customers do not respond to rate design is counter-intuitive, inconsistent with experience, and contrary to a century of rate design. Even routine scientific findings require replication to be accepted; surprising results require multiple confirmations.

**Q: Are there specific reasons for being skeptical about the practical significance of Ito's conclusions?**

A: Yes. I have identified five such considerations. First, since the study relies on econometrics, it cannot possibly be considered definitive. Econometric analyses attempt to tease and understanding of causation out observable data driven by complex human behavior. The three reviews of residential electric price elasticity analyses that I discussed above at 13, covering 61 studies over the period 1971–2010, reported estimates of short-run price elasticity ranging from −0.004 to −2.01 and long-run price elasticities from −0.04 to −2.25.

Results can vary widely between analyses. Even with the multiple studies from different periods and datasets, it would be a stretch to claim a definitive value for total residential price elasticity. The single Ito study is just one of a number of analyses, most of which reach conclusions very different from Ito's.[12]

[12] Borenstein's paper demonstrates how unstable econometric analyses can be. For example, at the top of page 32 of the paper Borenstein reports positive coefficients for many of the price variables, including the average-price variable, suggesting that higher prices result in higher consumption. Some

Second, one of Ito's major findings is that customers do not calibrate their monthly usage to fall just above or below the tier breakpoints.

> if consumers respond to the true marginal price,… I…expect a disproportionate share of consumers bunching around the kink point in the data. (Ito 2012 at 12)

> I find no bunching for any year of the data…The absence of bunching implies two possibilities. First, consumers may respond to marginal price with nearly zero elasticity.… Second, consumers may respond to alternative price. If consumers respond to any "smoothed" price such as average price, the price has no more kink points. (ibid. at 13)

Ito hypothesizes that customers, if they were responding to the tiered rates, would not just attempt to conserve and stay in the lower block, but carefully control their monthly usage to aim for a point slightly below a breakpoint. It is not clear to what extent Ito's results were driven by some combination of the following factors:

- Perhaps customers ignore marginal prices, as Ito suggests.
- Perhaps the tiered rates gave customers a general price signal that more conservation was better (which would be consistent with other messages they would have been receiving), and they did not pay much attention to whether their bills were well below a break point. Tiered rates could encourage the vast majority of customers to reduce their consumption, minimize the energy they use in their highest-priced block (regardless of whether they can eliminate all use in that block), and minimize the probability of exceeding the next breakpoint and paying a higher marginal rate, all without producing any observable bunching.

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of those implausible coefficients are statistically significant, even though they are certainly wrong. The elasticities in that table also vary widely among the time periods, with the average-price coefficient varying from +0.05 in 2000–2002, to −0.45 in 2002–2004, to −0.12 in 2004–2006.

- Perhaps customers were just not very successful in estimating where their bills were likely to fall on a monthly basis, in the face of variable weather, occupancy, and other usage drivers. The customers in this study did not yet have access to cumulative consumption data during the billing cycle. In other words, customers may not be able to fine-tune their monthly consumption to keep usage just below a tier breakpoint.

Third, the period used in the analysis includes the California electricity crisis and its aftermath, including the wholesale price run-up in 2000, brown-outs and black-outs in 2000 and 2001, the 2001 bankruptcy of PG&E, and a price jump in 2001 when market prices were allowed to flow through to consumers.[13] The period of supply problems (in which reducing load was a powerful social imperative) only partially overlapped the period of higher prices. Resentment of Enron and the other brokers who manipulated market prices, and of the high-priced contracts to which the state committed ratepayers, may also have affected consumption over time. Hence, it is hardly surprising that sorting out the marginal and average price effects from other factors would be difficult in this turbulent period.[14]

Fourth, while Ito considers his sample to be particularly valuable in that the SCE and SDG&E customers live "within one mile of the utility border," in the same six small cities, that fact may actually confuse the issue. Attitudes and approaches regarding energy consumption are not just the product of individual contemplation,

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[13]Another price jump occurred in 2006.

[14]Borenstein acknowledges this problem in the context of his explanation for his unusual choice of data (at 22):

> Unfortunately for this analysis, many other events had occurred that could confound the time-series comparison. California's electricity crisis from June 2000 to May 2001 brought public conservation campaigns, threats of blackouts, and explicit conservation rebates during the ensuing summers for households that reduced consumption by at least 20% compared to summer 2000. The rebates were distributed through a lump sum bill credit at the end of the summer, further muddying the analysis.

but are also the result of social pressure and modeling. Since the customers would be interacting with one another, through work, social contacts and community organizations (e.g., parent-teacher organizations), the actions and strategies that an SCE customer adopted may be conveyed to an SDG&E customer, and vice versa. Consequently customers (whether or not they understood their own bills) may have been responding to the bills of their neighbors with a different rate structure.

Fifth, Borenstein (2009 at 9) acknowledges that the customers in the study did not have good information about the block prices they faced.

> Until a redesign of utility bills in 2008, SCE residential bills did not give a customer information about the marginal price of consumption above the tiers on which he is consuming. Even calculating it from their website required merging of data from different web pages.

The most importance lesson from Ito's study may be that customers need clear and effective communication about prices for tiered rates to be effective. Indeed, in a review of rate-design research, Puller and West (2013, 351) reach the following conclusion from Ito's paper:

> This line of research suggests that if academics are to make policy recommendations based upon "getting the marginal price right," then we also should advocate for bill design that saliently displays that price signal.

More generally, Puller and West (2013, 351) find:

> This observed behavior is consistent with consumers responding to either the marginal price (i.e., the slope of the non-linear tariff) or to their average price (e.g., the average cents/kWh that is reported on many bills). Either behavioral response is possible depending on consumer knowledge of the tariff function and the type of information that is saliently reported on bills. Utility bills often do a poor job of clearly displaying the marginal price of each additional unit of energy. It is common for utility bills to display some breakdown of total expenditures, but bills (that we observe) often do not saliently display the marginal price schedule. Casual empiricism suggests that utility customers are better informed about their total monthly expenditures on gas/electricity rather than the marginal price; contrast this with drivers who are

> likely better informed about the (marginal) price per gallon than their total monthly expenditures on gasoline.

**Q: Does Borenstein's analysis of Ito's data indicate that marginal rates have no effect on customer behavior?**

A: No. To the contrary, Borenstein (2009 at 35) found,

> Overall, the results indicate that among the distribution of consumers there are many who likely respond to little more than average price information, while others either consciously or unconsciously are aware of—and show some response to—the expected marginal price that they are likely to face. The estimated level of response is not as robust over time as one might hope for, but it appears to be in the elasticity range of −0.1 to −0.2 for expected marginal price.[15]

### *B. Clarifying the Effect of Tier Price on Consumption*

**Q: How did PG&E estimate the effect of its proposed two-tiered rate design, compared to the existing rate design?**

A: In the testimony of Dennis M. Keane, Philip J. Quadrini, and Karen J. Zelmar on long-term residential rate design (February 28, 2014, at 2–2-67), PG&E estimates the effects of moving from the existing rate design to the two-tier design that PG&E proposes for 2018, assuming that price elasticity varies among tiers. Curiously, PG&E assumes that all Tier 1 usage, whether by customers with bills entirely in Tier 1 or by customers with bills in Tier 4, responds to the Tier 1 price, and similarly for the other tiers.

**Q: Is this a reasonable approach?**

A: No. PG&E's computation illogically assumes that a customer with usage in Tier 4

[15] While Borenstein (2009 at 35) describes this elasticity range as "medium to long run elasticities," he uses the changes in rates and usage over various two-year periods and acknowledges that customers were "responding to changes in the price schedule that occurred at least a few months earlier," so his elasticities appear to reflect only short-term responses.

responds to the Tier-1 price for some kilowatt-hours, the Tier 2 price for other kilowatt-hours, and so on. If customers understands the rate design at all, only the Tier-4 price would affect their behavior because it is the Tier-4 price that they would avoid with conservation. I illustrate this error in Figure 1, which shows how PG&E models price response by tier, and Figure 2, which shows which energy contributes to changes in bills.

**Figure 1: PG&E Treatment of Tier Price Response**

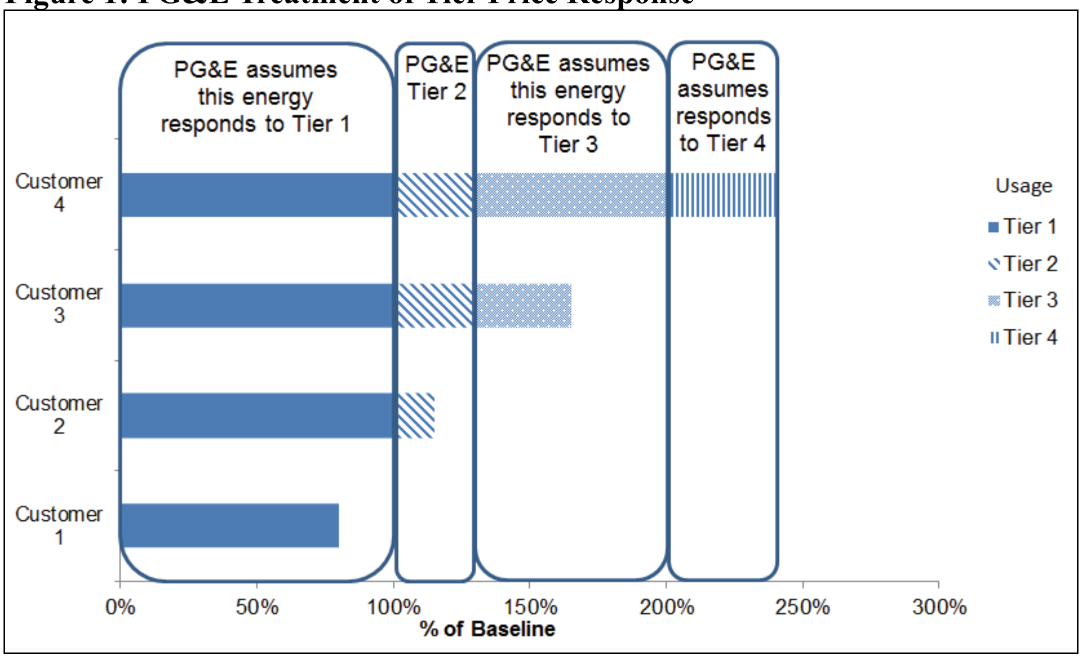
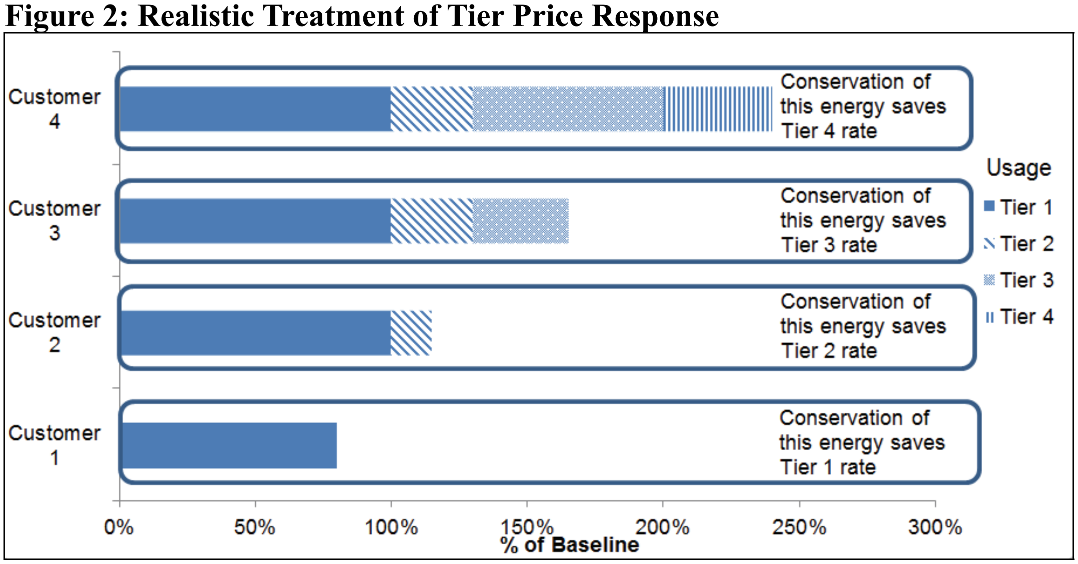



**Figure 2: Realistic Treatment of Tier Price Response**



**Q: Can you illustrate the error in PG&E's computation with a simple numerical example?**

A: Yes. I applied PG&E's approach to the example in my Table 1, above, comparing from a flat rate to a two-tier rate and using PG&E's default price elasticity of –0.2.

**Table 2: Illustration of PG&E Mis-estimation of Price Response**

| | | | **Total Use GWh/year** | | |
|---|---|---|---|---|---|
| | | | | After Price Response | |
| **Usage** | **Tier** | **Price** | Before Price Response | *PG&E Method* | *Realistic Method* |
| *Flat Rate* | | | | | |
| Total | | $0.16 | 1,440 | | |
| *Inclining Block Rate* | | | | | |
| 700 | 1st | $0.10 | 450 | 494 | 494 |
| >700 | 1st | $0.10 | 540 | 593 | |
| | 2nd | $0.24 | 450 | 415 | |
| | sum | | 990 | | 913 |
| Total | | | 1,440 | 1,503 | 1,407 |

In this example, PG&E's approach would lead to the conclusion that the tiered rate would increase total usage, while a more realistic computation shows the tiered rate reducing usage. In both computations, reducing the price for the customers with bills exclusively in the first tier increases their usage from 540 to 593 GWh. In the PG&E approach, the 420 GWh of first-tier consumption by the customers with bills in the second tier would also increase, from 420 to 461 GWh. PG&E would recognize that the first-block increase by the larger customers would be barely offset by the reduction in those customers' usage in the second block.

As I explained above, PG&E's approach is unrealistic, since those second-tier customers cannot use more energy in the first tier, and any change in usage is billed at the higher second-tier rate. In the realistic computation, the large customers would reduce their usage by 77 GWh, much more than the increase in usage by the small customers.

**Q: Are there any other problems in PG&E's computation of the effects of rate design?**

A: Yes. In its computations, PG&E did not properly apply the price elasticities it claimed to have used. A price elasticity of −0.20 means that increasing price by $\Delta p$ percent would reduce usage by

$$(1+\Delta p)^{-0.2}$$

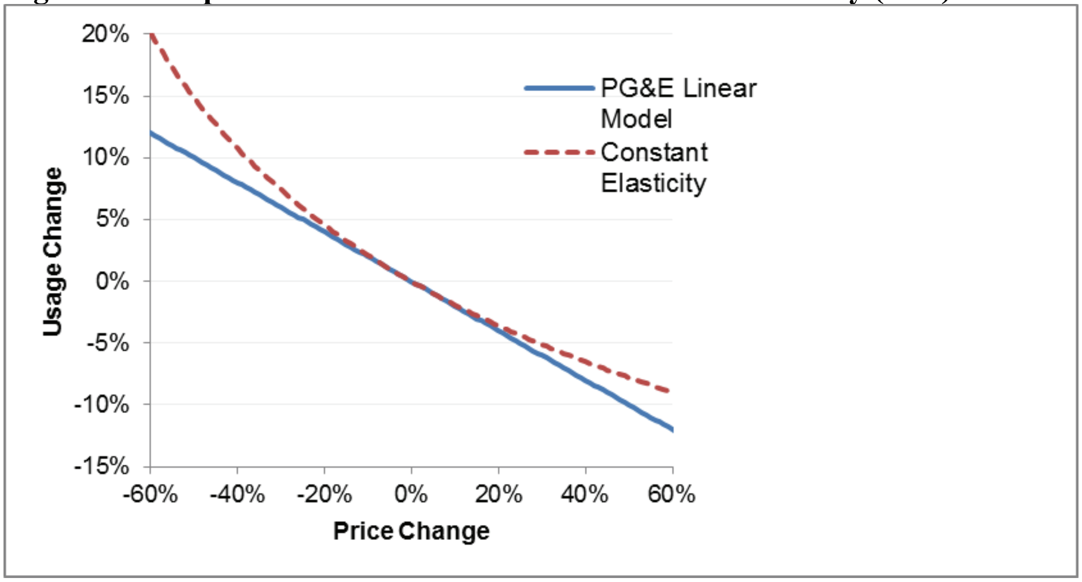
In contrast, PG&E's work paper in IREC 004-01 shows that PG&E actually computed the price response as

$$\Delta p \times -0.2$$

The effect of this error is to overstate the usage reductions due to rate increases in the lower tiers and understate the usage increases due to rate decreases in the higher tiers.

As illustrated in Figure 3, so long as the price change is small (e.g., ±10%), PG&E's linear demand model produces a percentage usage change close to the change that would be expected with a constant elasticity. As the price increases in absolute terms, PG&E's result deviates considerably from constant elasticity). Specifically, PG&E understates the usage increase for price decreases and overstates the usage reduction for price increases. These systematic errors for large price changes are important in PG&E's computation, since PG&E is proposing to increase the price of the first tier non-CARE rates by up to 60% (and CARE rates up to 75%) and decrease the fourth tier by 42%.

**Figure 3: Comparison of PG&E Model and Constant Elasticity (−0.2)**




**Q: Have you corrected PG&E's computation?**

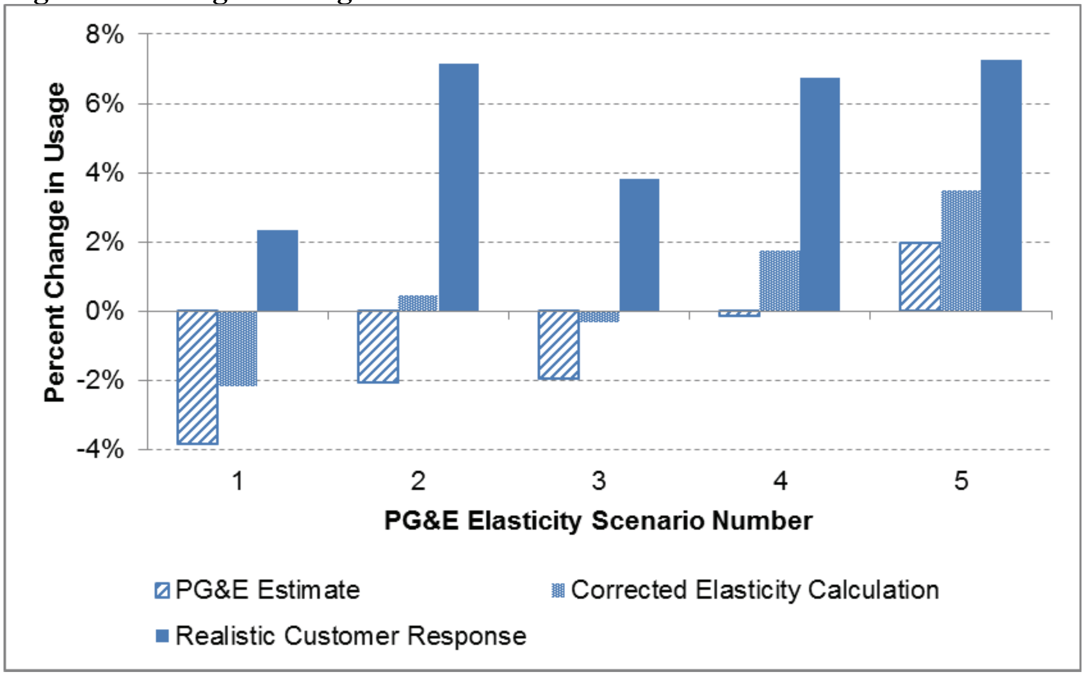
A: Yes. Figure 4 shows the change in usage due to the change from 2014 rates to PG&E's proposed 2018 rates, for the following three cases:

1. The utility's estimate, which assumes linear price response and that each customer responds differently to the various prices in the tiers that customer uses.
2. The utility's computation, corrected for proper application of price elasticity.
3. A realistic analysis that assumes that each customer responds to the price that determines the change in the customer's bill as the customer changes usage.

I used PG&E's five elasticity scenarios, which assume the following elasticities:

- −0.2 for all tiers.
- −0.2 for Tiers 1 and 2, −0.4 for Tiers 3 and 4.
- −0.13 for Tier 1, −0.26 for Tiers 2–4.
- −0.1 for Tier 1, −0.2 for Tier 2, −0.3 for Tier 3, −0.4 for Tier 4.
- −0.01 for Tier 1, −0.2 for Tier 2, −0.3 for Tier 3, −0.4 for Tier 4.

**Figure 4: Change in Usage with Move to Two-Tier Rate**




The increase in usage as a result of rate flattening is determined primarily by the elasticity assumed for Tiers 3 and 4. In Scenarios 2, 4, and 5, with elasticities of −0.3 or −0.4 for the higher tiers, PG&E's proposed flattening would increase consumption about 7%, while in Scenario 1, with −0.2 elasticity, the increase is 2%.

## V. Designing a Tiered Rate

**Q: Have you developed sample tiered rates?**

A: Yes. I started by developing an estimate of the energy billed in each tier (as currently defined) and the energy in bills ending in each tier, and hence controlled by the rate in the tier. I developed sample rates for both PG&E and SCE.

For the purpose of this testimony, I have assumed essentially the current approaches for setting baselines (i.e., 50% to 55% of average use for the pricing group plus medical allowances). As new end uses emerge, the baselines should be redefined. Specifically, the Commission should increase the baseline for owners of electric vehicles (which can be documented by the vehicle's registration). If the

Commission finds that other major incremental electric end uses (e.g., high-efficiency heat pumps, including domestic hot-water heat pumps) are cost-effective for inclusion in DSM programs, baseline allowances should be implemented accommodate those loads.

**Q: How did you develop the PG&E tier data?**

A: In response to DR TURN 014-Q02, PG&E provided the monthly energy billed in each tier, for customers with usage ending in each tier (e.g., Tier 1 energy for Tier 1 customers, Tier 1 energy for Tier 2 customers, Tier 2 energy for Tier 2 customers, and so on). I compiled the monthly data for 2013 and computed the percentage of energy billed in each tier and controlled by each tier.

Table 3 summarizes the results of my analysis. Three-fifths of sales are billed in Tier 1, but only about 18% of sales are in bills that end in Tier 1. At the other end of the data, Tier 5 represents only about 8% of energy billing, but 20% of the sales are in bills ending in Tier 5.

**Table 3: Summary of PG&E Residential Energy by Tier**

| | Tier as % of Baseline | | Tier as % of MWh | |
|---|---|---|---|---|
| | Range | Width | Billed in Tier | Controlled by Tier |
| Tier 1 | ≤100% | 100% | 60% | 18% |
| Tier 2 | 100%–130% | 30% | 11% | 12% |
| Tier 3 | 130%–200% | 70% | 15% | 27% |
| Tier 4 | 200%–300% | 100% | 8% | 23% |
| Tier 5 | >300% | | 6% | 20% |

**Q: Based on these sales data, have you developed a sample tiered rate design?**

A: Yes. I started with PG&E's current 17.5¢/kWh average rate (PG&E Proposal at page 1-8), and created a three-tier rate design that produces the same revenue. To maximize the conservation incentive while simplifying the current four-tier rate, I developed a three-tier rate. To produce price differentials of roughly 1.0:1.4:2.0 for the three tiers, I selected a rate 20% below the average rate for Tier 1, 15% above average for Tiers 2 and 3 (which I refer to as Tier 2/3) and 58% above average for Tiers 4 and 5 (Tier 4/5).[16] Table 4 summarizes the resulting prices and the change in the price signal compared to the flat rate, compared to the flat rate. The overall price effect of this rate design is a 27% increase in the conservation incentive, equivalent to an average marginal rate of 22.2¢/kWh.

**Table 4: Sample Three-Tier PG&E Rate Design**

| | **Rate per kWh** | **Δ from Flat Rate** | **% of MWh Controlled** | **Δ price signal** |
|---|---|---|---|---|
| *Tier 1* | $0.140 | -20.0% | 18% | −3.6% |
| *Tier 2/3* | $0.201 | 15.0% | 39% | 5.9% |
| *Tier 4/5* | $0.276 | 57.8% | 43% | 24.7% |
| *Total* | $0.175 | 0.0% | 100% | 27.1% |

**Q: How would this rate design affect the bills paid by customers of various sizes, compared to a flat rate?**

A: Any customer using less than twice the baseline (or roughly 110% of the group average) would pay less with the tiered rate than the flat rate: 20% less for the bills below baseline, 12% less for bills at 130% of baseline (the end of Tier 2), 3% for bills at 200% of baseline.

**Q: How would this rate design compare to the current PG&E rate design?**

A: Table 5 summarizes the sample three-tier rate and the existing PG&E rate. In the interest of simplifying the rate design and reducing the rate in the last two blocks, my sample design would increase rates for most below-average customers and reduce them for customers who use more than the average for their pricing group.

[16] I use this terminology to link my sample-tariff tiers to the existing tiers and (I hope) minimize confusion.

Bills would rise about 13% for customers using the baseline quantity and 18% for customers at 130% of baseline, decline about 2% at twice baseline, 10% at three times baseline and 14% at four times baseline.

**Table 5: Comparison of Existing and Sample 3-Tier PG&E Rate**

| | Sample 3-Tier Rate | Existing Rate | Δ from Existing |
|---|---|---|---|
| *Tier 1* | $0.140 | $0.132 | 6% |
| *Tier 2* | $0.201 | $0.150 | 34% |
| *Tier 3* | $0.201 | $0.324 | −38% |
| *Tier 4/5* | $0.276 | $0.364 | −24% |

*Existing Rate from PG&E Policy Filing, Table 1-2. Sample Rate from Table 4*

**Q: How does your three-tier rate design compare to potential two-tier designs?**

A: Compared to a two-tiered design, the three-tier rate design allows for lower bills for all customers with below-average usage, along with higher average conservation incentives. I developed two two-tier rates for comparison. Table 6 summarizes a rate with the second tier (covering existing Tiers 2 to 5) price 20% higher than the baseline tier, similar to the utility proposals, while Table 7 summarizes a rate with the baseline tier set at the same price as in the three-tier sample rate in Table 4.

The price signals for both of these examples are much weaker than the signals in the three-tier sample rate. The three-tier rate provides an average conservation signal 22.6% higher than a flat rate, while the two-tier rates provide average conservation signals just 8.2% and 12.9% higher than the average rate. The conservation signal for the three-tier rate would be about three times as strong as those for the two-tier rates in Table 6 and Table 7.

**Table 6: PG&E Two-Tier Rate, 20% Price Difference**

| | Rate | Δ from Average Rate | % of MWh Controlled | Δ price signal |
|---|---|---|---|---|
| *Tier 1* | $0.162 | −7.5% | 18% | −1.3% |
| *Tiers 2-5* | $0.195 | 11.4% | 82% | 9.3% |

| | | | | |
|---|---|---|---|---|
| *Total* | $0.175 | 0.0% | 100% | 8.0% |

**Table 7: PG&E Two-Tier Rate, 60% Price Difference**

| | Rate | Δ from Average Rate | % of MWh Controlled | Δ price signal |
|---|---|---|---|---|
| Tier 1 | $0.140 | −20.0% | 18% | −20.0% |
| Tiers 2-5 | $0.228 | 30.3% | 82% | 28.0% |
| Total | $0.175 | 0.0% | 100% | 8.0% |

The two-tiered rates would also have much more severe effects on small customers than the three-tier rate. As shown in Table 8, the low-difference two-tier rate would increase bills to baseline customers almost four times as much as the three-tier rate. Both two-tier rates would result in small increases, rather than small decreases, for customers at 200% of baseline (about average usage), and reduce bills for the largest customers much more (26% to 53% more) than the three-tier rate.

**Table 8: Effect of Two-tier Rates on Customer Bills**

| | **Change in Bill from Existing Rate to** | | |
|---|---|---|---|
| **Bill as % Baseline** | 3-tier | 2-tier 20% | 2-tier 48% |
| *100%* | 6.1% | 22.6% | 6.1% |
| *130%* | 12.5% | 24.3% | 16.7% |
| *200%* | −5.1% | 1.9% | 0.5% |
| *300%* | −11.4% | −14.3% | −12.1% |
| *400%* | −14.6% | −22.3% | −18.4% |

**Q: What are the differentials between tiers in the rates for PG&E that you describe above?**

A: Table 9 juxtaposes the sample rate set forth in Table 4 with PG&E's current non-CARE rates and with PG&E's proposed rates for 2015 and 2018.

**Table 9: PG&E Proposed Rates and Tier Differentials**

| | Rates ($/kWh) | | | | Increase from Previous Tier | | | |
|---|---|---|---|---|---|---|---|---|
| **Tier** | Sample 3-Tier | PG&E 2014 Actual | PG&E 2015 Proposed | PG&E 2018 Proposed | Sample 3-Tier | PG&E 2014 Actual | PG&E 2015 Proposed | PG&E 2018 Proposed |
| *Tier 1* | $0.140 | $0.132 | $0.147 | $0.177 | | | | |
| *Tier 2* | $0.201 | $0.150 | $0.202 | $0.212 | 44% | 14% | 37% | 20% |
| *Tier 3* | $0.201 | $0.324 | $0.202 | $0.212 | — | 116% | — | — |
| *Tier 4/5* | $0.276 | $0.364 | $0.304 | $0.212 | 37% | 12% | 50% | — |

The sample rate is very similar to PG&E's proposal for 2015. Both of those rate designs dramatically reduce the increase of the weighted average of Tier 2 and 3 over Tier 1 from the 105% in the 2014 rate. The differential between Tier 4/5 and Tier 1 falls from 176% in the 2014 rates to 107% in PG&E's 2015 proposal and 97% in my proposal.

**Q: Have you performed similar analyses for the other utilities?**

A: I have performed a more limited analysis for SCE using data provided in response to DR SEIA-01 Q8. SCE's data is for a four-tier rate with the final tier being all load above 200% of baseline. As shown in Table 10, SCE reports a lower percentage of non-CARE residential energy billed in Tier 1, a comparable amount Tier 2, and a higher percentage of energy in Tiers 3 and 4 when compared to PG&E. Some of SCEs distribution is accounted for by its 53% baseline compared to PG&E's 55%.

**Table 10: Summary of SCE Residential Energy by Tier**

| | Tier as % of Baseline | | % of MWh | |
|---|---|---|---|---|
| | Range | Width | Billed in Tier | Controlled by Tier |
| *Tier 1* | ≤100% | 100% | 53% | 12% |
| *Tier 2* | 100%–130% | 30% | 11% | 10% |
| *Tier 3* | 130%–200% | 70% | 17% | 25% |
| *Tier 4* | >200% | 100% | 19% | 53% |

**Q: How did you calculate Table 10?**

A: I started with SCE's response to DR SEIA-01 Q8, which compiled the monthly number of kWh sold in each tier for customers whose bills ended in each tier. For each rate group (CARE, FERA, and regular domestic, differentiated into bills ending in each of the four tiers), SCE provided the number of kWh that the group used in each tier up through its marginal tier. SCE then summed across all customer groups to calculate the amount of load in each tier by month.

To find the percent of load controlled by each tier, I added together the total load of customers whose bill ended in a given tier for each month and then aggregated this data annually. SCE directly provided the amount of load billed in each tier by month.

**Q: What is the implication of the different bill frequency of SCE, compared to PG&E?**

A: The rate design I developed and explain in Table 4 for PG&E (i.e., Tier 1 set at 20% below average, Tier 2/3 set 15% above average) would result in Tier 4/5 being only about 16% higher than Tier 2/3. To maintain a price signal in line with that developed for PGE and maintain the tier differentials, my sample SCE rate sets Tier 1 at 25% below average, Tier 2/3 at 10% above average, and Tier 4/5 55% above average. This rate is shown in Table 11.

**Table 11: Sample Three-Tier SCE Rate Design**

| | **Rate** | **Δ from Average Rate** | **% of MWh Controlled** | **Δ price signal** |
|---|---|---|---|---|
| *Tier 1* | $0.131 | −25.0% | 12% | −3.1% |
| *Tier 2/3* | $0.193 | 10.0% | 35% | 3.5% |
| *Tier 4/5* | $0.271 | 55.0% | 53% | 29.2% |
| *Total* | $0.175 | 0.0% | 100% | 27.8% |

A customer with average usage would see a bill about 9% lower than the average rate,[17] and the overall conservation incentive would be about 22.7¢/kWh

[17] This result is the sum of a 25% reduction on 53% of average usage and a 10% increase for 47%.

(30% higher than the average rate), compared to 21.4¢/kWh for the PG&E design.

**Q: How do your sample rates for SCE compare to SCE's proposed transitional rates?**

A: Table 12 compares my sample rates to the energy rates proposed in Table III-2 of SCE's Phase One Rate Change Proposal (February 28, 2014) for non-CARE customers. The differences are probably due primarily to the treatment of CARE sales between the two computations.

**Table 12: Comparison of Sample Rate to SCE Proposal for 2015**

| | Sample 3-Tier Rate | SCE 2015 Proposal | Difference |
|---|---|---|---|
| Tier 1 | $0.131 | $0.139 | −5.6% |
| Tier 2/3 | $0.193 | $0.209 | −7.9% |
| Tier 4/5 | $0.271 | $0.279 | −2.7% |

The differences in the rates result in part from SCE's proposal of a $5 fixed monthly charge and the difference in bill frequency between the non-CARE customers and the data from the bill calculator, which mixes CARE and non-Care customers together.

Using a Tier-1 rate closer to SCE's 2015 proposal would result in a customer with average usage paying less than the average rate.

**Q: What are the differentials between tiers in the rates for SCE that you describe above?**

A: Table 13 juxtaposes the sample rate developed in Table 12 with SCE's current non-CARE rates and with its proposed rates for 2015 and 2018 (from Table III-2 of the SCE Proposal).

**Table 13: SCE Rates and Tier Differentials**

| | Rates ($/kWh) | | | | Increase from Previous Tier | | | |
|---|---|---|---|---|---|---|---|---|
| **Tier #** | Sample 3-Tier | SCE 2014 Actual | SCE 2015 Proposed | SCE 2018 Proposed | Sample 3-Tier | SCE 2014 Actual | SCE 2015 Proposed | SCE 2018 Proposed |
| Tier 1 | $0.131 | $0.132 | $0.139 | $0.162 | | | | |
| Tier 2 | $0.193 | $0.165 | $0.209 | $0.195 | 47% | 25% | 50% | 20% |
| Tier 3 | $0.193 | $0.274 | $0.209 | $0.195 | — | 66% | — | — |
| Tier 4/5 | $0.271 | $0.304 | $0.279 | $0.195 | 41% | 11% | 33% | — |

My rate example is very similar to SCE's proposal for 2015; both of those rate designs eliminate the rate increase between Tiers 2 and 3 and reduce the increase of the weighted average of Tier 2 and 3 over Tier 1 from the 82% in the 2014 rate.

## VI. Design of Time-Dependent Rates

**Q: What are time-dependent rates?**

A: Time-dependent tariffs change the usage charges over time, within the week and the day.[18] The simplest time-dependent tariffs are time-of-use (TOU) rates, which have different prices for fixed hours of the day, on specific days of the week. Other time-dependent tariffs include such options as the following:

- critical-peak pricing, in which a super-peak price is fixed in cents per kWh but the number and timing of the super-peak hours are determined by load and supply conditions on a daily basis;
- variable pricing, in which a timing of the pricing periods is fixed, but the price for some periods is determined on a daily basis;

[18] Rates may also vary between seasons, but since each monthly bill typically reflects only one seasonal rate (or a blended rate in transitional months), seasonal rates are not generally considered to be time-dependent.

- real-time pricing, which varies pricing in response to hourly load and supply conditions, typically based on conditions forecasted in the previous day or hour.

**Q: What is the relevance of time-dependent rates for this proceeding?**

A: While another proceeding is dealing with the specific design of time-dependent rates, the Commission has requested that parties discuss these types of rates in this case, and the utilities have suggested pilot TOU rates. AB327 Section 745(c) states that the "commission may require or authorize an electrical corporation to employ default time-of-use pricing for residential customers" with certain provisions. In this preceding, the Commission's February 13, 2014 memo asked the utilities whether time-of-use rates should be default or optional, if they should be flat or tiered, and how these rates might be structured (rate ratios, seasonality, and the like).[19]

I discuss below considerations for time-of-use rates. These same considerations may be applicable to other time-dependent rates to varying extent.

### *A. Principles of Time-of-Use Rate Design*

**Q: What considerations should the Commission bear in mind in the design of time-of-use rates?**

A: The Commission should carefully review the range of costs included in the design of time-of-use rates, the selection of time periods, the price differentials between time periods, and the criteria for placing customers on time-of-use rates.

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[19] Assigned Commissioner's Ruling Requiring Utilities to Submit Phase 1 Rate Change Proposals, Appendix A: Rate Design Questions, February 13, 2014, at 1–6. The Third Amended Scoping Memo and Ruling of Assigned Commissioner dated April 15, 2014, at4, excluded TOU period discussion from Phase I.

**Q: What are the important considerations in the costs reflected in time-of-use rates?**

A: The choice of time periods should be driven by cost while avoiding excessive complexity and recognizing practical constraints. The definition of time periods includes the number of periods, the timing of the periods, the treatment of weekends, and the grouping of months into pricing seasons.

It is important that the definition of time-of-use periods be subject to revision over time, as load shapes and costs change in response to changes in underlying demand (e.g., increased end-use efficiency, addition of electric vehicle load and other electrification) and supply (e.g., addition of centralized and distributed renewable generation, changing fuel prices, retirement of steam plants in California and neighboring regions). Time-of-use rate designs that reflect cost patterns in 2014 may be inconsistent with the cost patterns of 2020.

**Q: What are the important considerations in determining the number of time periods for time-of-use rates?**

A: While a time-of-use rate with just two time periods in each season is simple and easy to understand, just two periods may not capture the variation in costs among periods. With just two periods, one or both periods may need to be too broad, including hours with a wide range of costs. A two-period rate will also require that weekend hours be classified as either peak or off-peak, even if a large number of those hours are intermediate in cost.

**Q: What are the important considerations in the timing of rating periods for time-of-use rates?**

A: The choice of periods affects both pricing and customer incentives. For example, a shorter peak period will tend to result in a higher price for the peak period and for the off-peak period would a broader peak. Lumping too many hours into a single period may obscure important differences among the hours in the period. A long peak period may encourage some customers to move some loads into the far off-peak, but not all end-uses can be moved forward or back by four or five hours. A long peak period will do nothing to encourage shifting of loads from the highest-cost hours to lower-cost hours within that broad period.

Figure 5 shows the hourly LMPs for the California ISO NP15 node, for October 2013 and January, March, April, and August 2014. The hourly price curves vary widely between months, but some patterns are apparent. August prices rise almost linearly from about 4 AM to 6 PM, and then fall equally smoothly. In contrast, prices in the other months start low in the overnight hours, rise to a morning peak about 8 AM, falling to an intermediate level from about 10 AM to 5 PM, and then rising to a higher peak about 7 to 9 PM.

**Figure 5: Hourly LMPs, NP15, Selected Months**

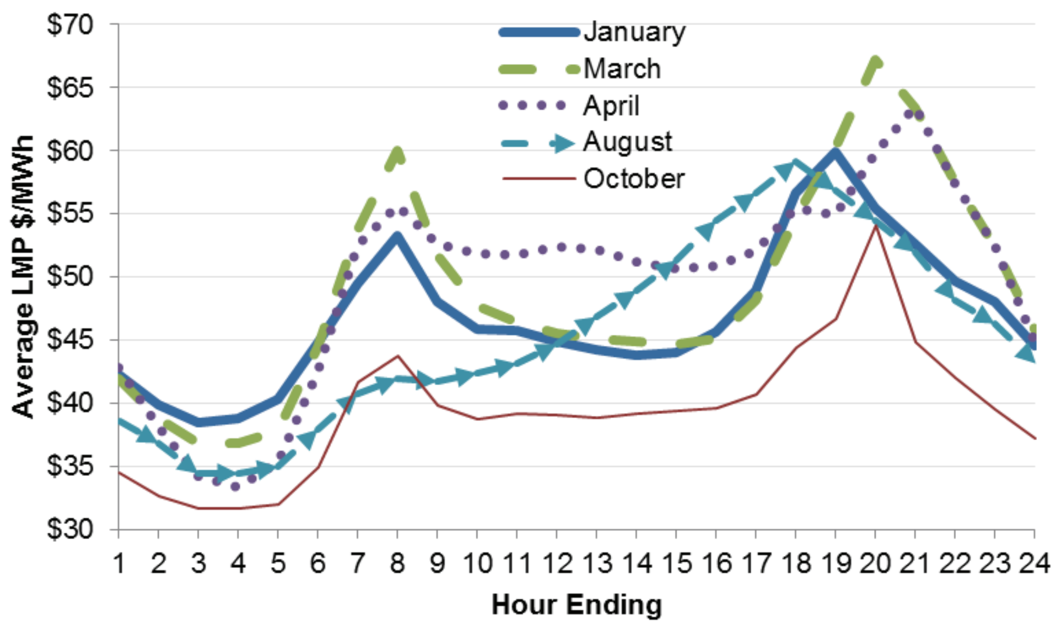



Figure 5 does not include generation-capacity costs, or transmission-and-distribution peaks. A more-comprehensive analysis of historical and modeled future costs would be needed to form firm conclusions about the appropriate periods.

Nonetheless, study of Figure 5 suggests that ignoring the morning peak or the mid-day intermediate costs in the winter may result in price signals that encourage the shifting of loads from one high-cost period to another, rather than from the high-cost periods to the overnight period. PG&E proposes a winter peak period (November through April) of just three hours, which would miss both the morning peaks and the high prices from 8 PM to 10 PM, and would lump those high-price hours in with the truly off-peak hours.

As for summer price periods, there may be enough difference between the very low-cost overnight hours, the shoulder prices in the morning and evening, and even higher prices around 6 PM to justify three pricing periods. PG&E proposes a summer peak period of 1 PM to 7 PM, lumping together very wide ranges of costs in both the peak and off-peak hours.

Separating out the truly low-cost hours will be helpful in encouraging the adoption of electric vehicles. An off-peak period of eight or nine hours should be enough to charge most vehicles, and would allow a lower off-peak price than a longer off-peak period that included more of the shoulder hours (or in the case of PG&E's winter proposal, the morning peak hours).

**Q: What are the important considerations in the treatment of weekends in time-of-use rates?**

A: Weekend prices are very similar to weekday prices for all hours in August and the evenings in January (see Figure 6 and Figure 7). Depending on the portion of capacity costs allocated to the weekends (e.g., the loss-of-load expectation, and the number of transformers, feeders and other equipment peaking on weekends), weekend daytime costs may be lower than the weekday peak costs, but still much higher than the overnight off-peak costs. The most effective time-of-use rates may include three prices in each season: an off-peak price for overnight and perhaps parts of Saturday and Sunday, a peak price in the highest-cost hours, and a shoulder price for intermediate hours (morning or mid-day in winter, morning and evening in summer, and weekend evenings).

**Figure 6: Hourly LMPs, Weekday, Saturday and Sunday, NP15, January 2014**

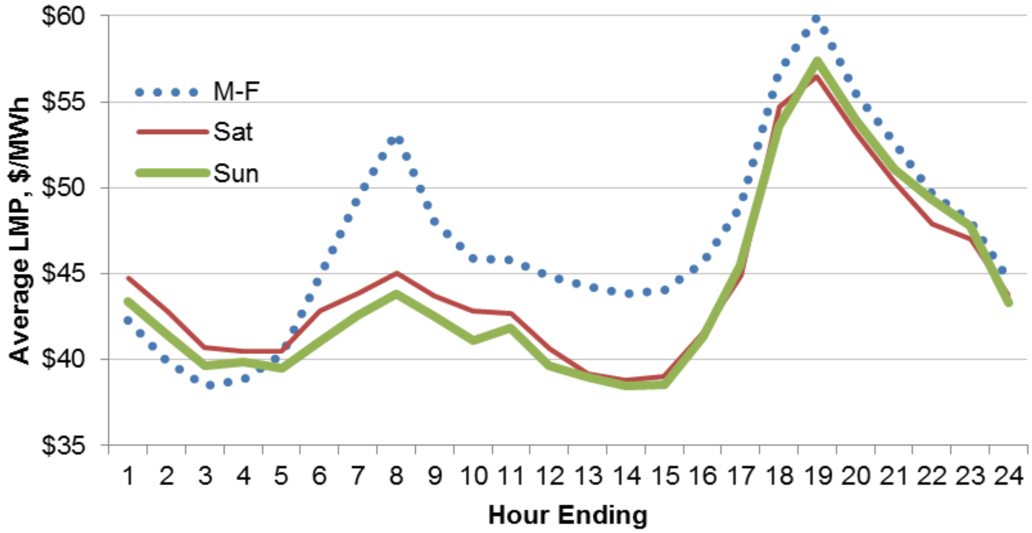
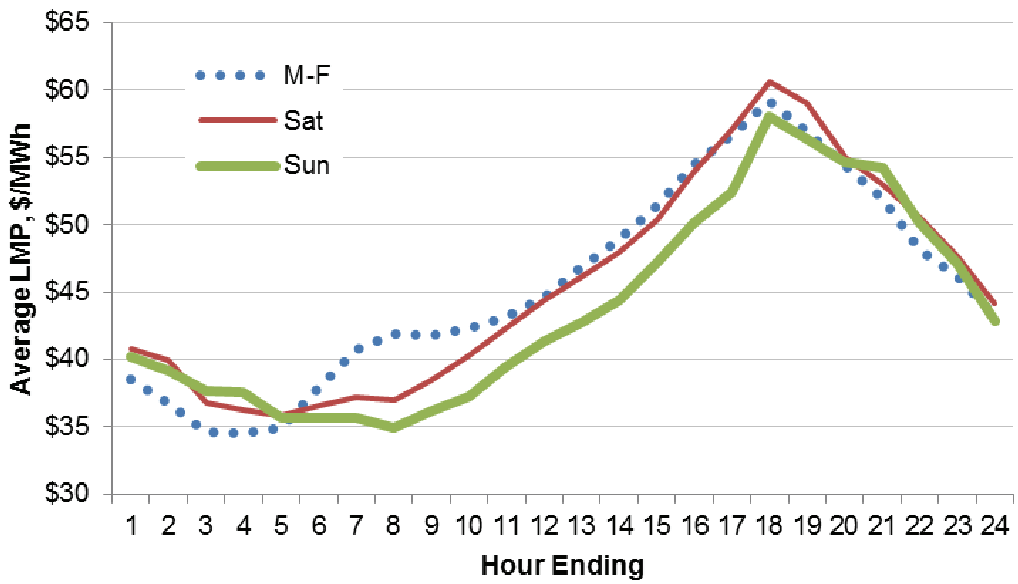



**Figure 7: Hourly LMPs, Weekday, Saturday and Sunday, NP15, August 2014**



**Q: What are the important considerations in the grouping of months for time-of-use rates?**

A: Time-of-use rate design should avoid lumping together months with very different price patterns. For example, PG&E's proposal treats May through October as summer, but cost patterns over the day in October are unlikely to be similar to those in August (see Figure 5). Providing reasonably accurate price signals requires that similar months be grouped together. If the timing of high costs and/or the level of costs varies enough among the months, TOU rates may need to be set for more than two seasons.[20]

**Q: What are the important considerations in the price differentials among time periods for time-of-use rates?**

A: The issue of price differentials interacts with the issues of selection of costs for TOU rate design and of the selection of time periods. Properly reflecting the time-of-use pattern of capacity costs will tend to increase price differentials, as will the differentiation of broad off-peak period into shoulder and off-peak periods and distinctions between peak seasonal months and shoulder months. Reflecting the environmental costs of generation will also change the relationship between off-peak and on-peak prices.

The question of differentials between costing periods is important to the success of time-of-use rates in reducing costs. In its draft TOU rate design (PG&E Proposal, Table 2-10), PG&E proposes a winter price differential of about 8%, which would probably encourage less than a 1% shift in energy consumption from the peak to the off-peak period. Splitting the off-peak period and differentiating

[20]Given the wide variation of climate and hence the timing of T&D peaks within the service territories of PG&E and SCE, the Commission should consider whether the T&D costs should be distributed differently in different climate zones.

winter from shoulder months may result in much higher differentials, larger shifts in usage and more favorable economics for off-peak charging of electric vehicles.[21]

### *B. Incorporating Tiers into Time-of-Use Design*

**Q: Are time-of-use rates an alternative to achieve the goals of tiered pricing?**

A: No. Shifting energy use from day to night (or from 1 PM to noon, in PG&E's summer proposal) will reduce costs, if the time-of-use rates are properly defined, but the effect on energy use is less predictable. Increased attention to energy conservation in the high-priced hours will tend to result in reductions in some end uses (such as lighting) that are not likely to be shifted to other periods. On the other hand, time-of-use rates may also encourage customers to over-cool their homes in summer mornings to reduce electricity use in the afternoon peak period, or over-heat their homes in the winter midday to reduce usage in the evening peak.

Tiered pricing, on the other hand, directly rewards customers for reducing energy usage.

**Q: How can tiered pricing be included in time-of-use rates?**

A: The simplest and most attractive approach may be to give customers a conservation credit for usage in the lower tiers. For example, based on the three-tier rate I develop in Table 4, after the three time-of-use rates (which would average 27.6¢ for the average load shape, to allow for the baseline discount), the bill could include a credit of 13.6¢/kWh for about 150% of the baseline quantity.[22] To make the incentive clearer for customers, the conservation incentive should be reported as a

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[21] If the differential is not substantially increased by better analysis and better definition of TOU periods, there would certainly be no basis for diminishing the conservation incentives of tiered rates to facilitate an ineffectual TOU rate.

[22] I do not have enough detail on bill frequency to determine the breadth of this discount, but the utilities do.

percentage of the bill, so that a customer up to 150% of baseline (with an average load shape) would see a 49% conservation credit, a customer using three times baseline would see a 25% credit, one at four times baseline would see a 19% credit, and so on.

## VII. Communications to Increase the Efficiency of Tiered Rates

**Q: How can the utilities improve customers' understanding of the incentives offered by tiered rates?**

A: The utilities should use the bill itself, bill inserts and general advertising to communicate the purpose of the tiered rates and the following messages:

- If your usage increases, your rate will increase.
- The more you conserve, the more you save.
- Your last kWh of usage is your most expensive.

On individual bills, the utilities can provide more specific information, such as the following:

- "Congratulations, you reduced your usage compared to this month last year, saving yourself $___ this month."
- "We are sorry to tell you that your usage increased compared to this month last year, costing you an extra $___ this month."
- "Your bill falls in our first/second tier. Your rate will go up by about 40% if you use ____ more kWh next month than this month."
- "Your bill falls in our highest-price tier, due to your above-average usage. You can save more than most customers by reducing your usage. Contact PG&E Energy House Calls [or Energy Upgrade California, etc.] for hands-on technical advice and financial assistance."

## VIII. Fixed Charges

**Q: What are the utilities' positions regarding fixed charges for residential rate design?**

A: The utilities propose to impose the maximum fixed monthly charge (which PG&E and SDG&E call a "monthly service fee" and SCE calls a "basic charge") permitted under AB 327 §739.9(f). By comparison, PG&E currently has no residential fixed charge and SCE's basic charge is $0.91 per month. SDG&E currently has a $0.17/day minimum bill (about $5.17 per month) for Rate Schedule DR, but proposes the same $10 fixed charge as the other utilities.

Pacific Gas & Electric describes in great detail the costs it believes should be included in the fixed charge:

> First, there are customer access and revenue cycle service costs…. These include the costs of connecting a customer to the grid and maintaining that connection and service to the account—including metering, preparing and sending bills, processing payments, providing service center resources, and other grid-related costs. Second, there are capacity-related costs associated with generation, transmission, and distribution assets. These generation and grid costs are driven by customers' coincident and non-coincident demands on the PG&E system, and for non-residential customers are generally collected via demand charges. For a customer class like residential, though, where demand charges are not currently employed, it is more appropriate to collect these types of costs through a fixed monthly charge rather than through volumetric charges —since the costs are incurred by the utility on behalf of each individual customer and do not change based on the volume of electricity that the customer consumes.
>
> In situations where certain costs are fixed and cannot be avoided, setting a rate to recover these costs through monthly fixed fees, rather than through volumetric rates, more appropriately reflects cost causation, and supports more equitable recovery of PG&E's fixed costs among customers. These fixed costs should be paid by all customers, rather than shifted unfairly from some onto others, as is currently the case. (Testimony of Keane, Quadrini, and Zelmar on Long-Term Residential Rate Design, February 28, 2014, at 2-6 to 2-7)

In a footnote, PG&E adds “There is also another category of costs—the cost of programs like those that provide incentives for energy efficiency—which do not vary with customers’ usage, yet are collected through volumetric charges that force higher users to bear a greater proportion of the program costs” (ibid. at 2-7, note 12).

**Q: Have the utilities properly identified the costs that should be recovered through fixed costs?**

A: No. The PG&E position is clearly incorrect. While “service to the account—including metering, preparing and sending bills, processing payments, providing service center resources” (which PG&E also refers to as “revenue cycle” costs) are driven by the number of customers, and a large portion of these costs are incurred even for the smallest customers, PG&E mixes these costs with costs that vary with the size of the customer: “the costs of connecting a customer to the grid” and “other grid-related costs,” which appear to overlap with the capacity-related costs of transmission and distribution. The capacity-related costs are driven by the customers’ demands at various hours on which the T&D equipment is heavily loaded (and even low-load hours on days on which equipment is heavily loaded and overheated), and must be recovered through billing determinants that vary, at least roughly, with the customers contribution to load in those hours.[23] Dividing the total cost of demand-driven investments in transmission, substations and feeders by customer number would represent a real subsidy of large customers, who drive

[23] Transmission facilities, in particular, are required for off-peak energy purchases and economic dispatch, as well as reliability over a wide range of hourly loads, generator availability, and transmission contingencies.

those costs, by small customers, who need very little of those investments.[24]

The position that PG&E takes on energy-efficiency program costs are equally absurd. A customer with a large inefficient home, many appliances, many lights, and high usage levels will have much more opportunity for insulation, window upgrades, efficient lighting, air-conditioner efficiency, duct sealing, hot-water conservation, appliance efficiency and the like, compared to a customer with a small, efficient apartment, few electricity uses, fewer windows, fewer lights, shorter duct runs, and so on. The value of energy-efficiency investment, and the need for the programs, is driven by usage levels, not by customer numbers. Again, charging the small customers with limited efficiency opportunities for the investments that reduce costs to the large customers with large opportunities for efficiency improvements would represent an egregious subsidy of large customers by small customers.

To a large extent, PG&E's argument for charging usage-related costs through a monthly "service" charge is based on the willful conflation of two meanings of *fixed*. One meaning of *fixed* with reference to costs is *fixed over load*, so that the cost is constant for customers of any size; that is the definition of *fixed* that is relevant to guiding rate design. Another meaning of *fixed* is *fixed over the year;* the cost does not vary in the short run. For example, PG&E's costs of transmission in 2015 are largely determined by the cumulative investment and construction commitments at the end of 2014. Most transmission investments require some years of lead time for permitting and procurement, although high loads in 2015 may result in failure and replacement of some transformers and underground lines and low

[24]Charging every customer for an equal share of transmission and substations would be akin to Honda charging every buyer the same amount for the "fixed cost" of the car's engine, whether the car is a Fit or an Odyssey.

loads in 2015 may allow PG&E to defer addition of other equipment in later 2015 or 2016. Even though PG&E's transmission costs are overwhelmingly *fixed over the year,* none of them are *fixed over load,* since transmission is added only for load-related reliability and energy savings.

**Q: What guidance has the legislature provided on the setting of fixed charges?**

A: In AB327, §739.9(e), the legislature provides that

> The commission may adopt new, or expand existing, fixed charges for the purpose of collecting a reasonable portion of the fixed costs of providing electric service to residential customers,…

but also required that the Commission

> shall ensure that any approved charges…(1) Reasonably reflect an appropriate portion of the different costs of serving small and large customers; (2) Not unreasonably impair incentives for conservation and energy efficiency.

In other words, the fixed charge is limited to the cost of serving small customers, with any additional cost of serving large customers recovered through usage-related charges. Further, the fixed charge cannot "unreasonably" reduce conservation incentives. The utility approach to fixed costs is inconsistent with both of these mandates.

### *A. Effects of Fixed Charges*

**Q: What effect would adding or increasing fixed charges have on the conservation effect of the residential rates?**

A: Every $1/month increase in the fixed charge would reduce the average energy rate by about $1.7–$2/MWh, or about 1%. A $10/month fixed charge would reduce the average energy charge by about 10%–11%; assuming roughly proportional distribution of the rate reduction across tiers, the reduction in the conservation incentive would be similar. Hence, a higher fixed charge will result in somewhat weaker price signals, further reducing the conservation benefits of the tiered rate.

**Q: Would fixed charges provide a meaningful price signal for customers?**

A: No. Customers are unlikely to respond to fixed charges. The only way to avoid the fixed charge is to discontinue being a utility customer. Few residential customers are likely to drop their service to avoid the fixed charge. I do not understand why the utilities would want to encourage customers to terminate their utility service, especially as the costs of distributed generation and storage fall.

The utilities have not presented any evidence that customers have been wastefully overusing utility connections. Few residential customers who would be inclined to add to the utility's customer number (adding service for a new building, or adding a meter for an ancillary apartment or outbuilding) will be discouraged from doing so by any plausible customer charge.[25]

**Q: Would the fixed charges result in any cost savings for the utilities and their customers?**

A: A fixed charge is unlikely to save any significant costs. Even if some scattered customers did decide to go off the grid, perhaps by relying on solar energy and batteries, or micro-cogeneration, that would not save the utility much beyond the costs of issuing the bill and eventually the costs of repairing and replacing the service drop and meter.

### *B. Costs Relevant to Fixed Charges*

**Q: What costs should be considered for inclusion in a fixed residential charge?**

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[25] Installing a separate meter for a separate dwelling within a building would encourage energy efficiency and conservation, and should be encouraged.

A: If the Commission wants to include a fixed charge for residential customers, to cover the costs related solely to a customer being connected to the system, without any energy usage, it should base that charge on the costs incurred by very small customers that would be avoided if the customer terminated its service. While there is a great deal of scatter in the usage within each customer type, smaller users tend to be concentrated in multi-family housing, so the fixed charge should be set with particular attention to the costs incurred if a single unit in a multi-family building were divided into two, or saved if two units became one (or a unit dropped utility service). The smallest residential customers should not have to pay costs incurred by the larger customers in the class, even if those costs are treated as customer-related for some purposes. Customer-related costs that vary with the size and/or usage of the customer (e.g., the service drop, bad debt exposure) should be collected through energy charges.

The fixed costs for a serving a small customer are thus limited to the following costs:

- maintaining and replacing the meter,
- billing,
- customer accounts and
- customer service.

The incremental cost per customer of the largely automated meter-reading, billing, and accounting systems is probably much less than the average cost, even over a wide range of customer number.[26] Since the distribution system, transformers and (for multi-family customers) service drops are shared, there is no incremental cost for adding a customer, other than usage-related costs.

[26]The costs of stationery and postage are essentially linear with the number of customers.

**Q: Have the utilities provided a cost justification for their proposed fixed charges?**

A: No. In fact, while PG&E proposes a fixed charge of $10/month in 2018, it found its fixed costs per customer to be $6.49/customer-month in 2014 dollars, or about $7/month in 2018 dollars, assuming 2% inflation. (2014 General Rate Case Phase II, Exhibit PG&E-4, at 3-31). That estimate of fixed costs includes average service-drop costs for new customers, which would overstate the costs for the smallest customers, most of whom are likely to be in multifamily buildings with shared service drops.

Thus, PG&E is proposing a fixed monthly charge more than 40% above its own full estimate of fixed costs, even before correction for shared services by small customers.

### *C. Fixed Charges versus Minimum Bills*

**Q: Is there an alternative to fixed charges, to ensure that all customers contribute to the costs of their being on the system?**

A: Yes. Rather than charging a fixed monthly charge, which is added to the energy charge, the tariff can impose a minimum charge, on either a monthly or annual basis.

**Q: Is there an advantage of a minimum charge, compared to a fixed monthly charge?**

A: Yes. The minimum charge allows more revenues to be recovered through energy charges, while still ensuring that all customers pay some fixed costs. As a result, conservation incentives are higher with the minimum charge than with a fixed charge.

Table 14 presents two sample rate designs: Tariff 1, with a $5 fixed charge and Tariff 2, with a $12 minimum bill and energy rates 4.4% higher than Tariff 1. On

Tariff 1, every customer pays a $5 monthly fixed charge, requiring lower energy charges. On Tariff 2, any customer with usage less than about 85 kWh in a month would pay $12, while customers with higher usage would pay only for the energy they use.[27] On this example, Tariff 2 provides a conservation incentive 4.4% higher than Tariff 1.[28]

**Table 14: Comparison of Fixed Charges**

| | **Tariff 1** *Fixed Charge* | **Tariff 2** *Minimum Bill* | **Share of Energy Controlled** |
|---|---|---|---|
| Tier 1 $/kWh | $0.134 | $0.140 | 25% |
| Tier 2/3 $/kWh | $0.201 | $0.210 | 50% |
| Tier 4/5 $/kWh | $0.268 | $0.280 | 25% |
| Fixed Charge per month | $5 | | |
| Minimum Bill per month | | $12 | |
| Average Conservation Incentive | $0.201 | $0.210 | |

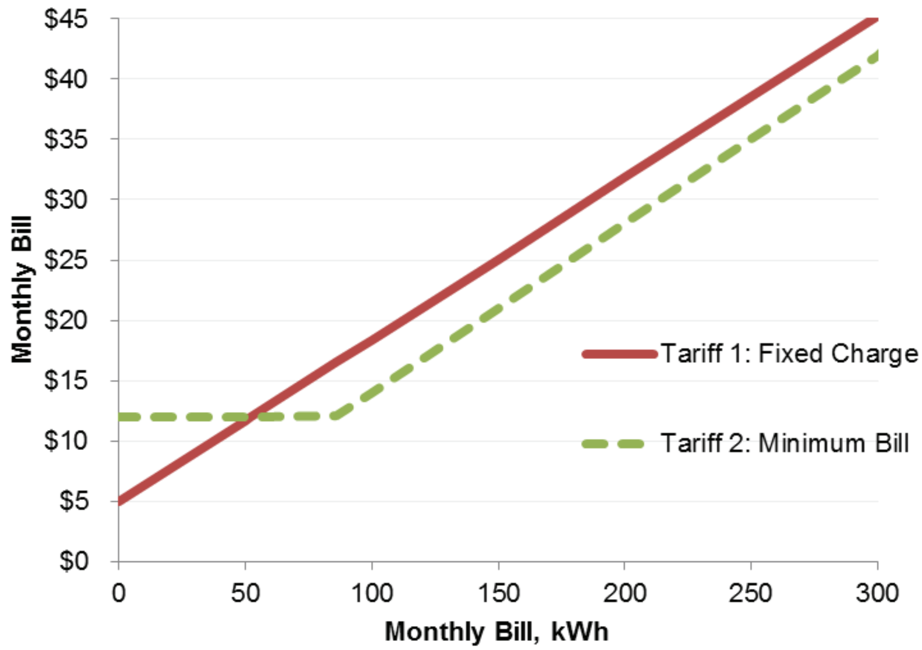
**Q: How would these tariffs differ for small customers?**

A: As shown in Figure 8, Tariff 2 would charge more than Tariff 1 for the very small percentage of customers with bills under about 50 kWh (and their even smaller percentage of energy). Other customers with bills less than about 600 kWh (roughly average usage) in this example would have lower bills under Tariff 2 than Tariff 1, while above-average customers would pay slightly more under Tariff 2. Most importantly, all bills over 85 kWh would be subject to a stronger marginal price signal under Tariff 2.

[27]The number of kWh covered by the minimum bill is simply that minimum bill divided by the Tier-1 energy rate. The minimum bill could also be set at the bill for a fixed percent of baseline energy, such as 30%. Another alternative would be to apply a minimum bill only to the non-generation charges.

[28]The conservation incentive would be lower for the customers who sometimes use less than 85 kWh in a month, but those would represent a tiny percentage of total usage.

**Figure 8: Bills Less Than 300 kWh, Fixed Charge versus Minimum Bill**




**Q: Are you concerned that the bills under 85 kWh would have no conservation price signal?**

A: No, for four reasons. First, the bills over 85 kWh would represent almost all the class energy usage. Second, most residences with usage that low are likely to be unoccupied, so the price signal would not be effective. Third, even an occupied unit with usage that low would have little opportunity for price response, since most of the usage would be from loads that are difficult to control (e.g., a small, efficient refrigerator; a cable or internet connection; and appliance standby usage). Fourth, an electric bill of less than $12/month is not likely to attract much attention from most customers.

**Q: What positions do the utilities take regarding the relative value of minimum bills, compared to fixed charges?**

A: In its February proposal, PG&E asserts (at 2-8) that "a monthly service fee is a superior alternative to a minimum bill amount" because "fixed costs are incurred to serve all customers [while] a minimum bill amount is applied only to a very small percentage of customers with little or no usage in a given month." In addition, PG&E complains (in the same place) that a

> minimum bill amount [of $4.50] yields only a small amount of revenue (less than $4 million per year). In contrast, a $5.00 monthly service fee would yield over $150 million in annual revenue.

**Q: Are PG&E's concerns valid?**

A: No. The first complaint misses the point of rate design with a revenue constraint: without a fixed monthly fee, the energy charges can be higher, giving better conservation incentives. Those higher energy charges also result in larger customers contributing to the fixed charges.

The company's second concern actually demonstrates the superiority of the minimum bill, which uses up a smaller amount of the revenue requirements, leaving more revenue to provide useful energy price signals for customers. The monthly service fee would waste some of the potential conservation incentive on a charge that does not reward efficiency.

**Q: Does this conclude your testimony?**

A: Yes.

Dated: **Error! Reference source not found.**

Respectfully submitted,

By:
Name: Paul Chernick
Title: President

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## Attachment A: Statement of Qualifications of Paul Chernick

**Paul L. Chernick,** president of Resource Insight, has twenty-seven years of experience in the electric and gas utility field. He has consulted and testified extensively on utility and insurance economics. His current responsibilities include quantifying stranded investment, assessing prudence of power-planning investment decisions, identifying excess generating capacity, analyzing effects of power-pool pricing rules on equity and utility incentives, reviewing electric utility rate design, assessing energy-conservation and renewable-energy opportunities, and estimating magnitude and cost of future load growth. He has been a leader in designing and evaluating electric, natural gas, and water utility conservation programs, including hook-up charges and conservation-cost-recovery mechanisms, and advising regulatory commissions in least-cost planning, rate design, and cost allocation.

Mr. Chernick's experience includes three years on the staff of the Massachusetts Attorney General's utility division and twenty-eight years as principal and president of his own consulting firm. His 1982 paper, "Capacity/Energy Classification and Allocations for Generation and Transmission Plant," set forth the now widely employed principle that cost allocation should reflect the influence of energy use on capital investment.[29]

Mr. Chernick has testified in more than two hundred and eighty regulatory and court proceedings and has performed a wide variety of studies for public agencies, non-profit organizations, and corporations. His clients are regulators, public advocates, energy utilities, non-utility power producers, environmental advocates, and municipal governments. He is author of more than thirty-five published papers and has provided training to public advocates and regulatory staffs.

Mr. Chernick holds an SM from the Technology and Policy Program and an SB in Civil Engineering from Massachusetts Institute of Technology. He is a member of Chi Epsilon, Tau Beta Pi, and Sigma Xi honorary societies, and received an Institute of Public Utilities Institute Award.

## Attachment B: Works Cited


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